

SCORDALE LEAD MINES, CUMBRIA A PRELIMINARY ASSESSMENT OF THE THREAT FROM RIVER EROSION

INTERIM SURVEY REPORT

Abby Hunt and Stewart Ainsworth



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Scordale lead mines, Cumbria: a preliminary assessment of the threat from river erosion

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Contents

1. Introduction	1
1.1 Project background	1
1.2 Aims of the project	1
1.3 Project structure	3
2. Purpose of this interim report	4
3. Current understanding	5
3.1 Geology	5
3.2 Topography	5
3.3 Land use and access	7
3.4 Archaeological and historical background	8
4. Key areas at risk	9
4.1 Area A	9
4.2 Area B	9
4.3 Area C	13
4.4 Area D	14
5. Project progress	16
5.1 Survey	16
5.2 Publication	16
6. Conclusions and recommendations	17
7. List of references	22

List of Illustrations

1. Map showing the Scordale environs	2
2. Annotated aerial photograph showing the areas of Scordale to be surveyed	6
3. Aerial photograph of the northern part of Scordale	10
4. Erosion of waste heap 41 over culvert 35	11
5. Erosion below the crushing-mill	11
6. Remains of a buddle	13
7. The remains of a dressing-mill	15
8. Plan showing areas recommended for excavation and sampling	19

1. Introduction

This interim report covers the initial stages of the Scordale Lead Mines project up to the end of January 2007. Its specific purpose is to outline the current understanding of the site for management and conservation purposes as well as summarize the progress of the project.

1.1 Project background

Scordale, centred at NY 760 223, is a dramatic and steep-sided valley leading off the North Pennine hills, immediately north-east of the village of Hilton in Cumbria; through it flow the Scordale and Hilton Becks (Figure 1). Within the valley are extensive remains of lead and minerals mining which date from the 14th through to the early 20th century. These remains are recognised as being of national importance and were designated as a Scheduled Ancient Monument in 1999 (SAM 27842). As well as being scheduled, the remains are situated within a Site of Special Scientific Interest (SSSI), a Special Area of Conservation (SAC), a Special Protection Area (SPA) and the North Pennines AONB. The valley lies within the Warcop Ranges, an active military training area, and consequently has severely restricted periods of access.

Currently, components of the scheduled remains in this valley vary in condition from good and stable to poor and in rapid decline. This decline seems to have occurred mostly in recent years, and the current understanding is that this is as a result of severe rainfall episodes, with consequent river erosion and sediment re-distribution along the Scordale and Hilton Becks (Lane and Dugdale 2006a).

In response to this continuing threat, English Heritage and the Ministry of Defence (MOD) Defence Estates Environmental Support Team are working in partnership to address this issue through the Scordale Lead Mines project. In addition to the immediate threat to the archaeological remains there is a wider background of research into the relationship between environmental, climate change and archaeological factors affecting the long-term management, conservation and interpretation of this important upland lead-mining landscape (Ainsworth 2006; Ainsworth and Hunt 2007; Lane and Dugdale 2006a). Although there has been a 1:10 000 scale aerial photographic transcription of the archaeological features on the Warcop Range (Boutwood 2002) there has been no previous detailed survey or analysis of the remains in Scordale from which a qualitative assessment of the archaeological resource could be made, no understanding of how the remains have contributed to the erosion and sedimentation problem and no quantification of the threat posed by the river erosion to the scheduled monument.

1.2 Aims of the project

The overall aim of the project, through archaeological survey and analysis, is to provide a record and an understanding of the lead-mining remains in Scordale, and to place them in their landscape context. This study is aimed at informing management decisions for the scheduled remains as well as the larger river-catchment areas of the Hilton Beck and River Eden, within and beyond the Defence Estates land. As well as providing a comprehensive

