BLAKETHWAITE DAMS, BLAKETHWAITE GILL, MELBECKS, NORTH YORKSHIRE (NGR NY 935 029)

CONDITION INSPECTION



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EXECUTIVE SUMMARY

In February 2015, Ed Dennison Archaeological Services Ltd (EDAS) were commissioned by Mr Robert White, Senior Historic Environment Officer of the Yorkshire Dales National Park Authority (YDNPA), to undertake a visual inspection of the remains of the Blakethwaite Dams complex in Blakethwaite Gill, north-west of Gunnerside village in Melbecks, Swaledale, North Yorkshire (NGR NY 935 029 centred) to assess the extent of any recent erosion and to provide an up-todate photographic survey which might lead to consolidation and/or repair strategies; the dams were previously surveyed in 1996. The project was funded by the YDNPA and English Heritage (now Historic England) through the Yorkshire Dales Industrial Monuments Management Scheme.

Quite why the two Blakethwaite Dams should be so close together has yet to be adequately explained. Crucial to this understanding is the appreciation that the two dams are located at very different heights - the upper dam, which is probably in the best location given the size of the body of water it retains relative to the difficulties in construction, lies c.30m higher than the lower dam. The upper dam, which also appears to be the better constructed, has the capacity to store a greater quantity of headwater in the more shallow-sided valley which is fed by numerous natural springs and rills. The steep-sided nature of the valley around the lower dam means that it would not have been able to retain a particularly large body of water, although this may of course have been adequate for the purpose it fulfilled. Water for the lower dam was supplemented by the 'Long Race', an artificial leat that runs for a total distance of c.6km-7km from Moss Dam and beyond.

It is also not known precisely when the two dams were actually constructed, although their function was primarily to power two separate underground engines in the Blakethwaite workings, built in mid 1837 and early 1842. It has been inferred that these also represent dates of construction for the two dams, the upper dam feeding the earlier 'Victoria Engine' and the lower dam the later Whitham's engine. While it has been suggested elsewhere that the lower dam is later than the upper dam, the reverse could equally be true, and it is also possible that supply was switched between the two engines. As yet, no detailed or dateable information regarding the construction of the dams has been found, but plans of c.1842 show both in place. Even if the dams were constructed one after another, there is unlikely to have any significant time gap between them. What is clear is that they were built by the Strands Company, who held the lease to the Blakethwaite mines from April 1836 until 1861, and so the dams and their associated water courses represent an initial phase of investment to make the mine sett more profitable.

A small number of minor management actions is recommended to help maintain and preserve the two dams, and further investigation of the complex water supply network is suggested.

1 INTRODUCTION

Reasons and Circumstances of the Project

1.1 In February 2015, Ed Dennison Archaeological Services Ltd (EDAS) were commissioned by Mr Robert White, Senior Historic Environment Officer of the Yorkshire Dales National Park Authority (YDNPA) to undertake a visual inspection of the remains of the Blakethwaite Dams complex in Blakethwaite Gill, north-west of Gunnerside village in Melbecks, Swaledale, North Yorkshire (NGR NY 935 029 centred) to assess the extent of any recent erosion and to provide an up-to-date photographic survey which might lead to consolidation and/or repair strategies. The extent of the project was defined by discussions between the Yorkshire Dales National Park Authority (YDNPA) and EDAS, and the project was funded by the YDNPA and English Heritage (now Historic England) through the Yorkshire Dales Industrial Monuments Management Scheme.

Site Location and Description

- 1.2 The Blakethwaite Dams lie on the Gunnerside Beck in Blakethwaite Gill, in an isolated and elevated position at the very upper reaches of Gunnerside Gill, some 6.5km to the north of Gunnerside village, Melbecks, North Yorkshire (see plate 1). They are set on the northern edge of Gunnerside Moor, and have limited access; the upper western dam is located at NGR NY 93454 02988 while the lower eastern dam is at NGR NY 93563 02942.
- 1.3 The only vehicle access is from the south-east, along a shooting track which leaves the unclassified Langthwaite to Feetham road at Surrender Bridge. The dams can also be reached on foot along the shooting track, or by walking up one of the footpaths which ascend Gunnerside Gill from Gunnerside village. The dams lie within a large area of unenclosed grouse moor, parts of which are also used for sheep grazing, and the whole of this area is open access land, as designated by the Countryside and Rights of Way Act 2000 (CROW).
- 1.4 Gunnerside Gill forms a well documented and well preserved lead mining landscape, which has been subject to detailed historical and archaeological survey in the past. The historical background and mining context to the Blakethwaite Dams has been provided by Gill (1995, 42-48), while the dams themselves were subject to an archaeological survey in 1996 (Ronan & Cardwell 1997) (see figures 8 and 9).
- 1.5 Both dams are Scheduled Monuments (National Heritage List for England (NHLE) 1015855), and both are recorded on the YDNPA Historic Environment Record (HER) as site MYD21730; other YDNPA HER site numbers are added as appropriate throughout the following text.

Aims and Objectives of the Project

- 1.6 The aims of the project were:
 - to inspect the dam structures, and to compare their description to that given by the previous survey in 1996, in order to determine whether their condition has significantly deteriorated during the intervening 19 years;
 - to add or enhance, as necessary, to the description and interpretation of the dams and associated features given in 1996;

 to produce a digital photographic record of the dams, illustrating their condition in 2015, supplemented by written notes and sketches based on the 1996 survey drawings where appropriate. These could then be used to draw up consolidation and/or management strategies, if appropriate.

Survey Methodology

- 1.7 The Blakethwaite Dams were visited by Shaun Richardson and Richard Lamb on the 18th March 2015. Copies of the previous 1996 surveys and descriptions were taken to the site, and annotated in the field. A digital photographic record was produced using a digital camera with 10 mega-pixel resolution, in accordance with English Heritage photographic guidelines (English Heritage 2007, 14). All photographs were clearly numbered and labelled with the subject, orientation, date taken and photographer's name, and were cross-referenced to digital files etc. a visit was also made to the North Yorkshire County Record Office (NYCRO) on 19th June 2015 to examine available plans and other documents.
- 1.8 An EDAS archive archaeological survey report has been produced, based on the results of the information obtained during the field work. The report has been illustrated by a selection of photographic plates, while the full photographic catalogue appears as Appendix 1. A properly ordered and indexed project archive (paper, magnetic and plastic media) was deposited with the YDNPA at the end of the project.

