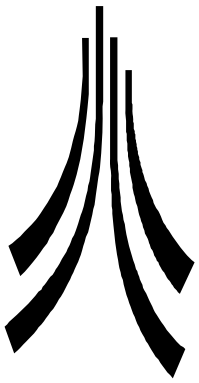
LANCASTER
UNIVERSITY
ARCHAEOLOGICAL
UNIT



April 1998

Carlton Bank Alum Works
Carlton in Cleveland
North Yorkshire

Excavation Assessment Report

Commissioned by: North Yorkshire Moors National Park Authority

Carlton Bank, Alum Works
North Yorkshire

Phase 3

Archaeological Excavation Assessment Report

Report no 1997-98/068/AUA7743

Checked by Project Manager. ..... Date
Passed for submission to client. ..... Date

© Lancaster University Archaeological Unit
Storey Institute
Meeting House Lane
Lancaster
LA1 1TH

April 1998

CONTENTS

ACKNOWLEDGEMENTS

The excavations at Carlton Bank alum works engendered a great deal of local interest and support for which Lancaster University Archaeological Unit is grateful. Special thanks are due to John Harrison (Cleveland Industrial Archaeology Society), who provided invaluable information on the North Yorkshire alum industry, and to Carol Cook (Cleveland Local History Society) for supplying a copy of her typescript report on the history of Carlton-in-Cleveland. For information concerning the extent of the reclamation area and his assistance throughout the project thanks are due to Colin Eaton (Kirklees). Graham Lee of North Yorkshire Moors National Park is particularly thanked for his enormous enthusiasm and support in the course of the project.

Banks Reclamation Ltd and C G Robinson Plant Hire are thanked for their assistance, and in particular for the skill of their drivers.

The excavation was initially directed by Denise Drury and supervised by Iain Hedley and Ian Miller; Dale Robertson, Pete Owen, Mark Tidmarsh and Nigel Cavanagh were excavation assistants throughout. The final stage of the excavation was directed by Ian Hedley.

This assessment report has been written by Iain Hedley, and was edited by Jamie Quartermaine and Rachel Newman. The project was managed by Jamie Quartermaine.

SUMMARY

An excavation of the Carlton Bank alum works, Carlton-in-Cleveland, North Yorkshire (NZ 520027), was undertaken by the Lancaster University Archaeological Unit (LUAU) in advance of a land reclamation scheme to stabilise the spoil tips. This was the third stage of a multi-phased project which has involved topographic survey, field evaluation (LUAU 1996), a geophysical survey and geochemical analysis.

The fieldwork involved an initial surface survey of the excavation area and immediate locality, a series of evaluation trenches which were subsequently incorporated into the extent of the open area excavation, and then the main mitigation excavation of the site. Following on from the excavation a watching brief of the landscaping works is being undertaken and will inform the results of the earlier phases of the work; however, the results of this element is not incorporated within the present assessment. The fieldwork was carried out in accordance with the project brief and design, in September 1997, and was monitored throughout by Mr G Lee (North York Moors National Park Authority). The project was funded by English Partnerships.

The North York Moors are of considerable national importance in the history of the British alum industry, producing the entire national output of alum from the early seventeenth century until 1847. The earliest successful working of Alum was in the Guisborough area at the beginning of the seventeenth century; the Carlton Bank industry, along with a series of other sites on the North York Moors coast, was established at the end of the seventeenth century (1680) and it continued in use up to 1774. Subsequent to the closure of the alum works there was some limited jet extraction in the nineteenth century. Most of the coastal sites have been adversely affected by coastal erosion and consequently the Carlton Bank works is of particular importance because it is relatively well preserved and because the remains have not been extensively overlain by nineteenth century workings

The Carlton Bank alum works survived as a large quarry and spoil tip, together with the buried remains of calcination and steeping processes. The excavation identified a series of steeping tanks, a large circular cistern, and a series of liqour troughs which linked the tanks and provided an outlet to the alum processing house at the base of the hill.

Following excavation an assessment has been undertaken of the results of the excavation and topographic survey to determine the scope of further work and analysis required to produce client and publication reports. The assessment follows the format outlined in the English Heritage guidelines *Management of archaeological projects* (2nd edition 1991).

1. INTRODUCTION

1.1 PROJECT BACKGROUND

1.1.1 The Carlton Bank alum works lies on the northern scarp of the Cleveland Hills above and to the south of the village of Carlton-in-Cleveland, North Yorkshire (NZ 520027). In 1995 a land reclamation scheme was proposed with the aim of stabilising the existing slope by the removal of the calcined shale tip from the hillside. Under the proposed scheme, the material from the tip was to be removed from the site and the slope graded to a stable angle of repose. This would involve the removal of much of the spoil tip and was likely to disturb some features associated with the alum works immediately behind it. As a consequence the North York Moors National Park Authority required that a mitigation strategy of evaluation and recording of archaeological deposits be undertaken in advance of and during the reclamation works.

1.1.2 Following the results of geotechnical analysis (Foundation & Exploration Services Ltd 1995) and a watching brief of geological test pits (Cleveland County Archaeology Section 1996), Lancaster University Archaeological Unit (LUAU) was commissioned to conduct a topographical survey and archaeological evaluation. The evaluation revealed that many of the features identified during the topographical survey were of relatively recent origin. However, one trench, situated on the western part of the site, revealed several features which were not visible from surface inspection, including decayed timber, stone walls and yellow puddled clay; these were interpreted as remains relating to the alum works. The presence of previously unrecorded below ground features prompted the need for further archaeological work on the site prior to the commencement of the reclamation scheme. The results of this phase of work were documented in a report (LUAU 1996) submitted to the client.

1.1.3 An additional programme of evaluation work, involving geophysical survey, detailed recording of a section of the erosion scar, palaeoenvironmental and geochemical analysis of the spoil tip, was undertaken between December 1996 and July 1997 and the results were presented in a second report (LUAU 1997b). An additional topographic survey was undertaken immediately prior to the commencement of the excavation (LUAU 1997c).

1.2 SITE DESCRIPTION

1.2.1 The alum works at Carlton Bank, North Yorkshire, survived as a large quarry and spoil tip, together with the buried remains of calcination and steeping processes. The site (NZ 520 027) lies on the north-facing scarp of the North York Moors, at the north-westernmost point of the Cleveland Hills, an area of Jurassic rocks which dip very gently to the south. The crest of the scarp is formed by Lower Deltaic Sandstone, beneath which there lies a considerable thickness of 'Alum Shales'. These in turn overlie thin Dogger limestone which is on top of further shales containing a seam of jet. The alum quarry is cut into the steep scarp face from the north, within the Alum Shales, and extends south to the edge of the Lower Deltaic Sandstone, with shallower lobes extending south-east to north-west below the strike of the outcrop. The outcrop

of a jet seam, just below the floor level of the quarry, is marked by an horizontal line of nineteenth century workings along the hillside.

1.2.2 The crest of the scarp lies at *c*400m OD, and the base is at *c*200m OD; the floor of the main quarry is at 320m OD. The vegetation cover consists of heather moorland on the flatter areas, giving way to rough grass on the steeper slopes, with bracken and some scrub towards the base of the scarp. There is extensive bare ground on the sides of the quarry (due to the unstable and steep surface of weathered shale) and on the tips to the north of the quarry (due to the instability of weathered shale, coupled with the acid and infertile nature of the component calcined shale). The tips and the slope below them have been affected by land slippage, which has in part prompted the present programme of landscaping.

1.3 ARCHAEOLOGICAL BACKGROUND

1.3.1 The North York Moors are of considerable national importance in the history of the British alum industry, and produced the entire national output of alum from the early seventeenth century until 1847. The earliest successful working of Alum was in the Guisborough area at the beginning of the seventeenth century. The Carlton Bank industry, was established at the end of the seventeenth century (1680), along with a series of other sites on the North York Moors coast, which ran from Ravenscar to Saltburn on the coast (with some inland works near Whitby), and south-westward to Osmotherly following the northern scarp of the Cleveland Hills (Gould 1993, 8). The industry continued at Carlton Bank in use up to 1774. Subsequent to the closure of the alum works there was some limited jet extraction in the nineteenth century.

1.3.2 The North Yorkshire alum industry has received much archaeological interest in recent years, largely from local groups. Much work has been published on the technology and chemistry of the industry, principally by the Cleveland Industrial Archaeology Society. Excavation and survey has been undertaken at Boulby (Chapman 1975; 1994), Loftus (Marshall 1993), Saltwick (Marshall 1994), and Ravenscar (Marshall 1992). Research by David Pybus at Sandsend is continuing; however, all of these sites are coastal and research has largely been initiated by the threat of destruction from coastal erosion.

1.3.3 No archaeological research had been undertaken at the Carlton Bank alum works prior to the commencement of the current project. However, the site was assessed under the English Heritage Monuments Protection Programme (Gould 1993). The assessment concluded that there was insufficient evidence, based on surface inspection alone, to recommend its protection by statutory means (scheduling). It was stressed, however, that any surviving buried remains could potentially be of national importance and that appropriate conservation and management measures should be undertaken in the light of a development threat.

1.4 PREVIOUS WORK

1.4.1 A contour survey of the quarry, tips, and surrounding area was undertaken in 1995-6, as part of a geotechnical report for the reclamation scheme (Foundation & Exploration Services 1995). This survey accurately depicted the overall forms of the quarry and tips, but smaller-scale archaeological features were not picked up by the coarse survey point grid employed.

1.4.2 Geological test pits were dug in March 1996, and were recorded as a watching brief by Cleveland Archaeology (Cleveland County Archaeology Section 1996). Despite the competent recording of the sections, this information contributed little to the overall understanding of the site, since the 'footprint' of each trench was small relative to the anticipated plan size of many alum working features. On the available information it was impossible to determine whether some pits were wholly within large archaeological features.

1.4.3 ***Phase I:*** a field evaluation was then undertaken by LUAU at the request of the North York Moors National Park Authority, and a report was submitted in July 1996 (LUAU 1996). The evaluation comprised a topographical survey to record the character of the relatively small-scale features that were not recorded by the earlier contour survey, and a programme of trial trenching was undertaken to test a sample of the features identified. Whilst many of these proved to be relatively recent, some, more deeply stratified, features were found to be associated with the alum works.

1.4.4 ***Phase II:*** a further phase of work was commissioned by the North York Moors National Park Authority in 1997 (LUAU 1997a). This comprised a geophysical survey, the detailed recording of a section of both bank and spoil tip revealed in an erosion scar, palaeoenvironmental investigation of a waterlogged deposit at the base of the slope, and geochemical analysis of the spoil tip. This programme revealed the potential for other subsurface features immediately above the edge of the spoil tip, and also that the tip had been carefully engineered, with the spoil deposited in horizontal layers, rather than being tipped over the edge of the slope in a more casual fashion.

1.4.5 ***Phase III:*** following the results of earlier work at the site, the North York Moors National Park Authority requested that a programme of mitigation recording of the sub-surface features be undertaken in advance of and during the reclamation works. This involved a programme of detailed surface survey (LUAU 1997c), mitigation excavation, and a watching brief during the reclamation programme. This assessment report presents the interim results of the mitigation excavation which was undertaken in September 1997.

2. ORIGINAL RESEARCH DESIGN

2.1 AIMS AND OBJECTIVES

2.1.1 The conclusion of the evaluation (LUAU 1996) was that archaeological deposits of potential significance would be affected by the landscaping scheme, particularly on the south side of the top of the spoil tip. Mr G Lee, Archaeologist for the North York Moors National Park Authority, deemed that this area should be subject to a controlled archaeological excavation, prior to the commencement of landscaping. In accordance with a verbal brief by the National Park Archaeologist a project design was prepared by LUAU (*Appendix 1*) for a mitigation excavation and survey programme.

2.1.2 The primary objectives of the excavation programme were driven by a need to record the site in advance of the commencement of the reclamation scheme. The objectives were thus to define the extent, character and condition of the archaeological deposits to be affected by the scheme, and the precise function of those remains recorded during the initial evaluation, as well as to advise on appropriate methods of avoiding damage to those areas peripheral to the scheme. Above all the excavation was to investigate the overall development of the alum works and to attempt to establish an absolute chronology for the site.

