

GRINTON LEAD SMELTING MILL,  
COGDEN GILL, SWALEDALE,  
NORTH YORKSHIRE

ARCHAEOLOGICAL RECORDING AFTER  
JULY 2019 FLOOD DAMAGE



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## EXECUTIVE SUMMARY

*In August 2019, Ed Dennison Archaeological Services Ltd (EDAS) were commissioned by Mr Miles Johnson, Senior Historic Environment Officer of the Yorkshire Dales National Park Authority (YDNPA) to undertake a programme of archaeological recording following flood damage in July 2019 at the Grinton lead smelting mill, Cogden Gill, Swaledale, North Yorkshire (NGR SE 04877 96425 centred). The scope and scale of the project was defined by discussions between EDAS and the YDNPA, and the work was wholly funded by the YDNPA.*

*The project involved a survey of the flood damage followed by further recording as necessary during the subsequent repair and remedial work. The former comprised a detailed re-survey of the area between, and including, the smelt mill and the reservoir and dam to the south at a scale of 1:200, building on an earlier survey undertaken by EDAS in 1996/1997. Part of the flood damage had exposed new sections through the reservoir's dam, and so two sections at 1:20 scale were produced, together with another section to record exposed deposits in the reservoir itself. On-site fieldwork was undertaken in August and September 2019. Visits were then made on the 7th February and 11th March 2020 to monitor the remedial works that were undertaken to repair the flood damage.*

*The most significant archaeological deposits exposed by the July 2019 flooding were revealed in the sections through the dam and the reservoir behind. Evidence for at least two, and possibly three, phases of dam construction were recorded, using a combination of stone, turf and earth structures. Accurate dating of these phases is difficult, but it is speculatively suggested that a raising and widening of the dam using turf was undertaken in 1774 in conjunction with improvements to the smelt mill, and that perhaps the dam was significantly enlarged further in 1820-22, again in conjunction with improvements to the mill. A spillway from the reservoir, probably utilising the original course of the back, and present by 1893 but probably earlier in origin, was exposed in both plan and section by the flooding. Finally, the deposits exposed in the east side of the reservoir (a sequence of alternating fine silty clays and similar material with inclusions of stones) represent alternate silting and flooding events. This is a useful reminder that the July 2019 flooding forms part of a sequence of serious floods in Swaledale and Wensleydale that have been documented from at least c.1535.*

## 1 BACKGROUND INFORMATION

### Reasons and Circumstances of the Project

- 1.1 In August 2019, Ed Dennison Archaeological Services Ltd (EDAS) were commissioned by Mr Miles Johnson, Senior Historic Environment Officer of the Yorkshire Dales National Park Authority (YDNPA), to undertake a programme of archaeological recording after flood damage which occurred in July 2019 at Grinton lead smelting mill, Cogden Gill, Swaledale, North Yorkshire (NGR SE 04877 96425 centred) (see figure 1). This flood damage was significant, with severe erosion through the reservoir dam to the south of the smelt mill, various areas of collapse to the revetment walls of the canalised beck, and the complete collapse of a c.27m section of an underground culvert to the west of the mill; the last in particular threatened to undermine the south-west corner of the smelt mill.
- 1.2 The urgent nature of the project meant that the scope and scale of the archaeological recording was defined by discussions between EDAS and the YDNPA, and involved a pre-intervention survey of the flood damage followed by further recording as necessary during remedial work; no formal "Written Scheme of Investigation" (WSI) was produced. The project was wholly funded by the YDNPA.
- 1.3 As the area of the lead smelting mill is a Scheduled Monument (see below), emergency Scheduled Monument Consent (SMC) for the proposed flood damage repair work was granted on 19th November 2019 (Historic England reference S00225406).

### Site Location and Designations

- 1.4 The Grinton lead smelt mill complex is located c.2km to the south of Grinton village, on the east side of Cogden Gill at the junction of Smales Gill and Lemon Gill (see figure 1). The long axis of the smelt mill is aligned north-east/south-west with a detached peat store placed at approximately 90 degrees to this (see figure 2); for ease of description below, the mill is considered to be aligned north-south.
- 1.5 The smelt mill is both a Grade II Listed Building (National Heritage List for England (NHLE) 1318580), first listed on 13th February 1973, and a Scheduled Monument (NHLE 1016203), first scheduled on 15th May 1974; the Scheduled Monument area includes the mill, the flue, the fuel (peat) store and associated earthworks. The dual listing means that the Scheduled Monument legislation takes precedence. The wider moorland surrounding and including the site is designated as a Site of Special Scientific Interest (SSSI).
- 1.6 The smelt mill is also listed on the YDNPA Historic Environment Record (site MYD4538) and Historic England's National Record of the Historic Environment (NRHE - Pastscape) (monument 48831; NMR SE 09 NW 39).

### Previous Architectural and Archaeological Investigations

- 1.7 The smelt mill and peat store were surveyed in 1948 by Robert Clough (1980, 110-111), although it is generally considered that his part-reconstructions are not always accurate. The peat store was then surveyed as part of a limited programme of excavation undertaken during a consolidation and reroofing project (Francis & Cranstone 1992). The bellows frame inside the smelt mill has also been discussed by Raistrick (1975, 46-47), Woodall (1980, 293-294) and Lamb (1992, 35) while the complex as a whole is described in detail by White (Tyson,

Spensley & White 1995, 107-127). A survey of the mill was also produced by Turnbull (1994).

- 1.8 Turnbull's survey was significantly enhanced by EDAS in September 1996 (Dennison 1998). This work included a re-survey of the interior of the building (ground floor and upper level plans), a detailed survey of the surviving timberwork within the bellows room, a new ground floor plan of the adjacent peat store, and a new survey of the earthworks surrounding the mill complex (see figure 3); the latter was extended in September 1997 to include the smelt mill flue and chimney, and a small reservoir. Part of the 1996-97 work included the supervision of a limited programme of clearance inside the mill, together with the excavation of a small number of exploratory sondages. These revealed the base of a second sandstone keeper for the western ore hearth, parts of the flagstone floor as previously implied by Clough, and exposed a well preserved east tuyère hole, together with bolts and ties and a second draught hole, probably associated with a slag hearth; it was also later established that the flue vaulting was keyed into, and was therefore contemporary with, the north wall of the mill. As a result of the 1996-97 EDAS survey work, text and illustrations, including reconstruction drawings of the mill in operation and a general landscape view, were produced for two interpretation panels which were subsequently erected inside the mill's furnace room (see figure 4 for landscape view). A further EDAS project in October 2001 monitored and recorded consolidation works to the Lemon Gill culvert (Dennison 2002).
- 1.9 Using information gathered from the EDAS 1996 work, Richard Lamb produced an important paper discussing the workings of the slag hearth and blowing mechanism of the mill, in the context of its technological development (Lamb 2017).
- 1.10 Following the clearance of the furnace room to facilitate a wedding reception held at the mill on 27th July 2019, the flagstone floor in this part of the mill was fully exposed and subject to detailed drawn and photographic recording (Dennison, Richardson & Lamb 2019). This turned out to be extremely fortuitous, as only three days later, on the 30th July, much of Swaledale, Arkengarthdale and the Leyburn area of Wensleydale were subject to intense rainfall which caused severe flooding. In addition to the significant damage to farms, businesses and homes, substantial damage was also caused to numerous archaeological sites and landscapes, including that around Grinton smelt mill.

### **The Proposed Works**

- 1.11 The extent and scope of the proposed flood damage repair works was detailed in a specification produced by the YDNPA (see Appendix 3). In summary, the works involved the construction of several new lengths of rock-armoured walls along the eroded or collapsing sections of the beck, in particular to the west of the smelt mill. This was to involve the importation of large stone blocks or boulders, or the reclamation of the same from the site, to create crude revetment walls, with subsequent infilling of soil and other material behind. A number of the erosion hollows were also to be infilled, and some sections of the banks of the beck were to be re-profiled with low rock-armour walls to their base. The flood debris to the immediate south of the smelt mill was to be removed down to existing ground level. Finally, a new outflow pipe was to be constructed from an existing spring to the beck, to prevent future eddying and erosion.

## **Scheduled Monument Consent**

1.12 Emergency Scheduled Monument Consent (SMC) was granted for the flood repair works on 19th November 2019 (Historic England reference S00225406). A number of conditions were attached to the SMC, as follows:

- (i) The works to which this consent relates shall be carried out to the satisfaction of the Secretary of State, who will be advised by Historic England. At least 4 weeks' notice (or such shorter period as may be mutually agreed) in writing of the commencement of work shall be given to Neil Redfern, Principal Inspector of Ancient Monuments, Historic England, 37 Tanner Row, York, YO1 6WP, Tel: 01904 601897, Email: neil.redfern@HistoricEngland.org.uk, in order that an Historic England representative can inspect and advise on the works and their effect in compliance with this consent.
- (ii) No works/ground disturbance/alterations to which this consent relates shall be begun until the Secretary of State, advised by Historic England, has agreed the scope of work and a detailed method statement.
- (iii) Photographs and/or survey drawings to a scale and quality to be agreed in writing shall be prepared of the monument before the start and/or after completion of the works shall be sent to Neil Redfern at Historic England within 3 months of the completion of the works (or such other period as may be mutually agreed).
- (iv) No ground works/building works shall take place until the applicant has confirmed in writing the commissioning of a programme of archaeological work before and/or during the development in accordance with a written scheme of investigation which has been submitted to and approved by the Secretary of State advised by Historic England.
- (v) All those involved in the implementation of the works granted by this consent must be informed by the owner, occupier and/or developer that the land is designated as a scheduled monument under the Ancient Monuments and Archaeological Areas Act 1979 (as amended); the extent of the scheduled monument as set out in both the scheduled monument description and map; and that the implications of this designation include the requirement to obtain Scheduled Monument Consent for any works to a scheduled monument from the Secretary of State prior to them being undertaken.
- (vi) Equipment and machinery shall not be used or operated in the scheduled area in conditions or in a manner likely to result in damage to the monument/ground disturbance other than that which is expressly authorised in this consent.

## **Aims and Objectives**

1.13 The requirements of the archaeological recording at the Grinton lead smelting mill, as agreed with the YDNPA, were to:

- (i) record the damage caused to the smelt mill and its associated landscape, and also any new archaeological material or features that might have been exposed, as a result of the July 2019 flooding;

- (ii) produce a detailed 'Level 3' survey of the damaged area, to provide a basis for any subsequent remedial works that might be proposed;
- (iii) produce a survey report and archive, appropriate to and commensurate with the results obtained.

## **Fieldwork Methodologies**

### *Documentary Research*

- 1.14 No original documentary research was carried out as part of the project. However, all available existing material relating to the history and development of the smelt mill complex was collected and collated, to inform the subsequent recording work. Liaison was also undertaken with Richard Lamb, who has a particular knowledge of the site, so that any remains that were uncovered could be properly interpreted.

### *Topographical Survey*

- 1.15 As noted above, the landscape of the smelt mill complex had been the subject of a detailed measured earthwork survey in 1996 as part of the works then carried out (Dennison 1998; see figure 3). The current survey used the data from the 1996 survey, and re-surveyed the erosion and flood damage around the smelt mill using the same methodology, at a scale of 1:200. In so doing, the new data could be plotted over the previous survey results, to more accurately assess the extent of the damage. For the sake of continuity and ease of description, the main site elements and identifiers used in the 1996 survey were retained for the current survey.
- 1.16 The first phase of the survey work was undertaken using EDM total station equipment. Sufficient information was gathered to allow the survey data to be readily located through the use of surviving structures, fences, walls, water courses, trackways and other topographical features. The survey recorded the position at ground level of all structures, wall remnants and revetments, earthworks, water courses, leats, paths, stone and rubble scatters affected by the flooding, and the position of dumped material was also recorded. The site survey was integrated into the Ordnance Survey national grid by resection to points of known co-ordinates, and the temporary benchmark established by the 1996-97 survey (on the window sill of the east window in the south wall of the furnace room, height of 95.92m LD). On completion of the total station survey, the field data was plotted and re-checked on site in a separate operation. The resulting survey was produced at scales of 1:200 and 1:500 and presented as interpretative hachure plans using conventions analogous to those used by Historic England. The survey work equated to a Level 3 archaeological survey as defined by English Heritage (2007, 20-24).
- 1.17 The initial topographical survey was undertaken on 7th August 2019, with the hand enhancement taking place on 11th September 2019.

### *Drawn Record*

- 1.18 One of the elements of the smelt mill's landscape damaged by the flooding was the retaining dam of the reservoir to the north-east. The dam had already been breached at some point in the past, but the flooding cut back either side of the breach substantially, revealing constructional detail and evidence for possible phasing that was not previously visible. Both newly-exposed sections were drawn



at a scale of 1:20, together with a typical section through the deposits within the former reservoir behind the dam at the same scale. Local levels were taken from a temporary bench mark previously established for the 1996-97 earthwork survey, on the sill of the east window of the south wall of the smelt mill (at 95.92m LD). The locations of the newly-exposed sections were also recorded on the general site plan. All drawings were produced by hand measurement according to Historic England guidelines (2016, 13-17).

- 1.19 Following standard archaeological procedures, each identified discrete stratigraphic entity (e.g. a cut, fill or layer) visible within the sections was assigned an individual three digit context number, and detailed information was recorded on *pro forma* context sheets. A total of 36 archaeological contexts were recorded (see Appendix 2). In-house recording and quality control procedures ensured that all recorded information was cross-referenced as appropriate. All recording was undertaken in accordance with the Chartered Institute for Archaeologists guidelines relating to archaeological watching briefs (CIfA 2014a). This element of the project was undertaken on 15th August 2019.

#### *Photographic Survey*

- 1.20 General photographic recording of the survey area, together with close-up photography of significant details, was undertaken using an SLR digital camera with 12 mega-pixel resolution; artificial lighting was used where necessary. The guidelines produced by Historic England (2015; 2016, 17-21) were followed and each photograph was normally provided with a scale.
- 1.21 All digital photographs were taken in colour, and were clearly numbered and labelled with the subject, orientation, date taken and photographer's name, and were cross referenced to film and image numbers. A photographic register detailing (as a minimum) the location and direction of each shot was completed (see Appendix 1). A number of the site photographs have been reproduced in this report as plates.

#### *Written Accounts*

- 1.22 Sufficient notes were taken on site in order for a detailed description of the survey area to be prepared, in combination with the drawn and photographic records.

#### *Monitoring during Repair Works*

- 1.23 The above records, which were used by the YDNPA to prepare a specification for the remedial works, were augmented and enhanced during monitoring work carried out during the repair and remedial works. These works mostly comprised cutting back eroded sections through the reservoir dam and along both sides of Lemon Gill, and placing imported boulders along the watercourse and infilling behind with reclaimed spoil. Two visits were made to the site as part of the monitoring work, on 7th February and the 11th March 2020, and appropriate records in the form of photographs, plans and descriptions were made, although no new significant archaeological information was noted.

### **Reporting and Archive**

- 1.24 An EDAS archive survey report has been produced, based on the results of the documentary collation and the information obtained during the fieldwork. This report assembles and summarises the available evidence for the site in an ordered

form, synthesises the data, comments on the quality and reliability of the evidence and, if necessary, how it might need to be supplemented by further field work or desk-based research. The report is also illustrated by reduced versions of the survey drawings, historic maps and plans, and a selection of photographic plates. The report also contains various appendices, including a photographic catalogue.

- 1.25 The report was produced in an electronic (pdf) format, and was distributed to all interested parties, including Historic England and YDNPA. An appropriate entry was submitted to the OASIS (On-line Access to the Index of Archaeological Investigations) project, including the deposition of a digital copy of the report with the Archaeology Data Service, via the OASIS form.
- 1.26 A fully indexed and ordered field archive has been prepared, following the guidelines produced by the Museum and Galleries Commission (MGC 1994) and the Chartered Institute for Archaeologists (ClfA 2014b). The archive comprises primary written documents, site drawings, plans, sections and photographs, and an index to the archive (EDAS site code GES 19). The site archive was deposited with the YDNPA at the end of the project.

