AUGILL SMELT MILL
Cumbria

Archaeological Building Investigation

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SUMMARY

Oxford Archaeology North (OAN) undertook a building investigation of Augill smelt mill in Cumbria (SD 8160 1468), which is a scheduled monument in November 2001, The investigation was carried out in order to inform a management plan for the site and involved a Royal Commission on the Historical Monuments (England) (RCHM(E)) Level 3 survey of the building to produce a plan of the site and drawings of all the elevations, with the exception of the east external elevation, which was too badly collapsed to examine usefully. This survey involved taking rectified photographs of the building, enhanced by digital data collected with a reflectorless total station; the plan was produced entirely with the reflectorless instrument. The analysis of the fabric of the building corresponded to RCHM(E) Level 2, and assessed the building's form, function and development. A topographic survey of the earthworks surrounding the building was also undertaken using a conventional total station.

The smelt mill is thought to have been built in 1843 to process lead ore produced in the mines to the north. At some time in the mid to late nineteenth century it was converted to enable the roasting of iron ore nodules, which were also discovered in the vicinity. The mill went out of use in the late nineteenth century and was subsequently used as a stable. The roof was removed in the mid twentieth century and the building quickly fell into dereliction.

The building comprised a north / south orientated long room, with a smaller room on the southern end. Externally, against the northern gable is a wheel pit and on the east wall of the long room is a series of four hearths. A long, broad flue is set along the outside of the same wall and extends from there, through a long circuitous route, to a chimney on the summit of the adjacent hill.

The building survey identified three phases of alterations to the building, which appear to relate to the main historical events outlined above. The most significant alteration involved the raising of the walls by up to 1m, probably to allow for the establishment of a first floor and thereby to enable the charging of the hearths from above. Further modifications included the probable partition of the southern room and the creation or alteration of access into this southern end of the building, which probably occurred at the same period as the raising of the walls. The conversion of the building to a stable led to further, more cosmetic alterations, including the removal of machinery and blocking of unnecessary doorways and hearths.

Several of the earthworks within the immediate environs of the smelt mill probably relate to its operation or construction, including a leat (now almost totally obscured), an associated track, the flue, two quarries, and a charcoal burning platform.

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Daniel Elsworth undertook the building investigation, assisted by Neil Wearing and Gunnar Hellström. Daniel Elsworth compiled the report, with additional information from Rob Kinchin-Smith. Andrea Scott, Emma Carter and Daniel Elsworth produced the illustrations. The report was edited by Jamie Quartermaine and Rachel Newman, the project being managed by Jamie Quartermaine.

1. INTRODUCTION

1.1 CONTRACT BACKGROUND

1.1.1 During November 2001 an archaeological building investigation was undertaken, by Oxford Archaeology North (OAN) (formerly Lancaster University Archaeological Unit), of Augill smelt mill in Cumbria (SD 817 147), on behalf of the North Pennines Heritage Trust. The smelt mill is a Scheduled Monument (S32897). The programme was designed (*Appendix 2*) in accordance with a brief (*Appendix 1*) provided by the North Pennines Heritage Trust, to create a detailed record of the building and environs which would inform a management plan of the site. The survey followed on from, and was informed by, an archaeological assessment of the site undertaken by Ed Dennison Archaeological Services in 1998 (EDAS 1998), which provided a detailed documentary study of the smelt mill.

1.1.2 The programme involved a survey of the building, undertaken to Royal Commission on Historic Monuments (England) (RCHM(E)) Level 3-type standards, and a topographic survey of the environs of the site.

1.2 GEOLOGICAL AND HISTORICAL BACKGROUND

1.2.1 The following is a summary of the historical and topographical background of the site, based upon the assessment report by Ed Dennison Archaeological Services (EDAS 1998); a more detailed account of the history of the site is provided within that report.

1.2.2 ***Topography and Location:*** the site is to the east of Brough, at the head of the Eden valley, and is on the western approach of the Stainmore pass, crossed by the historically important trans-Pennine Stainmore road (the modern A66). The smelt mill is situated at the intersection of Augill Beck and the former line of the A66, which was also the line of the earlier turnpike road; the former crushing mill is *c*600m north of the smelt mill, up the Augill Beck, and the mines are a further *c*500m up the beck at the head of the valley. The smelt mill is built on a narrow terrace at the base of a steep 'V'-sided valley, and a large reservoir for the smelt mill has been built above the east side of the valley. An extended flue extends up the valley side to the site of a chimney built on the summit of the ridge to the east of the Augill valley.

1.2.3 ***Geology:*** the Augill valley is crossed by a belt of steeply dipping strata comprising sandstones, shales and limestones. The lowest limestone strata has tiny cracks filled with galena, pyrites, and pink barytes, forming the Augill vein, which has been cut by the valley, and the beds are exposed at the base and head of the valley. Low grade ores have been worked by open cast working and the better ores were obtained by the cutting of shafts into the valley bottom (Dunham 1990, 116-7).

1.2.4 ***Historical Background:*** little is known of the early origin of mining in the Augill Valley, and the earliest reference to it is on Hodgson's of map Westmorland (1823-4) which shows 'Lead Mines' on the west side of the beck. A trade directory of 1849 records that '*there is a prolific lead mine and smelt mill erected in 1843*'

(Mannex and Co 1849, 145). The Ordinance Survey 1st edition map (1863) (Fig 2) shows the mill as a rectangular building, with small unroofed buildings to the east and west. A leat is shown extending north-east from the wheel pit of the smelt mill along to the eastern side of the valley towards a weir, *c*100m upstream. In addition, there is a large angled reservoir to the south-east of and above the mill; there are no leats shown connecting this to the smelt mill. A chimney is shown to the east of the valley on the local high point, but there is no flue shown connecting this with the mill. Significantly, the mill is described as Augill Foundry (Iron) suggesting that by this date the mill had been converted for the working of iron.

1.2.5 By 1894 the mill had gone out of use, as Kelly's 1894 *Trade Directory* notes '*formerly extensive lead mines and a smelt mill now disused*' (Kelly 1894, 129).

2. METHODOLOGY

2.1 PROJECT DESIGN

2.1.1 A project design (*Appendix 2*) was submitted by OAN for an archaeological study of the Augill Smelt Mill, in accordance with a brief prepared by the North Pennines Heritage Trust (*Appendix 1*), and, following acceptance of the project design by Cumbria County Council's Archaeology Service and English Heritage, OAN was commissioned to undertake the work. The brief required a topographic survey of the environs of the smelt mill and a fabric survey of the mill itself. In all respects the project design has been adhered to in full; the work was consistent with the relevant standards and procedures of the Institute of Field Archaeologists, and generally accepted best practice.

2.2 TOPOGRAPHIC SURVEY

2.2.1 A detailed instrument survey was undertaken of the environs of the smelt mill extending no more than 20m around the mill, sufficient to show the immediate context of the site. The recording was undertaken to an OAN level 2b survey (OAN 2002), which is equivalent to RCHM(E) level 2. Survey control was established over the site by closed traverse and internally was accurate to +-15mm; the control network was located by tying into the extant OS depicted topography.

2.2.2 The surface features were surveyed by EDM tacheometry using a total station linked to a pen computer data logger, the accuracy of detail generation being appropriate for a 1:250 output. The survey was enhanced by manual survey on-site using AutoCAD 14 within the pen computer. Most topographic detail was also surveyed, particularly if it was archaeologically significant or was in the vicinity of archaeological features. The survey drawings were generated within a CAD system and were merged with the fabric survey.

2.2.3 ***Photographic Survey:*** in conjunction with the topographic survey, a photographic archive was generated, which recorded significant features and general landscapes. It was undertaken using 35mm black and white, colour slide film, and digital photography.

2.3 FABRIC SURVEY OF THE SMELT MILL

2.3.1 The survey of the smelt mill was undertaken to RCHM(E) level 3 standards, resulting in the production of plans, and elevations of the building, alongside a photographic record, and a detailed description of the structure. The work was undertaken by means of instrument survey to create the plan, and the elevations were recorded by means of rectified photography, with the control provided by means of the survey instrument.

2.3.2 ***Instrument Survey:*** the instrument survey was undertaken by means of a reflectorless total station, which is capable of measuring distances to architectural detail by reflection from the surface of that element (without need of a prism), and therefore allows the recording of detail with limited access. The survey was

undertaken with respect to a series of accurately surveyed control stations established by traverse around the outside of the building. The survey data were enhanced on site by manual survey and was digitally enhanced using AutoCAD 14 on the pen computer. The survey resulted in the production of plans, control for the rectified photography, and the long cross-section through the building.

2.3.3 ***Photographic Survey:*** rectified photography was undertaken in monochrome medium format of all elevations. Survey control was applied to the photography by means of the reflectorless total station. The photographic images were digitally calibrated using Archis software and incorporated as raster images into the CAD system (AutoCAD 14); elevation drawings were produced with respect to these images (Figs 5-13).

2.3.4 A general oblique photographic survey was undertaken of the building in accordance with RCHM(E) Level 3 recording. The record was fully indexed and photographic views were shown with respect to the existing architects' plans. This included external and internal elevations and appropriate architectural detail. A record was made in 35mm colour print and black and white formats of the interiors of the structure, showing similar detail to that recorded by medium format, as well as a broad range of general views.

2.3.5 The photographic record of the smelt mill included:

i) general external coverage (colour print and medium format black and white);

ii) general internal coverage (black and white contact prints and colour print (35mm));

iii) general views showing the overall setting of the building;

iv) close-up views of significant internal and external architectural details (black and white contact prints and colour print (35mm));

v) general views of representative structural detail (black and white contact prints and colour print (35mm));

2.3.6 ***Descriptive Record:*** the survey of the site involved the production of a detailed descriptive record of the fabric of the building in accordance with the RCHM(E) Level 3 standard. This involved internal and external examination of the extant fabric, and an assessment of the development of the building.

2.4 ARCHIVE

2.4.1 The results of the work programme formed the basis of a full archive to professional standards, in accordance with current English Heritage (1991) guidelines. This archive is provided in the English Heritage Centre for Archaeology format, as a printed document, and will be submitted to the Cumbria Record Office (Carlisle). A synthesis (the evaluation report and index of the archive) will be submitted to the Cumbria Sites and Monuments Record and the National Monuments Record.

3. TOPOGRAPHIC SURVEY RESULTS

3.1 THE ENVIRONS OF THE SMELT MILL

3.1.1 The earthwork survey was carried out within a radius of *c*20m centred on the smelt mill. Some features appear to relate directly to the mill, while others relate to different activities on the site (Fig 3).

3.1.2 ***Smelt Mill-Related Features:*** features relating directly to the smelt mill include the buried flue (Site 1), the leat (Site 2) and an associated track (Site 3). The leat, as described by EDAS (1998, 18), was difficult to identify, although the track it runs parallel with was visible (Fig 3), albeit badly eroded in places by the river. Approximately 25m to the north-east of the building, was a second, *c*2.5m wide channel orientated north-east/south-west (Site 4), extending across the side of the valley. A track (Site 5) runs parallel to it on the east side, which has been utilised in the construction of a modern footpath (*Section 3.1.6*). It is probable that this channel carried the water to the site from the reservoir to the east, above the smelt mill. The buried flue (Site 1) was more difficult to identify, having been covered and disturbed by later activity on the site, but it would appear to have run from the centre of the east side of the smelt mill on a north-west/south-east orientation before returning at some unknown point to the north-west, and heading towards the chimney on the top of the hill.

3.1.3 ***Other Features:*** there are two small stone quarries (Sites 6 and 7) within the study area, one to the east of the mill, and one other to its south-east, just below the reservoir. The quarry to the north-east (Site 6) cuts across the line of the second channel (Site 4), although not the adjacent track (Site 5). This would suggest that the quarry was probably later than the channel. The spoil from the other quarry (Site 7) has spread over the line of the flue (Site 1) and would therefore appear to post-date the construction of this element; it is probable that both these quarries post-date the initial construction of the smelt mill. A series of small tracks (Sites 8 and 9) extends across the slope and connect to the larger track; they are orientated towards Quarry 7, but there is no direct relationship.