2.1.3 The programme was also designed to investigate and record the presence of artefacts recovered from within the excavation area, and place these in both an industrial and a regional context. A programme of geochemical sampling from unweathered deposits was also recommended to augment the pilot study undertaken in phase II (LUAU 1997a).

3. FIELDWORK METHODOLOGY

3.1 PROJECT DESIGN

3.1.1 The survey and excavation methodologies followed an agreed strategy, outlined in the project design (*Appendix 1*) which was offered in response to a verbal brief by Mr G Lee, Archaeologist for the North York Moors National Park Authority. Any subsequent modification to that original strategy was undertaken in consultation with, and with the agreement of, Mr G Lee.

3.1.2 The results of the topographic survey have been presented in an earlier report (LUAU 1997c) and this assessment report presents the interim results of the excavation and the geochemical sampling only.

3.2 EXCAVATION METHODOLOGY

3.2.1 A phased approach to the excavation was taken, with the site divided into excavation areas. This was in part dictated by the requirements of spoil management and the need to allow machine access across the site, thus the central part of the site remained unexcavated until the later stages of the excavation. This allowed open-area excavations to be conducted simultaneously in the eastern and western parts of the site. Towards the final stage of the excavations these areas were linked by the part-excavation of the central area forming one large open-area excavation (Fig 3).

3.2.2 All excavation areas were machine-cut in the first instance, and all overburden was removed mechanically, under archaeological supervision. Following the results of the evaluation and initial machine stripping, it was found that the entire site was covered by a substantial deposit of redeposited grey shale intermixed with occasional calcined shale lenses. This deposit post-dated the abandonment of the alum works and was removed using a mechanical excavator fitted with a 2m toothless ditching bucket.

3.2.3 Instability was encountered during initial machine stripping in the eastern part of the site, where a number of large voids appeared. The voids were in part caused by the high ground pressure of the JCB wheels. The area was abandoned on safety grounds, and partially backfilled. During the later stages of the excavation a 360° mechanical excavator fitted with a 0.90m toothless bucket was employed and the eastern part was re-excavated. Machine excavation continued to the point at which archaeologically significant deposits were reached. Thereafter, all significant archaeological features were uncovered in plan, cleaned and recorded, and, where appropriate, were further excavated by hand or by machine.

3.2.4 The sides of the excavation areas were stepped or battered at a depth of 1.2m to prevent collapse. Several trench edges were cleaned by hand and recorded as drawn sections at a scale of 1:20.

3.2.5 All elements of the work were, as a matter of course, recorded in accordance with current English Heritage guidelines (*MAP2*) and the best practices formulated by English Heritage's Central Archaeology Service and the Institute of Field Archaeologists. All excavation, by whatever method, was recorded by the compilation

of *pro forma* context and object records, and the production of accurately scaled section drawings (at scales of 1:20 and 1:10), as well as a comprehensive photographic record. Features were recorded in plan using a total station, from which plots were generated, and details manually draughted. On completion of the fieldwork the site was partially backfilled and made safe.

3.3 GEOCHEMICAL AND OTHER SAMPLING METHODOLOGIES

3.3.1 Samples of calcined shale were taken from the fills of two steeping tanks and the basal 'slam' deposit of a cistern or settling tank during the excavation, in accordance with appropriate professional standards, to enable geochemical analysis. The sampling programme was designed to supplement the pilot geochemical analysis of the spoil tip undertaken during Phase II (LUAU 1997a).

3.3.2 Timbers uncovered during the excavation were cleaned and recorded *in situ*, but not methodically sampled due to poor preservation. However, one substantially intact segment of timber post from the fill of a steeping tank was recovered and can be subject to basic analysis to enable species identification. The potential for Dendrochronology dating of the timber is considered to be fairly low because of the fairly poor preservation and because the chronology of the site is relatively secure from documentary evidence. However, subject to the identification of its species, it will be assessed for dating potential.

3.4 FINDS METHODOLOGY

3.4.1 The finds recovery and sampling programmes were undertaken in accordance with best practice (current IFA guidelines) and subject to expert advice. However, the artefactual sterility of most excavated layers within the site generated little need to formulate detailed sampling strategies for any artefact group.

3.4.2 All finds have been washed, marked, sorted, recorded, and catalogued to LUAU basic level, with brief descriptions, dimensions, etc detailed on standard *pro forma* record sheets.

4. INTERIM REPORT

4.1 AREA 1

4.1.1 Area 1 was *c*13m x 13m in extent and was situated on the east side of the site (Fig 3). It was initially excavated to test the nature and extent of a 'bridge' which had been recorded during the initial trial excavation, and to establish whether this was connected to a liquor trough running from the works to an alum house situated on low ground to the north. The bridge was at the north-eastern extent of the area and the trench was aligned along the trough towards the processing area. The bridge was observed to be larger than 2.7m long consisting of two parallel rows of dressed sandstone blocks, with stopped ends to the north-east. There was a single springer stone surviving at the north-east end indicating that it had an arched cover. The excavation was able to confirm that the bridge was limited in extent and therefore not an extensive enclosed culvert. Machine testing between the bridge abutments revealed yellow puddled clay (198) at the base of the trough which would have served to seal the trough.

4.1.2 The excavation of the area was suspended and the trench partially backfilled after the initial removal of approximately 1m of overburden revealed the presence of voids in the underlying strata. The voids measured up to 2.60m x 2.09m x 1.5m deep and caused serious instability problems for the mechanical excavator. For these reasons it was not possible to fully examine the trough leading south from the bridge.

4.2 AREA 2

4.2.1 Area 2, situated on the west side of the site, was machine stripped working from north to south (Fig 3). Voids were again detected; on this occasion they were fenced off with iron posts and mesh fencing, and the machine was able to work around them.

4.2.2 The excavation of this area revealed the remains of six tanks, which had been used for steeping calcined shale. Two of the tanks were complete, three were affected by later erosion, and a further tank was only partly exposed. The tanks were rectangular, and measured on average 11m x 4.7m by 1.06m in depth; they were orientated broadly north/south.

4.2.3 Tank 1 (104), on the north side of the excavation, was built of well-dressed and coursed dry sandstone blocks with walls backed by a deposit of yellow puddled clay (191). The floor of the tank was paved with squared sandstone slabs. Evidence from a void in the south end suggested that the floor overlay a deposit of yellow puddled clay which in turn overlay natural bedded shale (162), although this relationship could not be fully tested by the excavation for safety reasons.

4.2.4 A drainage hole was identified in the centre of the bottom course of the south wall and comprised a timber pipe set in puddled clay. A fragment of sandstone was found immediately in front of the pipe and would have been used to prevent blockage when the tank was drained.

4.2.5 The fill of the tank (195) consisted of calcined shale, which was possibly the remains of the last steep. The fill was half sectioned on the long axis before being completely

removed by machine. The section was recorded and samples were taken from individual deposits. The remains of a series of rotted timber fragments, running at intervals along the east and west edges of the fill, were noted during machining. Excavation revealed that these were the remains of timber posts sloping into the tank at approximately 45° and may have represented the remains of paddles used to stir the alum shale during the steeping process. In addition, several randomly spaced vertical timbers were recorded in the fill, which may have been coincident with notches cut into the paved floor (106). It is possible that they may have been employed as supports for horizontal planks placed across the tank to allow the alum workers to stir the whole body of the shale.

4.2.6 The remains of a further tank (No. 5: 139) were uncovered by machine immediately to the east of Tank 1. Although the eastern part was entirely destroyed, machine testing of the remaining fragments revealed that it was identical to Tank 1. The two tanks were separated by an upstanding revetted wall and it is probable that they were of contemporary build and probably built as a pair.

4.2.7 The remains of a raw alum liquor trough (103) running broadly east/west were located immediately to the south of Tank 1. The trough consisted of two walls of dressed and coursed sandstone masonry up to 1.4m wide in the east but tapering to 0.85m in the west. The fill of the trough (127-129) consisted largely of grey shale with lenses of calcined shale. A sondage was excavated in the fill of the trough and this revealed the rotted remains of two parallel box-sectioned timber pipes (152 and 96) set into a slot in the base. The drainage pipes from Tanks 1 and 5 joined with the north and south pipes, respectively.

4.2.8 Tank 2 (102) was slightly shorter and wider than Tank 1 and was built on a slightly different alignment. The build was similar although the floor consisted of timber planks (105). Again, voiding in the floor allowed the presence of bedded shale under puddled yellow clay to be determined beneath the timbers. The fragmentary remains of an additional Tank (6) (170) were uncovered by machine on the east side. Although the eastern part had been destroyed the build and alignment were identical. Once again, the tanks are likely to be of contemporary build and appeared to have been built as a pair.

4.2.9 Two further tanks (3: 135 and 4: 137) were uncovered on the west side of Tanks 1 and 2. On this occasion the tanks were placed end to end, with only a narrow wall between, and built on a slightly different axis to the other 'pairs' of tanks. They were also separated from Tanks 1 and 2 by a 2m gap which, at least at the south end, was occupied by a 'wall' of natural bedded shale. The build of these tanks was identical to that of Tank 1 with well dressed and coursed masonry and a paved sandstone floor. The fill of Tank 3 (135), situated to the north, was sectioned along its east/west axis. This revealed a very methodical tipping structure with distinct deposits sloping at 45° into the middle of the tank. Again the voiding through the floor allowed the presence of bedded shale beneath puddled clay to be determined. Timber pipes, to facilitate the inflow of water, were cut into the top course of both tanks. The drainage hole (151) of Tank 3 was located, which appeared to lead directly to the northern pipe (152) in the base of the liquor trough, though the full extent of this relationship could not be tested.

4.2.10 All of the tank walls were found to be built against a deposit of yellow puddled clay (191), which formed a core between the walls of the paired tanks. In a number of

places careful machine excavation revealed the presence of rotted timber planks (192) (Tank x) covering the whole width of the walls. The planks were held together by a central joist which was forced down into the clay core to prevent movement. The planking is likely to have been laid to allow wheelbarrow access and a working surface around the tanks. The tank fills, where tested, were found to consist of calcined shale and to contain both vertical and sloping timbers. Yellow 'sulphurous' deposits were found on the tank walls, and in particular, on the timber floors of Tanks 2 and 6 (170). This may have been produced from the breakdown of iron pyrite in the shale.

4.2.11 Only very limited structural stratigraphy was encountered in Area 2. However, the presence of three different tank alignments may indicate that the tanks were built in separate phases of construction.

4.3 AREA 3

4.3.1 Area 3, situated on the west side of Area 1 (11.5m x 16m), was excavated westwards in two stages and was subsequently linked to the re-excavation of the southern part of Area 1, thus forming a larger open area (18m x 15m). The overlying shale was considerably mixed in the north-west corner, and contained large dressed sandstone fragments, pantile and calcined shale lenses.

4.3.2 The principal features encountered in this area consisted of a circular cistern (183), a possible additional cistern (181), and a liquor trough (176) which continued the line of the trough encountered in Area 2.

4.3.3 The cistern was slightly sub-circular, with an average diameter of 5.3m, and was found to be 2.5m deep. The construction style followed that encountered in Area 2 with finely dressed and coursed dry sandstone masonry backed by yellow puddled clay. The fill was not fully excavated but was tested by machine. A deposit of pink clay (186), approximately 0.6m deep, formed the basal layer and is likely to have resulted from the settling of minute particles of shale in the raw alum liquor. This deposit was overlain by a thin deposit of pantile, rubble, calcined shale and a layer of timber planks (184). This may represent the remains of a fallen timber roof though no other evidence was found to support this hypothesis. The overlying fill (183) (of 1.9m depth) consisted of a very mixed deposit of brown clayey material with occasional sandstone fragments, which was similar to the mixed material observed in the north-west corner of Area 3 during the initial machine stripping. No redeposited grey shale was observed in the fill.

4.3.4 A sub-circular cut feature (181: 4.7m x 4.2m in size) was found immediately adjacent to the cistern on the south side. Although not fully tested, the fill (199) consisted largely of sandstone rubble, as well as timber fragments, puddled clay lumps and calcined clay lenses. The whole fill was very loose and appeared to represent the remains of a collapsed masonry structure, indeed, a few 'courses' of dressed and coursed masonry were noted against the edge of the cut (70). These courses leaned noticeably inwards from the top supporting the notion of collapse. This sub-circular feature was connected to the cistern by two short sections of masonry (182).