2 HISTORICAL CONTEXT

- 2.1 Before describing the current condition of the dams, it is appropriate to consider the general historical background provided in the Scheduled Monument description (NHLE 1015855) and other sources (e.g. Gill 2014; Gill 1995, 42-46) which provides some context to the dams.
- 2.2 The Blakethwaite Mines were recorded as part of the Surrender Grant in the late 1790s but mining was limited to a few shafts in Little Punchard Head and then an adit, Lonsdale's Level, driven from the north side of the Blakethwaite Beck. By 1806 the leases were split and the Blakethwaite mine sett was leased to Thomas Chippendale and Company for 21 years. By 1811 an ore shoot of c.750 feet long was being worked from the Low Level driven from the east side of the beck near its confluence with Cross Gill and from the Top Level at a higher elevation on the east side of Cross Gill (see figure 3 top); the Low Level was later known as the Raper Level. In 1812 the Blakethwaite (Main) Level was driven, from just below Ewe Leap Scar, in a north-east direction from the east side of the gill for a distance of 2430 feet before it hit the Blakethwaite Vein; this level was incorrectly identified as the Blakethwaite Low Level by NAA in their 1996 survey (Ronan & Cardwell 1997, 10) - the Blakethwaite Low Level actually lies just to the south of the dressing floor and former smithy building (Mike Gill, pers. comm.). A second deeper level was begun further south in 1814, but was abandoned in 1818. This abandonment may have been partly affected by Robert Clarke, one of Chippendale's partners, who took over the lease in 1818. The Blakethwaite Vein was cut by the Blakethwaite (Main) Level in 1818, and early returns from this and other veins encouraged investment, such as the building of a dressing floor on the east bank of the beck just south of the level entrance and the Blakethwaite smelt mill further south at the confluence of the Blind Gill and Blakethwaite becks: the mill was under construction in 1819, and was smelting between 1821 and 1878 (Raistrick 1975, 93-95).

- 2.3 Clarke and Company surrendered their lease in April 1836 which was then taken up by the Strands Company. In mid 1837 an underground water wheel was built to help drain the mines in the bottom of the previously dug 240 feet deep Pump or East Engine Sump on the Cocker Crosscut. This was the 'Victoria Engine' built by James Close and illustrated by Gill; the wheel was 29 feet in diameter, and it drove two cast iron beams and rods working pumps in the shaft bottom (Gill 2014, 74-75; Gill 2000, 74) (see figure 3 bottom). It was originally thought that water was brought to the wheel from the Top (or High) Level in Cross Gill, but Close's 1837 drawing shows two water courses running to separate shafts on the Low Level. which was dammed near its mouth to create a reservoir; this level is named on the plan as the Raper Level, presumably to reflect its re-opening of the former Blakethwaite Low Level by the Strands Company and to differentiate it from the other Low Level further down the gill. The upper water course seems to have originated at a sluice positioned at the north end of the Blakethwaite upper dam while the lower water course, running to the lower shaft on the west side of Cross Gill, may have originated from the lower dam; several leats are shown running east at different levels from the dams towards Cross Gill on Google Earth 2002 imagery. Another, lower, watercourse running to the Water Blast shaft on the Raper, or Low, Level on the east side of the gill can also be seen; this leat may be slightly older and probably dates to the time when the Low Level was being driven by Chippendale and Company, the water being used to provide ventilation via air pipes to the forehead (Mike Gill, pers. comm.).
- 2.4 As the main Blakethwaite Level continued to follow the Blakethwaite Vein to the west, the lead-bearing beds dipped below it, and so a second underground shaft (the West Engine Sump) was dug, probably between 1837 and 1840. In early 1842, a Whitham's water pressure engine was built in a chamber at the top of this sump to pump water and wind material from the workings (Gill 2014, 76; Gill 2000, 74). Water for this wheel was fed from the Blakethwaite lower dam via a launder in the old Lonsdale's Level which had previously been driven from the north side of the Gunnerside Beck just below the dam (see figure 4). However, despite this investment, returns from the mine started to fall and in 1861 the Strands Company gave up its lease, as well as those to other mines in Lowanthwaite and Swinnergill. After this, despite the Blakethwaite mine being taken over by Sir George Denys and the Blakethwaite Mining Company, then the AD Lead Company in 1873, and finally the Old Gang Lead Mining Co. Ltd in 1888, the Blakethwaite mine gradually fell into decline (Gill 1995, 46-47).
- 2.5 The two Blakethwaite Dams are believed to have been built between 1836 and 1842 by the Strands Company and they were certainly in existence by 1854 when they were surveyed by the Ordnance Survey (see figure 6). The reservoirs are not depicted on mining plans of 1821, 1823 or 1836 (NYCRO ZLB 41/17; ZLB 41/5; ZLB 41/6), although they are both shown on other mid 19th century plans (NYCRO ZLB 41/7-41/9) (see figure 4); these latter plans also name the 'engine' in the West Engine Sump and so presumably date to around or after 1842 when the engine was built. Both dams are also shown on another later mining plan dating to 1862 (NYCRO ZLB 24). It is currently not known whether both dams were built at the same time, or whether one slightly predates the other; this is discussed further below.
- 2.6 The Strands Company were responsible for a major investment in the Blakethwaite mine sett during the mid 19th century, work which included the development and improvement of the water management system. It also needs to be remembered that the Strands Company held leases to some of the Lownathwaite mines on the

west side of the gill at this time, providing them with an added incentive to improve the water supply. This period also saw the construction of Moss Dam (NGR NY 9218 0066), situated 2.5km to the south-south-west, which was fed by a long catchwater leat which brought water from Green Gill (NGR NY 9124 0421) some c.4km to the north. Moss Dam is believed to have been built in c.1842 to supply water to the two underground engines in the Blakethwaite Level via the Blakethwaite Dams and a long leat from Moss Dam (Gill 2014, 76; Gill 2000, 74). The 'Long Race' (YDNPA HER MYD21691) is depicted on the Ordnance Survey 1857 6" map running around the contours from the Moss Dam to the lower of the two Blakethwaite dams, and it was also fed directly by the Green Gill catchwater leat (see figure 7); the c.1842 plans and the 1857 map clearly show the Long Race entering the lower of the two dams (see figure 4), although aerial photographs may suggest that there was also an extension into the upper dam (YDNPA HER MYD21691). These aerial photographs also show other alignments around Blakethwaite Moss, which might indicate earlier or later recuts of this important water course. Roe notes that the catchwater leat was described as being 'new' on a map of 1855, and water would also have been taken off the 'Long Race' for the Strands Company's Lownathwaite mines and later the Sir Francis Mine (Roe 2004. 91). It should also be noted that another long leat is depicted on Google Earth 2011 imagery, running around the contours along the north side of the Gunnerside Beck from the area of Straites to the north-west of the upper dam, the straightened east end of which is shown on the 1857 map; this was presumably a bypass rather than a feeder leat, although it could equally well be an earlier feature associated with the earlier phases of mining in this area (YDNPA HER MYD50887). Stone for the dams may well have been obtained from a guarry located just to the north on the west side of Benty Gutter, where there is an area of disturbed ground (YDNPA HER MYD50880).

