REPORT ON THE PRE-RECLAMATION ARCHAEOLOGICAL SURVEY AND EXCAVATIONS OF THE VALE OF CONWAY MINE COMPLEX, LLANRWST

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by P.T.Muckle

illustrations by H.F.Riley

Frontispiece: The Vale of Conway Mill after reclamation

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Plate 1. Aerial photograph showing the mill complex before reclamation.
North is at the top of the photograph.

1. INTRODUCTION

In 1990 the Snowdonia National Park Authority (SNP) commissioned a programme of reclamation at the Hafna-Nant Uchaf, Cyffty and Vale of Conway mine sites. A preliminary contract was completed prior to the commissioning of archaeological work. The second contract related to the making safe and sealing of open mine shafts and adits, diverting water courses away from toxic waste material and the consolidation of standing structures. A low-key industrial heritage trail through the forest including information boards at salient points is also planned by the Forestry Commission. The construction work was carried out by Jones Brothers of Ruthin (JBR) under Parkman Consulting Engineers (PCE).

The SNP commissioned the Gwynedd Archaeological Trust Ltd. (GAT) to carry out the following programme of archaeological work, starting in January of 1992:

(i) Standing structures, crusher house, small building, cottage and ore bin: to provide a drawn, written and photographic record prior to consolidation, and during works where appropriate.

(ii) Tramway: to record by photograph and survey, and to excavate a sample to ascertain whether any tram rails survive and if so whether they are likely to be disturbed by machine clearance of felled timber.

(iii) Buddle pit and settling tanks: to record by photograph and written record before works; to clear of vegetation, excavate and record in detail.

(iv) Shafts and adits: to record prior to treatment by photographs and written records; to record any features made visible during treatment. Llanrwst deep adit to be recorded in detail by elevation and plan prior to removal of drystone revetment; to supervise the rebuilding of the wall.

(v) Ore bin (OB1): to provide a drawn, written and photographic records in advance of rebuilding. To advise on aspects of rebuilding.

(vi) The Cottage: to record prior to consolidation using drawn, written and photographic records.

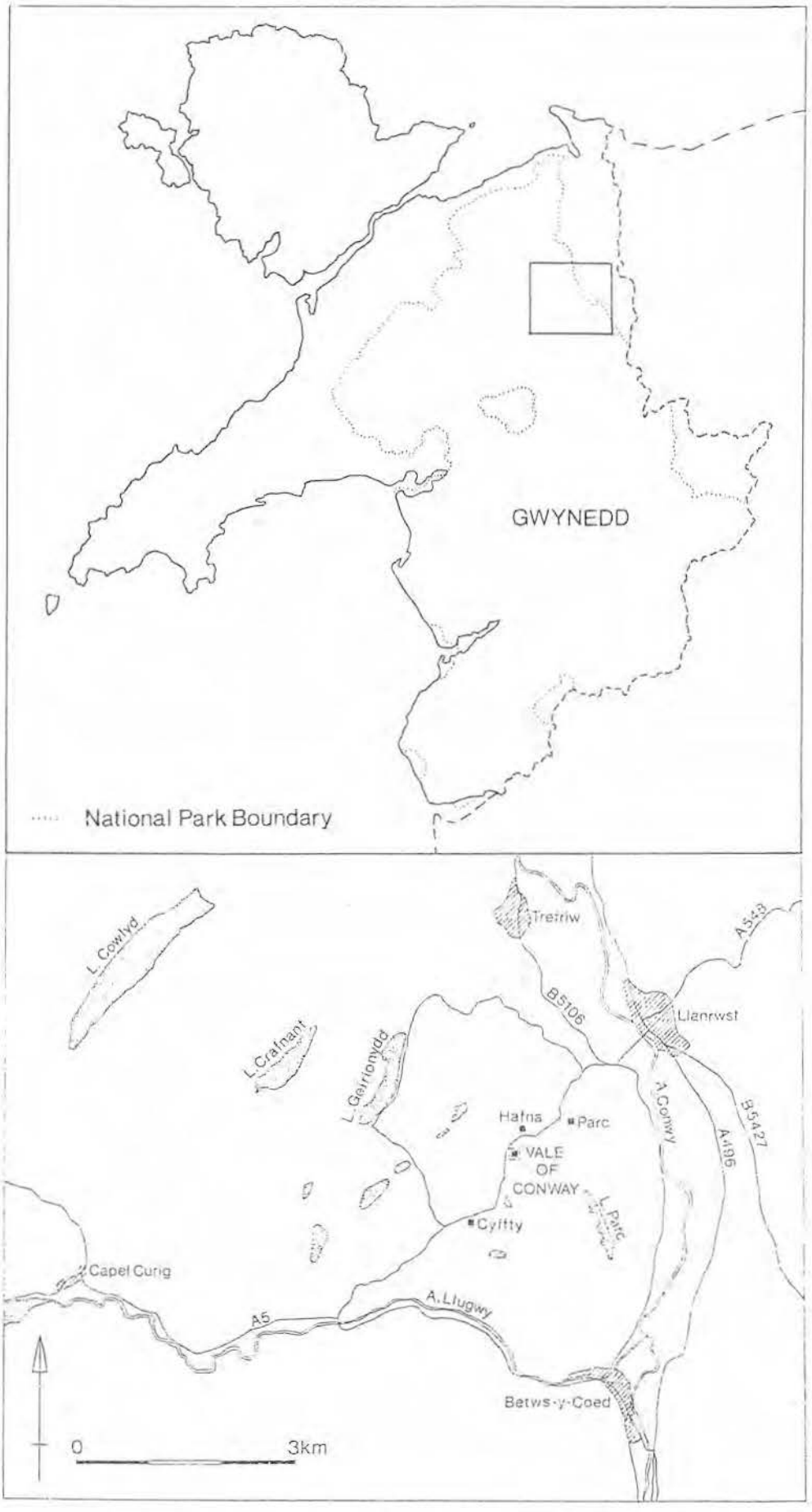


Fig. 1 Location of Vale of Conway Mill and related surface features

2. METHODOLOGY

(i) Surveying. The main features of the mill were surveyed using a total station and easyCAD software. The resulting map was drawn at scales of 1:200 and 1:50 to which further details were added in the field, particularly minor variations in ground levels and subtle slopes and inclines, many of which became obscured by unavoidable machine tracks. A profile through the site from the tramway to the settling tanks was included.

(ii) Photography. A complete series of monochrome prints and colour slides were taken of the site prior to any building work. Individual features were photographed after clearance of vegetation and rubble, and the entire site was photographed after consolidation works.

(iii) Drawn records. Ground plans and elevations were produced at scales of 1:50 and 1:20, and detail added on at a scale of 1:10 where necessary. Where structures were to be rebuilt stone-by-stone elevation drawings were produced at a scale of 1:20. A fold-out key to the symbols used in the illustrations is shown on page 43 (Fig. 31).

(iv) Written records. These were written directly onto the drawn records and were completed in longhand where possible. Interpretation and comment were included in the record.

(v) Excavation and clearance. The buddle pit was excavated by hand under the supervision of GAT and a machine was used to clear away tree debris. The settling tanks were also cleared of vegetation by hand and a machine was used to remove a large tree stump. The tramway was sectioned in three places by hand-dug trenches (TT1 - TT3). The ore bin (OB1) was cleared of vegetation prior to recording. The small building was cleared of rubble to reveal flooring details.

(vi) The Archive. The archive containing field drawings, a written record and a photographic record is housed with the Gwynedd Sites and Monuments Record at the Gwynedd Archaeological Trust.

3. LOCATION, HISTORY AND MINE WORKINGS

The Vale of Conway Mill (NGR SH 77995985) is situated on the west side of the Nant Bwlch yr Haiarn valley within the Gwydyr Forest some 2.5 km south-west of Llanrwst at an altitude of about 190m (625ft) OD (Fig. 1). The sites lies 250m south of Hafna-Nant Uchaf and 100m east of an unclassified road running from the B5016 to the south-west of Llanrwst, running south-westwards before joining the A5 west of Betws y Coed. The area is owned and managed by the Forestry Commission and is within the Snowdonia National Park, an area of outstanding natural beauty.

Before clearance the mill site was completely obscured by coniferous forest planted within the last 20 years. An early photograph of the crusher house in use shows fairly large spruce trees growing adjacent to the wheelpit, suggesting that the forest is not merely a recent phenomenon (Plate 4).

The surface features of the mine include three adits at the southern end of the study area leading onto a major tramway running north/north-eastwards towards the mill (Fig. 2). To the west of the tramway are three depressions and an ore bin, and to the east is a spoil heap or siding and a series of shafts. At the northern end of the tramway is the mill complex, which comprises a yard and barrow-way, a crusher house and wheelpit, a small building, an incline and dressing floor, a buddle pit, spoil heaps and settling tanks (Plate 1). About 70m north of the mill and 20m west of the forest trail are the remains of a small cottage and yard.

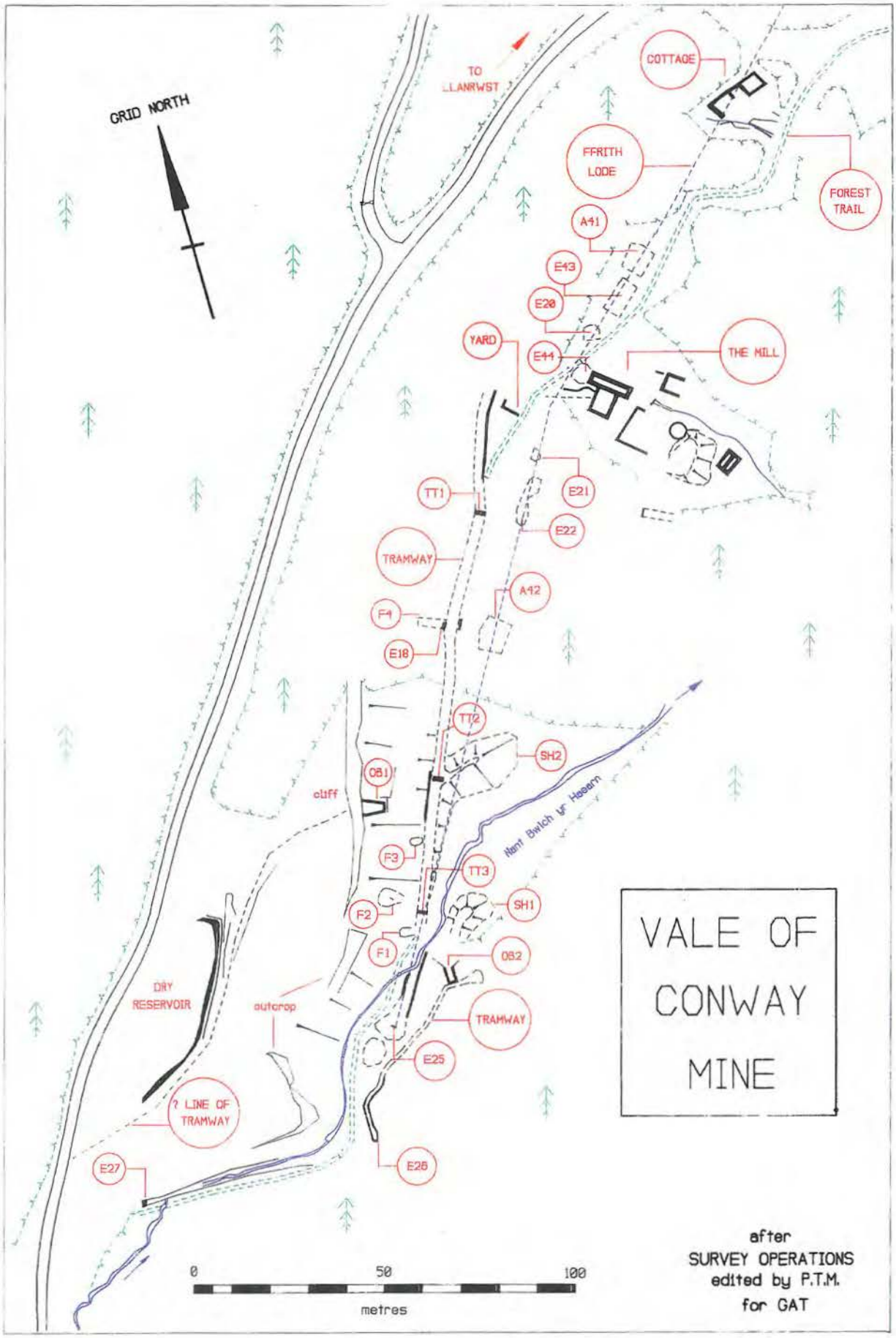


Fig. 2 Plan of surviving surface features within the study area

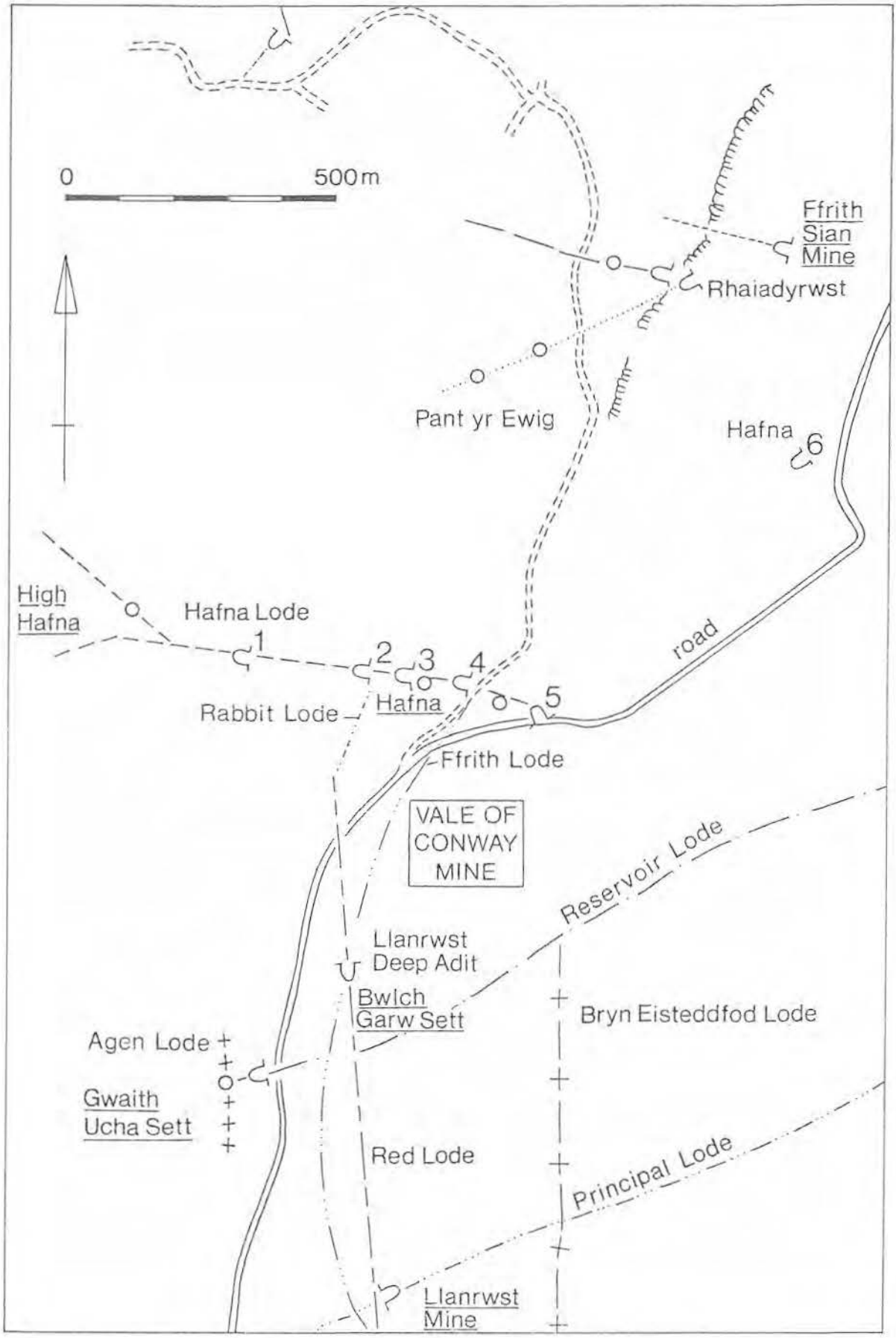


Fig. 3 Mineral lodes in the vicinity of Vale of Conway mine

History

The Vale of Conway venture was started in 1876 after the amalgamation of two leases, Bwlch Garw and Gwaith Ucha, into an area of 51 acres. During 1877 eighteen men were employed driving the level and constructing the mill buildings and tramway. However by May 1878 the mine was inactive and in the hands of a caretaker. Some work was undertaken sporadically over the next few years but the Vale of Conway Company was dissolved in 1886. The Vale of Conway sett became incorporated in the Hafna leases from 1899 onwards (Bennett and Vernon 1990).