## 2 ARCHAEOLOGICAL AND HISTORICAL BACKGROUND

- 2.1 The historical and archaeological background to the Grinton lead smelt mill complex has already been researched and discussed in some detail (Tyson, Spensley & White 1995), and so the following provides a brief summary from this source (unless otherwise stated), to place the archaeological recording into context.
- 2.2 The Grinton mill is one of a number of lead smelting mills which were built in this part of Swaledale, the others being Grovebeck Mill, New Mill and Scott's Mill (Smith 1997). None of the others survive to any great degree, and the Grinton mill represents the best preserved example of all the lead smelting mills within the Yorkshire Dales National Park. No specific date for its construction is known, but it was probably built by Reginald Marriott in the early 18th century, possibly between 1705-10, after he purchased the rights to the surface wastes in the Manor of Grinton. Marriott had previously sent most of his lead ore to a smelt mill at Marrick and the fact that he had obtained the rights of turbarry (peat cutting) in the area, as well as owning some coal mines and stone quarries, meant that he was in a good position to build and operate a new mill at relatively low cost. The location for this new mill took advantage of the plentiful water supply provided by a spring and the Cogden Gill, and was close to the developing lead mines on Grinton How. For this reason, the mill is also known as the How or Low Mill.
- 2.3 The first documented reference to the mill occurs in 1722-23, and in 1733 the mill and its utensils were included in a proposed sale to the London Lead Company. However, this sale never materialised and in 1756 the mill was sold by Hugh Marriott's widow to Caleb Readshaw, a Richmond merchant with interests in other mines in the Dales (Tyson & Gill 1992, 152); at this time the mill was described as "the smelting mill with a little house or chamber and backside thereunto". The first account of production at the mill occurs in the 1750s, with 194 foddors (213 tons) of lead being smelted between August 1758 and September 1759. A map of the Manor of Grinton made in 1768 by George Jackson depicts the mill as a single building (named as 'How Mill') without a chimney or a separate peat store (Richard Lamb, *pers. comm.*). A slightly later map of 1774 shows a T-shaped building with water courses, although no chimney or flue beyond the peat store is indicated (see

figure 5A). In 1776 the tools and utensils at the mill were valued at £60 3s 7d, and the accounts suggest that Readshaw leased the mill rather than working it himself.

- 2.4 In 1791 the mill was sold by Caleb Readshaw Morley, the grandson of the Caleb Readshaw mentioned above, to James Fenton and Edward Wilkinson who became the new Manorial Lords. In 1803 the mill was sold again, to Christopher and Mathew Whitelock of Cogden Hall who were shareholders in the Grinton lead mines at this time. Between 1820-22 ore from the Grinton mill was being sent to five other nearby smelt mills, the majority to Summer Lodge Mill but also probably Scott's Mill in Grove Beck, and this has led to the suggestion that the Grinton mill was being rebuilt at this time (Richard Lamb, *pers. comm.*). Further evidence for this is provided by an 1830 report by the Crown's Agent, John Bower, which mentions that Robinson, Whitelock and Company had recently erected a new mill on the waste at Grinton.
- 2.5 The Ordnance Survey 1st edition 1857 6" map (sheet 52, surveyed 1854) shows the complex as comprising a T-shaped mill, with small annexes on the west and south sides in the south-west corner, a rectangular peat store with a range of structures attached to its west end and extending to the south, and a flue (named as a 'funnel') running to the top of Sharrow Hill; no chimney is depicted or named (see figure 5B). A second detached small L-shaped range of buildings is shown between the peat store and the reservoir. The Lemon Gill, running out of the north-west corner of the reservoir, is shown as being culverted adjacent to the smelt mill, and 'Covd D' (covered drain) is written. The second reservoir on the hillside to the south-west of the complex appears disused, although there is a 'sluice' in the watercourse leading into the main reservoir.
- 2.6 In 1876 the Crown sold the Grinton mineral rights to the Charlesworth family of Chapelthorpe Hall in Wakefield, who had purchased the manor in 1855. A list of equipment at the mill is given as: "250 loads of peat. 2 ore hearths, slag hearth and furnace. Bellows, weighing Beam etc. Water Wheel, Spur Wheel and Crank. 4 metal rollers, spindles and levers". In the 1881 prospectus for the Grinton Mining and Smelting Company Ltd, the agent John Rodwell noted two Scotch hearths, a slag hearth, a roasting furnace, three water wheels, and bellows etc which required repair. In 1890 it was reported that these repairs were complete, and included the erection of a new Scotch hearth, a slag hearth and a roasting furnace which took less than half the amount of water than had been needed to drive the waterwheel for blast purposes. In 1892 it was also reported that a long length of new flue had been built (or possibly repaired).
- 2.7 Gill notes that the Grinton Mining and Smelting Company gave up working the mines in 1893, supporting Raistrick's date of 1893 as being the closure of the mill (Gill 1992, 129). The company itself was dissolved in December 1895. Lamb notes that the apparently extensive repairs and new works of 1890 occurred rather late, given that the mill closed only a few years later, and it may be that some of these works were never actually completed (Richard Lamb, *pers. comm.*).
- 2.8 The Ordnance Survey 1st edition 1893 25" map (sheet 52/8, surveyed 1891) depicts the complex largely as shown in 1857, although in more detail (see figure 5C). The smelt mill appears to have lost its south-west annexes, although two stub walls are shown on the east end of the south wall. The alignment of the flue is shown as running east past the peat store, and it is now named as a 'flue'. The range of buildings extending to the south between the mill and the peat store is depicted as having two equally-sized cells at the south end. Two stub walls also extend from the south wall of the southern cell. The range of buildings to the

south, named as a 'Smithy', is depicted as a row of four roughly equally-sized cells, with a smaller cell extending east from the east side and an internal structure in the southernmost cell; this range is larger than that shown on the 1857 6" map, and the northern cell may well have been added. A line representing a culvert is shown extending from a sluice in the centre of the reservoir dam, running in front of the smithy range and across the flue to enter the north end of the smelt mill. The site is similarly depicted on the later 1913 Ordnance Survey 25" map, although only the mill, peat store and smithy range are shown as being roofed, with the range between the mill and peat store shown as foundations (see figure 5D).

- 2.9 Since the end of smelting, the buildings have been used for agricultural purposes. Early photographs show sheep hurdles adjacent to the peat store and a sheep dip was added to the interior of the smelt mill, in the furnace room, in 1924. The structures deteriorated over time and a Building Preservation Notice was served in 1972 to prevent further deliberate demolition for building stone, as had occurred with the office/smithy range. Subsequent consolidation works include emergency repairs undertaken by the Department of the Environment in 1977-78 and the re-roofing of both the mill and peat store in 1987 by the National Park Authority.
- 2.10 As noted above, several phases of archaeological investigations have taken place at the smelt mill since 1994, culminating with the clearance of the interior of the furnace room between February and June 2019, fully exposing the flagstone floor beneath (Dennison, Richardson & Lamb 2019).

### **3 POST-FLOODING SITE DESCRIPTION**

#### **Introduction**

- 3.1 The features within the survey area are described below in a logical sequence, broadly from south to north across the survey area. The purpose of the description is to illustrate which elements had been damaged by the July 2019 flooding, and what new information had been revealed, and so the description given previously (Dennison 1998) is not repeated in full; figure 3 shows the previous earthwork survey. As has been already noted, for the sake of continuity, the previous unique letter identifiers have been retained for this description.
- 3.2 When considering the text below, reference should also be made to the survey plan (see figure 6) and plates, and the photographic record which appears as Appendix 1. Digital photographs are referenced in the following text in italic type and square brackets, the numbers before the stroke representing the film number and the number after indicating the image e.g. [5/32]. Finally, in the following text, 'modern' is taken to mean dating to after c.1945.

#### **The Reservoir and Dam**

- 3.3 The main reservoir for the smelt mill lies at the south end of the complex, and the water body was formerly retained by a dam. The dam is aligned north-east/south-west, and is slightly curvilinear in plan; at its greatest extent, it is 29m long, 4m wide and 1m high. The Lemon Gill passes through the dam at its western end. The 1996 survey noted that a timber, 1.3m long, with a slot for a vertical member, could be seen in the floor of the stream where it passed through the dam, and the Ordnance Survey 1893 25" map shows a 'sluice' at this location (see figure 5C); the timber presumably either represented part of this arrangement, or part of the dam structure itself. The timber was no longer present when the current post-flooding survey was undertaken.

- 3.4 The majority of the dam appears to be predominantly of earth construction, with the remains of intermittent pitched sandstone revetment walls visible to the base of both sides of the dam, that on the north side continuing to the west side of the beck. A detailed description of the dam's construction, as revealed by the erosion caused by the flooding, is given below. The 1996 survey noted that, at the east end of the dam, there was a second wall line 1m north of and parallel to the base of the dam, suggestive of a stone-lined overflow channel ('m'), or perhaps part of a headrace for a waterwheel located at the south end of the adjacent, now demolished, smithy range. The feature ('m') remains visible as an earthwork, with no surface evidence for any wall lines. It seems more likely that any overflow would have been placed where the dam was crossed by Lemon Gill, and this certainly seems to be the suggestion given on the 1774 and 1893 Ordnance Survey 25" maps (see figure 5). To the west, adjacent to the east side of the beck, further stones and possible wall lines were identified in 1996 which might suggest another small structure ('n'). This is now difficult to discern, although the revetment at the base of the dam is visible.
- 3.5 The area retained by the dam was relatively small, although it presumably fluctuated according to the available water supply; the Ordnance Survey 1893 25" map shows a triangular area of water extending for some 40m to the south of the dam (see figure 5C). The centre of the reservoir was crossed by a vehicle track leading to Grinton Moor, already present in 1996. The July 2019 flooding cut through this track, leaving a deep gully up to 9m wide and c.2m deep, with vertical sides, as well as resulting in significant erosion to the south-west continuation of the track across the moor, as evidenced on photographs taken by YDNPA on 1st August 2019 (see plates 1 and 2); the main gully and the track had been infilled and the track reinstated by the time of the current survey [2/900] (see plate 3). In addition, a very large quantity of silt and angular stone rubble (averaging between 0.30m to 0.50m across) had been washed down Lemon Gill, filling the former reservoir area [2/901] (see plate 4). Prior to the current survey, as part of the reinstatement of the vehicle track, some of this material had been pushed into the gully, although the majority remained in place. The spring noted by the 1996 survey had had a wooden fence erected around it since 1998, but it was now badly choked with debris. A pipe, assumed to be supplied by the spring, emerged from the southern end of the gully scoured by the floodwater, so that the gully had been significantly widened and deepened from this point as far as the dam.
- 3.6 A smaller reservoir, recorded by the 1997 expanded survey, above and to the south-west of the main reservoir, was unaffected by the flooding. However, the leat running from it into the main reservoir had been eroded, and there was a sub-oval area of collapse at the lower, northern end [2/899].

### **The Area Between the Dam and the Smelt Mill**

- 3.7 The 1893 Ordnance Survey map depicts a second sluice in the approximate centre of the dam (see figure 5C), an area now marked by a prominent depression through the earthwork ('o'). This sluice allowed water into a leat, which ran partly overground towards the peat house, and then turned to enter the bellows room of the smelt mill on a launder which drove the waterwheel there; a similar layout is shown on the 1774 map, indicating that this arrangement is at least later 18th century in date. In 1893, shortly after the leat had left the dam, two overflows or offshoots are shown leaving the leat to run south-west into a canalised section of the Lemon Gill beck. By 1913, only the southern of these two features was marked, and the reservoir itself appears to have silted up (see figure 5D).

- 3.8 During the July 2019 flooding, water had clearly passed through the dam via the central depression ('o') and then travelled north-west, scouring the ground surface here. To the immediate north of the dam, adjacent to this central gap, eddies had scoured a steep-sided rectangular depression, c.2m long by 1m wide and up to 0.50m deep [2/898]. In the north end of the depression, a surface of pitched stone rubble was visible. Some 8m to the north-west, in the widened base of the beck, a similar surface was visible where the eastern bank had been cut back by the flooding [2/896, 2/897] (see plate 5). When viewed in section (see below), the surface slopes downwards from south-east to north-west; the section in the beck is set c.0.70m lower than that in the depression by the dam. It is probable that, taken together, these two surfaces represent one of the overflows or offshoots shown here in 1893. The 1996 survey also recorded a stone-lined culvert ('t' on figure 3) entering the beck a short distance to the north-west of the pitched rubble surface visible in the bank, but this had been destroyed by the flooding which had scoured the bank here.
- 3.9 The results of the previous survey led Dennison to propose that, in view of the absence of any earthworks in the area between the reservoir dam and the point where the line of the leat becomes visible as an earthwork close to the peat house ('p'), the water was carried in an overground launder along this section. This theory was supported by the identification of a slightly upstanding c.1m square earthwork ('r') and the corner of a probable pillar ('s'), both to the west of the ruined office/smithy range; these were suggested to represent the bases of supports for a raised launder. The stone corner ('s') remained just visible within a spread of silt deposited by the flood water [2/902], while the slightly more prominent earthwork ('r') remained unaffected. The overground launder was depicted in the reconstructed landscape view of the complex (see figure 4).
- 3.10 The higher part of the area between the dam and the smelt mill, to the west of the track, was unsurprisingly less damaged than the lower part adjacent to the beck. To the north of the dam, the southernmost cell of the former office/smithy range, formed by a sub-rectangular earthwork, had had a small amount of silt and vegetation washed into it by the floodwater, although the earthwork itself was largely unaffected [2/904] (see plate 6). Further to the north, water had scoured out a pair of vehicle tracks leading down the slope towards the smelt mill; the tracks were c.16m long and c.3m wide in total [2/890, 2/892] (see plate 7). The flooding had also washed down a large spread of small angular stones and gravel from the adjacent track into the area to the south of the peat house, forming an abraded pattern [2/889] (see plate 8), and some of this material partly filled the earthwork marking the former course of the leat to the smelt mill ('p') [2/888] (see plate 9).
- 3.11 To the west of the former office/smithy range of buildings, the 1996 survey had recorded four shallow rectangular depressions typically measuring 2m by 1m and between 0.05m and 0.2m deep ('y'), either side of a natural slope. Three were placed on an approximate east-west alignment, with the fourth slightly to the south, and they were all at differing elevations; they do not appear to be interconnected and, although man-made, their original function (if any) remained uncertain. Some of these had been partly obscured by spreads of silt and small angular stones washed across them, but two of the depressions remained clearly visible.
- 3.12 To the north, at the western end of the afore-mentioned vehicle tracks, a major erosion channel had been created, measuring a total of 11m long and up to 1m deep. This channel was only c.1m wide at the south-east end, but it widened to over 2.50m as it moved north-west [2/893, 2/894] (see plate 10). It is possible that,

rather than being caused by flood water coming over the dam, the channel had been created by water exploding through an underground fissure (Miles Johnson, YDNPA, *pers. comm.*).

- 3.13 This erosion channel, and the flood water, had washed a great deal of material down towards the smelt mill itself. On the south side of the building, there was a spread of silt, soil and angular rubble (up to 0.50m across), up to 0.50m deep and over 20m long [2/869, 2/881-2/883, 2/891, 2/903] (see plates 11 and 12). The 1996 survey had recorded the fragmentary remains ('u' and 'v' on figure 3) of a range of buildings depicted on the Ordnance Survey 1893 25" map between the mill and peat store, at right angles to the flue (see figure 5C). The eastern edge of the deposited soil and rubble had obscured parts of these earthworks, although a right-angled corner ('v') was still evident as an earthwork, but without the low defining walls. In addition, the flood water had worn a narrow erosion channel in the steep west-facing natural scarp lying to the rear of the building range [2/887].

### **The Smelt Mill**

- 3.14 As already noted above, between February and June 2019, the interior of the furnace room of the smelt mill was cleared of an accumulated depth of over 0.50m of sheep droppings and soil to facilitate a wedding reception to be held in the building. The flagstone floor thus exposed was subject to detailed drawn and photographic recording (Dennison, Richardson & Lamb 2019).
- 3.15 The spread of silt, soil and rubble described above to the south of the smelt mill had been washed into the furnace room by the flood water, and water had obviously flowed through the interior and then out the other side. As a result, the furnace room had an average depth of 0.5m of silt and angular rubble (to 0.2m across) deposited across it and, apart from in the very south-east corner, the flagstone floor was once again completely obscured [2/907-2/909, 2/915-2/919] (see plate 13). Some material from the wedding reception, which had taken place three days before the flooding, remained in place against the west wall of the building [2/912-2/914]. The floor of the bellows room had not been cleared prior to the wedding reception, but the soil surface within had been slightly levelled and raked to tidy it up. The flooding had washed a shallow layer of silt and soil through the bellows room, but very little stone rubble [2/922-2/924] (see plate 14).
- 3.16 A quantity of silt and some vegetation must have been carried completely through the bellows room as a large sub-circular depression, previously some 2m deep, to the immediate north of the smelt mill had been partially infilled [2/856, 2/857] (see plate 15).

### **The Canalised Beck and Culvert**

- 3.17 Prior to the July 2019 flooding, the beck running down Lemon Gill to the west of the smelt mill was canalised between stone walls for a distance of some 35m; these walls had been repaired in October 2001 (Dennison 2002). The beck then entered a culvert to the south of the smelt mill, emerging some 34m to the north-west (see figure 3).
- 3.18 The flooding had caused severe damage to both the canalised section of the beck and the culvert. Scouring of the beck between the dam and former start of the culvert had exposed several sections of a pitched rubble base to the floor of the watercourse; not all of this was previously visible, although some had been recorded by the earlier surveys. The first section of pitched rubble was seen c.10m

to the north of the dam. Immediately to the north of this, the flood water had lowered the base of the beck, thus creating a low waterfall, which had resulted in a small plunge pool to the north [2/895] (see plate 17). Some 5m to the north-west of this, the pitched surface recommenced, before the start of the walls of the canalised section. The pitched rubble base continued for a distance of c.18m, before a c.13m long gap which had been removed by the flood water, before a final 9m long section. Within this section of the canalised beck, the west revetment wall had suffered a 5m long collapse towards its centre [2/905, 2/906] (see plate 18); this collapse appears to tally with an area of erosion repair carried out prior to the 1996 survey.