4.3.5 The feature may represent the remains of a collapsed cistern as they were commonly built in pairs and the short sections of masonry (182) may represent an overspill from one cistern to the other. However, the feature is significantly smaller in size than the confirmed cistern and therefore may have had an alternative function, perhaps relating to the transfer of liquor from the cistern to the trough. Both the cistern and the pit were set within a platform of yellow puddled clay (198).

4.3.6 The trough (176) encountered in Area 2 was found to continue along the south side of Areas 1 and 3, its walls butting against the bridge (131) at the east end of the site. The north wall (65) was fully exposed in plan and was seen to revet the puddled clay platform. The trough was constructed of roughly dressed random sandstone blocks, and its construction was noticeably less sophisticated than that of the trough encountered in Area 2. However, the feature was not fully tested and the nature of the build beneath the upper course could not be determined. Although the south wall (177) lay largely outside the area of excavation, a short section, measuring 4.5m in length, was exposed: the width of the trough at this point was seen to range from 1.25m to 2m. The fill of the trough (178) could not be fully examined but was seen to consist largely of redeposited shale. Occasional rotted timber fragments, and the general subsequent drainage pattern, suggested that timber pipes lay in the base, possibly connecting with the outflow pipes (152 and 96) encountered in the trough in Area 2. No connection could be detected between the cistern and the trough, although such a connection may have been above ground or may have lain further west in Area 4.

4.3.7 Again, no phasing was detected in Areas 1 and 3 and it may be that the features here represent a single phase of construction.

4.4 AREA 4

4.4.1 Area 4 (12m x 3.2m), situated between Areas 2 and 3, lay in the centre of the site and remained unexcavated until the later stages of the excavation in order to allow machine access. In the northern part of the area the redeposited grey shale was excavated to the maximum reach of the mechanical excavator but was not bottomed, and it was observed to continue below 4m. The edge of the spoil tip was identified but there were no traces of structures were located in this area and it is considered likely that all trace of the Alum works in this part of the site had been destroyed by waterborne erosion. This effectively divided the site into two distinct halves: Area 2 to the west and Areas 1 and 3 to the east.

4.4.2 The shale deposits in Area 4 were largely identical to the banded shale and clay deposit recorded in the erosion scar during previous work at the site (LUAU 1997b). It is likely that an earlier erosion scar existed in broadly the same area. At some stage the earlier erosion feature was dammed, either to prevent further erosion or to control the flow of water, thus allowing a pond of still water to develop to the rear. The banded shale deposits are likely to have resulted from the deposition of small fragments of shale in the water, each band representing a flooding episode with coarse material at the base grading to fine clayey material at the top. This was either a late phase of the alum works or potentially could even have related to the later the working.

4.5 DISCUSSION

4.5.1 Although the full extent of the alum works was not investigated, a number of preliminary conclusions can be surmised; it must be noted, however, that the landscaping work at the site is on going with accompanying archaeological watching brief and thus the following interpretation may be amended in the light of further fieldwork.

4.5.2 The presence of naturally-bedded shale beneath a thick deposit of puddled clay observed in numerous places across the site, including a 2m wide 'wall' of bedded shale separating Tanks 2 and 4, suggests that the original shale floor at the mouth of the quarry was excavated in such a way as to allow the structures, at least in the southern part of the site, to be slotted into place. This was also found at Saltwick Nab (Marshall 1994, 10) where available space for construction was similarly restricted.

4.5.3 There is evidence that the tanks were built in pairs and on three slightly different alignments, possibly suggesting three separate construction events. This may also, however, relate to the process of steeping as this was commonly a three stage process (Rout 1997, 17). The pairing of the tanks may suggest that two steeping operations were in operation at the same time, although it is also possible, given their size, that two further tanks may have been located to the east of Tanks 5 and 6. Eight tanks would fit more closely with Colwell's seventeenth century account of a four stage process (Rout 1997, 38). The post-abandonment erosion observed in Area 4 would have removed all trace of these structures.

4.5.4 The dimensions of steeping tanks are generally considered to have been in the order of 15m (50 feet) x 4.5-6m (15-20 feet) and 0.6m (2 feet) in depth, usually tapering to 0.76m (2½ feet) at the trough end to assist drainage (Colwall 1678, 1052; Marshall 1994, 10-11; White 1858, 118). The steeping tanks at Carlton Bank, however, measure only 11m (36 feet) x 4.7m (15 feet 5 inches) on average, but are 1.06m (approximately 3½ feet) in depth. The increase in depth is significant and gives a total volume of 54.58 cubic metres, which is comparable with the larger of the historically attested tanks (Colwall 1678, 1052; Watson 1854, 49; White 1858, 118). It is likely that the modification in steeping tank design at Carlton Bank was dictated by the lack of space available to the original builders of the works.

4.5.5 The structures may have been refurbished on a number of occasions, possibly to replace the puddled clay, though no evidence of this was found.

4.5.6 The survival of timber pipes has allowed a tentative analysis of the process flow, though it may be that significant above-ground structures and timberwork, which have not survived, may have been central to the operation of the works. The survival of timber planks laid on top of the walls, and timber posts in the fill of the tanks, has also provided an insight into the process of steeping. The main outfall trough was observed to extend north-east towards and beyond the bridge (131) in area 1 and from here would have continued to the alum house at the bottom of the hill.

4.5.7 Numerous pantile fragments were encountered in post-abandonment contexts. Although the steeping tanks are unlikely to have been roofed, it is possible that buildings were located close to the works and there were roofing slates identified within the erosion gully attesting to the former existence of roofed structures in the locality. The timbers observed in the fill of the cistern may suggest, however, that this structure was covered.

4.5.8 Evidence from Area 4 suggests that significant erosion has occurred in the central part of the site which has resulted in the removal of the trough and the major part of Tanks 5 and 6. This may have occurred following an agreement in 1736 to lay the works idle in exchange for compensation (Marshall 1995, 41). Without care and maintenance the water management system is likely to have become blocked with shale very quickly and the subsequent overspill could have caused the destruction evidenced in Area 4. If this is the case then it is tempting to view the horizontal layering of the upper spoil tip as representing a methodical attempt to block the erosion scar following a re-occupation of the works.

4.5.9 Following the final abandonment of the alum works (*c*1774), the water management system is likely to have become blocked once more and the blocking of the original erosion feature would have allowed the run-off from the quarry to pond within the site. This is evidenced by the alternating thin layers of grey silt and clay within the quarry and in the section of the spoil tip, Once silted up, the subsequent overspill from the quarry would have caused further erosion of the unstable spoil tip and led to the creation of the present-day erosion scar. Both erosion features follow broadly the same alignment, possibly indicating the drainage course of least resistance.

4.5.10 The numerous voids encountered during the excavation are likely to be crownholes resulting from nineteenth century jet working beneath the site. They are caused by roof falls progressively working up to the surface, on a number of occasions perhaps precipitated by the weight and vibration of the machine. Where they have occurred within the site, significant damage to the archaeological remains has occurred.

5. QUANTIFICATION AND ASSESSMENT

5.1 ASSESSMENT OBJECTIVES

5.1.1 The principal aim of this assessment was to evaluate all classes of data from the excavations at Carlton Bank Alum works, Carlton-in-Cleveland, in order to formulate an appropriate project design for a programme of further analysis and eventual publication.

5.1.2 The objectives of this assessment correspond to those laid out in the guideline document *Management of Archaeological Projects* 2nd edition (English Heritage, 1991). It will present:

- a factual summary, characterising the quantity and perceived quality of the data contained in the site archive
- a statement of the academic potential of this data
- recommendations on the storage and curation of this data.

5.2 MATERIAL ASSESSED

5.2.1 Both the excavation and the earlier evaluation archives are assessed below. The primary archives, which are currently held at LUAU offices in Newcastle, consist of four main categories:

- Paper archive
- Digital Archive
- Artefact archive
- Geochemical archive.

5.2.2 ***Paper archive:*** all stratigraphic and artefact records are hand written on LUAU *pro formas*. Plan drawings have been digitised, section drawings remain as field drawings, digital survey data is maintained on disk, and as a hard copy of both the data, and the plans and topographical surveys produced from them.

5.2.3 ***Digital archive:*** the survey data was captured in digital form, and was translated into a digital computer-aided draughting (CAD) system. All survey and excavation plan drawings are maintained as digital files.

5.2.4 ***Artefact archive:*** finds were processed, and have been maintained in suitable conditions, at LUAU offices in Newcastle.

5.2.5 ***Geochemical archive:*** the quantity of samples taken during the course of the excavation is detailed below. All samples remain unprocessed and are retained by LUAU in Newcastle.

5.2.6 ***Quantification:*** defined below are the components of both the mitigation excavation and the earlier evaluation archives:

Components	***Excavation***	***Evaluation***
context records	199	67
finds records	8	13
samples	18	2
plans	6	6
sections/profiles	6	3
photographs (black and white)	215	61
photographs (colour slide)	298	108
digital survey files	30	
CAD drawing files	16	

The finds record comprises:

Components	***Excavation***	***Evaluation***
brick/tile	3	2
glass fragments	23	
metal	1	5
pottery sherds	1	
Clay pipe		4
Composite	1	

The sample record comprises:

geochemical samples	16	
wood	2	2

5.3 PROCEDURES FOR ASSESSMENT

5.3.1 ***Stratigraphic data:*** the initial task of this assessment was to complete the compilation of the site archive, checking and cross-referencing the components as necessary. In addition, the broad phasing and an interim report for the site (*Section 4*) have been prepared.

5.3.2 ***Artefact categories and geochemical evidence:*** the small number of artefacts recovered during the excavation have been assessed by rapid scan. All samples remain unprocessed.

6. SIGNIFICANCE OF THE RESULTS

6.1 THE STRATIGRAPHIC RECORD

6.1.1 ***Quantification:*** a total of 199 stratigraphic contexts were defined and examined in the course of the excavation. They comprise largely redeposited natural shale, some of which contain lenses of calcined shale, pantile and masonry fragments, overlying the structural and other associated remains. At the base of the alum works lay naturally-bedded shale.

6.1.2 ***Evaluation:*** redeposited shale apart, the record forms a well-defined and well-sealed group. The stratigraphic sequence revealed is uncomplicated and suggests that all excavated parts of the alum works were in use at the same time. Evidence of phasing was restricted to the steeping tanks which appear to have been built in paired units. No evidence was found to suggest that there was a significant time gap between the principal construction events.

6.2 ARTEFACTS

6.3.1 ***Quantification:*** a very small amount of artefacts was recovered from post-abandonment contexts. The assemblage comprised a single sherd of late eighteenth century pottery, a fragment of mid-eighteenth century glass, two sample fragments of pantile and a small quantity of nails. The most significant artefact, however, was a pick axe identified from a disturbed context during the evaluation.

6.3.2 **Assessment*:*** With the possible exception of the pick axe the material has little relevance to the interpretation of the excavations and contributes little to the history of the Carlton Bank Alum works, except to confirm the late eighteenth century abandonment of the works. The pantile does, however, suggest the presence of roofed structures in the general vicinity, if not in the works itself.

6.3 WOOD

6.3.1 ***Quantification:*** two samples of wood were removed from the site, comprising the remains of a post from Steeping Tank 1 and a sample of very rotted timber planks. Both samples are unprocessed.

6.3.2 ***Evaluation:*** both samples will be suitable for species identification. Historically, the only trees believed to be suitable for use in the Alum Industry were those species, such as Scots Pine, which had a high enough resin content to withstand the action of the sulphuric acid generated during the steeping process. The wood samples from the excavation will provide an opportunity to test whether this was indeed the case at the Carlton Bank Alum works.

6.4 PROCESS RESIDUES

6.4.1 ***Quantification:*** a number of samples was taken during the excavation (16 in total) from the fills of Tanks 1 and 2, including sulphur crust from the tank walls, and also from the basal deposit ('slam') in the cistern. All samples remain unprocessed.