2.7 It is often stated that the Blakethwaite Dams were also used to store water for the Blakethwaite mine dressing floors located some 1km downstream to the southsouth-east, and also to the Blakethwaite smelt mill even further down the gill. At present, it is uncertain how water would have been taken to either. Water may have travelled underground and emerged from the Blakethwaite (Main) Level - a leat or watercourse appears to be shown on 1857 map emerging from the level before returning to the beck a short distance to the south. Gill also calls the Blakethwaite (Main) Level a launder level, and it is shown on Close's 1837 plan as being the tailrace for the engine. There is also at least one probable leat shown running down the gill on the west side of the beck shown on Google Earth 2002 imagery, and NAA recognised one or more unidentified stone structures to the north of the Blakethwaite dressing floor which might be associated with a launder crossing the beck to feed to Blakethwaite dressing floor (Ronan & Cardwell 1997. 11). Google Earth also shows the west bank leat appearing to run south as far as the Blakethwaite smelt mill, and the BHWB 1994 survey identified a leat and launder, supported on stone revetments and pillars, as well some culverted sections, on the west side of the gill just to the north of the smelt mill; the water would have powered the bellows for the ore hearths (BHWB 1996, 26). However, it is also guite likely that any original arrangement for the water supply would have been improved and enhanced over time, but the Blakethwaite dams were certainly being used to supply water to the smelt mill in 1878, as a new lease for the Old Gang mines signed in January 1878 stipulated that dammed water was not to be used in the mines as it was needed for the Blakethwaite smelt mill (Flynn 1999, 66). Despite all the above, it is equally possible that the Blakethwaite dams were just used to maintain a more regular supply of water to the beck, with water being taken off into a leat for the last 100m or so, nearer the dressing floor and smelt mill

(Mike Gill, *pers. comm.*); this is certainly the situation depicted on one of the mid 19th century mining plans (NYCRO ZLB 41/7).

2.8 An undated survey drawing of the 'Blakethwaite Dam' survives, part of the original contract documents held by J L Barker of Healaugh – a copy of this drawing by Peter Jackson in December 1972 is now held by NMRS records; Mike Gill kindly provided EDAS with scans of the drawing (see figure 5). It is difficult to marry the details shown on the drawing to either of the dam structures which survive today, but the fact that the drawing is titled in the singular implies that it relates to only one of the dams. The dimensions shown on the drawing and the general profiles of the structure more closely match those of the lower dam; 'no 1' is presumably a plan, 'no 2' appears to be an east-west section through the northern half, with the sloping wall representing the buttress on the east side, and 'no 3' is a more detailed drawing of a section shown in 'no 1', which might be an idealised north-south section along the west side.

3 DESCRIPTION OF THE DAMS

Introduction

3.1 The dams are described below in a logical sequence, based on a summarised version of the information contained in the survey gazetteer of components originally compiled by NAA in 1996 (Ronan & Cardwell 1997, 13-15 & Appendix 3); the description concentrates on updating or amending, rather than repeating, the previous survey results. To ensure continuity, the letter/number identifier sequence used by NAA has also been retained (see figures 8 and 9). Reference should also be made to the annotated survey plans and plates, and the digital photographic record which appears as Appendix 1; digital photographs are referenced in the following text in italic type and square brackets, the numbers before the stroke representing the film number and the number after indicating the frame e.g. [5/32]. For descriptive purposes, both dams are considered to be aligned north-south.

The Upper Dam (NGR NY 93454 02988) (YDNPA HER MYD21730)

Historical Background

- 3.2 The historical context noted above suggests that the upper dam was built primarily to supply water to power a hydraulic engine (the 'Victoria Engine') constructed in the East Engine Sump on the Cocker Crosscut of the Blakethwaite Level in mid 1837. An 1837 drawing of the engine (reproduced by Gill 2014, 75) shows two water courses running to shafts on the Raper Level, which was dammed near its mouth to create a reservoir (see figure 3 bottom). As noted in Chapter 2 above, water was brought to the engine via an upper watercourse from the upper dam (after crossing the Benty Gutter) and a lower watercourse from the lower dam to shafts on the west side of Cross Gill (Gill 2014, 72); parts of these surface leats are visible on Google Earth 2002 imagery. It was suggested in the 1996 NAA survey (Ronan & Cardwell 1997, 13) that the upper dam was probably the earlier of the two dams, and that with the aid of the 'Long Race' (see below), it would have provided water for the Blakethwaite dressing floor and smelt mill; however, as noted above, the 'Long Race' is depicted on the mid 19th century plans as entering the lower dam, although of course it could have originally extended further northwest to the upper dam.
- 3.3 The upper dam is shown on several mid 19th century (c.1842) plans, as well as the 1857 Ordnance Survey 6" to 1 mile map, where both dams are named

'Blakethwaite Dams' (see figures 4 and 6). On the latter map, the only source of water for the upper dam appears to be the Gunnerside Beck, although it was also noted above that other leats are shown on Google Earth imagery running along the north side of the beck into it. The dam itself is indicated at the south-eastern end of the triangular body of water, and has an opening through it to the south of centre. What appears to be a very straight artificial leat runs from a natural watercourse descending from Blakethwaite Meres to the north towards the north end of the dam, and Google Earth imagery shows that this formerly extended for some distance to the north-west.