The Mine Workings (After Bennett and Vernon, 1990)

The Hafna lode was the most important in the Nant Gwydyr area. South of Hafna mining was concentrated on a series of north-south trending lodes, for example, the Ffrith Lode which was worked extensively near the surface during the early years of mining. The Agen Lode was the most westerly, and outcrops on the escarpment on the west of the Nant, where it was worked from shafts and adits as the Gwaith Ucha mine. During the 1870s the proprietors of the Vale of Conway company drove westwards on the Reservoir lode, from the side of the Nant, until they reached the Agen lode, when they stopped beneath the old Gwaith Ucha workings.

The second important north-south lode is the Ffrith lode, which was worked from shafts on the floor of the valley as the Bwlch Garw mine. To the north of the Reservoir lode its trend changes to north-north-east, when it carries on to intersect the Hafna lode to the east of the Hafna No. 4 adit. The third of the north-south lodes is the Rabbit lode, which is probably the strongest of the three. It appears to be a continuation of the Red lode from the Llanrwst sett and has been tried in several places by a series of shafts and levels immediately to the south of the Hafna mine.

For the purposes of this report the site has been divided into four groups of features running roughly from south-west to north-east, the adits and shafts, the tramway and ore bin, the mill complex and the cottage (Fig. 2).

4. ADITS AND SHAFTS

Shafts are vertical openings usually found along the line of the mineral lode. In the Gwydyr Forest they survive as open holes with drystone edges, but more often are recognised as overgrown depressions 5 - 15m across and up to 5m deep. Many of the features referred to as "shafts" in the report are more likely to be the result of the Ffrith Lode being worked up to surface, the exceptions being A42 and E43.

Adits, day levels or levels are near horizontal tunnels to allow access to shafts or drainage. These are more easily recognisable because they are often cut through bedrock faces (referred to here as "the mouth") and do not have the same tendency to collapse, although this depends on the type of material they are driven into. There are also often surface features surviving such as revetted portals and tramways leading towards the entrance.

Reference numbers for previously identified features follow those used on survey plans supplied by Parkman Consulting Engineers (Fig. 2). The shafts were all investigated by machine and capped where necessary. The features are described in the order that they occur from south-west to north-east.

ADIT E27 (SH 47054516, 213m/699ft OD)

E27 is the uppermost adit in the study area. The entrance has been completely blocked by small and medium sized boulders, allowing no water seepage which suggests that the blockage is solid for some distance. The adit runs from west to east. The western end of the adit has been cut

through bedrock at an angle of about 10 degrees from vertical, slanting to the left as viewed from the east. The entrance is about 1m (3ft 3in) wide, up to 2.5m (8ft 2in) high and extends 25m (27yd) south of the collapse. The south side of the adit is revetted for a further 10m (33ft) south of the bedrock, and embanked on the north side. A stream flows into the adit entrance from above on the south side about 5m (16ft 6in) east of the blockage.

ADIT E26 (SH 47664517, 203m/666ft OD) (Fig.4)

The Adit mouth is better preserved than E27 because of its inherent stability as a result of being cut through a vertical face of bedrock and not stoped out. The adit mouth has been partially infilled and the actual hole visible is 0.3m (1 ft) high and 0.5m (1ft 7in) wide, although originally it may have been about 1m (3ft 3in) wide and 1.5m (5ft) deep. There is a revetted drystone entrance way 1.2 - 1.5m (4 - 5ft) wide and 1 - 1.4m (3ft 3in - 4ft 8in) deep built perpendicular to the rock face, running north for about 10m (33ft) and curving north-eastwards for a further 5m (16ft 6in), where the revetment becomes negligible. The east side of the revetment is generally more complete than the west, especially towards the north end of the entrance. In order to treat the adit a 6m (19ft 8in) length of the west wall had to be taken down before a pipe could be laid. The section of wall was drawn, planned, and photographed, the stones numbered before the wall was dismantled under the supervision of GAT and placed to one side under tarpaulin, prior to reconstruction *in situ*. (Plates 2 and 3). A certain amount of drystone walling had to be built to support the reconstructed wall.

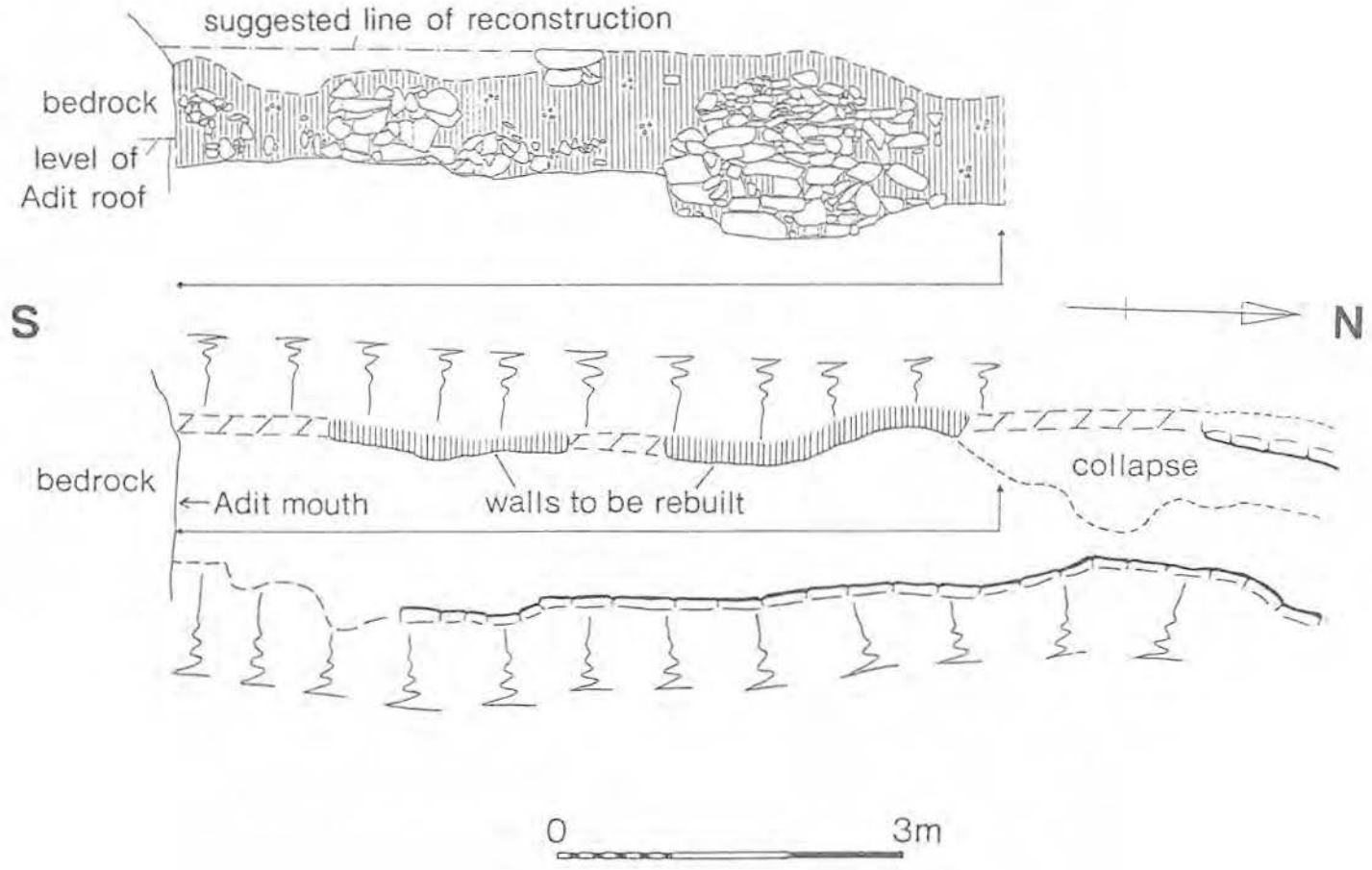


Fig. 4 Adit E26 - plan and elevation showing position of replaced stones

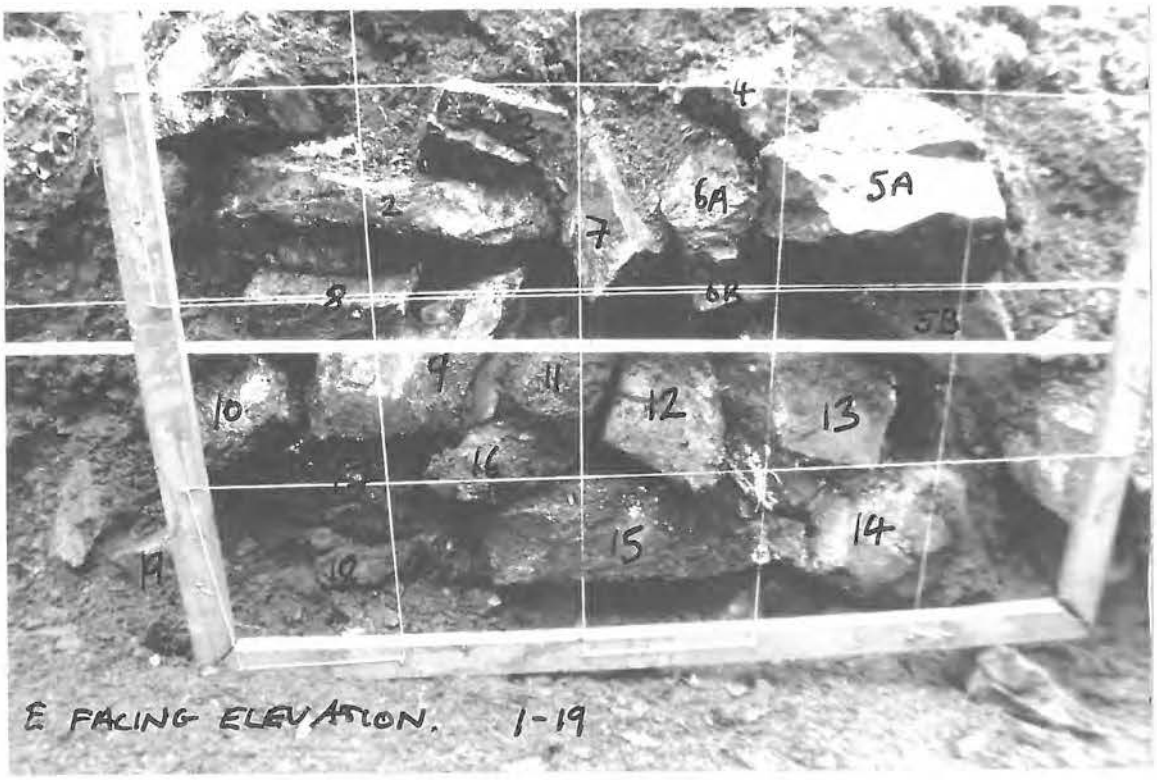


Plate 2. Adit E26, working shot showing numbering system employed in the reconstruction of the wall. The planning frame is 1.5 - 2.5m north of the adit mouth on the west side of the portal (GAT 1059/08/05, frame 1m).

Plate 3. Adit E26 from the south after the wall had been numbered and dismantled, and the adit entrance cleared of rubble prior to treatment (GAT 1059/92/03/15, scale 2m).

ADIT E26 TRAMWAY

Ore was carried from the adit on a tramway down the revetted entrance way from where it was taken on a narrow tramway or barrow-way 1m wide, running northwards and to the east of and above adit E25. The tramway is built up substantially on its lower side to a height of about 5m (16ft 6in), using drystone revetment and loose stone buttressing, and is revetted in places on its upper side. The tramway comes to an abrupt end about 25m (27 yd) after it passes over adit E25, where it widens out to 4m (13ft) to allow trams or barrows to pass. There is an ore bin (OB2) 6m south-east of the current end of the tramway on the west side. The back wall of the ore bin is made of a vertical drystone revetment 2m (6ft 6in) wide and 2m (6ft 6in) high, which is a continuation of the tramway revetment. The sides of the bin are about 1m (3ft 3in) high from the floor of the bin and run 8m (26ft) downslope at an angle of about 45 degrees. The main tramway leading to the mill leads towards the ore bin but cannot be traced directly below due to stream erosion and landslip. There is a spoil heap about 8m north of OB2 (SH1), indicating that a certain amount of sorting occurred before the ore was taken to the mill, The spoil heap measures 12m north-south and 8m east-west, and is about 4m high.

ADIT E25 (SH 47804555, 197m/646ft OD) Llanrwst Deep Adit

The Llanrwst Deep Adit gave access to the Red lode and the Ffrith lode, two of the three major lodes in the area. The mouth to the adit is cut into the north-east face of near vertical bedrock, and is visible as a hole 1m (3ft 3in) wide and 0.3m (1ft) deep. It is possible to see about 2m (6ft) inside the adit, which is 1.5m (5ft) high and contained a depth water of about 0.3m (1ft) during the investigation. Health and Safety regulations prevented ingress, although it appeared that the roof of the adit had collapsed a short distance in. The floor of the adit entrance has a diameter of 2m (6ft 6in) and forms the base of an inverted semi-conical depression 4m (13ft) deep and 10m (33ft) across at the top, open to the north-east and sloping steeply upwards to the south-west from the adit mouth. About 2m (6ft 6in) to the north-east of the adit mouth are the first traces of revetment up to 1.5m (5ft) high, on either side of a channel 1.5m (5ft) wide. The revetment runs 12m (39ft) north-east before widening to 2.5m (8ft 2in) to form a slight funnel, where the walls are at their maximum height of 2.3m (7ft 6in). The east side of the revetment was built to hold back a steep bank and the Deep Adit tramway above, and the west revetment was to retain a bank of waste rock created during the digging of the adit.

There is a circular depression 3m (9ft 10in) deep with a diameter of 8m (26ft) approximately 1.5m (5ft) south-west of the adit, which is the result of the adit roof collapsing, presumably after timber shoring had rotted away and water flow increased when pumping operations ceased.

ADIT E18 (SH 48204640, 195m/640ft OD)

E18 was previously unknown and was discovered towards the end of the contract. The adit is located on the west side of the tramway below the feature F4 and appears to run westwards, perhaps connecting to the Red lode. The adit mouth as revealed was about 0.75m wide and 0.5m high, although the full extent was not visible. There was a 1.2m (4ft) depth of water in the adit, preventing further investigation.

SHAFT A42 (SH 48354685, 189m/620ft OD)

A42 was the only open shaft in the study area and as such extremely dangerous, therefore only a minimal record could be made. The shaft measured about 4.5m (14ft) north-south by 3m (9ft 10in) east-west and was estimated by PCE to be about 15m deep (50ft). The shaft has since been capped.

SHAFT E22 (SH 48504715, 190m/623ft OD)

Shaft E22 was situated in the midst of thick forest and could not be realistically photographed. The shaft was a depression 1.5m (5ft) deep, 13m (42ft) south-west by 6m (20ft) north-east.

SHAFT E21 (SH 48564730, 190m/623ft OD)

Shaft E21 was a small heavily vegetated depression 10m (33ft) south of the yard and east of the tramway, measuring 2m (6ft 6in) across and 1m (3ft 3in) deep.

SHAFT E44 (SH 48764748, 186m/610ft OD)

Shaft E44 was a depression immediately west of the wheelpit measuring 4m (13ft) north-south by 3m (9ft 10in) east-west and 0.75m (2ft 6in) deep. In view of its very close proximity to the wheelpit it seems unlikely that this was an shaft or collapsed level, and was probably the trench in which the launder base feeding the water wheel was bedded.

SHAFT E20 (SH 48774755, 186m/610ft OD)

Shaft E20 was a depression measuring 8m (26ft) north-east/south-west by 5m 16ft 6in) north-west/south-east, and was about 4m (13ft) deep. On investigation it was found to be stable, and probably represented collapse from the level below.

SHAFT E43 (SH 48904763, 186m/610ft OD)

Shaft E43 was uncovered unexpectedly - there was no indication above ground of such a feature. The shaft measured 6m (29ft 8in) north-east/south-west by 2.5m (8ft 2in) north-west/south-east, and was 15m (50ft) deep. Shoring timbers were visible about 5m (16ft 6in) down the shaft, although they could not be investigated in detail because of safety considerations. The shaft has since been capped.

SHAFT A41 (SH 48954775, 186m/610ft OD)

Shaft A41 was 6m (19ft 8in) north-south by 3.5m (11ft 6in) east-west, and was 5m (16ft 6in) deep generally with a hole 12m deep uncovered by machine in the southern quadrant. The shaft has since been capped.