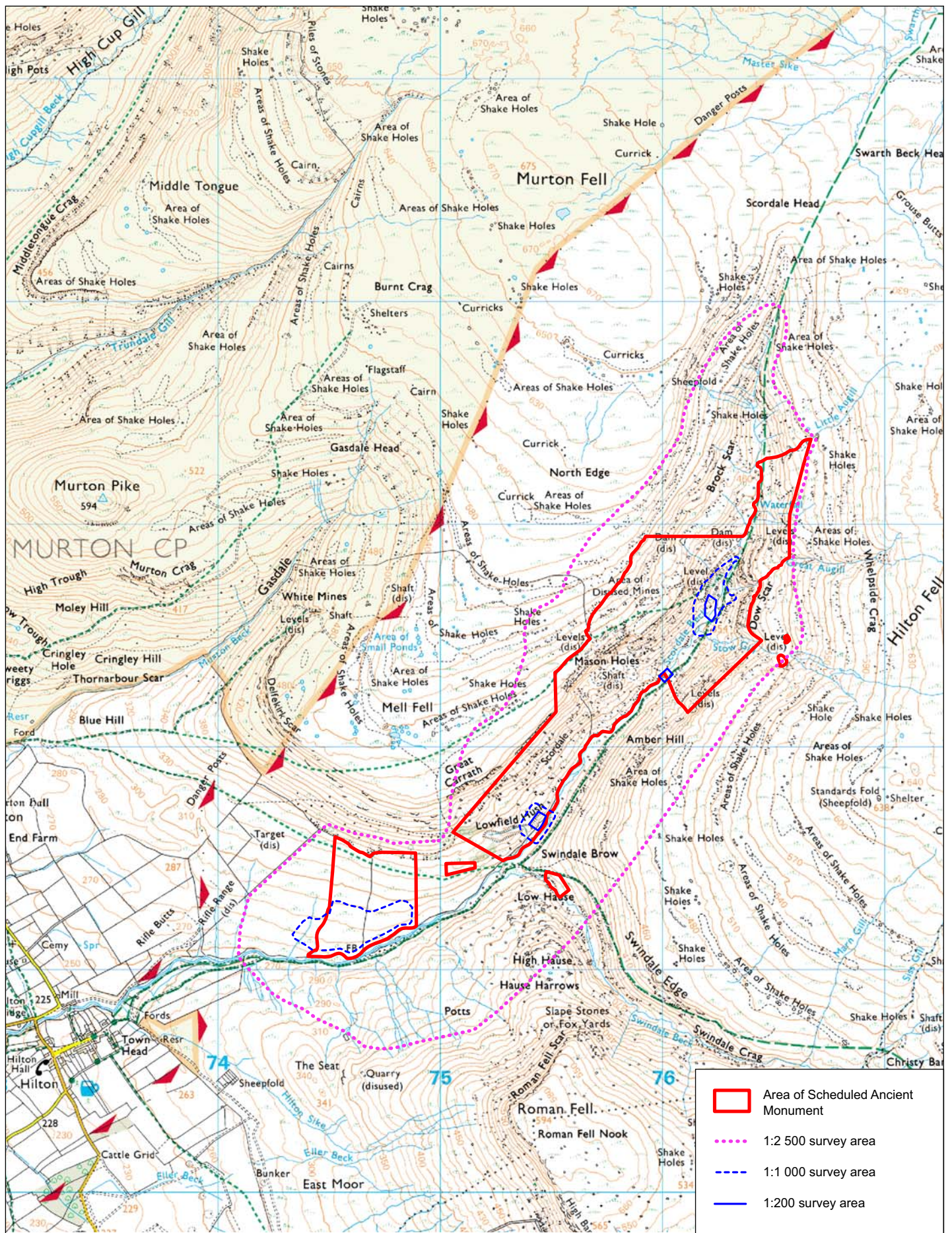


Figure 1. Map showing the Scordale environs, including the area of the relevant Scheduled Ancient Monuments and the survey areas. (This map is based upon Ordnance Survey on behalf of the Controller of Her Majesty's Stationery Office © Crown Copyright. Unauthorised reproduction infringes Crown Copyright and may lead to prosecution or criminal proceedings. English Heritage 100019088. 2007)

record of the archaeological remains in the Scordale valley, one of the main objectives of this project is to rapidly identify the key archaeological remains at threat from river erosion to permit an appropriate management strategy to be defined. This will prove particularly important for those remains which cannot be saved from destruction by natural forces, and for which 'preservation by record' may be the only recourse.

1.3 Project structure

To fulfil the aims outlined above, a survey project to be undertaken in five phases was agreed between English Heritage and the MOD (Ainsworth 2006). In particular, investigation was to be prioritised towards identifying remains that were subject to extreme and immediate threat from river erosion. The project commenced in summer 2006 and fieldwork is due to be completed by the end of 2007. The five phases of work are:

- Phase 1. Digital aerial photography, including preparation of orthophoto imagery.
- Phase 2. Ground survey and assessment of proposed sedimentation zone on SAM 32821.
- Phase 3. Preservation by record. Identification and detailed ground survey of key areas of threat within SAM 27842.
- Phase 4. Landscape context. Photogrammetric transcription of area of full SAM 27842 (including SAMs 32851, 32850, 27841, 27840, 32821 and intermediate areas), ground survey and archiving.

Following Phase 4, there will be an assessment of the field, documentary and cartographic data which will result in a separate proposal to ensure effective publication, integration and dissemination of the results.

- Phase 5. Publication and outreach.

2. Purpose of this interim report

It was agreed that after the completion of Phase 3, English Heritage would provide an interim summary of the results of the project so that an informed way forward for the management and conservation of the most threatened scheduled remains could be pursued by both partners.

The specific purpose of this interim report therefore is to:

- outline the current understanding of the site for management and conservation purposes
- identify the key areas at risk and present any recommendations to aid conservation and management
- summarize the progress of the project so far

In this report, numbers which appear in brackets eg (27) are the unique numbers allocated to features which will be recorded on the Geographical Information System (GIS) database as part of Phase 4 of the project. This database will comprise a brief description of the feature as well as a number of other attributes to facilitate management, conservation and monitoring.

A full analytical and methodological report as well as the database will be produced at the end of Phase 4 the project.

3. Current understanding

The priority has been to establish the key archaeological remains at risk from river erosion. This has been achieved by a process of rapid assessment within the limits of the zone identified for survey at the project initiation stage. As a result of this rapid assessment, four areas of threat have been identified (Areas A-D: see Figure 2 and Section 4). At this stage there has been no perambulation of the upper slopes of Scordale, which although known to host archaeological remains (on the basis of visual inspection from the valley bottom, examination of historic records, and air-photographic interpretation), are not perceived to be at risk from the main effects of river erosion. These higher areas, and the remainder of the valley landscape within which the threatened remains identified can be contextualised, will be surveyed during Phase 4 of the project. Detailed documentary research will also take place at this stage. However, to help place this current assessment of the most threatened remains into context, a summary of the natural and historical landscape character of Scordale is relevant to this report (see below).

3.1 Geology

The principal geology of the Scordale valley is Carboniferous limestone with a number of ore-bearing veins and associated 'flats' (ore deposits which lie roughly horizontal, following the limestone bedding). Various mines in the valley have been worked for galena (lead sulphide), witherite, barytes and fluorite. The most productive exploitation for minerals has been of the Melmerby Scar Limestone, which comprises much of the lower slopes, and a higher succession of limestones of the Middle Limestone Group (Smiddy, Lower Little, Jew). Intruded at the top of the Melmerby Scar Limestone is the Whin Sill (Dunham 1948; Forbes *et al* 2003).

3.2 Topography

Scordale is a deeply-incised valley at the south-western edge of the North Pennines escarpment. The project area itself covers a stretch of the valley approximately 4km long, from the lower slopes of the escarpment up onto the high fells (Figure 1). At the head of the valley, where Scordale Beck emanates, the land is at approximately 600m above Ordnance Datum (OD), falling rapidly to approximately 370m above OD around the principal lead-processing remains (Area B), just over 1km to the south. From here, Scordale Beck, which becomes Hilton Beck further down the valley, descends more steadily to a height of some 230m above OD in Hilton village itself, a further 3.5km to the south-west. At its head, the valley has very steep sides, with the Scordale Beck flowing along a deeply-incised channel, in places descending the initial steep gradient in a number of waterfalls above Area B. During the late 19th century, the tipping of mining-waste across its course dictated that the Beck had to be taken in a culvert (35) underneath. This formed part of a managed water system above the main processing area which controlled water via leats and ponds to the mills and washing areas. Following the abandonment of the mines, the uncontrolled cascades of water upstream from the culvert appear to have contributed to the partial collapse of the culvert itself, the waste heap and further erosion downstream. Other watercourses feed into