3.1.4 On the north side of the group of earthworks, and to the east of the smelt mill, is a small, rounded platform (Site 10) at the end of a small track running north-west/south-east. This platform is approximately 3m long and 2m wide, and could potentially represent the remains of a charcoal burning pitstead, which would have produced a necessary ingredient of the smelting process (EDAS 1998, 28). The dimensions are, however, a little on the small side for such a structure, which would typically be between 5 and 10m in diameter (Rollinson 1974, 121).

3.1.5 On the west side of the smelt mill, the earthworks all seem to relate to the formation of the river and include at least two terraces. No evidence for the small enclosure shown on the OS 1st edition (1863) was visible. To the south and south-west are two large mounds of rubble (Site 11), both of which appear to be modern. These are banked against and therefore post-date a series of walls (Site 12), the southernmost examples being relatively recent structures post-dating Wall 13, to the north-west, which is low, ruined and overgrown; the latter wall is shown on the OS 1st edition map (1863), while the western elements of Wall 12 are not.

3.1.6 The most recent earthwork on the site is the footpath on the east side (Site 14), which zig-zags up the slope on a north-east/south-west orientation. On the lower, steeper part of the slope it has four timber steps cut into the bank, while further up the slope it has utilised part of the earlier track (Site 5). Although only a footpath, this feature has resulted in substantial erosion on the slope, channelling water overspilling from the reservoir above, which has caused marked erosion scars.

4. BUILDING SURVEY RESULTS

4.1 THE SMELT MILL

4.1.1 The mill lies on the east bank of Augill Beck, with high ground rising to the north and east. The mines which served the mill are situated to the north (EDAS 1998, 1), and the conduit used to carry fume from the flue during the lead smelting process originally connected to a chimney on the hill some distance to the north-east (*ibid*). The building consists of a long rectangular building set into a moderate slope (Plate 2). It is roughly aligned north-east/south-west, although for the purposes of this report it will be considered to be on a north/south alignment. It is divided into two unequal primary cells: the larger cell at the north end, the smaller at the south. The southern cell is again divided east/west with a raised floor on the east side, forming an upper storey, which was accessible only from the up-slope eastern side. To the west was a smaller room accessible from the western valley floor (Fig 4).

4.1.2 The mill building is built in randomly coursed rubble blocks, mostly a fine light pink sandstone with some fine limestone, and other, glacially-derived, stone types. Quoins are picked out in larger, dressed sandstone pieces, while the lintels tend to be limestone voussoirs or of timber. The roof is missing although some stone coping remains. At the north end is the wheel pit, immediately adjacent to the north elevation; it is partially infilled and the northern face is both part degraded and obscured by infill.

4.2 EXTERNAL ELEVATIONS

4.2.1 ***North external elevation of the mill (Fig 7):*** the north external elevation forms the gable end of the building (Plate 3). The stonework is roughly rock faced, with large dressed quoins. The wall top is capped with large coping stones, which are selectively secured by two iron brackets. The base of the wall forms the southern face of the wheel pit and is *c*2m lower than the other elevations. Near the base of the elevation, and slightly west of the centre, is a square aperture (N3) with a stone lintel, blocked with loose sub-angular and rounded stone. Above this, and nearer to the centre, is a small hole broken into the wall (N1), which would appear to have been the support for the wheel's axle shaft; it is *c*0.3m high by *c*0.25m wide. There is a further small, narrow aperture (N2) to the east of this with a stone lintel and over-long sill. There is also a series of small putlog hole apertures set into the northern face of the wall. Near the base, and within the wheel pit, are two apertures, both to the west of aperture N3, and set vertically above; each has been deliberately constructed with an overset lintel, their internal sizes being 0.21m x 0.19m for recess N4, and 0.12m x 0.16m for recess N6. They appear to be set only into the northern face of the wall, but, as the southern face is buried above the upper level of aperture N4, it was not possible to confirm this. A further recess (N5) was set into the upper, central part of the elevation. This again had a deliberately set lintel and was 0.18m x 0.18m in size. This recess did not extend through to the southern face and had been blocked with a single unmortared stone. It would appear to be a further putlog hole.

4.2.2 There are also several minor subsidence cracks and some damage to the wall top. The upper courses of the elevation have a greater proportion of limestone, and the central core has a thicker, white mortar, not present around the tops of the gable; this suggests that the wall top is of a separate build.

4.2.3 ***West external elevation, mill (Fig 6):*** the wall is described from the north end (Plate 2). The northern corner is constructed of large dressed sandstone quoins. Immediately south of these is a relatively large hole broken through the wall, causing two large cracks to appear above it. There are four tall windows (W1, W2, W4 and W5) of similar proportions, and similar build, across the remainder of the elevation. All have a double limestone lintel and in each case the sills have been damaged and/or rebuilt, leaving very rough openings. In the centre, with two windows on either side, is a large wagon doorway (W3). It has a large, voussoired, three centred arched top, on dressed sandstone-quoined jambs. Large iron gate hooks remain *in situ* on both sides and a short length of iron chain hangs from the centre of the internal lintel. The south end of the west elevation has a pedestrian doorway (W7) on the ground floor, with a double lintel of limestone; the northern jamb of the door has largely collapsed and only a single quoin survives which supports the lintel. There is another window above (W6), with a timber lintel. The southern end of the wall is finished with dressed quoins as is the northern end.

4.2.4 Like the north elevation, the upper part of the entire west external elevation, above the tops of the windows, is of a noticeably different character, being predominantly of limestone with a less prominent mortar. Even the quoins display a difference in character; at the south end the lower ones are smaller and less well finished than the upper ones. The upper window at the south end of the building (W6) extends up to the present roof line, and was evidently also a later addition. Throughout, the wall top is badly collapsed and exposed to the core in several places.

4.2.5 ***South external elevation, mill (Fig 5):*** the southern external elevation forms the gable end of the building (Plate 1). Its build is also of randomly coursed stone, with dressed quoins at each corner; the majority of the build is in sandstone with a thick, white mortar, and the upper part has apparently been rebuilt in limestone. There is also a large area of limestone around the centre of the lower part of the wall, suggesting some degree of rebuilding or repair in this area. There are no door or window apertures through the wall. The rebuilt gable top incorporates a large iron cog (S1), which has been used as a surround to form a small hole into the southern end of the building.

4.2.6 ***East external elevation, mill:*** the east external elevation is largely ruinous with only a few courses visible externally, and a large hole south of the centre. It is essentially a revetment wall built into the higher ground to the east, with the flue (Site 1) visible as a series of small depressions and areas of collapse or openings. The elevation was built in limestone, of roughly dressed blocks, in random courses with dressed quoins at the corners. The north end, immediately south of the corner, is largely collapsed, with a hearth/opening immediately south of this. The central area is also badly collapsed, with three holes in the ground that open into the flue, and very little of the wall itself survives. The southernmost end survives to a height of approximately 1.2m. There is a large wagon-type doorway

into Room 2 with a fallen timber lintel (which has evidently been reused). This doorway is partially blocked on the north side with a short section of rough stonework, which is *c*1.3m long and *c*0.4m high.

4.2.7 ***Wheel pit:*** the wheel pit is stone lined on the east and west sides in up to ten roughly made courses, possibly of drystone construction, which are keyed into the north elevation of the mill. The south elevation of the wheel pit is the external wall of the mill, while the north elevation is covered by topsoil and leaf litter. There is little sign of any stonework on this side, which suggests that it was both partially collapsed and obscured by overburden.

4.2.8 ***East elevation, flue:*** the flue is stone lined and approximately 0.8-1.2m deep and 0.8-1m wide. Some of the original flagstone capping has survived but the majority has collapsed. Several short drystone partitions have been added, each corresponding to one of the ovens.

4.3 INTERNAL DETAIL

4.3.1 ***Room 1:*** Room 1 is a large, long room, forming the north end of the building, and housing the furnaces. The walls are of the same material as seen externally and there are various internal features corresponding to the furnaces and associated elements (Fig 4).

4.3.2 ***Room 1, north internal elevation (Fig 10):*** this forms the northern gable, and was constructed of sandstone in the lower part, but rebuilt in limestone toward the wall top, which was finished with large slate coping (Plate 8). There is a single narrow aperture on the east side (N2), with an over-long stone sill. Immediately east of this, and partially below it, is a rough, broken-out area, which has been almost entirely filled with loose stone. There is a small hole in the centre of the wall (N1) and another on the west side (N7), broken into the wall approximately 1.1m from the present ground surface. The central hole (N1) corresponds to that exposed on the external face of the wall, and was undoubtedly the axle support for the wheel. The top of a small aperture (N3) is visible in the centre at present ground level, but only the stone lintel and the top 0.2m of the opening are exposed. This corresponds to the blocked aperture on the northern face of the elevation, and its buried nature suggests that the internal ground level against the north wall was formerly substantially lower.

4.3.3 ***Room 1, west internal elevation (Fig 9):*** the lower part of the elevation is constructed of sandstone while the upper part has been rebuilt in limestone. There are four large windows (W1, W2, W4 and W5) spaced regularly across the elevation, each with timber lintels (although the southernmost has collapsed). The sills are up to 0.4m lower on the inside, and they are recessed by 0.3m. The recess between the level of the internal and external sills has collapsed, although in the southernmost window (W5) it has been filled with very rough stonework at an angle of *c*45°. This suggests that the windows have not been glazed for some time. The southern window (W5) has a pair of small holes below it, on either side of the sill, which may have formed part of the original structure of the sill.

4.3.4 In the centre of the elevation is a large wagon doorway (W3) with a timber lintel and quoined jambs. The lintel was evidently reused as it has a pair of single tenons at each end, and numerous bolts and bolt or peg holes are visible. In the

centre of this lintel, a short length of iron chain is attached, and immediately to the south of it is a small hole, which may be a putlog hole or the result of masonry collapse.

4.3.5 There are three alcoves built into the wall, one at the southern end between the southernmost two windows (W8), the second (W9) on the north side of the wagon doorway, and the third (W10) is between the two northern windows. They each have stone sills and lintels and are 0.6m wide, 0.5m high and 0.35m deep. At the far northern end of the wall is an irregular hole through the wall, which has caused a large crack above; this may be the result of a collapsed alcove.

4.3.6 ***Room 1, south internal elevation (Fig 8):*** the southern internal elevation forms the partition between Rooms 1 and 2 (Plate 9). It originally had a gable top but this is now substantially collapsed. The lower west side is built of roughly coursed sandstone covered by a thick mortar, with randomly coursed limestone forming the majority of the upper part. There is a large pedestrian doorway (S2) to the east of the centre, raised 1.1m from the floor level, to the east of which the wall is entirely rebuilt in limestone. The doorway has a timber lintel and a sandstone step, and has been blocked with randomly coursed sandstone rubble. The wall keys into both the east and west walls, demonstrating that it has not been inserted, although the upper part has been built up.

4.3.7 ***Room 1, east internal elevation (Fig 11):*** the eastern wall is partly revetted into the slope to the east and thus more is exposed internally than externally; it has largely collapsed towards the southern end. There are several areas which appear to have been rebuilt or repaired, in particular the upper courses of the wall and some of the areas between the hearths (E2, E3 and E4). The southern end is still largely original, but only several rough courses of limestone survive before being lost to the general area of collapse to the north. Beyond this are the remains of three hearths, with several stub/partition walls between them. The southernmost stub wall is almost entirely obscured under the collapse, and north of it is a hearth (E4) with a large stone slab lintel. On either side are projecting stone slabs set at approximately 45°, meeting the stub walls on either side, and forming hoods. North of this hearth is another stub wall, also mostly obscured by rubble, with a further hearth (E3) immediately to the north of it. This central hearth is built in the same style as that to the south, with projecting slabs on both sides, although it also has a lower opening visible below its stone slab base, which is 0.6m wide and recessed at least 0.7m.