5. THE TRAMWAY AND ORE BIN

The Vale of Conway Mill processed ore from a number of mines in the area, from both the Bwlch Garw and Gwaith setts, from early Llanrwst (or Bwlch yr Haiarn), and possibly from Bryn Eisteddfod and even Hafna (Bennett and Vernon, 1990, 49). Ore from the various levels was carried to the mill via a system of feeder tramways or barrow-ways leading to the main tramway running south-west from the mill. These minor tramways have not been located on the ground. The principal point of work was on the number 2 level, from where ore was trammed downhill to run northwards on the eastern lower side of the mine reservoir before being tipped over the low cliff face into the ore bin (OB1). This tramway cannot be traced on the ground because of fallen trees and other dense vegetation. Other levels carrying ore to the mill include the number 3 level, Adit E26 and the Llanrwst Deep Adit (E25).

The main tramway can be reliably traced from the southern end of the valley just below Llanrwst Deep Adit (SH 47904562) to a point above and to the west of the yard (SH 48504798), a distance of about 150m (Fig. 2). The tramway built on a break of slope along the west side of the valley was terraced into the hillside with the lower side occasionally revetted by near vertical drystone walling. The tramway is on average 2.1 - 2.2m (6ft 10in - 7ft 2in) wide for most of its length, although towards the northern end varied between 2 - 4m (6ft 6in - 13ft), probably to allow trams to turn and pass.

The uphill side of the tramway was revetted for a length of 13m (42ft) up to 1.4m (4ft 8in) high below the ore bin, to give a solid vertical face over which the ore could be tipped. The downhill side of the tramway was also revetted for a length of 23m up to 1m (3ft 3in) high at its most northerly extreme above the yard, also to facilitate tipping.

It appears that the use of stone-built revetment walling was not necessary where tipping was not carried out, and that a simple revetment of loosely structured stone and earth sufficed. The cut into the escarpment on the uphill side of the tramway was on average 1.1m high (3ft 6in), although was significantly higher below OB1 (3.2m or 10ft 6in) and below the depression F2 (3.9m or 13ft), due to a build up of spoil.

About 45m along the tramway from the southern end is a spoil heap or siding 3 - 5m (10ft - 16ft 6in) wide jutting out on a level with the tramway 13m (42ft) eastwards at a horizontal angle of about 45 degrees from the tramway (SH2). The heap is built up at least 4m high over the sloping valley side, and the rubble extends for about 12m past the end of the level part of the siding, sloping down towards the valley floor. The heap is a result of hand sorted waste from the ore bin above being tipped into barrows or trams on the tramway which ran to the end of the siding before tipping the waste down the valley. The heap may also have been utilised as a siding to allow trams carrying ore from the Deep Adit (E25) to pass those carrying ore from the number 2 level. R.W. Vernon (1990, 50) shows the course of a leat running on the upper side of the tramway and parallel to it, carrying water to the waterwheel. The line of the leat could not be traced because of forestation and fallen trees.

Results of trial trenches

Three trial trenches were excavated across the tramway before a Komatsu PC120 mechanical excavator was used to clear away fallen trees and debris (Fig. 2). It was estimated that the machine would clean between 0.1m and 0.2m off the tramway surface. The trenches were dug to ascertain whether any rails or sleepers from the tramway were present in the levels likely to be disturbed by the machine.

TT1 - Trench 1 was excavated across the tramway at its northern end just after the junction between the proposed forest trail and the tramway revetment. The trench was 1m wide and 2m long, and was excavated to a depth of 0.4m through dark brown humic stony soil, to a compacted stony surface. There was no trace of rails or any other structure in the trench.

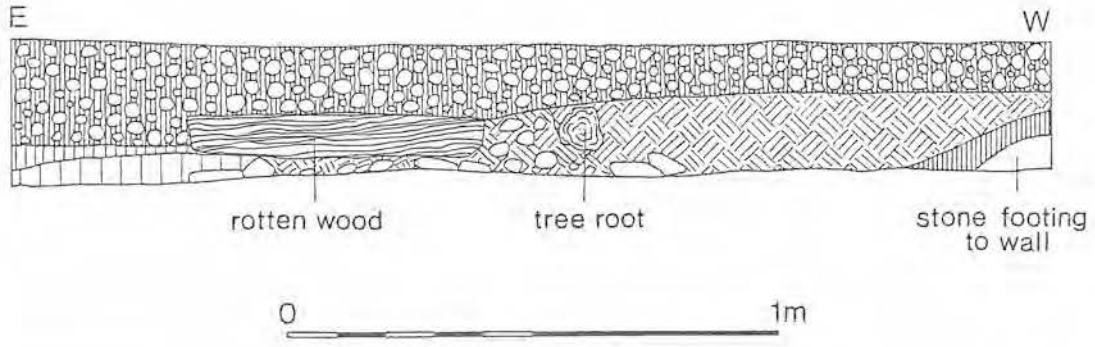


Fig. 5 Tramway trench 2 (TT2) - north facing elevation

TT2 - Trench 2 was excavated across the tramway below the orebin revetment (Fig. 5) and was a similar size to TT1. There was no evidence of the tramway other than a piece of rotten wood too small to be a sleeper which was probably a root or branch from a tree felled during an earlier clearance of the surrounding forest.

TT3 - Trench 3 was excavated across the tramway at its southern end. The results were similar to trench 1, except that the humic soil was more stony and reached a depth of at least 0.35m.
The results from the trenches indicated that the tramway had either been dismantled or the rails were buried under deposits unlikely to be disturbed by machining. There was no evidence of the tramway during the general machine clearance of the track.

A trench 0.5m deep was dug by machine across the tramway below feature F4 in order to lay a drain. A length of composite timber-planking and iron-plate tramway railing was excavated from this deeper trench (Fig. 6), suggesting that the tramway may survive at depths below 0.5m along part or all of the tramway. The rail was orientated across the tramway and not along it as might be expected, suggesting that the rail related to the adit E18.

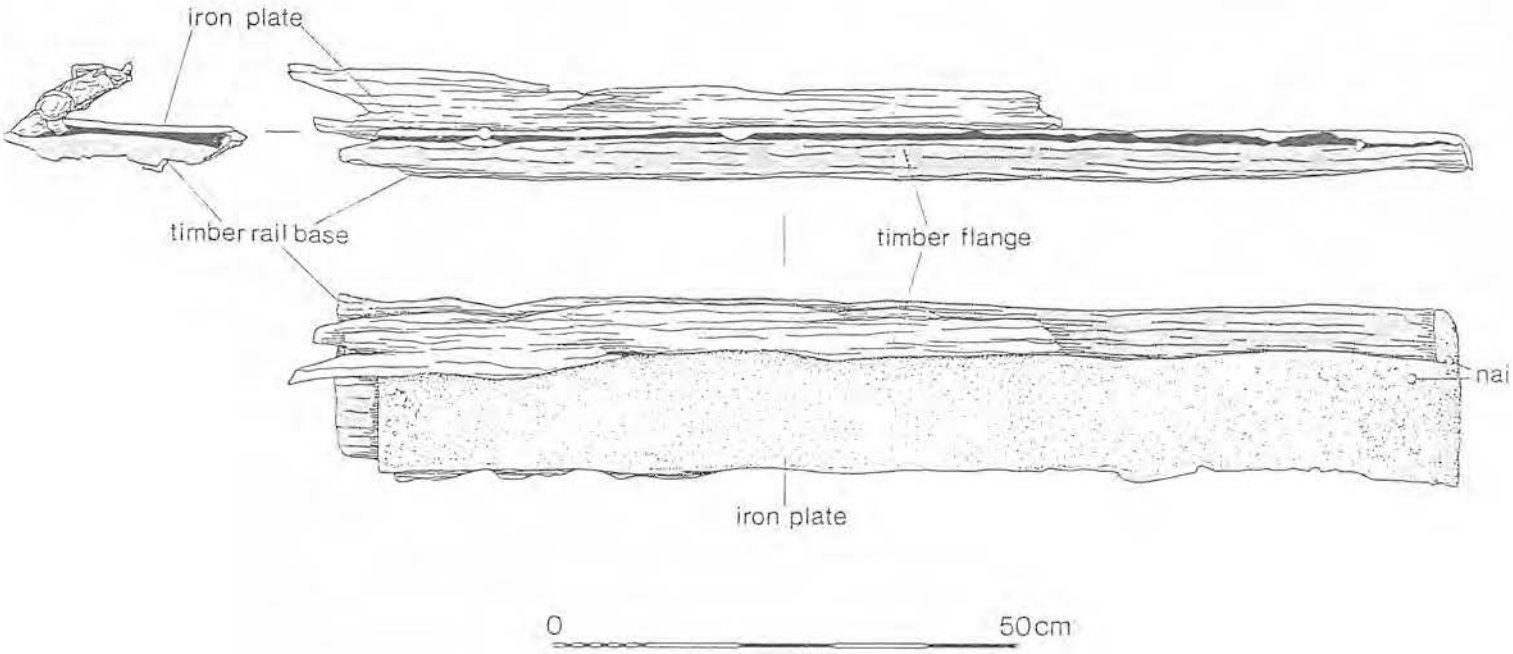
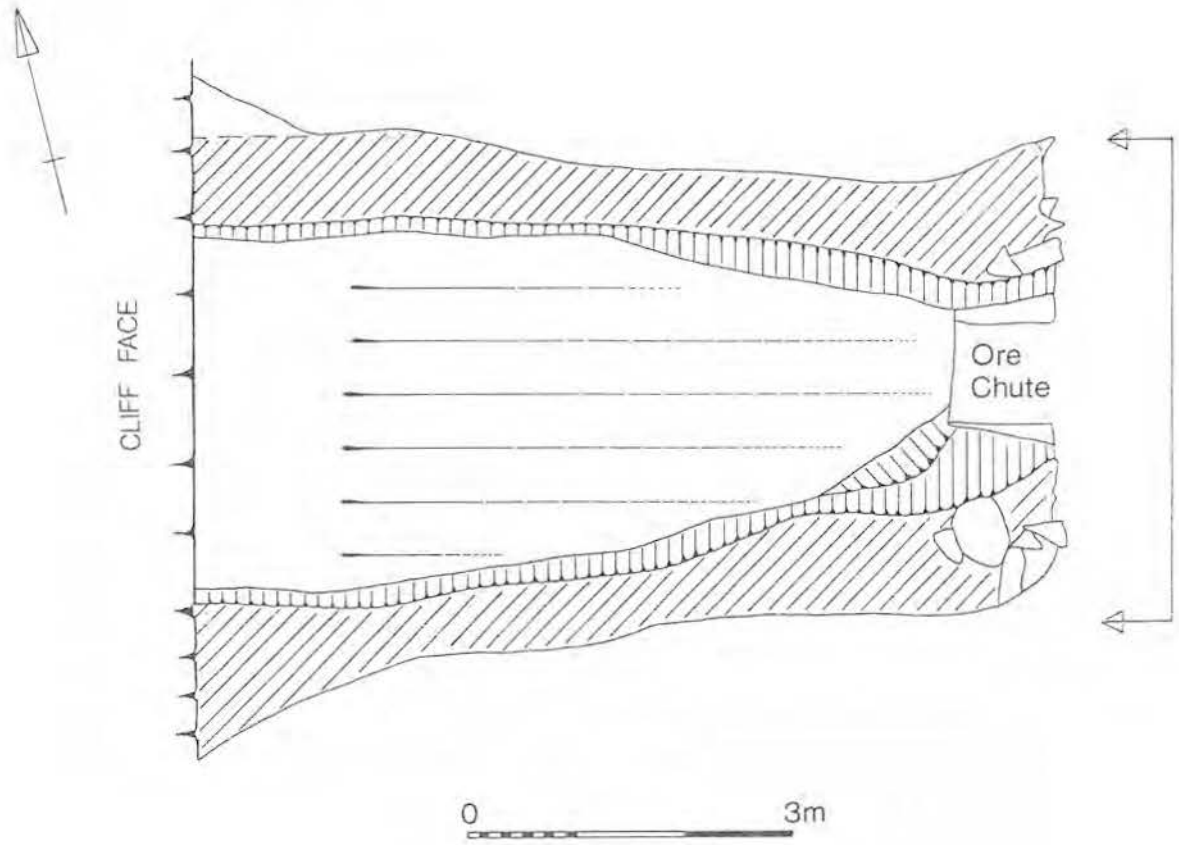


Fig. 6 Diagram of tram rail

The Ore Bin (OB1) (SH 47904602) (Fig. 7)

The ore bin or chute was built to hold ore trammed from number 2 level to the mill. It seems likely that the ore was broken (bucked) and sorted by hand on a dressing floor covering the flat area in front of the ore bin before being trammed to the mill. A photograph taken by R W Vernon in the 1970's shows the ore bin surrounded by forest but otherwise more or less intact. The forest has been subsequently cut down, with one tree at least falling onto the bin and collapsing the top half of the front wall. The wall has been re-built during reclamation works.



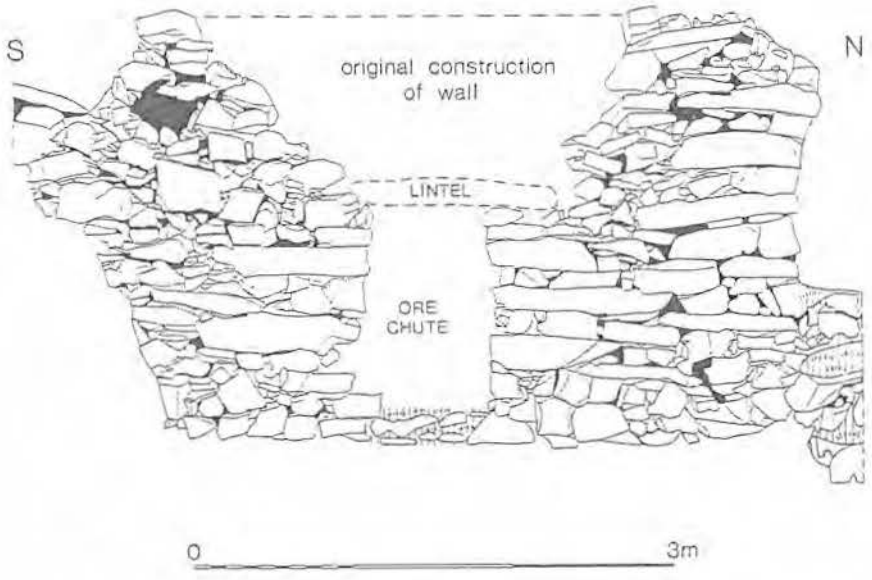


Fig. 7 Ore bin - plan and east facing elevation

The ore bin was built against the vertical face of a low rocky escarpment that rises about 5m (16ft 6in) from the base of the bin. The bin is trapeziodal in plan, being 6.5m (21ft 4in) wide externally at the upper end, 8m (26ft) long overall and 4.5m (14ft) externally at the lower end. Internally the bin is 3.2m (10ft 6in) wide at the top, 5.5m (18ft) long and 1.4m (4ft 6in) wide at the base. The bin interior is level for the upper 1.5m (5ft) then slopes down to the opening at an angle of about 20 degrees. The drystone walls of the bin are between 0.6m (2ft) and 1.5m (5ft) wide, and survive to a maximum height of 2.8m (9ft 2in) on the front wall, though are generally about 1m (3ft 3in) high on the sides. The front wall of the bin is constructed of large dressed angle quoins, and has an opening 1.2m (4ft) high and 0.7m (2ft 4in) wide in the centre towards the base through which ore was channelled. Abutting the ore bin and running 8m (26ft) north/north-east is a stretch of drystone revetment about 1m (3ft 3in) high, which may have formed the rear wall of a dressing floor.

Other features

F1 (SH 47864564)

A steep-sided heavily vegetated stone-free oval depression 5m (16ft 6in) east-west by 3m (9ft 10in) north-south and 1m (3ft 3in) deep. The upper, west side of the depression is not as steeply sloping as the sides and there is the suggestion of an opening or chute in the lower east side. The feature may be an early or little used ore bin, or may possibly represent collapse from a level following the Red lode.

F2 (SH 47884577)

F2 is an oval depression 10m (33ft) east-west by 4.5m (14ft) north-south and up to 1.5m (5ft) deep in the lower part. There are several large stones around the upper edge of the depression which form part of a low bank *c*.0.4m (1ft 4in) high and 1m (3ft 3in) wide. There is a length of drystone walling 1.5m (5ft) long and 1m (3ft 3in) high running east-west in the centre of the hollow. Towards the centre of the base of the wall is a near vertical hole 0.4 x 0.3m (1ft 4in x 1ft) that angles southwards for a depth of at least 1m (3ft 3in), possibly connected to the Red lode.

F3 (SH 47984589)

F3 is an oval depression measuring 4m (13ft) east-west by 2.5m (8ft) north-south and up to 1m (3ft 3in) deep. There is no stonework visible in the depression.