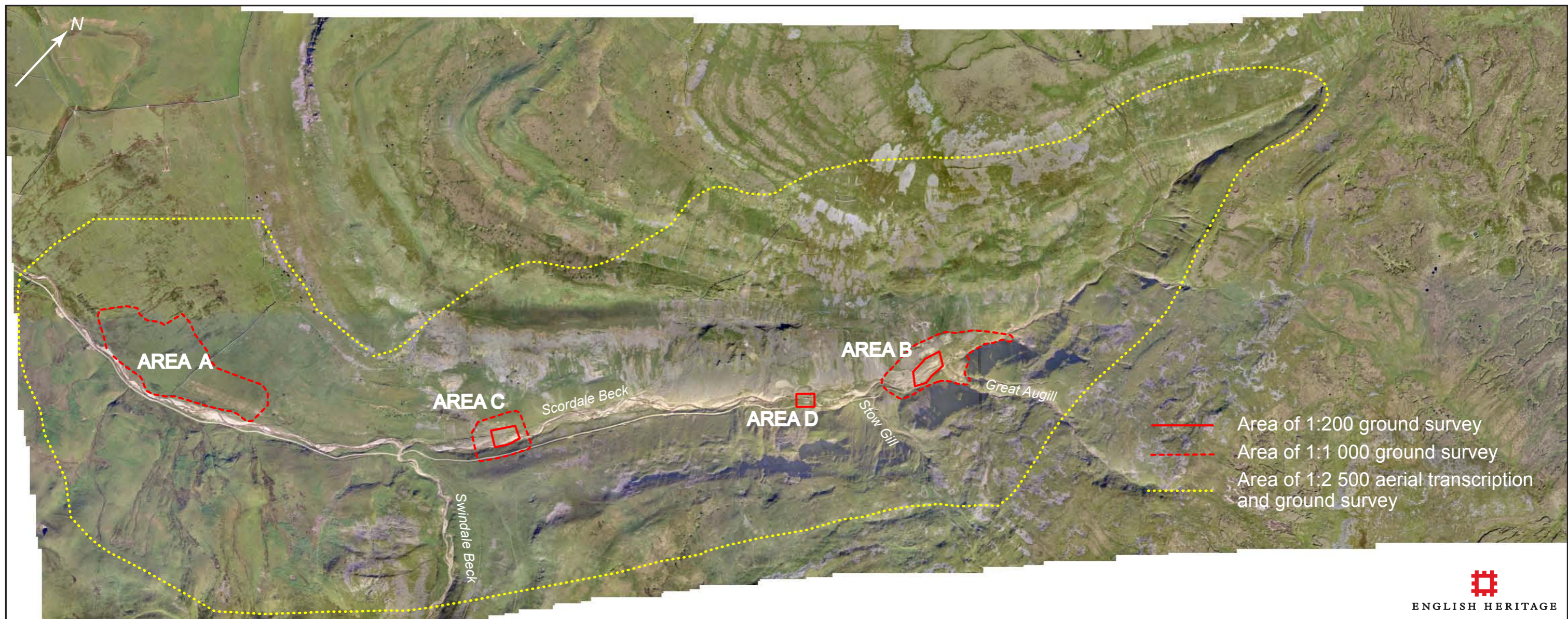


Figure 2. Annotated aerial photograph showing the areas of Scordale to be surveyed at various scales.

the Scordale Beck as it flows down the valley, principally Great Augill, which joins opposite the principal lead-mining remains in Area B, Stow Gill and Swindale Beck further south. During the course of the fieldwork in Phase 3 (twelve days over a period of seven months) Scordale Beck has fluctuated in flow, ranging from fast-flowing torrent to completely dry. However, although Great Augill has clearly flowed with extreme destructive force in the relatively recent past (witnessed by the truncation of 19th-century remains and need for remedial repairs to the modern track), at no stage has water been observed to run in the lower channels of its course into Area B. This is despite flows seen to descend from the high waterfall at the east after heavy rains and continuously from the area of the adit (11) to the north. This current lack of water-flow along the channel may result from conservation works and changes to the drainage pattern associated with the maintenance of the track by the MOD.

3.3 Land use and access

The majority of the land within the survey area is rough, unimproved pasture, currently grazed by sheep. There are also some parcels of enclosed land towards the western end of the survey area where the pasture has been improved, including the area of SAM 32821, which is also grazed by sheep and cattle. In places, field walls on the north side of the lower reaches of the valley are being undermined and are in varying states of collapse.

Since 1942, the principal land use within Scordale has been as an army firing-range. Many of the mining remains were destroyed between 1960 and 1980, although aerial photography indicates that most of the standing structures had collapsed by 1965 (Schedule Entry AA 13546/1; RAF 1965). As a result of this military use, public access along the valley is severely limited, with entry only allowed during non-firing periods and even then this is restricted solely to public rights of way, of which the former mine road (32), now the main access track, is one. As well as the damage to the scheduled remains (of which the mine road is part) by river erosion, the problem of maintenance of access along this track, which is the principal route onto the higher fells, is one of the management imperatives for the MOD, as it too has been affected by river erosion in a number of places. At the south-western end of the valley, recent attempts by the MOD to prevent further erosion of the track with large boulders has proved insufficient defence, as this revetment is itself now beginning to fail. At another place, between Areas B and D, the Scordale Beck has meandered to such an extent that the course of the track and the Scordale Beck are indistinguishable when water is flowing and even when dry, the line of the track is barely traceable across the river-deposited debris; washing floors or sedimentation ponds (83) were located in this area in the late 19th century (see Section 4). The water also impacts on the access track higher up the valley in Area B where braids of the Scordale Beck now flow through the dressing-mill (27) and encroach onto the track after periods of rainfall. Water issuing from abandoned ponds and water-management features associated with the mines is also eroding the track on the slope just to the north-west of the large culvert (35). An overspill channel, possibly part of the original water-management system, has also been carrying water to the east of the waste heap (41) which overlies the culvert (35), and which, although now dry, formerly cut across the track. The track overlying the culvert itself collapsed recently but has been

repaired by the MOD (P Abramson, *pers comm*). As well as the Scordale and Hilton Becks, water is issuing from a number of abandoned levels, reservoirs, ponds, hushes and leat systems associated with the lead mines, all of which is contributing, in a less dramatic way than the river, to the longer-term erosion and instability of the scheduled remains.

3.4 Archaeological and historical background

On the northern slopes above the lower reaches of the valley is a probable Bronze Age field system with dispersed settlement remains (SAM 32821). Part of this field system (Area A) was surveyed as Phase 2 of the project (Hunt and Oswald 2006). The main features can be characterised as a pattern of irregular, but generally quadrangular, fields, which are morphologically typical of the Bronze Age (2000BC - 750BC). These are associated with a scatter of cairns of various sizes, equally typical of Bronze Age agriculture, resulting from the clearance of unwanted stone, both exposed on the surface before cultivation and brought to the surface over time by ploughing. There are also a few probable roundhouse platforms, their distribution dispersed and generally adjacent to field boundaries. One or two smaller enclosures within the broader field system may be directly linked with the roundhouses. The cultivated area stretches across the whole of the south-facing slope down to the edge of the scarp defining the edge of the current flood plain.

There is evidence of post-medieval agriculture in the form of fields enclosed by drystone walls on the slopes to the north of the Hilton Beck (Area A), and preliminary interpretation of features visible on aerial photography would indicate the presence of a number of irregular enclosures on the higher slopes, the dates of which are as yet uncertain. There are clearly many other features on the valley slopes such as hollow ways and tracks as well as extensive remains associated with the mining activities. These will be further examined in Phase 4 of the project.