- 3.19 The culverted section of the beck, which extended for a distance of c.34m at the time of the 1996 survey (the northern c.7m having been repaired at this time) had been almost completely destroyed by the flooding. At the point where the south end of the culvert used to begin, the flood water had gouged out a second large pool, also removing the pitched rubble base here [2/867, 2/878, 2/879] (see plate 19). The beck now ran in a channel measuring up to 6m wide and with near vertical sides over 2m deep [2/859, 2/860, 2/876, 2/877], bringing it to within less than 3m of the smelt mill's south-west corner [2/852, 2/854] (see plate 20). A 9m long section of the culvert's east wall survived in the side of the beck adjacent to the smelt mill, with a substantial soil overhang to the upper part [2/872-2/875, 2/880; 3/818, 3/820-3/822] (see plates 16 and 21). There was no evidence remaining for the corresponding west wall.
- 3.20 In the west side of the beck, opposite the smelt mill, two sections of a collapsed cast-iron pipe had been exposed [2/853] (see plate 19); it is believed that this pipe once acted as a later water supply to the Grinton Youth Hostel, some 1.2km to the north, replacing an earlier leat (Miles Johnson, YDNPA, *pers. comm.*; Richard Lamb, *pers. comm.*). The large, rectangular stones which supported the former northern end of the culvert remained visible in the base of the beck to the north-west of the smelt mill [2/884]. Adjacent to these footings were two parts of the concrete-lined roof structure of the culvert that had been repaired in 1996 (Dennison 1998, 23) [2/855] (see plate 22).
- 3.21 Part of the arched tailrace culvert from the overshot wheel pit located against the north wall of the bellows room in the smelt mill emerged from the east side of the beck to the north of the culvert roof sections [2/870, 2/871] (see plate 22); this was not visible when the 1996 survey was undertaken. Internal inspection showed it to be well preserved [2/885] (see plate 23). Subsequent investigation by Alan and Judith Mills of the Swaledale and Arkengarthdale Archaeology Group suggests it has a slightly curving alignment running towards the north-east corner of the bellows room, that it has a flag floor and is c.1.0m high by 0.70m wide (Alan Mills, *pers. comm.*). Although the sides of the beck here were not as high as they are further to the south, the channel is still over 7m wide [2/858]. At the time of the survey, the top of a U-shaped piece of ground surface c.4m wide was collapsing into the beck's eastern side [2/866], and it is likely that the channel will widen still further in the future (see plate 24); part of this section coincides with the alignment of the below-ground tail race culvert.
- 3.22 Moving downstream, the beck had assumed a north-western course, and then it swung around sharply to the north opposite the point where the Smales Gill watercourse entered Lemon Gill; the combined watercourse continues north to flow along Codgen Gill. The beck curved around a substantial bank of silt, soil and angular rubble created by the flooding here; the bank was over 20m long and some of the stone blocks contained within were up to 1m square [2/862]. At the



north end, a revetment projects from beneath the bank, carrying the aforementioned cast-iron pipe across the beck to another revetment on the opposite side [2/864, 2/865] (see plate 25).

- 3.23 The onward line of the pipe is probably represented by a narrow footpath terraced into the western slope of Lemon Gill. This footpath was once carried south over Smales Gill on a slab bridge. This bridge had been completely destroyed by the flooding and the base of Smales Gill had been scoured out, leaving banks of silt and angular rubble (up to 0.50m across) to both sides [2/863]. The footpath [2/861] can be followed south along the west side of the Lemon Gill beck for c.35m until a point opposite the smelt mill, where the alignment had collapsed into the beck. It resumes again to the south of the smelt mill, and eventually continues on an embankment, revetted to the east side. This embankment crossed the base of a historic landslip, and this had collapsed further to the west of the embankment during the recent flooding.

### **Sections through the Dam and Reservoir**

#### *Section 1: East-facing Section, West Side of Watercourse (see figure 7)*

- 3.24 The east-facing section through the dam measured 10.50m long and stood a maximum of 2.50m in height [1/516] (see plate 26). Due to the undercut and partially collapsed nature of parts of the section, it was not always possible to discern the exact stratigraphic relationship of one context to another, and so the sequence described below is based partly on professional judgment.
- 3.25 The identified deposits in this section can be divided into two groups, positioned either side of the front (north) revetment wall (005) of the dam. To the north (i.e. downstream), all four deposits (001 to 004) sloped gently downwards from south to north, away from the dam [1/522-1/524]. The uppermost deposit was formed by a dark brown sandy silt topsoil, with an average depth of 0.20m (001). This overlay a loose mid-brown sandy silt which contained frequent inclusions of angular stones up to 0.20m across (002); this deposit reached up to 0.50m thick and the sandy silt content increased in depth from south to north. Beneath this, there was a shallower band of compacted orange-brown silty clay subsoil containing infrequent inclusions of angular stones up to 0.10m across, up to 0.20m thick (003). The silty clay subsoil overlay a similar deposit, although this was more mid-orange/brown in colour and contained bands of smaller stones (004) and was at least 0.50m thick. It was probably a natural deposit, and it continued below the base of the section.
- 3.26 To the south of the front revetment wall (005) of the dam, the recorded sequence of deposits suggested two, or possibly three, different phases of construction. The uppermost deposit was a loose mid-brown sandy silt with frequent inclusions of angular stones up to 0.20m across (006); it had a depth of between 0.10m to 0.20m. This deposit corresponded to the earthwork forming this side of the dam, although it probably represents a topsoil which has accumulated since the dam became disused. Below this, the uppermost deposit which appeared to form part of the final phase of the dam structure itself was a shallow 0.10m thick layer of a compacted clean mid-brown silty clay (007). This overlay a 0.25m thick deposit of laminated orange-brown clay and silt layers (008); the individual bands of lamination were very thin. To the north, an orange-brown silty clay with infrequent inclusions of small stones (009), 0.20m thick, appeared to have been heaped over an earlier phase of the dam (see below), sloping steeply downwards from south to north.

- 3.27 To the south, the rear (south or reservoir side) revetment wall (014) of the latest phase of the dam was visible [1/517] (see plate 27). This wall was faced with unmortared angular stones up to 0.40m long, and had a battered profile; it had a maximum visible height of c.1m and was c.0.5m wide. To the south of this wall, three layers of mid brown or orange-brown clean silty clay (015, 016 and 017) with a combined maximum depth of 0.60m had accumulated against the dam; it was assumed that these were deposited through periodic silting of the reservoir behind. At its base, the back wall of the dam (014) either overlay (or perhaps was more likely to be cut into) an orange-brown silty clay natural deposit which contained frequent inclusions of angular stone up to 0.20m across (018); the lower part of this deposit was obscured by slumped material and collapse. The south wall of the dam (014) had also been cut through an earlier shallower reservoir. This too had been allowed to silt up, with a 0.40m deep layer of clean orange-brown clay (010) having accumulated in the base. The overall width of the latest phase of the dam structure measured 5.20m wide, from the outer faces of both stone revetment walls (005 and 014), with the bank rising to a height of c.2.50m.
- 3.28 The main body or core of the dam, between the two revetment walls (005 and 014), was formed of layers of stacked inverted peat turves (013) [1/518, 1/521] (see plate 28). The upper surface formed a flat-topped bank, with the sides sloping downwards at an angle of approximately 45 degrees. Overall, this bank was c.2m wide and 0.75m high; the individual layers of turves had an average depth of 0.10m, sloping down from north to south. Beneath the bank, turves laid horizontally rather than in sloping layers continued for at least a further depth of 1.0m, making a total depth of c.1.75m. It is not clear if these horizontal layers were put down as part of the same constructional sequence as the bank, or if they are in fact earlier.
- 3.29 The peat dam structure may have overlain, or been contemporary with, the earliest visible parts of the dam, comprising a north (front) wall (005) and a south (back) wall (012), with an infill of turves (011) between; together, these three features had a total north-south width of 2.50m and a maximum visible height of 1.50m [1/519, 1/526, 1/527]. The front revetment wall (005) was a maximum of 1.20m wide and 1.50m high, and was built from large pieces of unmortared roughly coursed and squared stone; the north face had a slightly battered profile, but the south face was vertical [1/520] (see plate 29). The infill between the two walls was again formed by inverted peat turves, laid in broadly horizontal layers, forming a deposit 0.80m wide and 1.50m deep (011). The back revetment wall (012) was 0.80m wide and 1.50m high, and was again built from large pieces of unmortared roughly coursed and squared stone; the south face had a slightly battered profile, but the north face was vertical (see also plate 28).

*Section 2: West-facing Section, East Side of Watercourse (see figure 7)*

- 3.30 The west-facing section through the dam measured 16m long and stood a maximum of 2m in height [1/535]. As with the east-facing section, due to the undercut and partially collapsed nature of parts of the section, it was not always possible to discern the exact stratigraphic relationship between one context to another, and so the sequence described below is based partly on professional judgment. In general, the west-facing section was more affected by collapse than the east-facing section, and the resulting exposed stratigraphy was less complex.
- 3.31 The deposits in this section were essentially divided into two groups, either side of the front (north or downstream) revetment wall (024) of the dam. To the north, all deposits sloped gently downwards from south to north, downstream and away from

the dam [1/529, 1/532] (see plate 30). The uppermost deposit was formed by a dark brown sandy silt topsoil, with an average depth of 0.20m (001). This topsoil overlay a shallow layer of compacted topsoil and peat, up to 0.15m thick (019), beneath which there was a 0.25m thick deposit of an orange-brown silty clay (020). This silty clay overlay a pitched stone rubble surface (021) forming the now eroded base of the watercourse, which acted as the spillway from the reservoir; this spillway was present by the late 19th century, and may be significantly earlier. That part of the spillway that was visible in the section was at least 9.50m long and up to 0.60m deep [1/528, 1/530, 1/531] (see plate 31). Beneath the spillway, there was an orange-brown silty clay with frequent inclusions of angular stones up to 0.40m across (022), at least 1.0m thick and probably a natural deposit - it continued below the base of the section.

- 3.32 To the south of the dam's front revetment wall (024), the uppermost deposit was again formed by shallow layer of topsoil (001) which topped the wall and continued to the north. This overlay a loose mid-brown sandy silt with frequent inclusions of angular stones up to 0.20m across, but mostly smaller (025); it was up to 0.70m thick in places, but was generally less, and probably represents a wash out or flood deposit laid down after the reservoir was abandoned. Beneath this, there was a 0.40m-0.50m thick deposit of a fine dark brown silt containing a high proportion of organic material (027); this deposit represents the latest phase of silting of the reservoir behind the dam. The silt overlay a brown silty clay with frequent inclusions of angular stone up to 0.30m across, typically 0.50m thick (028).
- 3.33 The main body or core of the dam comprised layers of inverted peat turves (026) [1/536] (see plate 32). It is likely that, as in the east-facing section, the upper surface was originally formed by a flat-topped bank, with sides sloping downwards at an angle of approximately 45 degrees, although the top and northern edge were subsequently damaged. The bank was at least 2.50m wide by 1.50m high [1/533]. The individual layers of turves within had an average depth of 0.10m, and were laid evenly. They were only clearly visible in the southern and northern thirds of the bank, and were apparently absent from the central part [1/537]. The peat dam structure may have butted, or been contemporary with, the earliest visible part of the dam, comprising the front revetment wall (024) [1/534] (see plate 33). This wall was 1.20m wide and was built from apparently large unmortared pieces of roughly coursed and squared stone, and it stood c.1.50m high, with both faces having a slightly battered profile; there was a step at the base of the north side. What appears to be a crude buttress structure (023) of stone rubble, 0.50m wide and c.1.0m high, had been added to the north side of the wall at a later date. The core of the dam (026) overlay an orange-brown silty clay with frequent inclusions of angular stone up to 0.50m across (029). This continued to the south below the reservoir layers and the base of the section, and appeared to be a natural deposit.
- 3.34 Unlike in Section 1, the rear (south or reservoir side) revetment wall forming the other side of the dam was not visible in the section.

*Section 3: Reservoir - West-facing Section (see figure 8)*

- 3.35 A representative part of the west-facing section through the reservoir, exposed in the east side of the watercourse, was also recorded; the recorded section was 2m long and stood a maximum of 2m in height [1/538-1/542] (see plate 34).
- 3.36 The uppermost layer was formed by topsoil up to 0.08m thick (001). Beneath this, there was a deposit of loose sandy-silt containing a high proportion of angular stones up to 0.10m across (030), extending to 0.40m below ground level (BGL). It

overlay a shallow layer of fine brown silty clay (031), whilst beneath this, there was a similar deposit 0.22m thick but containing frequent inclusions of small, gravel-like stones (032). There was then another layer of fine brown silty clay (033), 0.14m thick, and beneath this, a similar deposit 0.30m thick but again containing frequent inclusions of small, gravel-like stones (034). It overlay a third layer of fine brown silty clay (035), 0.30m thick, which extended to 1.40m BGL.

- 3.37 This sequence of alternating fine silty clays and similar material with inclusions of stones represent alternate silting and flooding events to the reservoir, either during its use or perhaps after abandonment. If the former, the apparent lack of any evidence for re-cutting or cleaning might suggest that the reservoir, which was c.1.4m deep initially, was not well maintained. The lowest deposit visible in the section was an orange-brown silty clay with frequent inclusions of angular stone up to 0.40m across (036). This continued below the base of the section and appeared to be a natural deposit.

## **4 MONITORING OF REMEDIAL WORKS**

### **Introduction**

- 4.1 As part of the EDAS project, the YDNPA required some limited monitoring of the remedial works to be undertaken, in the form of a discontinuous watching brief, in order to observe and record any new structural or archaeological information that might be exposed. Two visits were therefore made to site while the remedial work was in progress, on 7th February and 11th March 2020. The repair and remedial work was undertaken using a tracked 360 degree excavator.

### **The Remedial Works**

- 4.2 The remedial works were defined by an YDNPA specification (see Appendix 3), and they took the following form. They are described from south to north, and are depicted on figure 9.
- 4.3 To the south of the track leading onto Grinton Moor, an improved channel with scaped sides was created for the Lemon Gill beck [4/129] (see plate 35). The track was removed and then reinstated over the top of a large diameter concrete pipe [4/126]; the existing outlet for the spring to the south-west remained in place but was enhanced for better flow. For a distance of some 22m between the track and the dam, through the reservoir, the sides of the beck were lined with low rock-armoured walls, constructed from large sub-rectangular blocks of stone, creating a slightly sinuous course with an average width of 2.50m. The adjacent ground surface was then scraped back at an angle of c.45 degrees for between 2m to 3m from the beck walls, apart from at the southern end of the east side where the gully created by the July 2019 flood was infilled [4/125, 4/127, 4/128, 4/130] (see plate 36). These landscaping works were monitored and no new information was exposed; the previously recorded vertical sections through the dam were smoothed back but the underlying structure was not affected in any significant way [4/131, 4/132].
- 4.4 Between the dam and the smelt mill, a c.11 m long section of new rock-armoured revetment wall was created on the east side of the beck, again using large sub-rectangular stone blocks, where the bank had been eroded by the July 2019 flooding [4/133, 4/134] (see plate 37). The area of erosion behind [4/139] was infilled using material taken from an area above the trackway over the beck [4/171], most of which had been deposited from further south by the flooding. In order to

access the eroded area to carry out the repairs, it was necessary to drive the tracked excavator and other vehicles across the ground to the east. This disturbed and flattened some of the shallow earthworks which had previously been recorded [4/135-4/138] (see plate 38), which caused some rutting, but any significant areas of disturbance were repaired at the end of the remedial works.

- 4.5 Further to the north, the prominent erosion channel that may have been caused by water exploding through an underground fissure to the south of the smelt mill was infilled. The wider spread of loose material washed down by the flood into the area to the immediate south of the smelt mill was then stripped away to the former pre-flood turf level, using a toothless scraper bucket; as the ground surface was not to be disturbed, and was in any case devoid of any earthworks, this was not subject to detailed archaeological monitoring [4/143]. A c.11m long section of the west revetment wall of the canalised beck was rebuilt using large sub-rectangular stone blocks, including the c.5m long section which had collapsed during the flooding [4/141, 4/142] (see plate 39). Any erosion behind the new wall was then infilled with reclaimed material.
- 4.6 The most substantial works were undertaken along the line of the former culvert to the west of the smelt mill, where the erosion had threatened to undermine the south-west corner of the building. As previously noted, the flood had left only 9m of the original 27m length of the east wall of the culvert standing. This did not provide adequate protection for the smelt mill, and further heavy rain in December 2019 caused the soil bank at the southern end of the surviving wall to fall away still further. Therefore, a c.40m long rock-armoured wall was constructed along the east side of the erosion gully created by the July flooding to the north of the revetted section of watercourse; a similar wall, c.4m long, was built to the south end of the west side [3/810-3/817, 3/825; 4/144] (see plate 40). Soil was taken from the partially eroded natural slope on the west side of the beck, creating a scarp, and was used to infill the void behind the new wall [3/823; 4/145, 4/146] (see plate 41). Whilst these works were taking place, a temporary pond was created in the base of the beck [3/829]. Several different layers of made-up ground were exposed in the west-facing section created to take the new wall. Beneath the turf and topsoil, there were at least four level layers of gritty ashy sand containing frequent inclusions of small stones, and varying in colour from an orange-brown through dark grey [3/832] (see plate 42). The new revetment wall stood three courses high, and had an average height of 2m [4/155-4/163, 4/166-4/168] (see plates 43 and 45). A gap was left where the smelt mill's tailrace emerged into the beck, and new walls curved inwards to meet it [4/150, 4/152, 4/153] (see plate 44). To undertake these works, access was required by the tracked excavator down the track to the north of the smelt mill [4/147].
- 4.7 To the north of the smelt mill, some of the material washed into the junction of Lemon Gill and Smales Gill was removed, in order to divert some water away from the deep erosion gully that had been created [4/154].

