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Roughton Gill Mine and Silver Gill Mine, Cumbria

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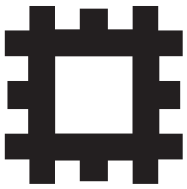
SURVEY REPORT

Archaeological Investigation report Series AI/8/2001



ROUGHTON GILL MINE and SILVER GILL MINE CUMBRIA

Archaeological Investigation Report Series AI/8/2001

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Frontispiece. General view of Iron Crag from the north (NMR/AA021999)

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1. INTRODUCTION AND SITE LOCATION

Roughton Gill Mine and Silver Gill Mine lie at the head of the glaciated Dale Beck valley in the Caldbeck Fells, part of the Skiddaw Massif area on the northern edge of the Lake District National Park in Cumbria (Fig 1).

Silver Gill is the earlier of the two mines, with documentary evidence suggesting that it was in operation by the early 14th century. It exploited a mineral vein whose principal outcrop is in Silver Gill, a steep-sided ravine at the head of the valley; but by the late 18th century, the vein had been effectively exhausted, and the mine had been subsumed within Roughton Gill Mine, named after the adjacent ravine to the east where other veins had by that time been located (Fig 2). By the later 19th century, a third mine – Mexico - was exploring the same group of veins where they outcropped in Clints Gill and Todd Gill further east again. Surface evidence of mining at the head of the Dale Beck valley is extensive, therefore, and covers most of the valley floor, as well as extending deep into several of the gills and up over parts of the surrounding high fell.

This report presents the results of an archaeological survey by English Heritage (EH) of the visible mining remains within an area of 36 hectares at the head of the valley,

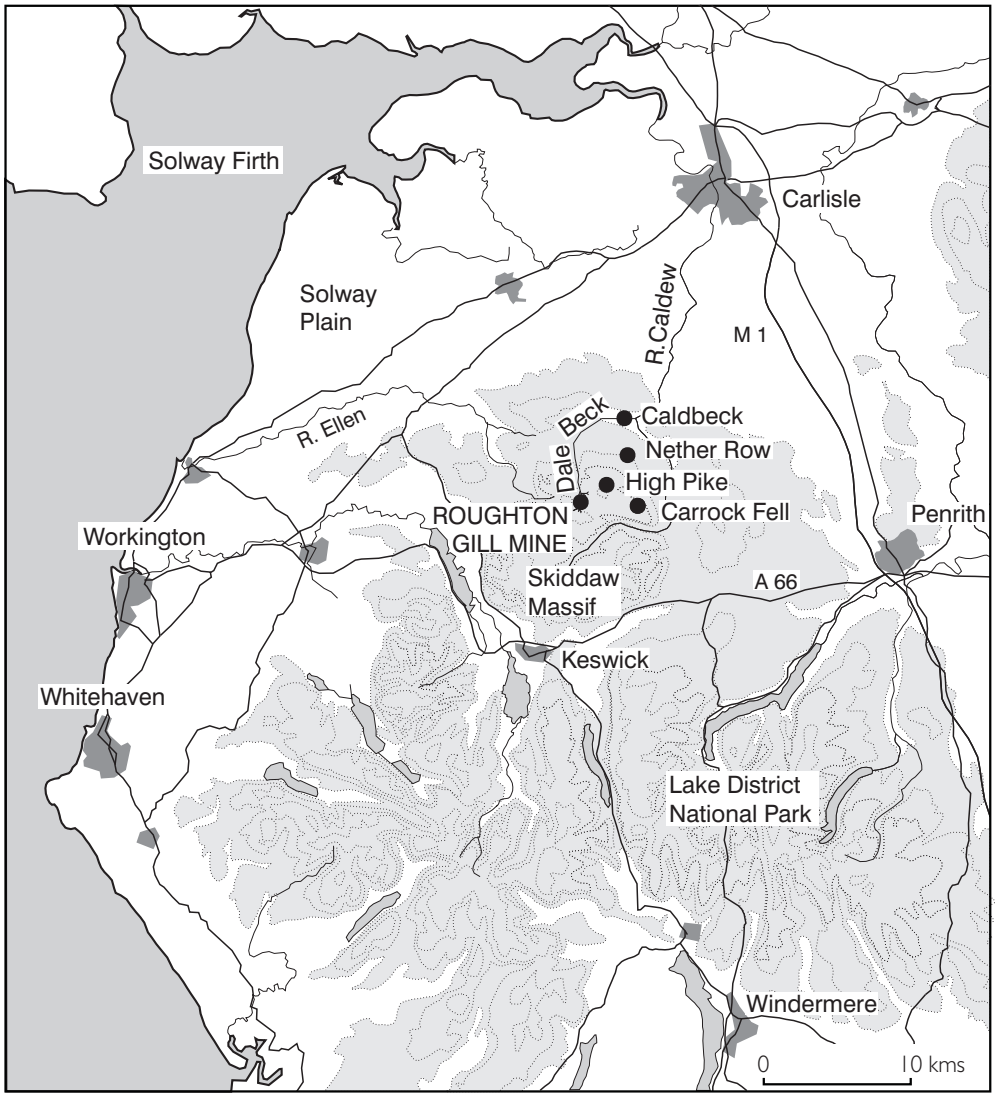

Figure 1. General location diagram

but excludes Mexico Mine and the majority of remains on the top of Balliway Rigg and in the uppermost reaches of Silver and Roughton Gills, and in Thief Gills (Figs 2 and 3). As the area surveyed comprises only part of the overall area of above-ground remains, permanent markers have been left on site so that any future work can be tied in precisely with the present survey. Details of these markers are given in section 8 and in appendix 3 below. The survey was undertaken for management purposes, largely at the request of the Lake District National Park Authority's archaeologist, John Hodgson, and was carried out in stages between May and December 2000.

Unauthorised mineral collection at the mines is illegal. Furthermore the underground workings are unstable and collapsing, and/or have deep shafts cut into their floors: unauthorised entry is ill-advised and potentially dangerous.

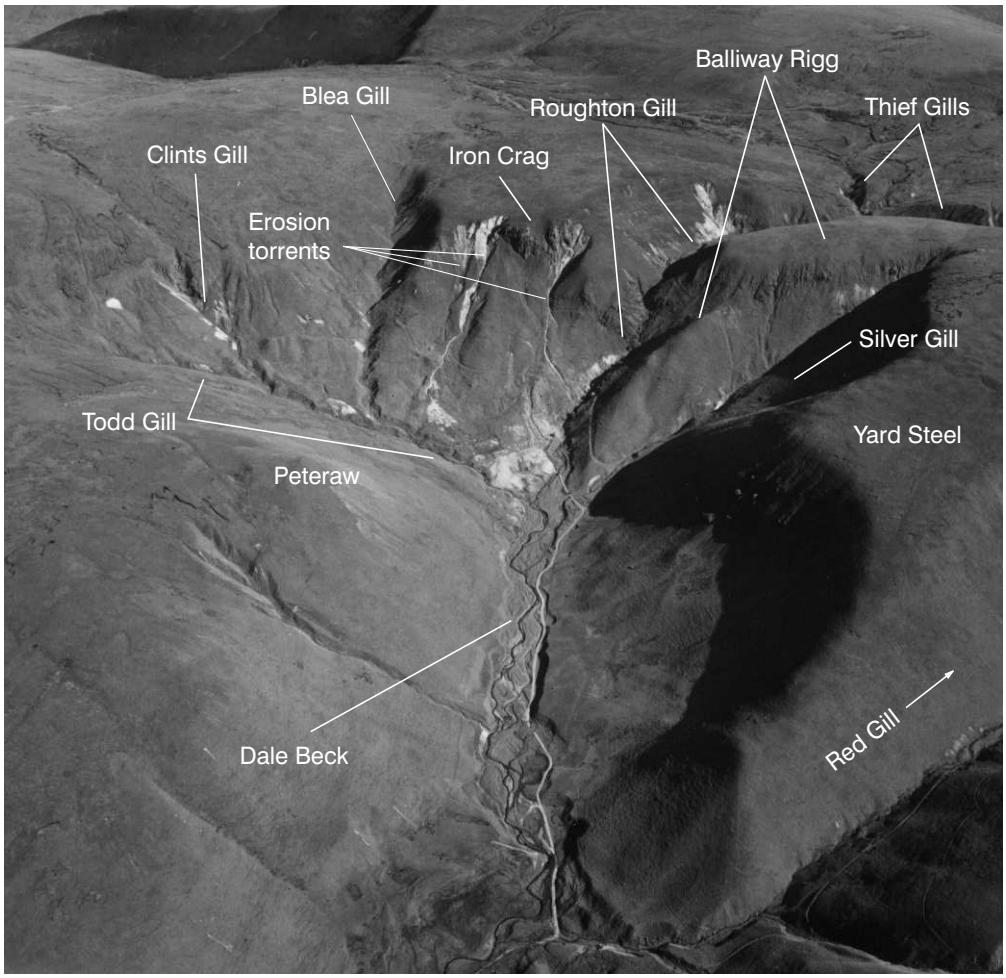

Figure 2. Aerial view of the head of the Dale Beck valley from the north, showing topographical features mentioned in the text (NMR 17466/24, photographed 16 June 2000)

2. BACKGROUND TO THE SURVEY

In April 1997, the Lake District National Park Authority (LDNPA) published its Skiddaw Massif Management Plan, setting out proposals for the future management of the massif area together with a programme of action. Section 3.2 of this document relates to the management of the geology and archaeology, and contains four proposals, including one to carry out a survey of all archaeological remains within the project area together with an assessment of their condition and the threats they face, as and when resources are available (LDNPA 1997, 34). In 1999 the LDNPA archaeologist, John Hodgson, supported by Andrew Davison, the EH Regional Inspector of Ancient Monuments, approached the Archaeology and Survey Projects Division of EH with the request to carry out the first part of this proposal. The Division is currently investigating the feasibility of such a major project plus the most appropriate survey methodology (Dunn 2000a). However, because the site of Roughton Gill Mine is under threat from natural erosive processes plus damage from mineral collection, EH agreed to survey the site in order to inform its future conservation and management (Dunn 2000b).

The objectives and methodology of the survey were agreed in a project design drawn up before work started (Dunn 2000b). In summary, fieldwork was to be carried out at Level 3 standard (as defined in RCHME 1999, 3-4), supported by less intensive (Level 2) documentary research confined to readily available published sources and limited consultation of archival material in Record Offices. No investigation was to be made of any of the underground workings. As it happens, most of the mine entrances are now blocked by rockfall or alluvial/colluvial deposits, but for safety reasons, even where they remain open, none of the underground workings was entered during the survey. The agreed working scale was 1:1000, with the option of windows at larger scale for complex or interesting areas; since virtually all point data were captured electronically, most parts of the survey may be plotted accurately at scales larger than 1:1000 anyway.

The boundaries were initially set as: in the north, the foot of Peteraw; in the east, the farther edge of Blea Gill; in the south, a line running broadly along National Grid northing NY 342; and in the west, a line returning down the watershed of Balliway Rigg almost to the mouth of Silver Gill where it veered slightly west to take in a mine level and various ruined buildings visible at the foot of Yard Steel (Dunn 2000b, Appendix 2). These boundaries were set in order to focus the survey on the surface remains of the lower levels of Roughton Gill Mine - the area under most immediate threat from erosion and mineral collectors - and to exclude Silver Gill Mine to the west and Mexico Mine to the east. However, on the ground the remains of all three mines interconnect and overlap to some extent, reflecting the fact that by the 19th century they formed part of the same mining sett and were worked by the same company. As a result, during survey EH took the decision to expand the originally agreed area in order to take in mine levels immediately east of Blea Gill which mark the furthest eastern extent of Roughton Gill Mine, as well as to the south and west to include, and make better sense of, a network of miners' paths and evidence of hushing discovered at the foot of Iron Crag and on Balliway Rigg. This had the effect of bringing the larger part of Silver Gill Mine within the survey. The revised survey area is the focus of Fig 3.

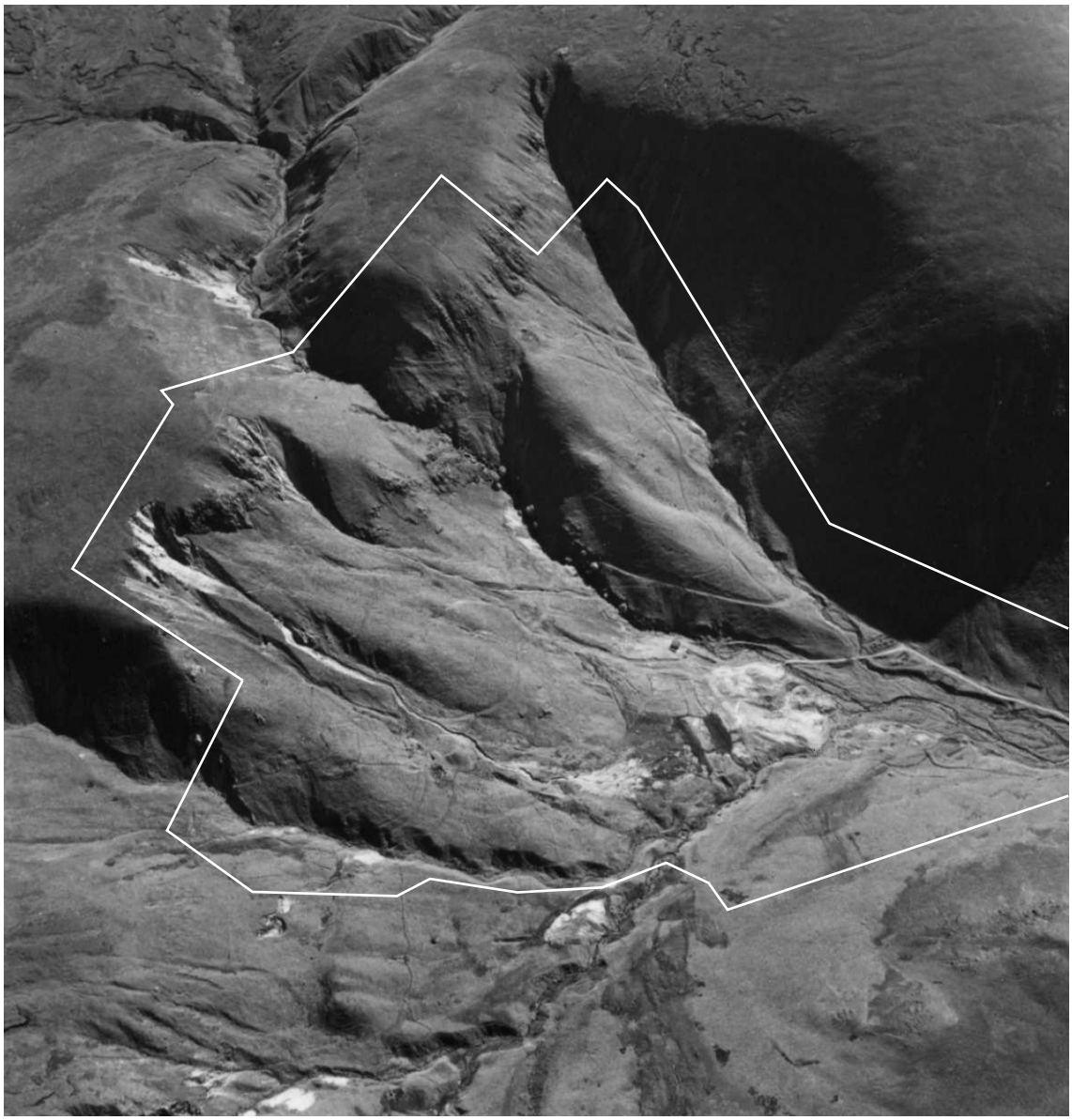

Figure 3. Aerial view of Roughton Gill and Silver Gill Mines from the east, with the limits of survey superimposed (NMR 17466/15, photographed 16 June 2000)

3. GEOLOGY, TOPOGRAPHY AND LAND USE

Roughton Gill and Silver Gill Mines lie at the foot of two adjacent ravines – known locally as gills – situated at the head of the Dale Beck valley, which together with Blea Gill, Clints Gill and Todd Gill further east, drain rolling high fell into a glacial corrie at the head of the valley. The five gills collectively provide the headwaters for a stream known successively as the Dale Beck, Branthwaite Beck, Park End Beck and Whelpo Beck, before it joins the River Caldew below Caldbeck village as the Cald Beck (Fig 1). The topography is severe, falling more than 200m within half a kilometre, from in excess of 600m AOD above Iron Crag and Balliway Rigg which form the southern rim to the corrie, down to *c* 390m at the head of the valley floor (area NY 3025 3455) where the main processing area of the mines was situated in the 19th century (Figs 2 and 3). Several mineral veins run broadly south-west to north-east through this area, and although masked by drift (a mix of boulder clay, blanket peat, and alluvium) on the tops and in the valley bottoms (British Geological Survey 1994), are frequently exposed to view in the steep gill sides.

The underlying geology is ancient, comprising mostly igneous rocks of Ordovician origin. The head of the Dale Beck valley marks the approximate boundary between plutonic intruded rocks of the Carrock Fell Igneous Complex to the south, and erupted volcanic and intercalated sedimentary strata of the Eycott Group further north, both lain down when this part of England rested above an active subduction zone. Faulting of these strata by later tectonic movements - in the case of this part of the Caldbecks in the late Devonian and Carboniferous periods - was followed by hydrothermal mineralization within the faults and the formation of a number of rich mineral veins running broadly south-west to north-east (Cooper and Stanley 1990, 13-27). Two veins in particular were recognised by early miners where they outcropped in the sides of Silver Gill and Roughton Gill, and were named the Silver Gill and Roughton Gill South veins; a third lode (now labelled the Roughton Gill North vein) which ran between these two was formerly the subject of much debate as to whether it was a distinct vein in its own right, or simply the northern edge of the South vein from which it was separated by huge plates of barren rock known in mining parlance as ‘horses’. Other lesser veins are also known.

The Caldbeck Fells are open fell typical of the Lake District generally, and used as sheep pasture. Whilst such grazing preserves the landscape character of the open fells, and prevents conversion to heather moorland or regeneration of former woodland cover, it can also contribute to problems of soil erosion on the steep gill sides. The fells are open to the public, but vehicular access along the track up the Dale Beck valley – which is unmade and difficult of passage to all but 4-wheel drives anyway - is restricted to authorised users only.

4. HISTORY OF RESEARCH

Until the present survey by EH, most research into the Roughton Gill mining complex has concentrated on the documentary record (section 5 below), with only limited examination of the physical remains. However, over the last 15 years or so, the Mines of Lakeland Exploration Society (MoLES) have carried out a series of small-scale investigations on the site, directed principally but not exclusively, at the underground workings. For example, in 1988, MoLES members uncovered a dressing floor and ore bin in Silver Gill, destroyed shortly afterwards by mineral collectors (Stanley and Cooper 1990, 58; Austin 1991, 10). They have also entered and examined all the currently accessible underground workings, plus others which have subsequently become blocked, including the 30-fathom level in Roughton Gill where a wooden mine-tramway survives *in situ* (Austin 1991, 9-10). In 1997, members of MoLES, following up documentary clues unearthed by Sam Murphy and Richard Smith, and with the permission of the LDNPA, also located a previously unsuspected coffin level in Silver Gill, thought to be the 16th/17th-century Emanuel Adit (Smith *et al*, forthcoming). MoLES are currently mapping and recording this newly-discovered level, plus many of the other underground workings in Silver Gill. They are also collaborating with Murphy and Smith in a survey of the surface remains in and around the top of Silver Gill, Balliway Rigg, and in upper Roughton Gill and Thief Gills, where, amongst other things, they have identified a major complex of water-management features related to hushing (Warren Allison, pers comm). Something of the extent of the mining activity in this area - which mostly lies south of the limits of the present EH survey - can be gauged from Fig 7.

5. THE DOCUMENTARY HISTORY OF THE MINES

The first indisputable references to mining at Silver Gill and Roughton Gill do not pre-date the late 17th century. However, both gills contain evidence of early, hand-cut, 'coffin' levels, and have long been assumed to be the site of the 'Caldbeck Mines' referred to in documents of the 16th century and earlier. This assumption has recently received strong support from a new study which has demonstrated how the internal evidence in 16th and 17th-century sources for the topography and lay-out of the Caldbeck mines can be correlated with archaeological evidence on the ground for the exploitation of the Silver Gill mineral vein in both Silver and Roughton Gills (Smith *et al* forthcoming).

According to Shaw (1975, 40), the Roughton Gill/Silver Gill mine complex was in operation as early as the 12th century, but it is unclear on what evidence this claim is based. More certain is the mention of 'a mine of copper and silver at Caldebek, Co. Cumberland' in an order of Edward II signed at the start of 1319 (PRO 1912, 389-90). Whilst the order contains no other information to help locate this Caldbeck mine more precisely, a clue comes from a later reference in 1331 to the subsequent royal appointment of Robert de Barton as the keeper of silver lead mines at Silverbek and Minerdale in Cumberland (PRO 1913, 280). Ian Blanchard (Sam Murphy, pers comm) has suggested that this is a reference to mines at Tynehead, near Garrigill in the far east of Cumbria, but it seems not unreasonable that Silverbek equates instead to Silver Gill in the Caldbeck Fells. (Gill has come to be used today as a quasi-synonym for beck, but is actually derived from the Old Norse *gil* meaning cleft or ravine; the modern name Silver Gill, therefore, more accurately describes the valley down which the stream - unnamed on OS maps, but presumably the same as Silver Beck - still flows). Minerdale is not so easy to identify, but Shaw (1975, 7) has suggested it is the early name for the modern Dale Beck valley, into which Roughton Gill and Silver Gill both run.

Historically the Caldbeck mines seem to have lain within the manor of Caldbeck Underfell. This manor was part of the Honour of Cockermouth, which by the early 15th century was in the possession of the Percy family, Earls of Northumberland. In 1453 the 2nd Earl created the office of Supervisor and Governor of Mines, seemingly with specific responsibility to oversee the operation of metal - as opposed to coal - mines within the Honour (Bean 1958, 28). Unfortunately, the post is not mentioned again, and probably did not long survive, suggesting that the mines were not being seriously exploited: later accounts record the farm of a gold/silver/lead mine at Cockermouth in 1483/4, but this was idle by 1500/1, whilst the existence of a number of valuable silver/lead mines, including the one at Caldbeck Underfell, is recorded in a Royal Commission survey of the family's northern estates in 1537, but without any indication that any were then being actively worked (*ibid*, 50-1). By 1537 the potential of the Caldbeck Mines had thus been widely known for well over 200 years, but in practice the mines appear to have been worked only sporadically, and probably on a small-scale. Bean suggests that it was a lack of working capital which prevented the Percys from developing the mineral potential of their Skiddaw estates further, but other, equally valid, reasons are probably to be found in the disruption caused by periodic loss of these estates throughout the 15th century by attainder to the Crown, together with a lack of resident English expertise in the techniques of mining and of how subsequently to treat the various ores won. All this changed completely, however, with the setting up of the Society (later Company) of Mines Royal in 1564.

The Company of Mines Royal was the direct result of royal policy under Elizabeth I to enlist German mining expertise in the working of English metal deposits, particularly copper. On 10 December 1564, Elizabeth indented with Thomas Thurland and Daniel Hechstetter, authorising them to prospect for and mine ores of gold, silver, copper, quicksilver, tin and lead. Hechstetter was a German mining expert who had the financial backing of the Augsburg firm of Haug, Langnauer and Company, and who was to act as the German representative and manager of the enterprise. The Augsburg firm supplied half of the finance for the project, the balance coming from 21 English shareholders. Although the indenture authorised prospection in a number of English counties, it was in Cumberland that Hechstetter decided to settle and concentrate his operations. Mines were opened at several locations around Keswick, including from 1568, Caldbeck. Haug and Company went bankrupt in 1575, but the Cumberland mines continued in operation - after 1580 let out by the remaining Mines Royal shareholders under a series of short, but not necessarily continuous, leases, until *c* 1630.

Considerable documentary evidence survives for the 60 or so years the Company of Mines Royal and their lessees were active at Caldbeck, including much that has been published verbatim or in an abridged form. Many of the original company accounts survive for the years 1564-77, and have been translated from the German by Collingwood (1912), while the English diaries and notebooks of Daniel Hechstetter the Younger relating to the period 1601-39, have been transcribed and published by Hammersley (1988); the latter publication also contains a transcript of a very informative inventory/report on the assets of the Company and state of the Cumberland mines in 1586, the original of which resides in the British Library. These sources, together with other documents in various local and state archives, have recently been studied in detail, and a strong case advanced identifying the various 16th/17th-century Caldbeck mine levels mentioned with archaeological features still visible in Silver Gill and, to a lesser extent, Roughton Gill (Smith *et al* forthcoming).

Although the Company accounts record expenses for limited works undertaken at Caldbeck in 1566, these seem to have been purely exploratory in nature, and mining did not begin in earnest until 1568 (Collingwood 1912, 5 and 12). Activity was initially focused on a mine called the Rider, which Smith *et al* (forthcoming) suggest was an extension of existing surface workings. However, by the second half of 1569 an unnamed adit was being driven 'by the Rider', with work also underway before Christmas on a second site called Lower Nick (Collingwood 1912, 80 and 90), which Smith *et al* suggest was probably another openwork. No accounts survive for 1570, but in 1571 work was ongoing at both the Rider and a new level called Emanuel (Collingwood 1912, 107-8). Again no records survive for 1572, but in the months before Easter 1573, Emanuel and another level called appropriately New Adit are recorded as in operation (*ibid* 136). Later that year a third adit - David – was being driven (*ibid* 140), but is not mentioned again and was probably an unsuccessful trial. The Rider, Emanuel, and New Adit were all worked in 1574 (*ibid*, 147). In 1575 two new mines are mentioned: Fortune, begun about the middle of the year - which Smith *et al* suggest was an openwork - and later that year Elizabeth (Collingwood 1912, 176-7), not mentioned again and probably an unsuccessful trial level. Work continued at both Fortune and Emanuel through 1576, with a new level - Marx – started half-way through the year (*ibid*, 185-9). Fortune and Marx were still being worked the following year (*ibid*, 194 and 199), although Smith *et al* doubt that the latter was producing much, if any, useable ore. The Rider, Emanuel, New Adit, and Fortune seem to have been the principal mines in this period, all yielding

considerable tonnages of copper and lead ores; when refined these ores also yielded quantities of silver.

It is at this point, following the bankruptcy of Haug & Company, that the detailed German mine accounts cease. Nevertheless, a number of sources - particularly those published by Hammersley (1988) - enable the history of the Caldbeck Mines to be followed in considerable detail for a further 50 years. In 1579, the Company of Mines Royal relinquished direct control of the mines in favour of letting them out on short-term leases. The first such lease was taken up by 'customer' Thomas Smith in partnership with the Company's former mine manager, Daniel Hechstetter, at the end of 1580, and ran until 1586. Daniel Hechstetter died in 1581, but was succeeded by his two sons, Emanuel and Daniel the younger, and by his son-in-law, Mark Steinberger (Hammersley 1988, 24). These individuals, in various combinations, seem to have continued operating at Caldbeck more or less continuously until *c* 1630, when the mines are reported as being given over (*ie* abandoned) (*ibid*, 179). Records indicate that three principal workings were being exploited: Emanuel and New Adits remained in use from the earlier period, whilst from the 17th century, Fortune Adit is also mentioned (*ibid*, 99), which Smith *et al* suggest was an underground continuation of the 16th-century outcrop working of the same name. Smith *et al* have also pointed out that Fortune Adit may be identical with, or at least situated very close to, a working in Silver Gill known from 18th-century sources and later as 'Golden Vugh' or 'Golden Hugh', and have suggested it is named after a certain 'Hew Stoddert alias golden hew' recorded in Caldbeck papers in 1622 (Hammersley 1988, 209). Hew could have been instrumental in the discovery or exploitation of the ore deposit here. However, an alternative explanation would be to derive the name from the miners' term 'Vugh', defined by Shaw (1975, 125) as 'a natural cavity in a vein often lined with beautiful mineral specimens'.

17th-century references make it clear that these three adits all lay one above the other, with Fortune 30 fathoms above New Adit, and Emanuel 14 fathoms above the latter, and were connected by internal vertical shafts at regular intervals to facilitate drainage and ventilation (Hammersley 1988, 288 and 98). However, because New Adit was the lowest, it suffered most from problems of flooding, and there are references to the need for a lower level to help drain it and so open up workable ore deposits known to exist in the floor of the mine. Several propositions are recorded: the first, in 1602 was to clear out old workings that pre-dated the advent of the Company of Mines Royal to Caldbeck. The depth of these workings was unknown, but it was hoped they might be deep enough to be extended horizontally under New Adit; the second, in 1617/18, was to continue 'an adit called the blinde wastel beinge begune above XXX yeares sence', but which would need to 'be driven some 210 fathomes vpon the leader' ('leader' meaning vein wall) in order to come in 30 fathoms under the floor of New Adit (*ibid*, 288); the third, in 1630, was to drive a fourth level some 15 fathoms below the entrance to New Adit, which would only need to be cut through 43 fathoms of barren ground before reaching the vein wall, after which a further 200 fathoms of driving would be needed along the vein to reach the head of the mine (*ibid*, 179). A marginal note appended to the latter, however, once more refers to the need to drive 'Blind Wastel' 240 fathoms to come in 25 fathoms beneath the head of New Adit. There is no documentary evidence to suggest that any of these options was ever attempted.

Other exploratory works are recorded. In a report of 1600, there is a recommendation to test the extremities of the mineral vein by a shaft at its western end, and a level in the east near to 'a Stolne (*ie* adit) called Blinde Wastell w^{ch} was ignorantlie driven

upon the ligget' (quoted in Smith *et al*). A second report two years later refers to the need to construct 'one or more dames…to beare or discouer the vaines in the topp aboute the lodginge howse of the myners' (Hammersley 1988, 99). At face value the latter would appear to be a recommendation to carry out hushing.

Besides such details on the adits, the various 16th- and 17th-century documents also provide useful information on buildings and structures existing at the Caldbeck Mines. The two principal buildings seem to have been a stamp mill/washing house complex, and a lodging house for the miners. Although ore-bearing rock was crushed on site in the stamp, this was simply to separate ore from gangue, and there is no indication that smelting was carried out at Caldbeck at this time. Rather, the Company of Mines Royal operated a central smelter at Keswick, to which they transported ore from all their mines in Cumberland.

Construction work on the Caldbeck stamp mill began as early as 1569, with one Wolff Hochholzer contracted to build it for £20. But Hochholzer was unable to complete the work for the sum originally agreed, and the mill was not operational before 1573 at a final cost to the Company of £36 12s 6d. It appears to have been a cruck-type building of two bays (Collingwood 1912, 76 and 138), but was already being extended by a further two or three bays later that same year, seemingly to provide a sheltered workspace plus lodging accommodation for the foreman, washers and workmen employed there (*ibid*, 138 and 142). In 1586 the mill was described as having stone walls, a timber floor, and a slate roof. Inside were twelve hammers, and, by 1586, seven washing tables; outside stood a further 20 wooden troughs for receiving the washed ore (Hammersley 1988, 371). Mention of a waterwheel makes it clear that the stamp was water-powered from the outset, whilst varied references throughout 1573 to men employed in constructing watercourses, digging water-trenches (leats?), erecting sluices and water pits, and building a weir, show that there was major investment in water management generally (Collingwood 1912, 138 and 142). A plentiful and regular supply of water was a pre-requisite for the functioning of the mines, as a letter written by Daniel Hechstetter the Younger in May 1619 makes clear when he bemoans the fact that the works were then lying idle due to the 'extraordinny dry springe which hathe so dried op the Rivers' (Hammersley 1988, 324). At some point in the first quarter of the 17th century, seemingly in the five years prior to 1619, the mill burned down and had to be rebuilt at considerable cost (*ibid*, 170 and 324), presumably on the same site. The exact location of the mill is unclear, although in 1586 it was described as standing 'at the foote of the hill of the Mynes' (*ibid*, 370). In 1573 a road was being constructed to it (Collingwood 1912, 138). Although it is not made clear where this road led, we might expect the most pressing need at this time was to connect the stamp to the active mine workings in Silver Gill.

In contrast to the stamp in the valley bottom, the miners' lodging house is described in 1602 as being 'in the topp' (Hammersley 1988, 99), from which it would be reasonable to deduce that it was on, or close to, the top of the fell. It appears that it was under construction, and in all likelihood completed, in 1571, for the mine accounts for that year refer to carpenters employed in erecting buildings at Caldbeck, and also to the provision of items of furnishing for the men's lodgings (Collingwood 1912, 107-8). Prior to this, the miners stayed in a house belonging to a certain Symon Scott (*ibid*, 71). Although it is not stated where Scott's house was, it was not on site, for in 1569 J. Scot was paid 4/- for carrying boards from the men's house to the pits (*ibid*, 80). This implies that for the first few years the miners had to walk - quite possibly a considerable distance - to work each day. In 1586 the lodging house is

described as having four rooms on the ground floor with a loft over used as a communal dormitory; the downstairs plan consisted of a kitchen at the east end, a dining room next-door, followed by an entrance passage and finally a small bedroom at the western end. We also know that it was thatched with bracken (Hammersley 1988, 369-70), and had at least 13 glass windows (Collingwood 1912, 136).

Following the documented closure of the mines in 1630, there is no further record of mining activity at Caldbeck until the last decade of the 17th century. Indeed in 1683 it was reported of the Caldbeck mines that 'there is no shafts in being… and if there hath been any, they are all filed up, and will be of no use…There is part of an Addit wrought, but how much it wants to be finished I know not' (Davies 1693, quoted in Cooper and Stanley 1990, 35). Although it is just possible that Davies was referring to a level in Red Gill (which is known to have been worked in the 17th century) rather than Silver Gill, the derelict state of the Silver Gill Mines is shown by a report of the same period quoted by Adams (1988, 72-3), unfortunately without authority: 'Balliway Rigg, in this hill the old man has carried a level through to the Silver Gill and Golden Hue being near 300 yards, and the wonder is that it should go so far without a shaft for ventilation.'

In 1692, perhaps in anticipation of the ending of the Crown's monopoly of Mines Royal in 1693, Dr Edward Wright and the newly formed Company of Royal Mines, Copper, leased mines at Caldbeck. Grant (1985, 145) has suggested that these Caldbeck Mines were at Carrock End rather than Roughton Gill/Silver Gill, probably following Shaw's (1975, 47-8) identification of Carrock End with early references to a mine 'at the Dutchmans Moss'. However, Richard Smith has recently found a crude map of *c* 1724 that suggests that Dutch, or Dutchmans, Moss is an early name for the Roughton Gill mineral vein(s) (R Smith and S Murphy, pers comm). Furthermore, in the late 17th and early 18th centuries, Wright and the Governor and Company of Copper Miners in England (successor to the Company of Mines Royal, Copper) sank a shaft on the tail of the vein near the waterfall above the later Roughton Gill 30-fathom cross-cut level, and were responsible for a hand-cut level along the vein broken into by this later cross-cut (Murphy, pers comm; Smith *et al* forthcoming). Grant has also suggested that Wright, who was in the van of developing the new technology of using coal to smelt metal ores in a reverberatory furnace, may also have been re-working lead slags at Caldbeck. This is improbable given the fact that the Company of Mines Royal carried out no smelting at Caldbeck, preferring to carry ore to their smelter at Keswick. More certain is that by 1698, Wright was smelting ore at 'the copper works at Corbeck' (Jenkins 1938, 233). The precise location of this copper works is unknown, although the 1724 map does depict the alleged site of a smelting mill situated somewhere to the east of Balliway Rigg (R Smith and S Murphy, pers comm). The map has not been consulted at first hand for the present report.

A year earlier, in 1697, Caldbeck lead was being smelted on behalf of Thomas, 1st Marquis Wharton, by David Davies, a lessee of the Duke of Somerset (Grant 1985, 144). The Wharton family had acquired the manor of Caldbeck Underfell in 1530, when they were granted it in tail male by the 6th Earl of Northumberland (Bean 1958, 146). They continued to hold it until 1739 when it was bought back by Charles Seymour, 6th Duke of Somerset, heir to the Percy estate (Grant 1985, 146). In the meantime, Somerset, in conjunction with Davies and others, was developing the mineral resources on other former Percy estates in Cumberland (Grant 1985). The most likely explanation for why Davies should be smelting ore for Wharton, is that whilst Wharton had granted a lease to Wright to work Roughton Gill/Thief Gills, he

was working the old German mines in Silver Gill himself. This interpretation is supported by a surviving map of 1710 entitled 'Map of the Great Lead Silver Mine of Golden Vugh and Silver Gill belonging to the Rt. Hon. Thos., Lord Wharton' (Cumbria Records Office (CRO), Carlisle, D/Sh/31(b)). The map is fairly crude, but shows two adits in cross section, labelled 'A' and 'B', the upper one described as 'Golden Vugh'. Wharton was definitely working Silver Gill in 1724, and in 1726 his mine agent, Thomas Hillary, was instructed to cease work at a couple of other locations in Caldbeck, but to continue operations at the Golden Hugh, and even to sink a shaft there. Wharton must also have taken back Roughton Gill/Thief Gills from Wright by this time, for amongst a series of Caldbeck mine properties known to have been operated by Hillary is 'Duchmoss' (Cooper and Stanley 1990, 36-7 and 60). Indeed, *c* 1724 a shaft was sunk directly on the Roughton Gill vein from nearly the highest point of the outcrop, by miners working for Lord Wharton (Murphy, pers comm). At about the same time, Hillary was also working a vein in Todd Gill on the opposite side of the Dale Beck valley to Silver Gill; this operation may have been an attempt to re-work a small copper mine recorded 'on the south side of Petra' (the modern Peteraw), *c* 1700 (Cooper and Stanley 1990, 63). However, all Wharton's Caldbeck mines ceased operating before 1730 (*ibid*, 36), and in 1739 Wharton sold the manor to the Duke of Somerset, although by this time the Duke also seems to have lost his earlier interest in mining (Grant 1985). Certainly in 1747 all mines on the northern flanks of the Fells were said to have been long since abandoned (Anon 1747). By 1774, the manor had passed to the Earl of Egremont, whilst the mineral rights belonged to Lord Pomfret (Cooper and Stanley 1990, 37).

Mining resumed at Silver Gill/Roughton Gill late in the 18th or early in the 19th century. It is frequently stated that a smelter was under construction near Roughton Gill in 1794 (*eg* Postlethwaite 1877, 40-1; Shaw 1975, 40; Cooper and Stanley 1990, 37 and 60). The additional information given by Postlethwaite, the earliest authority traced for this statement, shows that he equated this 1794 smelter with that depicted on 19th-century maps (*eg* Ordnance Survey 1867) lying some 2km north of Roughton and Silver Gills where Hay Gill runs into the Dale Beck valley. However, the Hay Gill smelter was not built until 1849 (Cooper and Stanley 1990, 60-1). The source of Postlethwaite's information is uncertain, but may well derive from a confused reading of reports that a William Rowe had discovered rich veins of copper and lead at Caldbeck in or before 1794, and that 'levels are now driving, and a smelting-mill erecting' (Hutchinson 1794-7, 389). The veins Hutchinson reports are described as 'on the south side of the High Pike' and 'upon the north side of Carrock mountain'. Neither place is a close geographical description of Silver Gill or Roughton Gill, which lie approaching 2km west of the former, and 4km west of the latter (Fig 1). A better candidate for a mine on the south side of High Pike would be Dry Gill Mine, or perhaps Driggith Mine, whilst the north side of Carrock mountain would seem to fit best with Carrock End Mine. Rowe is known to have had leases at both Carrock End and Driggith from 1790, and to have erected a smelter by Carrock Beck (Cooper and Stanley 1990, 47 and 49). Hutchinson's mention of a smelter in 1794, therefore, is quite clearly referring to that at Carrock Beck. No independent documentary evidence has been found to substantiate the existence of a smelter at Hay Gill - or anywhere else close to Roughton Gill - at this date.

Nevertheless, leases, prospectuses, and other documents surviving in the CRO at Carlisle, demonstrate quite categorically that mining was once more underway at Roughton Gill/Silver Gill by the first quarter of the 19th century. These archives have not been researched in depth for the present report, and published accounts derived from them sometimes appear confused and contradictory, especially as to dates.

Thus, in either 1822 (Shaw 1975, 43) or 1824 (Adams 1988, 73), the mine lease was taken up by a seven-man syndicate, including one John Dobson (after whom Dobson's vein - a lesser vein running parallel to the Roughton Gill lode – was named). The main working at this time is believed to have been the 30-fathom level in Roughton Gill, which Shaw (1975, 42) thinks was started as early as the late 18th century. It was dug to exploit the Roughton Gill mineral vein(s).

A small-scale map of the above-ground workings at Roughton Gill, dated 1825, is contemporary with the tenure of the mine lease by this syndicate. The original of the map currently resides in the Natural History Museum, but has been published by Cooper and Stanley (1990, 58), where it is incorrectly dated to 1823. It is reproduced here as Fig 4. The map shows five levels - three in Roughton Gill, labelled 'a', '2' and '5', and two in Silver Gill, labelled '3' and '4', plus a 'shaft' and a 'hole' (also labelled '1') in Silver Gill – although it does not indicate which, if any, were being actively worked. Of the features in Roughton Gill, 'a' is clearly the 30-fathom cross-cut, while '2' and '5' are on the Silver Gill vein and can be equated with mine entrances visible on the ground today, and identified by Smith *et al* (forthcoming) as, respectively, the documented 16th-century Blind Wastel, and the trial recommended to be made *c* 1600 on the eastern extremity of that vein (this section above). The features in Silver Gill are not so readily identifiable. Cooper and Stanley (1990, 58) have suggested that they should be equated with levels at 8, 20 and 50 fathoms which are mentioned in 1852, and that the 8-fathom level is Golden Hugh. However, the map describes '1' as a hole, not a level, and shows it directly on the line of the Silver Gill vein. This does not accord well with the 1710 Wharton map (this section above) which depicts 'Golden Vugh' very clearly as an adit. Furthermore, a working on the actual vein is an unlikely candidate for an 8-fathom level. Although it may well be the case that '4' equates with the 50-fathom level described in 1852, it is less clear whether '3' is the 8- or the 20-fathom level (but see below, section 6).