References in the documentary sources consulted suggest that there was mining activity within Scordale from as early as the 14th century (Wilson *et al* 1922, 48), probably focused on the area of open-cut workings known as Mason Holes (see Figure 1). Further documentary research and field investigation will be required to see if this can be substantiated from surface evidence.

The Hilton and Murton Mines (concentrated in Area B) are documented as producing lead concentrates under the London Lead Company from 1824. Production ceased in 1876, but the mines were re-opened in 1896 by the Scordale Mining Company. The mineral veins were worked by various companies until 1919, latterly for barytes. Further small-scale attempts at extraction were also undertaken in the 1930s (Dunham 1948, 115). Around the turn of the 20th century, barytes extracted from the mines was sorted and processed to some degree at the mining sites themselves, but was then transported down the 2.5 mile (4km) mine road to the outskirts of Hilton village where there was a grinding-mill (Wilson *et al* 1922, 47).

4. Key areas at risk

Within the valley of Scordale, four key areas of threat to the scheduled remains have been identified (Figure 2: Areas A-D). The areas are described below with a summary of the archaeological remains affected and the main threats.

4.1 Area A

Area A contains the remains of a Bronze Age settlement and field system and has been the subject of a separate field survey and analysis as part of Phase 2 of the project (Hunt and Oswald 2006). It has been summarised above (see Section 3.4).

This area is considered to be under threat primarily because of a proposal to allow Hilton Beck to migrate naturally in order to redistribute sediment and reduce impact and erosion on the track. Some collapse of walls has already occurred on the north side of the Beck due to erosion, and allowing the Beck to take its natural course would mean allowing more of the drystone walls to collapse and possibly replacing them further away from the water course. The 2006 analytical survey of this area has demonstrated that while most Bronze Age features have survived without being significantly affected by river migration for approximately the past 3000 years, this cannot be taken as an assurance of their continued survival.

This area has been surveyed at 1:1 000 scale.

4.2 Area B

Area B, towards the eastern end of the survey area, contains the remains of the main processing area and concentration of structures associated with Hilton and Murton mines (see Figure 3). The principal features in this area consist of the remains of two collapsed stone-built mills with wheel-pits, one a crushing-mill and the other a probable dressing-mill, nine process or storage buildings, the mine office, spoil heaps, dressing areas, washing structures (including round buddles), at least 6 adits, tramways, the mine road, reservoirs, mill-race, leats and culverts, and a number of associated tracks, paths and miscellaneous earthworks. A number of phases of activity are evidenced here, the majority appearing to relate to mining and dressing from the mid-19th century through into the early 20th century, although there is the possibility of buried earlier remains. Mapping from 1861 to 1920 (Ordnance Survey 1861; 1863; 1899; 1920) indicates a significant expansion of the industry in this area and many of the most visible features visible today relate to that period. Some of the archaeological remains most at risk from river erosion are found within this area.

At the point at which the mine road (32) crosses the Scordale Beck, water gushes through a narrow stone-lined culvert (35) below a waste heap (41), the construction of which on map evidence can be dated to between 1861 and 1899 (Ordnance Survey 1861; 1899), and then descends in a number of braided channels through what was the main processing area. On the north side of the crossing, erosion has caused the partial collapse of the waste heap and the culvert (Figure 4), truncation of two leats (53, 69) which originally fed water to the

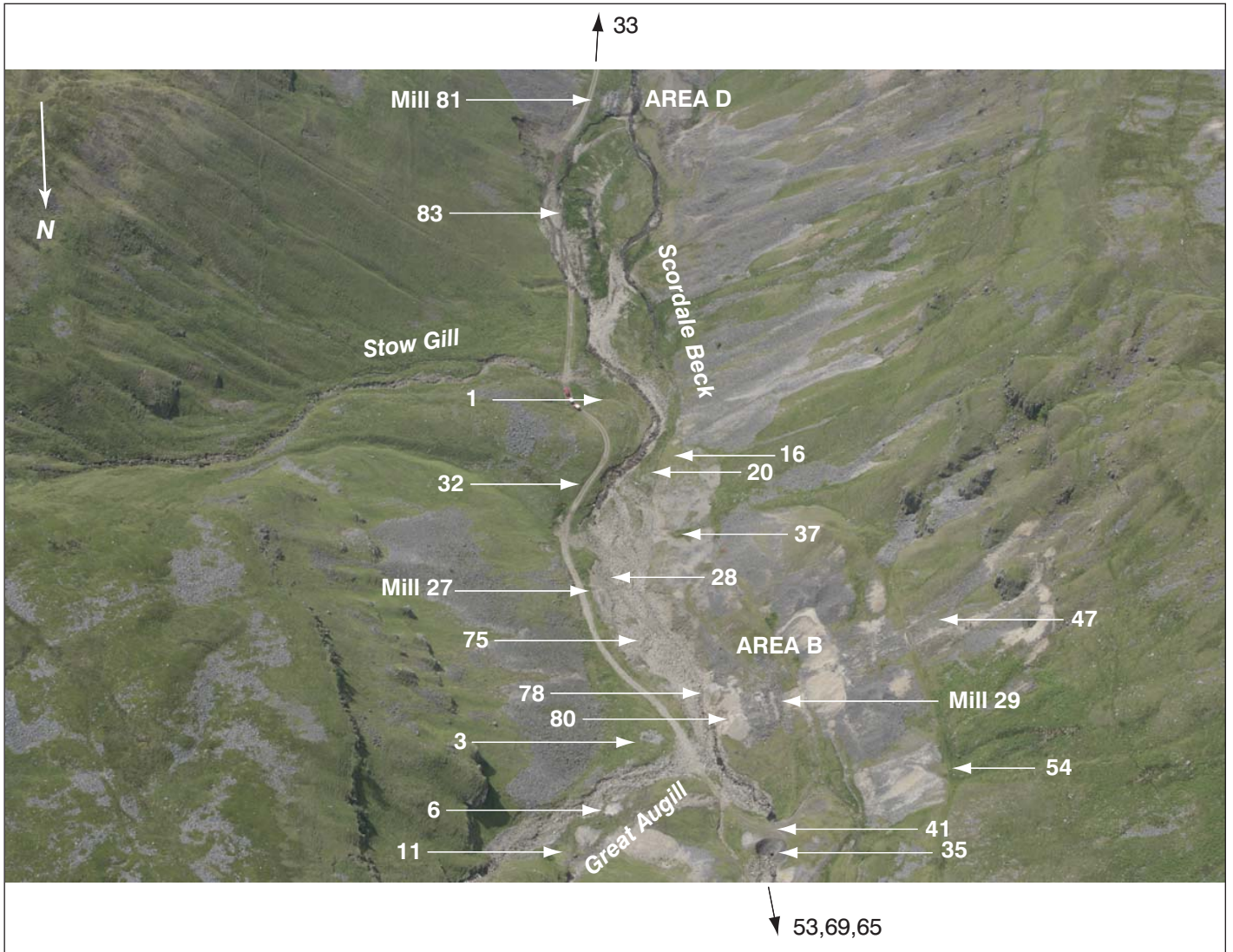


Figure 3. Aerial photograph of the northern part of Scordale indicating the location of features discussed in the text. (Aerial photograph © English Heritage. NMR 20555 Frame 20 13-Jul-2006)