Site Description

- 3.4 As was stated in 1996 (Ronan & Cardwell 1997, 13-14), the upper dam was built across the head of the valley to create a broad but shallow body of water up to 35m wide and 130m long [*1/122*] (see plate 3 and figure 9 top). It is now badly silted and the original water depth is unclear, although to judge by the rear (western) wall of the dam (NAA gazetteer 3C.4), it may have approached 1.5m deep [*1/129, 1/130*]. The dam itself is c.50m long by c.7m wide (top), and is of composite construction, formed by two outer masonry walls, presumably infilled by soil and rubble [*1/123, 1/133, 1/134*] (see plate 4); it lies at c.535m AOD, some 30m higher than the lower dam (see plate 2).
- 3.5 The rear (western) wall (gazetteer 3C.4) is as described in 1996 [1/137, 1/140-1/142]; the southern half has a curious appearance, the coursed dressed stone blocks to the north face being laid in rather sinuous courses. The wall rises from a plinth of roughly dressed and coursed rubble, and it is assumed that this has sunk, presumably from undercutting by the beck which runs along its base, causing the courses above to follow suit - it is difficult to believe that they were laid in this manner originally [1/102-1/106, 1/108] (see plate 5). As was stated in 1996, the south end of this face is beginning to collapse, due to subsidence caused by the beck [1/124, 1/125]. The breach in the west wall, the socket and associated metalwork marking a former sluice position (gazetteer 3C.5) are all as described in 1996 [1/126, 1/132, 1/138] (see plate 6). The beck now cuts through the earth infill/core between the dam walls [1/128, 1/139].
- 3.6 The front (eastern) wall of the dam (gazetteer 3C.3) is again largely as described in 1996, standing up to 5.0m in height towards the centre; a possible drainage feature at the base of the central part described in 1996 was not visible in March 2015 due to the volume of water passing over the dam [1/113-1/116, 1/120, 1/145, 1/147] (see plate 7). There is a central gap or breach to the front wall, and to the immediate south of this, the eastern wall face projects slightly. The south-west corner of this projection was decaying in March 2015, with several large blocks ready to fall [1/117] (see plate 8). There is also a rowan tree growing out of the dam's structure here, contributing to the collapse. To the north of the central gap, there is an angled revetment wall (gazetteer 3C.2) [1/127, 1/131] supported by a buttress (gazetteer 3C.1) [1/143, 1/144] (see plate 9); the condition of both does not appear to have deteriorated since 1996. However, it was previously stated that the revetment wall (3C.2) was keyed into the front wall of the dam - this relationship was not clear in March 2015, and the upper part of the revetment in fact appears to stop short of the dam wall; it may have decayed since 1996. The stepped buttress (gazetteer 3C.1) below the revetment wall is clearly later than the dam's east wall, as it butts the base [1/121]. The upper surface has a thick covering of moss and bilberry growing on it, and there are two rowan trees growing out of the buttress itself.

3.7 The straight leat, shown running to the north-west end of the dam in 1857, survives as an earthwork (gazetteer 3C.11) but it no longer has a clear relationship with the dam structure itself. There are also additional earthworks to the east of the northern half of the dam's eastern wall (gazetteer 3C.3) that were noted in 1996. There is a relatively level area to the immediate north-east of the wall, measuring c.1.8m wide at the southern end but increasing to c.3.0m at the northern end. Beyond the bank, a steep, south-east facing artificial scarp stands up to 2.0m in height and curves around to the east at its northern end. At the base of this curve, there is a shallow linear depression some 2.0m across, with a parallel linear bank on its south side. This may well be associated with the continuation of one of the watercourses which ran east along the top of the scarp and across Cross Gill to the Raper Level and so on to power the underground 'Victoria Engine'. To the east of the dam, the beck passes over a natural outcrop which, together with the cascade over the dam itself, creates a dramatic waterfall effect when the beck is in spate [1/146] (see plate 10).

The Lower Dam (NGR NY 93563 02942) (YDNPA HER MYD21730)

Historical Background

- 3.8 The historical context noted above suggests that the lower dam was built primarily to supply water to power a hydraulic engine built in the West Engine Sump, which was sunk towards the western end of the Blakethwaite Level workings in c.1837-40; it is also possible that it stored water for the Blakethwaite dressing floors located some 1km downstream to the south-south-east, but this has not been confirmed. Gill notes that a Witham's water pressure engine, with a 13 inch diameter cylinder, was built in a chamber at the top of the West Engine Sump in early 1842; the engine had been working for three weeks by April 1842 (Gill 1995, 45-46; 2000, 74; 2014, 76). Water from the lower dam was carried in a launder along the old Lonsdale's Level (located just to the east of the lower dam on the north side of the beck; see figure 4) to a point 160 feet above the engine, where it entered a falling main to gain the necessary head. It was suggested in the NAA 1996 survey (Ronan & Cardwell 1997, 13-14) that the lower dam was probably the later of the two dams, and was possibly built in 1842. It is interesting to note that this is the same date given for the construction of the Moss Dam, and also presumably the connecting 'Long Race'.
- 3.9 The lower dam is shown on several mid 19th century (c.1842) plans, as well as the 1857 Ordnance Survey 6" to 1 mile map, where both dams are named 'Blakethwaite Dams' (see figures 4 and 6). The c.1842 plans, as well as that dating to 1862, show the mouth of the Lonsdale Level below the dam on the north side of the beck. The main source of water for the lower dam appears to be the Gunnerside Beck, after it has passed over the upper dam, but other water was supplied by Benty Gutter from the north. This supply was augmented by the 'Long Race', a contour watercourse which originated at Moss Dam, some 2.5 km to the south-west, and eventually fell into the south side of the water body; again, the c.1842 plans show the 'Long Race' entering the lower dam (see figures 4 and 7). In 1857, a sluice is indicated at the north end of the dam itself (YDNPA HER MDY21729), through which retained water flowed to continue east as the Gunnerside Beck (see figure 6). The lower dam was apparently still holding water in 1862, when it is depicted on a tracing of Clarkson's plan (NYCRO ZLB 24) but it has been breached since.