F4 (SH 48204693)

F4 is a water channel or drain 7m (23ft) long, 1 - 1.5 m (3ft 3in - 5ft) wide and 0.75m (2ft 6in) deep, lying immediately above the tramway above shaft A42. At the junction of the tramway and F4 is the adit E18.

6. THE MILL COMPLEX (Fig. 8)

The Yard (SH 48514744, 190m/623ft OD) **and Barrow Way** (SH 48704741)

The yard lies 25m (82ft) west of the crusher house and below the end of the tramway. The yard measures 10m (33ft) north-east to south west and 5m (16ft 6in) north-west to south-east and is formed by a rear revetment wall of drystone which survives to a height of about 2m (6ft 6in), although the true ground surface has been largely obscured by collapse and vegetation. At either end of the rear wall are inclined revetments running north-west to south-east. The east side of the yard opens onto the barrow-way. Until recently the yard supported a thick growth of conifers which were felled to provide access for the forest trail. The stumps were left *in situ* and there was no further vegetation clearance because of the inevitable damage to the structure.

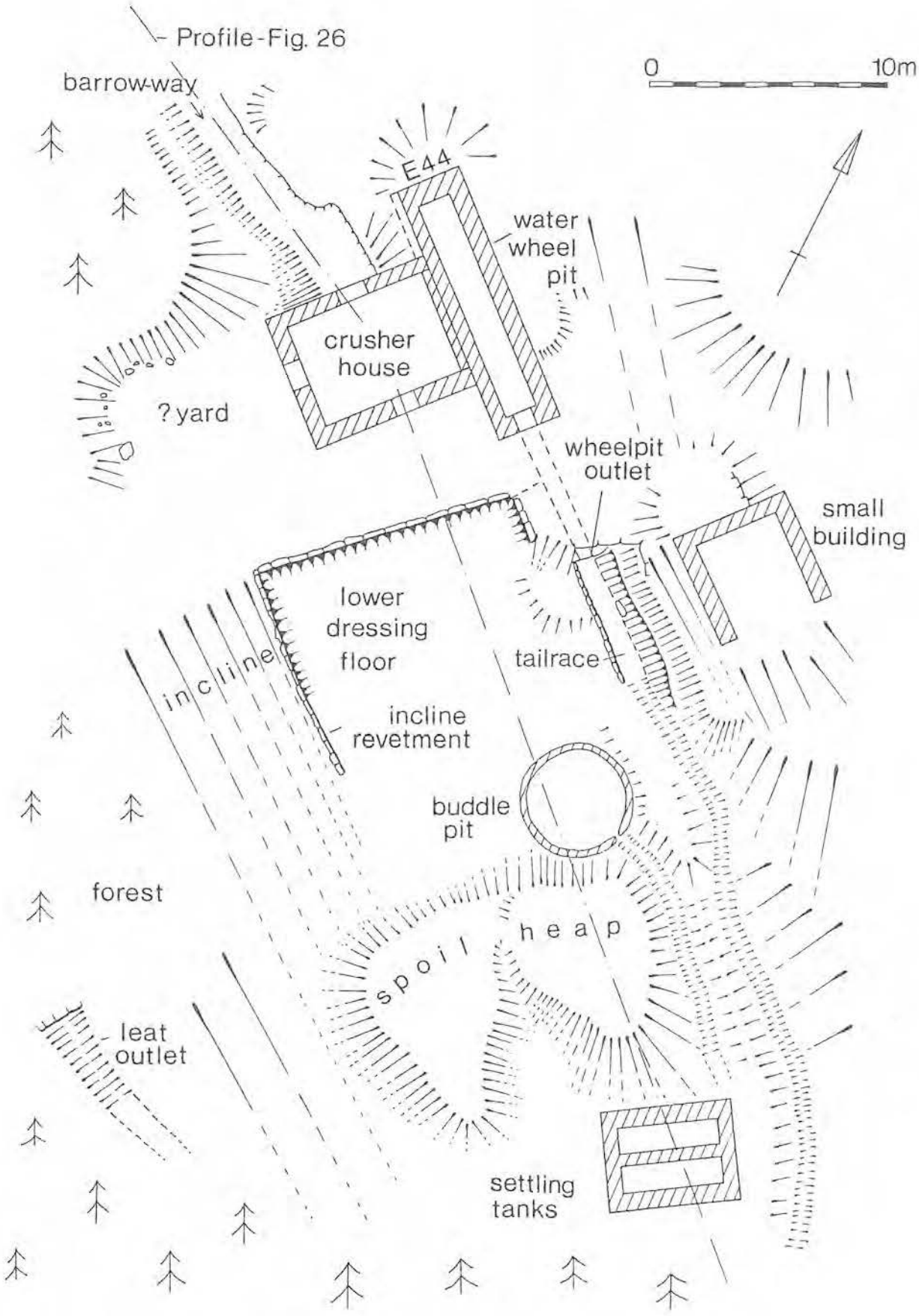


Fig. 8 Plan of the mill complex

The barrow-way connects the yard to the crusher house and runs at a slight downward slope to facilitate pushing fully loaded wheelbarrows. The barrow-way is about 2m (6ft 6in) wide and is built up over ground level on its lower side to lie flush against the entrance in the west wall of the crusher house. The barrow-way runs towards the crusher house at a tangent and widens to the north just before the entrance, probably to allow barrows to be turned and to pass each other. The barrow-way is retained by drystone walling on the north side, running 8m (26ft) from the crusher and surviving to its original height of 1.2m (4ft). The south side of the barrow-way is less steeply sloping and more heavily vegetated and there is no visible stonework. The base of the southern slope forms one side of a shallow ditch or drain.

The Crusher House (SH 48774737, 185m/607ft OD) **and Waterwheel Pit** (SH 8804742) (Plates 4 and 5.)

The crusher house, visually the most impressive and dominant structure within the complex, was designed as a three-sided building. It has a gable end at the south-west while the north-east end is open and abuts the waterwheel pit (Fig. 9). The building measures 6.2m (20ft 4in) north-east/south-west by 4.6m (15ft) north-west/south-east internally, and the walls more or less survive to their original height of 5m (16ft 6in), with some of the uppermost courses missing in places. The west wall of the building to the north-east of the barrow-way is slightly more dilapidated than the others. The walls are a uniform 0.61m (2 ft) thick.

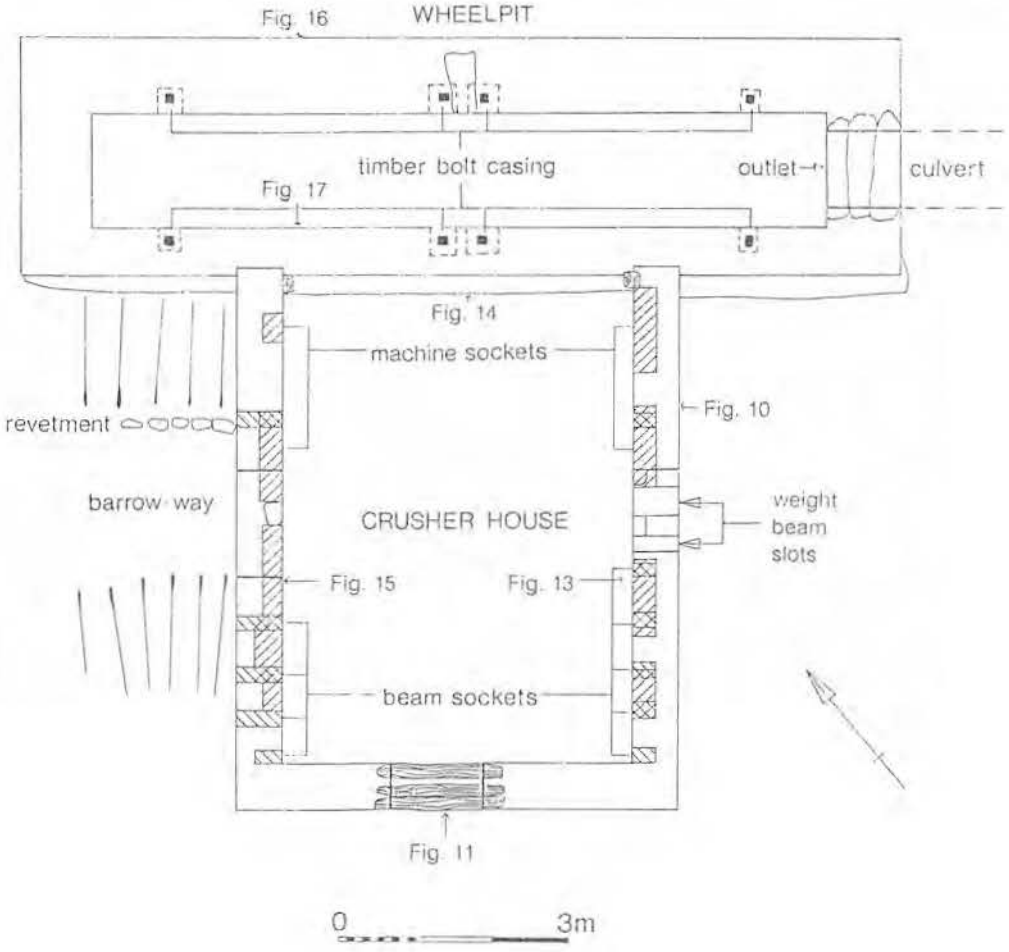


Fig. 9 Crusher house and wheelpit - plan and location of elevations.

The south-east facing external wall has a pair of slots slightly off-centre through which the weight levers which forced the crusher rollers together protruded (Fig. 10). The corners of the wall are neatly built of square and oblong blocks of dressed stone and tie in to form stressed quoins. The rest of the wall is built of undressed stone that is uncoursed in the main, although there are strings and hints of courses. The areas that appear to be randomly coursed have been heavily rendered with a coarse dark grey render. There are two level pairs of corbel stones on either side of the window, a pair below the window along the same alignment, and a fourth pair more narrowly spaced below. The purpose of the stones is unclear, they may have been to support a lean-to structure or alternatively may have supported scaffolding erected when the weight on the lever was adjusted. The wheel pit appears to have been built into the crusher at its upper levels to form the north-east walls of the building, although the pit was buttressed at its lower levels. On the north side of the window, and 0.3m (1ft) below, is a socket 0.2 x 0.2m (8in x 8in) of unknown function. Below the socket, at ground level, is a drain 0.3m (1ft) wide and 0.2m (8in) high, leading from the interior of the building.

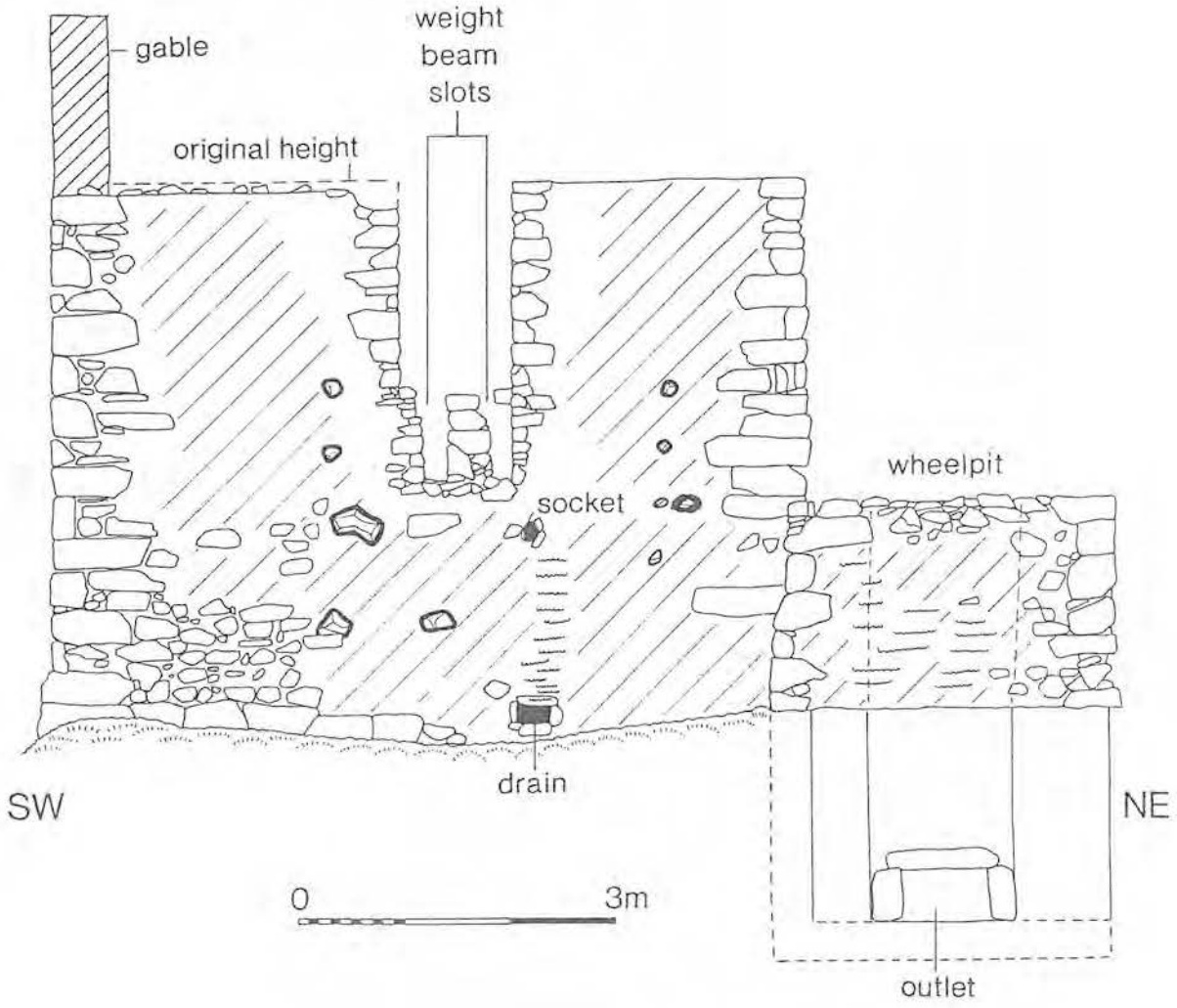


Fig 10. Crusher house - south-east facing external elevation

The south-west facing external wall contains the lower entrance to the crusher, where crushed ore was barrowed out onto the dressing floor (Fig. 11). The wall is similar in construction to the south-east wall with stressed quoins of large dressed stone and a lower course of large squared stones up to the height of the door lintel. The door is slightly off-centre and is 1.2m (4ft) wide and 1.9m (6ft 3in) high, above which are three very badly decayed timber lintels resting on dressed quoin stones, which have now been replaced. The wall immediately above the lintel had not been rendered and appears extremely unstable. Above this stonework and extending to the top corners of the wall the stones are small and irregular in shape and are not regularly coursed, apart from occasional two-stone strings of longer, flatter stones to tie in the ones below. The western third of the wall has been rendered more or less from bottom to top with a coarse grey render incorporating sandy tailings. There is far less rendering than on the south-east wall and the wall appears less stable as a result.

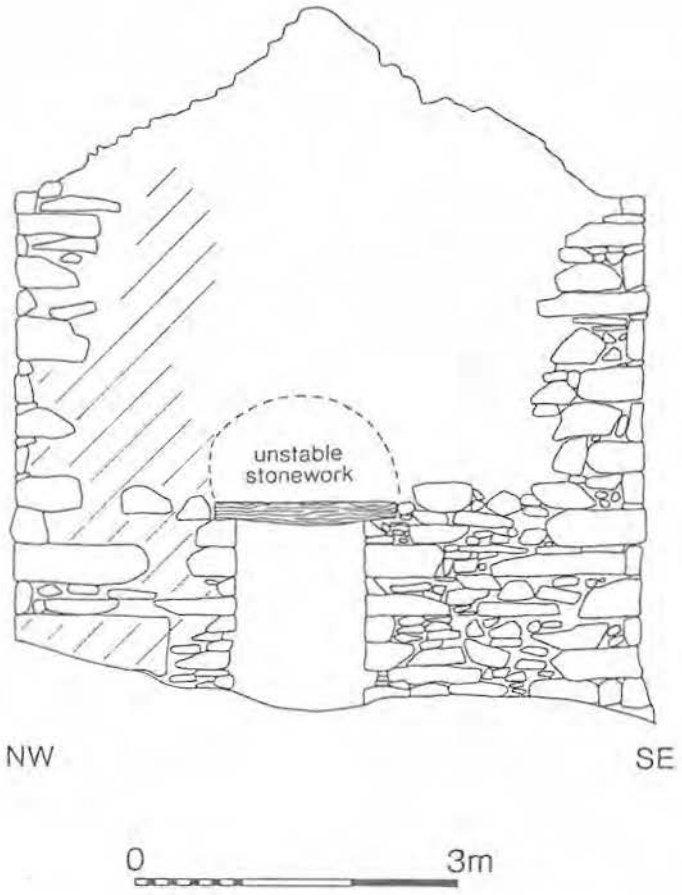


Fig. 11 Crusher house - south-west facing external elevation

The north-west facing external elevation contains the upper entrance to the crusher, through which ore from the yard was barrowed into the hoppers above the crushing rollers (Fig. 12). The entrance is 1.4m (6ft 6in) wide and 2.3m (7ft 6in) high, with stressed quoins. The barrow-way runs up to and is flush with the base of the entrance. There are 3 beam slots to the south of the entrance and one to the north. The slots are on average 0.15 - 0.2m (6 - 8in) wide and 0.2 - 0.25m (8 - 10in) high and are on the same level as the base of the entrance. The slots run through the wall and served as beam supports for the floor onto which the barrows were pushed. As there is no evidence of any slots in the northern quarter of the elevation it seems likely that the floor only covered the southern three-quarters of the building. There is a single corbel stone to the north of the entrance towards the top of the wall whose purpose in unknown. It may have been a support for the overhead launder feeding the waterwheel to the north, or possibly a support for a lean-to hood or porch over the barrow-way.