water-wheel at the crushing-mill (29), and the destruction of a trestle or bridge in the area at which the tramway (54) formerly crossed the Scordale Beck. The First Edition 25-inch map (Ordnance Survey 1861) also shows another bridge leading to a path slightly downstream of the tramway; there is now no obvious trace of this bridge, although the path survives as a level terrace (65).

Downstream of the culvert (35) under the mine road the erosion is at its worst on the west side of the Scordale Beck. Here, on top of waste material, *in situ* timbers, flooring and internal processing structures associated with the stone-built elements of a crushing-mill (29) to the west are exposed and falling into the Scordale Beck, whilst the slippage is also revealing stone structures at lower levels (80) (Figure 5). Although collapsed, the stone-built elements of the mill seem relatively stable. However, the east side is only a matter of 3m from the edge of the waste slopes which are being eroded by the Scordale Beck, and at the north, stone from the mill has already fallen down the slope. A crushing-mill has been depicted on mapping here since 1861 but seems to have expanded significantly, or have been replaced by a new, larger mill during the period 1861 to 1899 (Ordnance Survey 1861; 1863; 1899). The depiction of a mill race leading to the mill suggests that in 1861 it had a



Figure 4
*Erosion of waste heap
 41 over culvert 35 and
 the surrounding area
 (taken in November
 2006)*

water-wheel; a tramway from a level immediately to the south-west is also shown leading directly to this mill. The mapped position of the earlier mill would suggest that there is an amount of overlap with the later mill, the remains of which still survive. The west end of the earlier mill seems to coincide closely with the position of the present wheel-pit. It is therefore possible that some elements of the earlier structure were retained, with a larger diameter wheel replacing a smaller one, although this cannot be determined from ground evidence alone due to the large amount of tumble masking the remains. Photographs of this mill (Raistrick and Roberts 1990, 53; Tyler 2001, 79, 86; private possession, Mrs J Winder)



Figure 5
*Erosion below the
 crushing-mill (29)
 exposing further
 structural remains
 (80) (taken in April
 2006)*

taken when it was still operating in the 1920's, show a complex significantly larger than the present stone remains indicate, with a number of timber or corrugated-iron structures between the water-wheel and the Scordale Beck. Aerial photography taken in 1953 and 1957 shows that the stone structure visible today was still largely intact at that latter date, and consisted of an open wheel-pit on a north-south alignment with three open-ended bays on the east side and a small projecting structure on the north side (RAF 1953; 1957); by 1965 it was in a state of collapse (RAF 1965). This form can be still be recognised in the remains, which appear to have been deliberately collapsed; a number of wall faces survive to a height of 1.5m indicating that there is a high level of preservation below the tumbled walls. It is possible that the structures on the ground represent a number of phases. The early 20th-century photographs also show that at this period ores were fed into the mill from the slopes above - the remains of wooden chutes and waste residues can still be observed here (47) - and products were similarly fed by timber chutes to loading areas below, of which there is now no trace, although some of the stonework revealed in the collapsing sections of waste heaps (80) might relate to this. Immediately to the south of the crushing-mill, only the north-west angle of a separate stone building now survives (78), the rest clearly having collapsed into the Scordale Beck. This building (78) is also visible on the photographs noted above and its construction can be cartographically dated to the period 1861 to 1899 (Ordnance Survey 1861; 1899) and its walls stood until at least 2000 (NMR 2000). Further to the south on this side of the Scordale Beck, river erosion is causing collapse of waste material for a length of over 150m through the area, although only two identifiable features appear to be truncated by this. One appears to be a hollow way (37), and the other a possible approach to an adit (16).

On the opposite side of the Scordale Beck, two areas of archaeological remains are suffering destruction from river erosion. Between the track (32) and Scordale Beck are the remains of what appears to be a dressing-mill, with an open wheel-pit at its east side (27). This too is visible on the early 20th-century photographs noted above. Maps show this mill was constructed between 1861 and 1899 (Ordnance Survey 1861; 1899). This mill has suffered river erosion damage on its west side, where only the lower courses survive. Here, flooring, possible dressing-structure bases, timbers and dressing waste are all exposed. One of the braids of the Scordale Beck now flows through these structures. On the south side, a short, crumbling length of freestanding masonry (28) marks the remains of a buttress which formerly supported a timber launder which fed the overshot wheel of the mill. Two other buttresses appear to have existed here but have now been completely lost to river erosion.

To the north of the dressing-mill (27) noted above, between the mine road (32) and Scordale Beck, are a number of low earthworks and structures. The most clearly identifiable are a series of three round buddles and a possible rectangular structure (75) which are stepped down the slope (Figure 6). The west side of this group is suffering river erosion. Between here and the dressing mill, other low earthworks probably relate to further washing areas. Some of these have been subject to river erosion, but others have been covered by river-deposited stones and sediment. A washing area here may be what is depicted on the First Edition 25-inch map Ordnance Survey (1861) map, but the features shown are rectilinear



Figure 6
Remains of a buddle (75), the western edge of which is being eroded by Scordale Beck (right-hand side of the photograph). (Taken in July 2006)

not round; the round buddles which survive today may have replaced the features shown on the map. The remains of another buddle has been identified on the opposite side of the Beck, some 100m to the south (20).

Further downstream, river erosion has caused the truncation of a stone-capped leat (1), and the water flow which runs through the dressing-mill (27) is beginning to encroach onto other structures, possibly also part of the washing process and water-management system below the mill, and the mine road. This flow is causing some slippage of the slope on the east side of the mine road (32).

Area B has been surveyed at 1:1 000 scale, with the area of the mills and ground between having been surveyed at 1:200. Elevations of the standing walls of the mills and collapsing stone structures have been recorded photographically and by ground photogrammetry.