Site Description

- 3.10 As was stated in 1996 (Ronan & Cardwell 1997, 14-15), the lower dam is situated at the inlet of Benty Gutter, immediately to its east [1/164] (see plate 11 and figure 9 bottom). It lies some 115m east of the upper dam [1/109-1/110, 1/112, 1/118-1/119, 1/148], to create a body of water up to 35m wide and 70m long within a steep-sided valley [1/186] (see plate 12). Although considerably shorter than that retained by the upper dam, the water body was probably once considerably deeper, with silts indicating that it may have been as much as 4.0m deep (Ronan & Cardwell 1997, 15); the dam as a whole measures c.36m long by c.10m wide and it lies at c.505m AOD (see plate 2).
- 3.11 The dam is now breached, with a considerable proportion of the central part having been lost [1/153-1/158, 1/161-1/163, 1/178, 1/187, 1/200]; however, comparisons between photographs taken in 1996 and 2015 indicate that there has been no further substantial damage in the intervening period. The dam itself (gazetteer 3C.6) is of composite construction, formed by two outer masonry walls, infilled by soil and rubble; this form of construction is very evident at the breach [1/149]. 1/150, 1/185, 1/189, 1/191] (see plates 11 and 13). The inner faces of the two masonry walls are vertical, and set 1.85m apart, whereas the outer faces have a steeply tapered or battered profile; in contrast to the upper dam, the inner wall of the dam structure is built of much smaller stone laid in thinner and less regular courses with large blocks at the base [1/165-1/167, 1/170, 1/171, 1/173-1/177, 1/196 (see plate 14). The space between the two walls is a level grassed area [1/169, 1/183, 1/184, 1/190]. Timber fragments are visible within the corework of the dam in the area of the breach, suggesting they were used to strengthen and tie the structure together. There is a long, square-section, metal rod rising from the base of the western face of the dam to the north of the breach: this does not appear to have been noted in the 1996 survey [1/151]. The rod is now bent over, but is long enough when vertical to have reached the top of the dam; its upper end assumes a circular (unthreaded) section, and retains two square nuts [1/152].
- 3.12 To the east face of the dam's east wall, there are lower stepped buttresses to both sides of the breach (gazetteer 3C.7) [1/180-1/182, 1/192-1/195] although that to the south is only partly visible (see plate 15); both ends of the buttress are being undercut by the beck, especially that on the north side of the breach [1/179] (see plate 16). This buttress has an east-west aligned 2m high revetment wall (gazetteer 3C.8) [1/197] built against it, which contains a small vaulted culvert at its base, suggested in 1996 as being either the mouth of the Lonsdale Level or to be associated with the sluice marked here in 1857 (Ronan & Cardwell 1997, 15). The sluice lies at the north end of the dam rather than in the centre of the east side. and so is presumably associated with the one of the water courses running east along the north side of the beck, or is more probably controlling flow over the dam into the beck to prevent overflowing. The entrance to the culvert lies low down in the east-west revetment wall and is not very high internally [1/199] (see plate 17), although it almost certainly represents the former Lonsdale's Level through which water was taken in a launder to the Witham engine (see figure 4); the actual original entrance to the level may have been eroded or even partly demolished when the dam was built. To the east of the lower dam, a partly revetted trackway (gazetteers 3C.9 & 3C.10) [1/172] rises from the north side of the beck and runs to the north-east, gradually climbing the northern slope of the valley; this is not on the same alignment as that depicted in 1857 (see figure 6). Above this, not surveyed by NAA, there is a slight terrace running along the north side of the valley which probably represents the line of a leat running to Cross Gill, and it appears to be at the right height to correspond with the sluice shown in 1857 [1/188].

3.13 The point where the 'Long Race' is shown entering the body of water in 1857 is over a high, near vertical outcrop; the earthwork of the race can be traced as far as this point, but there is no clear indication that it ever continued further north-west towards the upper dam.

The Blakethwaite (Raper) Top and Low Levels

3.14 The YDNPA also requested that EDAS visit the area to the immediate south-east of the dams, to clarify the location and indeed the presence of two levels here.

Historical Background

- 3.15 The Blakethwaite (later the Raper) Low Level was driven a short distance downstream from the Cross Gill confluence, on the east side of the Gunnerside Beck, by Thomas Chippendale and Company during the early part of their 21 year lease of the Blakethwaite Mines. By 1811 an ore shoot of c.750 feet long was being worked from the Low Level driven from the side of the beck and also the Top Level higher up on the east side of Cross Gill (see figure 3 top). These levels and workings are depicted on Newbould's 1811 plan (NYCRO ZLB 41/4) as well as other mid 19th century mining plans, one of which calls the Low Level the 'Lonsdale Level' (NYCRO ZLB 41/14). The company also built an office (the 'High House') near the entrance to the Low Level (Gill 2014, 71), which is named as 'Lady Mary' on later c.1842 plans (NYCRO ZLB 41/7-41/9). As noted above, Close's 1837 drawing of the 'Victoria Engine' (reproduced by Gill 2014, 75; see figure 3 bottom) shows two water courses running to shafts on the Raper Level, which was dammed (actually completed walled up) near its mouth to create a reservoir. Members of the Earby Mines Research Group explored the mine, and in July 1979 they photographed the headworks of the water supply system in the Low Level and later gained access to the engine chamber; Gill (2014, 76-79) reproduces some of their photographs and discusses their findings.
- 3.16 A full height dam was created at the entrance to the Raper Low Level, to provide a reservoir to create a head of water for the 'Victoria Engine' the dam would have been needed to give the estimated depth of between four and five feet of water at the top of the nine fathom sump leading to the Blakethwaite Level (Gill 2014, 77). However, the Blakethwaite Beck has changed its course over time, and the entrance and dam to the Low Level has since been washed away (Gill 2014, 80 note 6).
- 3.17 The Ordnance Survey 1857 6" map marks 'Blakethwaite Level (Lead)' at the site of the Low Level (see figure 6), and it is sometimes known as the 'Blakethwaite Top Level' (see figure 6). Further to the north, on the east side of Cross Gill, a 'Level' corresponds to the Top Level; the latter lies just east of the upper track along this side of the Blakethwaite Gill, which crosses Cross Gill via a 'Ford'. On the map, a thicker line appears to emerge from the level entrance, presumably a watercourse, which runs south-west under the adjacent track and into Cross Gill.

Low (Raper) Level (NGR NY 93867 02762) (YDNPA HER MYD42287)

3.18 The truncated entrance of the level entrance survived in March 2015, now on the very edge of the beck [1/212, 1/218, 1/226-1/230] (see plate 18). It is unknown how much of the entrance has been lost, but it might be considerable as Close's 1837 drawing shows the reservoir dam lay beyond the entrance. The interior of the level is well preserved, with a broad semi-circular vault over [1/215] (see plate 19),

and the photographs published by Gill (2014) show that the level and engine chamber also survive well, although there have been some collapses.