A number of other features are of interest on this map: first, the description 'Situation of Old Water Wheel' written next to the junction of the Roughton Gill mineral vein with Roughton Gill; second, 'Site for the Smelt Mill' appended at the head of the Dale Beck valley close to the confluence of the streams flowing down Roughton Gill and Todd Gill; third, 'Smithy' which appears where the Silver Gill vein crosses the summit of Balliway Rigg. Only the first two need further comment here. The position of the disused water wheel, is close to where Wright and the Company of Copper Miners in England are known to have been sinking their shaft in the late 17th century, and in all probability, therefore, dates from that time. Whilst the phrasing 'Site for the smelt mill' suggests this mill had yet to be constructed when the map was drawn.

After 8 years (by 1832 therefore), the 30-fathom level was more or less worked out, and the mine syndicate sold shares to Mr J. Dickinson of Alston to raise capital to drive a new adit to work the lower levels of the mine. This 60-fathom level proved very profitable, and between 1838 and 1845, 3229 tons (3281 tonnes) of lead and 150 tons (152 tonnes) of copper ores were raised. The mine was abandoned in 1845 when the lease expired (Shaw 1975, 43; Adams 1988, 73; Cooper and Stanley 1990, 60).

In 1849 a new lease was taken out by the Roughtongill Silver Lead and Copper Mining Company, who pumped in large sums of money to develop the workings. A report on the state of the mine commissioned to accompany a subsequent share issue (seen in unreferenced facsimile only; original in CRO Carlisle) makes clear that by 1852 the Company had already begun a new, lower level (the 90-fathom level) in Roughton Gill, and was in the process of replacing the existing, badly-placed,

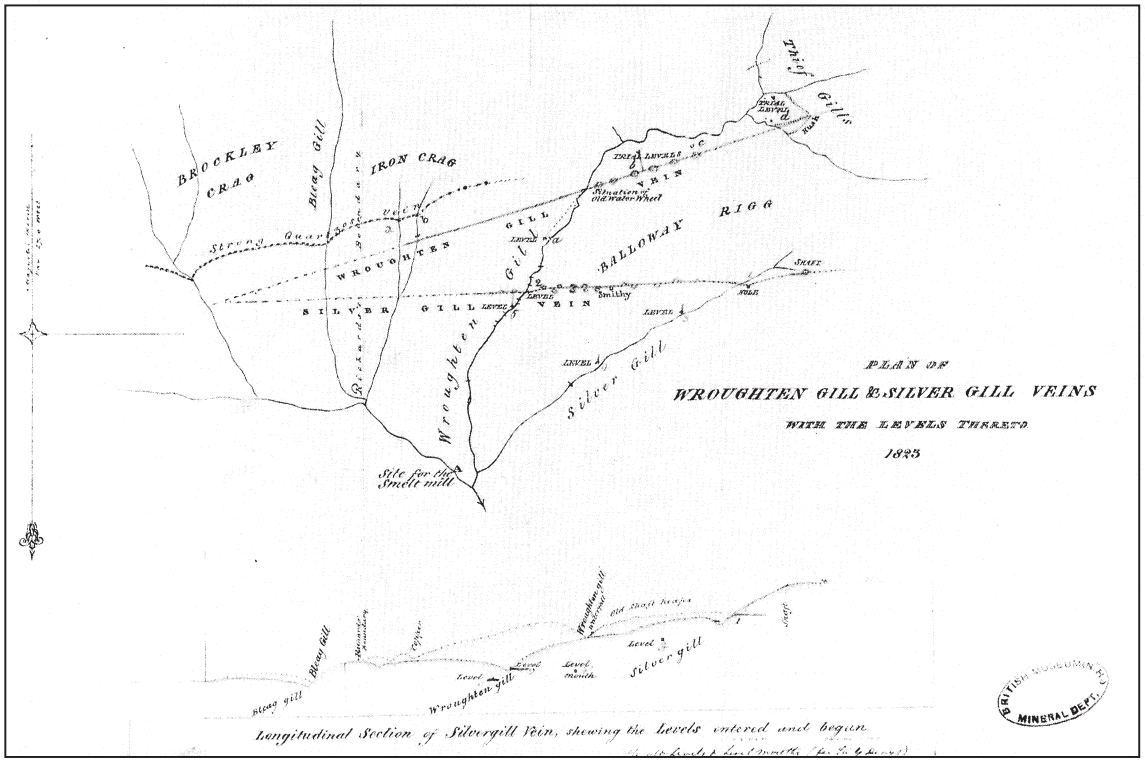

Figure 4. Plan of mine workings in Roughton Gill and Silver Gill dated 1825 (reproduced from Cooper and Stanley 1990, by courtesy of the Natural History Museum, London)

stamping, crushing and dressing machinery at the mine with new, more powerful and better-sited plant - all water-powered. It had also completed a new smelter some 2km down the Dale Beck valley at the mouth of Hay Gill (see also this section above), and had improved the road down the valley connecting the mine to the smelter and the public highway beyond. In addition the Company had cleared out the old 8-, 20- and 50-fathom workings in Silver Gill, and commenced development of Mexico Mine (also known as Crown Point) - which aimed to exploit the Silver Gill and Roughton Gill veins to the east of Blea Gill - by driving what are described as two 'shallow' levels, with a third, 90-fathom or deep, level planned but not yet started. A smithy and account house are also mentioned as existing at the mine. Shaw (1975, 44) speaks of both 60- and 90-fathom levels in Silver Gill - the former being taken forward in 1853, the latter given over by 1863 - although it is unclear what Shaw's authority is for either statement. It seems likely that the 60-fathom level is actually a mistake for the 50-fathom, replicating a slip of the pen apparent in a further report on the prospects of the mine produced in 1853 (seen in unreferenced facsimile only; original in CRO Carlisle).

At the start of 1855 the mine lease was taken over by J W Dixon and Samuel Merryweather, the latter mine manager under the previous lessees (Adams 1988, 73). Between then and the end of 1862, some 2913 tons (2978 tonnes) of lead/silver ores - yielding 2018 tons (2050 tonnes) of lead and 41,103oz (1,164,390gm) of silver - plus 158 tons (160 tonnes) of copper ore, were raised (Burt *et al* 1982, 123-4) - an average of around 400 tons of ore a year. In 1863, the mine was sold as a going concern to Messrs J J and J R Tustin for £14,000 (Adams 1988, 73), who were able to increase production to almost 500 tons annually, again principally lead/silver ores.

The OS surveyed the mine in 1863, and produced the first (and only) large-scale plan of the site whilst still in use. Although mapped at a scale of 1:2500, the survey was only ever published at the smaller scale of 1:10560 (Ordnance Survey 1867). However, the original 25" survey was engraved, and unpublished paper copies survive at both the CRO in Carlisle and at the OS's own map library in Southampton (Ordnance Survey 1863a and 1863b). The maps (reproduced here joined in a single sheet in Fig 5) show several buildings lying amidst spoil heaps at the head of the Dale Beck valley, with a 'Smithy' and three further, small, unnamed buildings or structures scattered along the west side of the valley at the foot of Yard Steel. These can presumably be equated with the smithy, accounts house, and various new mine plant buildings mentioned as present or under construction in 1852 (above, this section). A number of levels are also depicted in each of the named gills running into the Dale Beck valley - *ie* from west to east, Silver, Roughton, Blea, Clints and Todd Gills - plus an extensive network of unnamed tracks, paths, leats and ponds, and even, possibly, a tramway. Two unnamed circular structures shown in the vicinity of the main mine buildings would appear to be buddles.

On 29 April 1865, the Tustins in turn sold the mine to the Caldbeck Fells Consolidated Lead and Copper Mining Company Ltd, this time for £20,000 although only half was cash, the rest being taken as shares in the new company (Adams 1988, 73; Cooper and Stanley 1990, 60). Most of the workable ore deposits in the Silver and Roughton Gill (*ie* the western) section of the mine above the 90-fathom level had by this time been exhausted, but a report by consulting engineers on the future prospects of the mine promised further rich ore deposits in the east and at depth. Consequently, efforts were made to develop Mexico Mine, and also the existing Roughton Gill Mine below the 90-fathom level. In 1866, a shaft (named after the Company Secretary, James Lainton) was begun on the west side of Blea Gill to help

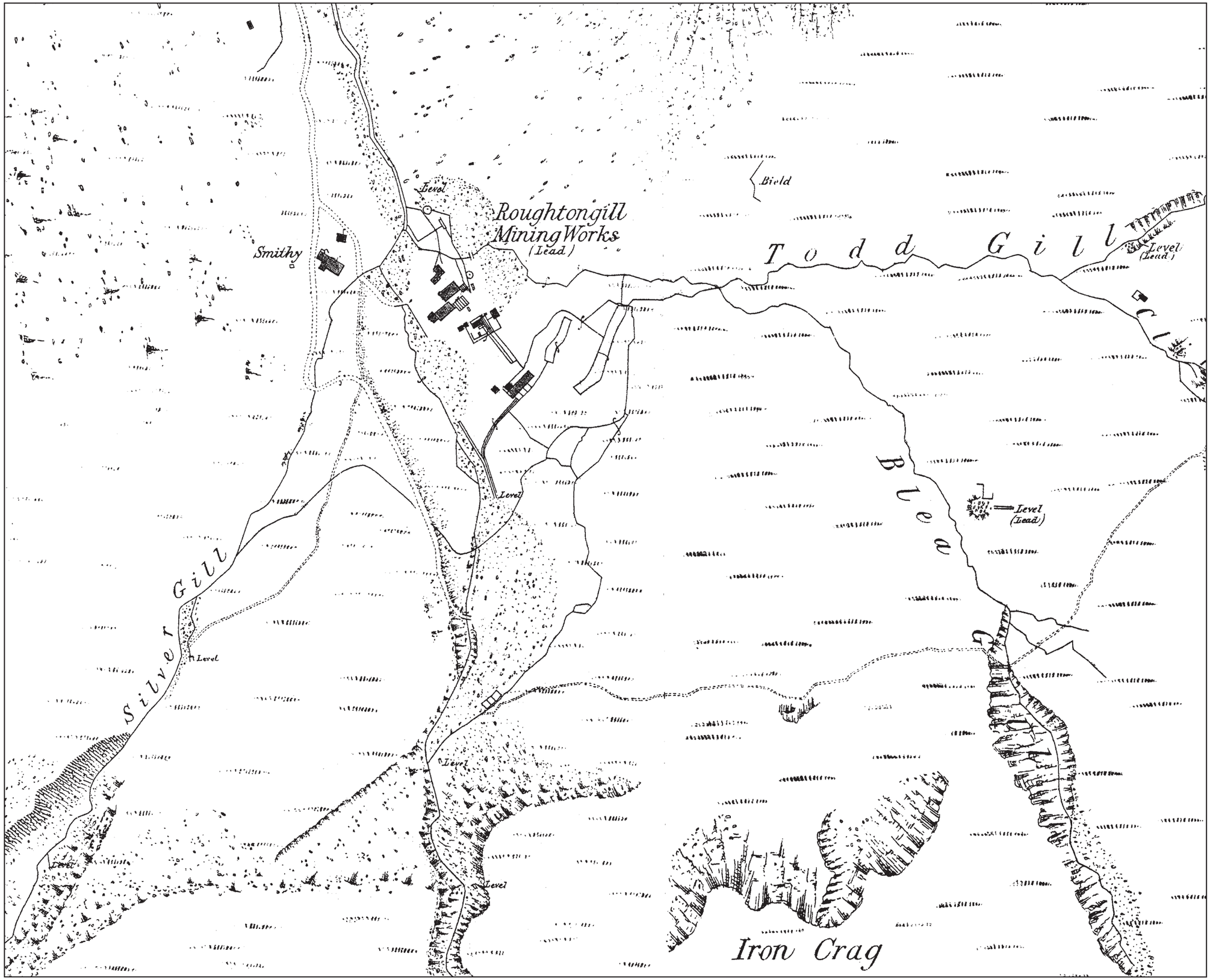

Figure 5.
Roughton Gill Mine as mapped by the Ordnance Survey in 1863.

drain these lowest levels as they progressed eastwards along the Roughton Gill vein(s) and Dobson's vein, away from the Roughton Gill 90-fathom cross-cut. Lainton's Shaft reached the 90-fathom level by the middle of 1867, but at £25 a fathom to dig had been an expensive undertaking. The Company had also then to invest in the purchase and erection on site of a steam pumping engine, housed within its own Cornish-style engine house, and powered by twin boilers driving a 60-inch cylinder. At the same time the Mexico Mine 90-fathom level had reached the Roughton Gill vein(s), but found them almost devoid of worthwhile ore. Development work on Mexico Mine ceased, and although Shaw records the sinking of an air shaft in 1867 by the side of Blea Gill to help ventilate the 90-fathom level, this eastern part of the mine complex seems to have been abandoned completely by *c* 1868. The Company then attempted to find ore by going deeper, and between 1869-70 extended Lainton's Shaft a further 20 fathoms, but at £1800 a year the running costs for pumping were too dear, and the shaft was closed down. The Company tried to tackle the resulting flooding problem by experimenting with various pumping devices at a second shaft – Junction Shaft – located near to Thief Gills, with moderate success (Shaw 1975, 43-4; Adams 1988, 74; Cooper and Stanley 1990, 61-2). Despite these problems, the Company was also still spending money improving the processing machinery at the mine. The half-year accounts for 1871 (seen in unreferenced facsimile only; original in CRO Carlisle) show that the Company had spent £375 12s 4d on its capital account, which included £220 10s 2d for the purchase and carriage of an auxiliary steam engine to run the dressing plant when there was insufficient water in the streams to operate the wheel, plus a replacement for the existing wheel. A further £52 13s 2d had been spent on extending a reservoir, and improving dressing floors, stamps, the ore house and stables, plus £49 0s 5d to purchase a 'Knife Propeller Buddle', and £4 12s 2d to acquire a new 'Round Buddle'. However, most of the workforce left in 1872 for better-paid employment elsewhere. In 1876, the Company went into liquidation, and was finally declared bankrupt in 1878 (Adams 1988, 74; Cooper and Stanley 1990, 62).

About 1888, the Cleator Iron Ore Company, who had been working the Roughton Gill vein(s) further to the east below Hare Stones (at the China Clay Mine) for baryte and umber, constructed a mill for refining umber at 'Roughtongill Head', whilst the baryte was processed at a second mill converted from the remains of the disused Hay Gill lead smelter. The umber mill was housed in newly erected wooden buildings, and was powered by an overshot waterwheel, 30 feet (9.14m) in diameter, relocated from the nearby Red Gill Mine where it had previously been used to drive a lead-crushing mill. Umber was brought down to the mill from the mine via an overhead tramway (Addison 1890). A plan in the CRO Carlisle (ZLB 41/177) purports to show the umber mill situated in the angle formed by the confluence of the streams flowing down Roughton and Todd Gills, connected to the China Clay Mine by an 'Incline Tramway'. However, comparison of the plan of the mill published by Addison, with building foundations surviving at Roughton Gill, shows that the mill was actually constructed on the opposite side of Todd Gill (see section 6.8 below). The China Clay Mine closed in 1894 (Shaw 1975, 44; Adams 1988, 74; *contra* Cooper and Stanley 1990, 48 where the date is misprinted as 1884), and the mill machinery was auctioned off .

In 1913, Carlisle Urban District Council purchased the idle Roughton Gill Mine for £15,000, and piped the water draining from the 90-fathom level into the public water supply, effectively ending any prospect of the mine reopening (Adams 1988, 74-5; Cooper and Stanley 1990, 62-3). A pump house operated by North West Water is now the only building standing on site.

6. THE EARTHWORKS: CATALOGUE AND DESCRIPTION

The main hachured 1:1000 scale site plan of the earthworks and other features at Roughton Gill as recorded by EH is shown in Fig 53. However, in order to provide the reader with a more readily understood overview, the principal archaeological elements are highlighted on Fig 42. Each archaeological element has been given a feature number, and assigned to one of nine general phases suggested by the documentary evidence (section 5 above), although the picture is complicated by the fact that mines were frequently re-worked, and often the associated mine infrastructure was re-used in later periods also. A catalogue of all features is given below, arranged in order of phase (sections 6.1 to 6.9); a final section (6.10) deals with a small number of miscellaneous features, regardless of likely date. Where features belong to more than a single phase, they are described in detail in the section dealing with their earliest use, with only brief discussion of them thereafter as appropriate. A number of annotated extracts from the survey diagram are included within the catalogue at the larger scale of 1:500, in order to present the evidence more clearly where the earthworks are important and/or complex. The areas covered by these extracts are shown on Fig 41. Features assigned to each period are highlighted on a series of phase diagrams (Figs 43 to 52) located towards the back of this report.

Phasing is based on a combination of documentary evidence and on stratigraphical relationships observed between earthwork features during the course of survey. However, while such earthwork relationships provide evidence for the relative ages of features, they cannot in themselves date individual features to a specific period. In the absence of either more detailed documentary research, or of controlled excavation to recover artefactual or other chronometric evidence, for some features the phasing offered can only be a best guess. Where there is such uncertainty over the true age of a feature, this is mentioned in the text, and alternative phasings discussed.

Within each section, features are described under a series of functional or typological heads: prospection; extraction of ore and mine drainage; mine access and ore transport; water management (excluding prospection-related water features); processing the ore; ancillary structures; and miscellaneous features. Not all heads apply to each phase: subsection 6.8 for example deals with the re-use of the site between 1888 and 1894 for umber milling, whilst subsection 6.9 describes 20th-century features related to the use of the mines as part of the public water supply. Most sections are prefaced by a short overview.

6.1 Phase 1. The mining landscape pre 1566 (Fig 43)

6.1.1 Prospection

Prospecting pit 1 (PP1)

The only feature within the survey area that can be assigned, even tentatively, to the earliest documented phase of activity on site, is a small fan of material overlying the upper slopes of the Silver Gill side of Balliway Rigg. The top of the fan lies at NY 30048 34149 at an altitude of 516.5m AOD. The feature is both slight - extending no more than 4m across the hillside by some 10m downhill – and grassed-over, but since it lies directly on the line of the Silver Gill mineral vein as shown on the latest geological mapping of the area (British Geological Survey 1994), is best interpreted as mine spoil. It lies on a very steep slope – *c* 1 in 2, or 50% - but is not scarred by

erosion channels, and in all probability, therefore, was never much larger: this suggests that it derives from a small surface working on the vein, and is not the entrance to a shaft or adit which would have resulted in a much larger apron of material. It is most probably a prospecting pit to test the vein, or less plausibly a small opencast working.

The antiquity of the pit is unclear. It almost certainly pre-dates the early 19th century, for it would seem to correspond to one of the unnamed holes or mounds depicted along the Silver Gill vein west of the 'Smithy' on the 1825 map of the mine complex (Fig 4). It also lies immediately east of a possible hush (H5, section 6.2.1 below), and although the stratigraphical relationship between the two features is uncertain, the hush is most likely later since once the vein had been exposed in the hush floor, there would have been little point in digging a prospecting pit to one side. It is suggested below that the hush is early 17th-century in date. If so, the pit is most probably one of the workings of 'the Old Man' – meaning miners pre-dating the advent of the Company of Mines Royal to Caldbeck in 1566 - referred to in 1602 (section 5 above).

6.2 Phase 2. The mining landscape 1566-1630: the Company of Mines Royal and lessees (Fig 44)

6.2.1 Prospection

At least five hushes or possible hushes, together with their associated water supply systems, lie within the area of survey. One is visible beneath Iron Crag, while the remaining four are on Balliway Rigg; the foot of what may be a sixth on the west side of Silver Gill is just clipped by the edge of survey. There is no real basis on which any may be phased stratigraphically. Although each intersects with a number of mine paths and tracks, the likelihood of continued natural erosion down what, by their very nature, are unstable archaeological features on steep hillsides, together with the strong probability that some paths may have been re-established in later periods, makes it impossible now to be certain if the hush has cut a path or *vice versa*. Phasing, therefore, comes down largely to hints in the documentary evidence. Although not described, a stony scarp corresponding to the northern edge of hush H3b (below) was depicted by the OS in 1863 (Fig 5), showing that this hush, at least, pre-dates the mid 19th century. Otherwise, the only documentary reference that has been found is a recommendation in a report of 1602 to build 'one or more dames…in the topp aboute the lodginge howse of the myners' (section 5 above) - which seems to be a reference to the need to carry out hushing on Balliway Rigg (*cf* section 6.2.6 below). On this basis, all hushes have been assigned to phase 2. The hushes on Balliway Rigg and in Silver Gill form a coherent group, and are indeed likely to be broadly of the same period. However, there is no *a priori* reason to link the hushing on Balliway Rigg with that beneath Iron Crag; the latter could very easily belong to a later phase. The six hushes, plus their associated water supply systems, are described below in order from east to west. Two adits - which as 'trials' are more properly prospection rather than extraction features - also belong to this phase, but are described alongside other mine levels in section 6.2.2 below.

Hushes 1-6 (H1-H6), hush leats 1-4 (HL1-HL4) and hush reservoir 1 (HR1)

H1 starts at NY 30385 34193 just below the foot of Iron Crag, and runs more or less perpendicular to the contours down to the base of Roughton Gill. About half-way down, it is crossed by the valley of a natural mountain torrent flowing down the west

side of Iron Crag, and the hush channel either now lies buried beneath alluvium brought down by the torrent, or has been eroded away. What is probably the course of the hush re-emerges on the far side, but has been 'captured' and scoured by the torrent whose main flow now appears to be directed down the former hush channel. However, the main supply of water for creating the hush came originally not from this torrent, but from a spring welling to the surface some 12m upslope from the hush's head, augmented by water brought in a leat (HL1) from a second mountain torrent flowing down the east side of Iron Crag. A shallow, dry, valley is visible on the hillside in between the two active torrents, showing that prior to the creation of the hush, water from the spring drained almost due north to the floor of the Dale Beck valley.

H2 starts at NY 30118 34086, just below the summit of Balliway Rigg, and runs generally north and north-eastwards into Roughton Gill. It is fed by a leat (HL2), only part of whose course lies within the survey area (Fig 6), but which MoLES (Warren Allison, pers comm) have traced back to its origin at the head of Silver Gill where it seems to have been designed to collect water draining out of blanket bog. This course is visible on Aerial Photographs (APs) held by EH (NMR 2000), one of which is reproduced here as Fig 7. The leat broadens to form the start of the hush at the shoulder of Balliway Rigg, and H2 is clearly visible in the field as a 7m-8m wide gash in the steep, upper, northern face of the hill, before fading out for a short distance and re-emerging about half-way down on a more north-easterly alignment where it merges with the course of H3a (see below) and is as much as 25m wide (Fig 8). According to the British Geological Survey (1994), this lower part of H2 lies just south of the line of the Silver Gill mineral vein where exposed in the flank of Balliway Rigg by Roughton Gill.

Figure 6. Hush leat HL2 on Balliway Rigg viewed from the south (NMR/AA021986)

H3 on Balliway Rigg starts at NY 30080 34092. Its upper course runs parallel with, but approximately 35m west of, H2. It lies almost directly on the spine of the hill, which drops down steeply from the summit to a small plateau at *c* 519m AOD, before continuing north at a lesser gradient down to the floor of the Dale Beck valley. At this plateau there is evidence that water was channelled in different directions to create at least three separate hushes, here labelled H3a-H3c. Two, H3a and H3b, are sizeable features, and run north-east into Roughton Gill, parallel to, but north of, H2 (H3a in fact may well cut the edge of H2) and seem designed to expose the northern limit of the Silver Gill vein in the eastern flank of Balliway Rigg (Fig 8). A much smaller channel which is visible heading north-west down Balliway Rigg into Silver Gill would also seem to be a hush (H3c) probably intended to investigate the possibility of additional mineral veins. (An even smaller channel immediately east of H3c is here taken to be part of the same feature). As with H2, H3 is fed by a leat (HL3), but

Figure 7. Aerial view of mining activity on Balliway Rigg and in upper Roughton Gill to the south of the present survey (NMR 17466/11, photographed 16 June 2000)

unlike H2, this leat is only 40m long and originates at a reservoir (HR1) centred at NY 30075 34043 cut into the blanket bog directly above the hush. The reservoir is small, with a surface area of no more than 150 square metres and a current (silted) depth of only *c* 0.15m; it is retained by a low dam along its northern edge. Although the reservoir may well have been filled by seepage from the surrounding bog, there are faint suggestions of another leat (HL4) heading towards it from the south-west. Only the eastern end of this feature – which on the ground resembles a well-trodden, narrow, footpath - lies within the area of survey, although MoLES (Warren Allison, pers comm) have traced it back to the same general point of origin as HL2, *ie* the highest point of Balliway Rigg immediately above the head of Silver Gill. On the ground it does not continue all the way through to the reservoir, but disappears on the edge of peat-cutting (PC1, section 6.3.6 below).

Both H4 and H5 are broad, fairly steep-sided gullies running in a general northerly direction down the western flank of Balliway Rigg into Silver Gill. They originate just below the summit of the hill, where their centres are about 30m apart, although H4 soon veers slightly to the west and almost converges with H5 towards the foot of the gill, before turning sharply away through two right-angles to resume its original course and distance. There is no sign of a leat feeding into the head of either gully, raising the possibility that both are the product of natural erosion. However, the sharp double bend in H4 looks most unnatural, and much more like a deliberate man-made deviation to steer around a pre-existing obstacle. In addition, if water was ever

Figure 8. Balliway Rigg from the east showing Blind Wastel and hushes H2, H3a and H3b (NMR/AA021993)

supplied by secondary leats coming off HL4, these could have been destroyed by the same peat cutting which has truncated that leat before it reaches HR1.

H6 is a narrow gully running down the flank of Yard Steel on the west side of Silver Gill. Only its very foot at the base of the gill lies within the area of survey at NY 2990 3411, and it has therefore not been investigated in detail by EH to see, for instance, whether the top of the gully is fed by a leat (nothing definite is visible on Yard Steel on available APs). On present evidence, it must therefore remain a possibility that it is a natural gully rather than a hush. Another, very similar feature exists a little further south up Silver Gill on the same side of the valley but beyond the limits of the present survey, and both this and H6 had been tentatively identified as hushes by MoLES before the EH survey (Warren Allison, pers comm). Circumstantial evidence for them being hushes comes from the fact that a late 16th/early 17th-century mine adit (section 6.2.2 below) is juxta-posed close to the foot of each feature in Silver Gill. However, closer examination in the field would be necessary before either can be confirmed as hushes, or dismissed as natural.

6.2.2 Extraction of ore and mine drainage

A resume of the documented history of the various mine levels dug by the Company of Mines Royal has been given in section 5 above. However, in brief, the three principal underground workings were Fortune, Emanuel, and New Adit, whilst two 'trials', including a level known as Blind Wastel, were made at different times further east. As trials, the latter two may perhaps more properly be categorised as prospecting, as opposed to extraction, adits, but are included here for convenience. A strong case has recently been made equating the first three of the documented workings with hand-cut 'coffin' levels known on the ground in Silver Gill, whilst the remaining two have been identified with similar hand-cut levels extant in Roughton Gill (Smith *et al* forthcoming). Fortune lies outside the area of the present survey, and is in any case currently buried beneath scree and invisible to surface inspection. However, EH did expand the original area of survey to take in both of the other exposed levels in Silver Gill, partly in order to have an accurate plan record, but chiefly to make sense of a network of miners' tracks on Balliway Rigg which connect with them (section 6.2.3 below). None of the mines described below is associated with spoil tips, suggesting that waste rock was dumped directly into the gills outside each entrance, and has been washed away. The fact that small streams still issue from the mine entrances shows that they were drained by gravity: levels were in fact never dug completely 'on the level', but always with a slight uphill gradient to allow for natural drainage. Documents record that Emanuel and New Adits were also linked by a regular series of internal shafts to improve drainage and ventilation (section 5 above), but these underground drainage features are beyond the scope of the present report.

Emanuel Adit (Mine level ML1)

Emanuel is the earliest recorded, named, adit in Silver Gill (first mentioned in 1571), and is documented as remaining in use for the best part of 60 years until the cessation of operations at Caldbeck by the lessees of the Company *c* 1630. Smith *et al* have equated it with the entrance to a coffin level located beneath scree by MoLES in 1997 (section 4 above) at NY 29915 34095, before which its existence was unsuspected. However, with hindsight, it is possible to suggest that the level was visible at times in the 19th century, and is probably the same as the Silver Gill 8-fathom level recorded in 1852 (see section 6.6.1 below). This matter is discussed further in section 7. Investigation by MoLES has shown that the mine is a cross-cut level to the Silver Gill vein, which has been worked in both directions, but principally to the west (Warren Allison, pers comm).

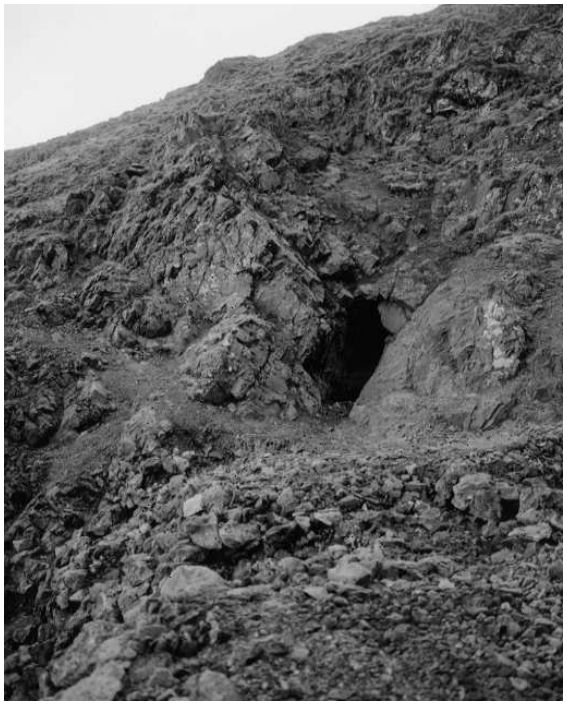

Figure 9. Entrance to the 16th-century Emanuel Adit in Silver Gill (NMR/AA021976)

The mine entrance is cut into a near-vertical face of rock at the foot of the east side of Silver Gill (Fig 9), at an altitude of 524.25m AOD. Since discovery, MoLES have installed a metal door a few metres inside the adit, which is locked to control unauthorised access, whilst the scree cleared away from the mine has been piled up across the valley floor; the larger material has been used to form a series of dry-stone revetments to prevent it all washing away and choking the lower course of the gill. A small but steady flow of water now issues from beneath the metal door, and flows down over the revetments to join the beck in the gill. The effect of the clearance has been to create a flat-topped, dam-like structure in the floor of the gill, visible from some distance away, which provides a horizontal approach to the mine from the west. In the 16th century, however, access to the mine was from the north and east via tracks on Balliway Rigg (T1 and T2, section 6.2.3 below), which provided links with the floor of the Dale Beck valley - the likely site of the stamping mill and main ore-processing area (MC1, section 6.2.5 below) - and to the miners' lodging house (AS1, section 6.2.6 below). Initial sorting and dressing of the ore, however, was carried out immediately outside the mine entrance: a dressing floor was discovered close by in 1988, since destroyed (DF1, section 6.2.5 below).

New Adit (Mine level ML2)

New Adit is first mentioned in the Company accounts in 1573, and also continued in use until the closure of the Caldbeck Mines around 1630. Smith *et al* (forthcoming) have equated it with a second hand-cut, coffin, level, visible today at NY 29942 34139 in Silver Gill. If Emanuel can be reasonably identified as the 19th-century Silver Gill 8-fathom level, then New Adit at an altitude of 500.5m AOD - 23.75m or almost exactly 13 fathoms lower – is certainly what was known in the 19th century as the 20-fathom level (section 6.6.1 below). Again this matter is discussed further in section 7. As with Emanuel, the mine is a cross-cut level to the Silver Gill vein (Warren Allison, pers comm).

The entrance to New Adit lies on the east side of Silver Gill, cut into a near-vertical rock face. It is now completely open, although loose scree occupies the slight height difference between the mine floor and the level of the beck in the gill. A small stream of water issues from the mine into the beck, while a few pieces of (probably 19th-century) worked timber are visible on the mine floor just inside the entrance. There are no obvious surface indications of a hand-dressing floor in the vicinity of the entrance, but it is a strong probability that one exists close by, probably in the floor of the gill. A track (T3) heads towards the mine from the north-east, rock-cut in its upper stages. This track branches off T1 lower down Balliway Rigg, and would have been the route by which the hand-dressed ore was moved down to the main processing area in the floor of the Dale Beck valley (sections 6.2.3 and 6.2.5 below).

Blind Wastel (Mine level ML3)

Blind Wastel pre-dates 1587. It is first recorded by name in 1600, when it was referred to as an adit 'ignorantlie driven upon the ligget' – ligget possibly meaning 'bottom of vein' (Hammersley 1988, 376) - and was mentioned subsequently in 1617/18, when it was described as 'beinge begune above XXX years sence' (section 5 above). Smith *et al* (forthcoming) suggest that it can be identified with a hand-cut, coffin, level visible at NY 30192 34233 in the west side of Roughton Gill at the foot of the exposed Silver Gill vein (Fig 10). They have entered the mine, which comprises a drive along the hanging wall of the vein, with a couple of short cross-cuts off it into the vein itself.

Figure 10. Entrance to the 16th-century Blind Wastel in Roughton Gill (NMR/AA021992)

The mine entrance is only slightly above the floor of the gill (*c* 445.7m AOD), cut into a vertical rock-face right on the northern edge of hush H3b where the latter meets the beck (Fig 8). A small stream issues from the mouth, which is currently open, although since the mine is not shown on the OS 25" survey of 1863 (Fig 5), there is the likelihood that it has been periodically blocked in the past. The mine was probably reached along tracks T5 and T6 which connected it respectively to the floor of the Dale Beck valley and to the miners' lodging house AS1 (sections 6.2.3 and 6.2.6 below).

'1600 Cross-cut' (Mine level ML4)

Another hand-cut, coffin level, visible in the base of the east side of Roughton Gill (Fig 23) at NY 30218 34264, has been identified by Smith *et al* (forthcoming) as a trial recommended to be carried out near to Blind Wastel in 1600, in order to test the eastern extremity of the Silver Gill vein; they have named it the '1600 Cross-cut'. It lies at *c* 432m AOD. It is unclear how it was accessed, for there are now no tracks which head towards it.

6.2.3 Mine access and ore transport

As already mentioned in the previous section, there are a number of paths or tracks on Balliway Rigg (T1-T6) which connect the various active mine workings with the processing and residential areas of the 16th/17th-century mining complex. Two other short lengths of track (T7 and T8) also probably belong to this phase. Many of these tracks seem to have remained in use to varying degrees in later periods also.

Tracks 1-8 (T1-T8)

The primary route to the early mines is T1 (Fig 11), which climbs the spine of Balliway Rigg from the floor of the Dale Beck valley. The initial part of the ascent from the valley floor has been destroyed by later access in phase 5 to the Roughton Gill 60-fathom mine complex along T16, and only survives on the ground south of T16a (Fig 27). A short distance beyond this point, the course of T1 drops down off the watershed onto the western flank of the hill in order to proceed in the general direction of Emanuel Adit. T3 branches off at NY 30066 34308 and heads towards New Adit (Fig 16). Up until this junction, T1 is well-engineered and maintains a fairly constant width (averaging around 2m) and gradient (*c* 1:4 or 25%); after the split, both tracks narrow, but since they also become even steeper it is debatable how much this narrowing reflects their original form, and how much is due to 400 years of soil creep and erosion on the steep, upper slopes of Silver Gill. Neither track now survives much beyond H5, although short lengths re-emerge as narrow, rock-cut,

ledges, close to their respective destinations where each runs across precipitous rocky outcrops. In comparison, T5 providing access to Blind Wastel up the eastern side of Balliway Rigg, is a far slighter construction (Fig 20), probably reflecting the fact that it led to an unsuccessful trial. All three tracks interconnect with a variety of features, including hushes, leats and other tracks. Unfortunately, because of the problems of continuing soil movement down the hushes already outlined above (section 6.2.1), the relationship of the tracks with the hushes cannot now be used to work out chronology. All three tracks, however, can be shown to be early in the stratigraphical

Figure 11. View north-east down track T1 on Balliway Rigg, with leat L8 at left of frame (NMR/AA021974)

sequence on account of clear relationships with other features which overlie them, principally L8 and T17**,** both of which are mid 19th century or earlier in date (sections 6.6.2 and 6.6.3 below).

T2, T4 and T6, on the other hand, seem designed to link the 16th/17th-century mine levels with a building platform, AS1, visible on a small plateau on the spine of Balliway Rigg, some 50m below the main shoulder of the hill. It is suggested below (section 6.2.6) that this platform is the site of the documented miners' lodging. Since Emanuel Adit and the lodging house are at almost the same altitude, T2 which runs between them has only a very slight gradient, and is visible on the ground as an intermittent, narrow, shelf following the contours, in places destroyed or masked by soil creep. T4 meanwhile branches off T1 at NY 30032 34188 (although it probably also originally linked in with T3), and traverses across the hillside to approach the lodge from the north-east. On the ground the track continues past the lodge and up the west flank of Roughton Gill, but this southern part may be a later extension (section 6.3.2 below). T6 branches off T5 leading up to Blind Wastel, and would originally have fed into T4, although the junction no longer survives; T6 is overlain by, and therefore demonstrably pre-dates, T12 heading towards the late 18th/early 19th-century Roughton Gill 30-fathom level (ML9, section 6.4.2 below).

T7 and T8 now only survive for very short distances on the ground. Both lie on Balliway Rigg, and although stratigraphical evidence points to them being early features, their true position within the overall site phasing is uncertain. It is also unclear to what either was leading. T7 is only visible for 15m immediately north of the upper reaches of hush H3b which appears to cut it, and since there is no evidence of it re-emerging south of the hush, it may well have provided access to a feature on

the side of the hill destroyed by the hushing. Its surviving length is centred at NY 30123 34207. T8 on the other hand runs close to the foot of Balliway Rigg, a few metres above the beck in Roughton Gill. It is traceable for 20m, centred at NY 30172 34506 after which it has been destroyed by a large cut-scarp associated with a northwards-flowing leat (L4) terraced into the side of the hill (section 6.3.3 below). The track is an enigmatic feature: it pre-dates the leat, but there is no obvious candidate where it could have been leading unless it was to a waterwheel or some kind of mill-building situated at the head of the leat. For this to be so, it would mean that both road access and arrangements for conveying water around the site were subsequently altered (see also sections 6.2.4 and 6.2.5 below).

6.2.4 Water management

The courses of two leats or possible leats (L1-L2), survive on Balliway Rigg, and are here assigned to phase 2 based on a combination of stratigraphical and circumstantial evidence, although they may well date to either phase 3 or phase 4 instead. Furthermore, because the two features only survive in short, discontinuous, lengths – often with each length having a different earthwork form – their true interpretation and course is open to some question, but they are interpreted here as conveying water from the beck in Silver Gill and/or the blanket bog on the top of Balliway Rigg, to the possible site of a waterwheel in Roughton Gill (section 6.2.5 below).

Leats 1-2 (L1-L2)

L1 is centred at NY 30147 34418, and flows from west to east across the lower part of Balliway Rigg. It seems to have been built to bring water from Silver Gill to a point in Roughton Gill directly opposite the extant 20th-century water pumping station where it may have powered a waterwheel (section 6.2.5 below). However, on the ground, L1 as here defined, survives as three separate sections (labelled L1a-L1c). Although the interpretation of sections L1b and L1c as part of the leat is certain, there is some doubt over whether section L1a can be similarly claimed: in earthwork form it is a flat terrace rather than an embanked channel, raising the possibility that it is a miners' track instead. A couple of observations, however, favour interpreting it as part of L1. First, if it is a path, it does not link with T1, but starts abruptly on the hillside a few metres to one side, with no indication to show that it is earlier and has been overridden by the other track; this ceases to be a problem if it is viewed as a leat carrying a wooden launder which could be continued over T1 on trestles. Second, its other end is now destroyed by soil slippage, but has no obvious destination in Silver Gill; again, this ceases to be a problem if it originated at a small weir placed in the gill to divert water into a wooden launder. It could be argued that the feature is heading for the Silver Gill 50-fathom level of phase 4 (ML10, section 6.4.1 below), but this is unlikely since if L1a were a track giving access to it, one would expect a very clear link into T1. There is no such doubt over the identification of the other two sections of L1. The earthwork form of L1b is superficially similar to L1a, but on close inspection preserves very slight traces of a silted channel on its surface, whilst L1c - which is directly in line with L1b, and only separated from it by T16 of phase 5 (section 6.5.2 below) - is a shallow, earth-cut, channel dropping vertically down the east flank of Balliway Rigg. L1 is not directly dateable, but definitely pre-dates phase 6 for it is cut by L8 shown on the 1863 OS map (Fig 5). However, it is the relationship with L4 (section 6.3.3 below), plus the very obvious requirement for delivering a head of water to a particular spot in Roughton Gill as if to power machinery, which is the strongest evidence for placing it in phase 2 (see section 6.2.5 below).

As with L1, the interpretation of L2 is somewhat problematical, but there are a number of earthwork features which hint that water was being brought down from the blanket bog on the top of Balliway Rigg via one or more of the hushes on the upper slopes of the hill, before ending up in channels or launders running at the side of T1 and discharging into L1. The principal evidence for L2 comes from a path-like terrace on the west side of Balliway Rigg just below the spine, which heads straight towards L1b although separated from it by L8 of phase 6 (section 6.6.3 below); and from a short, 20m, sunken stretch of T1 immediately downhill from H4, which resembles a water channel rather than a path. Although not so well-defined, there are slight suggestions elsewhere of a silted channel on the inside edge of T1; however, these could equally be explained as the product of other factors such as surface run-off down the track, or even traffic wear, rather than an infilled leat. Even if correctly identified and assigned to the right phase, it is obvious that L2 must belong to the latter part of phase 2 (*ie* post 1602) since it cannot pre-date the hushing (section 6.2.1 above). Moreover, if L1a is a miners' track and not a leat (see above), then L2 and the remaining sections of L1 would be parts of the same feature.