4.3 Area C

Area C is located at the downslope end of Lowfield Hush, at the southern end of SAM 27842. The area is bisected by a drystone field wall and there are archaeological features on both sides of this, consisting of both earthworks and traces of stone-built structures. The main features include 2 adits, ore-bins, a wheel-pit, a mill, dressing areas, leats, and a limekiln. A number of phases of activity are represented here, from the early 19th through to the mid-19th century. Whilst the remains to the north-west of the field wall are fairly well protected, those to the south-east of the wall are at risk of river erosion. Eroded channels show that when the water level is high, water flows around the base of the building remains to the south-east of the field wall.

Examination of the field wall and its relationship to other features shows that it has had various phases of rebuilding and originally pre-dates the operation of the mine and processing areas. 'Low Field Mine' is labelled on a map of 1828 (Hodgson 1828) but is redundant by the

date of the First Edition 6-inch Ordnance Survey (1863) map. At this date a limekiln is labelled here, placing its likely construction between these dates. To the south-east of the field wall, a large stony platform indicates the position of a former building, possibly a mill. A possible wheel-pit has been identified, and which was fed by a contour-following leat on the west side of the valley and by channelled run-off from a nearby adit. The mill tail-race can be identified leading from this back to the Beck.

Area C has been surveyed at 1:1 000 scale, with the core area of the mill having been surveyed at 1:200. Database numbers have not yet been allocated to this area.

4.4. Area D

Situated between the mine road (32) and Scordale Beck are the collapsed remains of a stone-built wheel-pit with an associated rectilinear structure on its south-east side (81). It is situated on the valley floor and lies opposite extensive workings on the higher slopes. It is possible it may have some association with the workings to the east although further investigation of its context during Phase 4 of the project will be required to fully understand this structure. It does not appear on the First Edition 6-inch Ordnance Survey (1863) map, but an unroofed structure of similar form is depicted here on the Second Edition 6-inch Ordnance Survey (1899) map, indicating that it was constructed between those dates. It was still standing in 1957, but was in a state of collapse by 1965 (RAF 1957; 1965). At this stage of the project this is assumed to be a dressing-mill.

The 1899 map shows that the mill (81) is linked, possibly by a leat, to three unroofed rectangular features 90m further to the north-east. Aerial photography taken in 1953 shows what appear to be three rectangular depressions here and it is clear these are the same features shown on the 1899 map (RAF 1953; Ordnance Survey 1899). This area is now covered by a number of braided channels of the Scordale Beck, with resultant dumps and spreads of river-deposited rubble and sediment. The erosion caused by Scordale Beck in this area has also washed away part of the track and former mine road (32) to the east. However, amongst the debris, careful inspection has revealed that a small number of low, damaged earthworks survive, running roughly at right angles to the line of the track (83). These partially define three level areas, stepped down the gradual slope of the valley bottom and are undoubtedly the remnants of the features shown on the 1899 map. On the edge of one of these the remains of timber shuttering appears to be *in situ*. The evidence would indicate that they are former washing floors or settling ponds. Although they were still relatively intact in 1953, by 1957 a channel from the Scordale Beck had broken through them and had started to erode the track; they were still largely intact in 1965 but have deteriorated since (RAF 1953; 1957; 1965). It is probable that they were originally supplied with water via a timber launder from the otherwise inexplicable termination of a stone-capped leat (1) 125m to the north, although no evidence of this connection survives.

The mill (81) is situated slightly above the valley floor and the principal course of the Scordale Beck, but is also approached by a braid in the channel from the north-east; the latter seems to flow continuously even during dry periods (Figure 7). This braid is probably the feature

shown linking the washing floors or settling ponds to the mill on the Second Edition 6-inch Ordnance Survey map (1899). This channel is deflected around the north-east corner of the wheel-pit and has slightly undermined the masonry on that corner.

This mill has been surveyed at 1:200 scale and the washing floors at 1:2 500. Elevations of the standing walls of the mills and collapsing stone structures have been recorded photographically and by ground photogrammetry.



Figure 7
The remains of a dressing-mill (81) with a braid of Scordale Beck running up to and around it. (Taken in July 2006)

5. Project progress

As the survey area is wholly located within an active military training area, access is severely limited, and is restricted to the brief non-firing periods. As a result of these restrictions, the field survey methodology has had to be tailored to maximise the limited time available. Up to the end of December 2006, the English Heritage survey team had managed to gain access to the site for 12 days spread over seven months. The project is currently running to timetable.

5.1 Survey

Phase 1: Complete

Phase 2: Complete.

Phase 3: Complete.

Phase 4: Aerial photogrammetry complete. Ground survey will commence in early February 2007.

Phase 5: To commence in late 2007.

5.2 Publication

Three publications have been produced to date: Hunt and Oswald 2006; Ainsworth and Hunt 2007; Hunt and Ainsworth forthcoming.

English Heritage staff have also contributed to the production of a public information leaflet (Lane and Dugdale 2006b).

6. Conclusions and recommendations

6.1 The initial phases of fieldwork have established the nature and extent of the archaeological remains within the key areas and have identified areas most at risk from river erosion. The plans, photographs and elevations produced from the field survey will ultimately enable future erosion to be measured against the current levels. Although the core remains of the scheduled lead-mining complex have been surveyed in detail in Phase 3 and preliminary interpretations can be made, it is clear that it will not be until Phase 4 of the project has been completed that a fuller understanding of the broader infrastructure of the archaeology and industry in the valley will be reached and assessments of the attrition rate completed. Further in-depth documentary research will also help to further enhance the understanding of the mining landscape and its development.

6.2 Comparison of aerial photography from 1953 onwards with the ground remains today would indicate that there have been four major periods of decline of the physical remains of the Hilton and Murton mines complex in that time span. The first occurs between 1953 and 1957, when the Scordale Beck broke through the washing floors/settling ponds (83) north of Area D and stimulated the erosion of these features and the mine road (32). The second period is between 1957 and 1965, when the three mills (27, 29 and 81) in Areas B and D all appear to have been deliberately demolished rather than suffering erosion or structural collapse. The next period occurs between 1965 and 2000, during which the waste heap (41) to the north of the culvert (35) in Area B partially collapsed. The final, and perhaps most destructive period is from 2000 onwards, when there has been a severe loss of ground and remains on the west side of the Scordale Beck in Area B adjacent to the crushing-mill (29), increased braiding of channels further south causing increased destruction to mill (27), buddles (75), and the washing floors (83) near mill (81) in Area D.

6.3 Phase 3 of the project has enabled the identification of four key areas (A-D) where the threat to the archaeological resource is at its highest. Although erosion has been observed at a number of locations down the valley during the course of the rapid inspection, the highest threat/value ratio is perceived in those areas. In two of those, Areas B and D (see below), a tightly-focused excavation and sampling strategy is considered to be an appropriate response to immediate threats, whilst an intervention might be appropriate in the longer term in Area A. An intervention in Area C is not considered necessary at this stage.