6.4.2 ***Evaluation:*** the basic geochemical analysis of weathered samples taken from the spoil tip proved relatively uninformative when processed during Phase II. However, it was noted that questions relating to the chemistry of the process may be more satisfactorily addressed by the geochemical and mineralogical analysis of samples recovered from secure undisturbed contexts (LUAU 1997a, 31) and 'slam' deposits in particular. It is believed that, whilst geochemical comparisons with other alum industry sites are few, the analysis of the samples will significantly enhance the interpretation of this particular site and the North Yorkshire alum industry as a whole.

7. CURATION AND CONSERVATION

7.1 RECIPIENT ORGANISATIONS

7.1.1 The paper archive will be deposited with an appropriate body nominated by North York Moors National Park Authority.

7.1.2 The finds archive will be very small, comprising a few fragments of glass, a small number of pantile fragments, and a single sherd of late eighteenth century pottery.

7.1.3 The geochemical samples will retain little value following analysis and no curatorial provision is deemed necessary.

7.2 CONSERVATION

7.2.1 There will be no conservation requirement for material from the excavation.

7.3 DISCARD POLICY

7.3.1 Due to the general lack of artefacts generated by the excavation, it has not been necessary to implement a formal discard policy. However, the very small artefactual archive will be deposited in an appropriate manner following discussion between LUAU and the North York Moors National Park Archaeologist.

7.3.2 Analysis of the geochemical samples will be necessarily destructive. Given the likelihood of the continuing survival beyond the reclamation scheme of undisturbed deposits within Tanks 3 and 4, the preservation of 'voucher' samples is not considered necessary.

8. STATEMENT OF POTENTIAL

8.1 RESEARCH PRIORITIES FOR THE SITE

8.1.1 ***The development of the site***: the very small artefact assemblage has not allowed a secure chronological development of the site to be determined. To an extent the lack of finds may reflect the amount of noxious fumes that would have been given off by the process and would have limited the amount of consumption of foodstuffs in the immediate vicinity. Despite this gap in the evidence it has been possible to suggest a tentative sequence of events in the history of the alum works which may be enhanced by additional investigation during the present watching brief and documentary research.

8.1.2 The excavation has demonstrated that the raw liquor trough ran eastwards to a bridge but unfortunately its course beyond this point has not been identified. It is possible that much has been destroyed in the immediate vicinity of the site, both by erosion and later jet working. However, the determination of its course between the alum works and the alum house would significantly add to the interpretation of the spatial organisation of the site. This area will be examined in the course of the present watching brief which will have the potential to inform our understanding of the overall process..

8.1.3 The initial evaluation (LUAU 1996) identified the remains of calcining clamps within the quarry and it is likely that additional features will also survive in this area. Steeping tank 4 lay partly beyond the extent of the excavation in Area 2 and a timber pipe was recorded in the section at the south west corner of Area 2. This suggests that the steeping area may extent southwards towards the quarry area. It is possible that the proposed watching brief will be able to shed light on these aspects and would add significantly to the interpretation of the process flow within the site.

8.1.4 ***Technology***: in general, the technological aspects of alum works have been little studied in comparison with alum houses. Therefore, the site offers an important opportunity to investigate the processes involved in the production of raw alum liquor. Considered together, the geochemical samples, site layout, and timber pipes, will allow some examination of the process flow within the site. Replication experiments, which are designed to simulate the process of raw alum liquor extraction, will provide an insight into the efficiency of the steeping process and may allow comparisons to be made between Carlton Bank and the technological processes employed in the later coastal industry.

8.1.5 ***Historical context***: in broad terms, the development of the alum industry has been considered by a number of researchers (Morrison 1981; Pickles 1975) but rarely is there more than a brief reference to Carlton Bank in their consideration of the seventeenth and eighteenth century industry. In many cases, this has amounted to little more than the number of boiling pans in operation at the alum house at a certain date. It is clear, however, that tremendous scope exist to explore the historical background of the site in more detail. It is known that a significant documentary archive has survived, and that many of the sources contain information of particular relevance to the alum works (Cook 1996). These sources are known to include an early eighteenth century inventory and will, and a lease of 1774. An examination of these sources, supplemented by additional research, will considerably enhance the interpretation of

the site and may provide an insight into the reasons for its construction, operation, temporary abandonment, and eventual decline. It may also be possible to provide tentative social analysis of the workforce employed at the works, both from primary references to the site and parish records, and also by comparison with other well researched sites. Taken as a whole, the use of documentary sources would provide a depth of understanding which can not be achieved by excavation alone.

8.2 NATIONAL PRIORITIES ADDRESSED BY THE SITE'S POTENTIAL

8.2.1 The alum industry in Britain was largely confined to the northern fringe and coastline of the North Yorkshire Moors and Cleveland. In this respect the alum industry, and the importance of the Carlton Bank within that industry, should be viewed in a national rather than a regional context.

8.2.2 Despite the relatively large number of alum works known to have existed in North Yorkshire, work in recent years has largely concentrated on the alum houses (Marshall 1992; Marshall 1994). In general, fieldwork projects at alum works have been confined to field observation at a number of the coastal sites, in many cases driven by a need to record in advance of coastal erosion. This has resulted in an imbalance of knowledge which heavily favours the coastal sites, many of which belong to a period late in the development of the industry. Carlton Bank, however, is an inland site and is relatively early, thus provides a valuable opportunity to redress this imbalance.

8.2.3 Only a small number of alum works have been investigated in any detail, and very few have been excavated. It is clear, therefore, that any relatively large scale excavation of an alum works, such as at Carlton Bank, is of importance to the study of alum works more generally. Excavations at sites such as Boulby alum mine and the field observations at Saltwick Nab and Peak alum works, may provide a useful comparator (Chapman 1975; Marshall 1992 and 1994), and a consideration of their divergent development could be profitable.

8.2.4 Despite the waterborne destruction observed in Area 4, the structure of the alum works has survived relatively intact. Unlike many of the coastal sites which are unsuitable for long term preservation, Carlton bank provides a realistic opportunity for preservation. The site is also accessible to the public and, as an important example of the industry, has considerable interpretation and display potential.

9. REVISED PROJECT DESIGN

9.1 RESEARCH OBJECTIVES

9.1.1 The excavations have provided a unique opportunity to examine the primary processing site of a major seventeenth century alum works. The overall objectives are to assess the stratigraphic development of the site, to examine the overall alum production process and to set the site within the context of the national alum industry. On the basis of the assessment presented above the following research objectives can be outlined.

- Analysis of the stratigraphic record from the site in order to provide a sound understanding of the development of the alum processing site and subsequent workings of the area, from its establishment in c 1680 through to the present.

- Analysis of the development of the Alum production process, which should be undertaken alongside a programme of detailed documentary research. This would be undertaken in order to establish an historical framework within which to consider the surviving remains and also their context within the regional and national development of the alum industry.

- Analysis of the geochemical archive will enhance our understanding of the process of steeping calcined shale; however, it is considered that the methodology adopted during the pilot sampling programme (Phase II: LUAU 1997a) will not significantly add to this understanding. An alternative strategy proposed by Andrew Millard (Durham University) may provide more valuable information. This would involve the analysis of unweathered deposits from the steeping tanks, cistern, calcined shale and natural bedded shale in order to replicate the steeping process. This may require additional samples to be taken from the unexcavated deposits. These 'replication experiments' would be designed to determine the efficiency of the methods employed at Carlton Bank and may indicate the number of stages in the process. This may provide additional evidence towards an understanding of the commercial viability of the alum works, and thus allow an interpretation of its place within the broad economic history of the alum industry.

- Analysis of the limited artefact assemblage will provide some assessment of the chronology of the alum works.

- Species identification of a single piece of timber recovered from the fill of a steeping tank will test the documented tradition that only certain species produce timber with a high enough resin content to resist the sulphuric acid generated by the process.

- The excavation stimulated considerable local and regional interest in the site and the results have confirmed its national importance within the context of the alum industry. This justifies public presentation in the form of a publication in an appropriate journal (possibly *Industrial Archaeology Review*, the journal of the Association for Industrial Archaeology). Consideration will also be given for the provision of a more accessible publication for the general public.

9.2 METHODS STATEMENT

9.2.1 Programme:

- Phase 1 - Stratigraphic analysis
- Phase 2 - Geochemical analysis
- Phase 3 - Documentary research
- Phase 4 - Integration, synthesis and preparation of report
- Phase 5 - Generation of publication text for submission to an appropriate journal

9.2.2 ***Stratigraphic analysis:*** the stratigraphic sequence will provide the contextual framework for an integrated report which, following the incorporation of artefactual and geochemical data, will form the basis for the interpretation of the site. The interpretative framework will be based on the refinement of broad chronological phases into sub-phases reflecting changes in use of the site. The stratigraphic analysis will be closely correlated with the parallel documentary study of the site to provide a dated stratified framework.

9.2.3 Detailed analysis will be undertaken on those features which are highlighted by the structural and stratigraphic analyses as being of major interpretative importance to the site. The retrieval and analysis of less-secure data-sets will be subject to less intensive study, merely sufficient to add context to the development of the castle.

9.2.4 ***Geochemical analysis:*** to be undertaken by Andrew Millard, University of Durham. The method employed during the initial pilot study will provide little new information. However, replication experiments will simulate extraction techniques using samples of unweathered shale and samples from undisturbed deposits from the steeping tanks, and will be designed to analyse the efficiency of the steeping process.

9.2.5 ***Species identification:*** to be undertaken by Jenny Jones and/or Jacqui Huntley, Department of Archaeology, University of Durham. This will inform on the design of the tanks and the need for acid resistant woods to line the tanks.

9.2.6 ***Documentary research:*** a programme of documentary research should be undertaken in advance of publication. This will provide a framework within which to interpret the remains. It would provide a close examination of comparable work on similar sites within both a regional and national context.

9.2.7 Research has been undertaken in a private capacity by Carol Cook of the Cleveland Local History Society. This research concentrated on the history of Carlton-in-Cleveland village and only incidentally covered the alum works and the associated alum house. A detailed examination of all relevant documentary sources should be undertaken in order to enhance rather than the replicate this work. The study will examine the York Public record office, the Northallerton and Guisborough public libraries for primary sources pertaining to the Carlton Bank alum and jet extraction sites. It will also examine pertinent secondary sources relating to other alum works both in the region and nationally and will examine in particular parallels for the alum processing techniques exhibited at Carlton Bank.

9.2.8 **Academic *publication:*** the assessment has established that analysis of the geochemical samples recovered from undisturbed stratigraphic deposits within the tanks can contribute significantly to the understanding of the steeping process at the site, and may contribute significantly to a regional understanding of the industry. It is considered that the turnaround for such an analysis will not produce a significant time-lag between analysis and full publication.

9.2.9 The considerable local interest and enthusiasm generated by the excavation requires the widest dissemination at all levels of interest. It is proposed that the main academic report should be presented within an appropriate national journal such as *Industrial Archaeology Review*. The resources for the presentation of the text and illustrations for this publication are presented below:

9.2.10 ***General Publication:*** it is also proposed that the results of the archaeological recording be presented as a small illustrated 'Shire'-style publication, or indeed, if appropriate, in a form used by the National Park Authority itself, which would have a wider, and broader readership. It could be distributed at a low cost through the National Park Visitor centre. This publication has not been costed in this document as it would require further discussion with regard to scope, format, and funding.

9.3 RESOURCES REQUIRED

9.3.1 ***Stratigraphic analysis:***

Personnel	*Time required*	*Task*
project officer	12 days	Analysis
project officer	6 days	Report production
draughtsman	6 days	draughting of phase plans and sections

9.3.2 ***Geochemical analysis***

Personnel	*Time required*	*Task*
external consultant	8 days	replication geochemical analysis.

9.3.3 ***Species identification***

Personnel	*Time required*	*Task*
external consultant	1 day	species identification

9.3.4 ***Documentary research:***

Personnel	*Time required*	*Task*
project officer	7 days	primary research
project officer	4 days	documentary analysis and reporting
draughtsman	2 days	draughting of historic plans

9.3.5 **Academic *Publication Preparation:***

Personnel	*Time required*	*Task*
project officer	9 days	generation of appropriate publication text
draughtsman	5 days	generation of publication illustrations

9.3.6 ***General Publication:*** There is no provision for general publication within the present costings; this form of publication will need to be discussed with the national park archaeologist to assess the potential and extent of such a publication before any costs can be submitted.