6.2.5 Processing the ore

Hand-dressing floor 1 (DF1)

Although now destroyed by mineral collectors, in 1988 MoLES uncovered a hand-dressing floor just outside the entrance to Emanuel Adit (ML1). This lay on the edge of the present survey area at *c* NY 2990 3411. At the time, its discoverers thought it probably dated to *c* 1720 (Austin 1991, 10), but this was no doubt on the basis of the documented history of the mines as then understood. Since the mine is now known to have been begun *c* 1571, there seems every likelihood that the floor is an original feature first used in phase 2, and re-used in phase 3. The published plan of the floor includes a wooden trough at the base of 'a side gillet'; this would seem to be the base of the possible hush H6 which may, therefore, have been re-used to supply water for washing.

Waterwheel 1 (WW1) and mill complex 1 (MC1)

It has been argued above (section 6.2.4) that leat L1 (probably later augmented by L2) was designed to bring a head of water to a specific spot in Roughton Gill, probably to power a waterwheel (WW1). If L1 supplied water simply to feed into L4 (section 6.3.4 below) which runs away north from it, then it is far more likely that a single leat would have been constructed along the length of Balliway Rigg from the outset. The logic of this argument is that L1 brought water to a designated spot in Roughton Gill for a particular purpose (or purposes), and that L4 was only constructed later so that the water could be taken for use elsewhere when the original purpose no longer pertained. There is today minimal space between the side of the gill and the (present) course of the beck. Therefore, unless the beck has changed its course appreciably, it is unlikely that this wheel stood directly under Balliway Rigg – a wooden launder could easily have continued the leat across the beck to a more convenient location on the other side, perhaps in the vicinity of NY 3023 3442. Unfortunately, if so, the site of the wheel has been destroyed by activity in phases 6-9 associated with the driving of the Roughton Gill 90-fathom level and the subsequent re-use of that mine as part of the public water supply. Although incapable of proof on the available evidence, it is tempting to equate this wheel with the documented 16th/17th-century stamping mill/washing house complex (mill complex MC1). The matter is discussed further in section 7.

6.2.6 Ancillary structures

Miners' lodging house (Ancillary structure AS1)

A building platform is situated at NY 30082 34162, on a small plateau on the spine of Balliway Rigg at *c* 519m AOD some 50m below the main shoulder of the hill. The platform is covered in stony debris, probably demolition rubble from whatever building(s) stood on it. Its surface measures a maximum of 12m east-west by 6m transversely, but is much eroded and altered by a later, small, dry-stone building from phase 4, whose ruins still occupy the western end (AS2, section 6.4.4 below). A short length of possible stone wall is visible through the tumble and debris at the north-east corner of the platform. The platform is here assigned to phase 2 since it seems to lie at the hub of a network of tracks on Balliway Rigg, including several leading to the early mine levels in Silver Gill. This, plus its general situation and orientation east-west, means that it fits very well with the documentary evidence for the 16th/17th-century miners' lodging house (section 5 above). A midden and/or heap of ashes overlies the hillslope immediately north of the platform, although this could be associated with the phase-4 structure.

6.3 Phase 3. The mining landscape *c* 1695-1730: Wright, Wharton and Hillary (Fig 45)

Documentary evidence (section 5 above) suggests that in the late 17th and early 18th centuries there was exploration/exploitation of mines in Silver, Roughton, and Todd Gills. It is unclear which, if any, of the phase-2 Silver Gill mines were being re-worked: the only mine mentioned by name at this time is Golden Hugh/Vugh, which is probably best equated with Fortune Adit (section 5 above) and therefore beyond the limits of the present survey. However, a number of prospection and/or extraction-related features that survive on the ground in Roughton and Todd Gills may tentatively be assigned to this phase.

6.3.1 Prospection

Prospecting pit 2 (PP2)

A pit, *c* 1m across and 0.9m deep, has been excavated into the foot of the south-western slope of Peteraw at NY 30250 34628 (Fig 36). What appears to be solid bedrock is exposed in the back of the hole, while a couple of large boulders which may have come from it lie close to the northern edge; the rest of the spoil has been tipped downhill where it forms a small, grassed-over, mound. The feature is most likely a prospecting pit. It cannot be securely dated, but the most plausible period is phase 3 when mining is documented close by in Todd Gill. It lies roughly on the projected line of mine level ML7 (section 6.3.2 below), suggesting that these two features may be associated.

6.3.2 Extraction of ore and mine drainage

Mine level 5 (ML5)

The remains of a probable adit entrance buried beneath scree lie at *c* NY 30210 34039, on the west side of Roughton Gill, just north of where the gill crosses the

eponymously-named North vein (Fig 14). The entrance passage is about 1m wide. Only the first few metres are visible, defined by a cut scarp to the north-west, and a bank of dumped material to the south-east, the latter now being gradually cut into and eroded away by the beck; this bank was presumably intended to act as a flood wall protecting the entrance from the beck when in spate. The passage floor is at *c* 516m AOD, whilst its orientation suggests the level was driven towards the south-west, presumably as a short cross-cut to the vein which it would have intersected at an acute angle after about 40m. However, there is no sign of water draining from the mine, suggesting that it may only be a short trial not taken all the way to the vein. There is no direct dating evidence, but since there are records of Wright and the Company of Copper Miners in England working the vein in this area in the late 17th/early 18th century (section 5 above), it is probable that it belongs to phase 3.

Mine level 6 (ML6)

A mine level (Fig 12) is visible in the northern bank of Todd Gill, downstream from the confluence with Blea Gill. The mine does not go straight back into the valley side, but is visible running for about 50m from west to east along the floor of the gill,

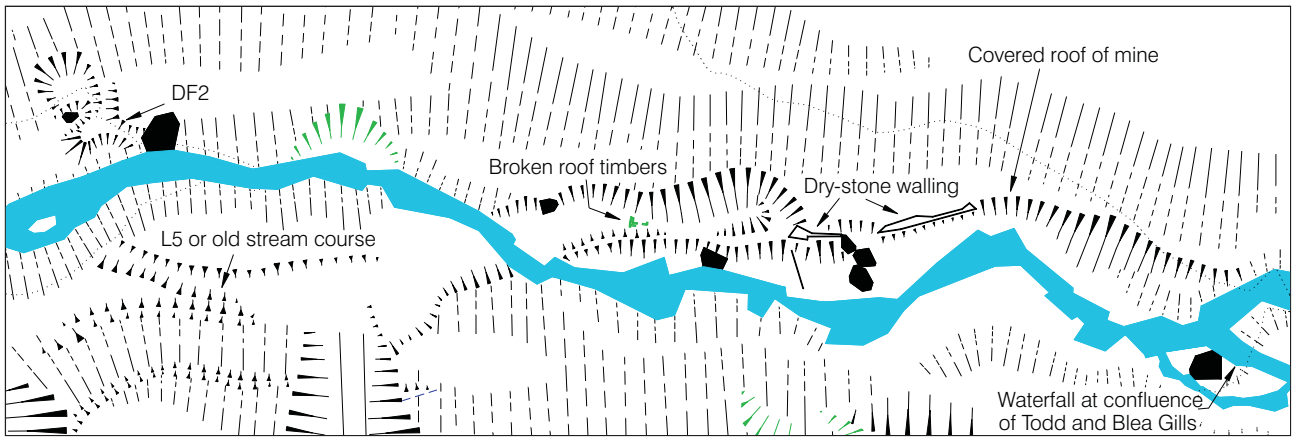

Figure 12. Annotated extract from survey reproduced at 1:500 scale, showing features associated with mine level ML6 in Todd Gill. (See key to Figure 53 for explanation of conventions)

starting at NY 30341 34547. It gives the impression of being more of a 'cut and cover' construction, rather than a true mine: the northern wall of the mine has been formed by cutting back the gill side, but the southern wall comprises just that - a built bank or drystone wall – with a roof then laid between the two. The roof was apparently of timber, for it has collapsed or been broken into close to the entrance, and planking is exposed at NY 30350 34547 (Fig 13); further east the roof seemingly remains intact, and the course of the mine can be followed as a narrow, grassy, shelf along the side of the gill. Since the height of the exposed timbers (*c* 393.3m AOD) is only a metre or so above the present level of the beck in the gill - which flows right past the mine entrance - it is clear that the

Figure 13. Exposed roof timbers in mine level ML6 in Todd Gill, viewed from the west (NMR/AA021950)

mine could not have operated unless the beck had been diverted. This was probably achieved by employing an elevated wooden launder running from the small waterfall which marks the confluence of the becks flowing down Todd and Blea Gills, to a point just past the mine entrance, where a short stretch of possible leat survives (L5, section 6.3.4 below). The mine was dug along an unnamed vein containing zinc plus some copper (Cooper and Stanley 1990, 63; British Geological Survey 1994). There is no stratigraphical evidence for its date. It is not shown on any pre 20th-century mapping, and so it could be argued that it is late; however, the best guess is that this is the mine in Todd Gill recorded as being operated by Thomas Hillary on behalf of Lord Wharton *c* 1724 (section 5 above). A possible hand-dressing floor survives at its mouth (DF2, section 6.3.5 below).

Mine level 7 (ML7)

An elongated scoop, 22m long, cut into the foot of Peteraw on the east side of the Dale Beck valley is best interpreted as the remains of an entrance passage leading to a buried mine portal in the vicinity of NY 30204 34654. The slumped passage is up to 5m wide overall by a maximum of 1.5m deep at its east end, with suggestions of a short stretch of stone wall at ground level on the north side close to the start; the passage floor now stands at *c* 371m AOD, but the original mine floor is probably lower, buried beneath perhaps as much as 1m of silt. There is no clear indication of how long the underground portion of the mine is, although the fact that there is no sign of water draining from it might suggest it is relatively short. The orientation of the passage at just south of east would, if projected, take it almost vertically beneath a prospection pit (PP2, section 6.3.1 above), suggesting these two features may be contemporary. There is no evidence for spoil dumps outside the mine entrance, but the likelihood is that mine waste was tipped directly into the floor of the valley and has been washed away. No mineral veins are shown by the British Geological Survey (1994) in this area, and it is unclear what the mine could have been dug to investigate or exploit. There are no real clues as to date. A documentary reference to early 18th-century mining on the south side of Peteraw (section 5 above) suggests the most likely context for it is phase 3. However, a level depicted by the OS in 1863 (Fig 5) a little to the south (ML19, section 6.6.1 below) raises the possibility that ML7 may belong to phase 6 instead.

Mine level 8 (ML8)

Another possible buried mine level lies a few metres north of ML7. The existence of a level here is suggested by the way the terrace scarp defining the edge of the present river flood-plain at the foot of Peteraw swings in and out again, whilst a low bank up to 1m high protrudes from the face of the terrace and curves sharply north, creating a 1m-2m wide passage between it and the base of the terrace, leading to where it swings in. This last feature has every appearance of being a flood bank protecting the mouth of a former drift mine; flood deposits have built up outside it, while the start of the entrance passage it defines is also now partly blocked by material brought down by the beck. However, there is no sign of the actual mine entrance, which must lie buried in the face of the river terrace in the vicinity of NY 30185 34674. The floor of the entrance passage is at *c* 368m AOD. It is again unclear what mineral vein the mine was intended to investigate or exploit, but for the same reasons as ML7 above, the best guess as to date must be phase 3, or less likely, phase 6.

Waterwheel 2 (WW2) and mine shaft 1 (MS1)

The 1825 map of the mines records the site of an old waterwheel close to the point where Roughton Gill is shown cutting the Roughton Gill vein (Fig 4). The EH survey found no evidence for the wheel itself at this location, but a surviving dam and leat (section 6.3.4 below) immediately upstream of a 5m-high waterfall strongly suggest that it stood at approximately NY 30215 34020 (Fig 14). The wheel was thus adjacent to mine level ML5, but the two features are unlikely to have been functionally related. Much more likely is that the wheel was required for pumping and/or winding operations associated with a nearby mine shaft. EH found no physical evidence for a shaft, although the existence of one in this general area (MS1) is recorded in late 17th/early 18th-century documents (section 5 above). Because of the uncertainty as to its location, MS1 is not marked on Figs 42 or 45.

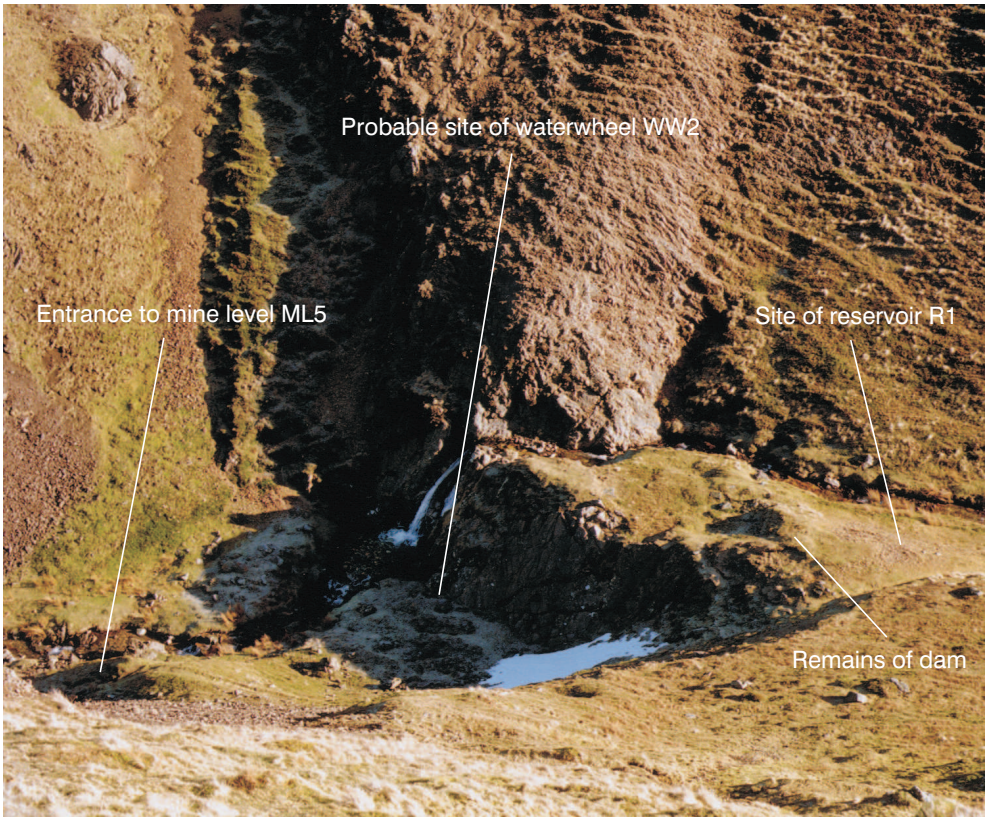

Figure 14. View east over reservoir R1 and the site of waterwheel WW2 in upper Roughton Gill (NMR/AA021987)

6.3.3 Mine access and ore transport

The renewed interest in the Silver Gill mines in this phase means that some of the phase-2 tracks on Balliway Rigg are likely to have been re-used, the most obvious one being T1. Since new mines were also being dug higher up Roughton Gill and in Thief Gills, T4 would also very probably have been brought back into use in this phase; if so, this is also a possible time for it to have been extended along the side of Roughton Gill. The only totally new track at this time would appear to be T9.

Track 9 (T9)

T9 is a short length of track which heads uphill parallel to the western lip of Blea Gill, and crosses the gill at NY 3052 3442. It is cut by both the phase-6 track T21 and the phase-7 leat L28 (sections 6.6.2 and 6.7.3 below), suggesting that it is relatively

early in the overall sequence of features. It is also seemingly cut by an area of peat-cutting (PC2), which it is suggested below (section 6.3.6) belongs to either phase 3 or phase 4. However, since there is no obvious destination for the track, it must be a possibility that it is contemporary with and served as access to the peat-cutting, rather than necessarily being earlier and being truncated by it.

6.3.4 Water management

Reservoir 1 (R1) and leat 3 (L3)

The severely eroded remains of a small earthen dam, centred at NY 30217 34012, span the bottom of Roughton Gill, just above the point where the beck cascades over a 5m-high rock outcrop (Fig 14). The dam is now no more than 0.5m high, but is unlikely to have been much higher originally since leat L3 pierces its western end *c* 0.25m below the dam top adjacent to the valley side. The leat is only visible for the width of the dam – not much more than 8m - and in all probability fed a wooden launder which ran out over the documented waterwheel of phase 3 (WW2, section 6.3.2 above) sited immediately below the outcrop. The leat is thus part of a head race. The dam was evidently never intended to form a massive storage reservoir (R1), simply to maintain a small but sufficient head of water which could be diverted into the head race.

Leat 4 (L4)

L4, centred at NY 30191 34469, flows from south to north along a terrace cut into the east side of Balliway Rigg, some 2m above the floor of Roughton Gill. It starts a few metres north of the end of L1, to which it is orientated at 90^0. For the first 10m or so of its course, it exists as a rock-cut channel up to 1m deep, after which it is traceable intermittently as an embanked channel for at least another 60m. At this point all trace of the channel is lost, destroyed in stream erosion/deposition from the beck in Roughton Gill, but the underlying terrace on which the leat is built continues for a further *c* 30m until cut away by track T23 of phase 6 (section 6.6.2 below). L4 does not resume beyond the track, suggesting it has been destroyed by, or lies buried beneath, flood deposits in the valley floor. The purpose of the leat is not immediately apparent. It obviously has a close relationship with L1, but if L1 and L4 are contemporary and were constructed simply to deliver water from Silver Gill to a point in the Dale Beck valley near the present end of L4, it would have been far simpler to channel water directly along the spine of Balliway Rigg. Then again, if L4 is purely a tail race or bypass channel for water brought down L1 to power a waterwheel as suggested above (section 6.2.4), then waste water would have been discharged straight into the beck in Roughton Gill, rather than being channelled for over 100m in a specially constructed leat, in places cut through solid rock. That neither was done suggests that L4 is later than L1, and was constructed after L1 had lost its primary purpose. On this basis, L4 has been assigned to phase 3, although conceivably it may be later, especially if L1 is later than phase 2. Its purpose is discussed further in section 7 below.

Leat 5 (L5)

It has been suggested above (section 6.3.2) that mine level ML6 would have been flooded and impossible to work unless the beck in Todd Gill was diverted out of the valley floor. It has been further suggested that this was probably achieved by an

elevated wooden launder (L5) running from the waterfall marking the confluence of the becks flowing down Todd and Blea Gills, to a point west of the mine entrance. This should have guaranteed that the floor of the gill was dry enough to work the mine. If this argument is accepted, it is possible that a dry channel (centred at NY 30324 34543) visible for some 20m on the floor of the gill on the opposite side to both the mine and the present course of the beck, is a short length of leat linking the end of the elevated section of launder with the original stream course (Fig 12). However, it is also possible that the channel is no more than an abandoned natural stream bed; it certainly corresponds to the course of the beck as shown by the OS in 1863 (Fig 5).

6.3.5 Processing the ore

Hand-dressing floor 2 (DF2)

A generally flat area in the base of Todd Gill at NY 3032 3455 some 25m west of the entrance to mine level ML6, is possibly the site of a hand-dressing floor belonging with that mine. There are a couple of small artificial-looking scoops here in the side and floor of the gill which may just possibly be the sites of grates or ore bins, but the surface evidence is far from conclusive (Fig 12).

Mill complex 2 (MC2) and smelter 1 (S1)

A map of *c* 1724 map depicts the alleged site of a smelting mill somewhere east of Balliway Rigg (section 5 above). However, the map has not been consulted at first hand for the present report, and it is unclear if it contains any more precise locational information. In the meantime, such a vague description does no more than indicate that the alleged smelter stood on the east side of Roughton Gill, probably somewhere within the area of the present survey. If there was a smelter at the mines in this phase, then there must also have been a processing area consisting of stamps and buddles to dress the ore. Although unlocated, this putative phase-3 dressing plant is here termed mill complex MC2, and the smelter S1, for purposes of later discussion in section 7. Because of the uncertainties over their location, neither is marked on Fig 45.

6.3.6 Miscellaneous features

Two areas of peat-cutting (PC1-PC2) fall wholly or partly within the survey area. Even in the 16th century, demand for charcoal for use in smelting outstripped what was available from local sources, and peat was often substituted, especially for lead smelting where high temperatures were not so essential. Peat may also have been cut for domestic use around the mines - for instance in the phase-2 miners' lodge, AS1 (section 6.2.6 above) - or for other industrial purposes such as in a smithy, but if so demand was probably far less. Neither area of peat-cutting can be directly dated, and of course they need not necessarily be of the same date. However, there is some stratigraphical evidence that PC1 post-dates the phase-2 hushing on Balliway Rigg, whilst the only phases in which there is any documentary suggestion of smelting actually on site at Roughton Gill are phases 3 and 4 (section 5 above). Because of this, both peat-cuttings are here assigned to phase 3, although either or both could be later.

Peat-cutting 1-2 (PC1-PC2)

PC1 on the top of Balliway Rigg is represented by a series of low, overgrown, steps or cutting edges in the blanket bog. There are two main edges, *c* 0.15m high, in the

extreme south-west corner of the survey area, whilst a third scarp close to the reservoir HR1 is much smaller but probably still part of the same area of extraction. The possible leat HL4 of phase 2 (section 6.2.1 above) seems to end immediately above the western of the two main edges, suggesting that this marks the limit of cutting here, and also that the leat is earlier and has been destroyed further east. Although the bog was not perambulated to the south, there is no reason why peat extraction does not extend in this direction too. However, within the area under review, PC1 is centred at NY 3003 3403.

PC2 is confined to a much smaller and lower area of bog on the west side of Blea Gill centred at NY 3049 3444. Three extraction edges up to *c* 0.4m high, are visible, suggesting that the area cut extends no more than some 25m back from the lip of the gill by 35m along it. The two northern cutting edges both seem to interrupt the course of track T9, but it is unclear whether T9 is earlier than, or was used as access to, the peat-cutting (section 6.3.3 above).

6.4 Phase 4. The mining landscape *c* 1794-1832: the Roughton Gill 30-fathom level (Fig 46)

6.4.1 Extraction of ore and mine drainage

Documents show that the principal mine in this phase was the 30-fathom cross-cut in Roughton Gill. However, the 1825 map (Fig 4) also shows mines in Silver Gill which can probably be equated with those referred to in 1852 as the 20-fathom and 50-fathom levels (section 5 above); the 20-fathom level is probably identical with the phase-2 New Adit (ML2, section 6.2.2 above), suggesting that it may have been cleared out and re-worked at this time. Two other adits, ML11 and ML12, have been tentatively assigned to this phase; the reasons for so doing are discussed more fully below. Although ML12 is probably only a trial on the Roughton Gill North vein - and as such a prospection feature – it is described here under the heading of extraction, since without inspection of the actual underground working it is impossible to differentiate between the two types of adit.

Roughton Gill 30-fathom cross-cut (Mine level ML9)

The Roughton Gill 30-fathom cross-cut is documented on a map of 1825 (Fig 4), but was probably commenced several years if not decades earlier (section 5 above). It was dug to exploit the Roughton Gill vein(s). Sections of the underground workings are hand-cut, and accordingly Cooper and Stanley (1990, 55) have suggested that the mine is earlier than the generally accepted date; but the hand-cut section is reported to have a slightly different floor level, indicating it is more likely to be part of an older working broken into by the 30-fathom level (Warren Allison, pers comm). This older working probably dates from Wright's exploration of the Roughton Gill vein in phase 3. The mine was abandoned, worked-out, in 1832, and superseded by the 60-fathom cross-cut (ML13, section 6.5.1 below) lower down the gill.

The mine lies at NY 30227 34124 at an altitude of *c* 498.5m AOD. The entrance, which has been cut into a near-vertical face of rock at the foot of the east bank of the gill, is currently blocked (Fig 15), but has been open in the recent past: a photograph taken in 1987 (Cooper and Stanley 1990, 55) shows a short, stone-revetted, passage way leading to the entrance, with part of a wooden tramway sleeper visible in its floor (tramway TR1, section 6.4.2 below). All that is visible now is the very top of the

Figure 15. The blocked entrance to the Roughton Gill 30-fathom cross-cut (NMR/AA021989)

entrance arch, the rest lying buried beneath scree which has washed down from a natural gully above; a length of modern plastic drainpipe protrudes through the scree to drain the mine (Fig 18). There is no evidence of spoil tipping at the entrance, and mine waste was probably tipped straight into the beck and has washed away, or else was carted down to a small processing area (DF3, section 6.4.3 below) visible a little downstream on the east bank of the gill, and tipped down the hillside or into the beck there. The mine was accessed, and ore taken away, via tracks T10, T11 and T12 which head towards it from both sides of the gill (section 6.4.2 below).

Silver Gill 50-fathom cross-cut (Mine level ML10)

This mine level is first documented by name in 1852, but was already in existence in 1825 (Fig 4). The entrance is now blocked, but was open several years ago when it was investigated and proven to be a cross-cut to the lower levels of the Silver Gill vein (Warren Allison, pers comm). According to Adams (1988, 70), by 1852 it extended for 60 fathoms west along the vein. The mine entrance is now visible as a small scar in the east bank of Silver Gill (Fig 16), at NY 30037 34287 and an altitude of *c* 444.2m AOD. There is currently no sign of water draining from the entrance, although a short length of stream issuing from the mine and flowing north into the beck is shown by the OS in 1863 (Fig 5). Rather than dumping the mine spoil directly outside the entrance, it was tipped out over the hillside a short distance downstream; the rather small-sized dump that resulted (centred at NY 3004 3431) preserves evidence of finger tips at its western and northern edges. The top of a small wooden post together with a short length of planking are visible near the south-west corner, but may be no more than part of a revetment holding the tip back from the drainage outfall. The dump contains vein-stuff (Warren Allison, pers comm), but it is unclear

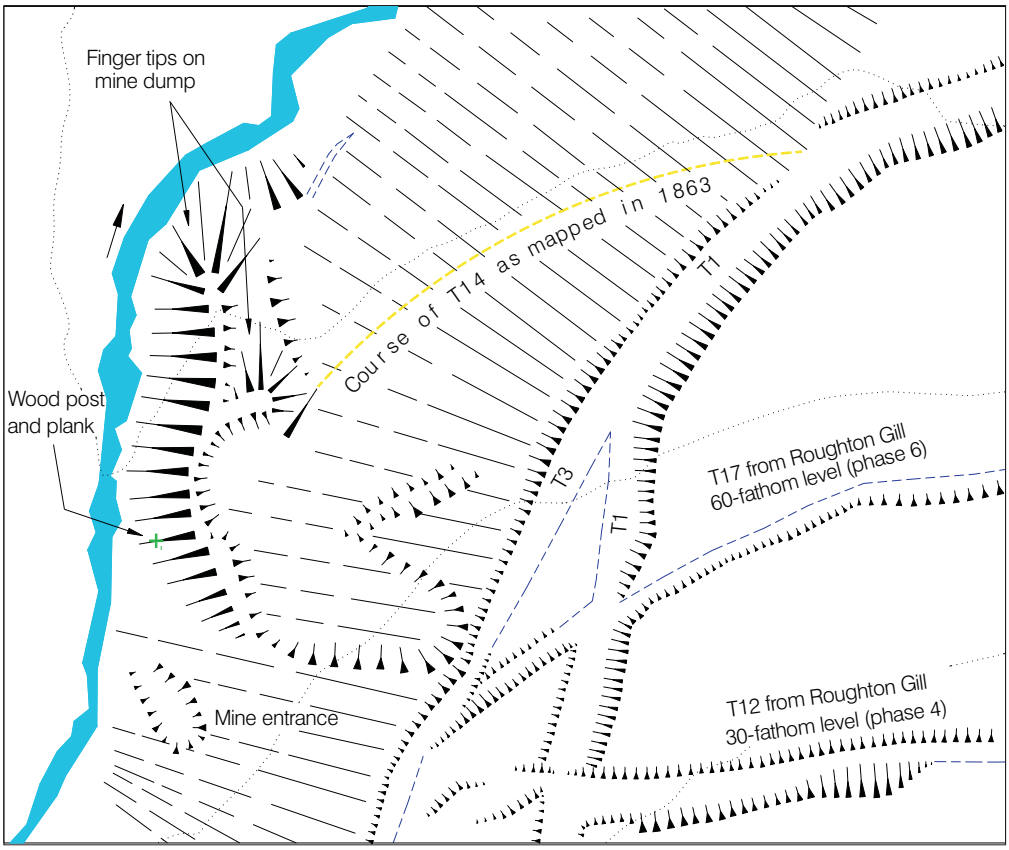

Figure 16. Annotated extract from survey reproduced at 1:500 scale, showing the Silver Gill 50-fathom cross-cut and associated features. (See key to Figure 53 for explanation of conventions)

how much worthwhile ore, if any, was got from the mine. The mine was accessed via a short branch from track T1; this track T14 no longer survives on the ground (section 6.4.2 below), but was recorded by the OS in 1863 (Fig 5).

Mine level 11 (ML11)

A blocked mine level exists at NY 30356 34307 below Iron Crag at an altitude of *c* 457m AOD, as evidenced by a small apron of spoil immediately below a silted gash in the hillside (Fig 21). The apron is heavily eroded, with two active erosion channels progressively spreading the spoil over the hillside beneath. There are no stratigraphical relationships with other features to help date the mine, and no documentary references have been found for it. Nevertheless, it was most probably started in phase 4. Its projected course underground either intersects with, or passes very close to, the probable western end of Dobson's vein, depending on whether Adams (1988, 70) or the British Geological Survey (1994) is believed. According to Adams, Dobson's vein was discovered in the 1820s, but does not continue as far west as the Roughton Gill 30-fathom level, implying other trials must have been made at this time: ML11 is the most plausible candidate. However, a short length of track (T15, section 6.4.2 below) which heads away west from the mine seems to link it to the Roughton Gill 60-fathom level, suggesting the mine remained in use in phase 5. Leat L27 seems to cross the apron, but is probably later (section 6.7.3 below).

Mine level 12 (ML12)

A possible small trial working on the outcrop of the Roughton Gill North vein is visible at NY 30473 34220 at an altitude of *c* 501m AOD. In its present earthwork form (Fig 17), it appears to be no more than modern illicit digging by mineral collectors on the line of the vein where exposed in the west side of a mountain torrent: the rockface surrounding the vein has been hacked into for several metres, with the debris thrown out in a small fan onto the hillside below. John Hodgkins of MoLES (pers comm) remembers seeing a short adit at this location about thirty years ago, whose entrance must now lie obscured beneath the more recent debris; a level is also indicated at this location on a sketch map published by Adams (1988, 70). However, the mine is completely without any visible archaeological trace. As it lies on the Roughton Gill vein at about the same altitude as the 30-fathom level, it is here assigned to the same phase; it may well be later.

Figure 17. Illicit mineral collecting at mine level ML12, viewed from the north-east (NMR/AA021962)

6.4.2 Mine access and ore transport

Tracks 10-14 (T10-T14)

T10 seems to have been built to connect the 30-fathom level (ML9, section 6.4.1 above) with the outside world. However, unlike the modern road to the site which approaches Roughton Gill from the north along the Dale Beck valley, T10 takes a more direct route across the fell tops from the north-east. What must be the same track was mapped by the OS in 1863 (Ordnance Survey 1867), only it then ended up at the 60-fathom level in Roughton Gill (ML13, section 6.5.1 below), the 30-fathom having been abandoned by this time. This late, re-routed, part of T10 is described as T10a in section 6.5.2 below. In 1863, T10 is shown climbing the northern edge of the fells outside Nether Row (Fig 1) by way of Potts Gill, crossing both Short Grain and Long Grain in their upper reaches, and then descending slightly to run around the face of the glacial corrie at the head of the Dale Beck valley. Having crossed Clints Gill, it entered the eastern edge of the current survey area at NY 30628 34292 where it can be traced on the ground as a narrow (*c* 1m-wide) terrace in the steep hillside. It would originally have forded the beck in Blea Gill; its course within the gill has now eroded away, but can be picked up again on the far side following approximately the 485m contour. It subsequently rises slightly as it crosses the hillside beneath Iron Crag and approaches the steep and rocky upper reaches of Roughton Gill where it changes from a terraced earthwork into a rock-cut ledge. On the ground it now fades out at NY 30219 34141 at a rock shelf above the beck in Roughton Gill (Fig 18), but presumably formerly continued as far as the 30-fathom mine entrance 16m further south by way of some form of wooden walkway elevated above the floor of the gill. (See also tramway TR1, this section below).

T11 is a short length of track paralleling the latter course of T10, but some 10m or so lower down the hillside (Fig 18). It, too, was presumably once connected to the 30-fathom level by some form of elevated walkway above the beck, but now only commences on the ground at NY 30213 34146 some 20m downstream of the mine

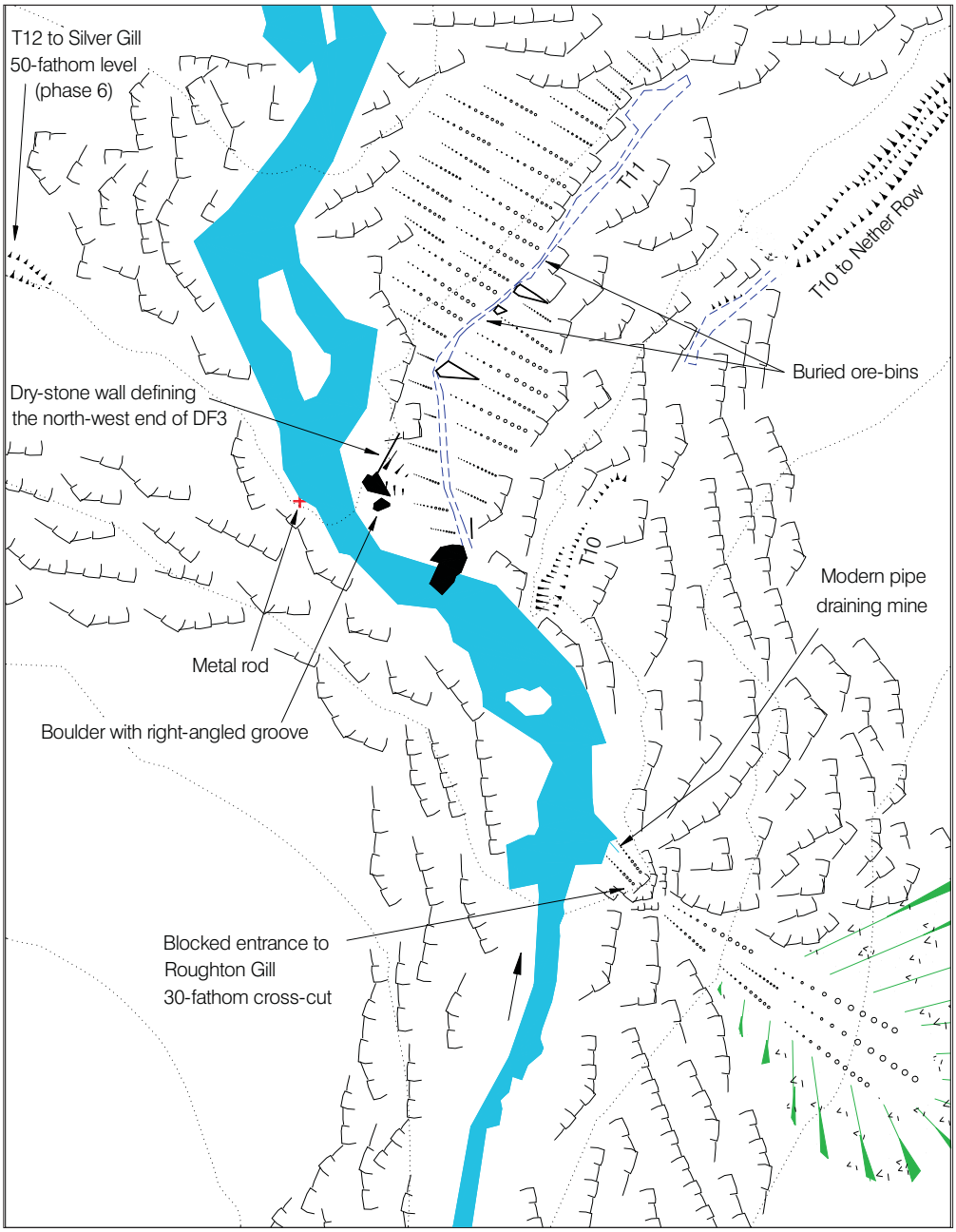

Figure 18. Annotated extract from survey reproduced at 1:500 scale, showing features associated with the Roughton Gill 30-fathom cross-cut (ML9) and hand-dressing floor DF3. (See key to Figure 53 for explanation of conventions)

entrance, where there is evidence of a small ore-processing area (DF3, section 6.4.3 below). The track heads away north and east as a rock-cut ledge half-buried in scree, and leads past a series of buried ore bins, shortly after which it dies out. A narrow earthwork terrace survives on the ground 60m further along the hillside, centred at NY 3030 3422, at about the same altitude, and is probably part of this track. But this terrace ends after 40m on the edge of the mountain torrent descending the west side of

Iron Crag, and does not re-emerge beyond it. It is unclear where T11 was heading, but it may have joined T10. (See also tramway TR1, this section below).

T12 lies on the opposite side of Roughton Gill to T10 and T11, and served to link the 30-fathom level – or more correctly DF3 – with the Silver Gill 50-fathom level (ML10) which was also being worked at this time (section 6.4.1 above), and thereafter with the floor of the Dale Beck valley via the pre-existing tracks T1 and T3 on Balliway Rigg. The first 25m of its course west of DF3 has been eroded away (Fig 18), but again probably consisted of a wooden walkway or deck arrangement where it crossed the beck; a short length of metal rod which survives at NY 30203 34151 set vertically in the west bank of the beck may be connected with this.

T13 branches off T12 just before the latter's junction with T1 and T3, and led back uphill to connect with the phase-2 T4. It, therefore, provided ready access between the two principal active mines (the Roughton Gill 30-fathom level, ML9, and the Silver Gill 50-fathom level, ML10) and a building on the spine of Balliway Rigg (AS2, section 6.4.4 below), functioning in this period as either a smithy or magazine.

The 50-fathom-level in Silver Gill was accessed from the floor of the Dale Beck valley via the lower section of the already existing track T1, and a short length of new track (T14) branching off it. This route certainly existed in 1863 when mapped by the OS (Fig 5), but was undoubtedly in use in phase 4 also. It has now totally eroded away, although its projected course is shown on Fig 16.

Tramway 1 (TR1)

It has been stated above (section 6.4.1) that a photograph of the Roughton Gill 30-fathom level, taken in 1987, shows a wooden tramway sleeper *in situ* in the mine entrance. The entrance is now blocked, but was open in 1991 when the mine was entered and the remains of a wooden tramway of 19.5" gauge seen inside (Austin 1991, 9-10, where the gauge is incorrectly stated as 24"). Although only conjecture, it is possible that this tramway formerly continued along tracks T10 and T11 as far as the ore bins and dressing floor DF3 (section 6.4.3 below) lower down the gill.

6.4.3 Processing the ore

Hand-dressing floor 3 (DF3)

DF3 is centred at approximately NY 3021 3415 just above the east bank of the beck in Roughton Gill (Fig 18). However, the floor is heavily eroded, and little now survives except for a stretch of dry-stone walling, up to 1.8m high, constructed of large dressed boulders. This walling probably marks the built-up, north-west, end of a platform, which in the east originally ran back as far as track T11. A medium-sized boulder which now lies at the eroded western foot of the platform at NY 30207 34149 has a right-angled groove of 0.02m cross-section extending for 0.4m along one edge; it is unclear if, or how, this stone relates to activities on the floor. The remains of up to six ore bins survive a little further to the north along T11 just beyond the platform. These were first discovered by MoLES, and their location indicated to EH by Warren Allison. They are now almost completely obscured by scree, but the tops of three stone walls, together with suggestions of vertical rock edges parallel or perpendicular to them which just protrude through the scree, indicate that there are five or six bins here, between 1m and 2m wide, with the farthest two possibly rock-cut.

Mill complex 3 (MC3) and smelter 2 (S2)

The 1825 map (Fig 4) includes the words 'site for the Smelt mill', suggesting that there was the intention at this time to build a smelter (S2) near the confluence of Todd and Roughton Gills in the vicinity of NY 3025 3455, but that nothing had yet been done. It is unclear if it was ever built, although the planned site is indicated on Fig 46. John Hodgkins of MoLES has, in the past, found small pieces of slag in this general area (pers comm), but it is possible that they could be slags brought back onto site at a later period from, say, the Hay Gill smelter for re-processing, and do not prove conclusively that S2 was built. The intention to erect a smelter does suggest very strongly, however, that ore was being fully processed somewhere on site in this phase. Initial sorting and dressing would have been done close to each mine entrance (*eg* DF3 above), but final crushing and buddling were presumably carried out at some location yet to be discovered. Although unlocated – and therefore not shown on Fig 46 - for purposes of later discussion in section 7 this putative phase-4 processing plant is here termed mill complex MC3.

6.4.4 Ancillary structures

Smithy and/or magazine (Ancillary structure AS2)

The ruins of a stone building are visible at NY 30080 34160 set into the western end of the platform of the phase-2 miners' lodge (AS1, section 6.2.6 above) on the spine of Balliway Rigg. The building is small, with internal dimensions of only *c* 4m north-south by 2m east-west. The dry-stone walls survive up to 0.8m high externally, but 1m internally since the building is slightly sunken-floored. The door was most probably in the south wall, which is the most poorly preserved, and there are no indications of window openings in any of the walls. The 1825 map (Fig 4) shows a 'smithy' at this location, but it is unclear whether this building is it: the small size of the structure, its sunken nature and lack of obvious windows, together with its relative isolation, would support an alternative interpretation as a mine magazine.

6.5 Phase 5. The mining landscape *c* 1832-1845: the Roughton Gill 60-fathom level (Fig 47)

6.5.1 Extraction of ore and mine drainage

The principal mine of phase 5 is known to have been the Roughton Gill 60-fathom cross-cut (ML13), although no doubt other mines were tried or extended at this time as well. It has already been suggested above (section 6.4.1) that ML11 which lies 175m east of, but at about the same altitude as, the 60-fathom level, may well have continued to be worked in this phase. Other possible candidates are the 8-, 20-, and 50-fathom levels in Silver Gill, which were definitely operating in phase 6. However, as no documentary evidence has been found to support this conjecture, the latter three mines are not shown as in use in this phase on Fig 47.