'High House' Office Building (NGR NY 93871 02717) (YDNPA HER MYD21724)

3.19 A short distance downstream to the south, there is a small ruinous building, also shown in 1857, which represents the remains of the 'High House' or 'Lady Mary' building (see figure 6). The structure is aligned approximately north-south, and is rectangular in plan. It is of a low two storeys, and built of roughly coursed and squared stone, with corner quoins; it is built into a bank, so that externally only the first floor of the east elevation would have been visible. The building probably once had a pitched roof, covered with flagstones, but this has completely collapsed. The north gable is almost completely absent [1/219]. The only surviving ground floor doorway is set to the north end of the west elevation, and has a blocked window to the east [1/220, 1/221] (see plate 21). The south gable has also partly collapsed, but may once have contained a chimney flue rising to an end ridge stack [1/222]. There is a blocked first floor doorway at the south end of the east elevation [1/223]. Internally, the building appears to have comprised a single cell to each floor. There are surviving sockets for floor joists to the internal east wall [1/224], and a collapsed structure at the internal south-west corner [1/225]: this may form the remains of a fireplace for, if the building was heated (as seems a reasonable assumption), it is difficult to see where else such a feature would have been positioned.

Top Level (NGR NY 93921 02870) (YDNPA HER MYD43204)

3.20 In March 2015, what appeared to be the remains of a large drain or culvert were located slightly to the south-west of the position shown in 1857, very close to the east side of the main Cross Gill beck. A low coursed and squared stone wall curves around to the north-west [1/204], and is joined by a second wall opposite, the two being set c.1.0m apart. These walls continued parallel for a short distance, before disappearing into a low opening with a flat lintel [1/205] (see plate 20). Shortly beyond this point, and still to the south-west of the modern shooting track, there is an oval depression in the ground where the tunnel below has collapsed [1/207]; the interior appears to be less than a metre in height [1/208], seemingly too low to be a level. It is possible that all these features relate to the culverted watercourse shown in 1857, with the site of the level entrance lying further to the north-east, just beyond the modern track.

4 CONCLUSIONS

Discussion

4.1 Quite why there should be two dams so close together has yet to be adequately explained. Crucial to this understanding is the appreciation that the two dams are positioned at very different heights - the upper dam, which is probably in the best location given the size of the body of water it retains relative to the difficulties in constructing the dam, lies c.30m higher than the lower dam (see plate 2). The upper dam has the capacity to store a greater quantity of headwater in the more shallow-sided valley which is fed by numerous natural springs and rills (see plate 3). The position of the lower dam is puzzling, as the steep-sided valley here means that it is not able to retain a particularly large body of water (see plate 12), although this may of course have been adequate for the purpose it fulfilled. Water for the lower dam was supplemented by the 'Long Race', an artificial leat that runs for a total distance of c.6km-7km from Moss Dam and beyond (see figure 7), as

well as Benty Gutter from the north. The considerable amount of work necessary to construct the 'Long Race' implies that the water supply in the Gunnerside Beck was unreliable, particularly if most of the headwaters were already being held back and utilised by the upper dam. The upper dam structure also appears to be better constructed, both in terms of technique and materials.

- 4.2 Another question not yet adequately answered is when the two dams were actually constructed, although their function was primarily to power the two underground engines in the Blakethwaite workings. The 'Victoria Engine' was built in mid 1837 in the existing East Engine Sump of the Blakethwaite Level, while the Whitham's engine was built in early 1842 in the West Engine Sump, and it has been inferred above that these represent dates of construction for the two dams, the upper dam feeding the earlier 'Victoria Engine' and the lower dam the later Whitham's engine. It has been suggested elsewhere that the lower dam is later than the upper dam (Ronan & Cardwell 1997, 13-14), but the reverse could equally be true; it would seem just as logical to create a larger dam upstream at a slightly later date if the smaller dam downstream proved unable to fulfil power requirements. It may also be that the lower dam initially powered the 'Victoria Engine', but that its supply was later switched to the Whitham's engine, when the new upper dam (which appears to be better constructed and have a greater head of water) had been built. It is also possible that the supply to the lower dam became less reliable once the upper dam had been built, and so the Moss Dam and the 'Long Race' may have been built in c.1842 to augment its supply. It is unfortunate that the drawings of the 'Blakethwaite Dam' (see figure 5), which appear to relate to the lower dam, are undated, but other plans of c.1842 show both dams in place.
- 4.3 Even if the dams were constructed one after another, it seems likely that would not have been any significant time gap between them, and they may have been built at the same time or only one or two years apart. What is clear is that they were built by the Strands Company, who held the lease to the Blakethwaite mines from April 1836 until 1861, and so the all of the works noted above represent an initial phase of investment to make the mine profitable.
- 4.4 Despite the above, there still remains some confusion over the water supply to the Blakethwaite Dams and the associated underground workings. It would therefore be beneficial to walk and plot the alignment of the 'Long Race' and the catchwater race (see figure 7), and any associated feeder and earlier/later alignments, to better understand, appreciate and protect this important feature. Similarly, water leats along the sides of the upper part of the gill should also be investigated, so that the mechanics of water movement to and from the dams are better understood. The fact that the study of these often complex water supply systems is usually omitted from general archaeological surveys is to be regretted, as they are an integral part of any mining landscape without an adequate water supply to power winding and pumping engines, many of the lead mines would not have been able to operate.

Management Issues

4.5 Little erosion or collapse appears to have taken place at either dam since the NAA 1996 survey. They reported that the continued passing of visitors over the breach in the upper dam could lead to further deterioration (Ronan & Cardwell 1997, 21), but this does not seem to be a significant problem at present. They also suggested that the installation of a footbridge across the breach may prevent further damage but may also encourage visits, while a repair of the breach or the erection of a barrier on the west side could be considered. As in 1996, the main

threat to the structural stability of both dams is natural erosion from the beck passing through them. For the lower dam, NAA suggested that, while some consolidation of the stonework would be beneficial, a channel should be built to accommodate the flow, to prevent undercutting and collapse of the breach (Ronan & Cardwell 1997, 23). At the upper dam, some consolidation around the southwest end of the west side of the dam would also be useful.