6.3.1 Area A

The small number of prehistoric features which lie on the valley slopes in Area A are unlikely to be affected in the short term by allowing the river to migrate to the full extent of its former flood-plain. However, in the long term resultant bank erosion may impact on this area. Should this occur, the survey has highlighted seven specific places where Bronze Age earthworks are at high risk of potential damage by erosion; in all these cases, preservation by record might be the most appropriate response. At one location (a possible field clearance cairn) excavation might not produce significant additional information about the structure of

the cairn itself, but the mound could potentially seal palaeo-environmental deposits beneath it. However, there is likely to have been severe leaching in this context, so such preservation could not be guaranteed. Any groundworks resulting from the erection of a new wall or fence (to replace the wall which is currently collapsing) may repay a watching brief and also provide an opportunity to collect palaeo-environmental samples.

6.3.2 Area B

The highest levels of threat are in Area B. Within this area, seven specific locations could productively be subject to more detailed examination, in the form of excavation and sampling for scientific analysis (see Figures 3 and 8). They have been suggested primarily as they have high value within the scheduled area as representative remains of the lead and related minerals production process, have been partially eroded already and are at risk of being totally destroyed during the episodes of fast, high-volume water flow to which this valley is prone. One area for sampling away from the Scordale Beck is a possible buddle (6) higher up the valley slopes which is suffering erosion from run-off. The recovery of samples of dressing waste for scientific analysis is considered a priority as visible deposits and structures are currently being washed away. Recovery of data from such samples will increase the understanding and potential chronology of dressing on these sites. In addition, the results of such work would potentially help to inform the interpretation of various structures and the chronology of the site. The survival of timbers, particularly those still *in situ*, offers an opportunity for dendrochronological analysis.

The conservation of the standing fabric of the two mills (27 and 29) in Area B would benefit from the opinion of a specialist structural engineer as to their long-term stability, particularly (29) with its proximity to the collapsing waste heaps. A programme of regular monitoring and photography is also recommended for these and also the nearby waste heaps above the culvert (35).

Other features identified as having suffered, and which continue to suffer from river erosion in this area, such as culverts, leats, hollow ways, paths and waste heaps, are considered to be of low importance for intervention and their preservation by survey and photographic record is considered to be adequate at this stage.

6.3.3 Area C

The level of threat to structures in Area C is not considered to be high and is not a priority for intervention at this stage. However, regular monitoring of this site is recommended.

6.3.4 Area D

There is some slight undermining of masonry occurring at the mill (81) in Area D. Although there still appears to be a high level of structural integrity, this site would repay regular ground inspection and photographic monitoring. Consideration ought to be given to providing an appropriate level of protection to the northern edge of the wheel-pit before erosion causes further collapse. The conservation of the standing fabric would also benefit from the opinion of a specialist structural engineer as to its long term stability.

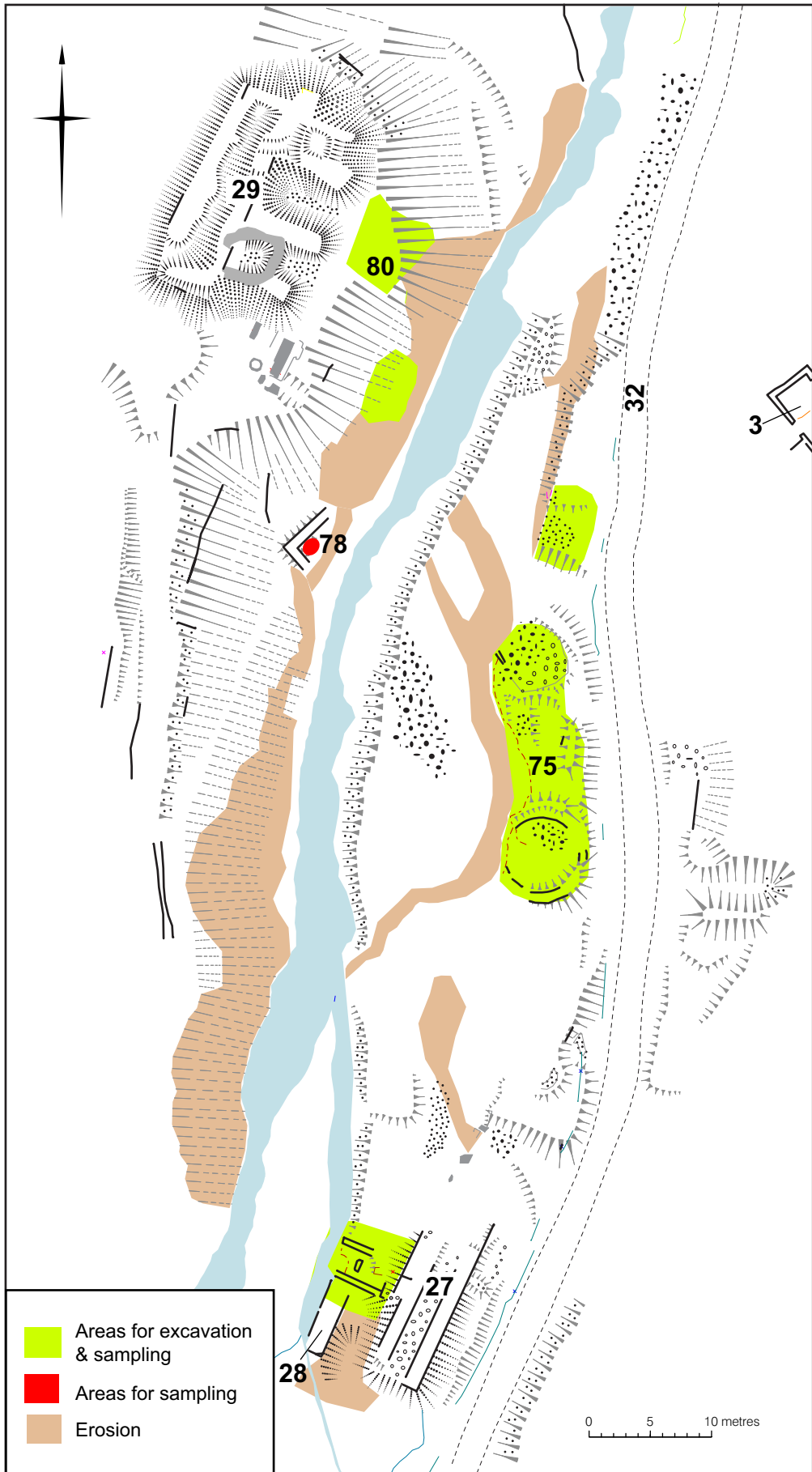


Figure 8. Plan showing areas recommended for excavation and sampling within the core of Area B. An additional area for sampling (6) c 80m to the north-east, is indicated on Figure 3

The probable washing floors or settling ponds (83) located immediately to the north-east of the mill are now located within the area where the Scordale Beck and the track have merged into a wide area of erosion and river-deposited rubble and sediment. Although some remains of structures survive, their long-term future is debateable given the extent of the braided channels in this area. Conversely, the deposition process in some parts may be preserving archaeological deposits. Test-pitting or sampling in this area may reveal more about the washing processes from the residues and therefore consideration ought to be given to including selected locations within the intervention strategy proposed for Area B.