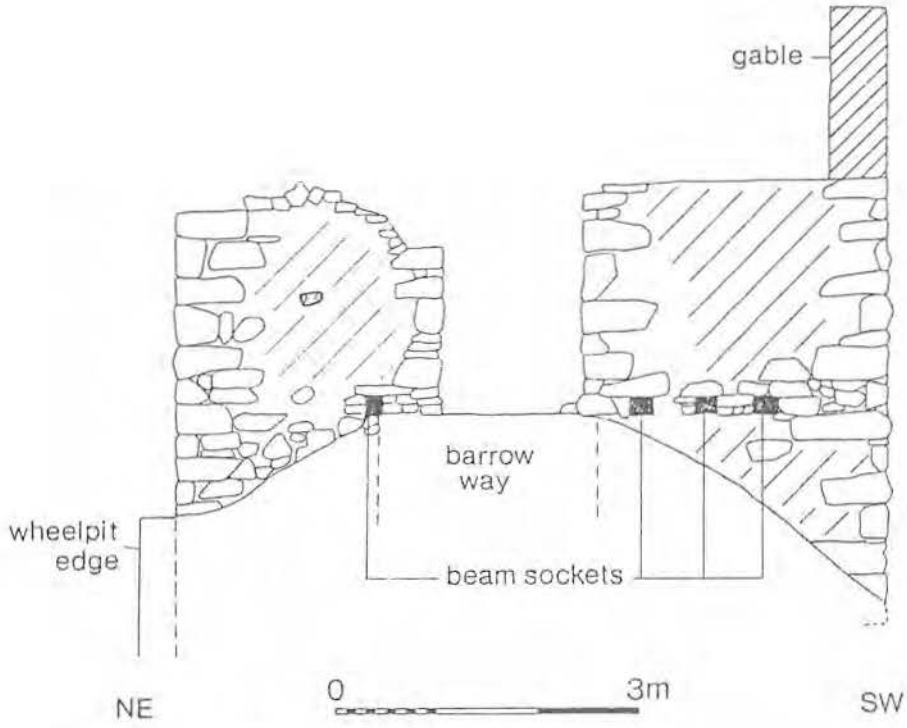


Fig. 12 Crusher house - north-west facing external elevation

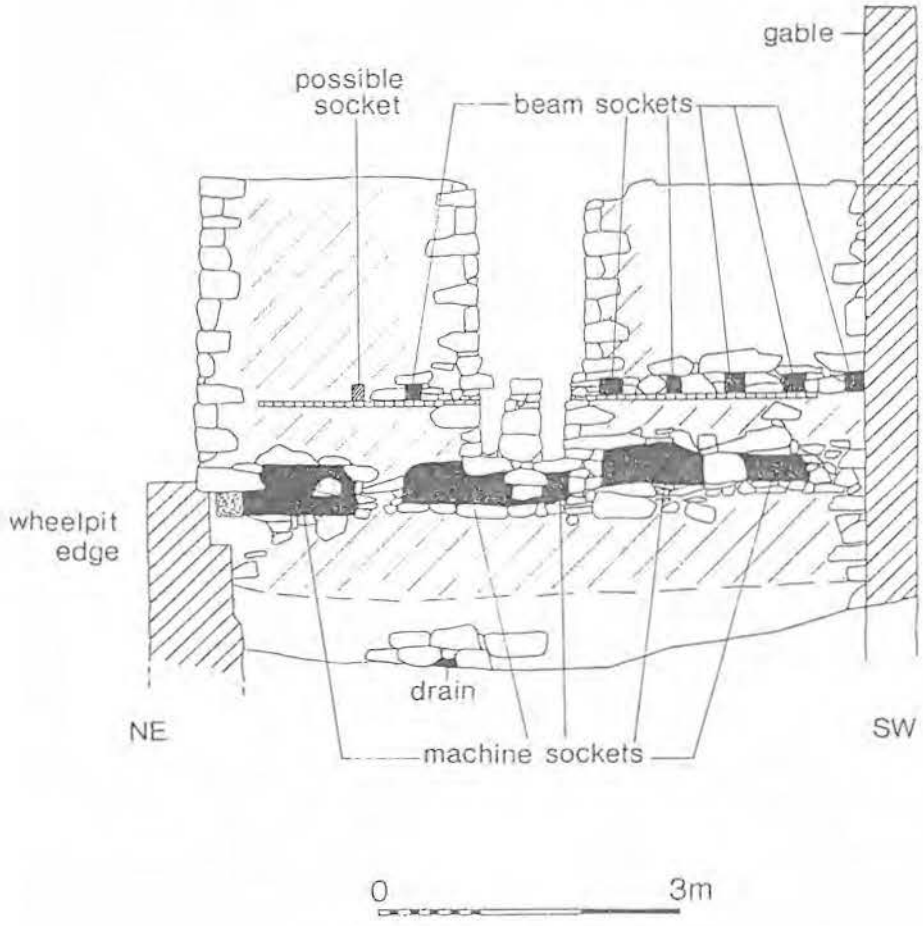


Fig. 13 Crusher house - south-east wall internal elevation

The internal elevation of the south-east wall features beam sockets for the floor, larger sockets to support the crushing rollers and machinery, and the slot or window for the weight levers (Fig. 13). To the south of the slot, approximately level with the top of the central pillar of the window are five beam sockets 0.1 - 0.15m (4 - 6in) wide and 0.15 - 0.2m (6 - 8in) high. There is also a single socket to the north of the window on the same level, and a possible blocked socket. The sockets are more or less evenly spaced 0.4m (1ft 4in) apart, and are recessed into the wall 0.15 - 0.2m (6 - 8in). The sockets are formed with stone lintels above and a wooden plank 0.05m wide underneath. The sockets correspond with similarly sized sockets on the north-west wall. About 1m (3ft 3in) below the beam sockets are 5 or possibly 6 larger machine mounting sockets. These are more dilapidated, with only the most southerly socket retaining a lintel and being more or less complete. This socket is 0.26m (10in) high, 0.7m (2ft 4in) wide and 0.3m (1ft) deep. There are 2 large sockets on either side of the window, and 2 smaller ones set close together under the lower ledge of the window, at a level 50mm (2in) below the large sockets on either side. There is a square cut timber beam set into the north end of the wall next to the wheelpit wall and above the wheelpit buttress. The timber protrudes 0.1m (4in) from the wall and is mirrored by a similar timber in the opposite wall.

The internal elevation of the north-east wall is made up of the south wall of the wheelpit and the buttress supporting it (Fig. 14). The wall survives to a height of 1.7m (5ft 6in) above present ground level, and the buttress is 0.6m (2ft) below that. The buttress is flat-topped to create a ledge 0.3m (1ft) wide.

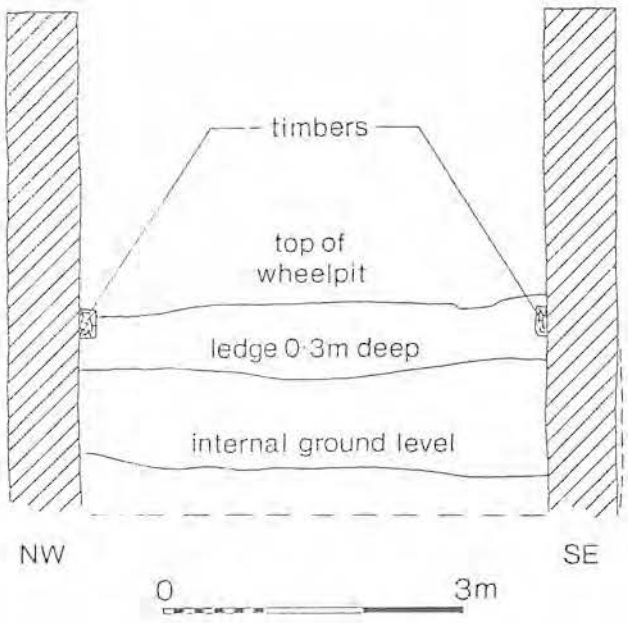


Fig. 14 Crusher house - north-east wall internal elevation

The internal elevation of the north-west wall mirrors the sockets described in the south-east wall, except that the lower series of machine mounting sockets are generally in a more dilapidated state (Fig. 15). The most northerly of the machine mounting sockets appears to have been unaltered. The beam sockets are not recessed but run through the wall, suggesting that the beams were threaded through from the west. The barrow-way entrance runs into the building on a level with the base of the sockets, although there are a course or two of stones missing from the inner side of the entrance way.

Plate 4 An early photograph of the crusher house

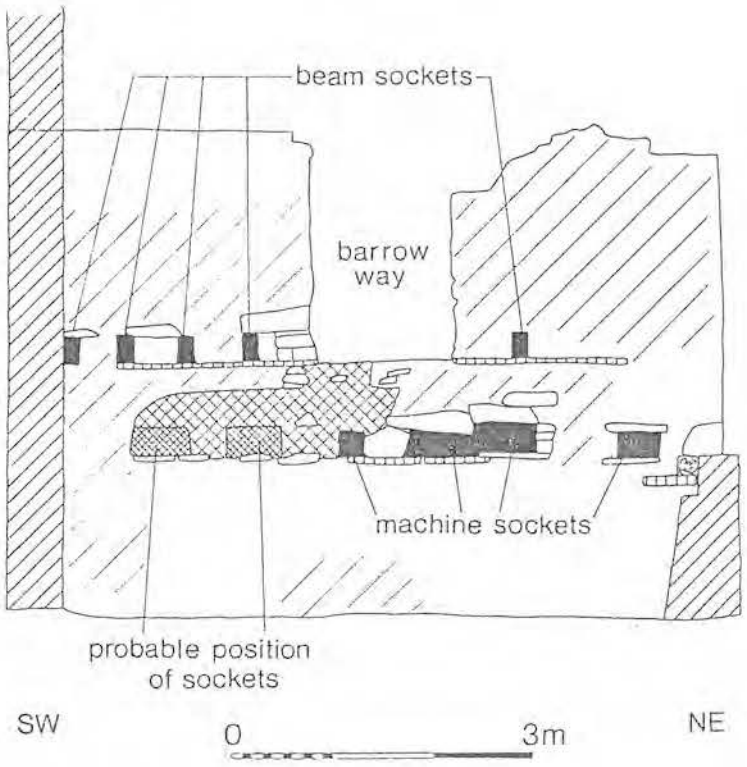


Fig. 15 Crusher house - north-west wall internal elevation

Consolidation of the Crusher House

Consolidation of the crusher house proceeded in three stages; the timber lintel in the gable wall was replaced, the machine mounting beams in the west wall were rebuilt and the entire structure was pointed and rendered. The rotted lintel was replaced with a timber one after the removal of the very unstable stonework immediately above it, though without having to dismantle the whole wall.

The machine mounting beams had originally been built into the wall, and during their removal in the last century a certain amount of damage occurred. Fortunately the stones that had been removed were left lying on the floor of the building, and this coupled with the impression of the beams in mortar bedding in some of the socket bases allowed a reasonably accurate reconstruction to be made.

The early photograph of the crusher (Plate 4) shows that originally the building was rendered, although apparently with a weak mortar that had largely crumbled due to weathering over the years (Plate 5). This was true of many of the structures; there was often little or no mortar visible in the joints between the stones but at the base of most walls a deposit of weathered mortar could be found. Plate 6 shows the interior gable wall of the crusher house during reclamation. Firstly, loose material was cleaned out between the stones to provide a key for the mortar, as can be seen in the bottom left hand side of the photograph. The wall was then pointed using a generous amount of mortar, as visible in the centre of the photograph. Finally, the mortar was rendered by throwing on local dark grey tailings sand (top and right of photograph).

Plate 5 The crusher house and wheelpit before reclamation

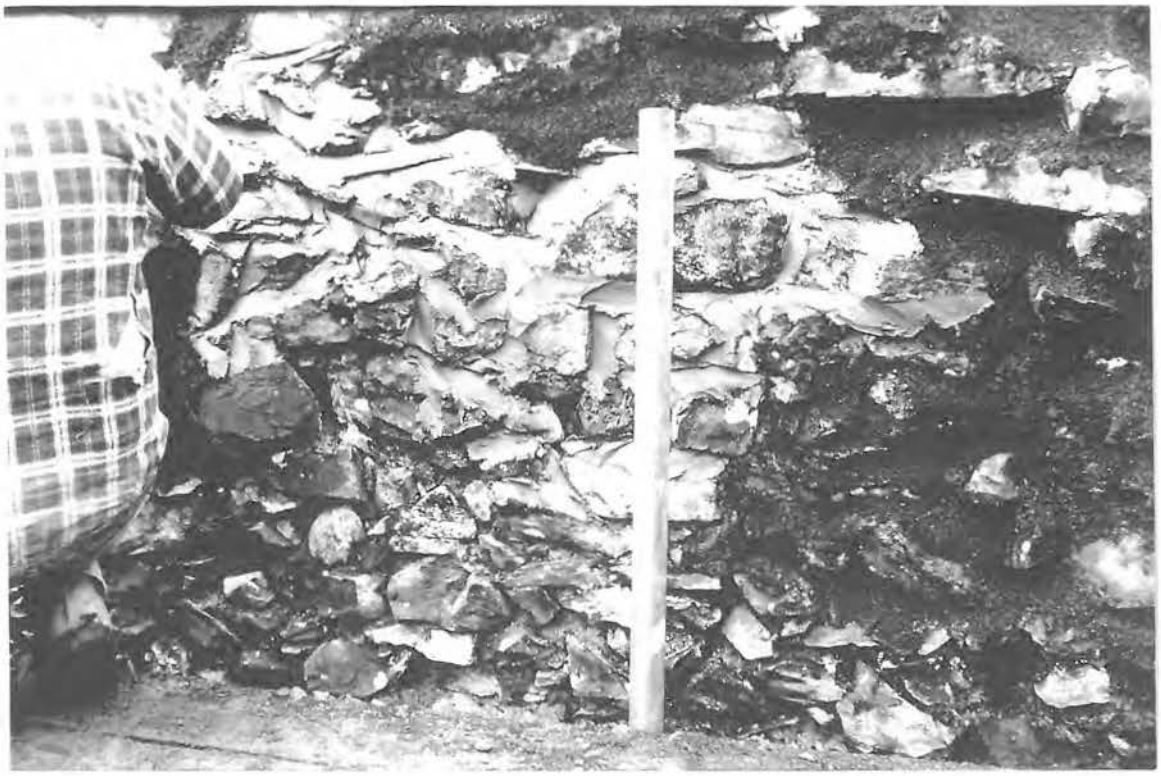


Plate 6. Work in progress on the crusher house gable wall (GAT 1059/09/24)

Plate 7. The buddle pit from the west after (GAT 1059/05/03, scales 2m and 1m)

The Waterwheel Pit

The wheelpit is built against the north-east open end of the building, where it bonds into the outer face of the south-east and north-west walls. (Fig. 8). The pit is constructed of massive dressed corner stones with a basal course of large squared stones, above which are more irregular courses of medium sized undressed stones (Fig. 16).