## 5 DISCUSSION AND CONCLUSIONS

- 5.1 The most significant archaeological deposits exposed by the July 2019 flooding were the sections through the dam and the reservoir behind. The east-facing section of the dam (Section 1), exposed in the west side of the gill, contained evidence for several different phases of construction. The earliest phase comprised the front (downstream) revetment wall (005) and the rear (reservoir side) wall (012) with an infill of peat turves between (011); together, these features gave the earlier dam a total north-south width of 2.50m and a maximum visible

height of 1.50m. It is possible that the bank of peat turves (013) seen on the south side of the rear wall was contemporary with these, although it seems more likely that it represents a later heightening and widening of the dam. If this is the case, then the dam would have increased from 2.50m to at least 3.50m in width, and in height from 1.50m to 2.00m. Nevertheless, the depth of water impounded behind the dam appears to have remained relatively shallow, and so it may have relied on storing a shallower depth of water over a wider area, rather than a greater depth over a smaller area. The reservoir behind the dam gradually silted up, depositing a 0.40m deep layer of clean, orange-brown clay (010) in the base. Finally, at a later date, the dam was increased substantially in size again, by the addition of a new rear revetment wall (014) and associated deposits over, creating a structure similar in size to the surviving earthwork - this enlarged dam was c.5.20m wide and c.2.50m high. The reservoir was at least 0.60m deep (although the deposits exposed in the west-facing section suggest that it increased to 1.40m in depth further to the south), and again displayed evidence for periodic silting.

- 5.2 Dating these phases accurately is difficult. A map of the Manor of Grinton made in 1768 depicts the mill as a single rectangular building with no other detail, but a slightly later c.1774 map shows the peat store with an attached range, the office/smithy range and two reservoirs (see figure 5A). It is assumed that one of these was the reservoir recorded as part of these works, with the other that surviving as an earthwork at a higher level to the south-west. However, it is possible, or perhaps even probable, that the mill was provided with a dam and reservoir as part of the original construction, possibly between 1705-10. It is therefore certain that part of the dam structure must be 18th century in date, and possibly early 18th century.
- 5.3 The dam and main reservoir appear to have reached their current dimensions by the time that the 1857 Ordnance Survey 6" to 1 mile map was published (see figure 5B). A sluice is still marked at one corner of the upper reservoir, although it appears to have become disused, although it is shown as water-filled in 1893 (see figure 5C). One might speculate that the main reservoir dam had reached its existing, final, form as part of the suggested re-building of the smelt mill between 1820 and 1822. If this was the case, then it would almost certainly push back both phases of the dam which incorporate turf in their structure into the 18th century. Equally speculatively, one might propose that the raising and widening of the dam using turf was done in 1774 when the bellows room was added to the mill and the furnaces repositioned (Lamb 2017). The use of turf in the construction is interesting, and the ability to still recognise individually-cut turves in the west-facing section significant.
- 5.4 Unfortunately, there is little published information on similar dams in the Yorkshire Dales, which makes placing the Grinton dam within its wider context difficult. The Blakethwaite dams at the head of Gunnerside Gill have been surveyed (and indeed the upper dam suffered catastrophic damage itself during the July 2019 flooding) but both are later and much larger than Grinton (Ronan & Cardwell 1997; Dennison & Richardson 2015). Generally, reservoirs for lead mining purposes were of relatively small capacity, so their dams were less than 8m high and with little in the way of ground preparation works; spoil was often used for dam construction, with stone or 'rip-rap' placed on the inside to protect against wave action, and spillways to remove flood water were common (Binnie 1987, 56).
- 5.5 A more direct comparison with the main Grinton reservoir dam might be made with the Blea Beck dams, which were built between 1821 and 1826 (Gill 1984 & 1988). They are of triangular section with a rounded crest and, although higher and longer

than that at Grinton, an exposed breach through the middle dam shows that it has a similar form of construction, with a battered stone rubble wall to the water face and a core formed of peat turves, although no stonework to the downstream side; it is presumed that would also have been a layer of impervious clay to prevent water seepage through the dam. While the Blea Beck dams are potentially over 100 years later than the Grinton dam, they may be reflecting a long tradition of using locally-sourced peat for construction (Richard Lamb, *pers. comm.*).

- 5.6 The spillway (021) recorded in the west-facing section through the dam (Section 2) represents the remains of the overflow, allowing excess water to be channelled through or over the dam via a weir to prevent overtopping, along the original course of the beck. The spillway had a pitched stone surface, and was at least 8m long, falling some 0.70m over this distance from south-east to north-west. Both this spillway and the separate headrace to the waterwheel in the smelt mill are shown on the 1893 map, as well as two overflows from the headrace to the spillway, and it is also perhaps depicted on the 1774 map. Finally, the deposits exposed in the west-facing section of the reservoir (a sequence of alternating fine silty clays and similar material with inclusions of stones) represent alternate silting and flooding events to the reservoir (Section 3). This is a useful reminder, as demonstrated by Spensley (2020), that the July 2019 flooding forms part of a sequence of serious floods in Swaledale and Wensleydale documented from at least c.1535.

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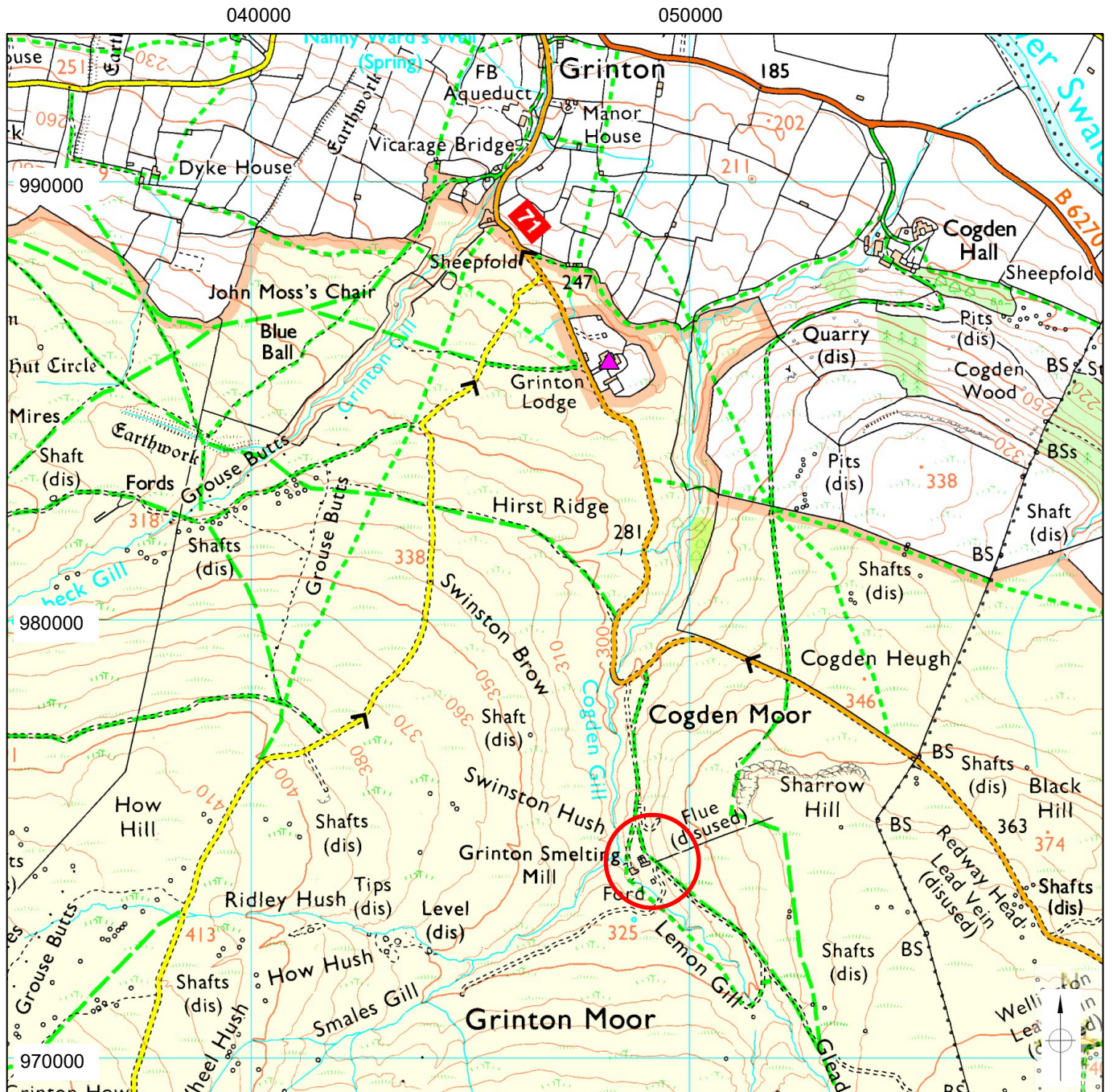
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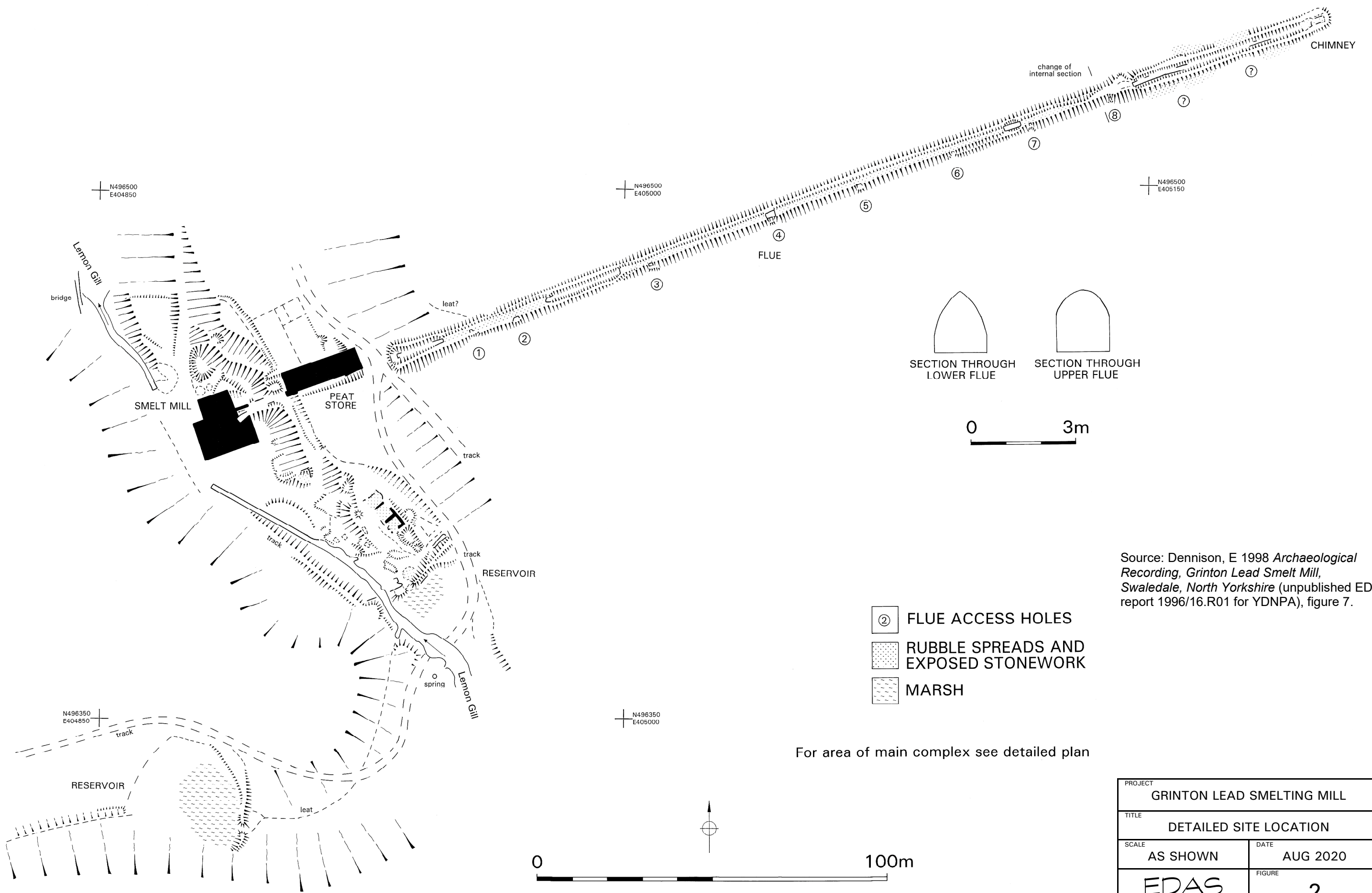
## **7 ACKNOWLEDGEMENTS**

- 7.1 The archaeological recording of the July 2019 flood damage and subsequent monitoring of the remedial works at the Grinton lead smelting mill was undertaken by Shaun Richardson (EDAS) and Richard Lamb. Funding for the project was provided by the YDNPA. EDAS would like to thank Mr Miles Johnson, Senior Historic Environment Officer of the YDNPA, for his help during the work. Site photographs and drawings were produced by Shaun Richardson, and a draft report was commented on and enhanced by Richard Lamb. The final report and drawings were produced by Ed Dennison, who retains responsibility for any errors or inconsistencies.



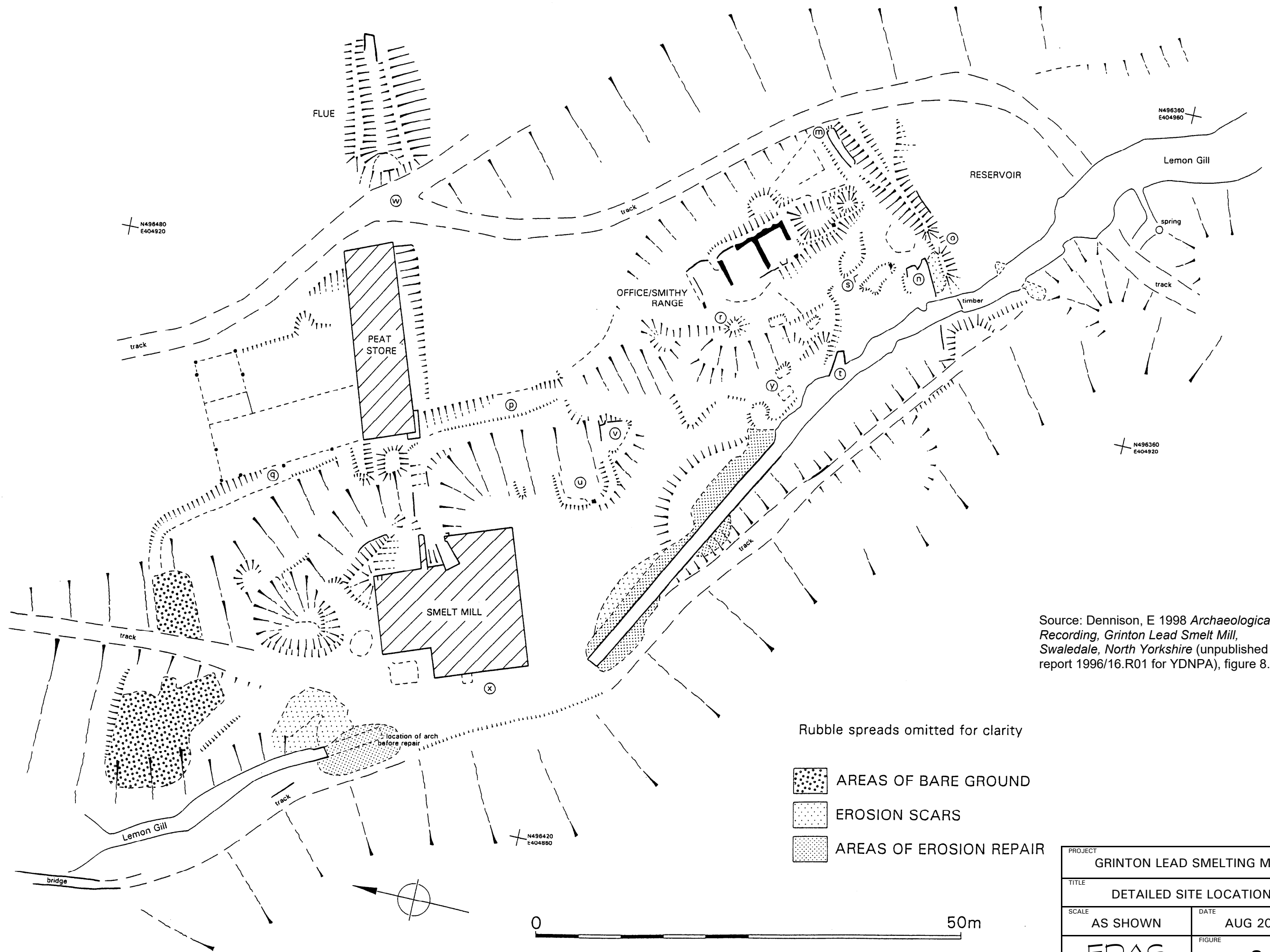
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 Ordnance Survey Licence 100013825 (2020).