10. BIBLIOGRAPHY

Chapman, SK, 1975 Excavations at the Boulby Alum Works, *The Cleveland Industrial Archaeologist*, **2**

Chapman, SK, 1994 *Boulby Alum Mine*, unpubl rep

Cleveland County Archaeology Section, 1996 *An Archaeological Watching Brief at Carlton Bank, Cleveland*, unpubl rep

Colwall, D, 1678 Account of the English Alum works (Reprint in Singer 1948), *Philosophical Transactions*, **12**

Cook, C B, 1996 *Information relating to Carlton Alum Works*, Unpubl typescript report to Kirklees Council

English Heritage, 1991 *Management of Archaeological Projects*, 2nd edition, London

Foundation & Exploration Services Ltd, 1995 *North York Moors National Park, Carlton Bank Reclamation Scheme. Factual Report on Site Investigation*, unpubl rep

Gould, S, 1993 *Monuments Protection Programme: the Alum Industry. Combined Step 1-3 Report*, unpubl rep

LUAU, 1996 *Carlton Bank Alum works, North Yorkshire: Report of Site Evaluation*, unpubl rep

LUAU, 1997a *Carlton Bank Alum works, North Yorkshire: Report on Phase 2 Evaluation*, unpubl rep

LUAU, 1997b *Carlton Bank Alum works, North Yorkshire: Archaeological Excavation and Recording Project Design*, unpubl rep

LUAU, 1997c *Carlton Bank, North Yorkshire: Archaeological Survey: Phase 3*, unpubl rep

Marshall, G, 1992 *The Ravenscar Alum Works*, National Trust

Marshall, G, 1993 *An Archaeological Assessment of the Loftus Alum Quarry*, unpubl rep

Marshall, G, 1994 *Saltwick Alum works: an archaeological interpretation*, Scarborough Archaeol Hist Soc, Res Rep **11**

Morrison, A, 1981 *Alum: North East Yorkshire's fascinating story of the first chemical industry*, Birmingham

Museums' and Galleries' Commission, 1992 *Standards in the museum care of archaeological collections*, London

Pickles, R L, 1975 *A Brief History of the Alum Industry in North Yorkshire 1600-1875*, The Cleveland Industrial Archaeologist, No.2

Rout, AE, 1997 The North Yorkshire Alum Industry: a technical analysis of the processes used, *Cleveland Indust Archaeol*, **24**

Singer, C, 1948 *The Earliest Chemical Industry*, London

Watson, W, 1854 *The Visitors' Guide to the Guisborough Alum works*, Stokesley

White, W, 1858 *A Month in Yorkshire*, place of publ not known

United Kingdom Institute for Conservation (UKIC), 1990 *Guidelines for the preparation of archives for long-term storage*, London

APPENDIX 1: INITIAL PROJECT DESIGN

Lancaster University Archaeological Unit

August 1997

CARLTON BANK
ALUM WORKS
NORTH YORKSHIRE

ARCHAEOLOGICAL EXCAVATION AND RECORDING

INITIAL PROJECT DESIGN

This project design is presented in accordance with current English Heritage guidelines, as specified in Management of Archaeological Projects*, 2nd edition, 1991*.

Proposals

The following project design is offered in response to discussions with Mr G Lee of the North Yorks Moors National Park for mitigation archaeological recording in advance of the stabilisation of the spoil tip of the former Alum Works at Carlton Bank, North Yorkshire.

1. BACKGROUND

1.1 Site Description

1.1.1 The alum works at Carlton Bank, North Yorkshire, survives as a large quarry, with associated features which may be a legacy of the calcining and initial steeping of the alum shale, together with a large spoil tip, over the scarp slope at the north-westernmost point of the Cleveland hills. The spoil tip has become increasingly unstable and subject to slumping in the last few years; therefore the decision has been taken by the North Yorks Moors National Park that stabilisation work should be undertaken, necessitating the removal of almost all of the spoil tip.

1.1.2 The site (NZ 520 027) lies on the north-facing scarp of the North York Moors, an area of Jurassic rocks dipping very gently to the south. The crest of the scarp is formed by Lower Deltaic Sandstone, beneath which lies a considerable thickness of 'Alum Shales'. These in turn overlie the thin Dogger limestone, over further shales containing a seam of jet. The alum quarry is cut into the steep scarp face from the north, within the Alum Shales, and extends south to the edge of the Lower Deltaic Sandstone, with shallower lobes extending south-east and south-west below the strike of this outcrop. The outcrop of a jet seam, just below the floor level of the quarry, is marked by a horizontal line of workings along the hillside.

1.1.3 The crest of the scarp lies at *c* 400m OD, and the base at *c* 200m OD; the floor of the main quarry lies at 320m OD. The vegetation cover consists of heather moorland on the flatter areas, giving way to rough grass on the steeper slopes, with bracken and some scrub towards the base of the scarp. There is extensive bare ground on the sides of the quarry (due to the unstable and steep surface of weathered shale) and on the tips to the north of the quarry (due to the instability of weathered shale), coupled with the acid and infertile nature of the calcined shale of which these tips are composed. The tips and the slope below them have been affected by landslipping.

1.2 Background History

1.2.1 Alum working in the area began in earnest in the seventeenth century. Alum shale was extracted by quarrying, often on a very large scale in comparison to other industries during the early post-medieval period. The broken shale was then calcined (roasted) in large heaps ('clamps'), mixed with a small amount of brushwood and/or coal; the clamps sometimes had permanent clay bases containing flues. Calcining took several months, and consisted of a slow burning to oxidise the pyrites to iron sulphate, which in turn reacted with the shale to form aluminium sulphate and iron oxide.

1.2.2 The aluminium sulphate, being soluble, was then leached out of the shale in a series of 'steeping tanks', lined with clay, stone, wood, or lead. Calcined shale was placed in these tanks, water added, and the mixture stirred and allowed to settle. A series of tanks was used, to produce a progressively stronger solution. The leached shale, still a distinctive red colour, was then dumped. All these processes took place within or very close to the quarry, due to the bulk of shale involved.

1.2.3 The 'raw' alum liquor produced was led into storage cisterns near the steeping tanks, and then fed by a culvert or 'liquor trough' to an 'alum house' where it was purified, converted into alum by the addition of potash or ammonia, and crystallised. Since these processes used large amounts of fuel, and relatively small amounts of alum (which was in liquid form), the alum house was sited downhill from the quarry, where transport of fuel and other imported materials was easier.

1.2.4 Until the sixteenth century, alum for use in Britain was imported from the Mediterranean, where a Papal monopoly existed. Sixteenth century attempts to develop home production, largely in southern England, were unsuccessful.

1.2.5 Technical success was achieved at the start of the seventeenth century, in the Guisborough area, under a Crown monopoly. By the middle of the century the industry was commercially viable, and it was returned to private ownership in 1679; many new works (including Carlton Bank) were opened, though most of these were short-lived. The British industry was concentrated almost exclusively on the North York Moors.

1.2.6 Following a slump in the 1770s, many works closed and production was concentrated in the few surviving works, still in North Yorkshire. In the mid-nineteenth century, a new process was developed in which freshly calcined shale (normally colliery waste) was treated with hot concentrated sulphuric acid. These works were sited on or near the coalfields, and rapidly made the older Yorkshire technology redundant, the last works in the North York Moors area closing in 1871.

1.2.7 The Carlton Bank alum works is recorded as having operated from *c*1680 to 1774, though the earliest record of its form is the mid-nineteenth century 1st edition Ordnance Survey (OS) map. This indicates the quarry which forms the present evaluation area, and an alum house *c*1 km to the north-west, at the base of the slope. No detailed modern study of the site is known to have been undertaken until the evaluation in advance of this

stabilisation work, and the North Yorkshire Record Office reports that it has no documents or pre-OS maps relating to the site. The site is however recorded as 'Alum Works' on a county map of 1771 though no detail is depicted.

1.3 Previous Work

1.3.1 A contour survey of the quarry, tips, and surrounding area was undertaken in 1995-6, as part of a geotechnical report for the proposed reclamation scheme (Foundation and Exploration Services 1995). This survey accurately depicted the overall forms of the quarry and tips, but smaller-scale archaeological features were not picked up by the contour interval (5m) employed.

1.3.2 Geological test pits were dug in March 1996, and were recorded as a watching brief by Cleveland Archaeology (Cleveland County Archaeological Section 1996). Despite competent recording of the sections, this information contributed little to the overall understanding of the site, since the 'footprint' of each trench was small relative to the anticipated plan size of many alum-working features, and on the available information it was impossible to determine whether some of the test pits were wholly within large archaeological features.

1.3.3 A field evaluation was undertaken by the Lancaster University Archaeological Unit (LUAU 1996), which comprised a topographical survey to record the suite of relatively small-scale features not recorded by the contour survey, and a programme of trial trenching to test a sample of the features identified. Whilst many of these proved to be relatively recent, some, more deeply buried, were associated with the alum works.

1.3.4 A further phase of work (LUAU 1997) comprised a sample geophysical survey, the detailed recording of a section of both bank and spoil tip revealed in an erosion scar, palaeoenvironmental investigation of a waterlogged deposit at the base of the slope, and sample geochemical analysis. This programme revealed potential other subsurface features immediately above the edge of the spoil tip, and that also the tip had been carefully engineered, with the spoil deposited in horizontal layers, rather than being tipped over the edge of the slope in a more casual fashion.

1.4 Circumstances of Project

1.4.1 A land reclamation scheme has been put forward, to stabilise the present slope by the removal of the calcined shale tip from the hillside. This material will be removed from the site and the slope graded to a stable angle of repose. This will necessarily remove the entirety of the spoil tips and also disturb some of the features associated with alum working immediately beyond. A scheme for ensuring that the slope remains well-drained will also be enacted, which will also affect some of the culverts identified in the topographical survey, which are probably associated with launders leading the alum liquor down to the alum house at the base of the slope. Therefore a mitigation policy for recording deposits in advance of and during the reclamation works has been requested by the North Yorks Moors National Park Archaeologist.

1.4.2 LUAU has considerable experience of the evaluation and excavation of sites of all periods, having undertaken a great number of small and large scale projects during the past 17 years. Evaluations and mitigation programmes have been undertaken within the planning process, to fulfil the requirements of clients and planning authorities, to very rigorous timetables. The survey and evaluation of the alum works at Carlton Bank has been undertaken by LUAU, and members of staff were involved with the English Heritage Monuments Protection Programme on the alum industry. LUAU has the professional expertise and resource to undertake the project detailed below to a high level of quality and efficiency. LUAU and all its members of staff operate subject to the Institute of Field Archaeologists' (IFA) Code of Conduct.

2. AIMS AND OBJECTIVES

2.1 The alum industry, along with working of jet, has had, perhaps, the most marked effect of any industry on the North Yorkshire moors area, which was for some three hundred years the focus of the industry. Alum shales outcrop along the scarp slopes of the moors, and are particularly prominent on the north-facing slope overlooking the Tees valley, and along the coast, between Kettleness in the north and Ravenscar in the south. These coastal works are the better known, and are some of the earliest, but also the longest lived workings. The inland sites are less common, which is unfortunate, as much information on the coastal sites has been lost to the sea, both as a deliberate policy of waste disposal, and through natural erosion of the coastline, whereas the inland sites survive largely intact.

2.2 The Carlton Bank alum works is probably one of the best surviving sites on the North Yorks moors and is additionally rare in that its period of use was limited to approximately one hundred years from the late

seventeenth- to the later eighteenth-century. Therefore, whilst it is not one of the earliest alum working sites, it has not been affected by the major changes to working practices which evolved during the nineteenth century, which have left the most visible remains on many of the surviving sites, particularly those along the coast. It thus provides an unusual opportunity to record earlier practices of alum working, in the context of the whole site, rather than of a partially destroyed site.

2.3 The English Heritage Monuments Protection Programme on the alum industry (Gould 1993) considered the site to be of potential national importance if good survival of below ground features was verified. The evaluations undertaken to date have done much to confirm this view. The mitigation recording is therefore essential to add as much information as is feasible in the context of the reclamation scheme.