The pit measures 11.5m (37ft 8in) by 3.2m (10ft 6in) externally and 9.6m (31ft 6in) by 1.5m (5ft) internally, and is 4.1m (13ft 6in) deep. The north-east wall is 0.95m (3ft 1in) wide, and the north-west wall 0.85m (2ft 9in) wide. The south-west wall is 0.6m (2ft) wide and partially bonded to the crusher house, and is buttressed on its south side 0.75m (2ft 6in) below the pit edge to a width of 0.3m (1ft). Viewed in plan there are four mounting sockets towards the inner edge of both long walls, in each of which are four timber casing planks forming square-sectioned shuttering 80mm x 80mm (3in x 3in). The iron beam anchor rods that were originally held in the shuttering have been removed. Viewed in internal elevation, the two main wheel-bolt adjuster sockets are 0.4m x 0.4m (1ft 4in x 1ft 4in) and set close together in the centre of each long wall 2m (6ft 6in) below the wheelpit edge (Fig. 16). The sockets are constructed using individual stone lintels above and not single timber beams as recorded in wheelpit 2 at Cyffty. The sockets form recesses 0.3m (1ft) deep to allow the adjustment and removal of beam anchor rods. On either side of the main sockets towards each end of the long walls are two smaller sockets, 0.2m x 0.2m (8in x 8in) in size, 0.2m (8in) deep and 2m (6ft 6in) below the wheelpit edge (Fig. 16). At the base of the south-east wall of the wheelpit is the outlet from the wheelpit, which is 1m (3ft 3in) wide and 0.7m (2ft 4in) high. The outlet leads to a structurally sound culvert to emerge at the tailrace 5.5m (18ft) east of the wheelpit.

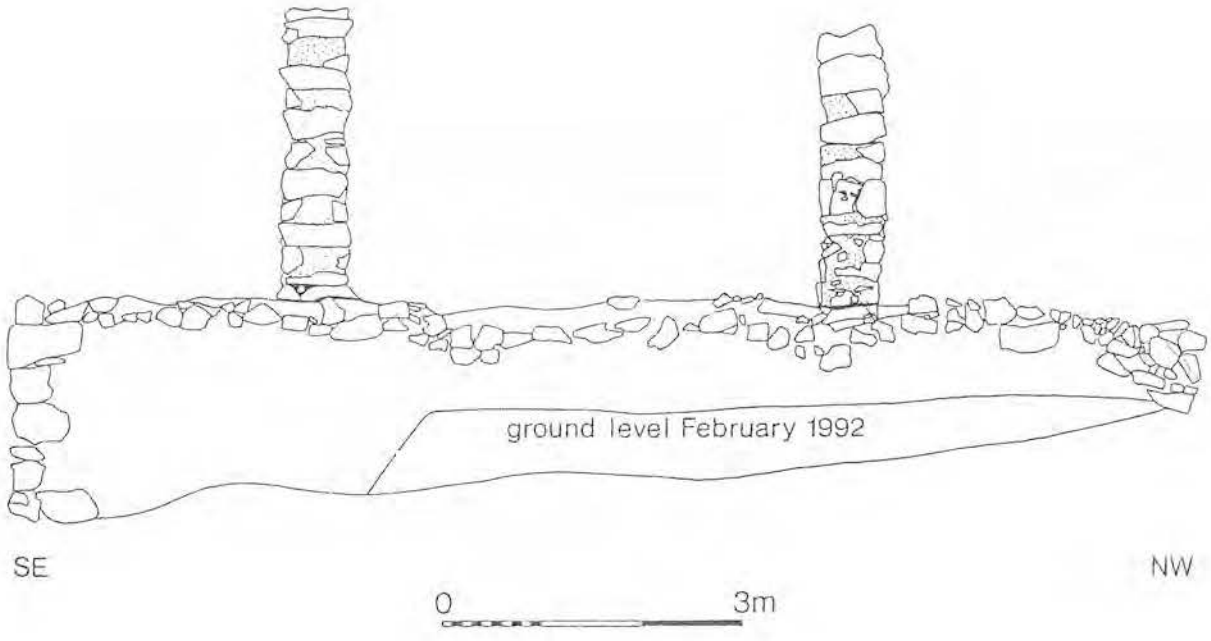


Fig. 16 Wheelpit - north-east facing external elevation

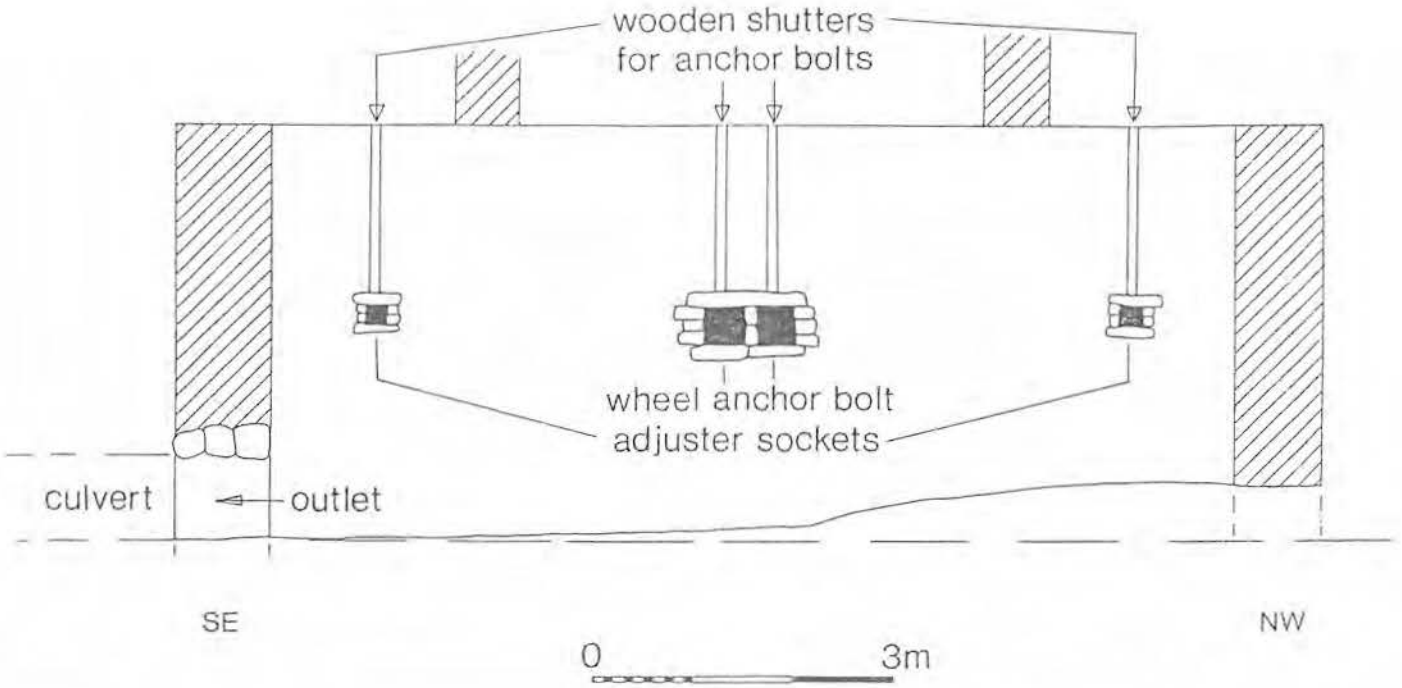


Fig. 17 Wheelpit - north-east facing internal elevation

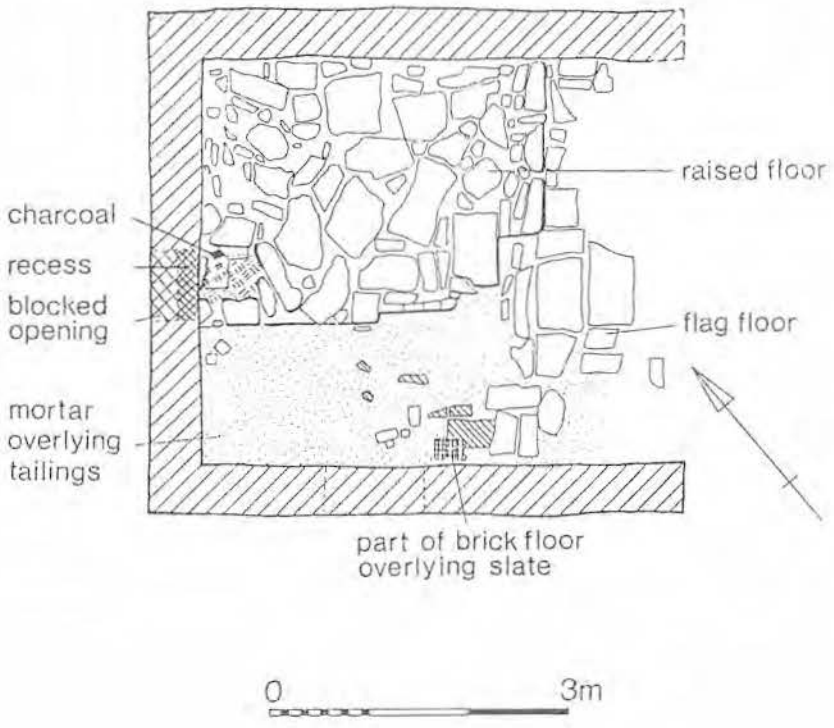


Fig. 18 Small building - plan showing flooring details

The Small Building (SH 48944736, 184m OD)

The small building is a three sided structure open to the south-east with a gable end on the north-west wall (Fig. 18).

The building lies about 6m east of the waterwheel pit, and to the north-east of and roughly parallel to the tailrace. There is a built-up area forming a ramp against the gable end of the building that is revetted by 2-3 courses of stone on the northern side. The building measures 5m (16ft 5in) north-east/south-west and 5.4m (17ft 8in) north-west/south-east; the side walls survive to an average height of 1.4m (4ft 4in) and the apex of the gable is 2.8m high (9ft 2in) (Fig. 19). There is no evidence of a south-eastern wall in the construction of walls of the building, and there are no heaps of rubble indicating collapse.

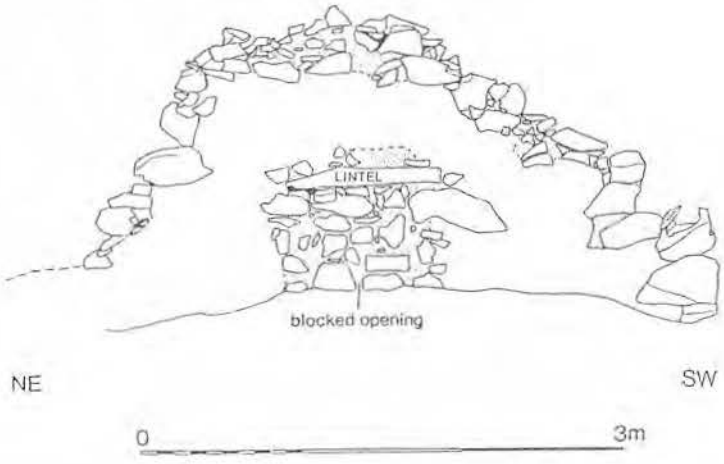


Fig. 19 Small building - gable wall external elevation

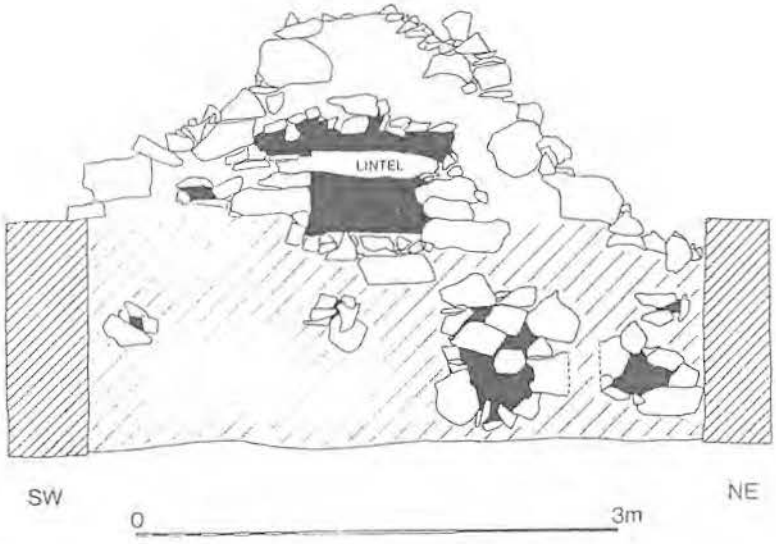


Fig. 20 Small building - gable wall internal elevation

In the centre of the north-west gable wall there is a partially blocked-off window forming a recess on the internal face. The recess is 0.7m (2ft 4in) wide, 0.3m (1ft) high, 0.2m (8in) deep and is 1.3m (4ft 3in) above the level of the floor (Fig. 20). The function of the window is unclear; it may have provided the access for power transmission from the water wheel to machinery inside the building. The ramp behind the building could indicate that ore was being barrowed to the back of the building and tipped in. The blocking of the window indicates that the function of the building altered during its use, perhaps from a small machine house to an office or store.

The building was cleared of rubble, which was mainly collapse from the centre of the south-west wall and purple slate roofing tiles. The floor of the building was on two levels, a raised flagstone floor 0.05 - 0.15m (2 - 6in) above a lower level of mortar and sandy tailings (Fig. 18). There was a low flagstone floor running across the open south-east side of the structure. There is evidence in the southern quadrant of the building of a brick floor overlying purple slates, which sit on 0.05m (2in) of grey sandy tailings and orange natural subsoil. In the west corner of the raised floor, below the recess and against the gable wall, is a square depression 0.4m x 0.4m (1ft 4in x 1ft 4in). Within the depression was a deposit of charred or decomposed wood 0.2 x 0.2m (8in x 8in) and 0.05m (2in) deep, lying against the gable wall, a fragment of rotted wood, and a small spread of mortar, overlying grey-brown sandy tailings. The location of the depression and the presence of charred wood suggests that it may have been a hearth, although there are no traces of heating or burning on the wall above.

The Dressing Floor (SH 48854726, 183m/600ft OD) **and Incline** (SH 48804724)

The dressing floor lies to the south-east and downslope from the crusher house. The floor is defined by a rear revetment wall 11m (36ft) long lying parallel to the crusher house and extending beyond its southern extreme. The wall is 1.8m (5ft 10in) high and built of large stones in rough courses at its base with more irregularly sized stones towards the top. The south-west of the dressing floor is defined by an inclining revetment 9m (29ft 6in) long built of more regularly coursed stone (Fig. 21). The incline revetment is bonded to the rear revetment. The north-east of the floor is defined by a buttress 1.5m (5ft) long and the tailrace. To the south-east of the floor lies the buddle pit.

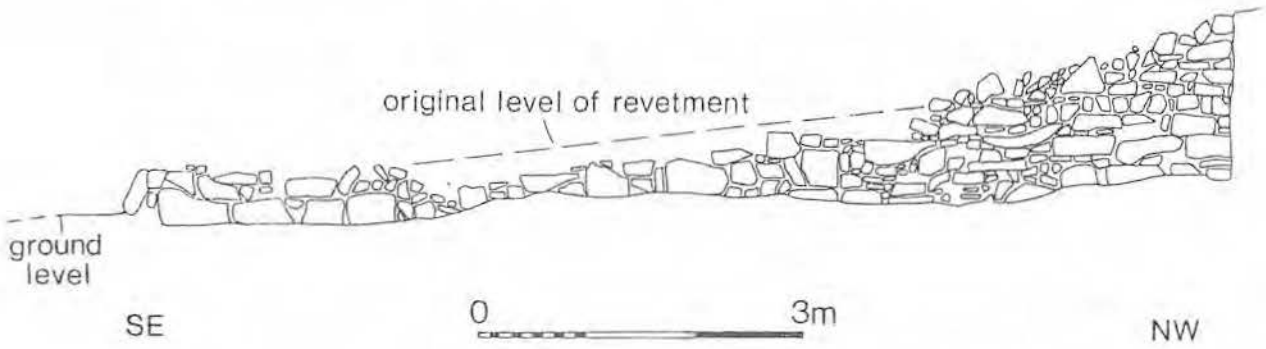


Fig. 21 Incline revetment - north-east facing elevation

The Waterwheel Pit Outlet and Tailrace (SH 48904733, 183m/600ft OD)

The wheelpit outlet lies to the south-east of the waterwheel pit at the base of the retaining wall of the upper dressing floor, which survives to more or less its original height of 1.6m (5ft 3in). The outlet is 0.61m (2 ft) wide and 0.5m (1ft 8in) deep. The side walls are of 2-3 courses of dressed stone over which sits a lintel stone 1m x 0.35m (3ft 3in x 1ft 1in) (Fig. 22). This method of construction is mirrored down the length of the culvert, which can easily be entered. Above the lintel are 4-6 courses of irregularly coursed medium sized stones capped with a single course of larger stones 0.8 0.35m (2ft 8in x 1ft 1in). The revetment is built 0.25m (10in) back from the wheelpit outlet. The maximum width of the tailrace at the west end is 1.4m (4ft 8in) at the level of the lintel stone, narrowing to 1.2m (4ft) at the base.