PROJECT		GRINTON LEAD SMELTING MILL	
TITLE		GENERAL SITE LOCATION	
SCALE	AS SHOWN	DATE	AUG 2020
EDAS		FIGURE	1






Source: Dennison, E 1998 *Archaeological Recording, Grinton Lead Smelt Mill, Swaledale, North Yorkshire* (unpublished EDAS report 1996/16.R01 for YDNPA), figure 7.

PROJECT		GRINTON LEAD SMELTING MILL	
TITLE		DETAILED SITE LOCATION	
SCALE	AS SHOWN	DATE	AUG 2020
EDAS		FIGURE	2

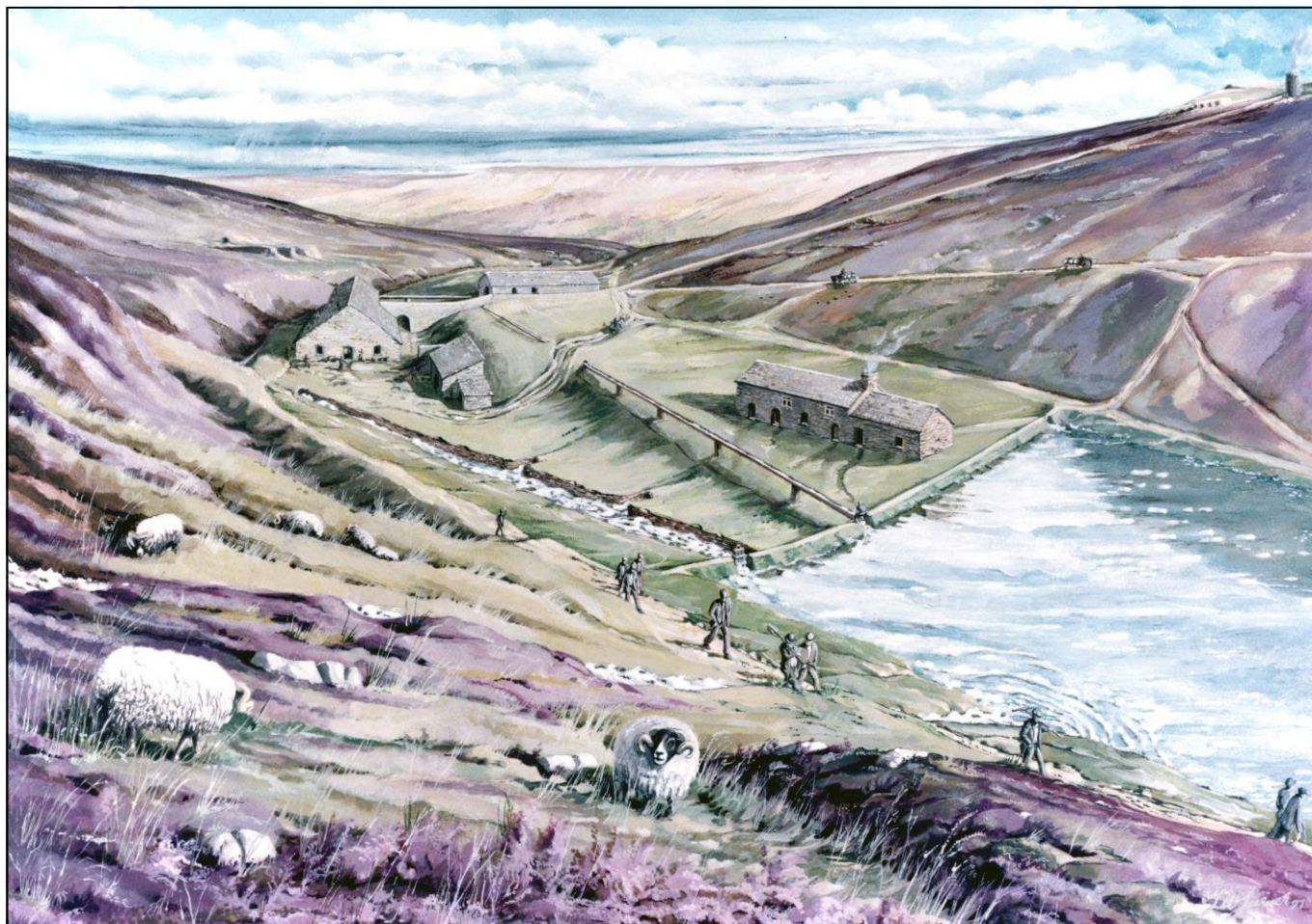


Source: Dennison, E 1998 *Archaeological Recording, Grinton Lead Smelt Mill, Swaledale, North Yorkshire* (unpublished EDAS report 1996/16.R01 for YDNPA), figure 8.

Rubble spreads omitted for clarity

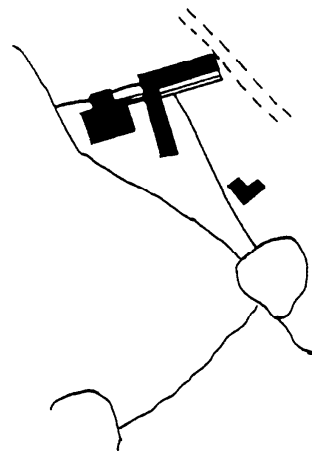
-  AREAS OF BARE GROUND
-  EROSION SCARS
-  AREAS OF EROSION REPAIR

PROJECT		GRINTON LEAD SMELTING MILL	
TITLE		DETAILED SITE LOCATION	
SCALE	DATE	AS SHOWN	AUG 2020
EDAS	FIGURE		3



Reconstruction illustrative drawing of Grinton lead smelting mill produced by Les Turner for EDAS, based on EDAS survey work 1996-97.

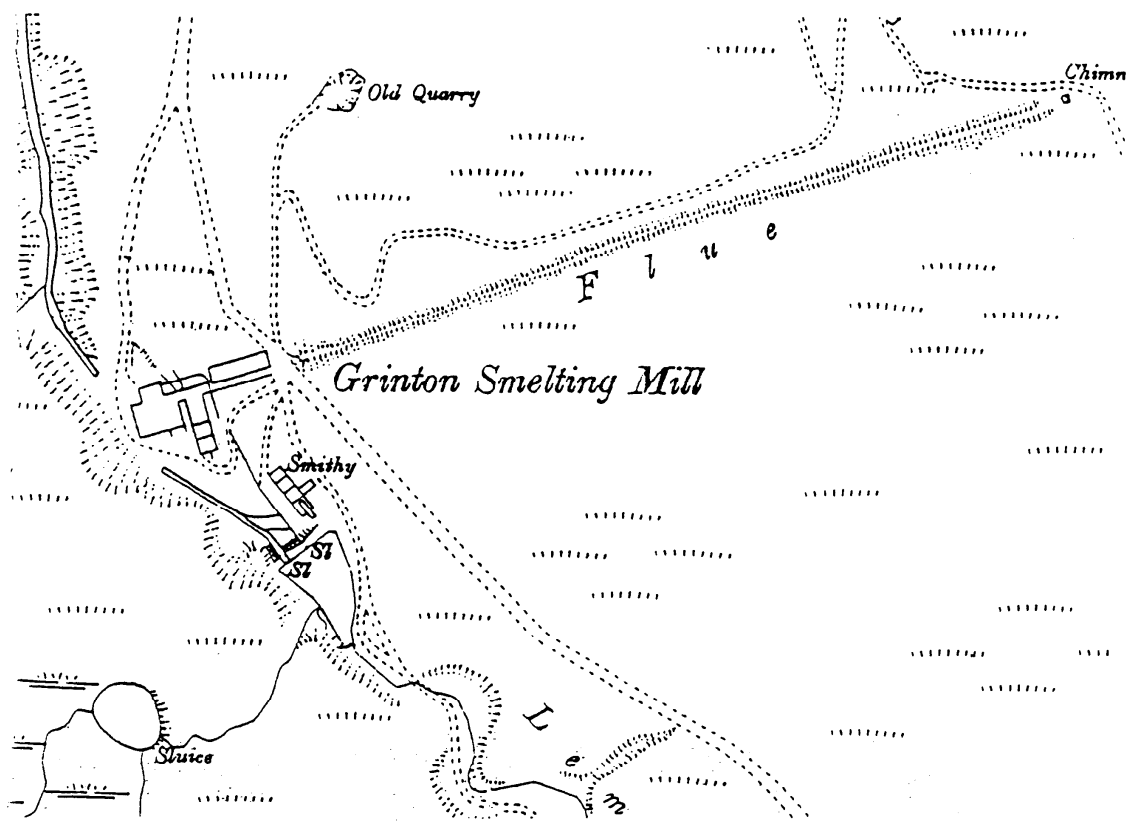
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TITLE		GENERAL SITE INTERPRETATION	
SCALE	NTS	DATE	AUG 2020
EDAS		FIGURE	4



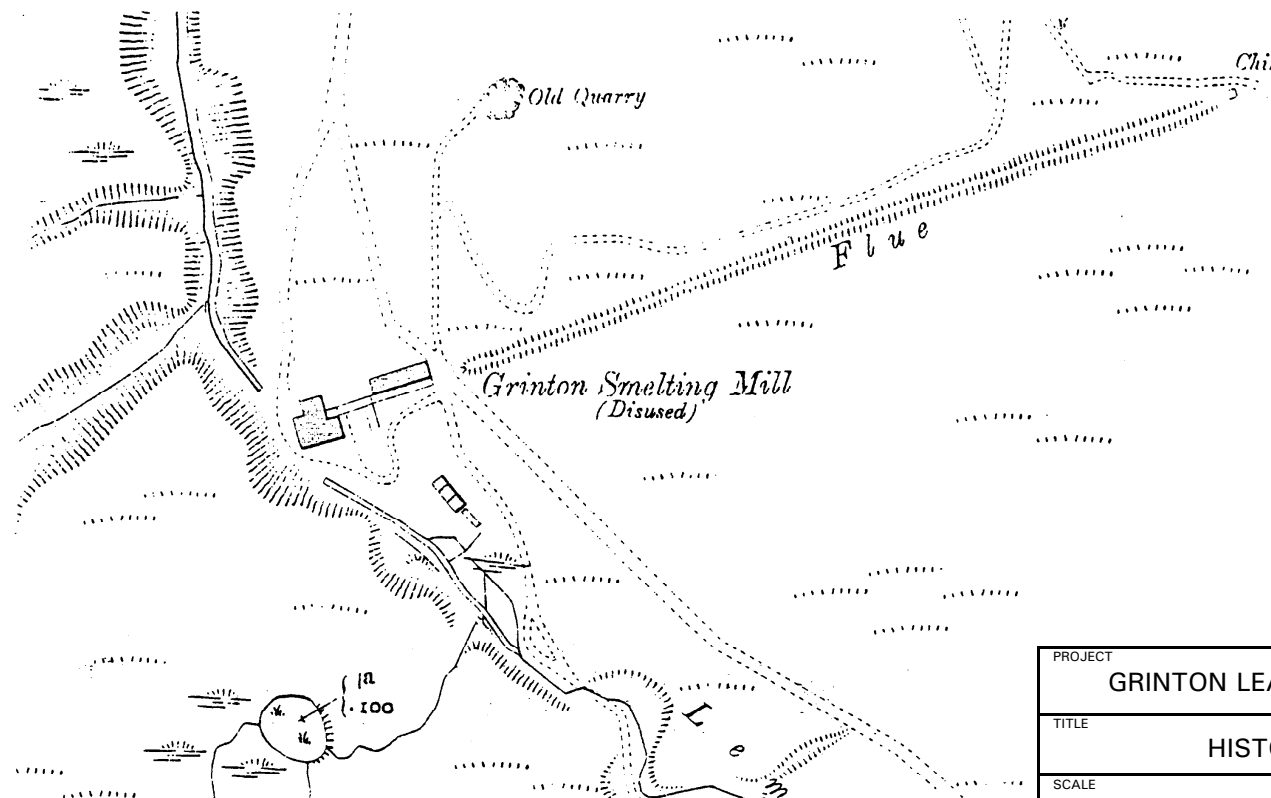
A) Sketch of c.1774 map.



B) Ordnance Survey 1857 6" map (sheet 52), surveyed 1854.

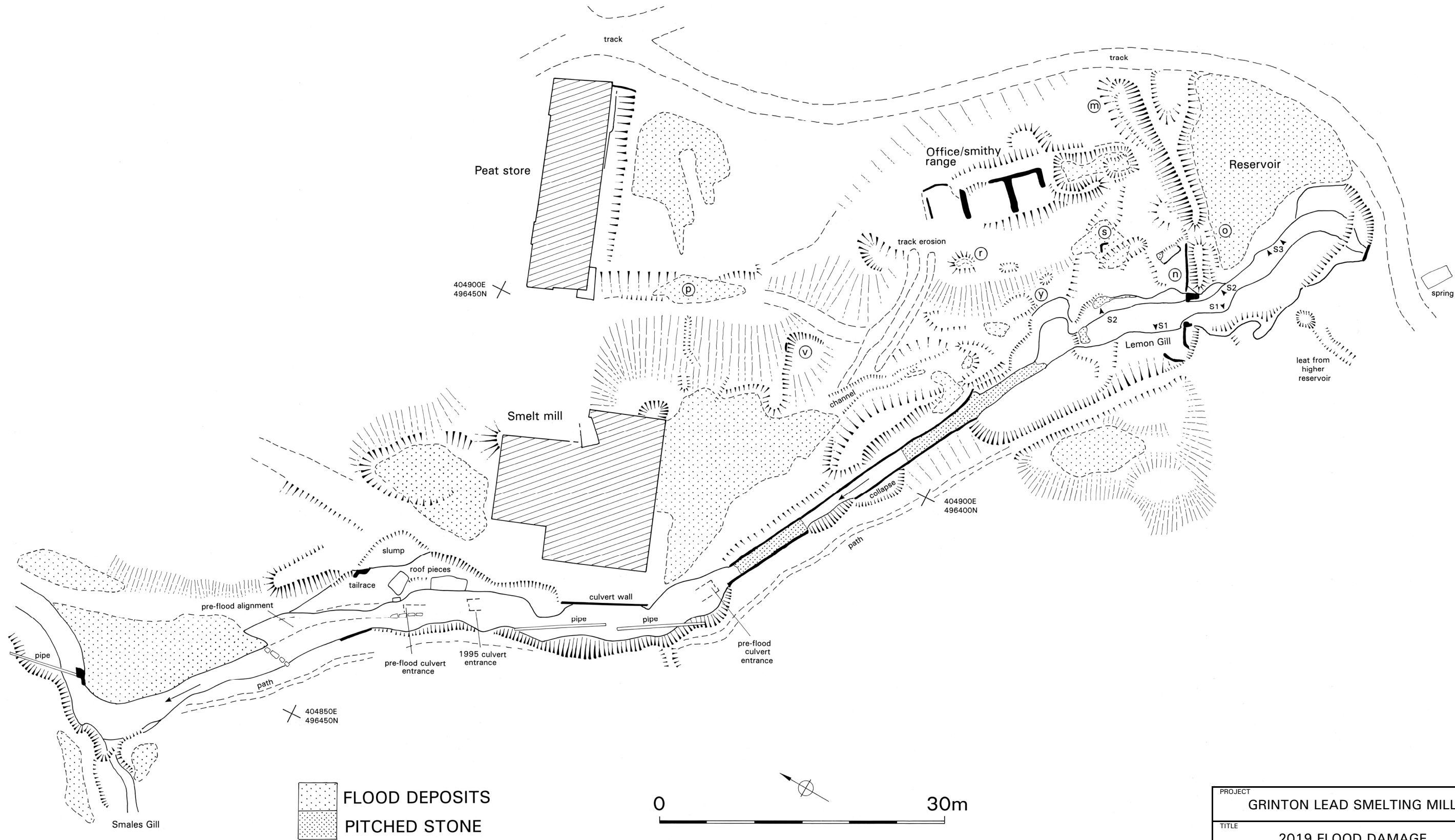




C) Ordnance Survey 1893 25" map (sheet 52/8), surveyed 1891.

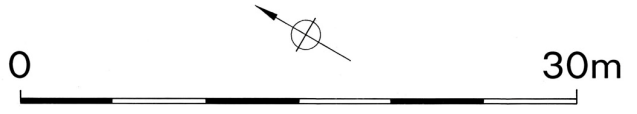


D) Ordnance Survey 1913 25" map (sheet 52/8), revised 1910.