Roughton Gill 60-fathom cross-cut (Mine level ML13)

The Roughton Gill 60-fathom cross-cut is documented as begun in 1832 to exploit the Roughton Gill lode at depths greater than could be reached from the 30-fathom level (ML9, section 6.4.1 above). It seems to have remained in operation right through the period until the expiry of the lease in 1845 (section 5 above), and was apparently

brought back into use after 1849 too (section 6.6.1 below). As well as being at a height of 60 fathoms, the mine had to be cut through at least 60 fathoms of dead rock before it reached the vein, which it then followed, principally towards the west (1852 company prospectus in CRO Carlisle, seen as unreferenced facsimile only).

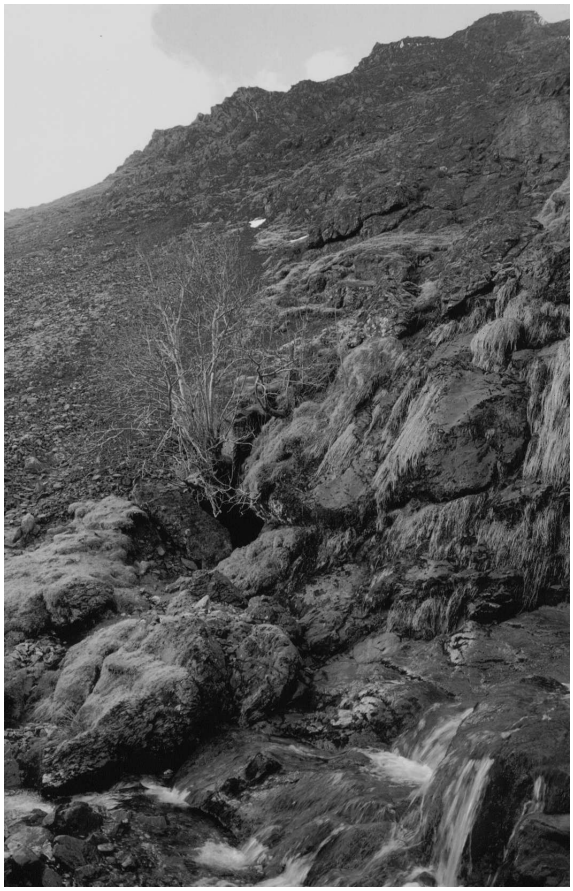

Figure 19. Entrance to the Roughton Gill 60-fathom cross-cut (NMR/AA021991)

The mine entrance lies at NY 30204 34219 in the east side of Roughton Gill at *c* 450m AOD. The mine is cut into the base of a vertical wall of rock which runs east-west across the floor of the gill and over which the beck cascades as a 6m-high waterfall. Although still visible, the entrance is now effectively blocked by a fallen rock slab (Fig 19); a small trickle of water drains out beneath the slab. There is no sign of tipping around the entrance, but tracks T10a and T16 (section 6.5.2 below) linked the mine with a processing area (mill complex MC4, section 6.5.4 below) situated a little further down the gill (Fig 23), and it is possible that much of the loose 'scree' on the hillside beneath these tracks originated as mine waste. Further tracks connected the mine to other parts of the site, but probably belong to later periods (section 6.6.2 below).

6.5.2 Mine access and ore transport

Tracks 10a, 15 and 16 (T10a, T15 and T16)

Following the abandonment of the Roughton Gill 30-fathom level (ML9) in favour of the 60-fathom level (ML13) in 1832, T10 which formerly ran between the 30-fathom level and Nether Row at the foot of the Caldbeck Fells (section 6.4.2 above) was re-routed to connect with the new mine. This diversion is here called T10a. However, the diversion is known only from OS map evidence of later periods; little now survives on the ground, and even where it does, the field evidence suggests that for the most part the track was never constructed to the same standard as the earlier route. The map shows that T10a diverged from the original course of T10 at *c* NY 3042 3426 (Fig 5), but on the ground the only trace of T10a is a narrow trodden path resembling a sheep track, which descends the contours and heads in the general direction of the 60-fathom level; it fades out completely after 50m. According to the map, in 1863 the track ended at a set of ore bins further west, part of mill complex MC4 (section 6.5 4 below), but since the 60-fathom level was already disused by the time the map was drawn, it seems reasonable to assume that the track would originally have continued on for another 50m as far as the mine entrance. On the ground this postulated section is represented by an irregular shelf following the

contour across a scree slope (Fig 23). In phase 6 this section is shown in use as a leat, which it is argued below must have already existed in phase 5 (L6, section 6.5.3 below). The leat would therefore have had to run alongside T10a in a launder.

T15 is a short length of path terraced into the hill immediately west of mine level ML11. It only survives for 30m, centred at NY 30335 34311, before disappearing on the lip of the valley produced by the mountain torrent flowing down the west side of Iron Crag. It is unclear where it led. It has been argued that ML11 is contemporary with the Roughton Gill 30-fathom level (ML9, section 6.4.1 above), but the difference in altitude between the two mines would entail the track having to climb steeply. Instead, T15 seems to be heading for the Roughton Gill 60-fathom level, suggesting that although ML11 originated in phase 4, it continued in operation into phase 5, and that T15 belongs to this later phase.

T16 differs from most of the other tracks on site in being far wider, more heavily-engineered, and in all probability surfaced. It is thus more properly a road. It originated at the base of the ore bins at the southern end of mill complex MC4, and ran north-east through the mill area and thence to the floor of the Dale Beck valley. Below the processing area, it turned sharply west and bridged Roughton Gill: rock-cut abutments survive on both sides of the ravine, but there is no sign of stonework, suggesting that the bridge was of timber. It continued down to the floor of the Dale Beck valley via a massive terrace in the eastern flank of Balliway Rigg. This section of the route is still an impressive feature today (Fig 20). Immediately after the bridge the road had to be terraced through a rock outcrop, indicating that it was originally some 3m-4m wide (Fig 23), but lower down erosion of the outer edge of the terrace and slumping of the cut scarp has reduced its present width in places to little more than 1m. Earthwork evidence indicates that the road initially ran in a

Figure 20. Tracks T5, T17 and T16 on Balliway Rigg viewed from beneath Iron Crag (NMR/AA021963)

near-straight line right down to the bottom of Balliway Rigg, where it crossed the beck in Silver Gill by means of a ford, and continued north down the Dale Beck valley along the top of the river terrace at the base of Yard Steel. The field evidence also shows that the section immediately before the ford was at some point superseded by a new route which cut through the watershed of the hill, bridged the beck in Silver Gill, and ran down the west side of the lower reaches of the gill (Fig 27), but this diversion probably dates to phase 6 (T16a, section 6.6.2 below). In phase 7 the road was also

extended east to Lainton's Shaft (T16b, section 6.7.2 below). There are occasional indications on the ground, especially where the road runs through MC4, and again in the superseded section, that the surface was cobbled or paved.

6.5.3 Water management

Water supply to mill complex MC4: reservoir 2 (R2) and leat 6 (L6)

R2 is centred at NY 3030 3431, on the east side of Roughton Gill at an altitude of *c* 446m AOD. OS map evidence shows it existed in phase 6 (Fig 5), when it seems to be part of a wider water management system designed to collect water from all over the

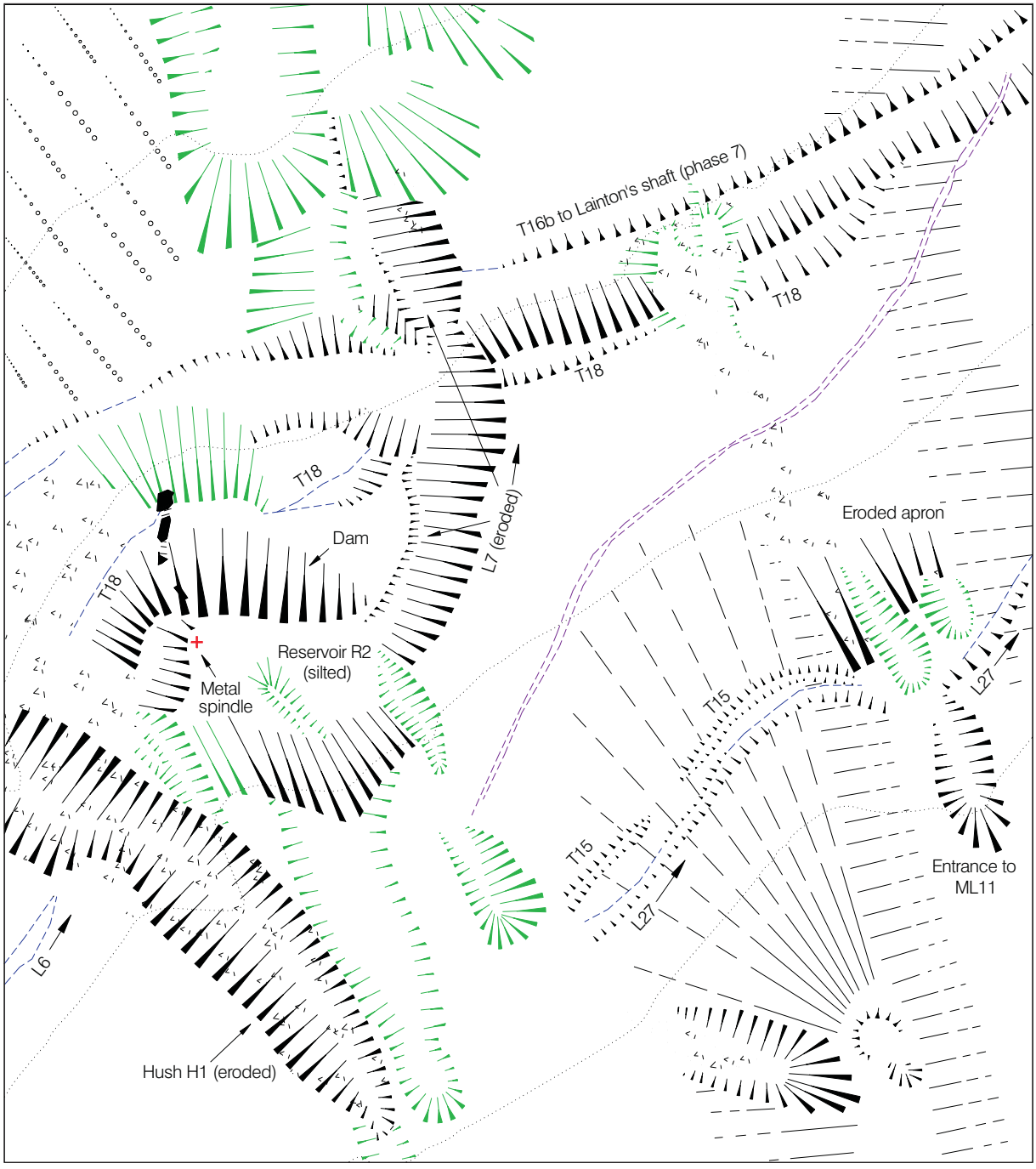

Fig 21. Annotated extract from survey reproduced at 1:500 scale, showing features around reservoir R2 and mine level ML11. (See key to Figure 53 for explanation of conventions)

hillsides, and channel it down to two much larger reservoirs in the floor of the Dale Beck valley (section 6.6.3 below). But since it lies adjacent to the ore-crushing and washing plant below the Roughton Gill 60-fathom level (mill complex MC4, section 6.5.4 below), it must have been originally constructed in phase 5, and initially functioned as both the mill pond and storage reservoir for that plant. It was formed by damming the shallow valley of a mountain torrent running down the west side of Iron Crag (Fig 21). It could thus have been partly fed by water flowing down the torrent valley, but the primary supply was undoubtedly water brought in from the beck in Roughton Gill via leat L6 (below). Only the dam now survives, up to 3.25m high. The reservoir has been completely infilled with alluvium brought down by the torrent; the map evidence shows that it was vaguely pentagonal in plan, but never very big measuring a maximum of *c* 12m east-west by 6m north-south. Traces of a second leat are visible flowing out of the north-east corner, but this is probably connected with the phase-6 re-use (L7, section 6.6.3 below). The position of the phase-5 outfall(s) which would have been needed to take water off to power machinery and to wash ore in MC4 is unclear, although the base of a metal spindle is visible near the top of the dam at NY 30297 34321, and may be part of a stopcock or sluice arrangement (Fig 22).

Figure 22. Spindle near top of dam to reservoir R2 (NMR/AA021994)

L6 lies on the east side of Roughton Gill just below the 60-fathom level (ML13), and was built to carry water some 130m from the beck in the gill to R2 (Figs 21 and 23). The leat existed in 1863 when it was mapped by the OS (Fig 5). However, since it has been suggested above (this section) that R2 dates from phase 5, L6 must have originated at the same time. On the ground the feature's connection with the beck no longer survives, although an irregular but broad terrace in the scree slope east of the mine entrance corresponds to the onward course of the leat shown on the map. It has been argued above (section 6.5.2) that this terrace was part of track T10a; if so, L6 was no doubt contained within a wooden launder along one edge of it. Map evidence shows that east of the ore bins, L6 and T10a diverged. This is supported by the field evidence, for the depicted course of L6 corresponds on the ground to a much narrower terrace leading straight towards R2. There is no sign of a built channel on the terrace, which corroborates the idea that the water was carried in a launder. However, the terrace is well engineered: it falls at a slight but near constant gradient of *c* 1:30 or 3%, and stretches of dry-stone walling are preserved in its rear face.

6.5.4 Processing the ore

Mill complex 4 (MC4) and waterwheel 3 (WW3)

It is likely that in phase 5, ore was being processed close to the entrance to the principal productive mine, namely the 60-fathom cross-cut in Roughton Gill (ML13). This is suggested both from hints of structures on the hillside just below the mine

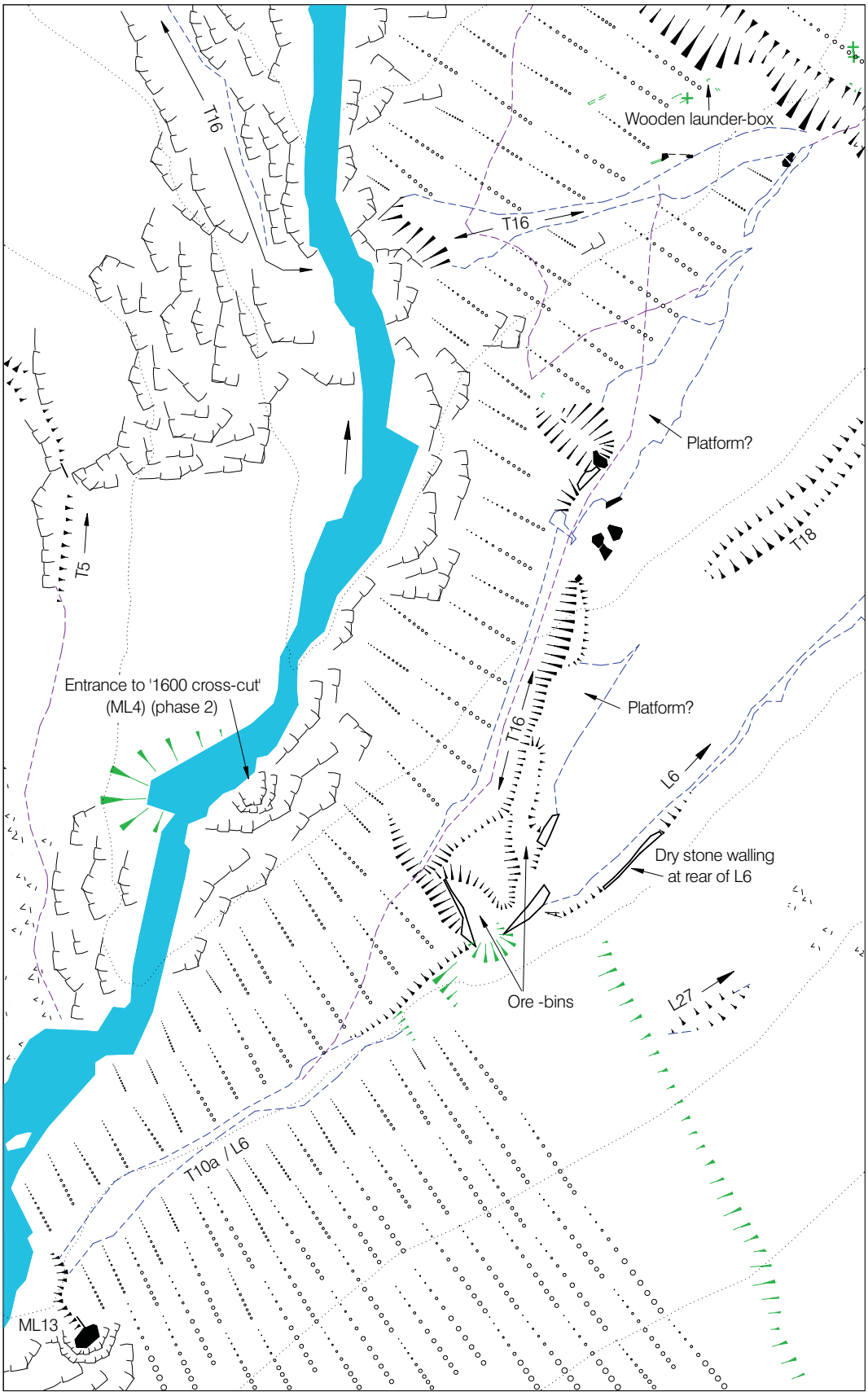

Figure 23. Annotated extract from survey reproduced at 1:500 scale showing the Roughton Gill 60-fathom cross-cut (ML13) and mill complex MC4.
(See key to Figure 53 for explanation of conventions)

entrance (Fig 23), and from documentary evidence (section 5 above) which relates that in phase 6 new plant had to be erected in a location more convenient to the then newly-driven 90-fathom level (ML14, section 6.6.1). This phase-5 mill complex (MC4) is perched precariously on a very steep slope, and is mostly now buried in scree eroding from above, with the result that little can usefully be said about the detailed layout and organisation of the complex.

Ore would have been brought out of the mine along track T10a as far as a set of three ore bins at NY 30239 34255, which were depicted but not named by the OS in 1863 (Fig 5). These bins are heavily eroded; although traces of stonework are still visible, much has collapsed. Track T16 leads away downhill from the bins, past at least two probable platforms at NY 30244 34270 and NY 30250 34295, although no structures can be made out on either. Suggestions of *in situ* walls and timber beams are visible through the scree below the second platform, but it is not clear to what these relate.

Figure 24. Detail of wooden launder-box buried in scree at mill complex MC4 (NMR/AA021966)

Further timber structures are also visible below T16 where it doubles back to the west across Roughton Gill. These are mostly only the tops of posts and edges of planks, sometimes seemingly *in situ*, often eroded out and lying loose on the surface; but occasionally more striking remains can be discerned such as at NY 30255 34321 where the end of an *in situ* launder box of 0.13m internal cross-section is currently exposed (Fig 24). MC4 would have received its water from reservoir R2 (section 6.5.3 above) just upslope and east of this spot. It is even likely that there would have been a waterwheel (WW3) somewhere within the complex to power stamps and crushers, but there is now no evidence to suggest where this might have been, and accordingly WW3 is not depicted on Fig 47.

6.6 Phase 6. The mining landscape *c* 1849-1865: the Roughton Gill 90-fathom level (Fig 48)

6.6.1 Extraction of ore and mine drainage

The principal mine in phase 6 was the 90-fathom level in Roughton Gill (ML14), begun in 1849. However, there were still workable ore deposits accessible in the 60-fathom level (ML13), and it is recorded that the old 8-, 20- and 50-fathom levels in Silver Gill (ML1, ML2, and ML10) were all cleared out and re-opened at the start of this phase, although it is unclear for how long they were worked (section 5 above). A 90-fathom level was also driven in Silver Gill in this period, and the OS record an adit in the floor of the Dale Beck valley at the foot of Peteraw, but not much is known about either (ML15 and ML19 below). Other levels or trials were made by the side of Blea Gill (ML16-ML18 below), whilst levels and shafts were also sunk at either end of the Roughton Gill vein(s). In the west these workings connected into the underground drives and passages of the Roughton Gill 90-fathom level, but their surface manifestations lie beyond the limits of the present survey in the upper reaches of Roughton Gill and Thief Gills, and are not described below. To the east of Blea Gill, the three eastern levels and one shaft which make up the Mexico Mine complex

were never connected into the Roughton Gill Mine levels (Adams 1988, 70-2); they also lie outside the area of the present survey, and likewise are not described below.

Roughton Gill 90-fathom cross-cut (Mine level ML14)

The 90-fathom cross-cut in Roughton Gill was begun in 1849 in order to access the lower levels of the Roughton Gill vein(s), and remained in use throughout phases 6 and 7 until the final closure of the Mine in 1876. The lode was eventually worked for about 370 fathoms to the west and 230 fathoms to the east, although worthwhile ore in quantity was only found between about 120 and 250 fathoms heading west. The 90-fathom level also intersected the Silver Gill vein: a drive was made for 100 fathoms to the west along the vein but did not encounter much worthwhile ore (Adams 1988, 70-2).

The mine entrance lies at NY 30247 34392 on the east side, and at the mouth, of Roughton Gill, just above the floor of the Dale Beck valley at an altitude of *c* 397m AOD. It is now blocked by a stone wall (Fig 25), built when the mine was purchased

Figure 25. The blocked entrance to the Roughton Gill 90-fathom cross-cut (NMR/AA021967)

in 1913 and the water piped into the public drinking supply. However, OS map evidence shows that in 1863 (Fig 5) the water draining from the mine entrance was channelled via leat L12 north and east into storage reservoir R4 (section 6.6.3 below). Mined waste was tipped outside the entrance, and together with tailings from the refining process now covers virtually the whole head of the Dale Beck valley within the angle of the becks coming down Roughton and Todd Gills - at least 4800 square metres. The area must once have been even larger for 'half' of the dump is reported to have been washed away in the flood of 1895 (Cooper and Stanley 1990, 63). The map also shows what is probably a tramway in operation across the dump surface (TR2, section 6.6.2 below).

At least two grades of waste can be distinguished on the dump: large fragments of rock predominate in the higher, southern and eastern parts, and visibly overlie finer, crushed, material which prevails in the lower, northern and western, parts (Fig 26). The latter area is where the main phase-6 processing plant (mill complex MC5,

section 6.6.4 below) is situated. This differentiation in make-up reflects both a chronological and functional divide across the tip. The primary dressing of ore took place towards the back of the dump where a series of ore bins survive. Gangue, together with any deads brought out of the mine, were then tipped in the area immediately surrounding the bins, and also progressively further east towards the beck in Todd Gill. Meanwhile, dressed ore moved down through MC5 towards the north-west and was progressively refined, and the tailings deposited over the northern and western parts of the dump. However, as well as being surrounded by tailings, the mill buildings also seem to sit on top of a considerable depth of mine waste, suggesting the area is the site of processing in earlier periods also. The implications of this are discussed further in section 7 below.

The flattened remains of three or four finger tips are still just about discernible on the top of the rocky dump above the beck in Todd Gill; these extant finger tips obviously date from the final days of mining in phase 7, but are indicative of how the dump would have grown in phase 6 also. Below the finger tips, the weathered tops of four wooden posts protrude through the upper levels of the eroding dump, and indicate that it was revetted to provide a stable edge over which tipping could take place. Another concentration of wooden posts immediately west of the finger tips is of unknown function. The course of the beck is now some 10m north of where it was recorded by the OS in 1863 (Fig 5), showing that continued dumping in phase 7 progressively pushed the beck across the floor of the gill. A small stream, which emerges from beneath the northern tip of the main dump at NY 30239 34562 and curves north into the modern beck, seems to mirror the stream course shown in 1863. A much better-preserved finger tip survives running north from the mine entrance, although now cut through by the phase-9 track T23b leading to the water pumping station (section 6.9.2 below). This finger tip separates the mine from the beck, and presumably had a secondary function as a form of flood defence. South of T23b it has a thin covering of grass, and its make-up, therefore, cannot be readily determined.

Silver Gill '90-fathom' cross-cut (Mine level ML15)

Shaw notes the existence of a 90-fathom level in Silver Gill (section 5 above). No other references to this level have been found, but it can be equated on the ground with the entrance passage to a mine cut into the foot of Yard Steel at the mouth of Silver Gill (Fig 27). The passage is about 20m long and up to 1.5m wide, and is orientated towards the south-south-west parallel with the beck in Silver Gill. For a large part of its length, the passage is rock-cut. It now ends against a vertical, unbroken, wall of rock at NY 30108 34462, in which there is no obvious indication of an actual entrance. However, a slight cutting-back of the rock at the base of the wall may be the top of an entrance arch, in which case the passage is heavily silted, perhaps by as much as 2m. This should not be surprising, for the passage is crossed by track T16a, and may well have had to be largely infilled in order for the track to assume the necessary gradient up the side of the gill. The floor of the passage currently stands at *c* 394m AOD; allowing for silting this would suggest the floor of the mine was originally closer to 392m. T16a now separates the entrance passage from a bank of mine waste which continues the line of the passage for 25m to the north-north-east. Such banks are common features amongst the later mine levels situated close to streams in both Roughton and Silver Gills (*eg* ML5, ML8, and ML14), and were presumably intended to act as flood defences when the becks were in spate. Part of a small platform is visible above the west side of the entrance passage at NY 30110 34477. It measures some 5m by 4m by 0.6m deep, but it is unclear if it is an earlier feature (building platform, perhaps) cut through by the passage, or is in

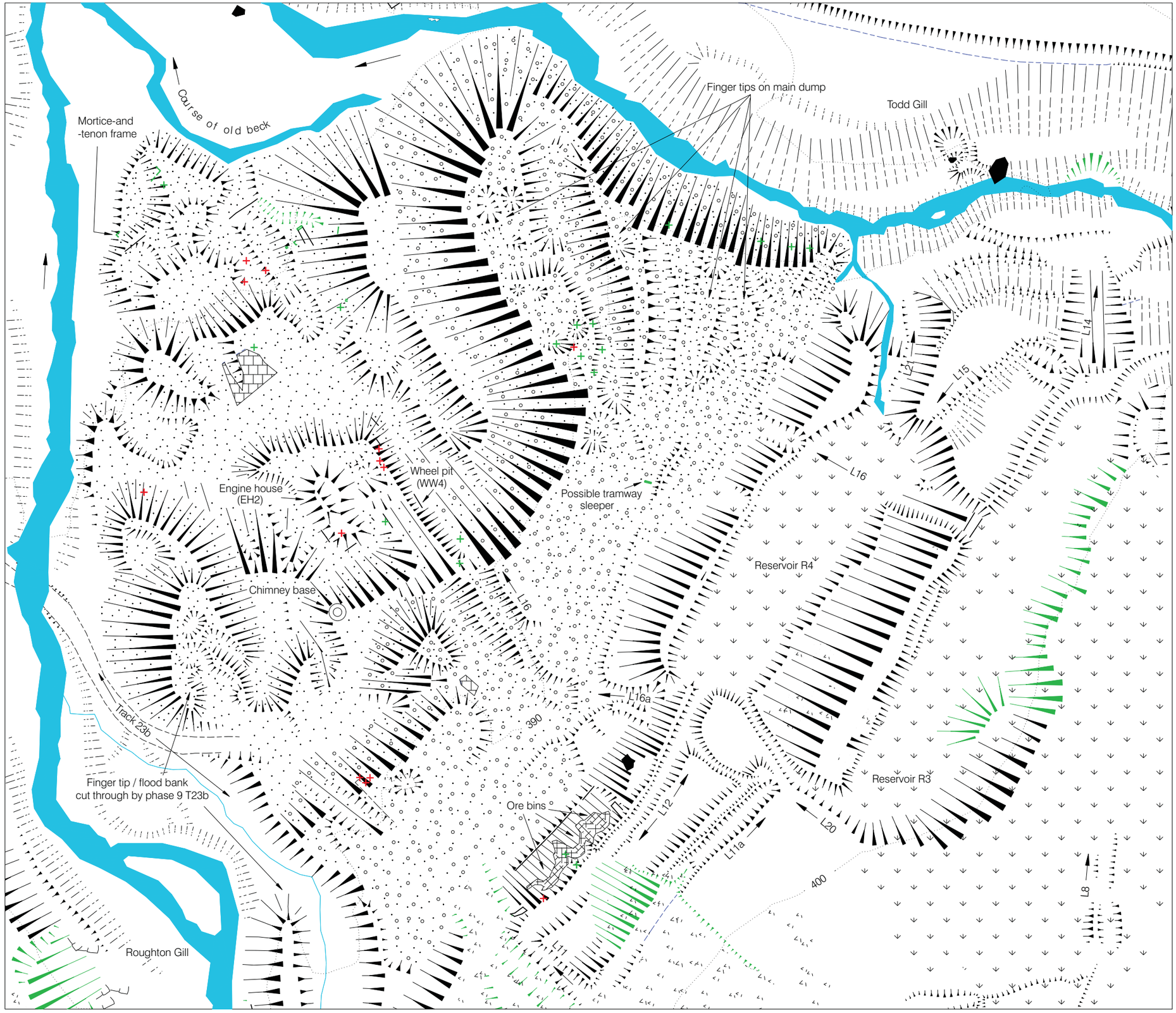

Figure 26.
Annotated extract from survey reproduced at 1:500 scale, showing the dump outside the Roughton Gill 90-fathom cross-cut, mill complex MC5, and reservoirs R3 and R4. (See key to Figure 53 for explanation of conventions).

some way connected with the operation of the mine. ML15 must have been approached from the north via a short length of track branching off T16 near the present smithy building. However, if so, it has been destroyed by, or lies buried beneath, T16a. It is likely that a buried drain was put in when T16a was constructed in order to allow water to continue to escape from the mine; the course of this drain possibly comes to the surface further north as leat L19 (section 6.6.3 below).

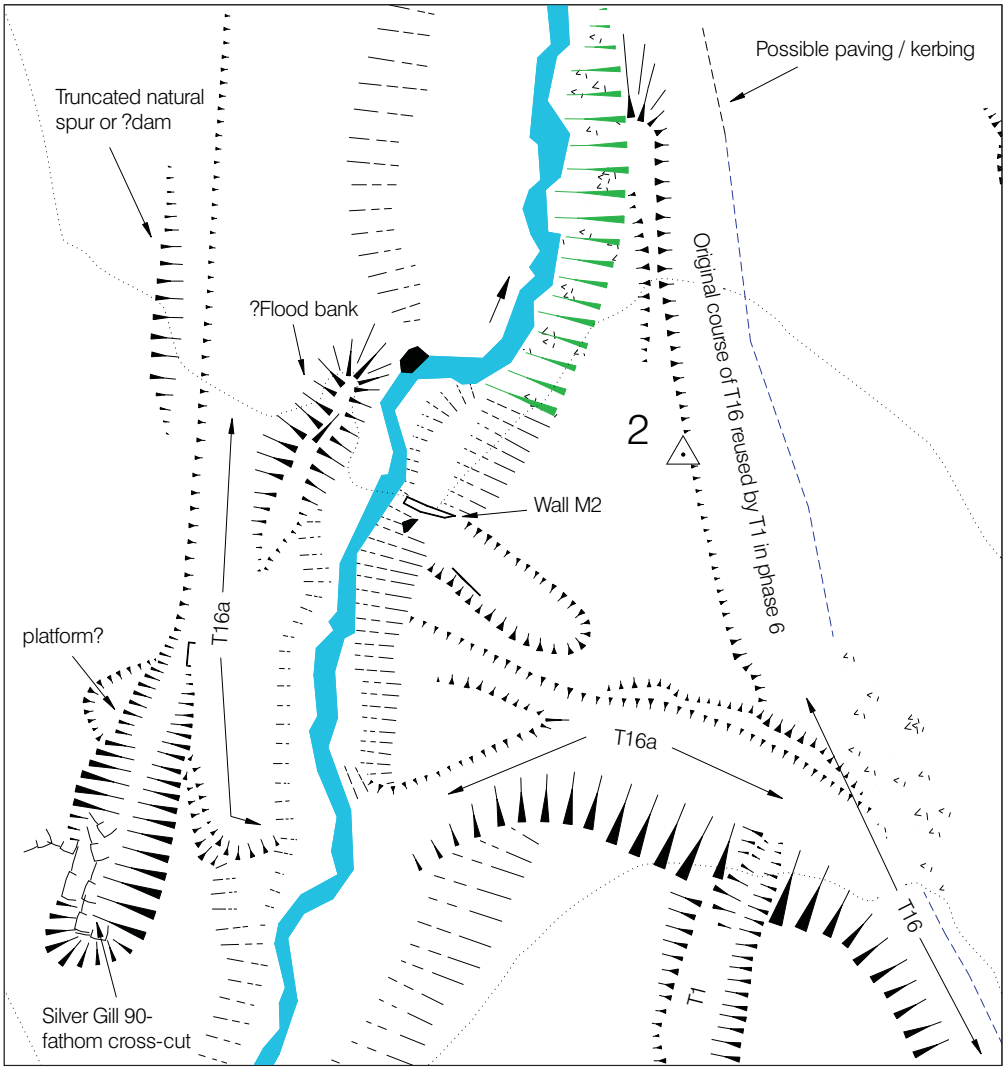

Figure 27. Annotated extract from survey reproduced at 1:500 scale, showing the Silver Gill 90-fathom cross-cut, the junction of tracks T1, T16 and T16a, and wall M2. (See key to Figure 53 for explanation of conventions)

Shaw states that the mine was given over by 1863. This is clearly true, for T16a which cuts it, is depicted on the OS 25" survey of that date (Fig 5). Its start date is unknown, but in all probability post-dates 1852 since the mine is not mentioned in the company share prospectus issued that year (section 5 above). The mine thus had a working life of 10 years or less. It must have been started as a cross-cut to intersect the west end of the Silver Gill vein at depth, but since this would have required a drive of *c* 270m (148 fathoms) through barren rock to get up to the vein, it seems unlikely the mine ever progressed very far.

Mine level 16 (ML16)

ML16 lies at an altitude of *c* 455m AOD immediately east of Blea Gill. No documentary references to it have been found, although it existed by 1863 when it was mapped by the OS (Fig 5). The entrance is now blocked, but lies somewhere in the vicinity of NY 30602 34381 as evidenced by the passage leading to it which is visible as a 20m-long, grassy, gash in the hillside (Fig 28). Since the orientation of this passage is almost due east, the mine was probably dug as a short cross-cut to the Roughton Gill North and South veins, which the British Geological Survey (1994) show passing from south-west to north-east just south of the mine; however, the BGS also show another possible lode running almost through the mine entrance, parallel to the Roughton Gill veins, and the mine may have tested or exploited this as well. Spoil from the mine was tipped immediately outside the entrance. This dump is now denuded of vegetation where it overlies the side of Blea Gill, and is being slowly eroded away, but the top of the dump is grass-covered and preserves the slight remains of at least three finger tips. A probable dressing floor (DF4) is visible at the dump's northern edge, while a small group of other features, including a building platform (AS7), lie just uphill (sections 6.6.4 and 6.6.5 below). ML16 was apparently linked to mill complex MC4 by track T18, while T19 connected it with developments at Mexico Mine further east (section 6.6.2 below). Only a faint trickle of water now emanates from ML16, but it seems likely that this and water from the mine's own leat system, was tapped in phase 7 and conveyed to the Lainton's Shaft area above the other side of the gill (L18 and L26, sections 6.6.3 and 6.7.3 below). This indicates that ML16 must have been disused by 1866-7.

Mine level 17 (ML17)

What is probably a small trial is evident in Blea Gill at NY 30536 34387. An apron of spoil surrounds a small rock-cut delve half-way up the west side of the downcut stream valley in the bottom of the gill, and should mark the entrance to a mine level (Fig 28). The hillside above the delve is eroding down onto it, and no actual entrance is now visible. However, the angle of the rock-cut, north-west, side of the delve shows that if it extends any further in to the hillside, the mine was oriented to the south-west, which would take it parallel to the prevailing strike of all known mineral veins. It was most probably dug, therefore, to investigate a possible lode seen outcropping in the gill side, but evidently proved fruitless: no vein is shown in this location by the British Geological Survey (1994). The mine is at an altitude of *c* 447m AOD. Although it cannot be directly dated, it is almost directly opposite ML16 which is known to have existed in 1863; on circumstantial evidence, therefore, ML17 has also been assigned to phase 6. It was approached from the west by track T20 branching off from T18 (section 6.6.2 below).

Mine level 18 (ML18)

A second probable trial in Blea Gill is evidenced by an apron of spoil on the hillside a little further up the valley on the opposite side of the gill to ML17, at NY 30578 34330. Again the hillside here is eroding, and no actual mine entrance is visible (Fig 28). However, the British Geological Survey (1994) show that the mine lies almost directly on the outcrop of the Roughton Gill North vein, and a short drive into the hill at this location would have intersected the South vein as well. The mine lies at an altitude of *c* 460m AOD. Although not directly datable, circumstantially it, too, seems most likely to belong to phase 6.

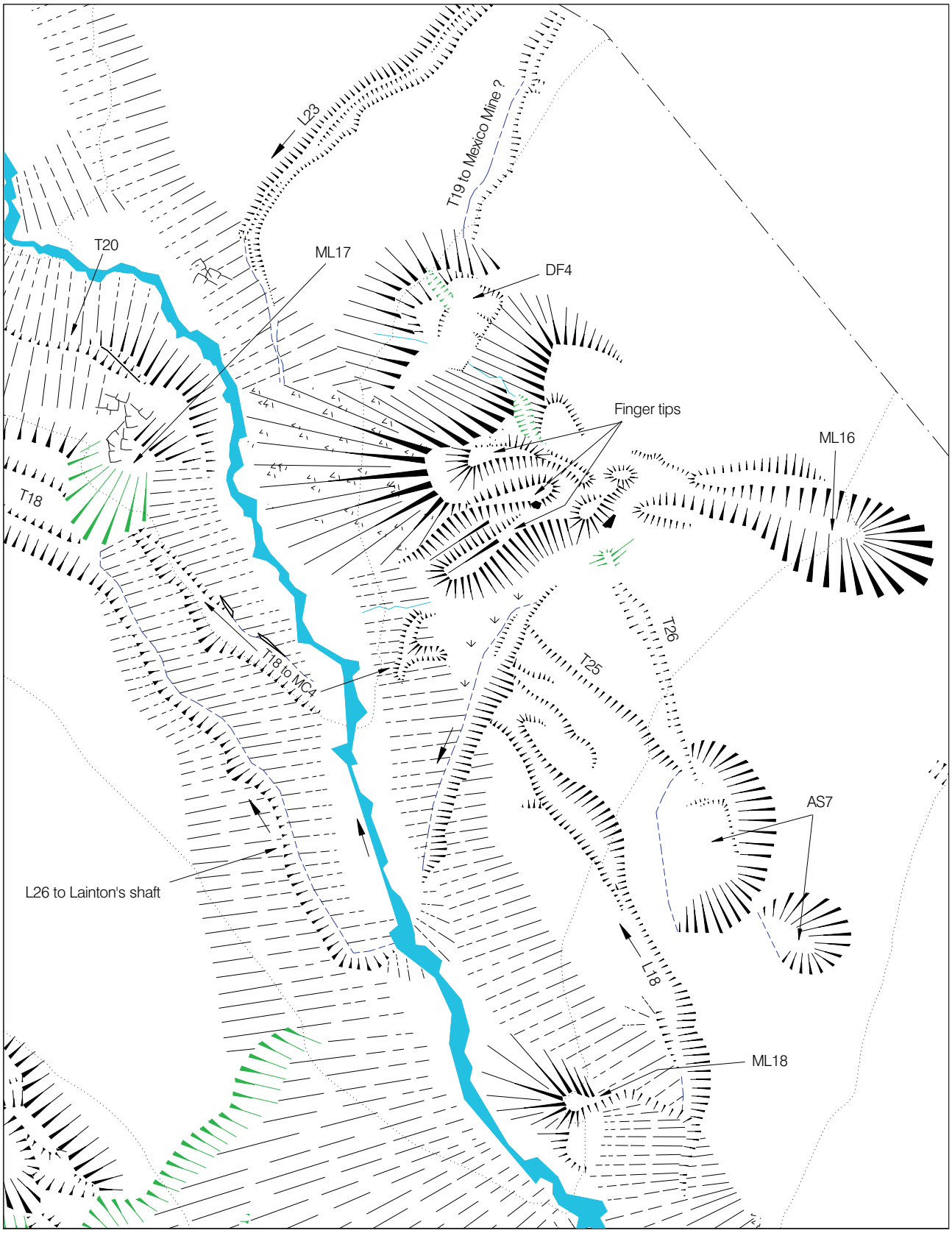

Figure 28. Annotated extract from survey reproduced at 1:500 scale, showing mine levels ML16, ML17 and ML18 plus associated features in Blea Gill. (See key to Figure 53 for explanation of conventions)

Mine level 19 (ML19)

A level is recorded by the OS in 1863 beneath the south-western foot of Peteraw (Fig 5); no actual mine entrance is shown, but the term 'level' appears on the map at *c* NY 3021 3460. However, no trace of a mine level is visible in the field. The archaeology of this area is difficult to interpret, but what survives on the ground are probably 'slimes' originating from mill complex MC5 and/or the later phase-8 umber mill (MC6, section 6.8.3 below), re-worked by flooding (Fig 36). The entrance to a mine could, therefore, easily lie obscured in this area. The published term seems too far south to apply to either of the mines, ML7 or ML8, known from phase 3 (section 6.3.2 above).