4.3.8 On the north side another projecting slab meets the next stub wall, which stands considerably higher than those to the south, and appears to have a small slab over the top of it. A further projecting slab extends to the north and terminates at an area of loose stonework, made up of several types of stone, which appears to be the blocking of what was once a third hearth (E2). Another projecting slab slopes down from the north side of this blocked area to the northernmost stub wall, which is also relatively well preserved, and several courses high. North of this stub wall, and incorporating it in its south jamb, is a low aperture (E1) with a stone lintel, which is open to the outside, and to some extent also to the flue (although this may be a result of external masonry collapse).

4.3.9 The position of a fourth, southernmost hearth would potentially have been in the position of the extensive area of collapse in the southern part of the wall and it can be conjectured, though not proven, that there was a hearth there also.

4.3.10 ***Room 2:*** Room 2 is a smaller room at the southern end of the building (Fig 4). It is divided by a low partition wall, and is split onto two levels, with the east side being the higher.

4.3.11 ***Room 2, north internal elevation (Fig 13):*** this is broadly comparable to the northern face of the same wall (southern internal elevation of Room 1); the lower courses are of roughly coursed sandstone, with one or two string courses of thinner slabs, while the upper part is constructed of randomly coursed limestone. The large doorway (S2) on the east side is blocked with relatively loose random courses, and has a timber lintel (Plate 4). The west side drops down over the partition wall to the western ground level.

4.3.12 ***Room 2, west internal elevation (Fig 9):*** the upper courses of this elevation are of limestone while the lower are of sandstone (Plate 10). It has a badly collapsed pedestrian doorway (W7) on the lower, south side of the wall, which incorporates the southern corner of the building in its south jamb. It has a stone lintel and has partially collapsed on its northern side. Above this is a window aperture (W6) in the upper part of the wall; this has a timber lintel, which is free standing as it is level with the wall top. There are four joist holes (W13) below the level of the window, and just above the doorway, which are indicative of a wooden floor. The joists are on the same level as the raised floor level on the eastern side of the building, and it is evident that there was a first floor room continuous across the whole of Room 2, with a lower, ground floor extending across only the western half of Room 2.

4.3.13 ***Room 2, south internal elevation (Fig 12):*** this is the gable end of the building, again on a split level created by the earth-retaining partition wall. The lower courses are of sandstone, with a heavy mortar, while the upper courses have been rebuilt in limestone. There is some rebuild or repair to the west of the partition wall, and a small opening with a stone lintel, approximately 0.3m square, at the apex, corresponding to the iron cog built into the external face (S1).

4.3.14 ***Room 2, partition wall, west facing elevation (Plate 6):*** this is an earth-retaining partition wall constructed of roughly coursed limestone to a height of 1.8m, and supports an upper floor on the east side of Room 2. The wall butts onto the north/south elevation and would appear to have been a later feature. It has three small holes within it, one of which is almost certainly a small alcove.

5. DISCUSSION

5.1 SMELT MILL OPERATION

5.1.1 The smelt mill comprised a line of four hearths set against and into the eastern wall of the mill building. These each had stone hoods and a large aperture feeding an external flue on the outside of the building that would have taken the fumes to the chimney on the adjacent summit. The length of the flue would have allowed for the condensation of the lead onto the flue walls, and the large internal size of the flue would have allowed access for workers to extract the lead residue from the flue's sides.

5.1.2 Although the hoods and flues survive, the hearths themselves have gone, and it is not evident as to their former character. A blowing engine at the northern end of the mill, and driven by the water wheel, would have provided blast air, potentially carried via wooden pipework, to tuyere apertures at the base of the hearths (EDAS 1998, 25). Again, in the absence of extant remains, the form and character of the blowing engine is uncertain.

5.1.3 Room 2, at the northern end of the mill, was probably a store room. It did not serve as offices as it has no fireplace / flue and initially had no window for illumination, although a window was subsequently inserted through the western elevation.

5.2 DEVELOPMENT OF THE SMELT MILL

5.2.1 The smelt mill is thought to have been built in 1843 (EDAS 1998, 24) and appears on the OS 1st edition map of 1863. It was later converted for use in the iron industry, most probably for roasting iron ore nodules (*op cit*, 26). It has evidently undergone some modifications, and three major phases of alteration have been identified; some of these may relate to the building's change of use.

5.2.2 ***First Phase of Alterations:*** the first phase of alterations was the rebuilding or raising of the wall tops of the whole smelt mill, which was most probably associated with the alterations made to the south end of the building, and the alterations to/addition of new doorways into Room 2. The rebuilt wall top is evident as a subtle change in stonework above door and window height in the east and west walls, and as a similar change to the gable tops, increasing the wall height by as much as 1m. This was partially identified by EDAS (*op cit*, 28), and is further suggested by the reused timber forming the internal lintel of the wagon doorway, and also by the incorporation of an iron cog into the south elevation. The consistent new build within the upper part of the walls would suggest that the walls were raised, particularly as this appears to coincide with a fairly consistent horizontal interface between the old and new build. The external southern elevation shows the line of the interface as being pitched, and similarly the external face of the northern gable wall shows a pitched interface line between the old and new build. However, the internal face of the northern gable has an horizontal interface line, indicating that the raising of the northern gable also involved the rebuilding of the internal face of the gable. If the wall was raised then the western first floor window of Room 2 must be a later insertion as it is

extends above the line of the horizontal interface; it should be noted that the entire surround for this doorway is constructed of limestone, rather than sandstone. The earth-retaining partition wall in Room 2 butts onto the north and south walls of the room, but it is not evident if this was a later constructional phase of the original build or a part of the later phase of alterations associated with the raising of the external walls. Overall, these alterations probably relate to the conversion of the building's use from a lead smelt mill to an iron ore-roasting furnace, although direct alterations to the structure of the hearths are not readily apparent.

5.2.3 There also appear to have been some alterations made to the upper part of the flue, with the addition of short sections of stonework, dividing it into smaller sections. It is not, however, clear whether this is an intentional feature of the original construction of the flue, or a later alteration denoting a change in function. Sub-divisions like this were typically a part of the primary stage of condensing the lead fume, whereby a complicated arrangement of the flues slows the movement of the fume, exposing it to cold surfaces and allowing an increased amount of lead condensation in this lower part of the flue (R Kinchin-Smith pers comm).

5.2.4 ***Second Phase of Alterations:*** the second major phase of alterations probably relates to the use of the building as a stable, and most likely consisted of the removal of the wheel and blowing machinery, and maybe the blocking of the upper doorway between Room 2 and Room 1. The removal of the wheel potentially caused the partial collapse to the north elevation of the wheel pit. The windows in the west elevation may have been stripped of any frames at this time, which could have caused the collapse of the sills. Essentially this phase represents the removal of features and fittings that were incompatible with the building's use as a stable.

5.2.5 ***Third Phase of Alterations:*** the third major phase of alterations consisted of the removal of the roof, which was apparently for sale in *c*1949 (EDAS 1998, 1). This in turn caused a large amount of the building to collapse, in particular the collapse of the east wall, and several areas along the west wall.

5.3 CHANGING USE OF THE SMELT MILL

5.3.1 It is perhaps too simplistic to attempt to relate each evident phase of the building's development to a documented episode of its history; however, there does appear to be some correlation. The conversion from lead ore smelting to iron ore roasting potentially occurred when the mines were taken over by J Walton and Company in 1859 (*op cit,* 26), and would potentially have required some changes to the building and to the hearths (*ibid*). The higher temperature required to roast iron ore (*ibid*) would probably have required the use of charcoal or coke (Marshall and Davies-Shiel 1977), although, as the roasting process required the charge to heat slowly over an extended period of time, conceivably any available fuel could be used (R Kinchin-Smith pers comm). Lead smelting, by comparison, could rely on the use of peat (Hunt 1970, 101; Shayler *et al* 1981, 10) and other less carbon-rich substances for its fuel (Jones 1996, 67). The putative charcoal pitstead (Site 10) provides an indication that, at some stage in the operation of the mill, charcoal was used as a fuel.

5.3.2 As the iron ore and charge would need to be loaded into the hearth from the top, in the same way as a lime kiln (Jones 1996, 224; R.Kinchin-Smith pers comm), it is conceivable that the raising of the walls of the smelt mill was to enable access to the tops of the ovens, via the door in the dividing wall between Rooms 1 and 2 and via a raised floor, now no longer present. Room 2 may have originally acted as an office (EDAS 1998, 27) but was latterly probably used as a storeroom for both fuel and ore. The need to load the iron ore from the top could have necessitated the change in floor level, allowing convenient storage on the solid raised floor on the eastern side of Room 2, and an elevated first floor, or mezzanine floor, in Room 1, accessed by the door in the dividing wall between Rooms 1 and 2, to provide for the charging of the hearths. The insertion of the large rear wagon entrance to the eastern part of Room 2 would have enabled the bringing in of materials to the storage room. The reused timber and cog within the rebuilt sections of wall are perhaps parts of machinery used in the lead smelting process that were made derelict by the change to iron roasting. The blocking of the northern hearth probably occurred at this time and suggests that only three, or possibly two, hearths were converted to iron roasting and the blocking would have provided a seal to this part of the flue.

5.3.3 ***Stable Usage:*** after the building became a stable the majority of the alterations are likely to have been essentially cosmetic. The machinery would have been sold for scrap, and any internal, unsellable fittings would have been removed to provide space for the horses. This would have resulted in the blocking of the doorway into the east side of Room 2, and through the Room 1/2 dividing wall, when increased access into the upper part of the room would have been unwanted.

5.3.4 Although already damaged and decaying due to its use as a stable, the removal of the roof in the mid-twentieth century (EDAS 1998, 1) caused a rapid deterioration in the condition of the building, which is still ongoing.

5.3.5 ***Smelt Mill Landscape:*** some of the earthworks within the immediate vicinity of the building directly relate to its mill operation; these include the flue (Site 1) and also the leat / track (Site 2), which are shown on the OS 1st edition map (EDAS 1998, fig. 4) and are still recognisable if not readily apparent. The channel (Site 4) that extends down the slope, apparently from the reservoir, would have supplied the water wheel, although, the leat (Site 2), supplied by Augill Beck, apparently also drove the wheel and there is some uncertainty as to when these different water supplies were used. It can be reasoned that the reservoir replaced the Augill Beck-fed leat when it became evident that the beck provided insufficient flow to drive the wheel; however, the flue (Site 1) takes a course around the north end of the reservoir, and suggests that the flue post-dated the reservoir, which must therefore have been in place from the outset. All that can be reliably asserted is that both the leat and the reservoir were in place by the time of the OS 1st edition map (1863).

5.3.6 Other features have a less direct relationship with the smelt mill; for example, the quarries (Sites 6 and 7) were probably later than the mill as they seemingly post-date the channel (Site 4) and the flue (Site 4) but potentially may have been used in its later remodelling. The sub-circular charcoal-burning platform (Site 10) may also have served to provide a source of charcoal from local coppicing, but was not necessarily used throughout the operational life of the mill. The numerous tracks

reflect activity on the site and may relate to activities relating to the operation of the smelt mill or coppicing from the surrounding woodland.

6. BIBLIOGRAPHY

6.1 CARTOGRAPHIC SOURCES

1823-4 J. Hodgson's map of Westmorland

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6.2 SECONDARY SOURCES

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APPENDIX 1
PROJECT BRIEF

APPENDIX 2
PROJECT DESIGN

September 2001

AUGILL SMELT MILL
CUMBRIA

ARCHAEOLOGICAL FABRIC SURVEY

Proposals

The following design is offered in response to a request from David Flush of North Pennines Heritage Trust for an archaeological fabric survey in advance of the consolidation of Augill Smelt Mill, Cumbria.

1. INTRODUCTION

1.1 PROJECT BACKGROUND

1.1.1 David Flush of North Pennines Heritage Trust has requested that Lancaster University Archaeological Unit submit proposals for archaeological recording at Augill Smelt Mill, Cumbria to inform a management plan for the site. The site is a scheduled ancient monument.