2.4 The primary pragmatic objectives of the excavation programme are driven by the inherent needs of recording in advance of and during the reclamation scheme. The objectives must be to define the extent, character and condition of the archaeological deposits to be affected by the scheme, as well as to advise of methods to avoid damage to those areas peripheral to the scheme. In addition, if possible, the function and date of those remains should be confirmed. Features should, wherever possible, be placed in the context of the alum process, in an attempt to understand better the late seventeenth-eighteenth century methods of production. Key elements of the stratigraphy will be examined in some detail, in an attempt to define an occupational sequence and if possible, an absolute chronology.

2.5 The programme will investigate and record the presence of artefacts revealed during the works programme. It will examine the range and character of the artefactual evidence within both an industrial and regional context.

2.6 An archive for the project to the specification provided in Appendices 3 and 6 of MAP2, prepared during the excavation programme, and supplemented as necessary during any phase of analysis will be prepared to professional standards for deposition in an appropriate repository. Following analysis, a text suitable for publication in an appropriate journal will be prepared.

3. METHODS STATEMENT

3.1 Programme

3.1.1 The following programme has been designed, in discussion with the North Yorks Moors National Park Archaeologist, Mr G Lee, to provide a suitable level of archaeological observation, excavation and recording prior to the stabilisation works on the site. It has been based in large part on the results of the 1996/97 evaluatory work by LUAU.

3.1.2 It is important, given the circumstances, that the programme of work should follow a series of stages, with a review of progress between each, allowing a flexible approach to the investigation of the archaeological deposits on the site.

3.1.3 The required stages to fulfil the aims of the project are:

a) *Survey Recording:* survey recording in advance of the reclamation scheme is required in two parts of the site. Firstly, those parts of an apparent culvert and perhaps also launder currently eroding from the central erosion gully should be cleaned and surveyed. In addition, those features recorded in the topographical survey (LUAU 1996) which will be removed by the reclamation scheme should be subject to more detailed survey recording prior to excavation.

b) *Machine Clearance:* the area immediately beyond the spoil tip which will be affected by the reclamation scheme should be subject to some archaeological recording in advance of the site works commencing. Firstly, a machine-cut trench should be dug to the south of Trench G (LUAU 1996) to establish whether the stone feature there is a culvert or a tank. Following this, and dependent on the results of this work, two areas should be subject to machine clearance to establish the presence or absence of archaeological features, revealed by surface traces or the geophysical survey. These areas should be centred on the site of Trench D (LUAU 1996) to the west of the central erosion gully, where a possible launders were revealed. The full extent of these features should be uncovered in this exercise, and the possibility of associated features should be confirmed or discounted. Secondly, the area to the east of the central erosion gully should be stripped to test for possible features highlighted by the geophysical survey, the possible settling tank revealed in the section of the erosion scar, and the other possible tank revealed by the topographical survey.

Machine clearance should be limited to the area to be affected by the reclamation scheme. Overburden will be cleared to a level just above the anticipated depth of the important archaeological deposits. The efficiency with which this is achieved is critical to the success of the excavation, and should be under the supervision of a

qualified archaeologist, to allow identification of key areas of material. This process will commence on either side of the erosion gully at the southern limits of the available area moving northwards.

c) *Excavation:* an area of approximately 1450sqm will be excavated, centring on those areas of prime archaeological interest revealed during the removal of the overburden. Manual excavation techniques will be employed to clean, define and sample features forming key elements of the site. The aim of this phase of the project is to excavate all elements of the site to establish function, date and the internal sequence.

d) *Watching brief:* during the removal of the spoil tip, a permanent presence watching brief will be maintained to record the infrastructure of the tip and any associated archaeological features (such as culverts and launders, and also perhaps settling tanks or even calcining bases) revealed during the process. This process should be subject to regular review and discussion between the contractors, LUAU, and the North Yorks Moors National Park archaeologist to ensure an adequate level of recording is maintained. It is possible that this may also trigger more detailed recording strategies, should material of importance and/or complexity be identified during this process.

e) *Site Archive/Review:* following fieldwork, the results should be collated and the site archive completed as soon as appropriate. The whole programme should then be reviewed with the North Yorks Moors National Park archaeologist as a formal assessment of the results, to agree the scope of any further work deemed necessary (assessment, analysis, synthesis) to complete the project.

f) *Analysis/Report:* a provisional programme of post-excavation analysis is proposed, on the basis of the anticipated recovery of material from the excavation; however, the extent of the programme can only be reliably assessed on completion of the fieldwork. The proposed programme anticipates analysis of the site stratigraphy and also analysis of the artefactual evidence leading to the production of a summary report for the client and for dissemination to the general public.

3.2 Methods

3.2.1 The site is not unique in the region, although few such sites have been subject to detailed recording. It will not be practical to excavate every feature in its entirety, and a rigorous sampling strategy will be applied.

3.2.2 *Survey Recording:* in earlier phases of work use has been made of the existing survey control installed by Foundation and Exploration Services, Basingstoke, during the borehole investigations. LUAU still hold co-ordinate information supplied by Foundation and it is proposed that this be used again unless either the main contractor wishes to install their own control in which case LUAU will tie into this, or the Foundation control no longer survives. The existing control is in the form of capped borehole tubes, which will be extended to incorporate stations outside of the sphere of reclamation activity in order to preserve control integrity for the duration of the project. It is proposed that survey control be extended by closed traverse to an accuracy of +/- 0.01m in plan and 0.005m in height. If the original survey control does not survive a local grid will be established until the main contractor installs their own control, at which point LUAU will tie into this.

3.2.3 *Survey detail:* as the current proposals for land reclamation would involve the destruction of areas located below the 311m contour level which are known to have archaeological potential, a LUAU Level 3 survey is recommended. Level 3 survey *(Mitigation)* is a comprehensive record of the archaeological features in relation to the surface topography. It incorporates an interpretative hachure survey alongside a full computer generated model of the ground surface enacted when a full survey is needed in conjunction with excavations or in cases where detailed survey of fragile upstanding earthworks is the only appropriate mitigative measure.

3.2.4 The Level 3 mitigation survey is designed to record the archaeological site as fully as current technology will allow in advance of its destruction. It is applied selectively to sites of particular importance and which have a good survival of surface features.

3.2.5 This will be achieved by means of its in-house total station facility, linked to a portable data logger with full micro-computer data transfer capability. The aim of the survey is to provide accurate, three-dimensional co-ordinates, with respect to the previously established control. In many cases only a relatively limited amount of additional data is required to upgrade the Level 2 survey to the full surface modelled Level 3 and therefore this can be an economic recording option.

3.2.6 The resulting data is modelled on CAD which maintains the original accuracy of the survey data and allows flexibility of drawing output at any scale. The drawing file will record the contour detail at different height separations and the final survey drawings can therefore be tailored to meet any requirements of the client.

3.2.7 In the case of the putative culvert within the central erosion gully, the features will be subject to hand-cleaning, as far as health and safety considerations will allow, before being subject to the methodology outlined above. Where material of great importance is revealed, the survey will be enhanced by hand-drawing of selected elements at a sale of 1:20. This information can be digitised to give greater detail to the CAD-generated drawings, if required.

3.2.8 *Machine Clearance:* a machine-cut trench will be excavated to establish the presence or absence of a stone culvert between Trenches F and G to the immediate east of the reclamation scheme. In addition, two areas, one on either side of the central erosion gully, will be stripped to allow the recording of features within the area affected by the reclamation scheme identified from the topographical survey, geophysical survey, and trial trenching (Trench D). This would be undertaken under the supervision of a fully qualified archaeologist, who would ensure that the overburden was stripped efficiently and that no important archaeological deposits were disturbed during this process. The archaeologist would lead a team who would identify archaeological material as they manually cleaned the site following the machine.

3.2.9 The overburden stripping will be undertaken by a JCB, using a 2m toothless ditching bucket. The machine will remove the topsoil across the area, an action that is critical to the success of the excavation, as the removal must be judged exactly so that neither too much overburden remains on completion of the task, nor should any deposits of archaeological significance be disturbed during this task. Features identified will be cleaned and planned with respect to the survey control framework which will have been established over the site using total station equipment.

3.2.10 *Excavation methodology:* the excavations will concentrate on defining all elements of the alum works within the area to be affected by the stabilisation works. These include possible tanks and culverts already identified by earlier phases of work. The programme will investigate all features associated with this and an attempt will be made to establish an overall chronology for the site, as this may allow an analysis of the development of the works. Any features of archaeological significance belonging to periods either preceding or succeeding that believed to be the core activity on the site will be treated appropriately.

3.2.11 The excavation will use a variety of techniques, from rapid cleaning to delicate excavation, to suit differing conditions. Following removal of the overburden, the core areas will be subject to manual excavation; the aim of this work will be to explore all features stratigraphically and to produce a clear plan of the complex.

3.2.12 The deposits encountered during the excavations will be sampled according to the appropriate professional standards to enable palaeoenvironmental and/or geochemical analysis if proven beneficial. To maximise the available resources, all features will be cleaned and a sample will be excavated, but they will not necessarily be excavated to their full extent if sufficient information can otherwise be retrieved to establish their date, function and stratified relationship. Layers and features will be cleaned and excavated by an appropriate technique.

3.2.13 All elements of the work will, as a matter of course, be recorded in accordance with current English Heritage guidelines (*MAP2*) and the best practices formulated by English Heritage's Central Archaeology Service. All excavation, by whatever method, will be recorded by the compilation of context records, of object records for any finds and a photographic record. The archaeological record will take a form which will allow the flexibility of database capture and manipulation, should the results warrant this treatment, or be an acceptable paper record (copies of standard LUAU recording forms are attached to this project design). Accurately scaled plans and section drawings (probably at scales of 1:20 and/or 1:10) will be generated with respect to a 5m grid that will be established over the core areas by total station and will be tied into the survey control framework. Most emphasis will be placed on identified dated deposits, particularly structural data and artefact recovery, although information relating to the continued use of the site through time will not be neglected. Three-dimensional recording of selected finds' classes will be undertaken using a data-logging total station, should the site warrant this treatment.

3.2.14 Finds recovery and sampling programmes will be in accordance with best practice (current IFA guidelines) and subject to expert advice. Any palaeoenvironmental and/or geochemical sampling will be undertaken with advice from specialists. The Unit has close contact with Ancient Monuments Laboratory staff at the Universities of Durham and York and, in addition, employs in-house finds and palaeoecology specialists, who are readily available for consultation. Finds storage during fieldwork and any site archive preparation will follow professional guidelines (UKIC). Emergency access to conservation facilities is maintained by the Unit with the Department of Archaeology, the University of Durham, and the English Heritage contract worker at York Archaeological Trust, and, in addition, employs artefact and palaeoecology specialists with considerable expertise in the investigation, excavation, and finds management of sites of all periods and types, who are readily available for consultation.

3.2.15 It should be noted that in a site such as this where little information is available, any discard policy should be formulated with care, and with advice from the Local Planning Authority and the local Museums Service. Such liaison should be formulated prior to fieldwork.

3.2.16 *Watching Brief:* a permanent programme of field observation will accurately record the location, extent, and character of any surviving archaeological features within the reclamation area. This work will comprise the observation (and where appropriate the supervision) of the process of excavation for works or construction purposes, the systematic examination of any subsoil horizons exposed during the course of works, and the accurate recording of all archaeological features and horizons, and artefacts, identified during observation.

3.2.17 During this phase of work, recording will comprise a full description and preliminary classification of features or materials revealed, and their accurate location (either on plan and/or section, and as grid co-ordinates where appropriate, using a data logging total station linked to a portable computer. All archaeological information collected in the course of fieldwork (including finds) will be recorded in standardised form, as described above (3.2.13), and will include accurate national grid references. Features will be planned accurately at appropriate scales, and where possible, a running section through the spoil tip will be maintained as it is removed. A photographic record will be undertaken simultaneously.

3.2.18 It is assumed that LUAU will have the authority to stop works for up to one hour to enable the recording of particularly important deposits, if necessary. Field recording will therefore also include a continual process of analysis, evaluation, and interpretation of the data, in order to establish the necessity for any further more detailed recording that may prove essential.

3.2.19 In the event of archaeological features or evidence of particular significance being identified, it may be necessary to undertake more detailed recording and/or excavation, utilising additional archaeological support (LUAU rapid response team). Such additional work as is considered necessary would be undertaken only after consultation with the North Yorks Moors National Park Archaeologist and the contractors. The recording techniques and procedures employed by LUAU for such detailed recording represent current best practice (as described above, 3.2.13).