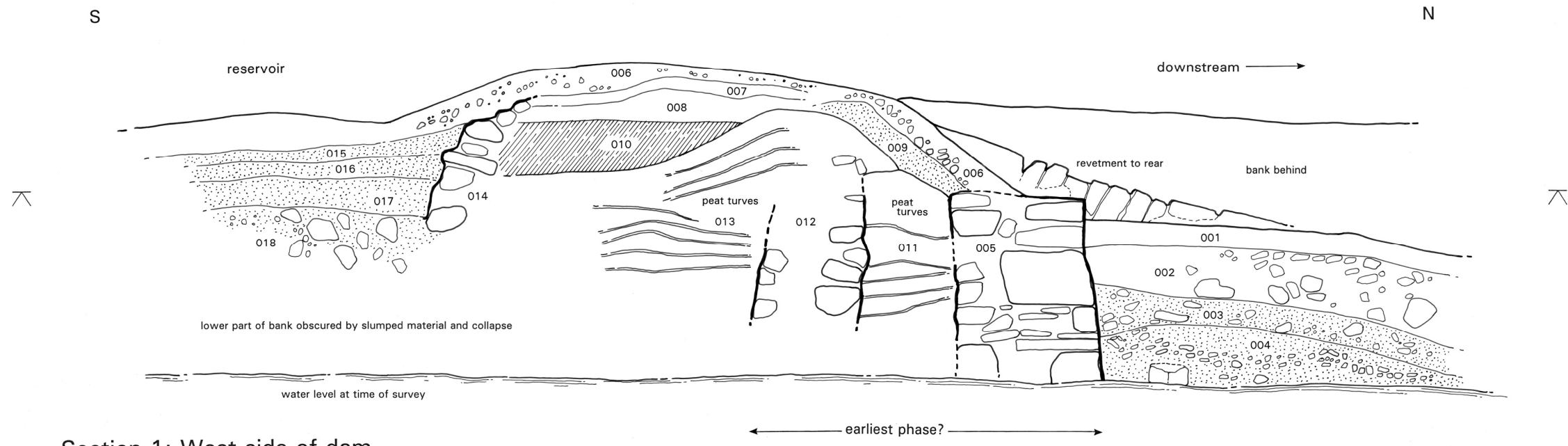
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TITLE		HISTORIC MAPS	
SCALE	DATE	NTS	AUG 2020
EDAS		FIGURE	5



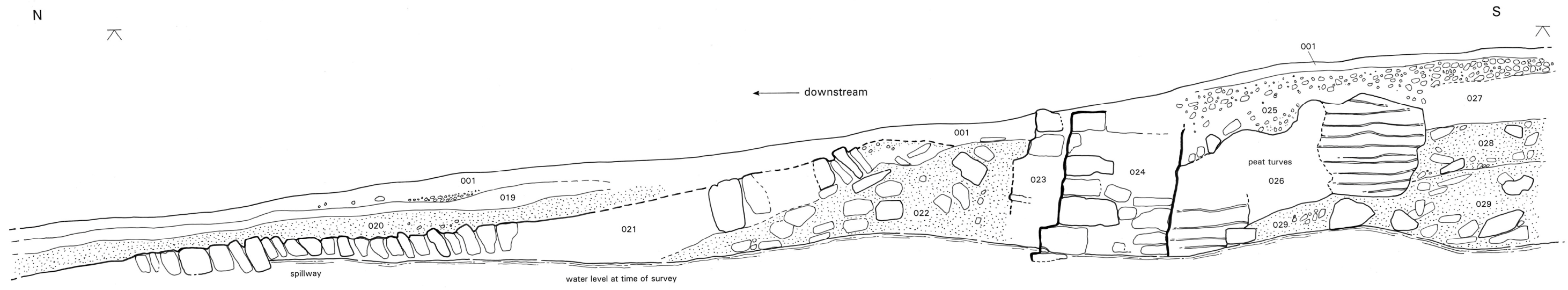
 FLOOD DEPOSITS  
 PITCHED STONE



PROJECT		GRINTON LEAD SMELTING MILL	
TITLE		2019 FLOOD DAMAGE	
SCALE	DATE	AS SHOWN	AUG 2020
EDAS		FIGURE	6



Section 1: West side of dam



Section 2: East side of dam

Levels at 100m OD based on temporary bench mark on the sill of the east window of the south wall of the smelt mill (at 95.92m LD)

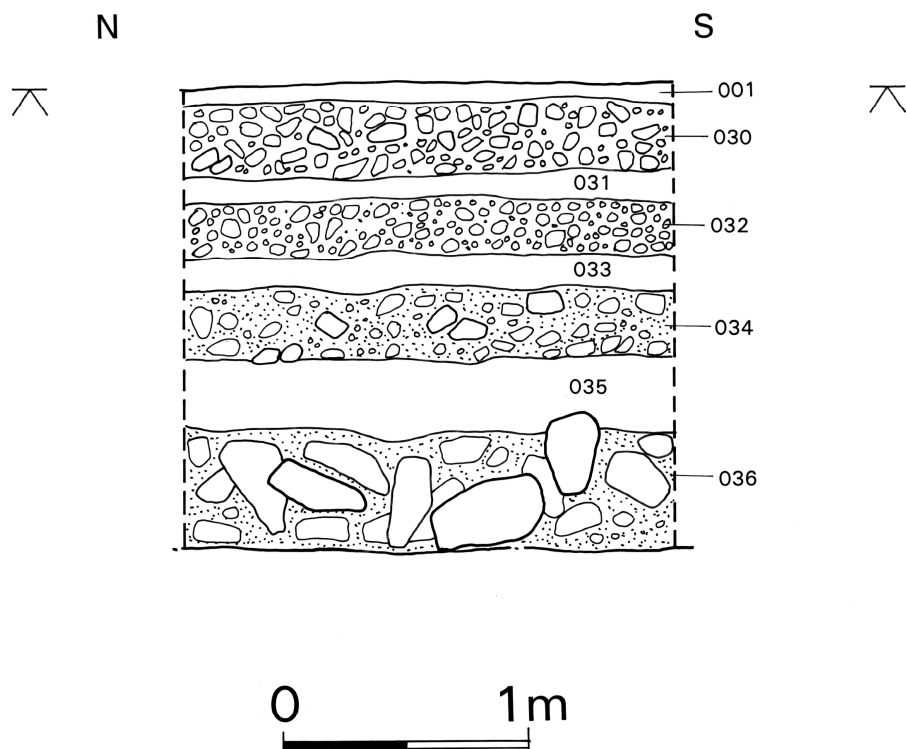
 CLAY  
 SILTY CLAY



PROJECT GRINTON LEAD SMELTING MILL	
TITLE SECTIONS THROUGH RESERVOIR DAM	
SCALE AS SHOWN	DATE AUG 2020
EDAS	FIGURE 7



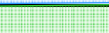


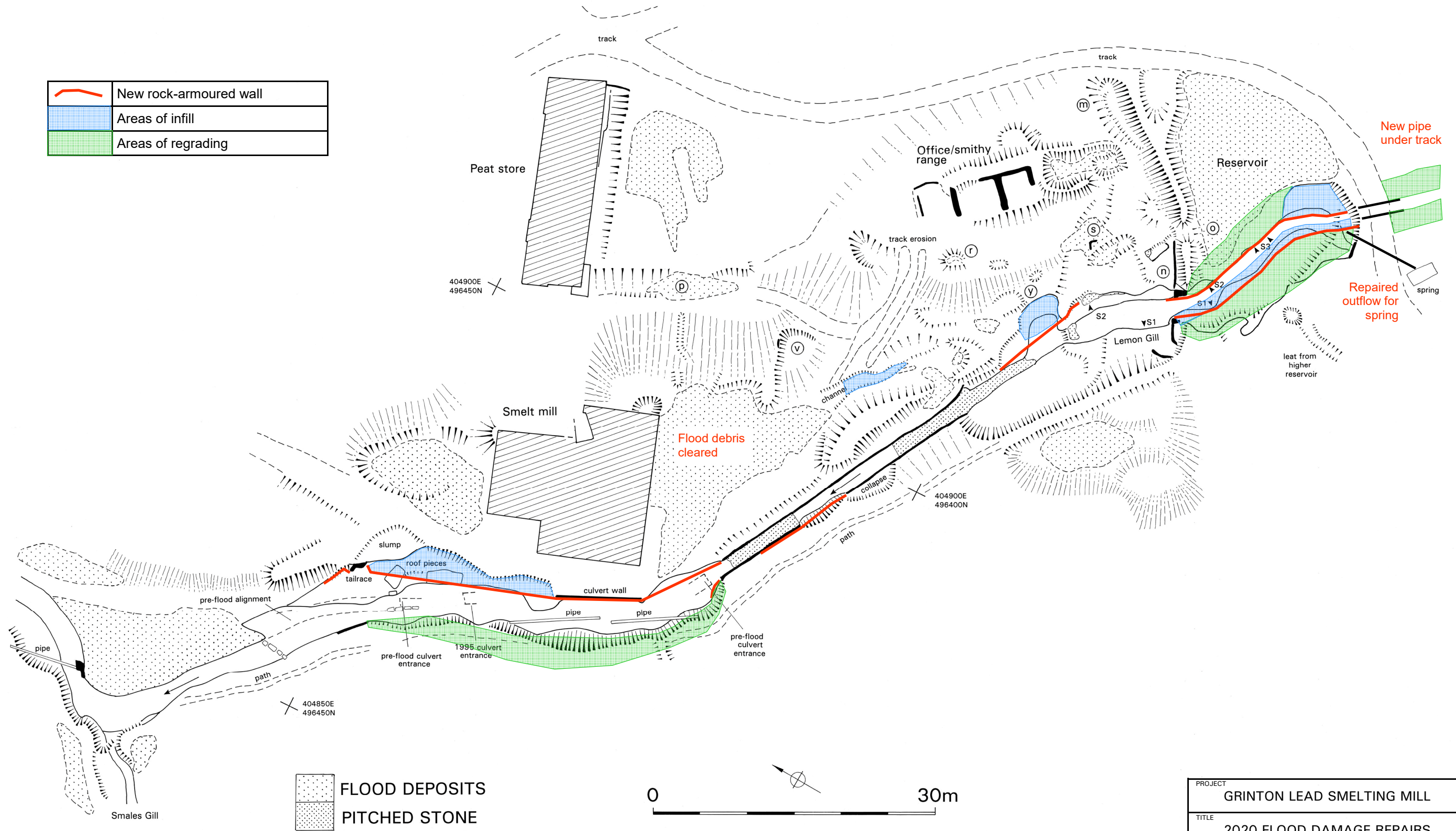
### Section 3: Reservoir deposits




Levels at 100m OD based on temporary bench mark on the sill of the east window of the south wall of the smelt mill (at 95.92m LD)

PROJECT		GRINTON LEAD SMELTING MILL	
TITLE		SECTION THROUGH RESERVOIR	
SCALE	AS SHOWN	DATE	AUG 2020
	EDAS	FIGURE	8

	New rock-armoured wall
	Areas of infill
	Areas of regrading



	FLOOD DEPOSITS
	PITCHED STONE

PROJECT GRINTON LEAD SMELTING MILL	
TITLE 2020 FLOOD DAMAGE REPAIRS	
SCALE AS SHOWN	DATE AUG 2020
EDAS	FIGURE 9



Plate 1: View of spring outfall and reinstated track, south of reservoir dam, looking S (photo courtesy Miles Johnson, YDNPA).



Plate 2: Eroded track running west from beck crossing point, looking S (photo courtesy Miles Johnson, YDNPA).



Plate 3: Flood damage adjacent to spring outfall, with reinstated track across gully, looking S (photo 2/900).



Plate 4: Flood debris in reservoir, looking E (photo 2/901).



Plate 5: Exposed section of pitched stone surface in east side of beck/spillway, looking S (photo 2/896).



Plate 6: Flood debris in south cell of smithy range, looking N (photo 2/904).



Plate 7: Erosion scars following vehicle tracks off north-west corner of smithy range, looking NW (photo 2/890).



Plate 8: Abraded gravels washed into area to south of peat house, looking E (photo 2/889).



Plate 9: Gravel washed into line of head race off south-west corner of peat house, looking N (photo 2/888).



Plate 10: Erosion channel to south of smelt mill, looking NW (photo 2/894).



Plate 11: Flood debris to south of smelt mill, looking N (photo 2/891).



Plate 12: Flood debris to south of smelt mill, looking SE (photo 2/869).





Plate 13: Flood debris in furnace room of smelt mill, looking W (photo 2/907).



Plate 14: Flood debris in bellows room of smelt mill, looking SE (photo 2/924).



Plate 15: Flood debris in depression to north of smelt mill, looking S (photo 2/857).

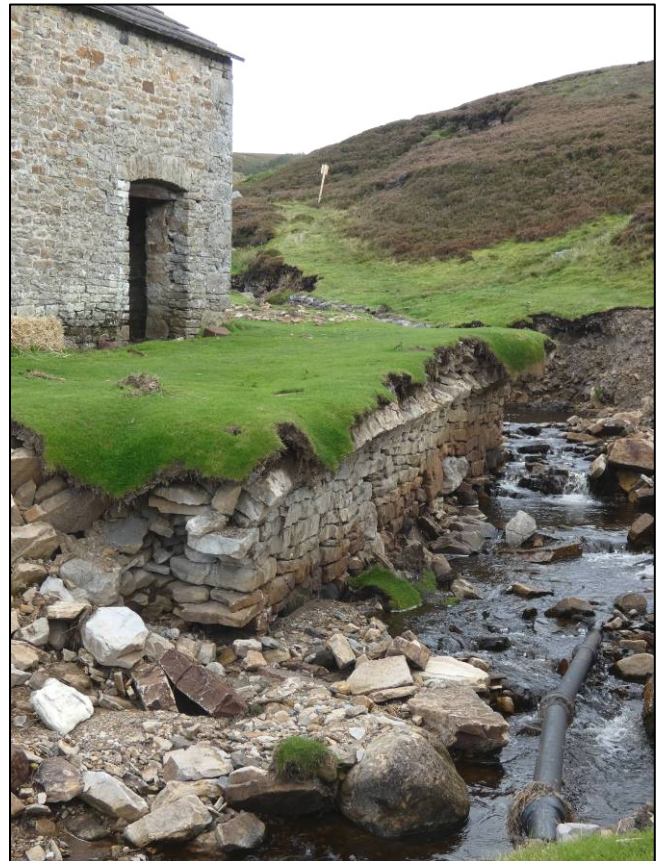


Plate 16: Remains of culvert wall, east side of beck adjacent to smelt mill, looking SE (photo 2/873).



Plate 17: Flood damage to beck between dam and smelt mill, looking S (photo 2/895).



Plate 18: Localised collapse to retaining wall, west side of beck, looking NW (photo 2/905).



Plate 19: Flood damage off south-west corner of smelt mill, at site of south end of former culvert, looking S (photo 2/878).



Plate 20: Damage to beck, north-west of smelt mill, looking S (photo 2/859).



Plate 21: Remains of culvert east wall, adjacent to smelt mill, looking E (photo 3/818).



Plate 22: Remains of culvert roof and smelt mill tailrace, east side of beck, looking SE (photo 2/870).



Plate 23: Inside of smelt mill tail race, looking SE (photo 2/885).



Plate 24: Slumped ground, east side of beck, north-west of smelt mill, looking N (photo 2/866).



Plate 25: Flood debris at confluence of Smales and Lemon becks, looking W (photo 2/864).



Plate 26: Reservoir dam, east facing section (S1), looking W (photo 1/516).



Plate 27: Reservoir dam, east facing section (S1), south part with south retaining wall (014), looking W (photo 1/517).



Plate 28: Reservoir dam, east facing section (S1), north part showing earliest phase of dam, looking W (photo 1/518).



Plate 29: Reservoir dam, east facing section (S1), detail of front north wall (005), looking W (photo 1/520).





Plate 30: Reservoir dam, west facing section (S2), deposits to north of front wall (024), looking SE (photo 1/529).



Plate 31: Reservoir dam, west facing section (S2), pitched stone surface (021) of beck/spillway, looking E (photo 1/528).



Plate 32: Reservoir dam, west facing section (S2), detail of peat infill (026), looking E (photo 1/536).



Plate 33: Reservoir dam, west facing section (S2), detail of front wall (024) and peat infill (026), looking E (photo 1/533).



Plate 34: Reservoir, west facing section (S3) showing laminated deposits, looking E (photo 1/538).



Plate 35: Regraded sides to beck, south of track, looking S (photo 4/129).



Plate 36: New retaining walls to beck and graded sides through reservoir, looking N (photo 4/130).



Plate 37: New beck retaining wall to east side of beck, north of reservoir dam, looking NW (plate 4/134).



Plate 38: Vehicle tracks to area between reservoir dam and smelt mill, looking NW (photo 4/138).



Plate 39: New retaining wall to west side of beck, prior to infilling, south of smelt mill, looking N (photo 4/141).



Plate 40: Rock-armoured wall under construction, adjacent to smelt mill, looking NE (photo 3/814).