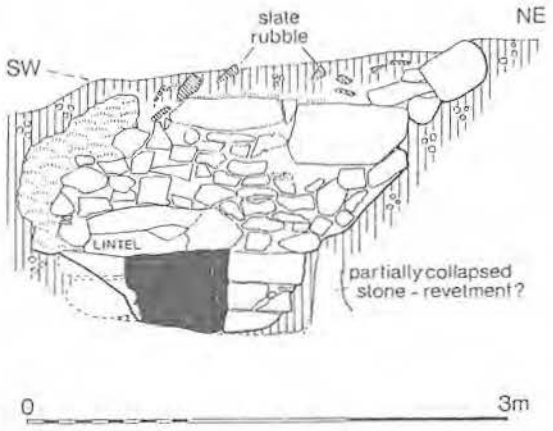


Fig. 22 Wheelpit outlet - east facing elevation

Water from the wheelpit was carried in a tailrace south-eastwards to pass north of the buddle pit and settling tanks. It seems likely that water to the buddle pit was taken from the tailrace at a point about 5m south-east of the outlet, although there is no direct evidence of this. The south side of the tailrace is heavily vegetated, though two courses of drystone standing 0.4m (1ft 4in) high remain. The north side of the tailrace is higher and more embanked than the south, being almost vertical for 1m (3ft 3in) then sloping more gently for 0.4m (1ft 4in). Whilst the south wall of the tailrace is built in line with the lintel supports of the culvert, the north side appears to be butted on to the dressing floor revetment 0.7m (2ft 4in). The revetment to the north of the tailrace is made of medium and large sized stones very randomly coursed, above which is uncoursed material that appears to have been dumped. 2.2m (7ft 2in) south-east of the tailrace outlet on the north wall is a large rounded boulder 0.95m (3ft 1in) high and 0.4m (1ft 4in) across set upright which indicates the probable inside edge of the tailrace. The width of the channel at this point is 0.8m (2ft 8in). The tailrace can only be reliably traced for 5m (16ft 6in), after which point there is no stone walling visible.

The Buddle Pit (SH 48944727, 182m/597ft OD)

The buddle pit lies to the east of the dressing floor and south of the tailrace. The pit is circular with an internal diameter of 4.45m (14ft 6in). It is faced with irregularly coursed stones to give a relatively smooth inner face. Before excavation there were 3-5 courses visible and the facing stood 0.3 - 0.4m (1ft - 1ft 4in) above the vegetation. The buddle is well preserved except for a small amount of damage to the west quadrant. There is an outlet 0.15m (6in) wide in the east side of the pit wall leading to the settling tanks, although there is no trace of a stone built leat leading towards the settling tanks. Before excavation the pit supported a thick mat of moss and grass and several small conifers.

A trench 0.5m wide was excavated across the centre of the buddle running east-west in a line with the outlet. The following section was recorded in the centre of the south facing section;

0-120mm	grey-brown humic sandy topsoil/tailings. Very damp, coarse and crumbly, and less humic towards the base.
120-140mm	orange/grey gravel, 1-2mm diameter.
140-170mm	fine clean grey sand.
170-200mm	grey-green silty clay laid in fine layers.

200-220mm	red-orange matrix of coarse sand and fine gravel with some streaks of bright orange.
220-260mm	green-grey silty clay with blue-grey mottling
260mm+	very compact orange-brown natural stony subsoil with small to medium sized angular stones.

The entire buddle was excavated to natural, producing no finds other than some wall tumble in the west quadrant of the pit (Plate 7).

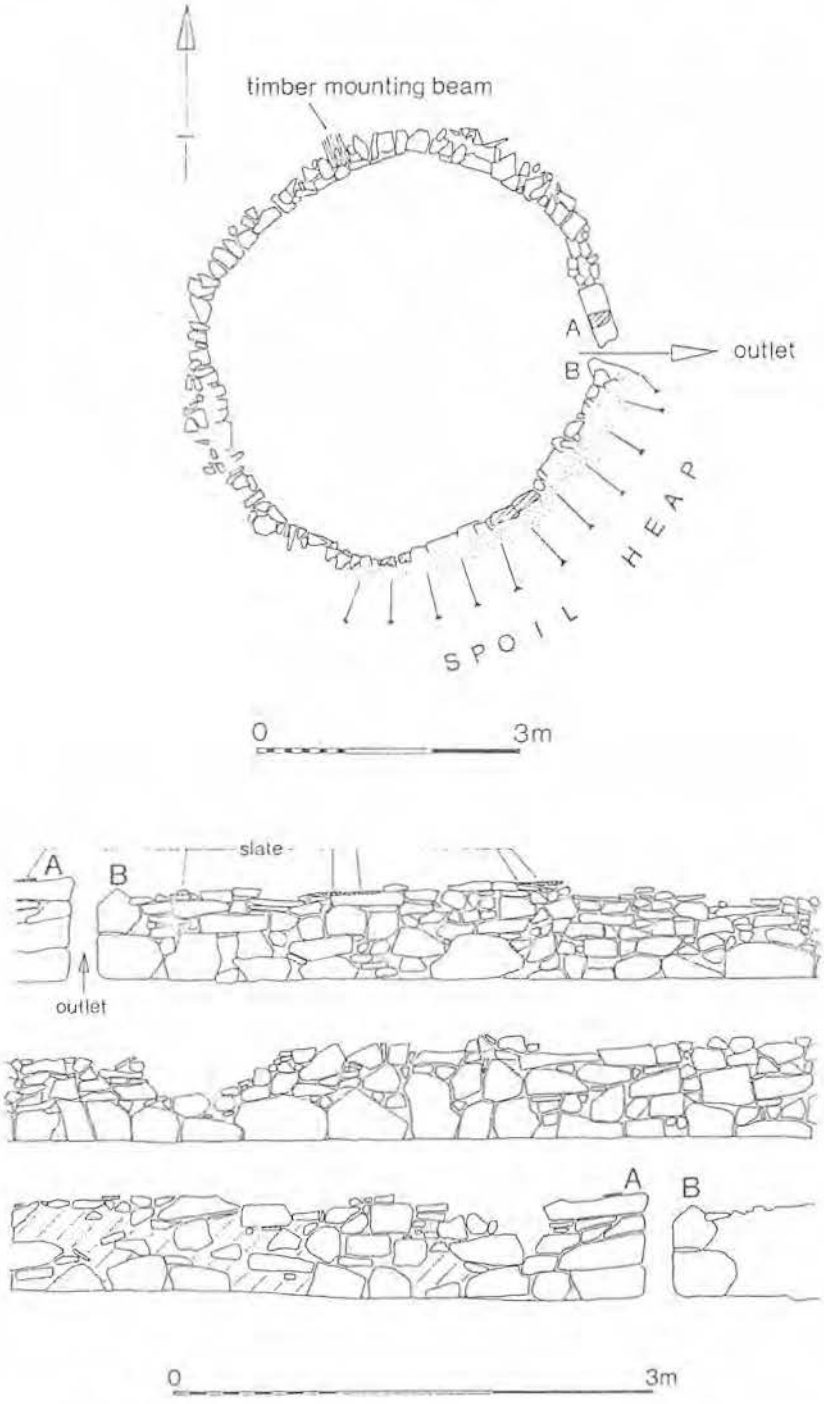


Fig. 23 Buddle Pit - plan and internal elevation

The Buddle had been constructed by means of cutting a circular pit into the orange-brown stony natural which was then retained by a mortared stone revetment, rendered to produce a relatively smooth inner face (Fig. 23).

The buddle wall survives to its full height of 0.61m (2 ft) on the eastern side but in parts of the southern and western quadrants it has not survived to its full extent. The wall is built of a bedding course of fairly large undressed stones, above which are 3 - 4 courses of irregularly shaped small and medium sized stones forming a flat upper surface. In the eastern quadrant of the pit, extending south from the drain, six fragments of thin purple slate form a capping course to the wall. It seems likely that the entire wall was originally capped with slate. There were no other features on the top of the wall other than a timber plank 0.2 x 0.3m (8in x 12in) in the north west quadrant. The plank may have been part of a launder base connected with the water inlet from the tailrace. The lower half of the internal wall face has been rendered around most of the pit, except for a stretch 1.3m (4ft 4in) long in the north-west quadrant.

The outlet from the buddle is in the east of the pit wall, and is built of 4 courses of rectilinear stones on the north side and 2 courses on the south side, giving a smooth inner face to the outlet. A trench was dug by hand across the exterior of the outlet but there was no trace of a stone-lined leat leading towards the settling tanks, suggesting that water and ore in suspension was carried to the tanks in a wooden launder.

The spoil heaps (SH 48954717, 183m/600ft OD)

Immediately to the east of the buddle pit is a roughly kidney-shaped heap 14m (46ft) north-south by 11m (36ft) east-west, and approximately 1.5m (5ft) high. The heap is composed of two distinct processing wastes, coarse pebbles and small stones dominating the southern half and finer sandy material in the northern half. A profile was cleaned on the eastern side of the heap (P1) to reveal a depth of 0.6m (2ft) of dark brown/orange stony sand, interpreted as redeposited natural, possibly originating from the digging of the pit. A pit was dug in the centre of the northern heap (P2) to reveal a depth of 0.7m (2ft 4in) of clean light grey sand, interpreted as buddling waste. The stony material in the southern part of the heap is probably waste from hand sorting.

The Settling Tanks (SH 49054712, 181m/594ft OD)

The settling tanks are in the most south-easterly and lowest part of the mill complex, and probably acted as traps for mineral particles to stop the pollution of the water system, a factor that was largely ignored at the later workings of Parc and Hafna. The settling tanks were fed from the buddle pit, although the exact line of the drain from the buddle cannot be traced because of damage by forestry machines in the 1970's. There are no obvious inlets or outlets to the tanks, which suggests that the tanks were launder fed from the buddle and the sludge was brought in over the tank walls. Before clearance the tanks were heavily vegetated including the remains of a large tree stump in the western half with roots 0.3m diameter growing through the walls of the tank. The tree was removed by chainsaw and machine without causing any damage to the structure (Plate 8.). Beneath the vegetation was a layer of dark grey humic sandy soil 0.2m (8in) thick, similar to that found in the buddle, sitting on top of orange brown natural. The tanks were not emptied because of the highly toxic nature of their contents.

The tanks are rectangular, 6m long (19ft 8in) and 4.5m (14ft 9in) wide and are orientated north-east/south-west Fig. 24). There is a dividing wall running along the centre of the long axis that is bonded into the end walls. The walls are built of between 3 and 6 courses of irregularly shaped undressed drystone, with a basal course of larger more regular stones. The walls are 0.61m (2 feet) thick and survive to a height of 0.55m (1ft 10in), which is their probable original height. The tanks are reasonably complete except for a small amount of damage to the central wall and to the south and west corners, where 1-2 courses have tumbled.

Exactly how the tanks operated is uncertain as they appear to be 2 discrete units side by side. The sludge may have overflowed from the upper tank to the lower tank, or alternatively could have seeped through the large cracks in the drystone walling, which do not appear ever to have been rendered. To the east and downslope of the tanks is the remains of the leat carrying water away from the wheelpit, buddle and settling tanks. The leat is 0.7m (2ft 4in) wide and can be traced from about 7m (23ft) east of the tanks.

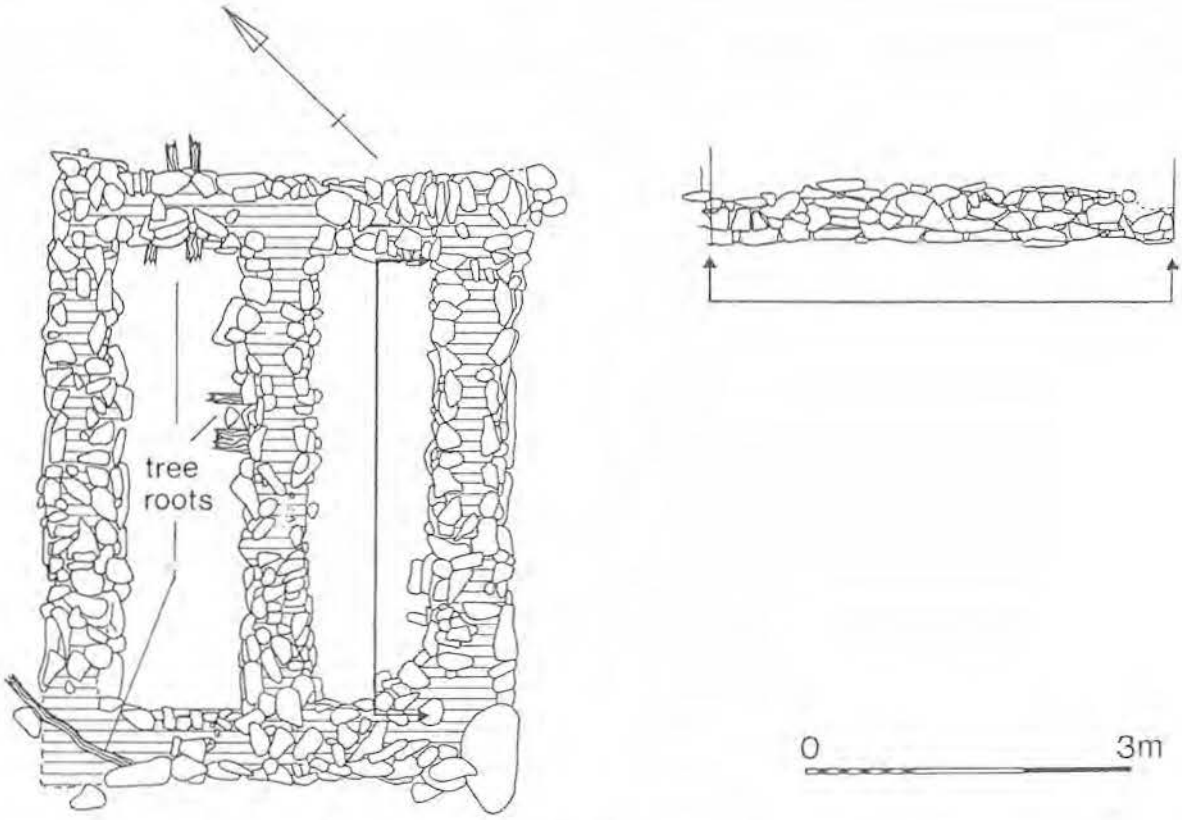


Fig. 24 Settling tanks - plan and north-west elevation

The Leat Outlet to the south of the Buddle (SH 48804707)

The outlet is in the extreme southern corner of the site and is almost hidden by the surrounding forest. Moss and litter spilling over the top of the outlet was not cleared because no consolidation was required (Fig. 25).