3.2.20 *Archive:* the results of the programme of fieldwork detailed above will form the basis of a full site archive to professional standards, in accordance with current English Heritage guidelines (*MAP*2, *Appendix 3*). This archive represents the collation and indexing of all the data and material gathered during the course of the fieldwork. It will include summary processing of any features, finds, or other data recovered. The deposition of a properly ordered and indexed project archive in an appropriate repository is considered an essential and integral element of all archaeological projects by the IFA in that organisation's Code of Conduct. LUAU conforms to best practice in the preparation of project archives for long-term storage. The expense of preparing such an archive is part of the project cost but only represents a very small proportion of the total. This archive (including excavated material) will be prepared in accordance with UKIC *Guidelines for the preparation of excavation archives for long-term storage*, and the Museums' and Galleries' Commission *Standards in the museum care of archaeological collections*. It can be provided in the English Heritage Central Archaeology Service format, both as a printed document and on computer disks as ASCII files. It is intended that archive records should be deposited with the North Yorks Moors National Park**,** and a further copy can be made available for deposition in the National Archaeological Record (RCHME). Discussions should also take place at this stage as to the need for conservation for long-term storage. This should involve a representative from the County Museums Service. The actual details of the arrangements for the deposition/loan of the material from the site (artefacts, ecofacts and samples) will be agreed with the site owner and the North Yorks Moors National Park archaeologist, dependent on the quantity and quality of the material recovered. The receiving institution should be a registered museum, approved by the Museums and Galleries Commission. LUAU would make the appropriate arrangements with the designated museum at the outset of the project, for the proper labelling, packaging, and accessioning of all material recovered.

3.2.21 *Assessment/Review:* assessment of the level (if any) of post-excavation analysis, as recommended by MAP2, will be undertaken by means of a formal review, involving LUAU and the North Yorks Moors National Park Archaeologist. This will agree the scope and timetable for any such analysis, as well as the length and outline content of a publication text.

3.2.22 *Analysis:* an appropriate programme of analysis should be undertaken to prepare a research archive, should the results warrant this, as detailed in Appendix 6 of *Management of Archaeological Projects.* This will involve the compilation of an archive report, detailing the stratigraphic history of the site, and a full text recording the significance of the structural, artefactual and environmental evidence. This will include analysis of the geochemical/environmental samples and report preparation, and the production of reports on any finds material. It is not possible to provide a totally accurate estimate of costs until the results of the assessment are known, but a best estimate of costs has been submitted on the basis of the results of the evaluation.

3.2.23 The results of the programme of works detailed above should be placed in the public domain by a number of routes. Firstly, a synthesised report of the results of the work should be compiled, which should be published in an appropriate manner. In addition, the completed project archive (site and research archive) should be copied on to microform and disseminated (as detailed above). A synthesis of the work should be placed in the North Yorkshire Sites and Monuments Record.

3.2.24 The precise nature and scale of the published report can only be established after the fieldwork has been undertaken, although it is certain that there will be sufficiently important material to warrant the publication of an article in an appropriate journal.

3.3 Other Matters

3.3.1 *Health and safety:* full regard will, of course, be given to all constraints during the excavations and watching brief, as well as to all Health and Safety considerations. The Unit Health and Safety Statement conforms to all the provisions of the SCAUM (Standing Conference of Unit Managers) Health and Safety manual, as well as the Lancaster University Health and Safety Statement. Risk assessments are undertaken as a matter of course for all projects, The Unit Safety Policy Statement will be provided to the client, if required. The location of services will be investigated from the statutory services and as a matter of course, a U-Scan device is used prior to the commencement of excavation. LUAU will work within the health and safety plan (reclamation phase) produced by the main contractor as a requirement of the Construction (Design and Management) Regulations 1994. It will contribute to this plan by providing risk assessments and a method statement covering its staff whilst working on the watching brief and recording programme. LUAU personnel will observe all restrictions regarding access to potentially unstable areas which should be identified and clearly marked by the main contractor. Work carried out in observing or recording features within the erosion gullies during the reclamation work will be guided by advice from the main contractors regarding the stability of the slopes. It is envisaged that these areas will be reduced in horizontal spits with the opportunity of recording any features revealed being accommodated by the contractor if in there judgement it is safe to do so.

3.3.2 *Insurance:* the insurance in respect of claims for personal injury to or the death of any person under a contract of service with the unit and arising out of an in the course of such person's employment shall comply with the employers' liability (Compulsory Insurance) Act 1969 and any statutory orders made there under. For all other claims to cover the liability of LUAU in respect of personal injury or damage to property by negligence of LUAU or any of its employees. there applies the insurance cover of £1m for any one occurrence or series of occurrences arising out of one event.

3.3.3 *Access:* there is currently unimpeded access for both machines and pedestrians. It is anticipated that the lead contractor involved with the stabilisation will have responsibility for the security of the site. Areas for parking a site cabin and portaloos, if these cannot be shared with the site contractor, as well as car parking, will need to be set aside for the duration of the excavations and watching brief.

3.3.4 *Presentation:* in the interests of health and safety, it is recommended that there should be no public access during the excavations, as well as the watching brief. No statements will be made to any third parties without the express consent of the client.

3.3.5 *Working Hours:* survey and excavation will be undertaken on the basis of a five day week, within daylight hours only. The watching brief will take place to the contractor's timetable.

3.3.6 *Reinstatement:* the level of reinstatement depends on the timing of the excavation in comparison to the timetable for stabilisation. At this stage, it is not anticipated that reinstatement will be required, and spoil will therefore be temporarily dumped on the top of the spoil tip to the north of the excavations. The trench across the putative culvert to the immediate east of the reclamation area will be rapidly backfilled if required.

3.3.7 *Equipment:* the following plant will be required on site:

a) The necessary plant (JCB) for the removal of overburden in association with the excavation of features at the top of the slope will be provided by LUAU.

b) Subject to agreement with the contractors and the North Yorks Moors National Park Archaeologist, it may be possible to share the contractor's site accommodation, but should this not be possible, Mobac or Rollalong-type accommodation for the provision of office space and mess huts will be hired by LUAU, if proven necessary. At present, the allocation for site accommodation has been expressed as a contingency sum.

3.3.8 Pr*oject Monitoring:* monitoring meetings will be established with the North Yorks Moors National Park Archaeologist at the outset of the project and at the critical review stages of the programme, although there will be additional site meetings as required.

3.3.9 *Archive Deposition:* the full archive will be deposited with the North Yorks Moors National Park within eight months of completion of the project, following any programme of processing/analysis agreed with the North Yorks Moors National Park Archaeologist.

3.3.10 *Publication:* the physical publication of the results of this work is beyond the remit of this project design, but hopefully will be subject to discussion at the completion of fieldwork; however, it is certain that there will be sufficiently important material to warrant the publication of an article in an appropriate journal. The costs set out below include the preparation of a summary account of the excavations suitable for publication.

4. WORK TIMETABLE

4.1 The preliminary survey work, particularly that on the central erosion gully, should take place before the contractor starts his site preparation. The other survey work and excavations can take place whilst the contractor is undertaking preliminary work on the site, but sufficient time must be allowed for the completion of this work prior to the commencement of the removal of the spoil tip. At present, there is no detailed timetable for this work. It is estimated that the post-excavation programme will be completed within six months of the fieldwork, allowing for other internal Unit work programmes to be met. Deposition of the archive will be scheduled for three months after the post-excavation programme is completed**.**

4.2 Project Timetabling

4.2.1 The internal project timetable is approximately as follows:

i survey/CAD production -		*erosion gully*	*3 days*
	-	*top of slope*	*6 days*
ii machine clearance	-	*culvert*	*1 day*
	-	*excavations*	*3 days*
iii excavation of features below 311.0m contour			*2.5 weeks*
iv watching brief			*9 weeks*
v archive/Review			*1 week*
vi analysis/Report (estimate)			*3 weeks*

5. RESOURCES AND PROGRAMMING

5.1 The following resource base will be necessary to achieve the survey, excavations, and watching brief as detailed above. The basic costs assume that the excavations will not identify complex and extensive stratigraphy.

5.2 The post-excavation programme will be subject to the results of the excavation and the attached costs do not anticipate the discovery of particularly complex stratigraphy or extensive analysis of environmental samples. A contingency has been allowed for the analysis of geochemical samples.

5.3 The project will be under the guidance of Rachel Newman, BA (Unit Deputy Director), to whom all correspondence should be addressed, although day-to-day management may be undertaken by an appointed LUAU Project Manager. Rachel is a native of the North East and has extensive experience of the archaeology of the region. She has a detailed knowledge of the North Yorks moors and has studied the alum industry of the area (particularly the coastal sites).

5.4 The site director will be Denise Drury (LUAU Project Officer), who has considerable experience of the excavation of industrial sites. The watching brief will be undertaken by Iain Hedley (LUAU Project Supervisor), who has worked for several years on the English Heritage Monuments Protection Programme of industrial sites, and undertook the evaluation of Carlton Bank in 1996

5.5 Christine Howard-Davis would undertake the necessary finds analysis. She has many years' experience of the identification and analysis of artefact of all periods. If proven necessary, a consultant(s) of suitable status would advise on details of the industry identified during this programme of work (David Pybus of Sandsend; David Cranstone of Newcastle).

5.6 Environmental Samples (if proven necessary)

Environmental Archaeology Unit, York University.

5.7 Geochemical Analysis (if proven necessary)

Andrew Millard, University of Durham.

5.8 Conservation (if proven necessary)

Jenny Jones, University of Durham.