6.4 The former mine road (32), which is now the main access track up Scordale, has clearly been re-consolidated in a number of places over the years to maintain its functionality. Despite attempts by the MOD to prevent further damage, the Scordale Beck and its tributaries still continue to erode it away, particularly in the lower reaches close to Area A. The study undertaken by Durham University (Lane and Dugdale 2006a) is partly aimed at alleviating this problem and is part of a wider study of the impact of the river erosion and sedimentation problem in the valley and beyond. Although only examined as part of the rapid assessment prior to Phase 3, it is clear that the archaeological value of the original road as the spine of the lead industry in Scordale also needs to be taken into account in formulating long-term conservation and management strategies for the scheduled monument. As well as connecting the industrial aspects of the valley, the mine road also provided the link to the settlement of Hilton and the lead-smelting mill and grinding-mill nearby. Occasionally, an original cobbled surface to the road can be observed, although in the majority the surface has been repaired or lost. In many places the original road is terraced and revetted with stone blocks to bear the weight of heavy traffic. At one particular location 65m to the south-west of Area D, is a stone-lined, arched culvert (33) which carries the mine road over a stream which descends from Amber Hill. This culvert, which is shown on the First Edition 25-inch Ordnance Survey (1861) map, is being eroded by overspill from the stream which has exposed the top of the arch; some of the stones of the arch appear to be loose. There is a risk that the arch may collapse along with part of the track, therefore the opinion of a specialist structural engineer should be sought as to its long-term stability and any necessary remedial action.

6.5 In the remainder of the valley, the rapid visual inspection from the track would indicate that other areas of collapse along the valley sides appear only to be affecting waste heaps and paths. However, Phase 4 of the project will cover these areas in more detail allowing a more comprehensive quantification of the archaeological resource in these areas.

6.6 The priority during Phase 3 has been the identification of features threatened by river-related erosion. However, during the course of this work a significant area of disturbance to the remains of the crushing-mill (29) in Area B was noted. On the south-east side of the wheel-pit, a roughly circular emplacement has been dug into the collapsed stonework, revealing what appear to be internal wall faces and some timber-work. Nearby are discarded bullet cases. A number of similar emplacements have been observed in Area B during the survey and the indications are that they are military fieldworks. In the case of the one in the mill remains, aerial photography indicates that it has been dug since 2000 (NMR 2000) ie

after the date at which the remains were scheduled, and the fresh and largely unweathered appearance of the mortar from the mill walls would suggest that this is a relatively recent construction. The mine office (3) also has had a small emplacement dug into it, although this disturbance appears to be much older in date. Consideration should be given to the erection of suitable notices on this and the other mills and buildings to prevent further damage.

6.7 Extensive disturbance has also been noted on the west of the Scordale Beck opposite the presumed dressing-mill (81) in Area D. Both the valley side and the valley floor, including mining-waste dumped on it, appear to have been scooped into and flattened, to such an extent that suggests earth-moving machinery was used. Large quantities of material appear to have been removed as part of this process. Examination of aerial photography indicates that this occurred between 1965 and 2000 (RAF 1965; NMR 2000). Scarring on the slope immediately above the track close to the mill (81) may also relate to this activity. The scale of the clearance, particularly on the west side of the Scordale Beck, is large but at this stage its context is unknown. It presumably relates to land-management processes performed by the MOD.

7. List of references

Ainsworth, S 2006 Scordale Lead Mines, Cumbria: Warcop Army Training Area. English Heritage project design.

Ainsworth, S and Hunt, A 2007 'A fluid landscape: lead mining and river systems in the North Pennines'. *Research News* 5 Portsmouth: English Heritage

Boutwood, Y 2002 Warcop Army Training Estate NMP: Summary Report. Unpublished English Heritage internal report.

Dunham, KC, 1948 *Geology of the North Pennine Orefield Volume 1, Tyne to Stainmore*. London: HMSO

Forbes, I, Young, B, Crossley, C, Hehir, L 2003 *Lead Mining Landscapes of the North Pennines Area of Outstanding Natural Beauty*. Durham: Durham County Council.

Hodgson 1828 *Plan of the County of Westmorland*. Surveyed 1823-5

Hunt, A and Oswald, A 2006 *Scordale, Cumbria: An archaeological survey and investigation of a Bronze Age field system and dispersed settlement*. Research Department Report Series no. 78/2006. English Heritage: York

Hunt, A and Ainsworth, S forthcoming 'Allowing nature to take its course: understanding the remains of a threatened lead-mining landscape in Scordale, Cumbria' *The Archaeologist*. Institute of Field Archaeologists

Lane, S and Dugdale, L 2006a Hilton Beck, River Eden, Cumbria. Fluvial Audit: Science Report. Durham University unpublished report

Lane, S and Dugdale, L 2006b *A Tale of Two Rivers*. Public information leaflet

NMR 2000 Aerial photograph, NY 7522/5 05-Apr-2000. NMR 17454/25

Ordnance Survey 1861 *First Edition 25-inch to the mile. Westmorland Sheet 10.14*

Ordnance Survey 1863 *First Edition 6-inch to the mile. Westmorland Sheet 10*

Ordnance Survey 1899 *Second Edition 6-inch to the mile. Westmorland Sheet 10 SW*

Ordnance Survey 1920 *Third Edition 6-inch to the mile. Westmorland Sheet 10 SW*

RAF 1953. Aerial photograph, 58.RAF.1156 30-Jun-53 Frames 21-20.

RAF 1957. Aerial photograph, 58.RAF.2190. 3-Jun-57 Frames 44-45

RAF 1965. Aerial photograph, 58.RAF.6681 2-Apr-65 Frames 167-168

Raistrick, A and Roberts, A 1990 *Life and Work of the Northern Lead Miner*. Stroud: Alan Sutton Publishing Limited

Tyler, I 2001 *Cumbrian Mining* Keswick: Blue Rock Publications

Wilson, GV, Eastwood, T, Pocock RW, Wray, DA and Robertson, T 1922 *Memoirs of the Geological Survey. Special Reports on the Mineral Resources of Britain Vol II – Barytes and Witherite* (3rd Edition), London: HMSO



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