Plate 41: Repaired area to west of smelt mill, looking S (photo 4/146).



Plate 42: Compacted surfaces exposed in west facing section to west of smelt mill, looking E (photo 3/832).



Plate 43: Completed rock-armoured wall to east side of beck, adjacent to smelt mill, looking SE (photo 4/155).



Plate 44: Gap in rock-armoured wall for smelt mill tail race, east side of back, looking SE (photo 4/150).



Plate 45: Completed rock-armoured wall to east side of beck, adjacent to smelt mill, looking NE (photo 4/160).



APPENDIX 1  
EDAS PHOTOGRAPHIC CATALOGUE

## APPENDIX 1: PHOTOGRAPHIC CATALOGUE

Film 1: Colour digital photographs taken 15th August 2019 (recording of dam sections)

Film 2: Colour digital photographs taken 11th September 2019 (recording of flood damage)

Film 3: Colour digital photographs taken 7th February 2020 (monitoring repair work)

Film 4: Colour digital photographs taken 11th March 2020 (monitoring repair work)

<i>Film</i>	<i>Frame</i>	<i>Subject</i>	<i>Scale</i>
1	516	Reservoir dam, E-facing section (S1), looking W	3 x 1m
1	517	Reservoir dam, E-facing section (S1), S part with S retaining wall (014), looking W	2 x 1m
1	518	Reservoir dam, E-facing section (S1), N part showing earliest phase of dam, looking W	2 x 1m
1	519	Reservoir dam, E-facing section (S1), detail of peat infill (011) between dam walls (005 & 012) (earliest phase?), looking W	1m
1	520	Reservoir dam, E-facing section (S1), detail of front N wall (005), looking W	1m
1	521	Reservoir dam, E-facing section (S1), central part, looking SW	3 x 1m
1	522	Reservoir dam, E-facing section (S1), deposits to N of front wall (005), looking W	-
1	523	Reservoir dam, E-facing section (S1), deposits to N of front wall (005), looking W	-
1	524	Reservoir dam, E-facing section (S1), deposits to N of front wall (005), looking SW	1m
1	526	Reservoir dam, E-facing section (S1), detail of front wall (005) and peat infill (011), looking W	1m
1	527	Reservoir dam, E-facing section (S1), detail of front wall (005), looking W	1m
1	528	Reservoir dam, W-facing section (S2), N part, pitched stone surface (021), looking E	1m
1	529	Reservoir dam, W-facing section (S2), deposits to N of front wall (024), looking SE	2 x 1m
1	530	Reservoir dam, W-facing section (S2), N part, looking NE	2 x 1m
1	531	Reservoir dam, W-facing section (S2), N part, pitched stone surface (021), looking E	1m
1	532	Reservoir dam, W-facing section (S2), looking SE	2 x 1m
1	533	Reservoir dam, W-facing section (S2), detail of front wall (024) and peat infill (026), looking E	1m
1	534	Reservoir dam, W-facing section (S2), detail of front wall (024), looking E	1m
1	535	Reservoir dam, W-facing section (S2), looking NE	3 x 1m
1	536	Reservoir dam, W-facing section (S2), detail of peat infill (026), looking E	1m
1	537	Reservoir dam, W-facing section (S2), detail of peat infill (026), looking E	1m
1	538	Reservoir, W-facing section (S3), looking E	2 x 1m
1	539	Reservoir, W-facing section (S3), looking E	2 x 1m
1	540	Reservoir, W-facing section (S3), looking E	2 x 1m
1	541	Reservoir, W-facing section (S3), looking NE	2 x 1m
1	542	Reservoir, W-facing section (S3), looking E	2 x 1m
2	852	Damage to beck, W of smelt mill, looking N	1m
2	853	Damage to beck, W of smelt mill, exposed water pipe, looking N	-
2	854	Damage to beck, W of smelt mill, looking S	1m
2	855	Damage to beck, W of smelt mill, former culvert roof sections, looking N	-
2	856	Flood debris in depression to N of smelt mill, looking NE	1m
2	857	Flood debris in depression to N of smelt mill, looking S	-
2	858	Damage to beck, NW of smelt mill, looking S	1m
2	859	Damage to beck, NW of smelt mill, looking S	1m
2	860	Damage to beck, NW of smelt mill, looking S	1m
2	861	W side of beck, revetment associated with water pipe, looking W	-
2	862	Damage to beck, N of smelt mill, showing changed alignment and dumped material, looking N	-
2	863	Flood debris from Smales Beck, N of smelt mill, looking W	-
2	864	Flood debris at confluence of Smales and Lemon becks, looking W	-
2	865	Flood damage near confluence of Smales and Lemon becks Beck, showing site of footbridge and water pipe, looking W	-
2	866	Slumped ground, E side of beck, NW of smelt mill, looking N	1m
2	867	Flood damage off SW corner of smelt mill, showing site of S culvert entrance, looking S	-
2	869	Flood debris to S of smelt mill, looking SE	-
2	870	E side of beck, remains of culvert roof and mill tailrace, looking SE	-
2	871	E side of beck, remains of mill tailrace, looking SE	-
2	872	E side of beck adjacent to smelt mill, remains of culvert, looking SE	1m

2	873	E side of beck adjacent to smelt mill, remains of culvert wall, looking SE	-
2	874	E side of beck adjacent to smelt mill, remains of culvert wall and fractured water pipe, looking S	-
2	875	E side of beck adjacent to smelt mill, remains of culvert wall, looking E	1m
2	876	E side of beck adjacent to smelt mill, remains of culvert wall and fractured water pipe, looking E	1m
2	877	Flood damage to beck adjacent to smelt mill, remains of culvert wall and fractured water pipe, looking NE	1m
2	878	Flood damage off SW corner of smelt mill, site of south end of culvert, looking S	-
2	879	Flood damage off SW corner of smelt mill, remains of culvert, looking N	-
2	880	Flood damage off SW corner of smelt mill, remains of culvert, looking N	-
2	881	Flood debris to S of smelt mill, looking NE	-
2	882	Flood debris to S of smelt mill, looking N	-
2	883	Flood debris to S of smelt mill, looking NE	-
2	884	E side of beck adjacent to smelt mill, remains of culvert roof and base stone courses, looking SE	-
2	885	Inside of smelt mill tail race, looking SE	-
2	887	Erosion scar to steep slope to E of smelt mill, looking E	-
2	888	Gravel washed into line of head race to off SW corner of peat house, looking N	1m
2	889	Abraded gravels washed into area to S of peat house, looking E	1m
2	890	Erosion scars following vehicle tracks off NW corner of smithy range, looking NW	-
2	891	Flood debris to S of smelt mill, looking N	-
2	892	Erosion scars following vehicle tracks off NW corner of smithy range, looking SE	1m
2	893	Erosion channel to S of smelt mill, looking S	1m
2	894	Erosion channel to S of smelt mill, looking NW	1m
2	895	Flood damage to beck between dam and smelt mill, looking S	-
2	896	E side of beck/spillway, exposed section of pitched stone surface, looking S	1m
2	897	E side of beck/spillway, exposed section of pitched stone surface, looking S	1m
2	898	Rectangular depression, immediately N of dam opening ('o'), looking NE	1m
2	899	West side of reservoir, erosion to leat from upper reservoir, looking W	-
2	900	Flood damage adjacent to spring outfall, with new track across gully, looking S	-
2	901	Flood debris in reservoir, looking E	-
2	902	General view of area between dam and smelt mill, looking N	-
2	903	Flood damage and debris to S of smelt mill, looking N	-
2	904	Flood debris in S cell of smithy range, looking N	-
2	905	W side of beck, localised collapse to retaining wall, looking NW	-
2	906	W side of beck, localised collapse to retaining wall, looking SW	-
2	907	Flood debris in furnace room of smelt mill, looking W	2 x 1m
2	908	Flood debris in furnace room of smelt mill, looking W	2 x 1m
2	909	Flood debris in furnace room of smelt mill, looking E	2 x 1m
2	912	Flood debris in furnace room of smelt mill, W ore hearth, looking NW	1m
2	913	Flood debris in furnace room of smelt mill, W ore hearth, looking NW	1m
2	914	Flood debris in furnace room of smelt mill, W ore hearth, looking NW	1m
2	915	Flood debris in furnace room of smelt mill, central ore hearth, looking E	1m
2	916	Flood debris in furnace room of smelt mill, slag hearth, looking NE	1m
2	917	Flood debris in furnace room of smelt mill, slag hearth, looking NE	1m
2	918	Flood debris in furnace room of smelt mill, looking W	1m
2	919	Flood debris in furnace room of smelt mill, looking S	1m
2	922	Flood debris in bellows room of smelt mill, looking SW	-
2	923	Flood debris in bellows room of smelt mill, looking S	1m
2	924	Flood debris in bellows room of smelt mill, looking SE	1m
3	810	General view of rock armoured wall under construction, adjacent to smelt mill, looking N	-
3	812	Rock-armoured wall under construction, adjacent to smelt mill, looking N	-
3	813	Rock-armoured wall under construction, adjacent to smelt mill, looking NE	-
3	814	Rock-armoured wall under construction, adjacent to smelt mill, looking NE	-
3	815	Rock-armoured wall under construction, infill material being collected, adjacent to smelt mill, looking N	-
3	816	Rock-armoured wall under construction, infill material being placed, adjacent to smelt mill, looking NE	-
3	817	Rock-armoured wall under construction, adjacent to smelt mill, looking NE	-
3	818	Former culvert east wall, adjacent to smelt mill, looking E	-
3	820	Former culvert east wall, adjacent to smelt mill, looking E	-

3	821	Former culvert east wall, adjacent to smelt mill, looking E	-
3	822	Former culvert east wall, adjacent to smelt mill, looking E	-
3	823	Rock-armoured wall under construction, adjacent to smelt mill, looking S	-
3	825	Rock-armoured wall under construction, adjacent to smelt mill, looking S	-
3	829	Temporary ponding in beck during repair work, looking SE	-
3	832	Smelt mill, compacted surfaces exposed in W-facing section to west of smelt mill, looking E	1m
4	125	New walls to beck and graded sides, through reservoir, looking S	-
4	126	New walls to beck and graded sides, new pipe under track, looking S	1m
4	127	New walls to beck and graded sides, through reservoir, looking N	1m
4	128	New walls to beck and graded sides, through reservoir, looking N	1m
4	129	Regraded sides to beck, S of track, looking S	-
4	130	New walls to beck and graded sides, through reservoir, looking N	1m
4	131	New wall to E side of beck and graded side, through reservoir and dam, looking NE	1m
4	132	New walls to beck and graded sides, through reservoir and dam, looking S	1m
4	133	New walls to beck and graded sides, through reservoir and dam, looking NE	1m
4	134	New beck lining to N of dam, E side of beck, looking NW	1m
4	135	Vehicle tracks across south earthwork cell of smithy range, looking E	-
4	136	Vehicle tracks to area between reservoir dam and smelt mill, looking N	-
4	137	Vehicle tracks to area off NW corner of smithy range, looking E	1m
4	138	Vehicle tracks to area between reservoir dam and smelt mill, looking NW	-
4	139	New wall to east side of beck, prior to infilling, N of reservoir dam, looking S	1m
4	141	New wall to west side of beck, prior to infilling, S of smelt mill, looking N	1m
4	142	New wall to west side of beck, prior to infilling, S of smelt mill, looking NW	1m
4	143	Flood debris to S of smelt mill, prior to removal, looking N	-
4	144	Rock-armoured wall to W side of beck, adjacent to smelt mill, looking S	-
4	145	Repaired area to W of smelt mill, looking N	1m
4	146	Repaired area to W of smelt mill, looking S	1m
4	147	Vehicle tracks to area N of smelt mill, looking N	-
4	150	Gap for smelt mill tailrace in rock-armoured wall, E side of beck, looking SE	1m
4	152	Rock-armoured wall adjacent to tailrace, E side of beck, looking N	1m
4	153	Gap for smelt mill tailrace in rock-armoured wall, E side of beck, looking S	1m
4	154	Flood debris at confluence of Lemon and Smales becks, N of smelt mill, looking N	-
4	155	Completed rock-armoured wall to E side of beck, adjacent to smelt mill, looking SE	-
4	156	Completed rock-armoured wall to E side of beck, adjacent to smelt mill, looking E	-
4	157	Completed rock-armoured wall to E side of beck, adjacent to smelt mill, looking SE	-
4	158	Completed rock-armoured wall to E side of beck, adjacent to smelt mill, looking SE	-
4	159	Completed rock-armoured wall to E side of beck, adjacent to smelt mill, looking E	-
4	160	Completed rock-armoured wall to E side of beck, adjacent to smelt mill, looking NE	1m
4	161	Completed rock-armoured wall to E side of beck, adjacent to smelt mill, looking NE	1m
4	162	Completed rock-armoured wall to E side of beck, adjacent to smelt mill, looking NE	1m
4	163	Completed rock-armoured wall to E side of beck, adjacent to smelt mill, looking NE	1m
4	166	Completed rock-armoured wall to E side of beck, adjacent to smelt mill, looking NE	1m
4	167	Completed rock-armoured wall to E side of beck, adjacent to smelt mill, looking NE	1m
4	168	Completed rock-armoured wall to E side of beck, adjacent to smelt mill, looking NE	1m
4	171	Infill behind rock-armoured wall, E side of beck at reservoir dam, looking N	-
4	174	General view with rainbow over mill and peat house, looking N	-
4	176	General view with rainbow over mill and peat house, looking N	-

APPENDIX 2  
EDAS CONTEXT REGISTER

## APPENDIX 2: LIST OF CONTEXTS

<i>Context</i>	<i>Description and Interpretation</i>	<i>Area of site</i>
001	Compacted dark brown sandy silt, average 0.2m deep - topsoil.	Whole site
002	Loose mid-brown sandy silt with frequent pieces of angular stone, up to 0.50m thick, with silty content increasing to the north - subsoil.	Dam Section 1
003	Compacted orange-brown silty clay with infrequent angular stones, maximum 0.20m thick - subsoil.	Dam Section 1
004	Compacted orange-brown silty clay with infrequent angular stones and frequent gravel, at least 0.50m thick - probably natural deposit.	Dam Section 1
005	Wall - large pieces of roughly dressed and coursed stone, no bonding material, 1.20m wide and 1.50m high, north face battered and south face vertical. Forms front (north or downstream) retaining wall of dam. Same as 024.	Dam Section 1
006	Loose mid-brown sandy silt with frequent angular stones, 0.10m-0.20m thick - probable former topsoil.	Dam Section 1
007	Compacted clean mid-brown silty clay, 0.10m thick - upper constructional layer of latest phase of dam.	Dam Section 1
008	Compacted orange-brown clay/silt, of laminated layers, overall up to 0.25m thick - constructional layer of latest phase of dam.	Dam Section 1
009	Compacted orange-brown silty clay, 0.20m thick - part of latest phase of dam, added to N face of earlier dam.	Dam Section 1
010	Compacted orange-brown clay, 0.35m thick - silting deposit?	Dam Section 1
011	Compacted dark brown-black peat, formed by horizontal turves, 0.80m wide and c.1.50m deep - infill between front and back walls of earliest phase of dam.	Dam Section 1
012	Wall - large pieces of roughly coursed and squared stone, no bonding material, 0.80m wide and c.1.50m high, north face vertical, south face slightly battered. Forms rear (south or reservoir side) wall of earliest phase of dam.	Dam Section 1
013	Compacted dark brown-black peat, formed by horizontal turves, overall c.2.0m wide and c.1.75m high, individual layers of turves 0.10m thick, sloping from north to south. Forms main core of dam, possibly intermediate phase of construction. Same as 026.	Dam Section 1
014	Wall - flattish roughly dressed rubble, c.0.5m wide and c.1.0m high, no mortar and battered profile - rear (South or reservoir side) of latest phase of dam.	Dam Section 1
015	Compacted mid-brown silty clay, 0.10m thick - latest phase of silting deposit in reservoir.	Dam Section 1
016	Compacted orange silty clay, maximum 0.15m thick - silting deposit in reservoir.	Dam Section 1
017	Compacted orange-brown silty clay, average 0.30m thick - silting deposit in reservoir.	Dam Section 1
018	Compacted orange-brown silty clay with frequent angular stones, at least 0.50m thick - probably natural deposit.	Dam Section 1

019	Compacted dark brown-black peaty topsoil, average 0.15m thick - modern run off from dam breach?	Dam Section 2
020	Compacted orange-brown silty clay, average 0.25m thick - overflow deposit over spillway?	Dam Section 2
021	Spillway - roughly dressed flattened and angled stone, up to 0.60m thick but generally shallower - surface of spillway.	Dam Section 2
022	Compacted orange-brown silty clay with frequent angular stone, at least 1.0m thick - probably natural deposit.	Dam Section 2
023	Buttress - crude stone rubble, 0.50m wide and c.1.0m high, with lime mortar bonding - later crude buttress to front (north or downstream) wall of dam structure.	Dam Section 2
024	Wall - large pieces of roughly dressed squared stone 1.20m wide and 1.50m high, with step at base of north side. No apparent bonding material and slight battered to both faces. Forms front (north or downstream) wall of dam. Same as 005.	Dam Section 2
025	Loose mid-brown sandy silt with very frequent small angular stones, up to 0.70m thick - wash out or flood material from post-abandonment reservoir?	Dam Section 2
026	Compacted dark brown-black peat, formed by horizontal turves, at least 2.50m wide and up to 1.50m deep. Individual layers of turves 0.10m thick evenly laid. Forms main core of dam structure. Same as 011 and 013.	Dam Section 2
027	Compacted fine dark brown silt and organic matter, 0.40m-0.50m thick - post-abandonment silting of reservoir.	Dam Section 2
028	Compacted mid-brown silty clay with frequent pieces of angular stone, 0.50m thick - wash down or silting of reservoir.	Dam Section 2
029	Compacted orange-brown silty clay with frequent pieces of angular stone, at least 0.9m thick - probably natural deposit.	Dam Section 2
030	Loose orange-brown sandy silt with very frequent angular stones, 0.30m thick - wash down or silting of reservoir.	Reservoir Section 3
031	Compacted clean dark brown silty clay, 0.10m thick - silting deposit in reservoir.	Reservoir Section 3
032	Compacted clean orange-brown silty clay with very frequent gravel and angular stones, 0.22m thick - silting deposit in reservoir.	Reservoir Section 3
033	Compacted dark brown silty clay, 0.14m thick - silting deposit in reservoir.	Reservoir Section 3
034	Compacted orange-brown silty clay with frequent pieces of angular stones, 0.30m thick - silting deposit in reservoir.	Reservoir Section 3
035	Compacted dark brown silty clay, 0.30m thick - silting deposit in reservoir.	Reservoir Section 3
036	Compacted orange-brown silty clay with frequent angular stones, at least 0.50m thick - probably natural deposit.	Reservoir Section 3

APPENDIX 3  
YDNPA SPECIFICATION FOR EROSION REPAIRS





**YORKSHIRE DALES**  
National Park Authority

Yorkshire Dales National Park Authority  
**SPECIFICATION**  
**Grinton Smelt Mill Watercourse**  
Grinton, Swaledale  
Central grid ref **SE0486 9641**

## BACKGROUND

Grinton Smelt Mill is a protected heritage site - a Scheduled Monument NHLE:1016203, the standing buildings and structures onsite are also protected as listed buildings. The smelt mill complex is a key site for the interpretation of lead mining heritage in the National Park. Details on the layout and historical significance of the site are included in the accompanying documentation.. The wider moorland surrounding and including the site is designated as a SSSI.