ILLUSTRATIONS

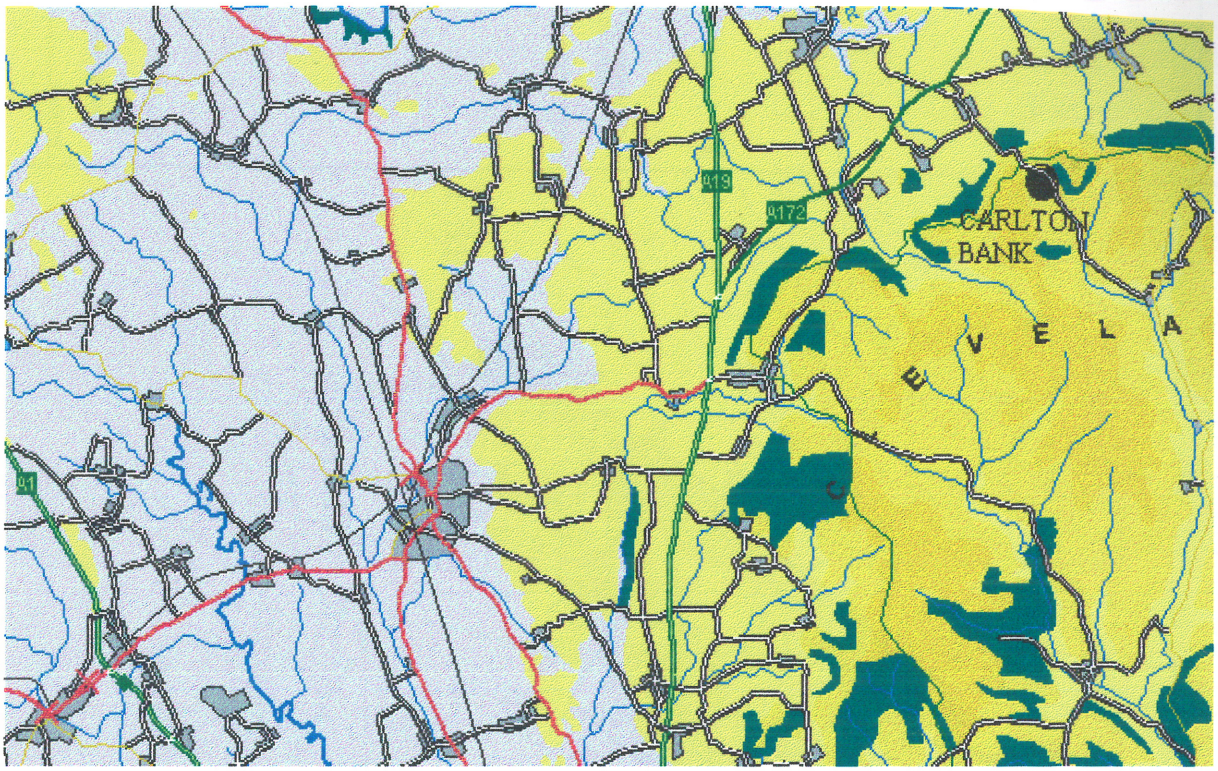


Fig 1 Carlton Bank Location Map

© Lancaster University Archaeological Unit April

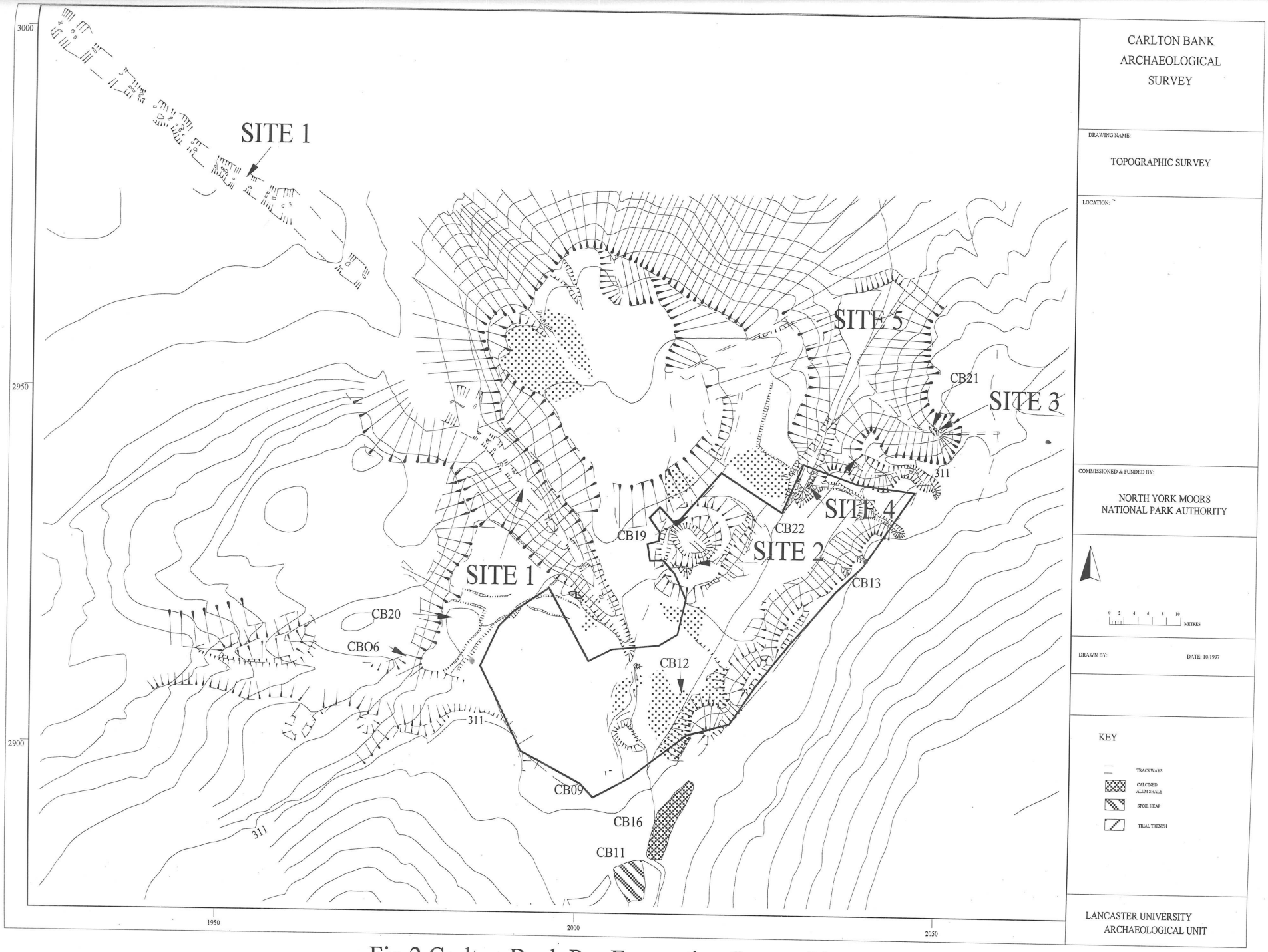


Fig 2 Carlton Bank Pre-Excavation Survey Plan

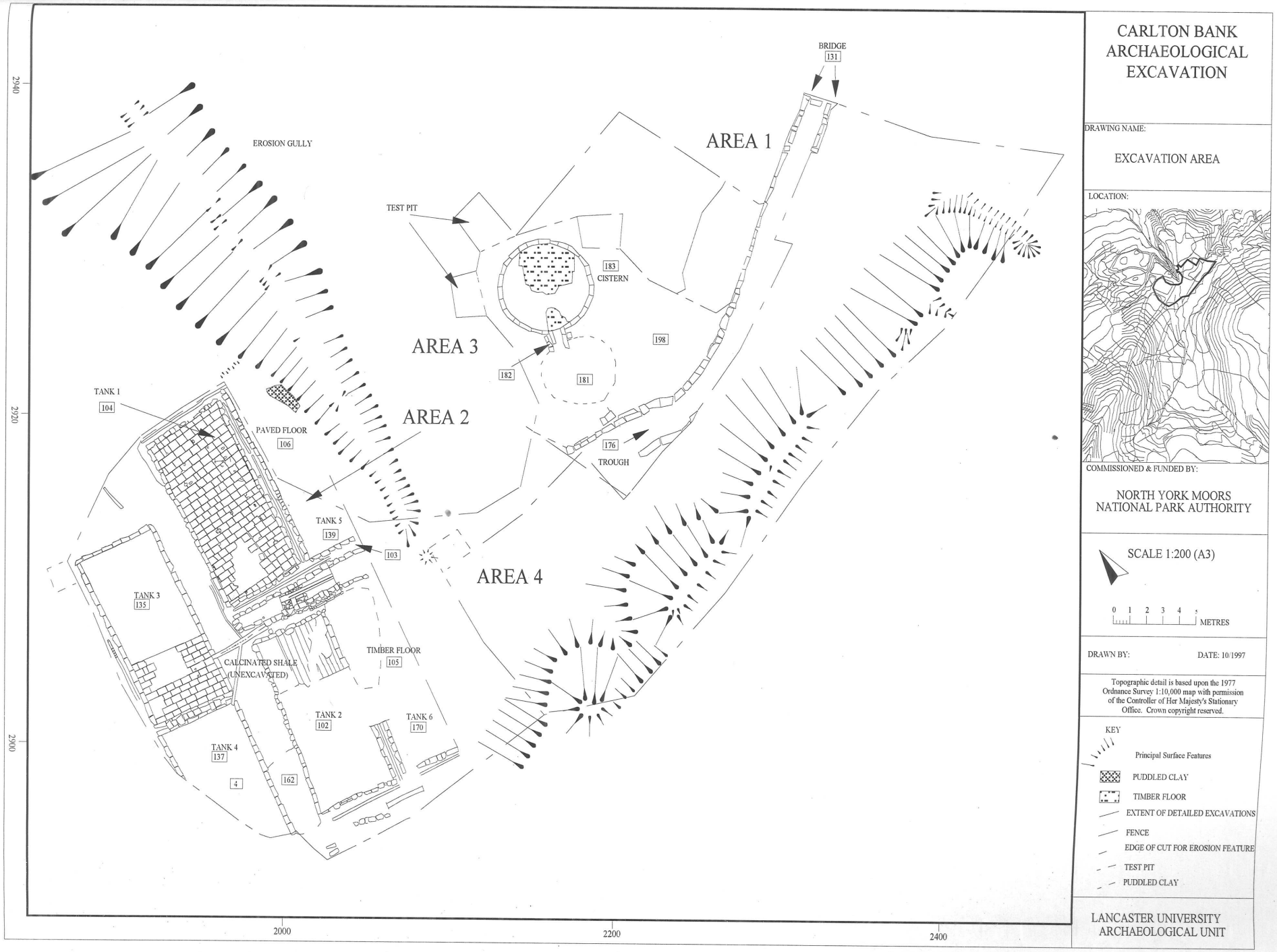


Fig 3 Carlton Bank Overall Excavation Plan

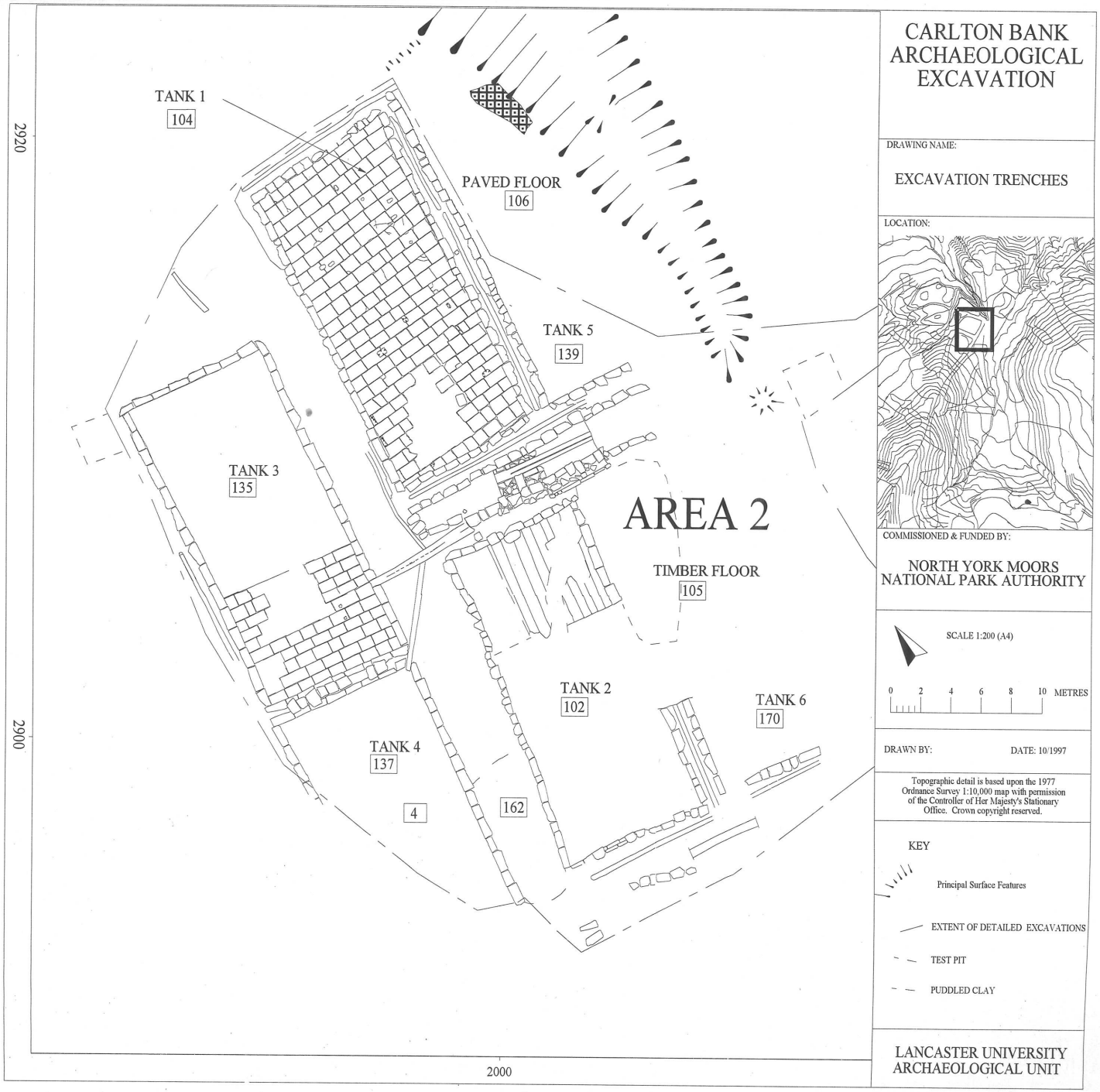


Fig 4 Area 2 Steeping Tanks Detail Plan