1.1.2 The mill was built in 1843 by the North Stainmore Mining Company to smelt ore from nearby mines. It comprised a rectangular building with three internal hooded hearths with a long flue extending up the slope of the hill to a chimney located on top of a Roman signal station. The mill was driven by an over shot wheel supplied by a high level reservoir to the east of the mill. In 1859-60 the mill was converted to allow for the roasting of iron nodules, and the mill finally went out of production in 1894. The mill was subsequently used as a stable and the roof was removed in *c*1949 (EDAS 1998)

1.2 LANCASTER UNIVERSITY ARCHAEOLOGICAL UNIT

1.2.1 Oxford Archaeology North has considerable experience of the archaeological survey and evaluation of sites and monuments of all periods, having undertaken a great number of small and large projects during the past 18 years. OAN has particular experience in the archaeological recording and excavation of industrial landscapes. Projects have been undertaken to fulfil the different requirements of various clients and planning authorities, and to very rigorous timetables. OAN has considerable experience of the investigation of the lead industry having undertaken numerous studies and surveys of lead complexes from around northern England, examples include the Rimmington lead mines, near Clitheroe, the major Snailbeach lead mines in Shropshire, the Gunnerside Gill lead mines of Swaledale, the Sargill smelt mill in Wensleydale, the Grassington lead mines of Wharfdale and the Wythburn lead mine and crushing / washing plant in Thirlmere. In particular OAN has been involved in extensive recording programmes at Nenthead; OAN undertook a major fabric survey of the smelt mill and stamps area of the Nenthead complex.

1.2.2 OAN has the professional expertise and resources to undertake the project detailed below to a high level of quality and efficiency. OAN is an Institute of Field Archaeologists (IFA) registered organisation, registration number 27, and all its members of staff operate subject to the IFA Code of Conduct.

2. OBJECTIVES

2.1 The following programme has been designed, in accordance with a brief by North Pennines Heritage Trust to provide a fabric survey of the former farmhouse. The required stages to achieve these ends are as follows:

2.2 SITE SURVEY

2.2.1 To provide a basic survey record of the extant fabric of the smelt mill building, in accordance with Royal Commission on the Historical Monuments (England) (RCHME) Level 3 survey. This would involve the creation of a rectified photographic survey, the production of a ground plan, a topographic site plan, and a drawings of the elevations.

2.2.2 The survey would provide for a basic analysis of the fabric and would result in a textual assessment of the development and form of the building.

2.3 SURVEY REPORT

2.3.1 A written survey report will assess the significance of the data generated by this programme within a local and regional context. It will present the survey results and would make an assessment of the development of the buildings.

3. METHOD STATEMENT

3.1 SITE SURVEY

3.1.1 A survey will be undertaken of the smelt mill in accordance with the RCHM(E) Level 3 recording. This would involve the creation of a ground floor plan of the building coupled with a topographic survey of its immediate locale, a general photographic survey, a rectified photographic survey, and the production of elevation drawings for the building. The elevations will be recorded by a combination of photographic and instrument based techniques.

3.1.2 ***Oblique Photography:*** a general photographic survey will record the internal and external elevations of the farmhouse. All investigation will be subject to safe working practices, and there may be areas of the building which cannot be recorded because there is no safe access. The photographic coverage will include close up views of architectural details, both structural and decorative, and will include details of the wheel pit. Oblique photography will be undertaken using both monochrome and colour (35mm) and/or digital photography in order to provide a general record of these buildings. The site will need to have been cleared of obscuring vegetation by the client in advance of the photographic survey and other elements of the survey.

3.1.3 ***Ground Plan of Building and Site:*** a ground plan will be created for the building and its environs which will be tied into a 1:10,000 digital base for the site. The plan will show the general locale of the building, including the river and the quarry and start of the flue at the rear of the smelt mill building. The topographic survey is intended to show only the immediate context of the smelt building and will record only the topography within 20m from the building and will define changes of slope as hachures rather than as contours. The earthwork remains around the site will be surveyed by means of a conventional total station, whereas the ground plan for the mill buildings will be by use of a reflectorless total station. The reflectorless total station is capable of measuring distances to architectural detail by reflection from the surface of that detail element; consequently it does not require the placement of a prism on the detail. It is therefore an ideal tool for the recording of detail where there is no safe physical access. The survey will be undertaken with respect to a series of accurately surveyed control stations established by traverse around the outside of the building. The data from both instruments will be combined within a CAD system and output as a series of plots to enable the enhancement of the drawing by manual survey. The graphic results of the survey will be digitised into an industry standard Computer Aided Draughting (CAD) system to enhance the manipulation and presentation of the results.

3.1.4 ***Elevation Recording:*** a record will be created of internal and external elevations of the building, using a combination of rectified photography and reflectorless survey instrument. The survey will record the more principal internal and external elevations assuming appropriate safe access. Where possible rectified photography will be taken to provide a basic face on record of the elevations. The rectified photography will be undertaken by in-house survey specialists and will be undertaken in black and white using a medium format camera. Control for the rectified photography will be provided by reflectorless instrument, and will record the locations of clearly defined elements of structural detail rather than targets to prevent the need for physically accessing the walls. The photography will be output at an appropriate scale; it will be scanned into a computer and presented as a raster backdrop within AutoCAD. Where there is any distortion within the photographic base, the digital image will be subject to digital correction using Archis software to convert the images to fully rectified images. The corrected images will then be incorporated as a rasta backdrop within AutoCad and the elevation drawings will be drawn up as a vector drawing from the rectified base.

3.1.5 Some walls will not be appropriate for survey by rectified photography either because there is insufficient of the walls exposed to warrant detailed photography or because it is not possible to place a camera sufficiently far from the wall. In these situations the elevation will be recorded entirely by reflectorless instrument. The data will the be superimposed with that of the rectified photography in the CAD system. Both elements of the survey will utilise the same survey control and will therefore be spatially linked.

3.1.6 The final drawings will show all significant stone detail, such as quoins, ashlar stones, and significant detail, but will not involve the digitising of all stone detail.

3.1.7 ***Analysis:*** a programme of analysis will be undertaken examining in detail the construction and form of the building, with the establishment of context records for all structural components. This will involve the internal and external examination of the extant fabric, where health and

safety allows, and will generate a description and assessment of the function, operation and phasing of the building.

3.2 SURVEY REPORT

3.2.1 ***Archive:*** the results of the fieldwork will form the basis of a full archive to professional standards, in accordance with current English Heritage guidelines (*The Management of Archaeological Projects,* 2nd edition, 1991). The project archive represents the collation and indexing of all the data and material gathered during the course of the project. It will include summary processing and analysis of all features, finds, or palaeoenvironmental data recovered during fieldwork, which will be catalogued by context. This archive can be provided in the English Heritage Centre for Archaeology format, both as a printed document and on computer disks as ASCii files, and a synthesis (in the form of the index to the archive and the report) will be included in the Cumbria Sites and Monuments Record. A copy of the archive can also be made available for deposition with the National Archaeological Record. OAN practice is to deposit the original record archive of projects (paper, magnetic and plastic media) with the appropriate County Record Office, and a full copy of the record archive (microform or microfiche) together with the material archive (artefacts, ecofacts, and samples) with an appropriate museum.

3.2.2 ***Survey Report:*** one bound and one unbound copy of a written synthetic report will be submitted to the Client, and a further copy submitted to the Cumbria County Council SMR. The report will include a copy of this project design, and indications of any agreed departure from that design. It will present, summarise, and interpret the results of the programme detailed above and present an assessment of the architectural significance of the structures on the site and will include photographs of any significant features. The report will also include a complete bibliography of sources from which data has been derived, and a list of further sources identified during the programme of work, but not examined in detail.

3.2.3 Illustrative material will include a location map, site map building plans, elevations, and also pertinent photographs. It can be tailored to the specific requests of the client (eg particular scales etc), subject to discussion. The report will be in the same basic format as this project design; a copy of the report can be provided on 3.5" disk (IBM compatible format).

3.3 OTHER MATTERS

3.3.1 ***Health and Safety:*** OAN conforms to all health and safety guidelines as contained in the Lancaster University Manual of Health and Safety and the safety manual compiled by the Standing Conference of Archaeological Unit Managers. The work will be in accordance with Health and Safety at Work Act (1974), the Council for British Archaeology Handbook No. 6, *Safety in Archaeological Fieldwork* (1989).

3.3.2 Full regard will, of course, be given to all constraints (services etc) during the excavation of the trenches, as well as to all Health and Safety considerations. OAN provides a Health and Safety Statement for all projects and maintains a Unit Safety policy. A risk assessment will be completed in advance of the project's commencement.

3.3.3 The programme is designed so that there is no need for project staff to work against or in the immediate vicinity of unstable high walls, as all recording techniques will be remote from the face.

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

3.4 PROJECT MONITORING

3.4.1 OAN will consult with the client regarding access to the site. Whilst the work is undertaken for the client, the County Archaeologist will be kept fully informed of the work and its results. Any proposed changes to the project design will be agreed with Cumbria Archaeological Service in consultation with the Client.

4. WORK PROGRAMME

4.1 The following programme is proposed:

4.2 ***Site Survey***

A 10 day period is required to undertake the site survey.

4.3 ***Post survey processing and preparation of report***

A 20 day period will be required to complete this element.

4.4 OAN can execute projects at short notice once an agreement has been signed with the client.

4.5 The project will be managed by **Jamie Quartermaine BA Surv Dip MIFA** (Unit Project Manager) to whom all correspondence should be addressed. OAN adheres by the IFA's Code of Conduct and the Code of Approved Practice for the regulation of Contractual Arrangements in Field Archaeology.