During the 31<sup>st</sup> July cloudburst, the site suffered significant damage, with near total loss of a formed arch culvert, one of the listed structures onsite. Part of one side of the culvert continues to survive as a standing structure, but much of the watercourse edge is now unconsolidated, and water action working against the adjacent hard and soft-edges of the watercourse is now leading to ongoing erosion in areas next to the main smelt mill. If the watercourse remains unmanaged, it is likely that further flood events will lead to its movement and potentially to partial loss of the smelt mill which lies very close to the eastern edge of the watercourse. The course of a public footpath 20/91/9 crosses the site, although is subject to a temporary closure following loss of the culvert over which it crossed.

At the south end of the dam, the piped outflow from the concrete spring head has caused a large area of erosion behind the dam, reducing the level of the watercourse and widening the existing breach of the original dam.

## PURPOSE OF THE WORKS

- To carry out emergency repairs to the watercourse edge close to the smelt mill, behind the remains of the dam, by minor remodelling of the watercourse, clearance of collapsed areas of culvert side and through the introduction of rock armour in sensitive areas.
- The removal and safe disposal of material (including both flood debris and the concrete remains of former consolidation work).

## GENERAL

- **All dimensions are approximate as the site is actively eroding, and should be checked by the contractor on site.** Final positioning will be agreed with the contractor prior to commencement of onsite works.
- The contractor must give the Authority and Grinton Estate at least 48 hours notice of their intention to start work on site. The Authority will notify Historic England of the intention to start works.
- Grinton Smelt Mill and the area outlined on the accompanying plan is a scheduled monument, and designated as part of the lovely Seat – Stainton Moor SSSI. It is important that the risk of damage to the ground surface, including both vegetation and archaeological features is actively managed throughout the project. All vehicle tracking off metalled routes, and all intrusive works will be subject to the presence of a monitoring archaeologist. Should significant remains be encountered, the contractor may be required to temporarily halt works, or move to an adjacent area while archaeological recording takes place. Should the monitoring archaeologist notice

erosion starting to occur because of tracking activity, then work will be required to cease until appropriate preventive measures are in place.

- Work must not commence on site without the approval of the Authority, the Grinton Estate or their agent.
- Any inconsistencies in the plan or specification should be brought to the attention of the Authority prior to the start of the works.
- All works are to comply with the relevant British Standards.
- All unused or waste materials must be removed from the site and the site left tidy.
- All working practises are to conform to current health and safety legislation and Current (2015) CDM regulations. It is not envisaged that this project will be notifiable to the HSE, but for the avoidance of any doubt, the work must take less than 30 days, involve less than 500 person days of work and involve no more than 5 workers on site at any one time.

## SITE ACCESS

**Access from road and storage:** Access to the site is via the aggregate surfaced track adjacent to Cogden Bridge. There is an area suitable for temporary storage of materials (normally an informal parking area) immediately adjacent to the road. There is also a metalled turning/parking area adjacent to the access track close to the peat store, which may be suitable for temporary storage of small amounts of material.

**Machinery:** Works are to be undertaken with a low ground pressure 360 tracked vehicle with a surface impact of less than 3lbs per square inch. Any damage caused to stone tracks and associated infrastructure will be repaired at the contractor's expense. Access tracks are shown on the accompanying plan.

Works to move boulders and install rock armouring should use an appropriate grabber, works to reprofile the watercourse edge and to lift flood debris will require a toothless ditching bucket.

Maintenance procedures for powered equipment must be carried out with great care. Oil and fuel spillage must be avoided. Spill kits of sufficient capacity to deal with any accidental spillage of fuel and hydraulic oils must be carried.

**Site logistics:** Final routes and method of transporting materials to site will be confirmed between the contractor and YDNPA Archaeologist prior to the commencement of works. In general terms, the measures required include:

- Works are to be undertaken during dry ground conditions, and work should cease during periods of extended wet weather.

- Works are to be planned by the contractor (and agreed by the Authority archaeologist) so as to minimise incidence of tracking (including, e.g. retention of vehicles on onsite overnight)
- Monitoring of both the streamside works and tracking will be undertaken by a contracting archaeologist – any evidence that erosion to earthworks or damage to vegetation is starting to occur will result in a requirement for use of mats, ramps and sandbags
- Materials removed from site to be disposed of at an approved location in agreement with the YDNPA.

The envisaged routes to undertake works are as follows:

- Access to the stream at the south end of the site (**area 3** on the site plan) is entirely along the main metalled access track.
- At the north end of the complex (**area 1**), machine access is down a graded, but vegetated track over a length of about 30 meters
- Access to the central section (**areas 2 and 4**) involve crossing a short area of sloping ground, and some archaeological earthworks. It is likely that ramps, bog mats, sandbags will be required to facilitate access without causing erosion here.

## HEALTH AND SAFETY

A public footpath runs across the work site. This has been temporarily closed by the YDNPA Area Ranger, however, the complex is sited on CRoW Access land, and is frequently accessed by members of the public. The successful contractor must carry out a full risk assessment and advise the National Park Authority of any further health and safety measures required in order to protect members of the public.

## CONSTRAINTS

The YDNPA Archaeologist has made various enquiries and applications to gain the appropriate advice, consents and permissions. Scheduled monument consent has been obtained for the works. As the worksite will effect a minor watercourse there will be relevant guidelines to consider (Pollution Prevention Guidelines PPG5).

Initial permissions and consultation with the affected Land Owner will be undertaken by the YDNPA Archaeologist but the contractor will be expected to liaise with the Grinton estate Gamekeeper, Des Coates (07837194706), regarding access and storage of any materials, and to maintain good relations with those involved.

# SPECIFICATION

The following specification is to be used as a guide for completing the requested work and states the minimum requirements for a satisfactory result. Any uncertainty or areas of estimation should be discussed with the YDNPA Archaeologist and a decision agreed on site.

The specification requires the contractor to:

- Provide all materials necessary to complete the work, unless otherwise stated.
- Transport all materials to site.
- Store all materials, plant and equipment safely and securely when on site.
- Carry out the work in accordance with relevant consents and agreements.
- Remove and dispose of all waste materials in a responsible way.

The below items are to be read in conjunction with the accompanying plan.

## Key for mapped items

Orange shade – rock armouring

Orange hatch - re-profiling and rock armouring

Yellow pecked line

Red hatch – removal of flood debris

Green items – removal of concrete arching

## Specification for works

### Areas 1 and 2

- Supply and install sufficient ½ - 1 tonne stone blocks/boulders to protect eroded sections of the edge of the watercourse to the north of the Smelt Mill – as outlined on the accompanying plan. In the main, the blocks will need to be imported from a suitable local quarry, however, a number of larger sandstone boulders were dislodged during the cloudburst, and are available within the beck. Blocks should be positioned to prevent future erosion of the land immediately adjacent to the smelt mill. The total length of rock armouring required is approximately 35m. The contractor is to back fill as needed behind the blocks to provide a level surface. The blocks should be laid in tight formation minimising gaps that water can eddy in. It is anticipated that tie in between the rock armouring and the surviving adjacent culvert will be undertaken later in 2020 by a suitable conservation builder.
- As needed, undertake minor realignment/clearing of the watercourse adjacent to the smelt mill to encourage the main flow away from the most vulnerable areas.
- Care should be taken to not disturb the surviving section of culvert wall along the east side of the watercourse, and a short stretch of culvert footings that now lie within the centre of the watercourse. Within the erosion scar and towards the northern end of area 1, is the end of the tail race from the main smelt mill, care should be taken not to damage this feature.
- There are two substantial concrete sections of formed arch, formerly part of the culvert. These should be removed from the beck and disposed of.
- Remove and dispose of the broken water pipe from the watercourse.

- Where Public Footpath 9 crosses the water course, adjacent to the mill building, the NPA plans to install a river crossing. Any rock armour or constructed stonework will need to include a suitable foundation for a simple bridge to be mounted or incorporate a stone clapper. This will depend on budget and aesthetic constraints.
- Once mounted, and regardless of material, the bridge or crossing should be securely fixed at a height requiring no step, up or down, greater than 300mm.

### **Area 3**

- Realign the piped outflow from the concrete spring head behind the site of the dam, reducing the eddying that is causing major damage to this area. There is currently a significant fall below the piped flow, which is causing ongoing damage. The replacement pipe should be of a larger diameter and is to be laid over larger boulders in order to temper the flow and disperse the energy arising from the spring head. Undertaking this work will require intrusion into the current shooting track, which should be reinstated after completion.
- Reprofile (to less than 45 degrees) the exposed vertical face that is cut through the dam deposits, rock armouring the base with a single course of ½ to 1 tonne blocks as required. As a temporary measure lay and peg in a suitable geotextile over the reprofiled watercourse edge. It is likely that (subsequent to this project) willow spiling or larch revetting will be used to provide longer term stability for those deposits adjacent to the watercourse.
- The Area Ranger will mark the route of Public Footpath 9 in this area. A level surface parallel to the water course will need to be maintained or created at the top of the newly profiled bank.

### **Area 4**

- Remove and safely dispose of surface flood debris from in front of the smelt mill. NB caution will be required in tracking over this area, and mats/sandbags/ramps may be required to avoid impacting earthworks and vegetation.

On completion of the works the site must be cleared of all remaining materials and waste. It is expected that because of prior work planning and monitoring, that works will be completed without damage occurring to the scheduled monument or to the SSSI. The contractor (in discussion with the Authority and Historic England) must make good any damage to the access route and surrounding land which has been caused by tracking, or in the transportation to or storage of materials onsite.

## **START AND COMPLETION DATES**

It is likely that work will have to be carried out (subject to weather constraints) during the winter of 2019. The project will need to be completed and invoiced prior to the end of March 2020.

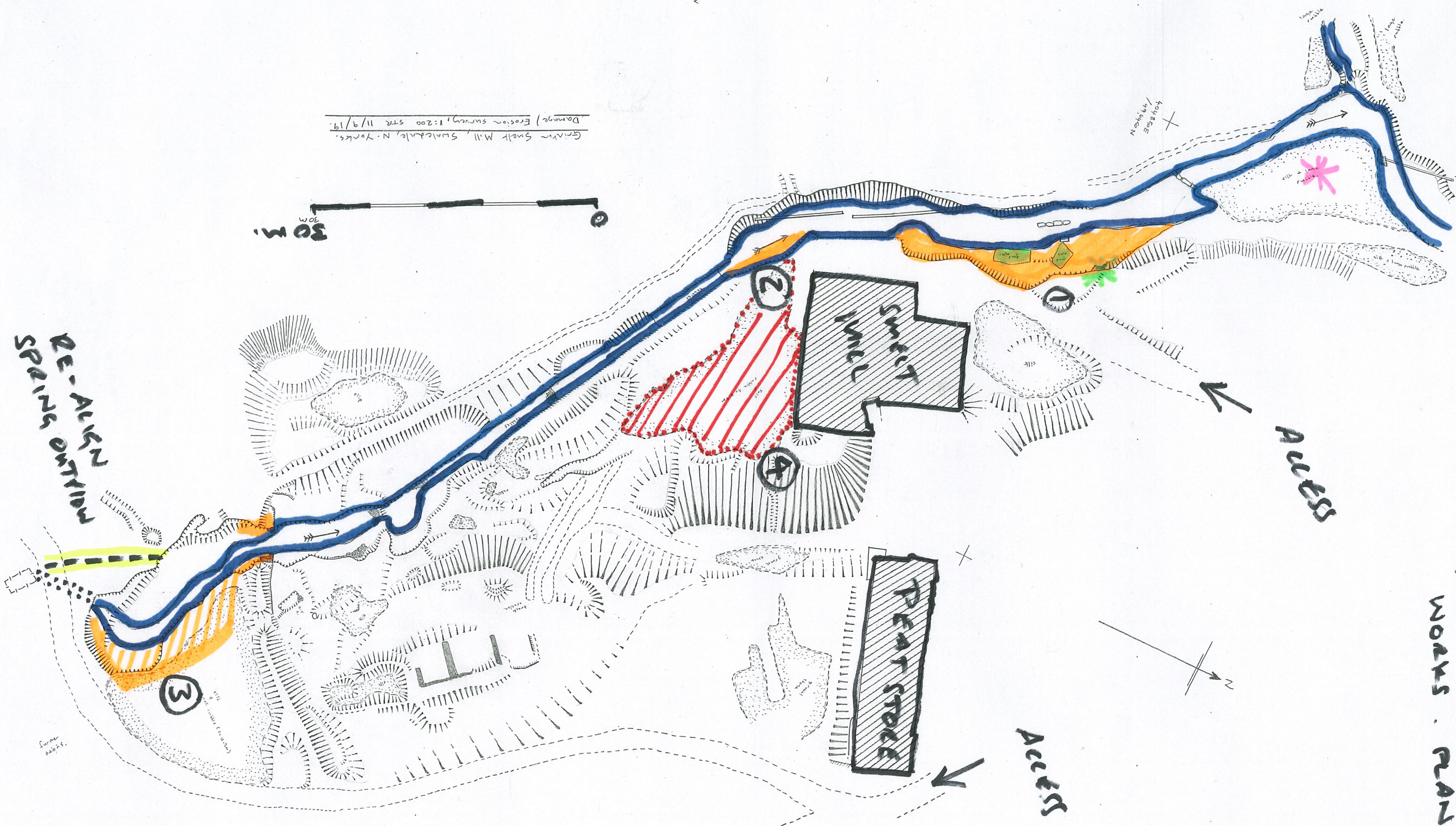
The contractor should indicate in their quotation their proposed start date and projected time needed to complete the works.

**To arrange a site visit please contact Miles Johnson on 01969 652361.**

**Required itemised costs**

<b>Item</b>	<b>Cost ex VAT</b>
<b>Preliminaries – supply of all required stonework, machinery, bog mats/ramps/sandbags.</b>	
<b>Supply of necessary site welfare etc.</b>	
<b>Removal and disposal of waste materials from site</b>	
<b>Areas 1 and 2 – adjacent to smelt mill (Rock armouring, waste removal, minor realignment works)</b>	
<b>Area 3 – adjacent to spring head (Realignment and new piping for outflow, rock armouring, reprofiling)</b>	
<b>Area 4 – in front of smelt mill (Removal and disposal of flood debris)</b>	

GRINTON SMELT MILL  
WORKS - PLAN



30 M.

Grinton Smelt Mill, Swaledale, N. Yorks.  
Damage / Erosion survey, 1:200 STR 11/9/19.

404850 E / 411400 N

404850 E / 411400 N

RE-AIRING MORTAR SPRING

ACCESS

ACCESS

PEAT STORE

SMELT MILL

3

2

4

10

2

Survey 11/9/19