6.6.2 Mine access and ore transport

Because many of the mine levels dating from earlier periods either continued in use, or were re-opened, in phase 6, several of the tracks leading to them must also have been brought back into service at this time. It is documented that the 8-, 20-, and 50-fathom levels in Silver Gill (ML1, ML2 and ML10) had been cleared out before 1852 and were being taken forward in search of fresh ore deposits (section 5 above). Therefore, tracks T1, T3 and T14 leading to them must all have been in active use once more; indeed, the lower part of T1 as far as, and including, T14 branching off it and leading to the 50-fathom level, were mapped as still in use by the OS in 1863 (Fig 5). T16 was partly re-routed to the west at some point between 1852 and 1863 (see T16a, below), but the superseded section down the spine of Balliway Rigg remained in use as an extension of T1 in order to provide a more direct route to the main ore-processing area (mill complex MC5, section 6.6.4 below) at the head of the Dale Beck valley. T4 which branches off T1 towards the top of Balliway Rigg, must also have come back into use in this phase as an above-ground link to the various mine levels and shafts sunk on the south-west end of the Roughton Gill vein(s) in the upper reaches of Roughton Gill and in Thief Gills, which all connected with the Roughton Gill 60- and 90-fathom levels underground (section 6.6.1 above). The phase-5 tracks T10 (in the guise of its later diversion, T10a) and T16, both connecting the Roughton Gill 60-fathom level and MC4 with the outside world, still remained in use in this phase, for they were mapped by the OS in 1863 (Fig 5); indeed it is recorded that during this phase, T16 in the floor of the Dale Beck valley was upgraded so as to improve the links between the mine and the new smelter at Hay Gill 2km to the north (section 5 above). Otherwise, ten new tracks can be assigned to this phase with varying degrees of confidence, linking the various foci of activity. In addition, there is evidence of a tramway (TR2) in operation connecting the Roughton Gill 90-fathom level with the ore bins and main dump above MC5.

Tracks 16a and 17-26 (T16a and T17-T26)

The field evidence shows that the phase-5 T16 running down the east flank of Balliway Rigg from mill complex MC4, and thence heading north along the floor of the Dale Beck valley, was at some time partly re-routed. This diverted section of track is here called T16a. It lies towards the base of Balliway Rigg, where T16 was altered to turn sharply west, cut through the watershed of the hill, and cross the beck in Silver Gill, before turning back sharply north to run down the west side of the gill, and finally rejoin T16 at NY 30127 34596. T16a thus cut through the line of T1 leading up to the Silver Gill 8-fathom level (ML1), but on the ground it can be seen that access along T1 was soon re-established for that track now overlies the uphill, cut, scarp of T16a (Fig 27). OS map evidence shows that both T16a, and the

re-establishment of access along T1, had already taken place by 1863 (Fig 5). The map also shows that T16a was carried across Silver Gill on a bridge, but no trace of this is now visible on the ground. Since T16a blocked the entrance passage to the Silver Gill 90-fathom level (ML15) at the base of Yard Steel, which is unlikely to pre-date 1852 (section 6.6.1 above), the diversion must have been put in after that date. The reason for doing so was presumably to make the gradient of T16 more constant, for the superseded section climbs the hill at almost 1:4 (25%) whereas the rest of the track up Balliway Rigg to where it spans Roughton Gill is a little less steep at just under 1:5 (20%).

T17 runs across Balliway Rigg upslope of T16a (Fig 20). In width and form, it is identical to the earlier tracks on the hill and does not replicate the scale and degree of engineering apparent in T16/T16a. Its eastern end now dies out at NY 30202 34278 some 60m north of the Roughton Gill 60-fathom level (ML13), but as it is both aligned on, and at virtually the same altitude as, the mine entrance, it must have originally led to it. The reason for the missing section is very obvious on the ground: it has been carried away by an active area of sheet erosion which is slowly but progressively expanding from the northern edge of hush H3b along the foot of the gill (Fig 8). T17 leads away north and west around the contour of Balliway Rigg, and connects with T1 and T3 on the west side of the hill just above the Silver Gill 50-fathom cross-cut (Fig 16). This course suggests it was constructed specifically to connect the Roughton Gill 60-fathom level with mines in Silver Gill, particularly the 50-fathom (ML10), rather than simply provide an alternative to T16 down to the floor of the Dale Beck valley. No documentary references have been found to suggest that the Silver Gill mines were being worked in phase 5 when the 60-fathom level was first operational, whereas there are references to these mines being cleared out and re-opened at the start of phase 6. T17 should, therefore, date to phase 6, not phase 5.

T18 lies on the opposite side of Roughton Gill to T17. It only survives as a number of discontinuous sections of narrow terracing in the hillside, but would originally have connected mill complex MC4 beneath the Roughton Gill 60-fathom level with mine level ML16 on the far side of Blea Gill. It now originates close to the base of the ore bins at the southern end of MC4, and heads east along approximately the 440m contour (Figs 23 and 21). It skirts the foot of the dam to reservoir R2, and would presumably have crossed over leat L7, although L7 now appears to cut it. It resumes on the far side and is traceable for a short distance immediately above the phase-7 T16b, but then disappears, cut away by it. Since it does not re-emerge on the other side, it is likely that its onward course was the same as that now followed by T16b as far as Lainton's Shaft (section 6.7.2 below). T18 re-appears from beneath the east side of the shaft complex as a well constructed, near-horizontal, earthwork terrace up to 2m wide following approximately the 450m contour, and drops down the slope only slightly as it crosses Blea Gill where there is good surviving evidence that its downhill side was stone-revetted (Fig 28).

T19 continues the line of T18 eastwards from ML16, although it does not appear to be quite so well constructed (Fig 28). Since only a very short length of it lies within the present survey area, it is unclear where it led, but it probably served to connect the mine with levels in the Mexico Mine complex further east. It should therefore belong to phase 6, but is unlikely to be exactly contemporary with T18.

T20 is a short length of track concentric with the latter course of T18 east of Lainton's Shaft, but some 7m downhill from it. Since there is no visible sign of it further west,

it presumably branched off from T18 somewhere beneath where the shaft complex now lies. It ends at mine level ML17 in the west side of Blea Gill (Fig 28).

T21 seems designed to connect mill complex MC4 with the lower levels of Mexico Mine in the east, but only discontinuous sections survive, and its course outside the survey area has not been checked. If it only goes as far as the Mexico Mine 90-fathom level, which seems not to have been underway much before phase 7, then it is possible that it did not originate before that phase. But since it is overlain by T27 (section 6.7.2 below), which heads uphill from mill complex MC5 in the floor of the Dale Beck valley towards the Lainton's Shaft area, it is here assigned to phase 6. In the west it presumably branched off T18 close to reservoir R2, but is not now visible before NY 30302 34394. It then proceeds for 50m in a north-easterly direction, before disappearing beneath an alluvial fan deposited by the active mountain torrent coming down the east side of Iron Crag. It re-emerges on the far side of the torrent valley, where it curves due east, crosses Blea Gill, and is joined by two other short lengths of track (T22) in a complex three-way junction as it climbs up out of the gill. T21 then exits the survey area.

T22 is a possible route running along the floor of Blea Gill. The best evidence for its existence is two short branches climbing the east side of the gill at the junction with T21, but otherwise there is very little sign of it in the floor of the gill: a faint earthwork on the north side of the beck immediately before the confluence with Todd Gill may be part, but it is equally possible that this is no more than an old stream course. However, the track could have functioned in phases 6 and/or 7 as a route between Mexico Mine in the east and mill complex MC5, and/or as access to leat L13 (section 6.6.3 below) for maintenance, etc.

T23 branches off T16 at NY 30155 34546, and heads for a very short distance south-east into mill complex MC5. In 1863, OS map evidence shows that it was bridged across the then course of the beck in Roughton Gill at *c* NY 3018 3453 (Fig 5), but no trace of the bridge structure now survives. A c 8m long length of dry-stone walling, 0.8m high, at the foot of the track scarp immediately north of the site of the bridge, probably originated as protection for the track against erosion by the beck, which at this time ran closer to the west side of the valley floor. The track would have remained in use in phase 7, but was subsequently re-directed and extended in phase 9 as access to the water pumping station (T23a and T23b, section 6.9.2 below).

T24 runs from the site of the phase-8 umber mill (MC6, section 6.8.3 below) east along the lip of Todd Gill. In the west it is a well engineered feature, measuring about 1m wide and terraced at a steady gradient of *c* 1:6.5 (15%) across the foot of Peteraw, but further east as it approaches the edge of the survey area it deteriorates into an irregular, slightly sunken, path. Because it continues beyond the limit of the present survey, and has not been followed, it is uncertain where it is leading, and to what phase it most probably belongs. Without field investigation of its whole length, a number of destinations are theoretically plausible: it could be access between the umber mill and the source of that umber at the China Clay mine, in which case it belongs to phase 8; at the other extreme, but perhaps less likely, it could even be 16th-century, and the original route linking Silver Gill Mine to Caldbeck before the present road down the Dale Beck valley was put in. However, on present evidence, the most likely explanation for it is that it is access between mill complex MC5 and a Mexico Mine level in the upper reaches of Todd Gill shown by the OS at *c* NY 3065 3455 (Fig 5); consequently, it is here dated to phase 6.

T25 and T26 are two short lengths of hollowed path (Fig 28) linking mine level ML16 in Blea Gill (section 6.6.1 above) with a building platform (AS7, section 6.6.5 below) further up the hillside. Either or both may have been hollowed out or deepened by subsequent water run-off down the hill.

Tramway 2 (TR2)

The 1863 OS map (Fig 5) shows what is probably a tramway emerging from the entrance to the Roughton Gill 90-fathom level, and branching in to two, with one branch running a short way north, presumably to the area then being used for tipping, while the other curves east and ends at a set of ore bins at the back edge of the main dump. Part of the second tramway bed may survive immediately west of the ore bins (see L12, section 6.6.3 below). However, the map only provides a snapshot in time, and without doubt the other branch of the tramway would have been re-routed or extended many times as dumping continued during both phases 6 and 7. A plank of wood embedded in the top of the dump at NY 30274 34513 (Fig 26) is in line with one of the phase-7 finger dumps above Todd Gill (section 6.6.1 above), and looks to have the correct proportions of a tramway sleeper, although there are no signs of holes in its surface to show where rails were attached.

6.6.3 Water management

In phase 6 major investment seems to have been put into collecting water from almost anywhere and everywhere around the mines, and channelling it towards mill complex MC5 at the head of the Dale Beck valley, where it was stored to provide power for the stamps and crushers, and afterwards re-used to wash the ore. Leat L6 and reservoir R2 at mill complex MC4 were retained from phase 5 (section 6.5.3 above), and linked into this water management network, which involved the construction of two, new, much larger, storage reservoirs, plus at least ten leats. Several leats are now only known from the evidence of the 1863 OS map (Fig 5), having been buried by alluvial/colluvial deposits, or taken over and scoured out by erosion gullies which run along their former courses. All feeder leats to the two new reservoirs shown on the map are described below whether they survive on the ground or not. However, the many small leats which the map depicts branching off the head race (L16) below the wheel pit (WW4), and taking the spent water off for other uses in MC5, are not listed or described here since none is now visible on the ground. Two other leats or drains have been identified on the ground which are not part of this system: L18 which is associated with mine level ML16 in Blea Gill; and L19 (which is probably more of a drain than a leat) carrying water away from a small building associated with the smithy (AS3, section 6.6.5 below) at the foot of Yard Steel and/or the buried Silver Gill 90-fathom level (ML15, section 6.6.1 above).

Water supply to mill complex MC5 (reservoirs R3-R4, and leats L7-L17)

Two massive ponds (reservoirs R3 and R4), partly excavated out of the hillside and partly retained by dams, lie parallel with each other immediately above mill complex MC5 at the head of the Dale Beck valley (Fig 26). R3 is the higher of the two, centred at NY 30318 34495, and is also the larger measuring some 65m long by 25m wide; R4 lies below it to the north-west, centred at NY 30292 34503, and measures some 40m by 15m. Both are now heavily silted with alluvial deposits brought down by the active mountain torrent east of Iron Crag, and their original depths are unknown; indeed, the uphill edge of R3 is being progressively buried beneath an advancing alluvial fan, and no longer survives in anything like its true form or position. OS map

evidence (Fig 5) shows that R3 was supplied by leats bringing water not just from the adjacent becks in Todd Gill/Blea Gill, but from as far away as Silver Gill and Roughton Gill (L6-L8 and L13 below), while R4 seems to have been fed by water draining from the Roughton Gill 90-fathom level (ML14) along leat L12. Since no leats are depicted connecting the two reservoirs, it suggests that each may have been built to fulfil a different initial purpose: R3 may have served primarily as a mill pond, for the map shows a single leat (L16) leaving its west side and running directly to a wheel pit (WW4); while R4 should, perhaps, be more properly be termed a storage reservoir - although no outfall leats are shown, it is likely to have fed water back into leat L12 if insufficient water was coming out of the mine, and thereby into L17 taking water to the ore bins for washing. However, since L17 subsequently flowed into L16, and water was taken off from L16 below the wheel pit for use elsewhere, such a simplistic division breaks down as the water moved through the mill complex and was re-cycled. The earthwork evidence shows very clearly that R4 was extended some time after 1863, but since the documentary record indicates that this alteration dates from 1871, it is described in section 6.7.3 below.

L7 ran steeply downhill from the east side of R2 (section 6.5.3 above), and connected into the north-east corner of R3 via L8. Its course was recorded by the OS in 1863 (Fig 5), but on the ground it is now hard to follow for much of the first 80m because subsequent erosion has scoured out or infilled its steep upper course which falls at a gradient of *c* 1:2.5 or 40% (Fig 21). L7 only truly survives in anything approaching its original form once it turns to the north-east at NY 30302 34394 to run more across the slope, although even here it is being gradually infilled by alluvial/colluvial deposits.

L8 brought water to R3 from the beck in Silver Gill. Unlike L7, it largely followed the contours, and is consequently far better preserved. Water was presumably diverted into it via a weir in the beck somewhere below the waste dump associated with mine level ML10, but this need not have been a major construction: in any case it no longer survives. L8 now starts as an earthwork at NY 30085 34376, and can be followed across Balliway Rigg as an embanked earthen channel up to 0.4m wide and 0.1m deep falling at a very slight but steady gradient of *c* 1:60 or 1.67% (Fig 29) as far as track T16 to the east. It cuts both T1 and L2 *en route*, although the former may well have been bridged across it. It would also have had to have been carried across T16 on a wooden launder, although interestingly on the 1863 OS map (Fig 5) this is not shown, as if the leat was then (temporarily or permanently) disused. The leat resumes on the far side of T16 as a shallow earth-cut channel, but soon turns sharply east and drops straight down the contours for a short distance at a gradient close to 1:3. The map shows that it continued across Roughton Gill and passed behind the entrance to the 90-fathom level (ML14), but again this section would have had to be in a wooden launder – certainly across the gill, and in all probability across the steep scree slope above the mine as well since no earthwork channel would survive here for long in such an unstable environment. In the field, earth-cut channel now resumes at NY 30278 34418, and broadly follows the contour around to the far end of R3, although the final 75m falls at a steeper gradient close to 1:15 (7%). This final section, however, has now largely disappeared on the ground, infilled by alluvial deposits brought down by the active erosion torrent east of Iron Crag (Fig 26).

L9, L10 and L11 are all very short, but are shown on the 1863 OS map (Fig 5), the first two providing alternative links between L7 and L8, the last (L11) linking L8 to another, parallel, leat (L12) further down the hillside. They probably acted as bypass channels when certain parts of the system had to be isolated, or when water was

Figure 29. Leat L8 on Balliway Rigg, viewed from the west (NMR/AA021973)

needed in reservoir R4 rather than R3. On the ground, L9 is now being progressively infilled/scoured by erosion, and only 30m survives looking more like a small erosion gully than a leat. There is no surface trace of L10, which would seem to have been totally infilled. Nor is there much trace of L11, although a small stretch of channel which survives on the ground flowing at right angles into L12 immediately west of the ore bins, may well represent its extreme northern end; if not, the course of this feature has been infilled or scoured out by the modern erosion gullies which lie immediately south-west.

L12 is shown on the 1863 OS map (Fig 5) leading north and east from the mouth of the 90-fathom level (ML14) and flowing into the south-west end of R4. Only the latter part of its course now survives from a point just west of the ore bins to the reservoir. West of the ore bins, the course shown on the map corresponds on the ground to a level terrace some 3m wide, whereas between the east end of the bins and the reservoir, the earthwork form of the feature changes character to a narrower, embanked, channel. This suggests that between the mine and the ore bins, L12 was carried in a launder at the side of tramway TR2 (section 6.6.2 above) which is also shown on the map.

L13 conveyed water from Blea Gill to the north-east end of R3. The 1863 OS map (Fig 5) suggests it took water from the confluence of the becks in Blea and Todd Gills, but the field evidence shows it rather took water only from Blea Gill at a point just above the confluence. As with L8, no trace of a stone weir survives in the beck, suggesting that water was diverted into L13 by nothing more than a wooden

clapperboard. L13 is traceable for the majority of its length along the side of Todd Gill as an embanked channel up to 0.4m deep; for the first 50m the channel had to be built up above, rather than cut into, the natural valley side, and in places this revetment is now collapsing downhill.

L14 is an overflow from L15 and/or the north-east end of R3, shown on the 1863 OS map (Fig 5). However, the mapped leat corresponds on the ground to a wide gash in the side of Todd Gill, showing that erosion has now totally destroyed the original archaeological feature. The leat probably went out of use in the middle of phase 7 when L15 (below) was made redundant by the enlargement of R4 (this section above).

In 1863, the OS (Fig 5) show L16 running from near the middle of R3, and curving round the end of R4 before turning sharply north-west below the ore bins into what looks like a wheel-pit (waterwheel WW4, section 6.6.4 below). It is thus properly a mill race. Meanwhile, L15 is shown coming off L13, passing very close to the end of R4, and flowing into L16; it probably functioned as a bypass channel for the reservoir, connecting L13 directly to L16 when R3 needed maintenance. The upper courses of both L15 and L16 still survive quite well on the ground as earth-cut channels, but both are visibly cut by R4, supporting the contention that the latter was enlarged in the middle of phase 7 (this section above). The middle and lower course of L16 - below R4, and running down through mill complex MC5 - also survives as a very silted earthwork channel. But it is likely that, following the enlargement of R4, L15 was completely abandoned, as was much of the middle section of L16, which appears to have been re-routed to flow directly out of the south-west corner of R4 (indicated as L16a on Fig 26).

L17 is a possible leat known from OS map evidence only (Fig 5); no trace of it now survives on the ground. However, unnamed line detail on the map seems to point to a leat running past the base of the ore bins. Whilst this could be a continuation of L16 flowing west, it is much more likely that it came off L12 and flowed east into L16 so that the water could subsequently be re-used lower down within mill complex MC5.

Water supply to mine level ML16 (leat L18)

L18 is not part of the system directing water to mill complex MC5, but was designed to supply water from the beck in Blea Gill solely to mine level ML16. Its course has eroded away within the downcut stream valley, but survives for 45m on the eastern lip of the gill as an earth-cut channel (Fig 28). On the ground the earthwork now connects with another leat taking water from the mine across the gill to the Lainton's Shaft area (L26, section 6.7.3 below), but this may well be its later course in phase 7. On present evidence, it seems likely that in phase 6, L18 would have been carried on a launder across in front of the mine to a rectangular platform that exists at the northern edge of the mine dump. This platform is interpreted below (section 6.6.4) as a hand-dressing floor (DF4), for which a regular water supply would have been needed.

Leat 19 (L19)

L19 is probably more of a drain than a true leat, but is included here for convenience. An open channel, some 30m long by 1m-2m wide and up to 0.4m deep (Fig 31), runs north from a small platform at the foot of Yard Steel, part of the smithy (AS3, section 6.6.5 below). It then curves under track T16a, and discharges through a buried pipe

into the beck coming down Silver Gill: the line of the pipe is visible on the surface east of the track as a slight ridge. As such, the feature may be no more than a drain from the small platform, but if so the question arises how did water reach the platform in the first place? The likeliest explanation is that the leat is only the visible end of a feature which runs for the most part underground from the buried entrance to mine level ML15 (the Silver Gill 90-fathom level) some 100m to the south. L19 may have existed when the mine was active, in which case it drained it and/or channelled water for use at the smithy; but at the very least a drain must have been put when T16a was constructed across the mine's entrance (sections 6.6.1 and 6.6.2 above), or else there would have been the risk of a sudden blow-out of pent-up ground water. Although not shown by the OS (Fig 5), L19 must have existed, therefore, by 1863.

6.6.4 Processing the ore

Documents indicate that at the reopening of Roughton Gill Mine in 1849, ore was crushed and washed at the existing mill complex MC4 situated adjacent to the existing Roughton Gill 60-fathom cross-cut (ML13). However, MC4 was obviously poorly situated once the new 90-fathom cross-cut (ML14) had reached the vein and began to produce ore in quantity, and by 1852 it is recorded (section 5 above) that work was well-advanced in re-siting the dressing plant to a location more convenient to the new mine. This new dressing plant is here termed mill complex MC5, and is to be equated with the remains of buildings visible below the spoil tip at the head of the Dale Beck valley. A brief account of the spoil tip has already been given (section 6.6.1 above).

Mill complex 5 (MC5) and waterwheel 4 (WW4) (Fig 26)

MC5, which is centred at *c* NY 3025 3455, was mapped towards the end of phase 6 by the OS (Fig 5). However, following the final closure of Roughton Gill Mine in 1876, the buildings seem to have been thoroughly demolished, and only scant structural traces are now visible on the surface (Fig 26). Nevertheless, the extant wall lines accord well with what is depicted on the map, suggesting that development of the complex in phase 7 was organic rather than radical. For this reason, all visible structural remains are described in this section unless there is good evidence that they were added later than the map. In phase 6, MC5 seems to have been totally reliant on water power, but by the middle of phase 7 it is recorded that an auxiliary steam engine had been installed (section 5 above); the archaeological evidence for this engine is discussed in section 6.7.4 below (engine house EH2). The archaeological and map evidence have been combined below to arrive at a tentative reconstruction of the function of several of the structures.

The best preserved structure is a bank of three stone-lined ore bins or chutes, whose concave and sloping rear faces partly survive centred at NY 30265 34466 at the southern edge of the mine dump. OS map evidence suggests that the chutes lay sandwiched between to the south, a probable tramway leading from the Roughton Gill 90-fathom level (TR2, section 6.6.2 above), and to the north, a long rectangular building; the top of a *c* 20m-long stone wall which is visible on the ground close to the foot of the chutes, matches very well the position and dimensions of the building depicted on the map, and must represent the remains of its rear wall. From this, it can be deduced that ore arriving from the mine was tipped from the tramcars directly down the chutes into bins housed in the building below, for preliminary (?hand-) dressing and washing. Water for the grates or jigs used in washing could have been brought in via leat L17, a possible off-shoot from L12, although the identification of L17 relies exclusively on interpretation of unnamed line detail on the 1863 map

(section 6.6.3 above). It is unclear if the long rectangular building at the base of the chutes is the same as that referred to in documents as the orehouse, but if so, then it was improved in 1871 (section 5 above).

A group of buildings and other structures shown by the OS towards the centre of MC5 at roughly NY 3024 3451, is probably the site of the stamp mill and/or crushers, which is where the dressed and washed ore would have been taken next. The main evidence for the identification of this building group is its proximity to what would appear to be a wheel pit shown (but not named) by the map, immediately to the south. This putative wheel pit (WW4) survives on the ground as a heavily-infilled channel at the foot of the tip of mined waste on which the ore bins sit. There are traces of massive stone walls on either side of the pit. However, there are few signs of the adjacent buildings shown by the OS. A pile of mortared rubble immediately west of WW4 is most likely to be part of the phase-7 engine house (EH2, section 6.7.4 below).

North of the wheel pit are the remains of a stone-flagged floor which corresponds to a rectangular unroofed structure (yard or dressing floor?) shown by the OS. A little further north again at the edge of the tailings, wall lines may be seen in several places, seemingly correlating with sides of buildings shown by the OS, but the buildings have either been almost completely demolished, or lie buried beneath rubble and eroding tailings. Intriguingly, there are traces of wooden structures now beginning to emerge as the dumps erode, including at NY 30205 34545 one corner of a wooden frame held together by a mortice-and-tenon joint (Fig 30). It is unclear if these wooden structures are part of MC5, or belong to earlier phases, but they do suggest that structural survival in this area may be quite good. Although functions cannot be assigned to specific phase-6 structures shown on the map, this is likely to have been the area where the finely crushed ore was buddled to achieve the final separation of lighter gangue materials from the heavier lead fines; indeed in 1863 the OS depicted a small circular structure here which may well be a buddle, but there is no evidence to suggest that it survives *in situ*. Further buddling evidently took place on the other side of Todd Gill at the foot of Peteraw, for the OS depict leats and a second probable buddle at this location too, but this area seems to have been thoroughly disturbed by subsequent flooding from the beck, and/or buried beneath slimes from the nearby umber mill in phase 8 (MC6, section 6.8.3 below). There are hints of buried walls visible in this area, but all are too slight to be interpreted (Fig 36).

Figure 30. Wooden mortice-and-tenon frame exposed by erosion at mill complex MC5 (NMR/AA021946)

Hand-dressing floor 4 (DF4)

A level platform area centred at NY 30566 34400 has been terraced into the hillside towards the base of the waste dump below mine level ML16 in Blea Gill. It measures some 8m long by 5m wide, and has traces of a low stone wall standing up to 0.55m high along its rear edge revetting the dump behind (Fig 28). It was not depicted by the OS in 1863 (Fig 5), and is therefore more likely to be a hand-dressing floor than a

building platform. If so, water may have been laundered in via leat L18 (section 6.6.3 above). Track T19 (section 6.6.2 above) leads north-east away from the floor, but on the ground it is unclear whether the track is contemporary with, or overlain by, the floor.

6.6.5 Ancillary structures

OS map evidence shows that in 1863 three roofed buildings plus one other small structure were ranged along either side of tracks T16 and T16a at the foot of Yard Steel (Fig 5). Only one is described, and that is the smithy. Nevertheless, since these buildings also lie away from the site of mill complex MC5 (section 6.6.4 above), this is enough to suggest that all probably had functions ancillary to, rather than part of, the main ore-refining process. The archaeological evidence points to there being at least five other structures in this area, one of which was clearly a stone building (Figs 31 and 34). Since the OS rules of depiction included all roofed, stone buildings, it is reasonable to suppose that this building post-dates the map, and belongs to phase 7. However, the other structures are now represented on the ground only by platforms, probably supporting timber buildings. Although they, likewise, have been here assigned to phase 7 because they do not appear on the map, it is possible that all or some were already present in phase 6 but were deemed by the OS to lie outside their rules of depiction (AS8-AS12, section 6.7.5 below). At least one other probable ancillary building existed in phase 6 away from the main mine complex in association with mine level ML16 in Blea Gill.

Smithy (AS3)

A ruined stone building lies on a rectangular platform terraced into rising ground at NY 30133 34556 in the angle formed by T16a and T23a (Fig 31). It corresponds with a building described on the 1863 OS map as a smithy (Fig 5), and is probably also identical with the smithy mentioned in 1852 (section 5 above). For the most part the building is now a mass of stone rubble up to 0.8m high, but sufficient wall faces can be made out within the tumble to indicate that the general ground plan is L-shaped and comprises seven rooms. The main body measures 19m long by 7.7m wide, with rooms arranged two abreast across the width; four rooms are visible along the northern side and three to the south; the room at the west corner extends 2.25m to the south-west to form the foot of the 'L'. However, comparison with the map evidence shows that this must be the smithy's final form in phase 7, and that in 1863 the ground plan was subtly different. A small platform, measuring *c* 5m by 3m by 1m deep, has been levelled into the side of T16a immediately opposite the west end of the smithy, and is presumably connected with the smithy's operation. An open channel (L19, section 6.6.3 above) leads north away from the platform, but it is unlikely that the two features are functionally related (unless the platform is the site of a lavatory? - it may be no more than the base of a coal store).

Ancillary structure 4 (AS4)

A ruined stone building lies at NY 30139 34574 a few metres north of the smithy (Fig 31). It is now a mass of mostly stone rubble up to 0.8m high externally, with a few brick and slate fragments present as well; a displaced, red sandstone lintel, measuring 0.95m by 0.25m by 0.10m, is visible at the west end. Sufficient wall faces can be distinguished through the tumble to show that the building is slightly L-shaped, measuring approximately 16.5m east-west by 4.5m wide, but with the east end projecting by an additional 1m or so towards the north. There is no evidence that it

was sub-divided, but a grassy track now cuts diagonally through the centre and may mask internal wall-lines (the track was presumably created recently as a short cut to the water pumping station (section 6.9.2 below), although it no longer seems to be in use). OS map evidence on the other hand suggests the building was of two-phases, and grew from a small square structure in phase 6 (Fig 5), represented by the wider east end, to its extant near-rectangular form probably in phase 7 (Ordnance Survey 1900). Although neither map names the building, it is tempting to equate it with the Account House mentioned in the 1852 report on the mines (section 5 above). A small platform, measuring *c* 5m square by 0.5m deep, has been levelled into the side of track T16a close to the west end of the building, and is presumably connected with its phase-7 use; it may be a coal bunker.

Ancillary structure 5 (AS5)

OS map evidence (Fig 5) shows that in 1863 an isolated roofed building measuring only some 5m by 3m, stood just north of a spring at the foot of Yard Steel feeding a small tributary stream flowing north into the Dale Beck. The mapped building corresponds with hints of a rectangular platform on the ground measuring 7m by 5m, at NY 30084 34722, close to the northern limit of survey (Fig 34). Although not named on the map, the size and isolation of the depicted structure strongly points to it being the site of the phase-6 mine magazine; it probably remained in use in phase 7 too. However, there is very little evidence for a stone building on the platform: a short length of possible wall line is visible running north-south, but is by no means convincing and may be no more than a natural rock formation. It must be a strong possibility, therefore, that whatever structure stood here was made of wood.

Ancillary structure 6 (AS6)

A small structure some 2m square is shown by the OS in 1863 at *c* NY 3010 3455 directly west of the smithy (Fig 5). It would appear to be unroofed, but is not named and its purpose is unknown. It does not correspond to any feature located by the present survey, and is not marked, therefore, on Fig 48.

Ancillary structure 7 (AS7)

A substantial platform has been terraced into the hillside at NY 30587 34354, 20m south of the entrance passage to mine level ML16 in Blea Gill (Fig 28). The platform is somewhat irregular, but has maximum dimensions of *c* 24m by 16m; its rear scarp stands almost 2m high. Although there are very faint traces of what may be soil build-up against the outside edge of a former rectangular structure on the platform, this whole area of hillside was quite wet and boggy when surveyed making it difficult to have great confidence in slight earthwork detail. However, there is no evidence for a stone building on the platform, and whatever stood on it was probably built of wood; its function is unknown. Nothing is shown at this location by the OS in 1863 (Fig 5), although the platform is almost certainly contemporary with, and linked to, operations at the nearby mine: a couple of short tracks lead up to it from the mine below (T25 and T26, section 6.6.2 above). Leat L18 (section 6.6.3 above) also lies just below the platform's front edge, but the slight difference in relative heights means that water is unlikely to have been fed directly from L18 to the platform. A second, much smaller, platform exists on the hillside immediately south-east of, and above, the larger one, but as there is no obvious means of access to it, it may be a natural feature.

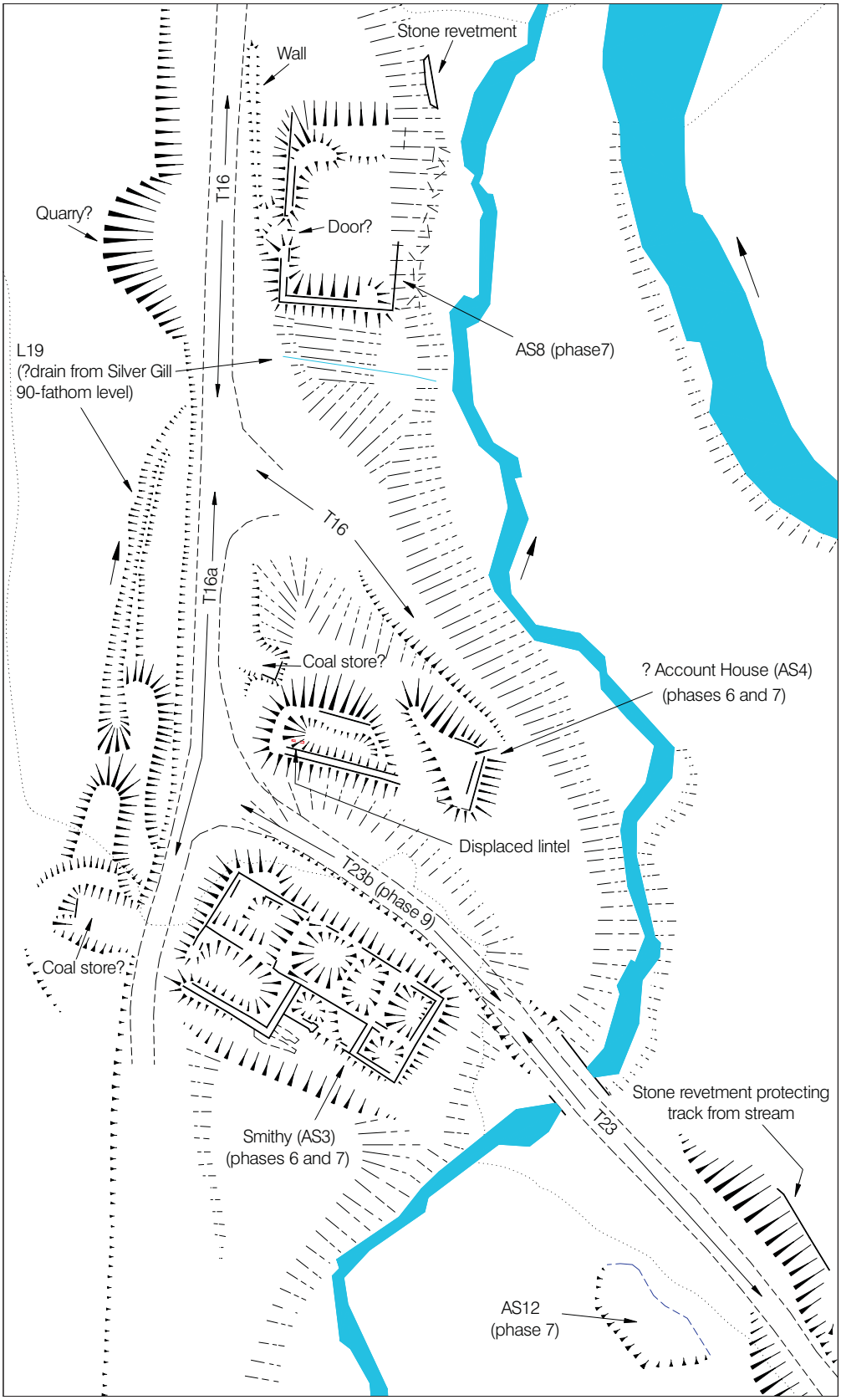

Figure 31. Annotated extract from survey reproduced at 1:500 scale, showing ancillary structures AS3, AS4, AS8 and AS12.
(See key to Figure 53 for explanation of conventions)

6.7 Phase 7. The mining landscape *c* 1865-1878: the Caldbeck Fells Consolidated Lead and Copper Mining Company (Fig 49)

6.7.1 Extraction of ore and mine drainage

By 1865 most of the workable deposits of ore in the 90-fathom level had been exhausted in the western sections of the mine (the Silver Gill and Roughton Gill levels), and efforts were concentrated on searching for new deposits further east and at greater depths. The main sequence of events has already been described above (section 5), but will be repeated briefly here. The levels furthest east making up Mexico Mine were enthusiastically developed at this time, but lie outside the area of the present survey and are not described below. However, the Roughton Gill 90-fathom level (ML14) remained in use, and underground was extended east along the vein(s), with Lainton's Shaft (mine shaft MS2 below) sunk by the edge of Blea Gill to help drain it. A Cornish pumping engine was installed at the shafthead, but little ore was found in the new levels and pumping was suspended in mid 1867. Operations resumed in 1869 and the shaft sunk a further 20 fathoms as deeper levels were opened in search of ore, but pumping was again suspended in 1870. Attention then switched to exploiting the new, deep, '20-fathom level' in the western section of the mine, but developments here (*eg* Junction Shaft) took place mostly underground, and are similarly beyond the scope of the present survey.

Lainton's Shaft (mine shaft MS2) and engine house 1 (EH1)

The head of Lainton's Shaft survives as a shallow (0.2m deep) depression, almost 6m in diameter, within the broad valley created by the coming together of two erosion torrents down the east side of Iron Crag (Fig 32). However, the bed of the easternmost torrent is now grassed-over and inactive, and must have already been so when the shaft was dug. A large level area was created at the east side of the valley by tipping spoil across the course of the torrent, and the shaft dug towards the rear of this platform at NY 30456 34356. The platform's surface lies at an altitude of 449m AOD, or 52m above the approximate height of the mouth of the 90-fathom mine level in Roughton Gill (ML14); allowing for a gentle rise up along the level to allow water to drain out under gravity, this would mean that the shaft still had to be sunk in excess of 40m (22 fathoms) to link up. Mine level ML20 (this section below) was driven almost due south below the platform to intersect the shaft, and water was pumped out through it probably as a temporary drainage measure whilst the shaft was being dug, although the water seems to have been channelled into leat L28 (section 6.7.3 below) for use at the Mexico Mine low (90-fathom) level rather than being allowed simply to run off downhill. It is documented (section 5 above) that a horse whim was installed at the shaft, presumably for winding and pumping duties whilst it was being excavated. There are no obvious remains of this whim (unless reservoir R6 has been wrongly interpreted; see section 6.7.3 below), but it would most probably have been located somewhere in the wide expanse of otherwise empty platform north of the shafthead; it could not have been sited west of the shafthead or else it would have interfered with access to the shaft complex as a whole along track T16b (section 6.7.2 below).

The remains of the stone-built engine house (EH1) lie only a few metres south-east of the shafthead, at NY 30463 34349 (Fig 32). The structure is much ruined, but the front wall survives to a height of 2.3m above the platform although largely buried beneath tumble (Fig 33); clearance of rubble and shallow excavation at the back of

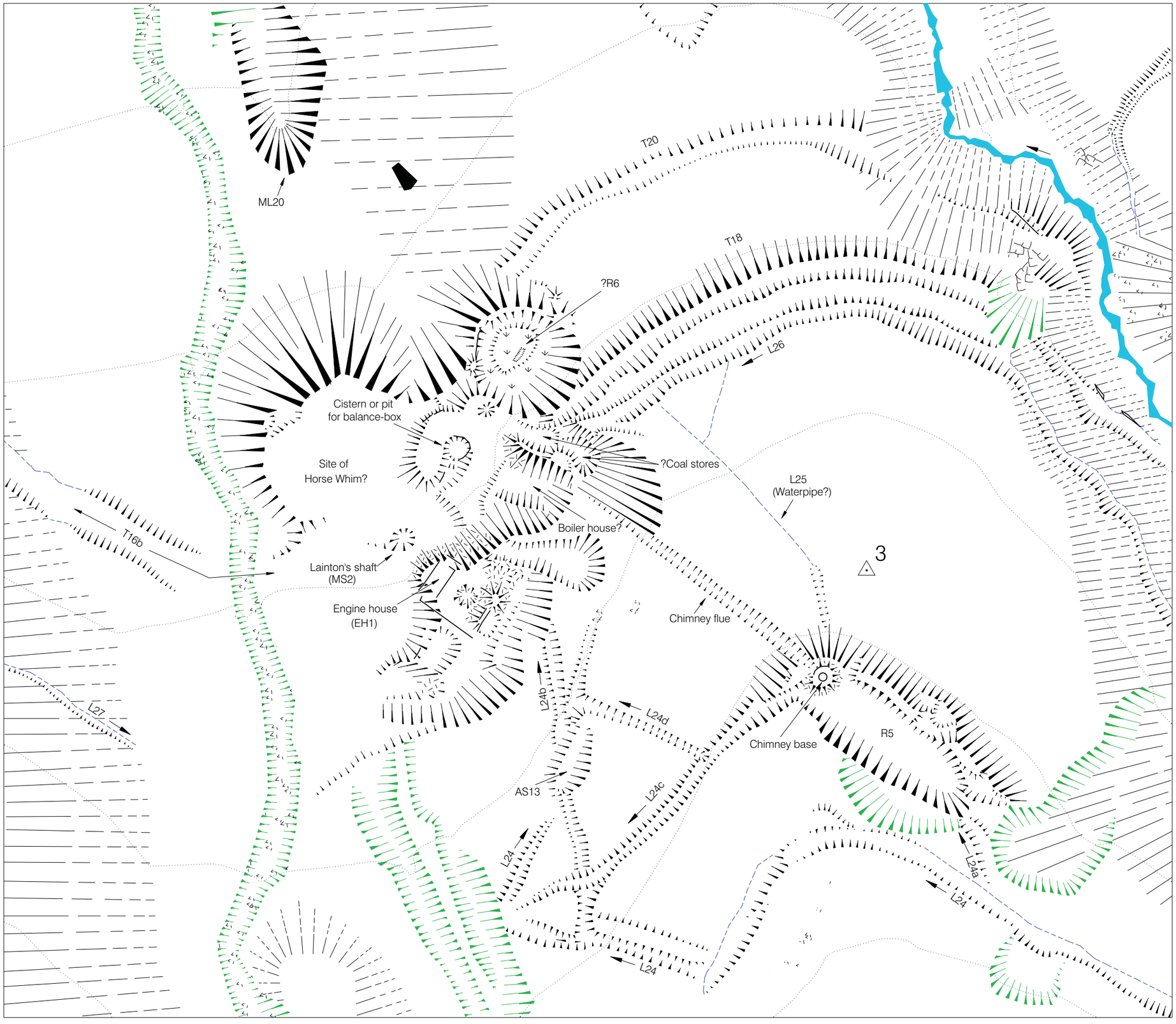

Figure 32.
Annotated extract from survey reproduced at 1:500 scale, showing Lainton's Shaft and associated features.
(See key to Figure 53 for explanation of conventions).

Figure 33. Ruins of the Cornish engine house at Lainton's Shaft, viewed from the north (NMR/AA021957)

the building has exposed coursed masonry in the rear wall to a height of 0.6m. The rear wall was of the order of 0.5m wide, but the front wall in particular may have been thicker due to heavier loading from the beam or bob connecting the engine cylinder to the pump rod. Exact measurements for the plan of the building cannot be discerned, but it measured at least 9.5m by 6.75m; an internal wall visible about a third of the way back may have helped support the weight of the bob. A channel, *c* 0.5m deep, which has been cut into the hillside some 16m north-east of the engine house is the remains of the chimney flue from the boiler house; no stonework is visible in the flue, but the stone base of the chimney survives inserted into the northern corner of reservoir R5 (section 6.7.3 below) some 15m above. Several bricks are also visible in the chimney base, and bear the stamp

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in their frog. The siting of the chimney suggests that, unusually, the boiler house was completely free-standing, and stood away from the engine house on a small platform terraced into the hillside at the base of the flue where much stone rubble and hints of possible wall lines are visible. Two smaller platforms terraced into the hill at the north-east side of the boiler house may be coal stores or similar structures.