ILLUSTRATIONS

PLATES

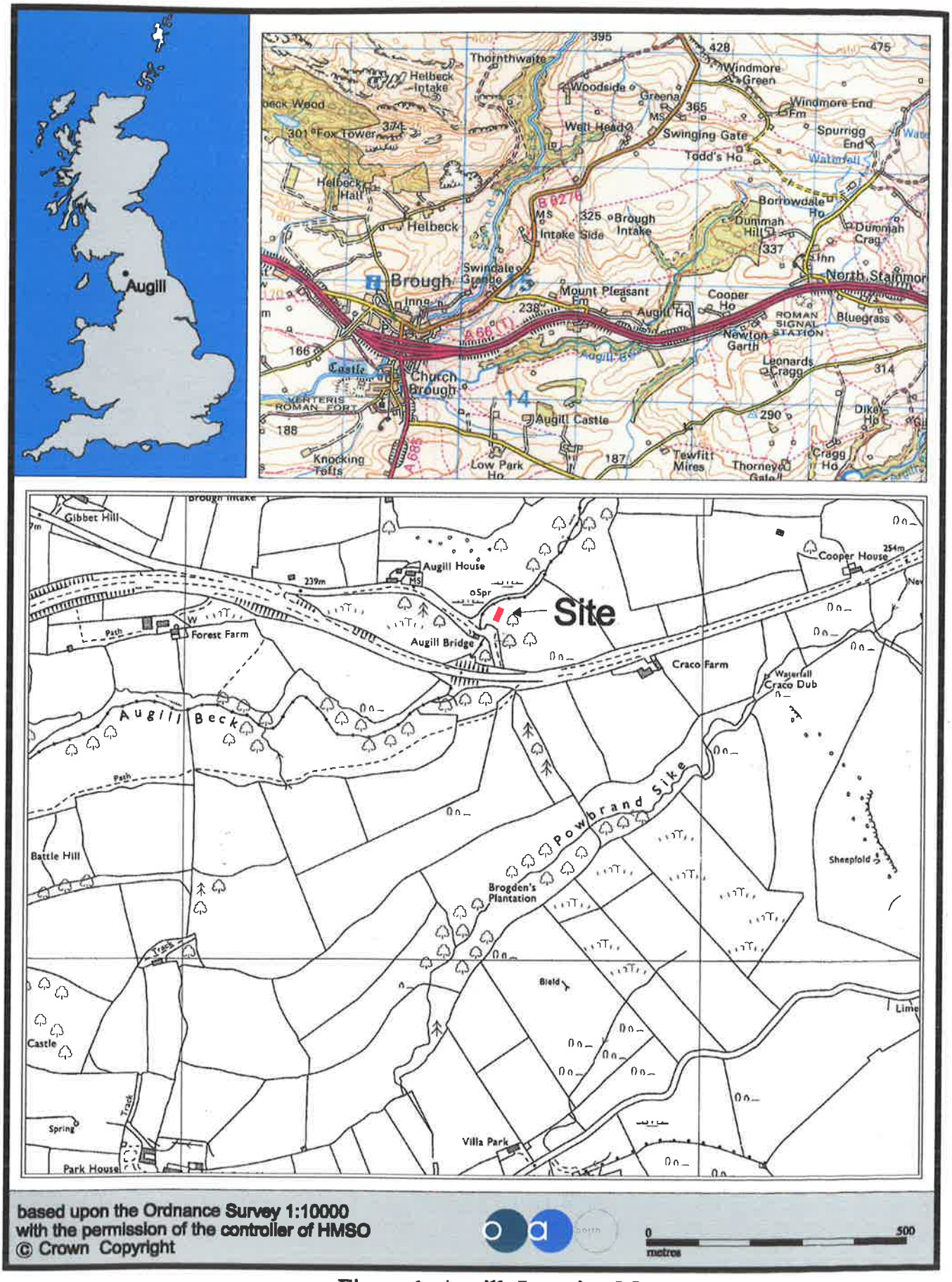


Figure 1: Augill: Location Map

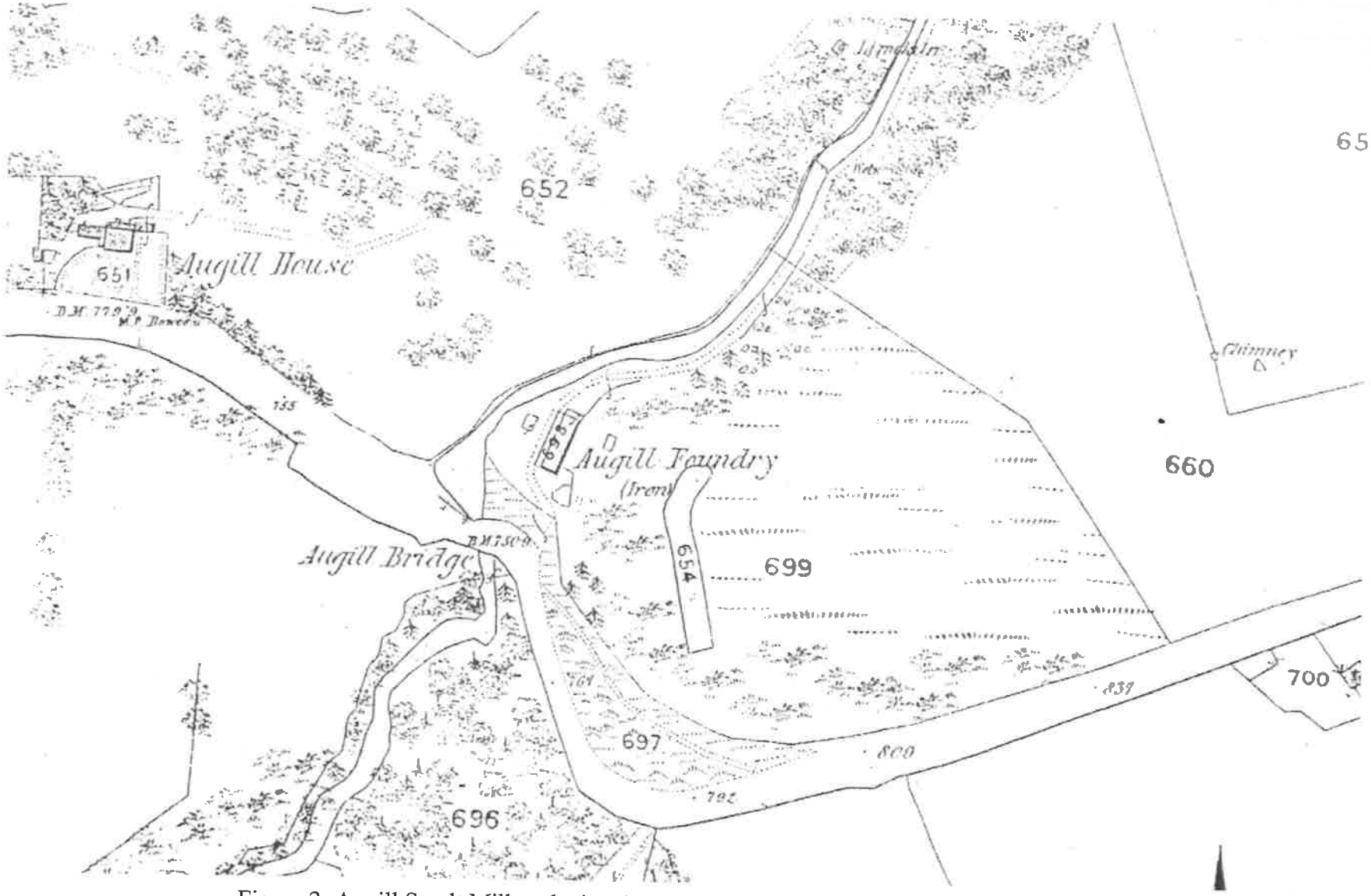
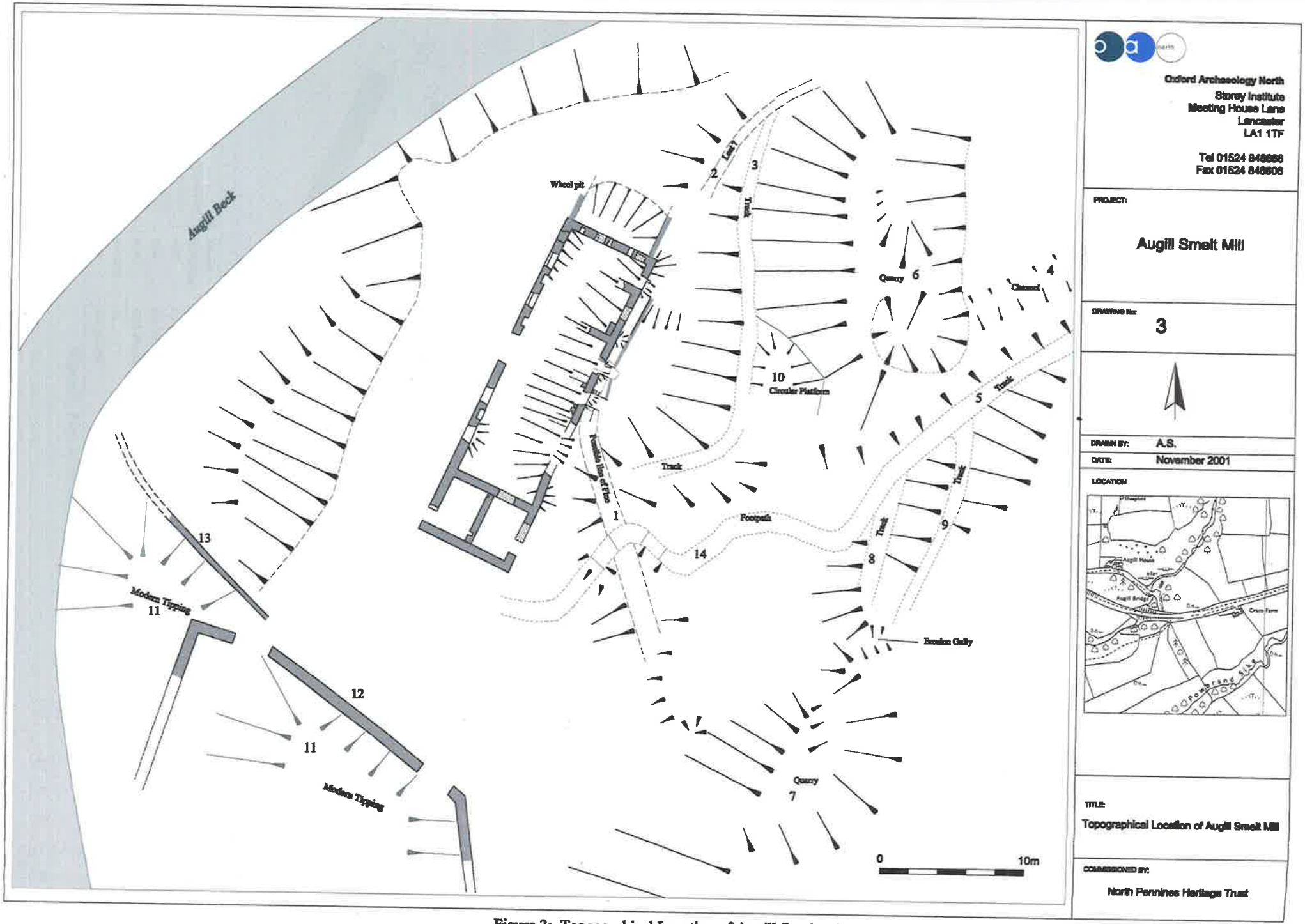


Figure 2: Augill Smelt Mill as depicted on the Ordnance Survey 25" 1st edition map (1863)



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Tel 01524 848666
Fax 01524 848606

PROJECT:

Augill Smelt Mill

DRAWING No:

3

DRAWN BY: A.S.

DATE: November 2001

LOCATION

TITLE:

Topographical Location of Augill Smelt Mill

COMMISSIONED BY:

North Pennines Heritage Trust

Figure 3: Topographical Location of Augill Smelt Mill

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PROJECT:	Augill Smelt Mill
DRAWING No:	04
SCALE:	1:100
TITLE:	Plan of the Smelt Mill
CLIENT	North Pennines Heritage Trust
DRAWN BY:	AS
DATE:	January 2002

LOCATION:

0 2.5m

KEY

Figure 4: Plan of the Smelt Mill

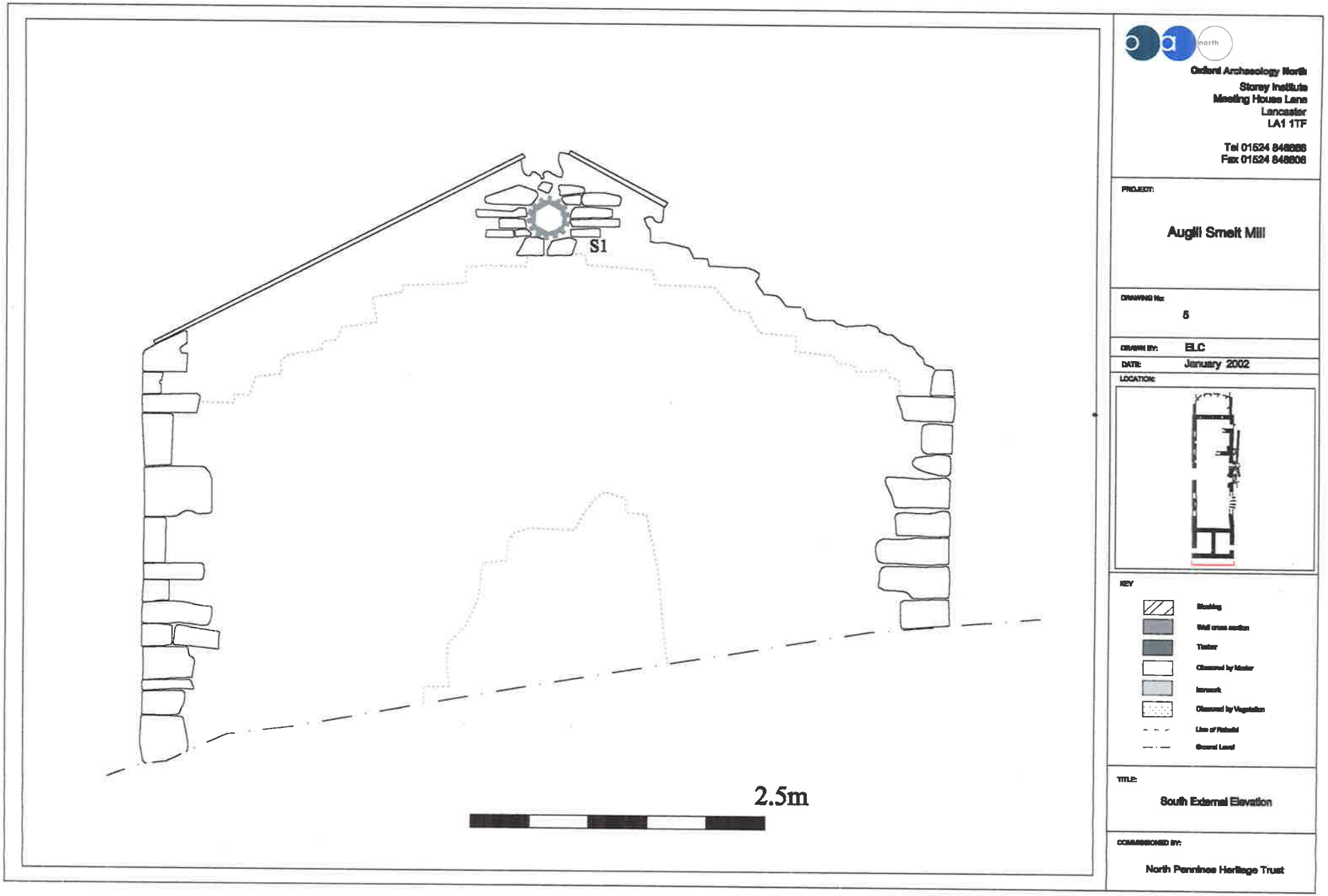


Figure 5: South External Elevation

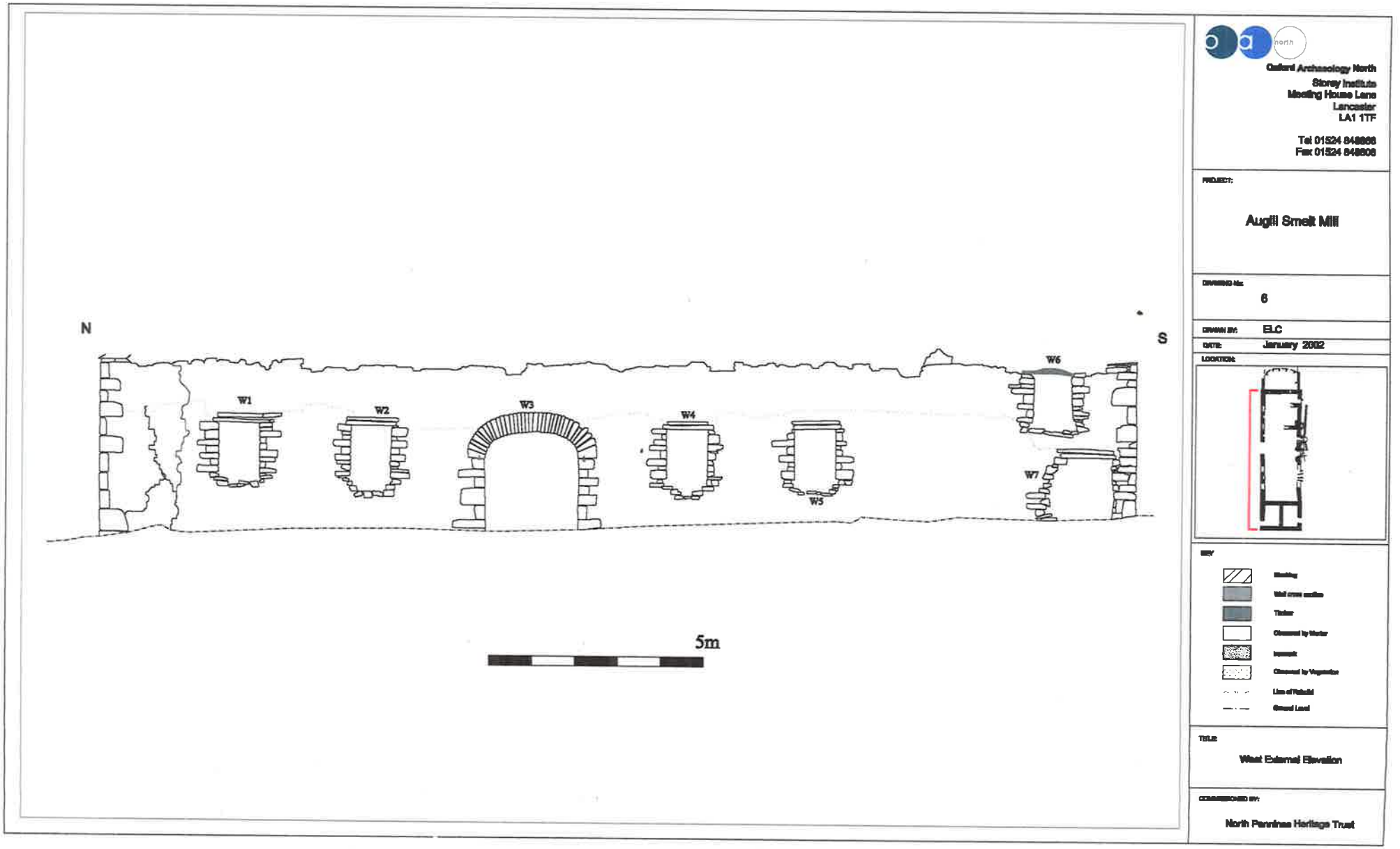


Figure 6: West External Elevation

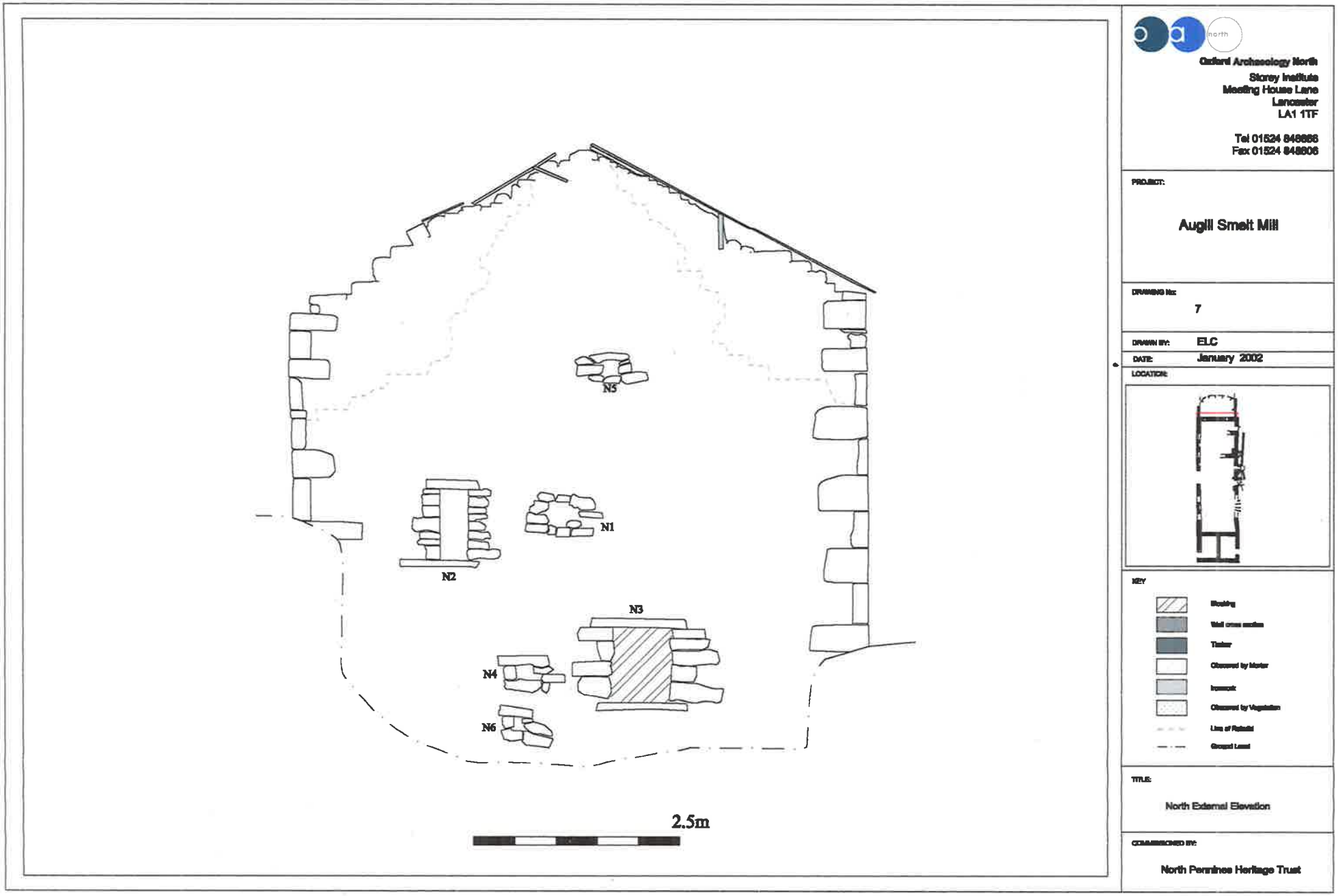


Figure 7: North External Elevation

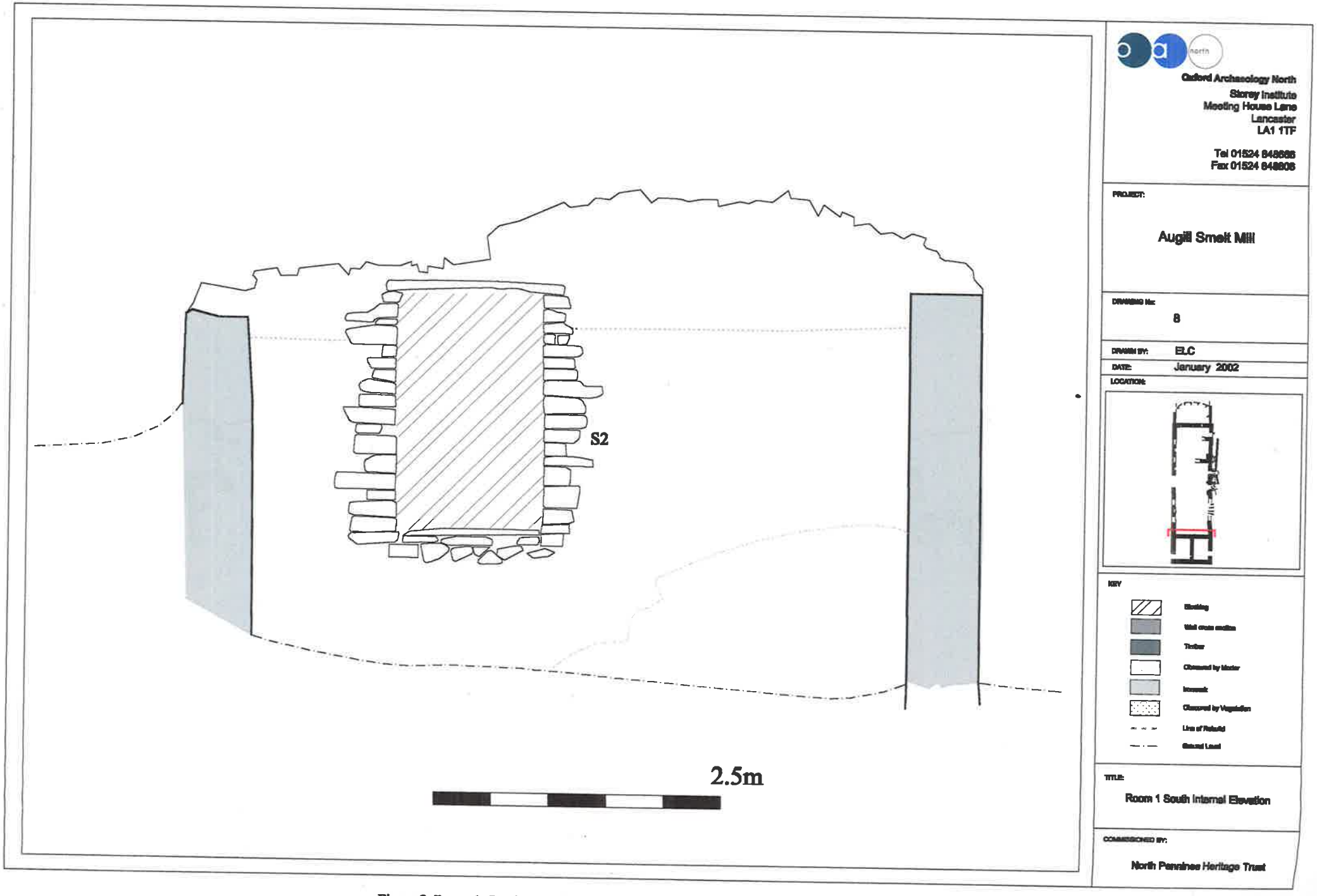
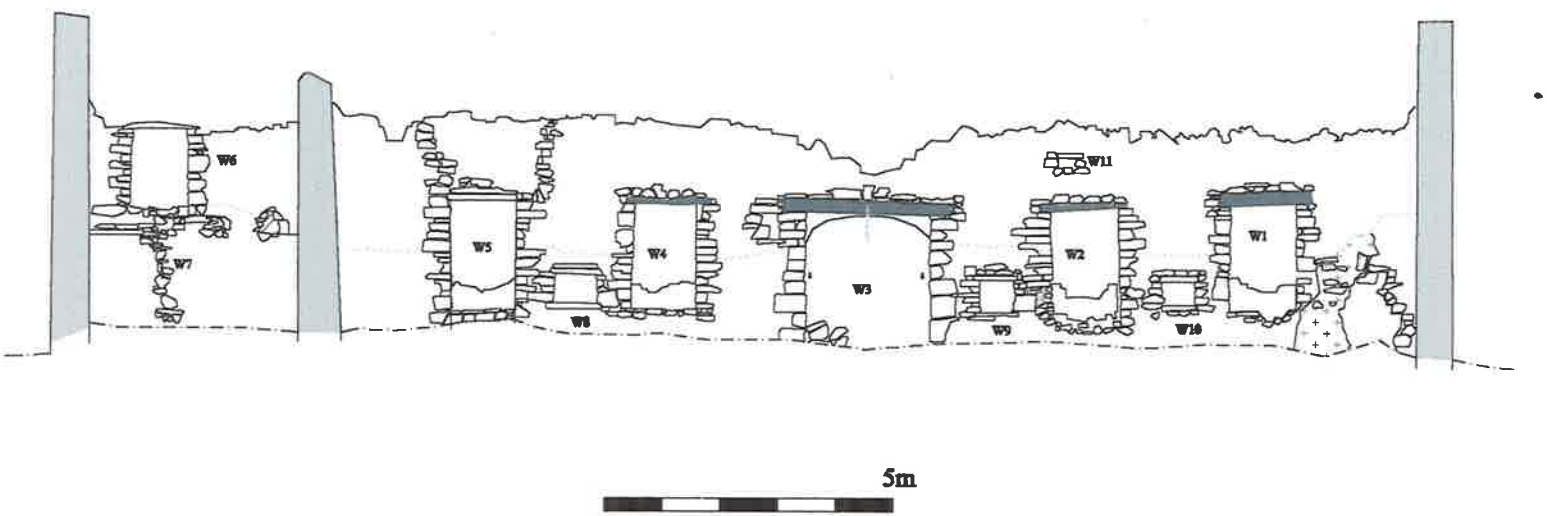


Figure 8: Room 1, South Internal Elevation



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PROJECT:

Augill Smelt Mill

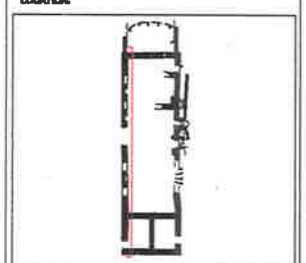
DRAWING No:

9

DRAWN BY: ELC

DATE: January 2002

LOCATION:



KEY

Flooding

Wall cross section

Timber

Obscured by Water

Rubble

Obscured by Vegetation

Line of Rebuild

Ground Level

TITLE:

West Internal Elevation

COMMISSIONED BY:

North Pennines Heritage Trust

Figure 9: West Internal Elevation

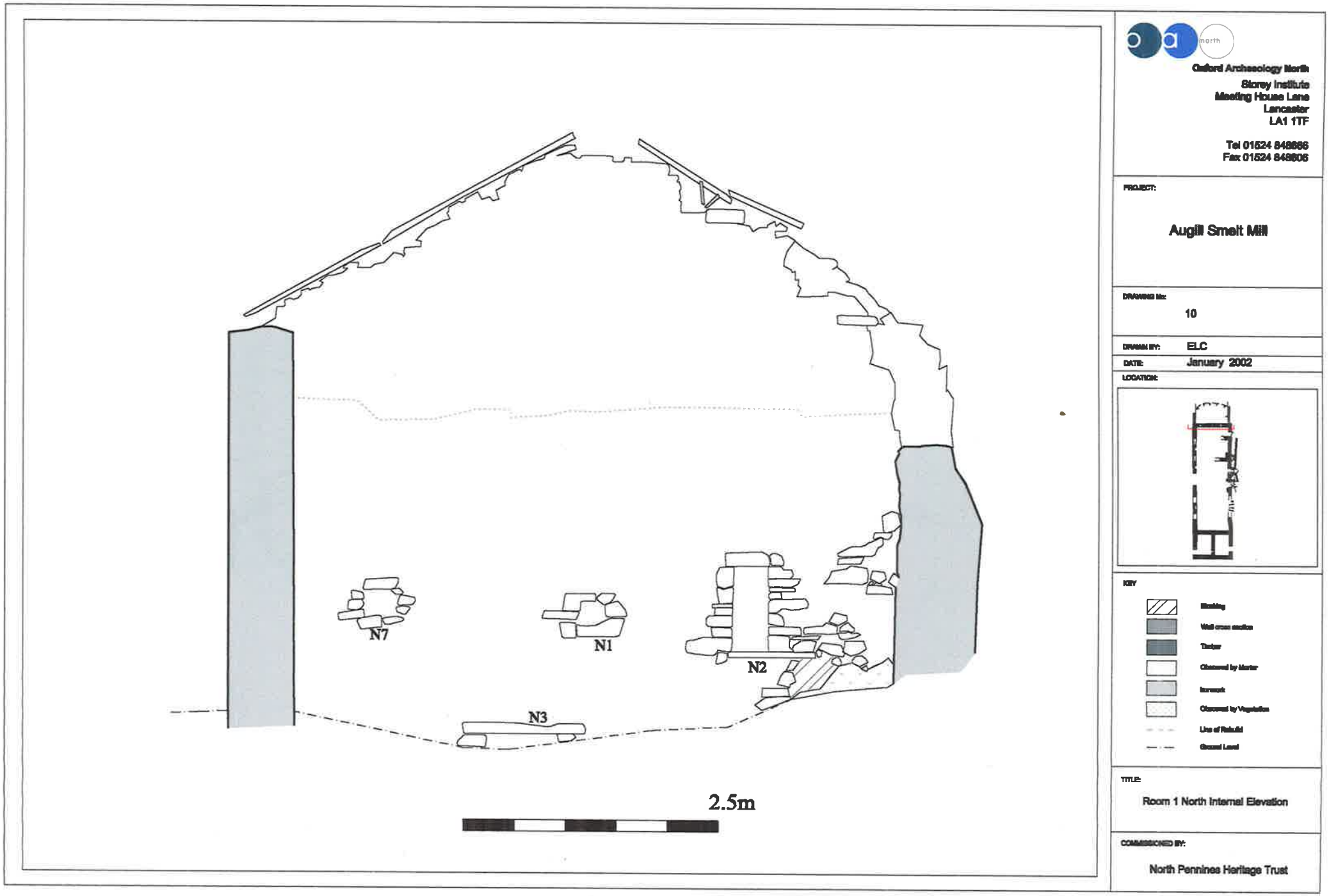


Figure 10: Room 1: North Internal Elevation

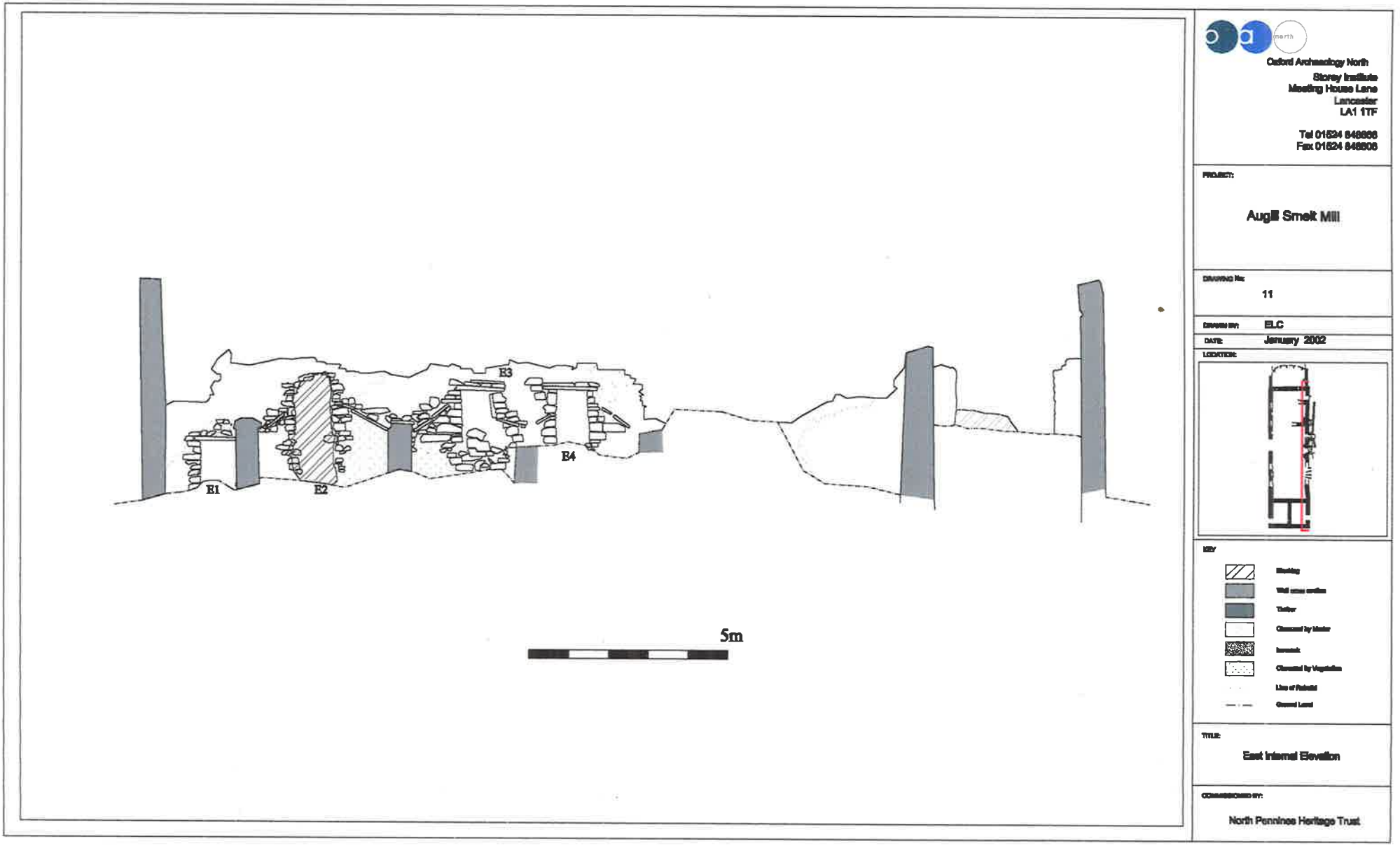


Figure 11: East Internal Elevation

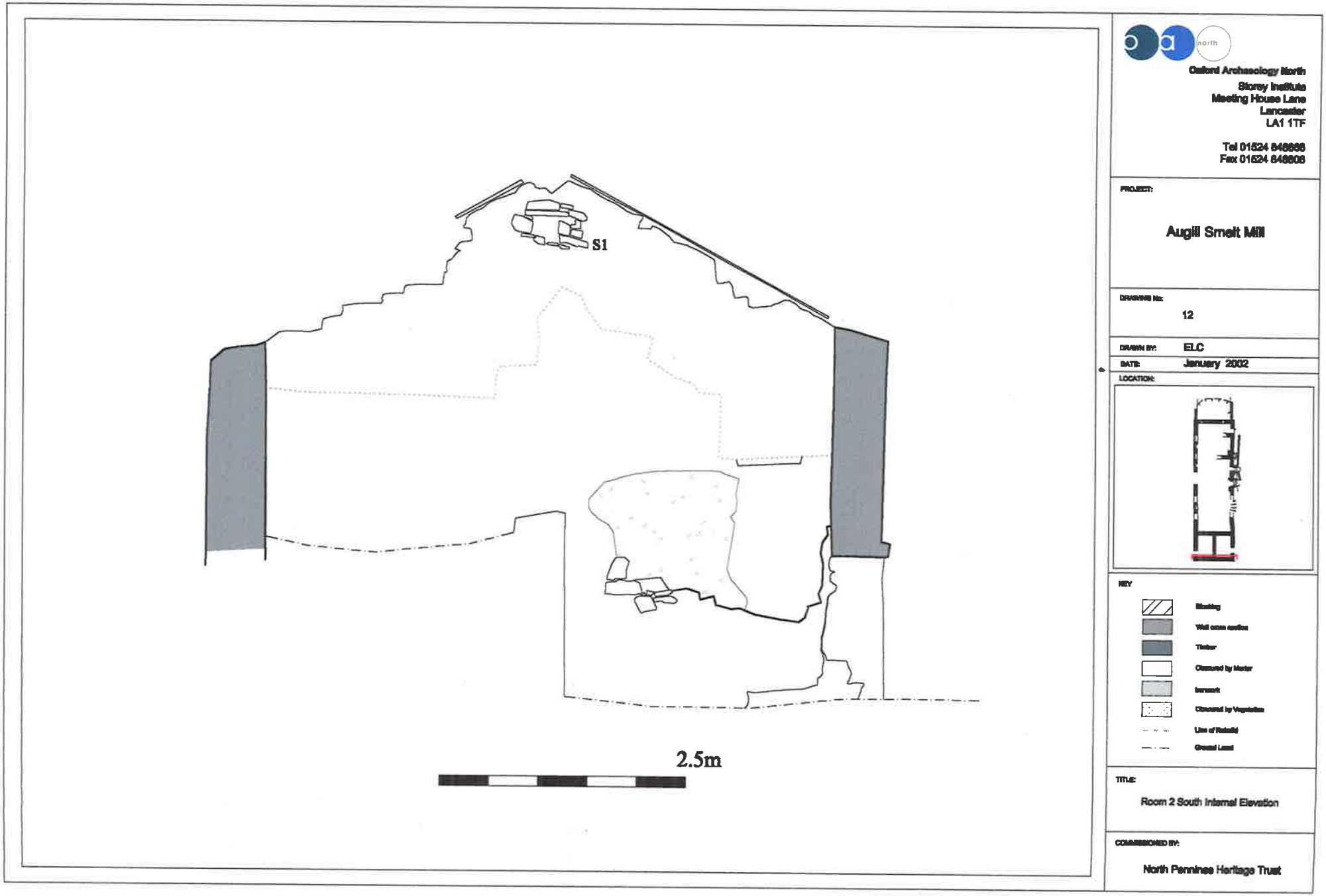
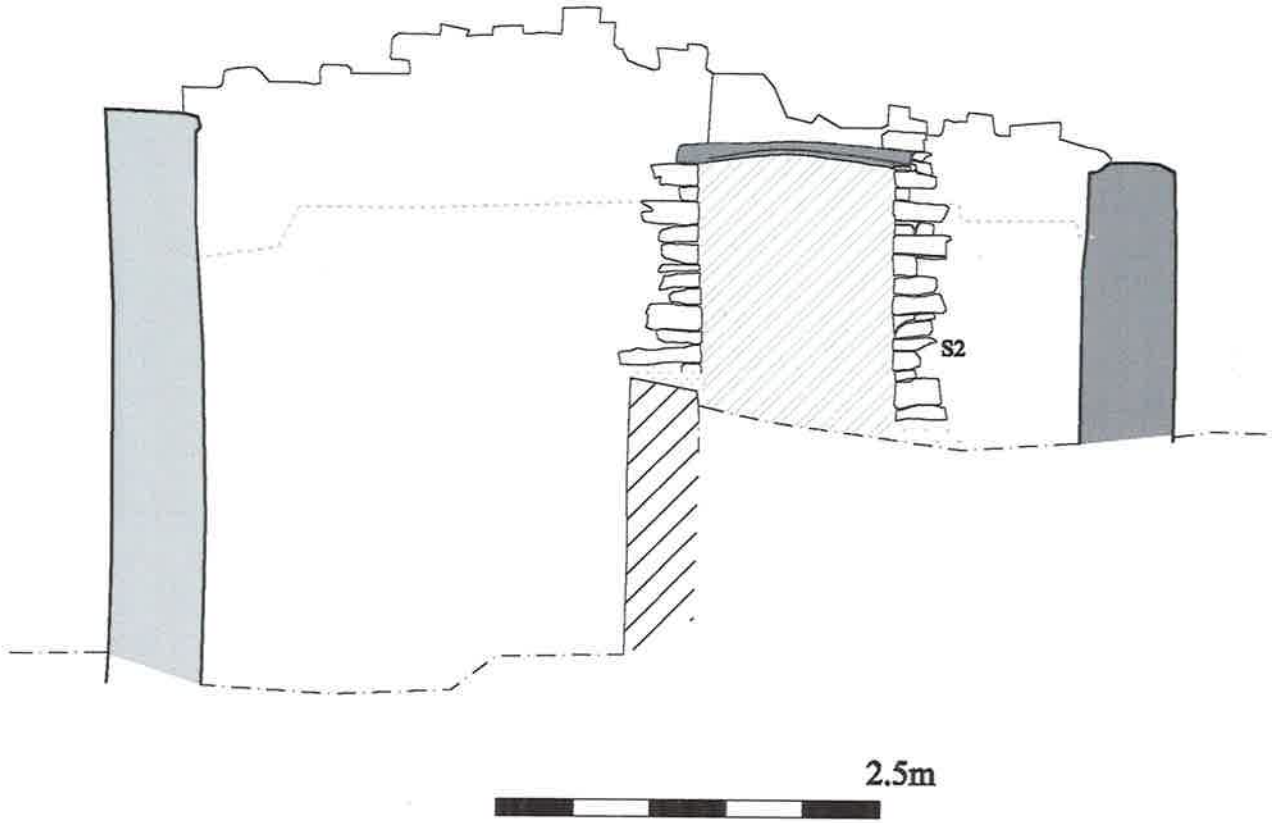


Figure 12: Room 2 South Internal Elevation



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PROJECT:

Augill Smelt Mill

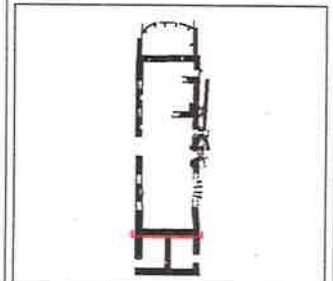
DRAWING No:

13

DRAWN BY: ELC

DATE: January 2002

LOCATION:



KEY

Blocking
Wall cross section
Timber
Obscured by Mortar
Inconsist
Obscured by Vegetation
Line of Rebuild
Ground Level

TITLE:

Room 2 North Internal Elevation

COMMISSIONED BY:

North Pennines Heritage Trust

Figure 13: Room 2, North Internal Elevation

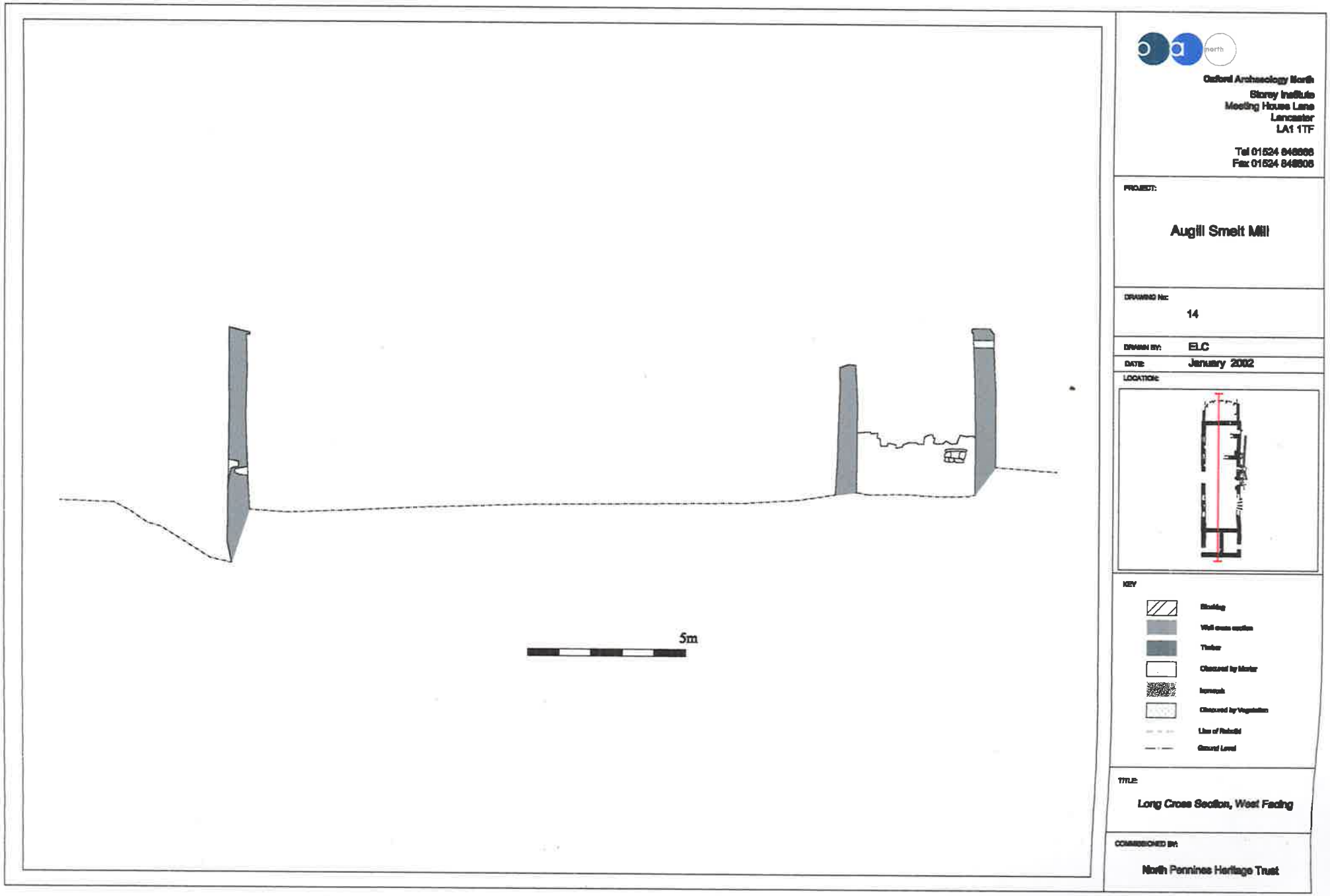


Figure 14: Long Cross Section, West Facing

Plate 1: South External Elevation

Plate 2: General View of Smelt Mill looking North-East

Plate 3: North External Elevation

Plate 4: Blocked Doorway Between Rooms 1 and 2

Plate 5: Blocked Hearth in the East Internal Elevation

Plate 6: Partition Wall in Room 2 looking North-East

Plate 7: The Two Surviving Hearths in the Internal East Elevation

Plate 8: North Internal Elevation, Room 1

Plate 9: South Internal Elevation, Room 1

Plate 10: West Internal Elevation, Room 2