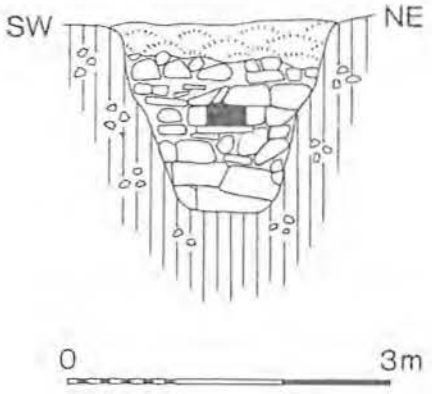


Fig. 25 The leat outlet - south-east facing elevation

Plate 8. The settling tanks after clearance

Plate 9. The hearth and flue in the cottage annexe

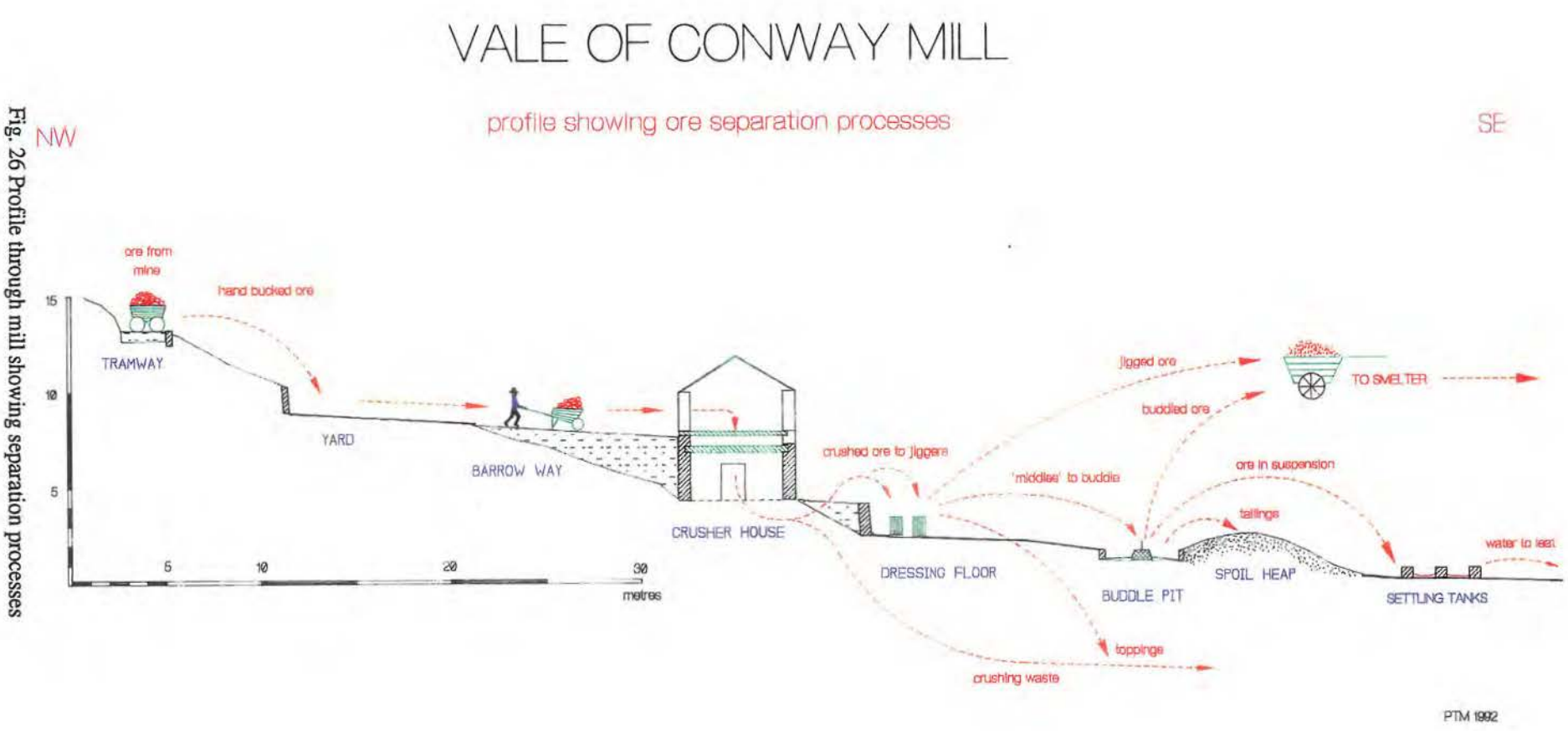


Fig. 26 Profile through mill showing separation processes

The outlet appears to carry water from the drainage channel under the tramway to the west. The revetment is made of angular, square and sub-rounded stones, dry-built to form tight joints. The revetment is 1.8m (5ft 10in) high, 2m (6ft 6in) wide at the top and falls away to a flat bottom 0.8m (2ft 8in) wide. The outlet is 0.8m (2ft 8in) from the base, and is 0.35m (1ft 2in) wide and 0.2m (8in) deep. The outlet flows into a channel that has been cut out of the natural subsoil and there is no revetment visible. The channel is steep-sided, flat bottomed, and the side walls fall gradually away until 10m (33ft) east of the outlet they become negligible.

Operation of the Mill (Fig. 26)

The mill was designed to crush and separate ore prior to being transported elsewhere for smelting. The various operations were performed at increasingly lower levels to enable the ore to "flow" from one process to another, often aided by water. As mentioned earlier, ore was carried from a number of levels in the area via a system of barrow-ways and tramways. Ore was partially sorted by hand after being tipped into ore bins, before being trammed down the main tramway to the mill.

Hand-bucketed ore was tipped from the tramway into the yard, where further sorting may have taken place, the waste of which would have been barrowed to the north of the crusher house. The sorted and partially broken ore was then barrowed to the crusher house. "Once in the crusher house the ore was fed, via a hopper, to pass between two rollers which were turned by the waterwheel. The two rollers were forced together by a lever on which weights were hung, and the crushed ore was collected from below the rollers and taken by barrow to the lower dressing floors. The jigs and buddle on this floor would also have been driven by the waterwheel" (Bennett and Vernon 1990, 56).

The drive wheels for the jigs and buddle can be seen mounted on the front of the wheelpit in the early photograph of the crusher house featured in the aforementioned work (p. 55). Jigs were strong sieves which could be raised or lowered in a tub of water through the movement of a lever. Owing to differences in the specific gravity of the vein stuff the action of the water-filled jigger separated it into three layers. The pure ore, being heavier, occupied the lowest layer; directly above it was a mixture of lighter bits of ore and stone, while the surface layer consisted of the worthless spar etc., known as the toppings or skimpings (Lewis 1967, 344). The middle layers from the jigger were then buddled in the buddle pit in the final separation, and the resultant pure ore taken away for smelting. The waste water from the buddle pit was carried to the settling tanks where ore in suspension eventually settled into a slime that could be re-processed.

7. THE COTTAGE (Fig. 27)

The cottage is 75m north/north-east of the mill complex, 15m west of the proposed route of the forest trail. It is possible that the cottage was occupied by a caretaker during periods of mining inactivity between 1878 and 1892, as recorded in the monthly return ledger for the Gwydyr Estate (Bennett and Vernon 1990). The cottage could also have been the mill office, or the area where processed ore was stored before being transported by cart to Trefriw quay some three kilometres north.

The main features of the cottage are an "L" - shaped yard retaining wall/revetment, a single roomed cottage, an annexed side building, a yard and a drystone-walled entrance way. The cottage and side building are both abutted to the yard revetment wall. The yard revetment is 15m long and is orientated east-west with the short arm of the "L" running 4m south from the west end.

The cottage is not built squarely onto the retaining wall, and measures 4.8m by 3.8m. There is a blocked-off entrance in the west gable wall, most of which has collapsed inwards (Fig 28). The south wall has an entrance at the west end and a window at the east end (Fig. 29). The east gable wall also contained a window (Fig. 30).

There is an annexe on the west side of the cottage defined by a length of wall 1.9m long running parallel to and 2.7m from the west gable wall of the cottage. A hearth and chimney are in the north-west corner of the building (Plate 10).

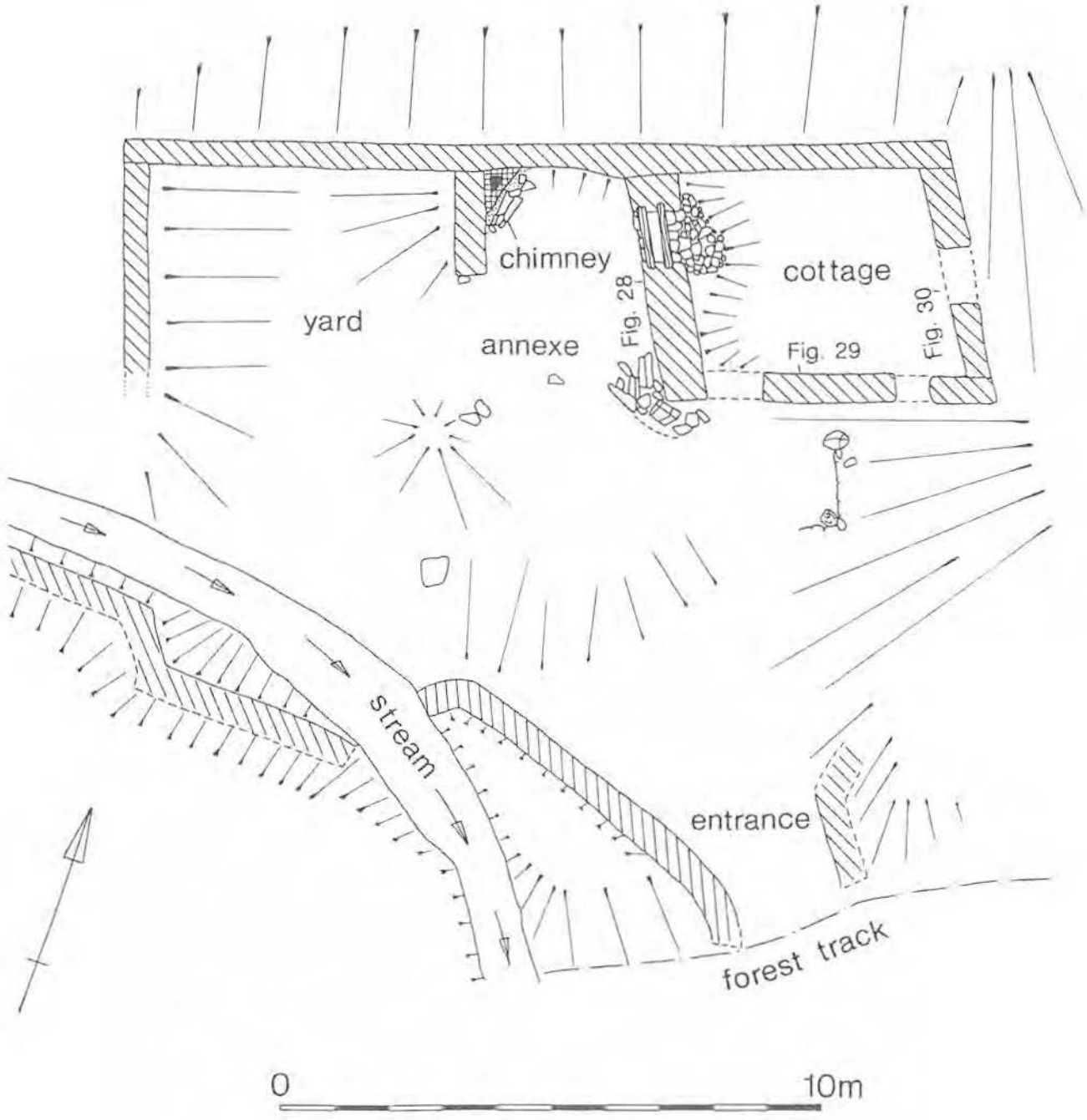


Fig. 27 The cottage - plan and location of elevation drawings

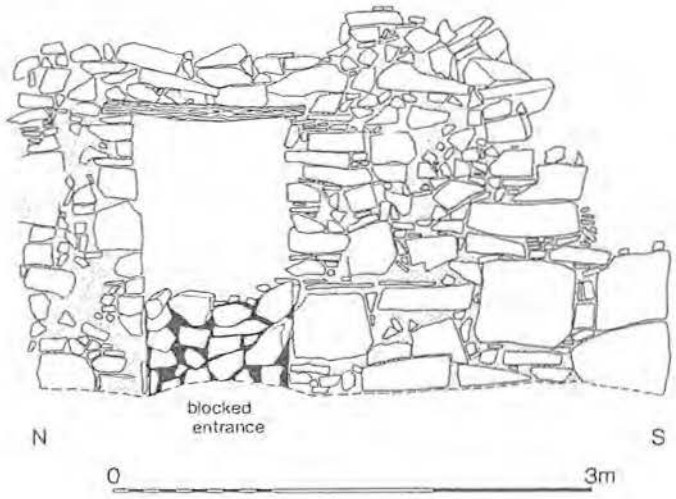


Fig. 28 The cottage - west wall external elevation

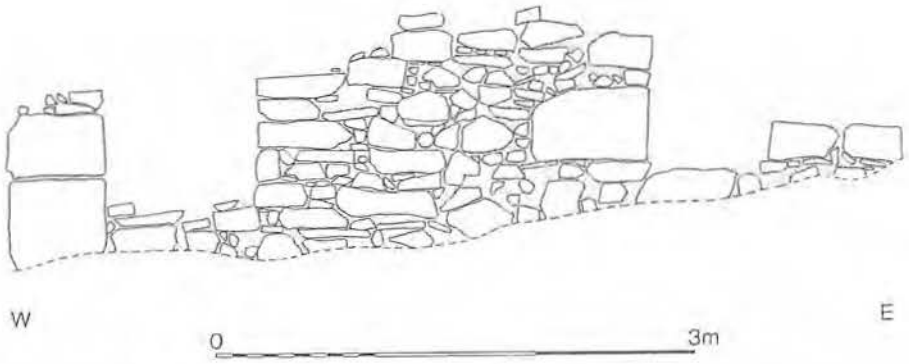


Fig. 29 The cottage - south wall internal elevation

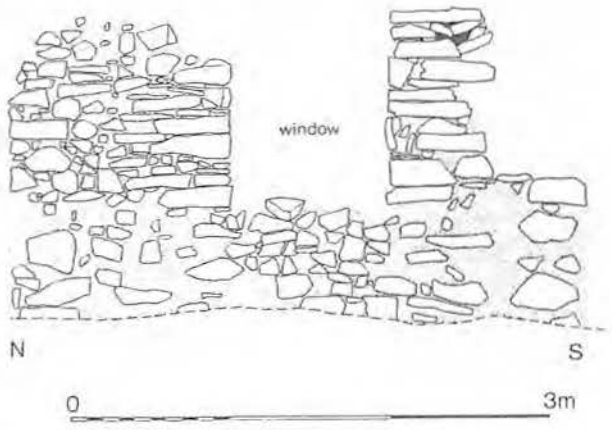


Fig. 30 The cottage - east wall internal elevation

8. ACKNOWLEDGEMENTS

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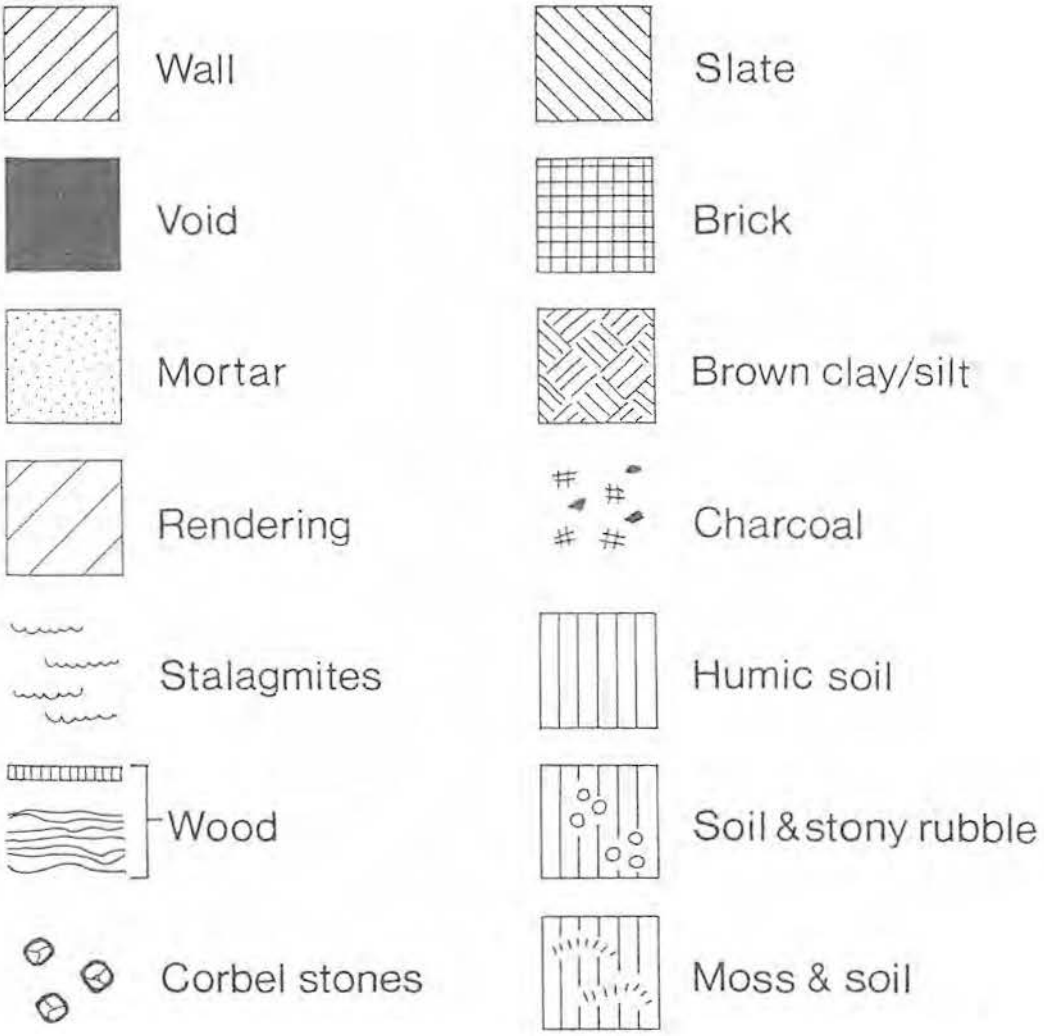
9. BIBLIOGRAPHY

Bennett, J. and Vernon, R.W. 1990. *Mines of the Gwydyr Forest. Part 2. The Hafna Mine, Llanrwst and some early ventures in Gwydyr Nant.*

Lewis, W.J. 1967. *Lead mining in Wales.* Cardiff.


Wall
Void
Mortar
Rendering
Stalagmites
Wood
Corbel stones
Slate
Brick
Brown clay/silt
Charcoal
Humic soil
Soil & stony rubble
Moss & soil