4.6 It would be beneficial to undertake some limited low-level consolidation or rebuilding works to prevent further or continued collapse of several key areas. At the upper dam, this could, for example, include the south end and around the central breach in the west wall, and the around the breach in the east wall (see plate 8), while for the lower dam, it would include the ends of supporting buttress on the east wall either side of the breach (see plate 16). It would also be beneficial to channel the water through the breach of the lower dam, to prevent further undercutting and collapse of the dam core (see plates 11 and 13) - this need only involve the placement of large stones either side of the stumps of the rowan trees growing from the east wall of the upper dam (see plate 7).

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PROJECT	
ΒΙ ΔΚΕΤΗΜ	AITE DAMS
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GENERAL	LOCATION
0	
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NTS	JUN 2015
	FIGURE
FDAS	1
	_



0

50m

Plan provided by YDNPA.

BLAKETHWAITE DAMS		
AS SHOWN	JUN 2015	
EDAS	FIGURE 2	





Bottom: James Close's 1837 draing, re-drawn by Mike Gill.

Source: Gill, M C 2014 'Victoria Engine, Blakethwaite Mine, Gunnerside'. British Mining no 98, 71-80





Top: Late 19th century plan of Blakethwaite mine (NYCRO ZLB 41/8).Bottom: Late 19th century plan of Blakethwaite mine (NYCRO ZLB 41/9).

BLAKETHW	BLAKETHWAITE DAMS		
CARTOGRAPH	IC DEPICTIONS		
SCALE	JUN 2015		
EDAS	FIGURE 4		





BLAKETHWAITE DAMS		
AS SHOWN	JUN 2015	
EDAS	FIGURE 5	







GUNNERSIDE GILL Phase 3 Survey Melbecks, N. Yorkshire. NY935030 Survey area 3C Blakethwaite Dams Site plan Northem Archaeological Associates July 1996



Source: Ronan, D & Cardwell, P 1997 *Gunnerside Gill: Phase 3 Archaeological Survey Report*, figure 11 (unpublished NAA archive report 97/44 for the YDNPA).

BLAKETHWAITE DAMS		
NAA 1996 GENERAL SURVEY		
AS SHOWN	JUN 2015	
EDAS	FIGURE 8	

50m



Source: Ronan, D & Cardwell, P 1997 *Gunnerside Gill: Phase 3 Archaeological Survey Report*, figures 12 & 14 (unpublished NAA archive report 97/44 for the YDNPA).



Plate 1: View to upper part of Gunnerside Gill to Blakethwaite dams, looking NW (photo 1/094).



Plate 2: View to upper dam from lower dam, looking W (photo 1/200).



Plate 3: Former reservoir of upper dam, looking N (photo 1/122).



Plate 4: Top of upper dam, looking N (photo 1/123).



Plate 5: West wall of upper dam, south end of west face, looking SE (photo 1/108).



Plate 6: Upper dam, breached former sluice position in west wall, looking SE (photo 1/126).



Plate 7: East wall of upper dam, showing breach in east face and buttress, looking N (photo 1/115).



Plate 8: East wall of upper dam, showing potential area of collapse at south end of east face, looking NW (photo 1/117).



Plate 9: Revetment and buttress to upper dam, looking W (photo 1/144).



Plate 10: Waterfall over natural outcrop to east of upper dam, looking W (photo 1/146).



Plate 11: Breach through lower dam and view up Benty Gutter, looking N (photo 1/163).



Plate 12: Former reservoir to west of lower dam, looking W (photo 1/186).



Plate 13: Breach through lower dam providing section through construction, looking S (photo 1/191).



Plate 14: South part of west wall of lower dam, looking E (photo 1/166).



Plate 15: Lower dam, looking SW (photo 1/192).



Plate 16: Eroding buttress on north side of east wall of lower dam, looking NW (photo 1/179).



Plate 17: Culvert through revetment on north side of lower dam (part of Lonsdale Level), looking E (photo 1/199).



Plate 18: Eroded entrance to Low Level, looking N (photo 1/230).



Plate 19: Interior of Low Level, looking N (photo 1/215).



Plate 20: Possible entrance to Top Level, looking NE (photo 1/205).



Plate 21: West elevation of 'High House' office building, looking E (photo 1/220).

APPENDIX 1 PHOTOGRAPHIC RECORD

BLAKETHWAITE DAMS PHOTOGRAPHIC CATALOGUE

Film 1: Colour digital photographs taken 18th March 2015

Film	Frame	Subject	Scale
1	88	View to upper part of Gunnerside Gill, looking N	-
1	91	View to upper part of Gunnerside Gill to dams, looking NW	-
1	92	View to upper part of Gunnerside Gill to dams, looking NW	-
1	94	View to upper part of Gunnerside Gill to dams, looking NW	-
1	95	View to upper part of Gunnerside Gill to dams, looking NW	-
1	97	View down upper part of Gunnerside Gill, looking SE	-
1	102	Upper dam, W wall (NAA 3C.4), S end of W face, looking NE	1m
1	103	Upper dam, W wall (NAA 3C.4), S end of W face, looking E	1m
1	104	Upper dam, W wall (NAA 3C.4), S end of W face, looking E	1m
1	105	Upper dam, W wall (NAA 3C.4), W face, looking NE	-
1	106	Upper dam, W wall (NAA 3C.4), W face, looking NE	-
1	108	Upper dam, W wall (NAA 3C.4), S end of W face, looking SE	1m
1	109	View to lower dam, looking E	-
1	110	View to lower dam, looking E	-
1	112	View to lower dam, looking E	-
1	113	Upper dam, E wall (NAA 3C.3), E face and buttress (NAA 3C.1), looking NW	-
1	114	Upper dam, E wall (NAA 3C.3), E face, looking NW	-
1	115	Upper dam, E wall (NAA 3C.3), E face and buttress (NAA 3C.1), looking N	-
1	116	Upper dam, E wall (NAA 3C.3), E face, and buttress (NAA 3C.1) looking N	-
1	117	Upper dam, E wall (NAA 3C.3), E face, showing potential area of collapse	-
		adjacent to breach, looking NW	
1	118	View to lower dam, looking E	-
1	119	View to lower dam, looking E	-
1	120	Upper dam, E wall (NAA 3C.3), E face and buttress (NAA 3C.1), looking NW	-
1	121	Upper dam, E wall (NAA 3C.3), E face and buttress (NAA 3C.1) ,looking NW	-
1	122	Former reservoir of upper dam, looking N	-
1	123	Upper dam, top of S side, looking N	1m
1	124	Upper dam, decay to S end of W wall (SC.4), W face, looking S	1m
1	125	Upper dam, top of S side, looking N	1m
1	126	Upper dam, former sluice position in W wall (SC.5), looking SE	-
1	127	Upper dam, breach in E wall (NAA 30.3), looking N	-
1	128	Upper dam, breach, looking N	-
1	129	Former reservoir of upper dam, looking S	-
1	101	Former dem N face of revetment (NAA 2C 2) looking S	- 1m
1	132	Upper dam, former sluice position in W wall (SC 5), looking SE	-
1	132	Upper dam, former sluce position in w wair (30.3), fooking SE	- 1m
1	13/	Upper dam, top of N side, looking N	1m
1	137	Upper dam, top of W wall (SC 4) Looking N	1m
1	138	Upper dam, it side of W wall (CC.4), isoking W	-
1	139	Upper dam, breach, looking F	-
1	140	Upper dam, W wall (NAA 3C,4). N end of W face, looking SF	1m
1	141	Upper dam, W wall (NAA 3C.4), N end of W face. looking SE	1m
1	142	Upper dam, W wall (NAA 3C.4), N end of W face, looking NE	1m
1	143	Upper dam, revetment (NAA 3C.2) and buttress (NAA 3C.1), looking W	-
1	144	Upper dam, revetment (NAA 3C.2) and buttress (NAA 3C.1), looking W	-
1	145	Upper dam, looking W	-
1	146	Waterfall over natural outcrop to E of upper dam, looking W	-
1	147	Upper dam, looking W	-
1	148	Lower dam, looking E	-
1	149	Lower dam, N part of W wall (NAA 3C.6), looking E	-
1	150	Lower dam, N part of W wall (NAA 3C.6), looking E	-
1	151	Lower dam, metal rod to base of N side, looking E	-
1	152	Lower dam, metal rod to base of N side, looking E	-
1	153	Lower dam (NAA 3C.6), breach, looking S	1m
1	154	Lower dam (NAA 3C.6), breach, looking S	1m
1	155	Lower dam, S part of N wall (NAA 3C.6), looking SE	1m
1	156	Lower dam (NAA 3C.6), breach, looking E	1m