A raised, sub-rectangular platform lies in front of the boiler house site, and is a strange and enigmatic feature (Fig 32). It stands some 0.8m high, and has a stone-lined shaft *c* 6m in diameter and 1.5m deep cut into its centre, connected to the platform edge by a channel whose orientation is roughly perpendicular to a line drawn through Lainton's Shaft and the engine house. MoLES have investigated the base of the central shaft, and proved that it never continued deeper (Warren Allison, pers comm). Nevertheless, the platform's proximity to the boiler house, plus the orientation of the channel to the pump shaft and engine house, strongly points to an

association between these features. Two possibilities may be offered: one, that the central shaft is a sunken cistern for the engine condenser, from where the warm condensate could be recycled back to the adjacent boiler house; or two, that it served as a pit for the box on the end of the balance bob needed to offset the weight of the pump rod. Of the two, the second is perhaps the more plausible, since no parallel has so far been found for the siting of the condenser so far away from the engine house. But more research is needed before the function of this feature can be confidently identified. A second, small, hole, only 0.6m deep, which lies close to the platform's northern corner, plus a rectangular slot visible at the centre of a raised 'island' in reservoir R6 (section 6.7.3 below) to the north-east, are both in line with Lainton's Shaft and the central shaft, but the significance of this observation is difficult to gauge.

Mine level 20 (ML20)

ML20 lies on the hillside below Lainton's Shaft at an altitude of *c* 429m AOD. The entrance at NY 30440 34409 is now blocked, but the entrance passage leading to it is orientated towards the south-south-east directly in line with the head of Lainton's Shaft (Fig 32). The mine should therefore connect with the shaft, and in all probability was dug as a drainage level. This interpretation is supported by reports from MoLES members - who entered the level some years back when the entrance was opened briefly by erosion - that the tunnel is only some 3 feet high, although roof collapses made it impossible to verify the connection into Lainton's Shaft; there are also tram rails inside (Warren Allison, pers comm). The end of the entrance passage now seems to cut the end of leat L28 (section 6.7.3 below), but presumably water pumped up Lainton's Shaft during its construction drained through the level, and was carried in a launder along L28 for use at the Mexico Mine low level complex east of Blea Gill (and beyond the limits of the present survey).

6.7.2 Mine access and ore transport

By the start of phase 7, the majority of ore deposits accessible from the existing levels in Roughton and Silver Gills had been worked-out, and most of the smaller tracks linking the dispersed phase-6 areas of activity were probably abandoned. However, parts or all of tracks T1, T3 and T4 on Balliway Rigg no doubt continued in use in order to provide overground access between mill complex MC5 and new levels in upper Roughton Gill and in Thief Gills, whilst T22 and T24, running along the floor of Blea Gill and the northern edge of Todd Gill respectively, would have remained in use as access to the Mexico Mine levels further east. T16 and T23 leading to the main processing area (MC5) in the Dale Beck valley floor obviously continued in use. Otherwise, only two new tracks can be identified as belonging to this phase, both connecting MC5 to the new developments at Lainton's Shaft (T16b and T27).

Tracks 16b and 27 (T16b and T27)

T16/T16a which in phase 6 ran from the Dale Beck valley floor up as far as mill complex MC4, was extended east at the start of phase 7 in order to provide vehicular access to the new pumping facility at Lainton's Shaft. Most of this new road (T16b) survives as a broad terrace on the hillside, although in places it is now gradually slipping downhill or being buried beneath slump and erosion from above, especially beneath reservoir R2 and mine level ML11 (Fig 21). Immediately west of its terminus at Lainton's Shaft, its course has been destroyed by the active mountain torrent that flows down the east side of Iron Crag (Fig 32).

T27 by contrast is a much smaller construction, seemingly designed to provide a direct route for pedestrians and/or horses between the head of the Dale Beck valley and Lainton's Shaft. Only a short stretch survives immediately south-east of leat L7. It overlies the phase-6 T21(section 6.6.3 above), but fades out on the ground shortly after.

6.7.3 Water management

In phase 7 there seem to have been three separate water management systems in operation supplying different parts of the mine. The system of reservoirs and leats delivering water to mill complex MC5 (section 6.6.3 above) obviously continued in use, but the archaeological evidence shows that the system was altered and improved in several ways, as described below. These improvements may not have happened until the middle of the phase, probably after 1870, but it is this re-jigged system that is highlighted on the phase diagram (Fig 49), and elements in use at the start of the phase but redundant by the end are not shown. In addition, a completely new water management system was constructed to supply the steam pumping engine at Lainton's Shaft, whilst for a time water pumped up the shaft seems to have been taken for use at the Mexico Mine Low Level too.

Changes to the water supply to mill complex MC5 (reservoir R4 and leats L11a, L16a, and L20-L23)

Comparison of the OS map evidence (Fig 5) with the earthwork evidence (Fig 26) shows very clearly that R4 was extended some time after 1863: whereas the map shows that leat L16 was laid out around the reservoir's north-east end, on the ground this end of R4 now clearly truncates the leat. The expansion can almost certainly be equated with a reference to the enlargement of a reservoir in the mining company accounts for 1871 (section 5 above). Although not mentioned in the accounts, it was probably at this time that L20 was constructed linking the western ends of the two reservoirs together; the leat does not appear on the 1863 map, although it is shown in 1898 (Ordnance Survey 1900). The expansion of R4 and the construction of L20, meant that the phase-6 leats L14 and L15 (section 6.6.3 above) would now have been redundant, as would the upper and middle parts of L16 supplying the mill wheel (WW4); it was probably at this time that a new outlet (L16a) was created at the south-west corner of R4, in order to provide a new link with the lower course of L16 immediately above WW4. A new overflow (L21) into Todd Gill was constructed at the east end of R4 when it was expanded. L11 also seems to have been diverted at some point in phase 7, and rather than joining L12 west of the ore bins, was re-routed to join it more to the east (L11a). However, the final part of this leat was later blocked off above L12, and the leat seemingly diverted into L20, although this junction too, seems later to have been blocked. The purpose or reasoning behind all these changes to the course of L11 is unclear.

Only the western ends of L22 and L23 lie within the area of survey, but relative levels indicate both flowed west into Blea Gill; L22 presumably conveyed water away from the Mexico Mine low level mine, whilst L23 may have brought water from the other Mexico Mine workings. Both leats would, therefore, have augmented the water level in the beck in Blea Gill, which could be drawn off lower down via L13 into reservoir R3. Hence, they should also be considered as part of the supply of water to mill complex MC5.

Water supply to the Lainton's Shaft complex (reservoirs R5-R6 and leats L24-L27)

A very complicated arrangement of reservoirs and leats is visible above Lainton's Shaft (Fig 32), and was presumably designed to ensure that the boilers for the Cornish pumping engine did not run short of water. However, at least two phases of alterations can be distinguished in the earthworks, which do not sit easily, therefore, with the documentary evidence that the pumping engine only operated for a short period in 1867, and again briefly in 1869-70, before being given up as too costly to operate (section 5 above). This raises the intriguing possibility that some – or indeed the majority - of the water management system described below actually pre-dates phase 7, and should be associated with some, as yet unidentified, earlier activity at this location. The matter is discussed further in section 7.

L24 was constructed seemingly to bring water from the beck in Blea Gill to a point on the hillside above the Lainton's Shaft complex, with a short spur L24a taking water off into reservoir R5. However, its course is rather tortuous, and it is not at all clear why this was so. Its origin within the downcut section of the gill has eroded away, and on the ground the feature now commences north of a rock sill (actually part of the Roughton Gill South vein, which is here composed mostly of quartz) as a narrow terrace, showing that the leat must have been contained within a wooden launder. This terrace follows the contours around to a point on the hillside just short of the inactive mountain torrent. Here it ends above a narrow, earthcut channel, 0.3m deep, which drops straight down the slope for 12m before turning sharply to the north to become a narrow earthwork terrace once more; it dies out on the hillside almost directly above the site of the engine house (EH1, section 6.7.1 above). It seems, however, that the final part of this course was changed at least twice. First, the earthcut channel was blocked off half-way down its length, and the leat diverted to run diagonally across the hillside (L24b) to a new, lower, position above EH1. Subsequently, leat L24c leading from the north-western end of R5 was constructed across L24b, either re-connecting with the original final course of L24, or instead with L27 leading from the west, whilst a spur channel (L24d) branched off it at a right angle directly above EH1, and dropped straight down the hillslope. A small platform (AS13, section 6.7.5 below) overlies the approximate midpoint of L24b, but is of unknown purpose.

Reservoir R5 above Lainton's Shaft originally measured some 50m long by 15m wide by 0.8m deep, and was created partly by terracing the hillside, and partly by throwing the upcast onto the downslope side to create a dam. Water came into the reservoir's south-eastern end along L24a – a short spur from L24 - and exited (probably at different periods) at the other end along L24c and L25. At some point the chimney from the boiler house was inserted into the northern corner (further evidence perhaps that R5 was disused by this time, and, together with many/all of its associated leats, pre-dates the development of the Lainton's Shaft complex).

L25 is a very slight, narrow channel, visible on the hillside below the north end of R5. It is probably an underground waterpipe rather than a true leat, but is included here for convenience. It seems designed to take water from R5 into L26.

L26 brought water draining from mine level ML16 on the east side of Blea Gill, to the Lainton's Shaft complex. It also no doubt tapped into L18 which formerly brought water to the hand-dressing floor DF4 below ML16 in phase 6 (sections 6.6.1, 6.6.3

and 6.6.4 above). L26 consists of a narrow terrace, indicating that it, too, must have carried water in a wooden launder laid on its surface.

L27 brought water to the Lainton's Shaft complex from the west. It must have originated at the beck in Roughton Gill, but if so, all trace of this initial part of its course which would have lain somewhere on the steep, rocky hillside above the Roughton Gill 60-fathom cross-cut (ML13) has disappeared; it probably consisted of a wooden launder. Earthwork evidence now only begins immediately east of the mountain torrent flowing down the west side of Iron Crag, where a narrow earthwork terrace follows the contours round to the active torrent descending the other side of Iron Crag.

Reservoir R6 is an enigmatic, penannular, feature at the north-east edge of the Lainton's Shaft complex. It consists of a platform part terraced into, and part built out over, the hillside, with a low dam or stone wall, 0.6m high, running along its curving eastern edge; the platform floor measures no more than 10m by 8m. Although categorised here as a reservoir, it is far from obvious what purpose a reservoir at this location would have served, and a slight raised 'island' in its centre raises the possibility of alternative interpretations, such as a horse whim. Both its date and function relative to Lainton's Shaft are uncertain; it could well be earlier and entirely unconnected with the shaft.

Water supply to Mexico Mine (leat L28)

L28 took water pumped out of Lainton's Shaft during its construction and channelled it across Blea Gill. L28 continues beyond the limits of the present survey, but seems to be heading in the general direction of the Mexico Mine low level.

Leat 29 (L29)

L29 survives as a short length of narrow earthwork terrace, centred at NY 30089 34669 at the foot of Yard Steel. From its orientation, it seems designed to connect two springs on the hillside to building AS9 (section 6.7.5 below), and is therefore either a path connecting the building to the springs, or more probably the remains of a leat carrying a wooden launder.

6.7.4 Processing the ore

Mill complex 5 (MC5) and engine house 2 (EH2)

It is likely that MC5 (Fig 26) continued in operation throughout phase 7, largely unaltered in form from phase 6. One recorded change, however, was the addition in 1871 of an auxiliary steam engine to supplement the workings of the stamps and crushers when the waterwheel could not operate because of drought. The base of a stone chimney lies at NY 30234 34496, on the edge of the mine dump, adjacent to a rectangular pile of heavily mortared rubble masonry west of wheel pit WW4 (section 6.6.4 above) at NY 30234 34509, and together probably represent the remains of this documented engine house. The chimney wall is 0.55m thick, matching precisely the thickness of the wall in building AS8 which also dates to this phase (section 6.7.5 below).

6.7.5 Ancillary structures

The phase-6 smithy, probable accounts house, and magazine (AS3-AS5, section 6.6.5 above) must all have continued in use in phase 7. But in addition, one stone building plus a number of earthwork platforms (quite probably the sites of less substantial timber buildings or huts) are visible on either side of tracks T16/T16a and T23, and are here all assigned to phase 7 as none were depicted by the OS in 1863 (Fig 5) (but see section 6.6.5 above for the possible dangers in using negative evidence from OS mapping). Because of their situation along the main road leading to the mine and mill complex area, all these buildings are here assumed to be ancillary structures rather than to have performed roles which were part of the main ore-refining process.

Ancillary structure 8 (AS8)

The ruins of a rectangular stone building lie at NY 30136 34617 on the east side of T16, just north of the junction with T23 (Fig 31). The building is situated immediately above the flood-plain of the Dale Beck, which is defined here by a steep scarp *c* 2.5m high. The scarp is being progressively eroded by the beck flowing down out of Silver Gill, and much of the building's eastern wall has already collapsed into the valley floor. Traces of a stone revetment at the foot of the river terrace indicate that this threat was perceived whilst the building was still in use, and that steps were taken to reinforce the bank. Nevertheless, sufficient of the building survives to show that it originally measured *c* 15m by 9m; wall faces also survive to a maximum height of 0.6m externally, and show that the wall was 0.55m thick. Stone tumble is confined to the perimeter of the building, leaving a fairly stone-free, grassy interior that bears no evidence of internal divisions. A break about a third of the way along the western wall indicates that the building was entered via a door facing onto T16. The slight footings of a demolished stone wall are visible through the grass, extending northwards from the site of this door for about 14m at a slight angle to the track. A cutting-back of the foot of Yard Steel directly opposite the entrance, is possibly the site of a small stone quarry associated with the building's construction. The building was mapped at small-scale in 1898 (Ordnance Survey 1900), but not named. Its function is unknown. An ore house and stables were both mentioned as existing at the mine in 1871 (section 5 above), but the building is patently not the stables, and is an unlikely candidate for an ore house.

Ancillary structure 9 (AS9)

A small platform has been excavated into the foot of Yard Steel at NY 30120 34640, some 20m north of, and on the opposite side of T16 to, building AS8 (Fig 34). The sides of the platform have slumped, but it is still vaguely rectangular, measuring *c* 6m wide and extending back into the hillside for 8m or so from the track edge; its rear scarp stands up to 1.3m high. The floor has a shallow hollow in its northern half, with a mound of spoil thrown out over the hillside beyond. There is no sign of whatever structure once occupied the platform, although the top of a faced, rectangular, stone block, flush with the present ground surface at the east side of the hollow close to T16, looks as though it is *in situ*. A possible leat (L29, section 6.7.3 above) heads towards the platform from the north-west, showing that whatever stood here, it probably required a regular water supply.

Ancillary structure 10 (AS10)

A much larger and better-preserved platform is centred at NY 30108 34676 some 35m further north again, and on the same side of T16 as structure AS9 (Fig 34). Its sides do not seem to have slumped as badly as those of AS7, and are still quite steep; traces of a stone wall are visible at the foot of the rear edge, which stands up to 1.7m high. It is thus possible to give fairly precise measurements for the platform's original floor area, which measured some 11.5m long by 7.5m wide, with suggestions of an additional 2m-wide front apron. However, apart from the wall at the rear of the platform - which may be a low revetment - there is no indication that the platform was ever occupied by a stone building. A small stream starts at a spring directly above the platform and flows past its north-west corner, and there are suggestions that a channel was deliberately dug to divert some of the stream's flow on to the platform. The fact that no building was mapped at this location in 1898 (Ordnance Survey 1900) is further evidence that whatever structure stood here was probably built of wood, not of stone. This and the provision of a water supply suggests that it may well be the site of the stables recorded in 1871 (section 5 above).

Ancillary structure 11 (AS11)

Immediately opposite AS10 at NY 30130 34674, are the remains of a platform cut into the side of the river terrace scarp (Fig 34). The platform is now overlain and split into two parts by the embankment built in phase 8 to carry the access road (T28, section 6.8.1 below) across the Dale Beck valley to the Umber Mill (MC6, section 6.8.3 below), but may originally have been almost rectangular, measuring some 14m by 7m. A stone revetment at the base of the southern half of the south-eastern side of the platform seems designed to protect it from the beck, but if so, was not successful since the northern half of the revetment and platform have been eroded away. The river scarp here is some 2m high, and the floor of the platform is only 0.3m above the flood plain, *c* 1.5m below the level of T16. There are indications that the platform was originally accessed from the south via a very short spur down from T16. However, the function of whatever structure stood on the platform is unknown.

Ancillary structure 12 (AS12)

A small platform is visible at NY 30160 34530 almost at the extreme northern end of Balliway Rigg, set back about 5m from the edge of T22, and *c* 1m above it (Fig 31). The platform is sub-rectangular, and measures a maximum of 10m by 5m. This part of Balliway Rigg comprises mostly compacted small stones devoid of vegetation, and the platform has been levelled into this matrix. There are no signs of any structure on the platform, but the presence of small fragments of Welsh slate points to the possibility of an insubstantial timber shack with a slate roof. The use of Welsh as opposed to local Borrowdale slate suggests that this structure should be placed late in the overall site sequence (Peter Blezard, MoLES, pers comm); it is here somewhat arbitrarily assigned to phase 7.

Ancillary structure 13 (AS13)

A small sub-rectilinear platform, *c* 9m by 1.5m, overlies the midpoint of leat L24b above Lainton's Shaft, at NY 30477 34328 (Fig 32). Its function and date are uncertain. The obvious conclusion to draw from its relationship to the leat is that it should be later; however, since water would presumably have been transported along

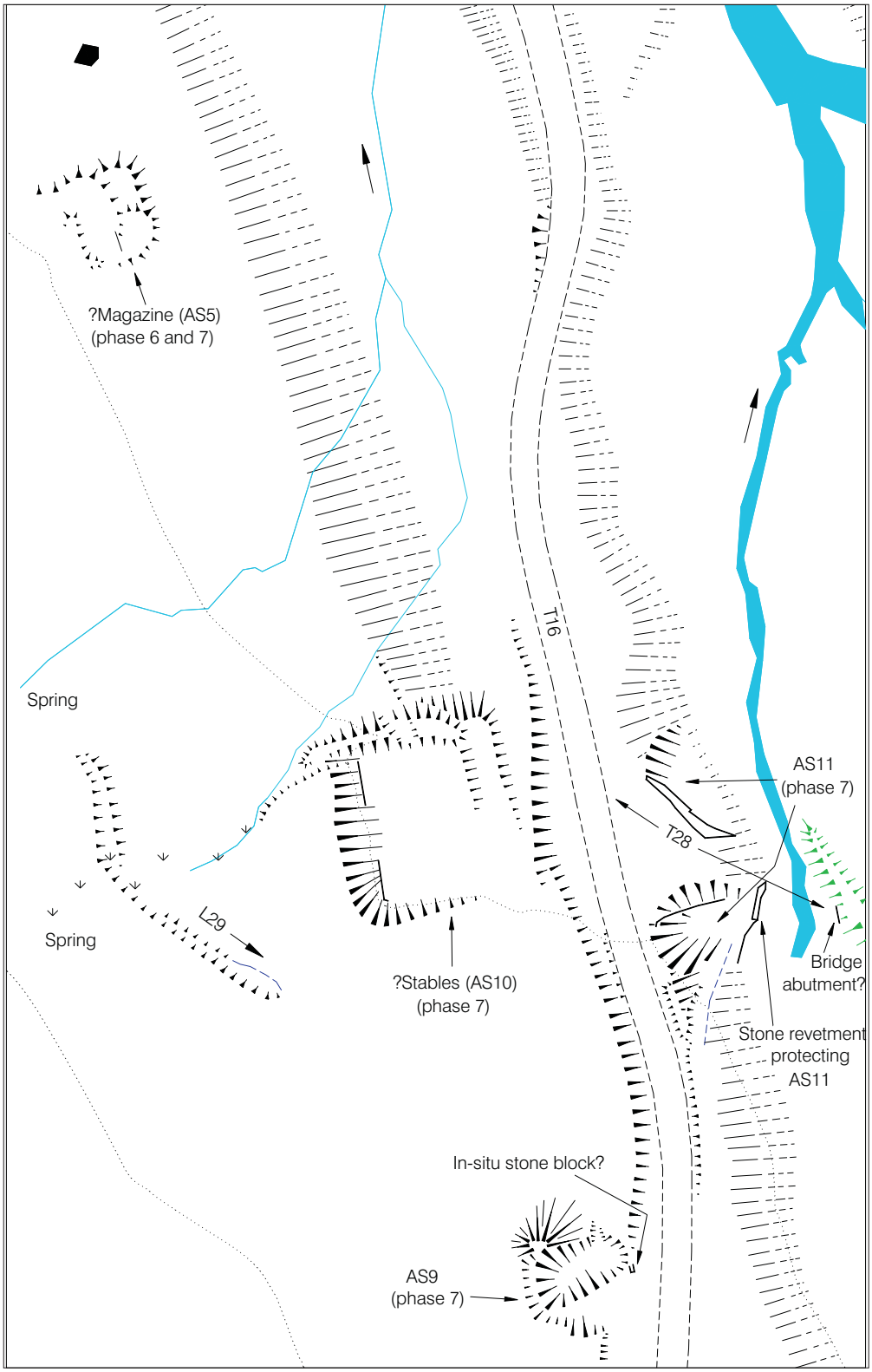

Figure 34. Annotated extract from survey reproduced at 1:500 scale, showing ancillary structures AS5, AS9, AS10 and AS11.
(See key to Figure 53 for explanation of conventions)

L24b in a launder, it may be possible that the two features are instead contemporary, and L24b supplied whatever structure stood on the platform.

6.8 Phase 8. The Cleator Iron Ore Company's Umber Mill (Fig 50)

6.8.1 Mine access and ore transport

Track 28 (T28)

When the umber mill (MC6, section 6.8.3 below) was erected on the east side of the Dale Beck valley, T28 had to be constructed across the floor of the valley to reach it. T28 was mapped by the OS in 1898 (Ordnance Survey 1900), although by then both it and the mill were already disused. Only the ends now survive; the middle part across the valley floor has been washed away. To the west it branched off T16 at NY 30122 34675 opposite building AS10 (section 6.7.5 above), and was embanked across the site of AS11 (Fig 34). The beck flowing out of Silver Gill then ran very close to the western edge of the Dale Beck floodplain, and joined the Dale Beck further north than it does today (Ordnance Survey 1900), with the result that T28 had to be bridged across it. Although this stream course is now no more than a remnant channel, no trace of the bridge survives apart from the possible base of the stone abutment on the east side. No doubt the track continued across the floor of the valley on a low causeway, but if so all traces have been washed away. T28 re-emerges on the far side of the valley above the floodplain, as a broad, grassy, terrace heading straight for the umber mill; a stone revetment 1.2m high marks its south-western edge (Fig 36). It then turns sharply east between two building platforms within the umber mill complex, and continues for a short distance above the mill as far as the probable terminus of the aerial ropeway (AR1, this section below). Its line is continued beyond the ropeway terminus by T24 (section 6.6.2 above), but the different width of the two tracks suggests that they belong to different phases (T28 may well overlie part of the earlier course of T24). In any case, the operation of AR1 would in all probability have prevented access between T24 and T28, as would the course of leat L30 (this section and section 6.8.2 below).

Aerial ropeway 1 (AR1)

Documentary evidence records that umber ore was brought down to the refining mill from the China Clay Mine via an overhead or incline tramway (section 5 above). Although the documents are not clear about what form this tramway took, it is most likely to have been some form of aerial ropeway; certainly the contemporary plan of the mill published by Addison (Fig 35) suggests it was operated by a belt drawing power from the mill's waterwheel. However, most of the presumed route of the ropeway lies outside the area of the present survey, and no certain evidence of its course has been located on the ground. Addison's plan indicates that at the mill, ore was off-loaded from the ropeway into a hopper situated immediately south-east of the drying-shed. No visible trace of the hopper survives on the ground, but the plan indicates that its mouth lay immediately below the end of the small gash or channel which now cuts across the end of T28 (Fig 36). This channel may therefore be where the hillside had to be cut away to accommodate the buckets swinging down to discharge their load into the hopper. If so, a stretch of what resembles a very slight terraced trackway on the hillside above may also represent part of the ropeway's course, although this feature may be no more than modern quadbike access.

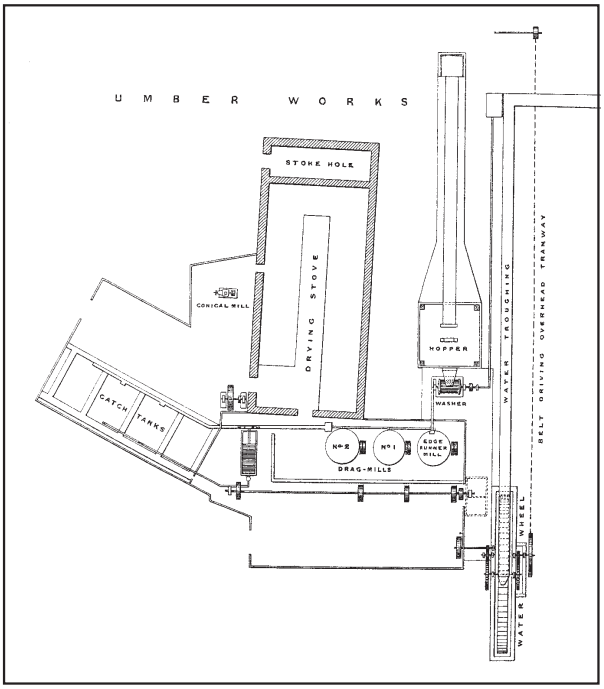

Figure 35. Plan of the umber mill (MC6) published in 1890

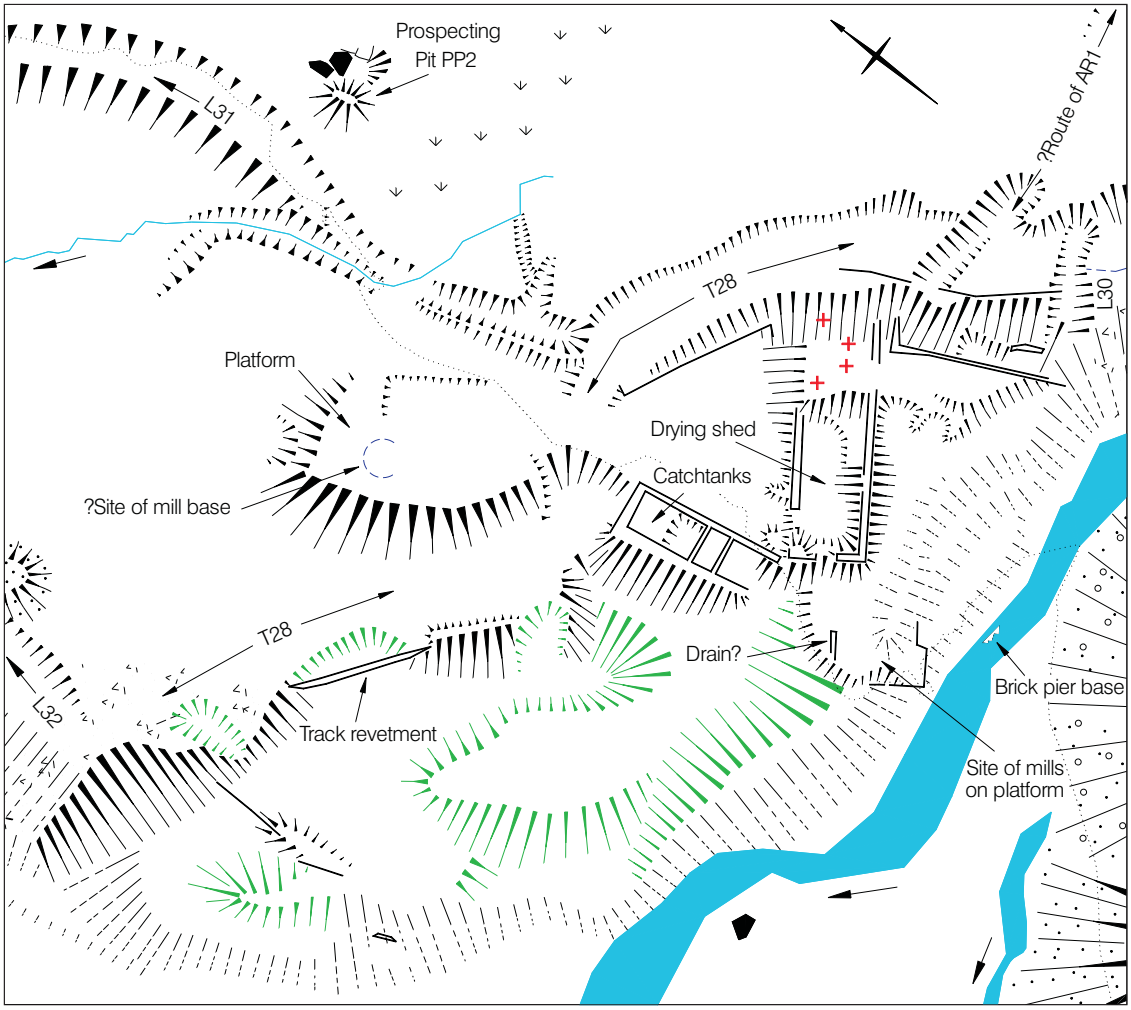

Figure 36. Annotated extract from survey reproduced at 1:500 scale, showing the umber mill (MC6) and associated features. (See key to Figure 53 for explanation of conventions). Note that extract is oriented towards the north-east to aid comparison with Figure 35

6.8.2 Water management

Addison's description of the umber milling process shows that water was needed both for power and for 'levigating' the umber from the ore (1890, 283-7). Several new leats were constructed, but it is likely that the main supply of water came from the complex system of storage reservoirs and leats built for mill complex MC5 in phases 6 and 7 (sections 6.6.3 and 6.7.3 above), which must have been brought back into working order. Whilst it is possible that the complete system was renovated, this would have been costly, and it is more likely that only part was put back into operation. The minimum requirement would have been R3 and R4, plus L13 and L20, and accordingly only these parts of the system are shown as in use on Fig 50.

Leats 30-32 (L30-L32)

L30 is the head race bringing water to the umber mill. Addison's plan of the mill shows it driven by an overshot wheel with water supplied by a race approaching from the south-east, and turning a sharp 90° angle towards the south-west above the wheel (WW5, section 6.8.3 below). The end of this race on the plan corresponds in the field to a short channel cutting across the junction of T24 and T28 (*cf* Figs 35 and 36). However, the plan describes the race as 'wooden troughing', indicating that the channel is not a leat, but where the hillside was cut away to accommodate a wooden launder. This is supported by the fact that there are no other traces of an earthwork approaching the spot. All the evidence points to water being laundered across Todd Gill from the pre-existing phase-6/7 reservoirs R3 and R4 on the opposite bank.

Two other leats - L31 and L32 - survive on the ground (Fig 36) and must belong to this phase. It is difficult to suggest any function for either other than that they took waste water away from the mill: L31 may have led water away used in the washing and levigating process (section 6.8.3 below), but it is difficult to see why L32 was needed in addition. Furthermore, both leats are sizeable, well constructed, channels, and seem over-engineered if waste disposal was their sole purpose. L31 ends on the hillside after only 60m, and most probably discharged into the Dale Beck via a wooden launder across T28, whilst L32 follows the contours at the foot of Peteraw for over 100m before turning sharply north-west and dropping down the side of the river terrace scarp; the foot of the terrace is revetted by a low stone wall at this point.

6.8.3 Processing the ore (mill complex MC6 and waterwheel WW5)

A plan of the umber mill (MC6), and written account of the refining processes, was published by the mill's designer, Percy Addison, in 1890 (Fig 35), and enables the mill to be firmly identified with a complex of buildings whose foundations are still

Figure 37. The drying shed at the umber mill (MC6), viewed from the north (NMR/AA021952)

Figure 38. Umber mill platform adjacent to the beck in Todd Gill, viewed from the south-west (NMR/AA021996)

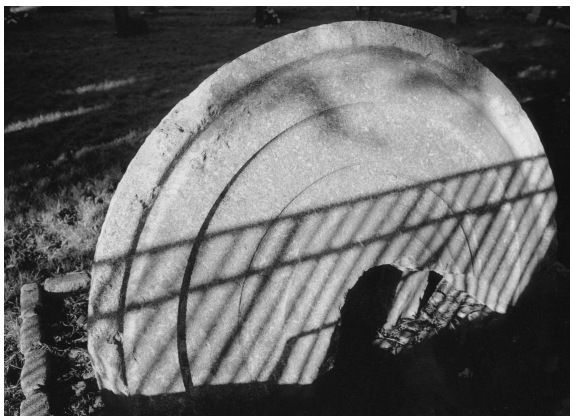

Figure 39. Umber mill grindstone relocated to Caldbeck churchyard (NMR/AA022006)

visible on the ground at NY 3025 3459 (Fig 36) at the foot of Peteraw, immediately north of mill complex MC5. The two surviving buildings are very clearly the drying shed (Fig 37) and catch tanks, whilst the south-east, stone-faced, end of the intervening platform (which Addison shows as the site of an edge runner mill and two drag mills) also survives adjacent to the beck in Todd Gill (Fig 38). Until recently, a broken grind- or millstone leant against the end of this platform (Cooper and Stanley 1990, 62), but has since been transported off-site and re-erected in Caldbeck churchyard as a reminder of the area's mining heritage (Fig 39). Addison's plan also shows that the waterwheel powering the mill stood at the end of the platform; the base of a brick pier visible in the beck at NY 30246 34573 is probably part of the supporting structure for the wheel (WW5). Although no manufacturer's stamps can be made out on the bricks in the pier, many loose bricks within the mill complex carry the imprint:

DEARNAN
·COLLY·

On the ground, a second, larger, earthwork platform is visible north of the catch tanks on the opposite side of T28, but is not shown or discussed by Addison; its purpose is consequently unknown, although it must be part of MC6. A faint L-shaped scarp indicates that some kind of impermanent rectangular structure originally stood at its centre, whilst a little to the south a penannular scar hints at the former location of a grindstone or some kind of mill base.

6.9 Phase 9. Carlisle UDC and the water pumping station (Fig 51)

6.9.1 Water supply features

The existing pump house is a rectangular building 6.4m by 4.7m, with rendered walls and a sloping roof, situated at NY 30234 34423 some 30m north of the blocked entrance to the Roughton Gill 90-fathom level (ML14). Former windows in the southern, northern and eastern walls are now bricked-up; a single door lies in the north wall. A thick concrete wall to the east of the building is of unknown purpose, unless it is to protect the pump house from scree eroding off the hill above. Water draining from the mine seems to run beneath the pump house, with the excess

draining through a culvert to the north, and running down the access road, T23b (section 6.9.2 below), into the beck; a waterpipe presumably runs beneath the track.

The east side of the beck in Roughton Gill has been revetted by a wall formed of large boulders and concrete, but stretches have already been destroyed by stream erosion; an additional area of sloping masonry protects the side of the mine dump below the pump house. A manhole cover lies at the foot of the steep ravine part of the gill, with a small submerged weir or pipe visible across the beck just upstream.

6.9.2 Access

Tracks 23a and 23b (T23a and T23b)

Access to the pump house is now via tracks T16 and T23, although this has involved re-routing both ends of T23 from their course in phases 6 and 7. Rather than branching off T16 at NY 30128 34596 and running between building AS4 and the top of the river terrace, T23 now leaves at NY 30127 34571 and passes between that structure and the smithy (AS3, section 6.6.5 above). The diversion (T23a) was necessitated by erosion of the river terrace, but the precise date when it was created is unknown (an earlier route is probably responsible for the grassy track bisecting building AS4). At its other end, T23 has been extended to the south-east (T23b) and has cut through the finger dump running north from the entrance to the Roughton Gill 90-fathom level (ML14, section 6.6.1 above) in order to lead directly to the pump house.

6.10 Miscellaneous modern or unphased features (Fig 52)

Wall 1 (Miscellaneous M1)

Figure 40. Wall M1 in Silver Gill, viewed from the north-east (NMR/AA021975)

M1 is a short length of drystone wall visible on the east side of Silver Gill at NY 29978 34213 (Fig 40). It revets a narrow terrace immediately above the beck, at an altitude of *c* 471m AOD. Its purpose and date are unknown, but it should indicate the presence nearby of a mining-related feature – perhaps a hand-dressing floor, or even a buried mine level. The possibility of the latter is discussed further in section 7.

Wall 2 (Miscellaneous M2)

M2 is visible on the same side of Silver Gill as M1, but lower down towards the foot of the gill at NY 30130 34490 at an altitude of *c* 390m AOD. Some 3 or 4 courses of fairly large stone blocks are visible jutting out for *c* 3m at right-angles to the beck (Fig 27), and might be part of a stone weir or dam. If so, the rest of the feature has

probably been destroyed by the Silver Gill 90-fathom level (ML15) and track T16a in phase 6, although part may survive buried beneath the mine's flood bank immediately west of the beck. The extant stretch of wall lies immediately adjacent to a slight linear depression on Balliway Rigg, which might conceivably be the scar of where something like a dam wall was originally anchored (the top of a further possible short length of stone walling is visible in the south side of this depression). M1 is also in line with a spur of higher ground projecting out into the other side of Silver Gill from the foot of Yard Steel opposite; however, this spur was severely cut back when T16a was built, and it is now impossible to determine from earthwork evidence whether the spur is natural or forms part of an earthen section of dam.

Channel (Miscellaneous M3)

A narrow channel, *c* 1.5m wide by *c* 0.5m deep, is present on the hillside above mine level ML16, and runs straight uphill for over 25m between approximately the 470m and 480m contours. However, there are no signs of structures or features at either end, and the function and date of the channel are unknown.

Bield (Miscellaneous M4)

A stony bank on the southern slope of Peteraw, centred at NY 30421 34608, is a ruined bield designed to provide shelter from wind and snow for the sheep grazing on the fells. It runs north-south for almost 30m between the 416m and 422m contours, although both ends curve slightly to the east. It is now no more than an overgrown, stony bank a few decimetres high, although originally it was probably a drystone wall. It incorporates at least one large, earthfast, boulder within its length. It pre-dates 1863, when it was depicted by the OS (Fig 5), but is otherwise unphased.

Weir (Miscellaneous M5)

A metal weir was erected in the spring of 2000 across one of the mountain torrents east of Iron Crag by researchers from Durham University's Geography Department, in order to measure water flows and erosion rates. The weir is marked on plan at NY 30454 34204.

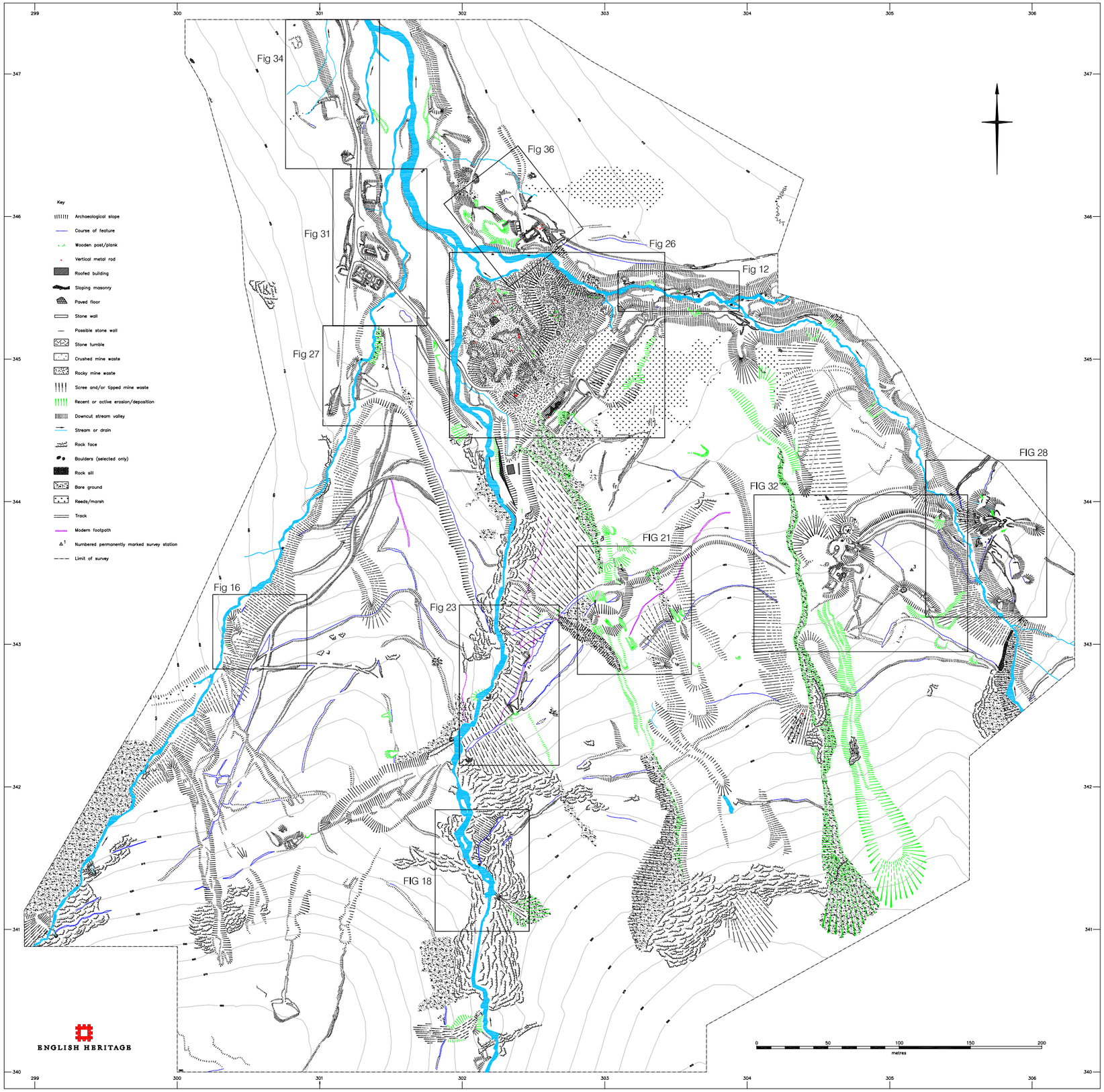

Figure 41.
Key-diagram for 1:500 windows.

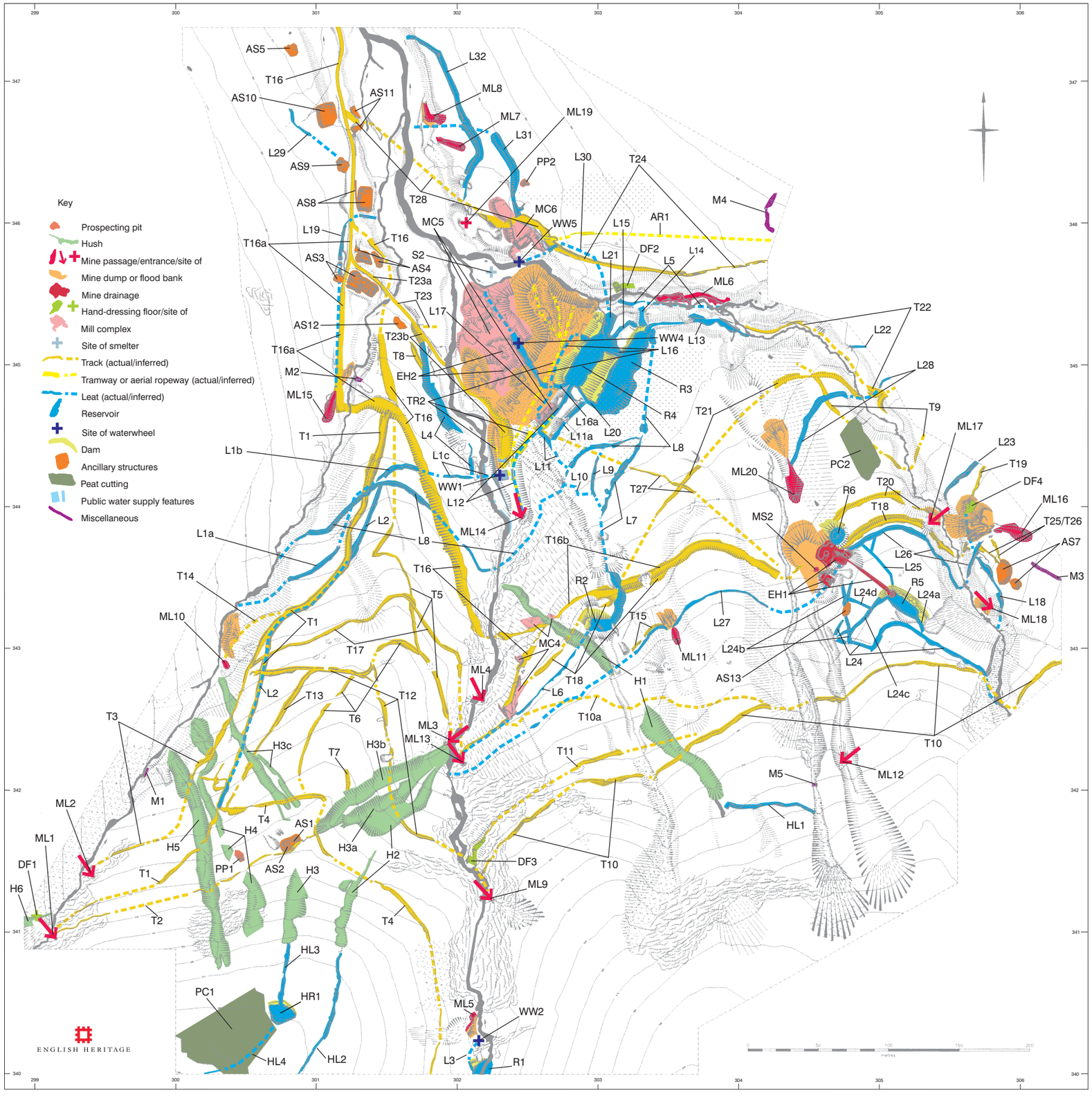

Figure 42. Interpretative diagram of all archaeological features described in the text.

7. DISCUSSION AND CONCLUSIONS

The survey has identified a succession of mining landscapes at the head of the Dale Beck valley, which documentary evidence suggests date to between the later medieval period and the end of the 19th century. The general phasing has already been outlined and discussed in the preceding feature catalogue (section 6). The following discussion is offered as a general commentary on the survey's findings, and also highlights a number of unresolved issues.

Phase 1: The mining landscape pre 1566

Shaw (1975, 7) has claimed that copper and iron mining in the Lake District started as early as the Romano-British period, but as yet there is no firm archaeological evidence that any of the area's non-ferrous metal deposits were being exploited this early. The first documentary references to mining in Cumberland are 12th-century, when the Carlisle area is recorded as a major source of silver and lead, but mining in the Caldbecks is not mentioned before 1319. It is likely that the mine referred to at this time was the Silver Gill Mine (section 5); activity at Silver Gill certainly pre-dates 1566 for men employed by the Company of Mines Royal spoke in 1602 of the activities of 'the Old Man' – traditional industry parlance describing any evidence for the activities of miners earlier than the current generation.

Physical evidence for medieval mining is notoriously hard to find, partly because it is often masked or destroyed by subsequent activity, but also on account of the simple technologies then employed which have left very little obvious archaeological trace. The survey has found only one feature which is even possibly attributable to the period - a prospection pit (PP1, section 6.1.1) on the line of the Silver Gill vein where it crosses Balliway Rigg. The 1825 map (Fig 4) implies a number of other trial pits or opencast workings formerly existed here, but if so, these are now buried beneath scree and colluvium; in any case they may not all be medieval. Lead ore would undoubtedly have been processed on site in this period, but the technology employed need not have comprised much more than an iron bar and a convenient stone on which to break up the ore, plus a water-filled trough to concentrate the heavier, lead-bearing elements. Smelting, too, would have gone on locally, in open, clamp kiln-like, furnaces, called boles (Blanchard 1981). But boles are another very simple and archaeologically inconspicuous technology, normally sited on the tops or near to the shoulders of hills in order to make use of prevailing winds to raise the temperature of the smelt; such terrain is heavily under-represented in the present survey.

Phase 2. The mining landscape 1566-1630

The activities of the Company of Mines Royal 'at Caldbeck' between 1566 and 1630, mark the start of mining on the Silver Gill vein on an industrial scale. Smith *et al* (forthcoming) have argued that a number of hand-cut or 'coffin' levels at the site can be correlated with recorded 16th- and early 17th-century mines and trials (ML1-ML4, section 6.2.2). However, the surviving company accounts from the 1570s mention three other adits which so far are unlocated, *viz* David, Elizabeth, and Marx (section 5). The accounts contain no clues as to the positions of these three relative to the identifiable mines, but we may speculate that at least one would have been sited to investigate the outcrop of the vein high up in the side of Roughton Gill, where it will have been masked or destroyed by later hushing (Blind Wastel dates from the 1580s, and lies at the base of the vein in Roughton Gill). In this respect, it

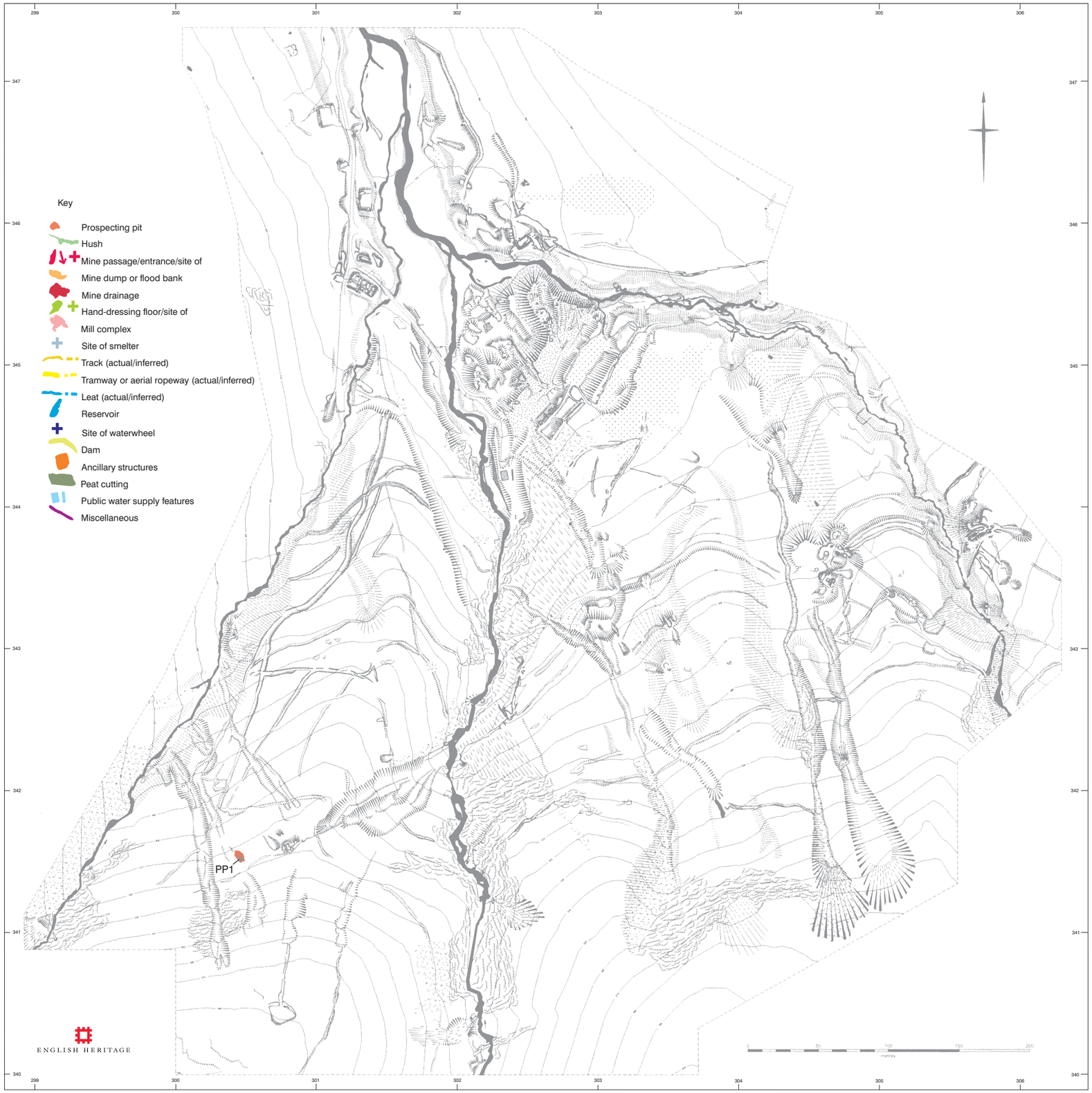

Figure 43.
Interpretative diagram of Phase 1 features described in the text.

may be relevant that the survey has identified a short length of track (T7, section 6.2.3) on the north side of hush H3b, which otherwise has no apparent destination.

The survey has recorded a building platform (AS1, section 6.2.6) on the spine of Balliway Rigg, and has followed Smith *et al* in identifying it as the site of the documented miners' lodging house said to lie 'in the tops'. However, the location of the stamping mill and washing complex (MC1, section 6.2.5), which documents place 'at the foot of the hill of the mines' (section 5), is more problematical. Smith *et al* have wondered whether old foundations close to the end of the main track (T1) coming down from the mines, and now covered by the roadway (T23) leading to the 19th-century mining works, mark its situation, citing the supply of water available from Silver Gill close by as further evidence of the suitability of the location. The identity of these foundations is unclear. The only obvious stone structure in the area is a substantial wall parallel with T23, which the survey suggests (section 6.6.2) is likely to be a 19th-century revetment to protect the track against stream erosion (the course of the Roughton Gill beck then lay further to the west).

It may be doubted, anyway, whether MC1 would have relied on water from Silver Gill alone. Any interruption to the water supply would have rendered the mill idle and threatened the mines' financial viability – as indeed happened in the dry spring of 1619 (section 5). The beck in Roughton Gill is the larger stream and presumably, therefore, also the less likely to fail in times of drought or severe cold. If MC1 lay near the mouth of Silver Gill as Smith *et al* suggest, then problems of relative height make it improbable that it could have made effective use of water coming down Roughton Gill. Instead, by far the likelier location for MC1 would be close to the head of the Dale Beck valley, where it could harness the greater reliability – not to mention power - of the Roughton Gill beck, if necessary augmented by water brought in from elsewhere as and when stream levels ran low generally. If this argument is accepted, then the site of the mill probably lies somewhere beneath the 19th-century mine dumps outside the Roughton Gill 90-fathom cross-cut, at best buried, and at worse destroyed, by them. Circumstantial evidence in support of the theory is provided by a leat system (L1/L2, section 6.2.4) which the survey has identified on Balliway Rigg. The purpose of these leats seems to be to bring water from Silver Gill (and/or the blanket bog on the high fell top) to a specific place at the foot of Roughton Gill as if to help power a mill wheel, which perhaps lay in the area of NY 3023 3442 (WW1, section 6.2.5). It is suggested here that this WW1 is probably part of MC1, but it has to be admitted that the actual date of L1/L2 - and therefore of WW1 - is unknown, and may be considerably later than the 16th century.

The survey has also identified a complex network of tracks on Balliway Rigg; although these tracks developed and evolved over many periods, several undoubtedly originated in the 16th and 17th centuries. Track T1, plus T3 which branches off it (section 6.2.2), would have formed the main access route between the hand-cut levels in Silver Gill and the stamp mill/washing complex MC1 already mentioned as lying somewhere in the floor of the Dale Beck valley. It is unclear how ore was brought down from the mines, but the width of T1 – especially in its lower stages - raises the possibility that it was by sled. Following crushing and washing, ore had to be transported to the Company's smelter at Keswick. The accounts record payments to various individuals undertaking this task (Collingwood 1912, *passim*), but make no reference as to the means or route taken. The obvious route today would be to follow the extant road (T16) north along the Dale Beck valley, and strike west around the foot of the Skiddaw massif. But there is no evidence that T16 was capable of taking wheeled traffic before the mid 19th century when large sums of money were spent

improving it (section 5); indeed, earlier in the century the mines were connected to Caldbeck village by a narrow track (T10, section 6.4.2) across the felltops, wide enough only for foot and animal traffic. Transport to and from the mines in the 16th and 17th centuries was presumably on foot or by packhorse, too, in which case the ore may well have been carried due south across the fells - probably via T1 on Balliway Rigg and T4 in Roughton Gill, and thence by way of the valleys of the River Caldew and the Glenderaterra Beck.

The survey has recorded at least six hushes or possible hushes, together with aspects of their associated water supply system of reservoirs and leats (section 6.2.1), whilst further hushes and leats lie south of the present survey area along the west sides of Silver and Roughton Gills, and in Thief Gills (Fig 7). It has been argued that the hushing on Balliway Rigg and in Silver Gill is probably all of a single period, datable on documentary evidence to *c* 1602 (H2-H6, section 6.2.1), although it is less certain whether the single hush (H1) recorded on Iron Crag also belongs to this phase (see below). All hushes recorded by the survey would appear to be prospecting hushes, after Cranstone's (1992) suggested terminology. Three (H2, and branches a and b of H3) which follow the line of the Silver Gill vein rather than running across it, could be categorised as exploitation hushes; but as there is little evidence of actual penetration into the vein it seems more likely that the intention was simply to bear the entire width to surface inspection. It is possible to determine the order in which these three hushes were created by considering how they were supplied with water. The earliest must be H2, fed by leat HL2 along the shoulder of Roughton Gill, for if H3 were earlier, H2 would surely have been supplied with water from reservoir HR1 instead; conversely, the need to construct HR1 is explained by the fact that HL2 was at too low an altitude to be used to bring water to the head of H3. This sequence is supported by the archaeological stratigraphy which shows that H3a cuts the edge of H2.

17th-century documents speak of the need for a new, lower, level in Silver Gill to help drain New Adit, and so open up ore deposits known to exist in the floor of that mine. Two propositions were mooted at various times: either to continue Blind Wastel and come in under New Adit from the east along the vein, or to drive a new cross-cut level from lower down in Silver Gill to intersect the vein 15 fathoms below New Adit. Contemporary documents suggest that neither proposal had been acted upon before the closure of Silver Gill Mine around 1630 (section 5). However, Adams (1988, 72-3) quotes a late 17th-century reference to the existence of an old level nearly 300 yards long, driven through Balliway Rigg towards Silver Gill and Golden Hue. Although Adams goes on to state that the location of this level poses something of a problem, the obvious reading is an adit driven from Roughton Gill transversely through Balliway Rigg. The recommended new, lower, level may have been dug, therefore, after 1630, but before the start of the next documented period of prolonged exploitation around 1695. If so, no sign of the level is visible on the ground today, but what may be a small stream shown draining from near the base of hush H3b on the OS map of 1863 (Fig 5) is too far north to be Blind Wastel, and hints at the possibility that another buried adit awaits discovery nearby.

Phase 3. The mining landscape *c* 1695-1730

Documents record active mine workings in Silver, Roughton and Todd Gills in this period, but give only a very sketchy picture of their layout. It is apparently at this time that the Roughton Gill vein was discovered and first worked by Dr Wright and the Company of Copper Miners in England, whilst Silver Gill Mine was re-opened by

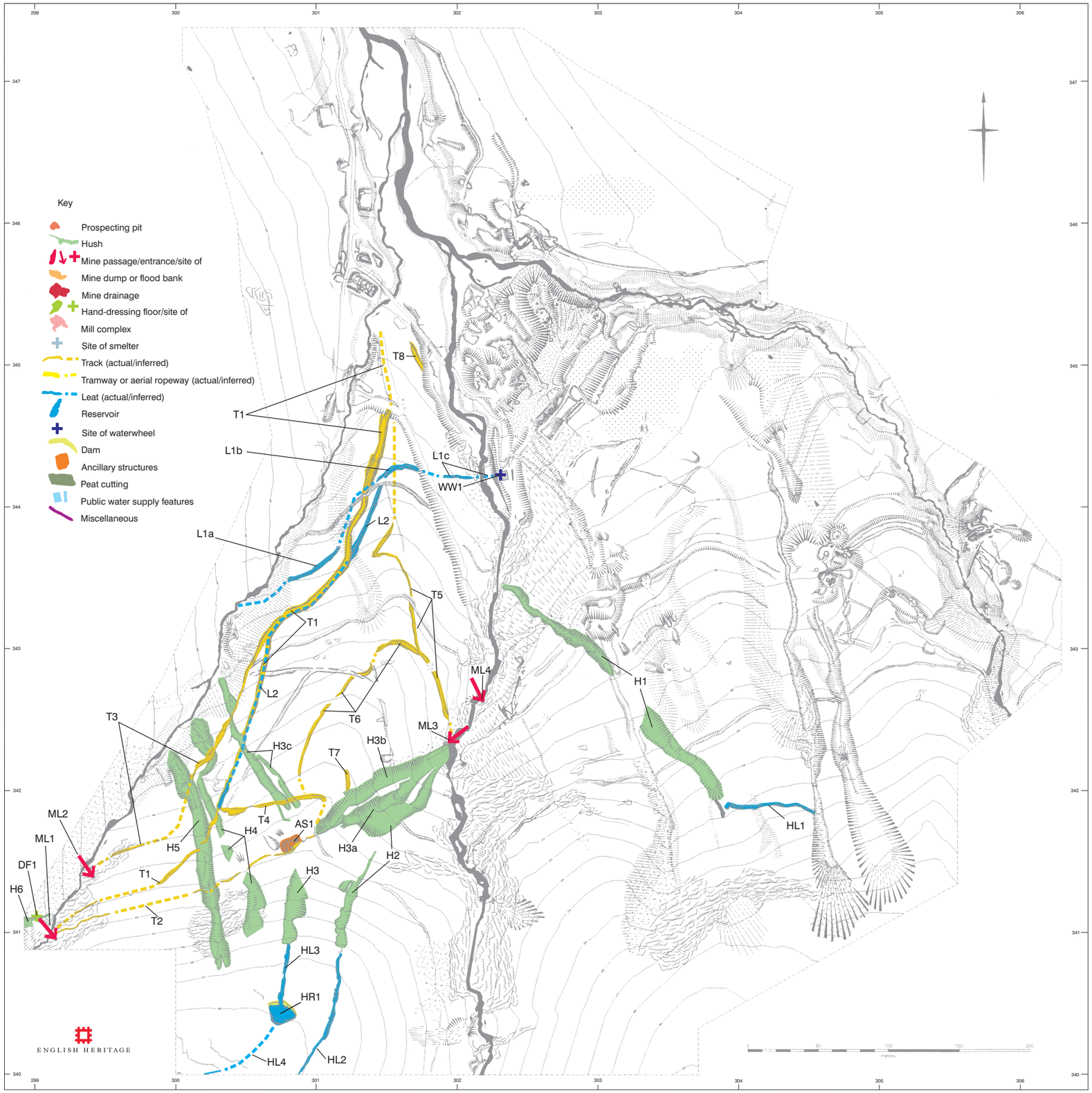

Figure 44.
Interpretative diagram of Phase 2 features described in the text.

Thomas Hillary on behalf of Lord Wharton. The documents suggest that Wharton concentrated his efforts at a mine called Golden Hugh, thought to be identical with the earlier Fortune Adit (section 5). However, it is possible that he also took forward the earlier proposal for a new, lower, cross-cut level in Silver Gill: the present survey has recorded an enigmatic stretch of dry-stone walling (M1, section 6.10) on the east side of the beck, which at *c* 471m AOD, 29.5m or some 16 fathoms below New Adit, is intriguingly at the correct relative altitude for the site of the proposed level. This walling coincides with a scalloping into the side of the gill immediately west of hush H5; the scallop is not readily explicable as part of the hush, and may rather be the site of a blocked mine passage.

The documents do not make clear where Wright or Wharton were processing their ores. Initial hand-dressing will have been carried out close to each mine entrance, and the survey has identified the possible remains of one such floor (DF2, section 6.3.5) near to mine level ML6 in Todd Gill. However, in 1724 a smelt mill is said formerly to have existed somewhere on the east side of Roughton Gill opposite Balliway Rigg. No further details about it are currently available, and it is unclear to whom it belonged (section 5), but if a smelter were present, then it is a possibility that there was also a stamp mill/washing complex nearby to process the ore more finely (S1 and MC2, section 6.3.5) . The survey has produced no archaeological evidence for where this alleged S1 (and putative MC2) were located, but given the constraints of the topography, the only two realistic possibilities on the east side of Roughton Gill are in the area of NY 3025 3426 (the site in phase 5 of mill complex MC4), or NY 3025 3455 (the site occupied in phases 6 and 7 by MC5). If Wright and Wharton were each dressing their own ores, then it is even possible that there was a second mill complex on site in this period, perhaps a rival smelter too. Intriguingly, the survey has recorded a leat (L4, section 6.3.4), which appears designed to capture the water coming into Roughton Gill via L1/L2, and divert it to the foot of Silver Gill. In addition, the survey has identified a remnant of dry-stone wall low down in Silver Gill, which is of unknown purpose but may be part of a weir or dam (M2, section 6.10). Although there is doubt as to the date of both features (and even the purpose of the latter is uncertain), together they do point to the possible existence of a mill/washing complex somewhere at the mouth of the Gill. The most likely context and date for any such complex would be early 18th century, linked to Wharton's operations at Golden Hugh.

Phase 4. The mining landscape *c* 1794-1832

The survey has recorded the presence of ore-bins and the remnants of a hand-dressing area (DF3, section 6.4.3) close to the entrance of the principal mine of this period, the 30-fathom level in Roughton Gill, but if ore were being dressed more fully on site, then, as with phases 2 and 3, the exact location where this was carried out is presently unknown. In 1825 there was at least the intention to construct a smelter in the floor of the Dale Beck valley close to the confluence of the Roughton Gill and Todd Gill becks (S2, section 6.4.3), suggesting that a mill complex (MC3) may have been situated here as well. If so, both smelter and dressing plant have been buried or destroyed by the waste tips and buildings of MC5 in phases 6 and 7. However, the Roughton Gill 30-fathom level is situated in a deep ravine difficult of access from the valley floor. The survey has recorded three tracks which converge on the mine (T10, T11 and T12, section 6.4.2). Of these, T12 could in theory have provided access to the Dale Beck valley floor, but more likely only connected the mine with the 50-fathom level in Silver Gill which was also being worked at this time. Both other tracks, in contrast, lead away east from the mine across the face of Iron Crag, and

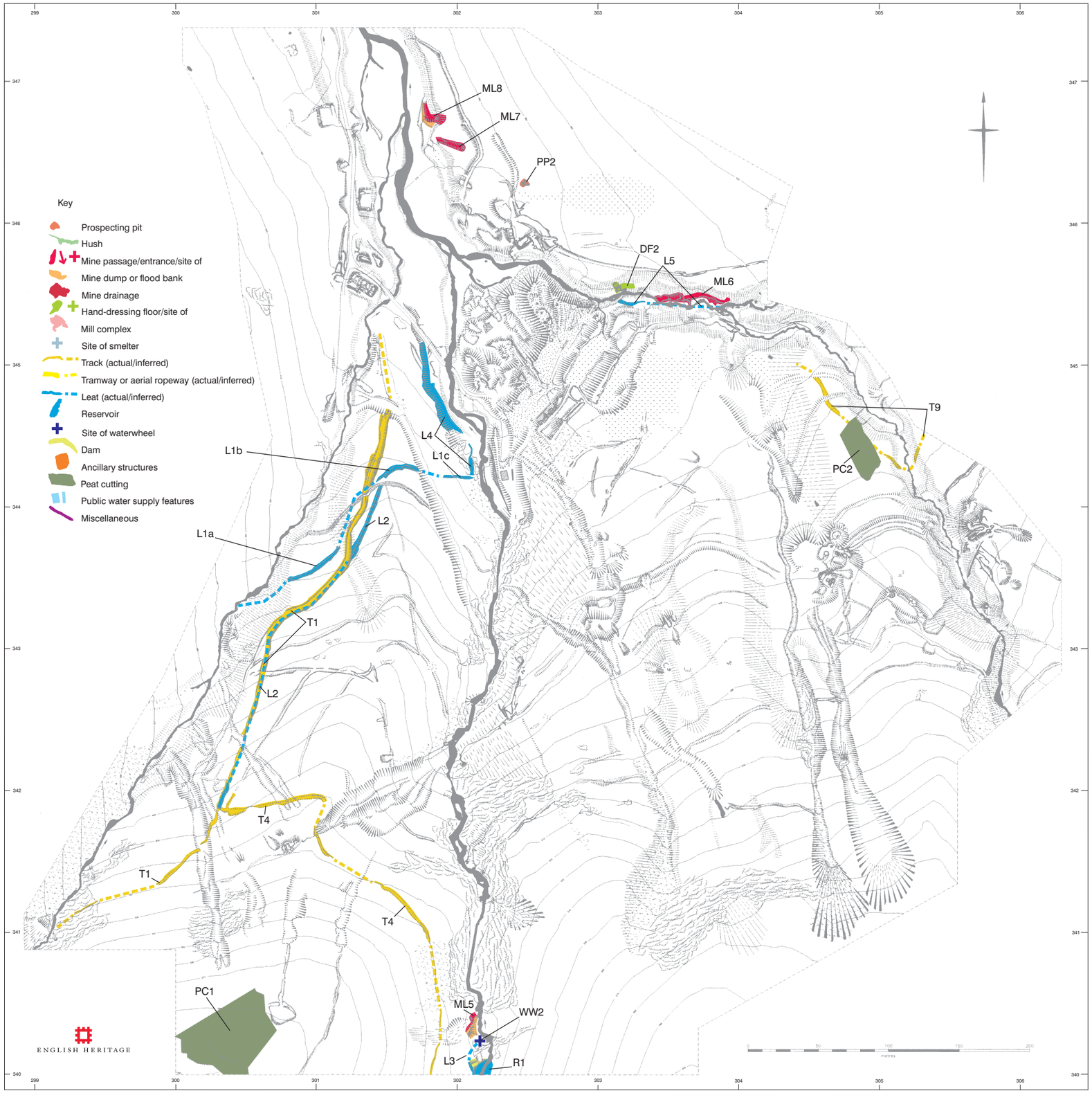

Figure 45.
Interpretative diagram of Phase 3 features described in the text.

raise the possibility that MC3 in fact lay somewhere in that direction. The likelihood of it lying beneath the phase-7 Lainton's Shaft complex is explored further below.

The survey has identified a mine level beneath Iron Crag (ML11, section 6.4.1), and has suggested that the mine must also have been active in this phase since otherwise it is hard to account for the documented discovery in the 1820s of Dobson's vein. However, it is inconceivable that the mine would have been started unless there was good prior reason for thinking a vein existed in the area, and it may well be that hush H1 (which descends the mountain side some 50m west of the mine entrance) dates to this phase rather than phase 2, and was the mechanism whereby the vein was first discovered. On present evidence this can only be a suggestion since there is uncertainty as to how far west Dobson's vein extends. Unless and until such time as it can be demonstrated that H1 cuts Dobson's vein, H1 is probably best viewed as contemporary with the other hushes on Balliway Rigg since it quite clearly cuts the line of the Silver Gill vein.

Phase 5. The mining landscape *c* 1832-1845

This is the first period in which the location of the dressing plant at the mines can be positively identified. Documents tell us that the owners of the mining concession raised fresh capital at the start of the phase in order to drive the 60-fathom cross-cut and work the lower levels of the Roughton Gill vein, but the survey has shown that some of this capital must have gone into financing the construction of a mill complex close to the mine entrance as well. The site is now heavily obscured by scree, however, and only small areas are currently visible to surface inspection (MC4, section 6.5.4). The complex is terraced into a steep hillside, and under serious threat from erosion, but the masking effects of the scree make it impossible to gauge accurately the degree of loss that has already taken place. The pressure of soil and rock moving downhill has already caused most of the stonework surrounding the ore bins at the rear of the complex to collapse, but the biggest threat and area of greatest existing loss must undoubtedly be to the front edge of the processing area. The survey has identified a number of wooden structures here which are slowly being exposed and destroyed as scree moves downhill. It is possible that underneath the scree blanket there are still pockets of good *in situ* structural preservation, but overall it seems likely that much will already have been lost. The survey has shown that the complex was accessed by a road (T16, section 6.5.2) terraced into the side of Balliway Rigg at a gradient often approaching 1:5 - another major building project which can be assigned to this phase.

A number of older mines are also documented as being re-worked at this time, including what were then known as the 8-fathom and 20-fathom levels in Silver Gill. These are undoubtedly the same as the 16th-century Emanuel Adit and New Adit. Heights of mines were conventionally given relative to the lowest exposure of the vein or to an existing mine level. EH has measured the heights of the floors at the entrances to the two mines as 524.25m and 500.5m AOD respectively, whilst according to Smith *et al* (forthcoming) the lowest point on the outcrop of the Silver Gill vein in Silver Gill itself is approximately 541m - a height difference of 16.75m or just over 9 fathoms for Emanuel, and of 40.5m or some 22 fathoms for New Adit. The apparent discrepancy between these values and the height differences implied by the 19th-century mine names could be explained by the fact that heights were measured by dropping ropes down shafts or stopes connecting the various levels at the vein wall, rather than at the mine entrances. The 8-fathom level does not appear on the OS map of 1863 (Fig 5), showing that it was already disused and obscured

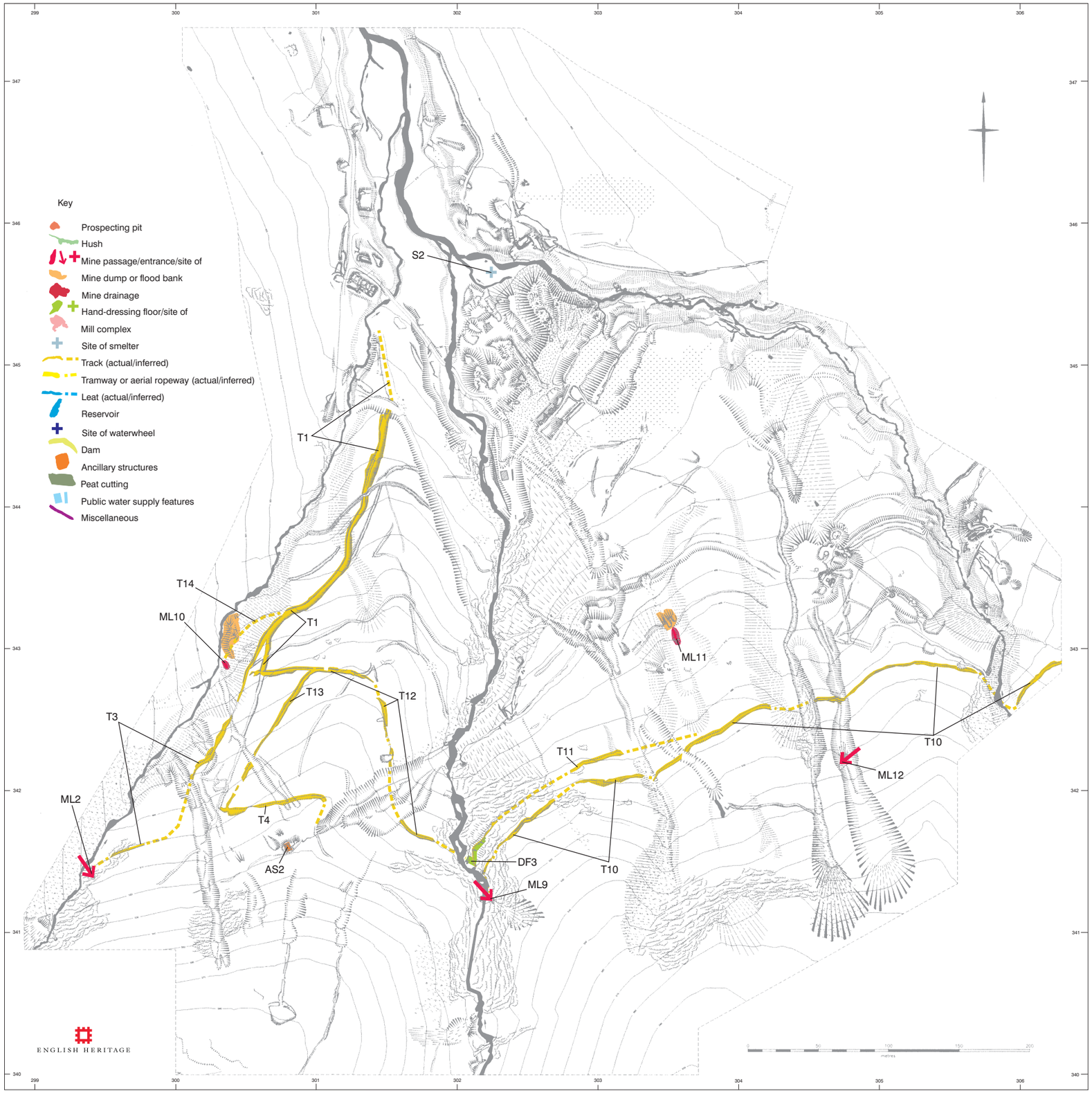

Figure 46.
Interpretative diagram of Phase 4 features described in the text.

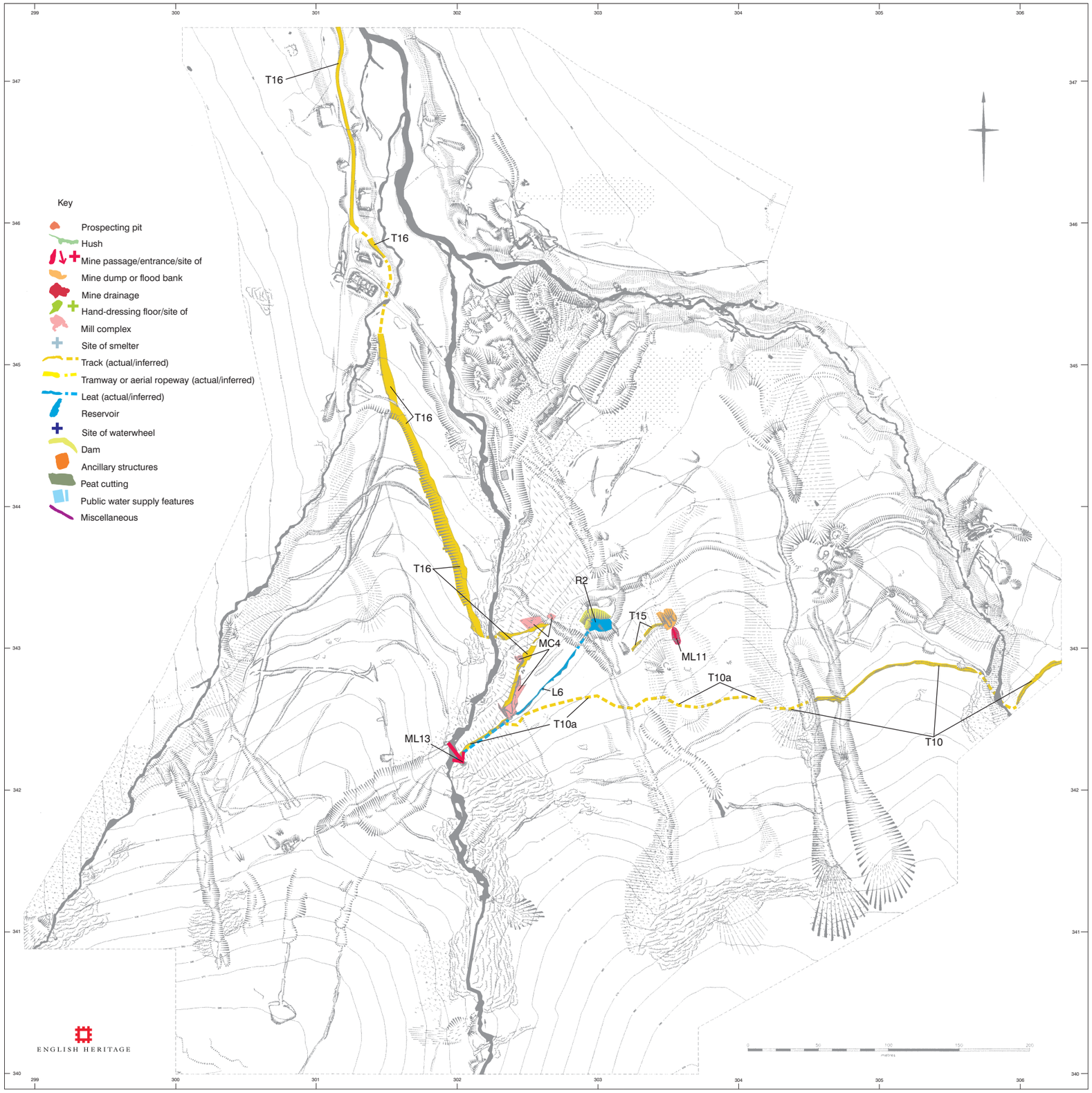

Figure 47.
Interpretative diagram of Phase 5 features described in the text.

beneath scree by the end of the phase. It was only re-discovered in 1997 (section 4), showing how readily mine entrances can become buried and forgotten. It must be a distinct possibilty that further adits await discovery in the steeper parts of the gills.

Phase 6. The mining landscape *c* 1849-1865

Documentary evidence indicates that this period is characterised by a degree of investment in the mine infrastructure probably unparalleled since the 16th century. The documents suggest that much of this investment went into the construction of a new dressing plant (MC5, section 6.6.4) and smelter, but the latter lies outside the area of survey at the mouth of Hay Gill, and the former was thoroughly demolished when the mine closed in 1876. Nevertheless, the survey has revealed that structural traces, including wooden features, do survive within the area of the dressing plant, and are gradually being exposed as the tailings dumps erode. Taken together, this suggests that it was principally the buildings that were salvaged, with many of the lesser structures simply abandoned. There must be the outside possibility, however, that some of the surviving wooden structures belong to earlier mill complexes instead, for example MC3 of phase 4.

The survey has also thrown light on the scale of work undertaken to ensure that the dressing plant did not run short of water. New leats brought water from as far away as Silver and Blea Gills and stored it in two new large reservoirs, whilst the existing water supply system to MC4 was diverted, and water draining from the 90-fathom cross-cut was also connected in to the system.

The survey has also recorded a level at the mouth of Silver Gill (ML15, section 6.6.1), and suggested that it is probably the same as the 90-fathom level mentioned by Shaw. All the evidence points to it being in operation for only a short time in the 1850s. It is probable that it was begun in order to examine the western end of the Silver Gill vein at depth, but was abandoned when an internal drive along the vein from inside the 90-fathom cross-cut in Roughton Gill – which intersected it further east - showed it not to be worth developing further. The survey has recorded the mine's altitude as c 391m, some 150m or 82 fathoms beneath the outcrop of the vein in Silver Gill. This suggests that Shaw's labelling of the mine as the 90-fathom level may well simply be a shorthand device for saying it was a deep level, and need not represent the original 19th-century name.