1	157	Lower dam (NAA 3C.6), breach, looking E	1m
1	158	Lower dam, S part of N wall (NAA 3C.6), looking SE	1m
1	161	Lower dam (NAA 3C.6), breach, looking N	-
1	162	Lower dam (NAA 3C.6), breach, looking N	-
1	163	Lower dam (NAA 3C.6), breach and view up Benty Gutter, looking N	-
1	164	Lower dam (NAA 3C.6), view up Benty Gutter, looking N	-
1	165	Lower dam, S part of W wall (NAA 3C.6), looking E	1m
1	166	Lower dam, S part of W wall (NAA 3C.6), looking E	1m
1	167	Lower dam, S part of W wall (NAA 3C.6), looking F	1m
1	169	Lower dam (NAA 3C.6), top, looking N	1m
1	170	Lower dam (NAA 3C.6), breach, looking N	-
1	171	Lower dam (NAA 3C.6), breach, looking N	_
1	172	Trackway (NAA 3C.9 & 3C.10) on N side of beck. F of lower dam, looking F	_
1	173	Lower dam, E wall (NAA 3C.6), looking N	1m
1	174	Lower dam, S part of F wall (NAA 3C.6), looking W	1m
1	175	Lower dam, S part of E wall (NAA 3C 6), looking W	1m
1	176	Lower dam, S part of E wall (NAA 3C 6), looking W	1m
1	177	Lower dam, S part of E wall (NAA 3C 6), looking W	1m
1	178	Lower dam (NAA 3C.6), breach, looking W	1m
1	179	Lower dam, eroding buttress in N side of F wall (NAA 3C 7) looking NW	-
1	180	Lower dam, F wall and buttress (NAA 3C 6 and 3C 7) looking W	1m
1	181	Lower dam, E wall and buttress (NAA 3C 6 and 3C 7) looking W	1m
1	182	Lower dam, E wall (NAA 3C.6). looking W	1m
1	183	Lower dam (NAA 3C.6), top, looking S	1m
1	184	Lower dam (NAA 3C 6), top, looking S	1m
1	185	Lower dam (NAA 3C 6), breach, looking S	-
1	186	Lower dam (nwwweele), bloadin, leeking e	-
1	187	Lower dam (NAA 3C 6) breach looking S	-
1	188	Trackway (NAA 3C 9 & 3C 10) on N side of beck. E of lower dam looking E	-
1	189	Lower dam (NAA 3C 6) breach looking S	-
1	190	Lower dam (NAA 3C 6), top looking N	1m
1	191	Lower dam (NAA 3C 6) breach providing section through construction looking	-
		S	
1	192	Lower dam (NAA 3C.6), looking SW	1m
1	193	Lower dam (NAA 3C.6), looking SW	1m
1	194	Lower dam and buttress (NAA 3C.6 and 3C.7), N part, looking SW	1m
1	195	Lower dam and buttress (NAA 3C.6 and 3C.7), N part, looking SW	1m
1	196	Lower dam, N part of E wall (NAA 3C.6), looking W	1m
1	197	Lower dam, revetment on N side (NAA 3C.8), looking N	1m
1	199	Lower dam, culvert in revetment on N side (NAA 3C.8; part of Lonsdale Level),	-
		looking E	
1	200	View to upper dam from lower dam, looking W	-
1	204	Top level, revetment wall, looking SE	1m
1	205	Top level, entrance?, looking NE	1m
1	207	Top level, collapse beyond entrance, looking NE	1m
1	208	Top level, entrance?, looking NE	-
1	212	Low level, entrance, looking N	1m
1	215	Low level, interior, looking N	-
1	218	Low level, entrance, looking N	1m
1	219	'High House' office building, N gable, looking S	1m
1	220	'High House' office building, W elevation, looking E	1m
1	221	'High House' office building, W elevation, looking E	1m
1	222	'High House' office building, S gable, looking N	1m
1	223	'High House' office building, E elevation, looking W	1m
1	224	'High House' office building, internal, looking SE	-
1	225	'High House' office building, internal, looking S	-
1	226	Low level, entrance, looking NE	-
1	227	Low level, entrance, looking NE	-
1	228	Low level, entrance, looking SW	-
1	229	Low level, entrance, looking N	-
1	230	Low level, entrance, looking N	-













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