Phase 7. The mining landscape *c* 1865-1878

Many of the major developments of this period took place underground, or at Mexico Mine, or in the upper reaches of Roughton Gill, and so lie beyond the scope of the present survey. However, one major event firmly within the survey area was the digging of Lainton's Shaft. Cornish mining engineers who had been commissioned by the mine's new owners to report on future prospects, stated that rich ore deposits could be found further east, and recommended the sinking of a pump shaft to help drain the mine passages as they were extended east along the vein from the 90-fathom cross-cut in Roughton Gill (section 5). However, the engineers seem to have recommended the application of Cornish mining techniques - with which they were obviously most familiar - directly to Cumberland without considering whether they were actually appropriate. Cornish mines lay mostly deep underground, and had to be continually pumped dry. But in Cumberland, the upland terrain meant that veins were normally intersected horizontally by levels, rather than vertically by shafts, and could (unlike their Cornish counterparts) be largely drained by gravity. Lainton's Shaft was

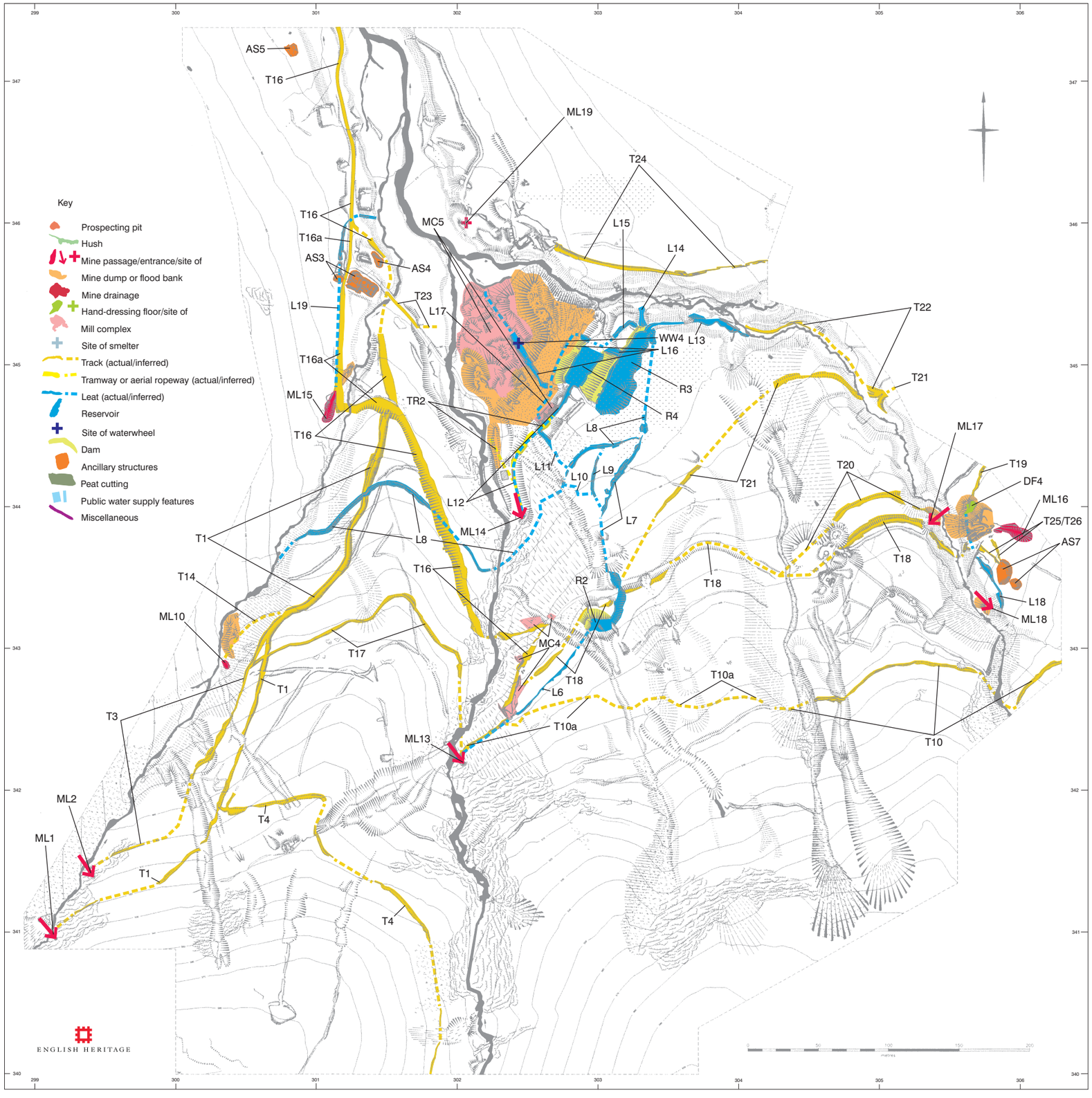

Figure 48.
Interpretative diagram of Phase 6 features described in the text

an expensive white elephant, therefore, in terms of its main purpose of draining the 90-fathom level, although it may have helped improve ventilation. It only truly came into its own between 1869 and 1870 as the Company began to sink below the 90-fathom level in desperate search of the elusive rich ore deposits they had been assured existed, and could no longer rely on gravity to drain the workings. However, although ore was found, it proved insufficient to justify the costs of pumping, and the shaft and whole eastern sector of the mine were abandoned.

The survey has identified a complex system of reservoirs and leats on the hillside above Lainton's Shaft, and interpreted it as designed to supply water to the boilers of the steam pumping engine (section 6.7.3). However, the survey has also shown that the layout of leats was modified on at least two occasions. This is difficult to reconcile with the short time that the engine is documented as actually in use. Furthermore, the survey has found that the chimney from the engine house was inserted into the end of reservoir R5, which suggests that the reservoir may by then have been disused. All this raises the possibility that the water supply system in fact pre-dates the sinking of the shaft, but if so, there is little evidence of what that activity may have been, or to what period it belongs. Provision of water suggests two possibilities: hushing; or dressing of ore. We may discount the first alternative, since there are no signs of hush channels in the vicinity. But the second option cannot be so readily dismissed, and has the advantage of providing a plausible context for the rather enigmatic feature on the eastern edge of the shaft complex. The survey has classified this feature as a reservoir (R6, section 6.7.3), but certain peculiarities of form such as the presence of a central raised 'island' cast doubt on the identification, and it is possible that it could rather be a horse whim, or perhaps even some kind of buddle. The date of this postulated earlier activity is equally uncertain, but the most likely candidates would be phase 6 connected with mine level 16 on the east side of Blea Gill, or perhaps phase 4 and the site of the postulated dressing plant MC3.

Phase 8. The mining landscape *c* 1888-1894

The contemporary description and plan of the umber mill 'at Roughtongill Head' published by its architect, Percy Addison (1890), has enabled the survey positively to equate the site of the mill with a group of ruined buildings (MC6, section 6.8.3) lying at the foot of Peteraw; previously the general assumption seems to have been that these buildings formed part of the ore-dressing plant of the Roughton Gill lead works (*eg* Cooper and Stanley 1990, 48 and 62). On the whole, the archaeological evidence accords well with what is shown on the plan, but the main buildings were evidently built in stone, not wood as stated. The survey has also revealed the presence of a number of additional features not included on plan (principally a large platform and two leats (L31 and L32, section 6.8.2) situated north of the access road T28) but has been unable to identify the precise roles they played in the functioning of the mill. No firm evidence has been found of the aerial tramway (AR1, section 6.8.1) which Addison claims transported umber to the mill from the China Clay Mine in the east, but the majority of its presumed course lies outside the area of the present survey, and it may be that traces survive elsewhere.

Until recently a broken grindstone stood close to the mill (Cooper and Stanley 1990, Fig 39), but has now been removed from site and erected in Caldbeck churchyard as a memorial to the long association between the Caldbeck area and lead mining. The identification of these ruins as those of the umber mill, however, means that the grindstone is likely to be a remnant of the umber trade, and probably has no direct connection with the lead industry.

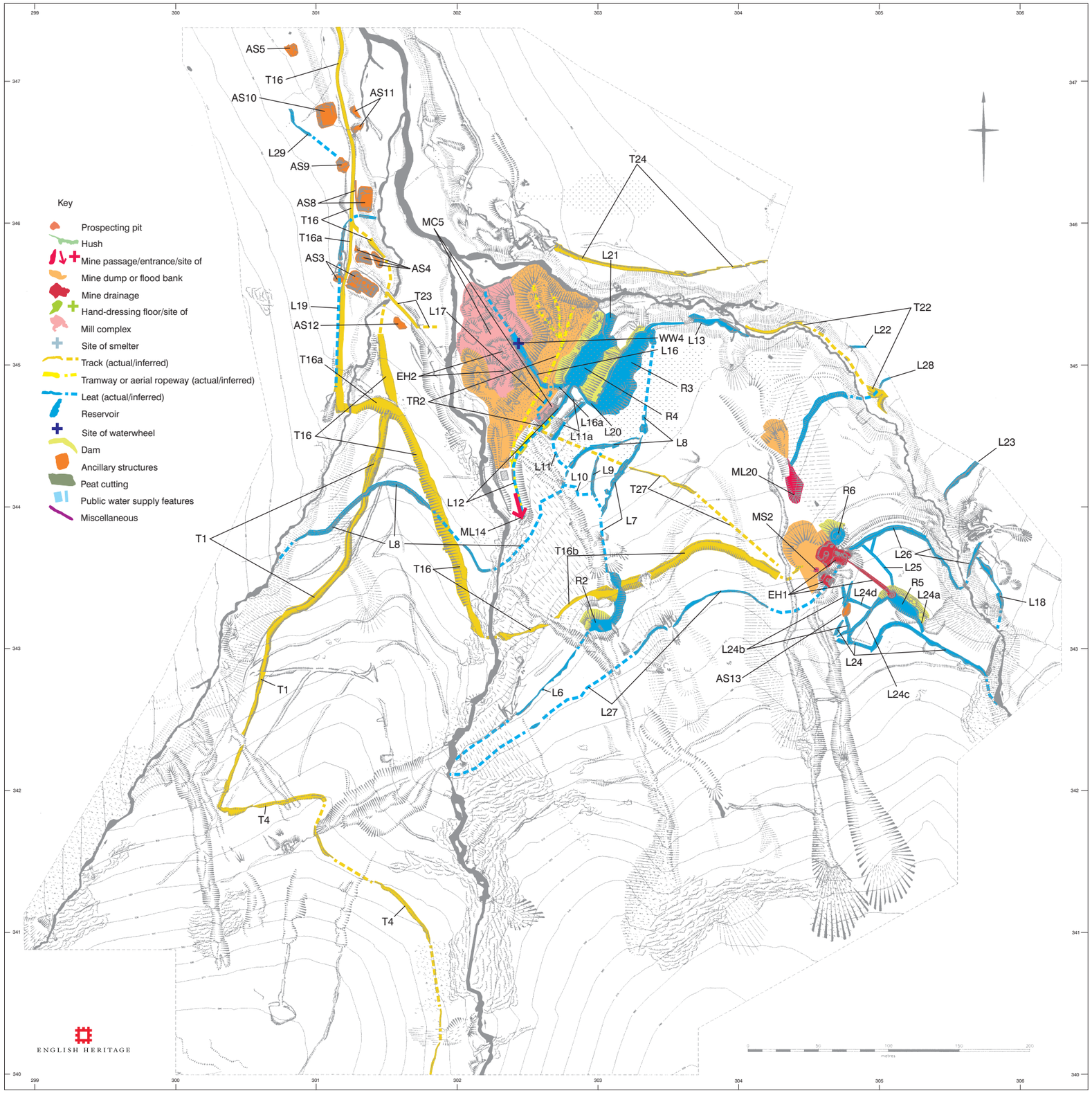

Figure 49.
Interpretative diagram of Phase 7 features described in the text.

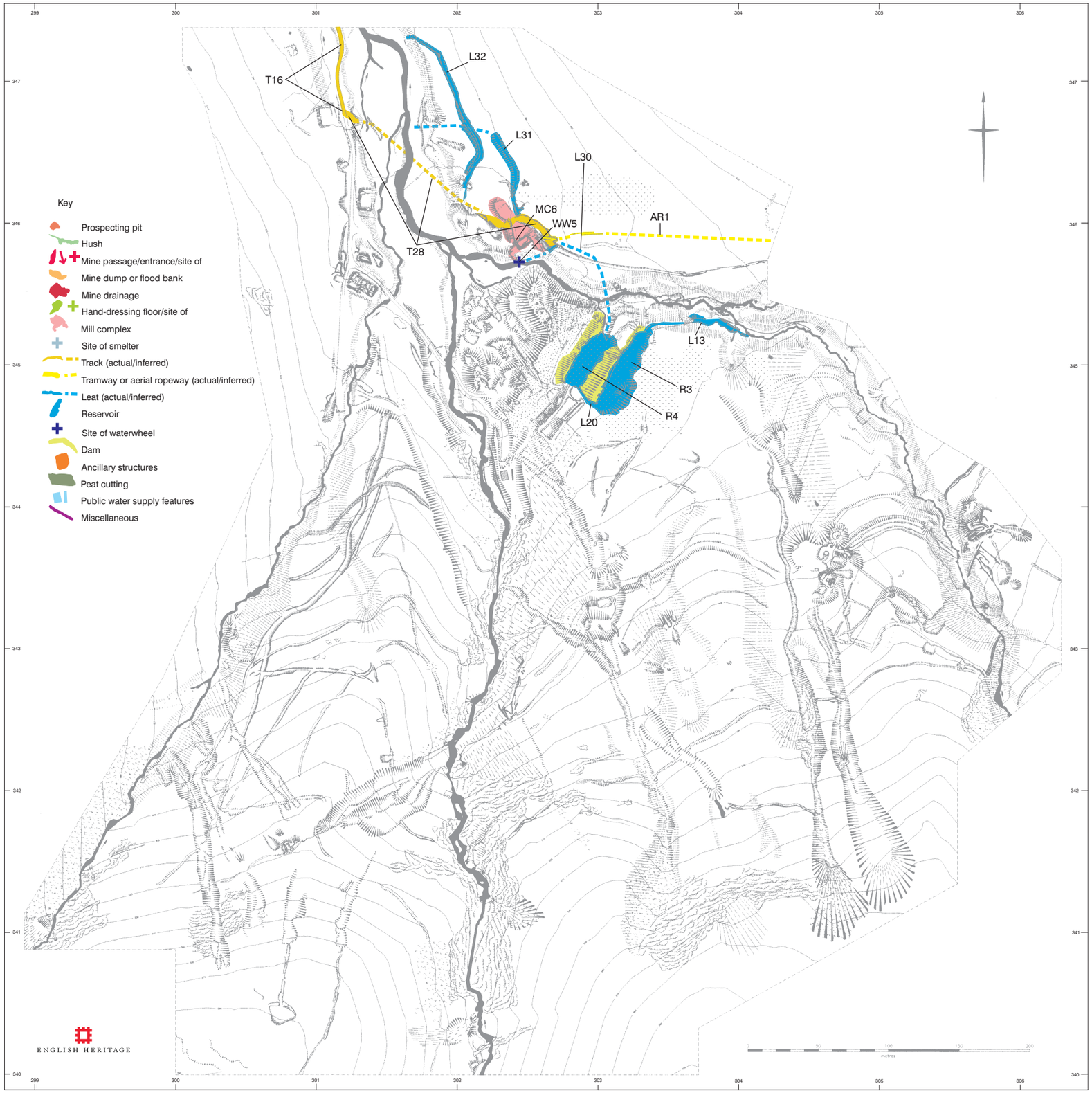

Figure 50.
Interpretative diagram of Phase 8 features described in the text.

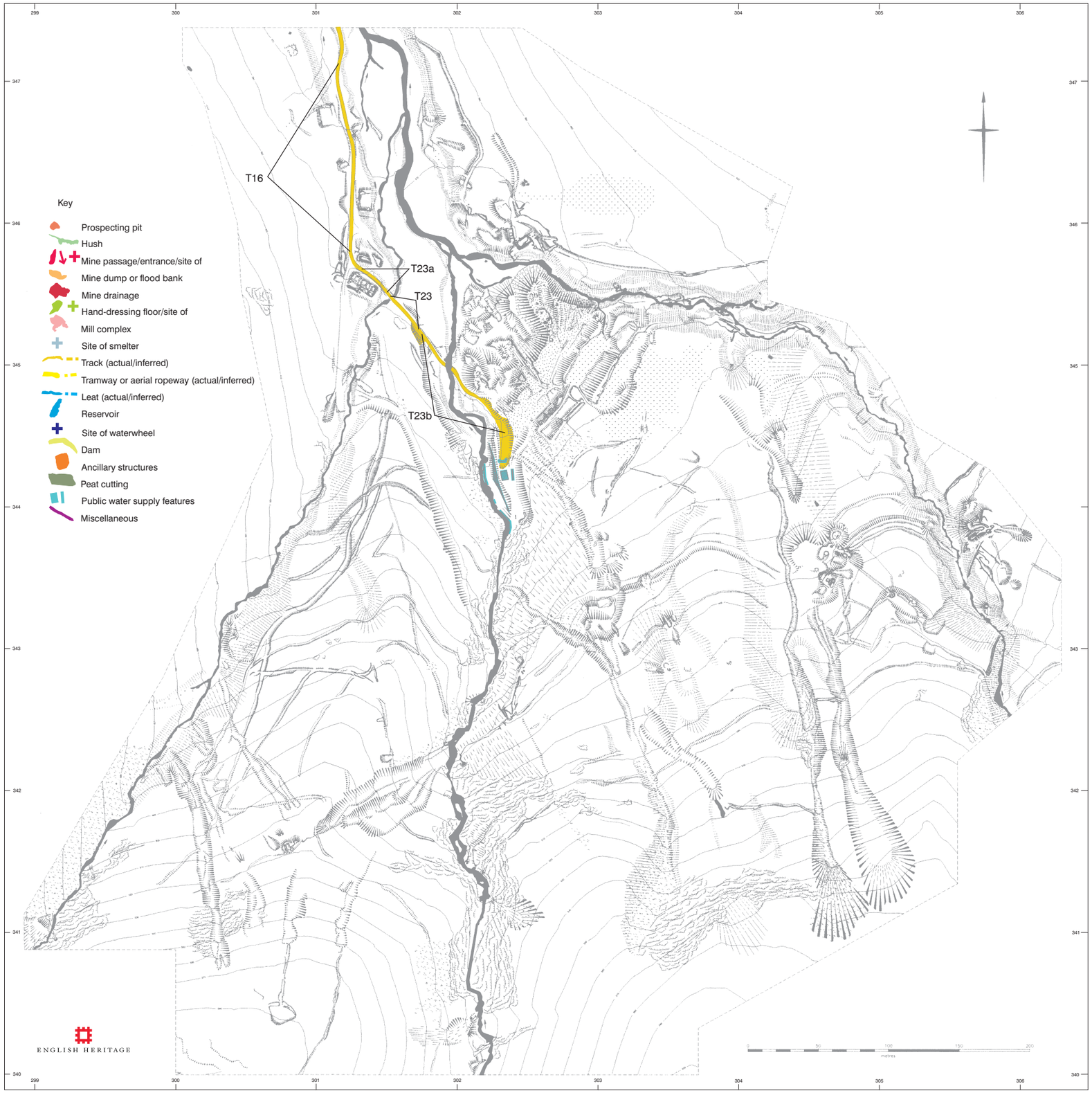

Figure 51.
Interpretative diagram of Phase 9 features described in the text.

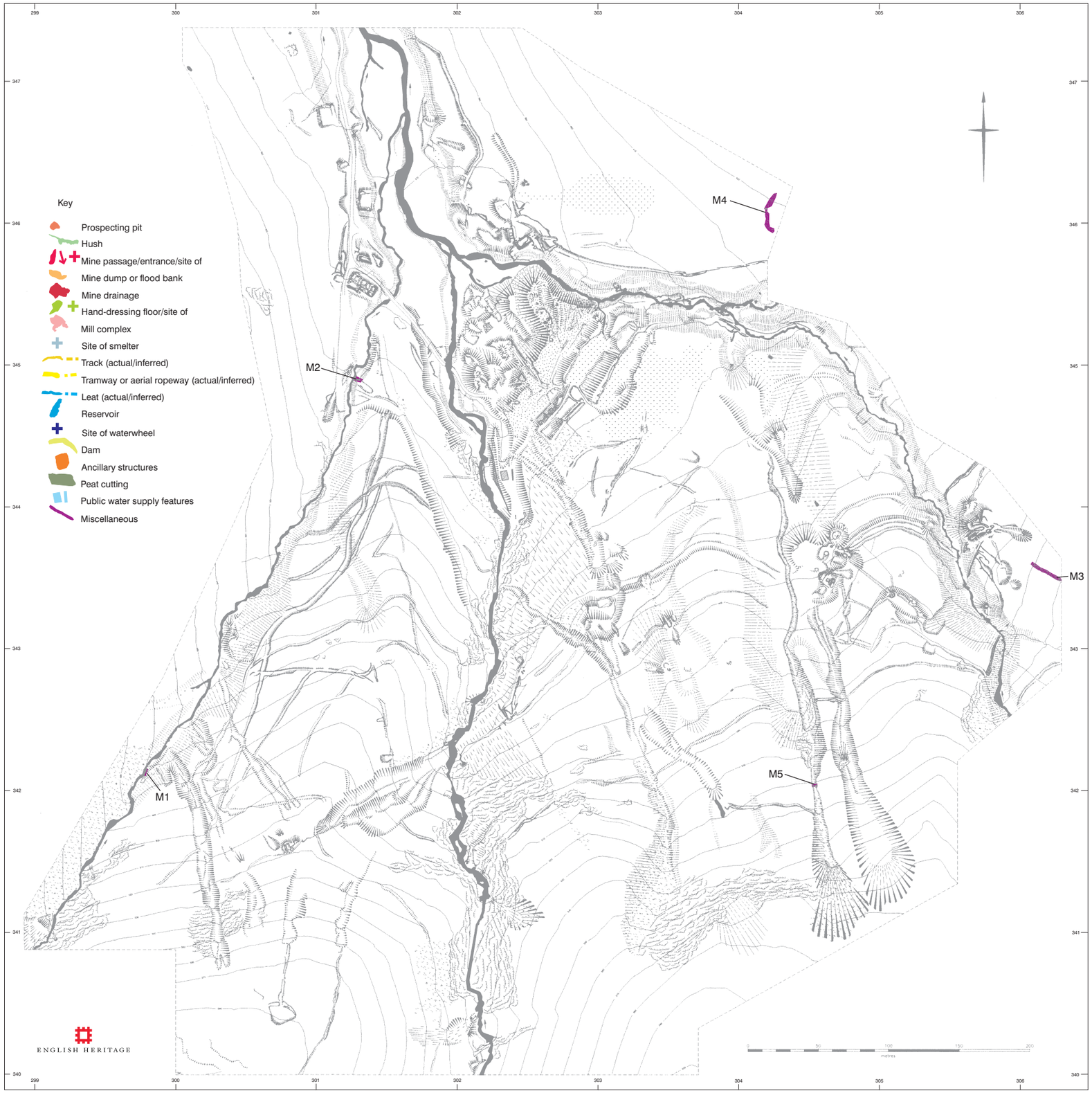

Figure 52.
Interpretative diagram of miscellaneous modern or unphased features described in the text.

8. SURVEY METHODOLOGY

The survey was carried out using a combination of traditional, theodolite-based, land survey techniques and Global Positioning System (GPS) technology.

Because of the initial unavailability of GPS, the survey was commenced using a Leica TC805 total station theodolite to observe a ring traverse of four stations as a divorced survey. The observed accuracy of this traverse was -26 seconds of arc and 0.015m in height, well within the acceptable limits of tolerance of ±38 seconds and 0.022m (calculated as a function of overall length of the traverse against the number of legs involved). Stations 1, 2 and 3 were all permanently marked by brass rivets drilled into earthfast boulders to enable re-occupation and re-generation of the survey grid at any future date. Points of archaeological and topographical detail were observed by radiation from this traverse, coded with line and point information, processed using KeyTERRA-FIRMA survey software, and loaded into an AutoCAD .dwg file.

When Trimble dual frequency GPS receivers became available half-way through the survey, station 1 was chosen to serve as the local (site) base station, and WGS84 co-ordinates were recorded for stations 2 and 3 relative to it. European Terrestrial Referencing System (ETRS89) co-ordinates were calculated for station 1 based on a synchronous occupation with the OS passive GPS station C1NY2938 some 4km to the north. The derived ETRS co-ordinates for station 1 were then converted to OS National Grid (NG) values via the NG transformation algorithm OSTN97, the positions of the other two stations adjusted accordingly, and the divorced survey theodolite data converted to OS NG. All further detail points were then picked up by differential GPS survey relative to station 1. ETRS89 co-ordinates derived using OS passive stations and differential GPS survey have a typical 5cm horizontal accuracy, although vertical accuracy can be as much as three times worse. Quality control tolerances for detail points were set at 0.02m horizontally, and 0.05m vertically, although occasionally at times of poor satellite availability these were degraded by up to a factor of 2. The relative accuracy of points in the database should therefore be within 0.04m horizontally, and 0.1m vertically, although absolute accuracy relative to OS NG values, particularly for heights, cannot be guaranteed better than 0.25m. All GPS data were processed using Trimble Geomatics Office software, and added to the AutoCAD .dwg file via KeyTERRA-FIRMA in order to incorporate line and point code information.

Details of, and information for relocating, all permanently marked survey stations are attached at Appendix 3 below.

9. ACKNOWLEDGMENTS

Field investigation and survey was carried out by Christopher Dunn, Marcus Jecock and Amy Lax, all staff of English Heritage's York office. The report was researched and written by Marcus Jecock, and edited by Christopher Dunn and Amy Lax. Drawn survey diagrams are the work of Philip Sinton, with the exception of Figs 42-52 which were produced by Marcus Jecock, who also adapted Fig 1 from an original prepared by Alastair Oswald. Site ground photography was by Keith Buck. Dr Paul Barnwell kindly assisted by borrowing books in the collection of Leeds University library.

English Heritage would like to thank Warren Allison, Peter Blezard, and John Hodgkins of MoLES, who willingly shared their first-hand knowledge of the site acquired over many years, and engaged in much useful dialogue as to the interpretation of features. This report would be the poorer without their insight and advice. Warren Allison also shared his personal library of mining documents copied from originals stored in the Carlisle Record Office. Sam Murphy and Richard Smith kindly provided a copy of their forthcoming joint paper on the identification of the Silver Gill vein as the site of the Company of Mines Royal's Caldbeck operations, and also shared their detailed knowledge and ongoing research into Roughton Gill Mine's later history, all in advance of publication. EH is also grateful to the Natural History Museum, London, for permitting reproduction of Fig 4. The LDNPA's Archaeologist, John Hodgson, is to be thanked for setting up the survey, and for lending the Authority's dyeline copies of the most recent survey of the Caldbeck Fells by the British Geological Survey.

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Appendix 1: The archive and photographic record

A survey archive consisting of original hard-copy items such as annotated field sheets, plus background information including Project Designs and correspondence, has been deposited with the NMRC in Swindon under Collections UID 1341265, where it is available for public consultation upon request. Digital data exist as a series of AutoCAD files; these are currently held at both the EH office in York and at the NMRC, and are also publicly available.

Original ground photography taken by EH is listed below, and can be consulted at the NMRC by quoting photographic job number 2K/02307.

AA021943	Ore bins in mill complex MC5, viewed from the north
AA021944	Base of engine-house chimney in mill complex MC5, viewed from the north
AA021945	Walls at northern edge of mill complex MC5, viewed from the north-west
AA021946	Wooden mortice-and-tenon frame exposed by erosion at mill complex MC5
AA021947	General view of mill complex MC5, viewed from the north
AA021948	Structures at northern edge of mill complex MC5, viewed from the north-east
AA021949	Wheel-pit WW4 and engine-house EH2 in mill complex MC5, viewed from the north
AA021950	Exposed roof timbers in mine level ML6 in Todd Gill, viewed from the west
AA021951	View east over umber mill MC6
AA021952	The drying shed at the umber mill MC6, viewed from the north
AA021953	The umber mill MC6, viewed from the south
AA021954	General view from the west of mine level ML6 in Todd Gill
AA021955	Mine level ML20 and the Lainton's Shaft complex viewed from the north
AA021956	Cistern or balance-box pit east of Lainton's Shaft
AA021957	Ruins of the Cornish engine house EH1 at Lainton's Shaft, viewed from the north
AA021958	Flue from boiler house at Lainton's Shaft, viewed from the north-west
AA021959	Detail of boiler-house chimney above Lainton's Shaft, viewed from the south-east
AA021960	View south-east over mine level ML18 in Blea Gill, with track T10 on the hillside behind
AA021961	Reservoir R5 above Lainton's Shaft, viewed from the south-east
AA021962	Illicit mineral collecting at mine level ML12, viewed from the north-east
AA021963	Tracks T5, T17 and T16 on Balliway Rigg viewed from beneath Iron Crag
AA021964	Track T16 and the 20th-century pump house viewed from beneath Iron Crag
AA021965	General view north-east over reservoirs R3 and R4
AA021966	Detail of wooden launder-box buried in scree at mill complex MC4
AA021967	The blocked entrance to the Roughton Gill 90-fathom cross-cut
AA021968	View south up Roughton Gill from the head of the Dale Beck valley towards mill complex MC4

AA021969	Roughton Gill and Iron Crag from the foot of Swinburn Gill
AA021970	General view of GPS at station 1, viewed from the north-east
AA021971	Detail of GPS at station 1, viewed from the north-east
AA021972	Detail of GPS at station 1, viewed from the south-east
AA021973	Leat L8 on Balliway Rigg, viewed from the west
AA021974	View north-east down track T1 on Balliway Rigg, with leat L8 at left of frame
AA021975	Wall M1 in Silver Gill, viewed from the north-east
AA021976	Entrance to the 16th-century Emanuel Adit in Silver Gill
AA021977	General view down Silver Gill from Emanuel Adit
AA021978	View north-east over the site of the 16th-century miners' lodging house and 19th-century smithy on Balliway Rigg
AA021979	View north down the Dale Beck valley from Balliway Rigg
AA021980	General view north-east down Silver Gill
AA021981	General view north-east from the top of Silver Gill
AA021982	View of tracks T1, T3 and T13 on the west flank of Balliway Rigg from near the top of Silver Gill
AA021983	General view north from the top of Balliway Rigg
AA021984	General view north from the top of Balliway Rigg
AA021985	View north-east across the main mine workings (mill complex MC5) at the head of the Dale Beck valley, from the top of Balliway Rigg
AA021986	Hush leat HL2 on Balliway Rigg, viewed from the south
AA021987	View east over reservoir R1 and the site of waterwheel WW2 in upper Roughton Gill
AA021988	Detail of the dam to reservoir R1 in upper Roughton Gill, viewed from the south
AA021989	The blocked entrance to the Roughton Gill 30-fathom cross-cut
AA021990	View south-east towards dressing-floor DF3 below the Roughton Gill 30-fathom cross-cut
AA021991	Entrance to the Roughton Gill 60-fathom cross-cut
AA021992	Entrance to the 16th-century Blind Wastel in Roughton Gill
AA021993	Balliway Rigg from the east showing Blind Wastel and hushes H2, H3a and H3b
AA021994	Spindle near top of dam to reservoir R2
AA021995	View east along track T16b
AA021996	Umber mill platform adjacent to the beck in Todd Gill, viewed from the south-west
AA021997	Brick pier base in the beck in Todd Gill near to the umber mill
AA021998	Mine level ML7 viewed from the west
AA021999	General view of Iron Crag from the north
AA022000	Building AS9 from the south-east
AA022001	Building AS8 from the west
AA022002	Smithy (AS3) from the west
AA022003	The entrance to the Silver Gill 90-fathom level from the north-east
AA022004	General view east up Todd Gill from the foot of Balliway Rigg
AA022005	The umber mill MC6 from the foot of Yard Steel
AA022006	Umber mill grindstone relocated to Caldbeck churchyard

Appendix 2: Concordance of NMR numbers linked to the survey

SITE NAME	COUNTY	DISTRICT	PARISH
Roughton Gill Mine	Cumbria	Allerdale	Caldbeck
Silver Gill Mine	Cumbria	Allerdale	Caldbeck

SITE NAME	NGR	NMR No.
Roughton Gill Mine	NY 3025 3455	NY 33 SW 12
Silver Gill Mine	NY 299 341	NY 23 SE 3
Prospecting pit PP1	NY 30048 34149	NY 33 SW 25
Emanuel Adit	NY 29915 34095	NY 23 SE 4
New Adit	NY 29942 34139	NY 23 SE 5
Blind Wastel	NY 30192 34233	NY 33 SW 13
'1600 cross-cut'	NY 30218 34264	NY 33 SW 14
Hush H1 and hush leat HL1	NY 3035 3423	NY 33 SW 15
Hush H2	NY 3015 3417	NY 33 SW 16
Hush leat HL2	NY 3011 3404	NY 33 SW 17
Hush H3	NY 3011 3418	NY 33 SW 18
Hush reservoir HR1 and hush leat HL3	NY 3075 3406	NY 33 SW 19
Hush H4	NY 3040 3417	NY 33 SW 20
Hush H5	NY 3020 3415	NY 33 SW 21
Hush H6	NY 2987 3410	NY 23 SE 6
Dressing floor DF1	NY 2990 3411	NY 23 SE 7
Miners' lodging house AS1	NY 30082 34162	NY 33 SW 22
Mill complex MC1	NY 302 344	NY 33 SW 23
Leats L1 and L2	NY 3012 3436	NY 33 SW 24
Prospecting pit PP2	NY 30250 34628	NY 33 SW 26
Mine level ML5	NY 30210 34039	NY 33 SW 27
Mine level ML6	NY 30341 34547	NY 33 SW 28
Mine level ML7	NY 30204 34654	NY 33 SW 29
Mine level ML8	NY 30185 34674	NY 33 SW 30

Mine shaft MS1 and waterwheel WW2	NY 3022 3402	NY 33 SW 31
Reservoir R1 and leat L3	NY 3021 3401	NY 33 SW 32
Leat L4	NY 3019 3445	NY 33 SW 33
Smelter S1	NY 3025 3426 or 3025 3455	NY 33 SW 34
Peat cutting PC1	NY 3003 3403	NY 33 SW 35
Peat cutting PC2	NY 3049 3444	NY 33 SW 36
Roughton Gill 30-fathom cross-cut	NY 30227 34124	NY 33 SW 37
Silver Gill 50-fathom cross-cut	NY 30037 34287	NY 33 SW 38
Mine level ML11	NY 30356 34307	NY 33 SW 39
Mine level ML12	NY 30473 34220	NY 33 SW 40
Track T10/T10a	NY 3041 3424	LINEAR 818
Dressing floor DF3 and ore bins	NY 3021 3415	NY 33 SW 42
Smelter S2	NY 3025 3455	NY 33 SW 43
Smithy AS2	NY 30080 34160	NY 33 SW 44
Roughton Gill 60-fathom cross-cut	NY 30204 34219	NY 33 SW 45
Tracks T16 and T23	NY 3015 3447	LINEAR 819
Reservoir R2/leat L6	NY 3030 3431	NY 33 SW 47
Mill complex MC4 and ore bins	NY 3025 3426	NY 33 SW 48
Roughton Gill 90-fathom cross-cut	NY 30247 34392	NY 33 SW 49
Silver Gill 90-fathom cross-cut	NY 30108 34462	NY 33 SW 50
Mine level ML16	NY 30602 34381	NY 33 SW 51
Mine level ML17	NY 30536 34387	NY 33 SW 52
Mine level ML18	NY 30578 34330	NY 33 SW 53
Mine level ML19	NY 3021 3460	NY 33 SW 54
Water storage system for mill complex MC5 (Reservoirs R3-R4 and leats L7-L17)	NY 303 345	NY 33 SW 55
Mill complex MC5 and ore bins	NY 3025 3450	NY 33 SW 56

Smithy (AS3)	NY 30133 34556	NY 33 SW 57
Ancillary structure AS4	NY 30139 34574	NY 33 SW 58
Magazine? (AS5)	NY 30084 34722	NY 33 SW 59
Ancillary structure AS7	NY 30587 34354	NY 33 SW 60
Lainton's Shaft (MS2)	NY 30456 34356	NY 33 SW 61
Engine house EH1	NY 30463 34349	NY 33 SW 62
Mine level ML20 (drainage level)	NY 30440 34409	NY 33 SW 63
Water storage system for Lainton's Shaft (R5 and L24-L27)	NY 305 343	NY 33 SW 64
Reservoir R6	NY 30469 34380	NY 33 SW 65
Engine house EH2	NY 30234 34509	NY 33 SW 66
Ancillary structure AS8	NY 30136 34617	NY 33 SW 67
Ancillary structure AS9	NY 30120 34640	NY 33 SW 68
Ancillary structure AS10	NY 30108 34676	NY 33 SW 69
Ancillary structure AS11	NY 30130 34674	NY 33 SW 70
Ancillary structure AS12	NY 30160 34530	NY 33 SW 71
Umber mill (MC6)	NY 3025 3459	NY 33 SW 72
Track T28	NY 3020 3463	NY 33 SW 73
Aerial ropeway AR1	NY 307 346	NY 33 SW 74
Water pumping station	NY 30234 34423	NY 33 SW 75
Bield	NY 30421 34608	NY 33 SW 76
Grindstone in Caldbeck churchyard	NY 3254 3981	NY 33 NW 28

Appendix 3: Co-ordinates of permanently-marked survey stations

Three of the four survey stations used by EH were permanently marked, and can be re-occupied if excavation or further survey work is contemplated at or near the site. The fourth station (station 4) was marked simply by a perishable wooden peg, and its co-ordinates are not given below. All three permanent stations are intervisible, and capable of re-occupation with either theodolite or GPS equipment. Their positions are marked on Figure 53, and can be re-located on the ground by scaling off distances from other detail on the plan. OS National Grid co-ordinate values are given below; ETRS89 co-ordinate values are also given for station 1 which was used as the survey's GPS base station.

Station 1. Brass rivet in earthfast rock on the lower slopes of Peteraw above Todd Gill.

OS NG: Easting 330,314.003
Northing 534,585.980
Elevation 398.45

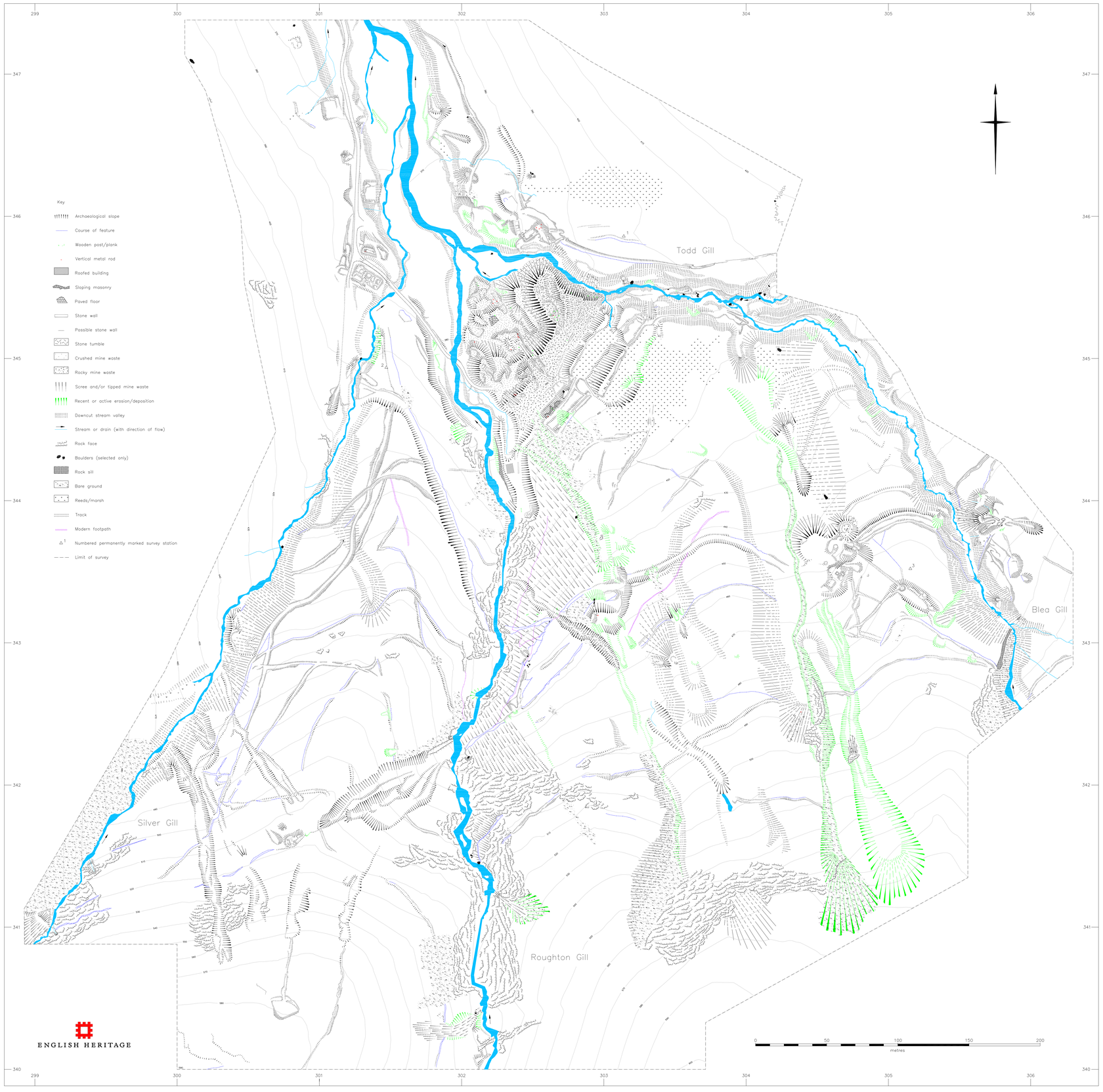
ETRS89: Latitude 54^{o} 42' 05.25941" North
Longitude 3^{o} 04' 58.35484" West
Height 451.442

Station 2. Brass rivet in earthfast rock on the spine of Balliway Rigg, close to the valley bottom.

OS NG : Easting 330,147.139
Northing 534,493.653
Elevation 392.87

Station 3. Brass rivet in earthfast rock on the hillside above Lainton's Shaft and Blea Gill.

OS NG: Easting 330,515.450
Northing 534,352.109
Elevation 467.35


299
300
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303
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305
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347
346
345
344
343
342
341
340
Key
Archaeological slope
Course of feature
Wooden post/plank
Vertical metal rod
Roofed building
Sloping masonry
Paved floor
Stone wall
Possible stone wall
Stone tumble
Crushed mine waste
Rocky mine waste
Scree and/or tipped mine waste
Recent or active erosion/deposition
Downcut stream valley
Stream or drain (with direction of flow)
Rock face
Boulders (selected only)
Rock sill
Bare ground
Reeds/marsh
Track
Modern footpath
Numbered permanently marked survey station
Limit of survey
Todd Gill
Blea Gill
Silver Gill
Roughton Gill
ENGLISH HERITAGE
0
50
100
150
200
metres