THE CLWYD-POWYS ARCHAEOLOGICAL TRUST

Clive Engine House, Talargoch Mine, Dyserth, Denbighshire

ARCHAEOLOGICAL SURVEY

CPAT Report No 472

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Report for WS Atkins

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CONTENTS

1 INTRODUCTION

1.1 In February 2002 the Contracting Section of the Clwyd-Powys Archaeological Trust (hereafter CPAT Contracts) was commissioned by W S Atkins Consultants Ltd to carry out an archaeological survey of the Clive Engine House, Talargoch Mine, Dyserth, Denbighshire, on behalf of Denbighshire County Council. A Consultancy Brief had been prepared by Denbighshire County Council detailing the work required, of which the archaeological survey formed a part.

1.2 The Clive Engine House is the best preserved example of a Cornish-style engine house in North Wales and is protected as a Scheduled Ancient Monument (SAM Fl 136). The engine house was constructed in 1860 and continued in use until 1884. The archaeological survey was undertaken with the aim of identifying, assessing and interpreting surviving archaeological features, both above and below ground, and comprised a photographic and written record of the engine house, a topographical survey and an electrical resistance survey.

2 LOCATION, TOPOGRAPHY AND GEOLOGY

2.1 The site lies between Dyserth and Meliden, Denbighshire, to the south of the minor road from Dyserth to Newmarket (Fig. 1). The Clive Engine House lies at the foot of Graig Fawr, on land sloping gently from east to west. At the time of the surveys the site was largely pasture, although small trees and undergrowth cover some of the mine workings.

2.2 The underlying solid geology is of Carboniferous limestone, overlain with boulder clay and gravel. The Talargoch Mine worked three main veins with mineralisation in the form of lead, silver and zinc: Panton's Vein on the north-west; the Talargoch Vein in the centre; and the South Joint Vein in the north-east. The Talargoch Vein runs the length of the mine and was the most productive. At the southern end of the mine, around the Clive Shaft, a number of smaller veins ran at right angles to the main veins and were exposed on the slopes of Graig Fawr, with the result that they were the earliest veins to be worked (Thorburn 1986, 9).

3 METHODOLOGY

3.1 The assessment was undertaken according to the principles described in the brief, the first stage of which consisted of a desk-top study of all readily available documentary, cartographic, pictorial and aerial photographic sources at the following repositories: County Sites and Monuments Record (SMR), Clwyd-Powys Archaeological Trust, Welshpool; National Library of Wales (NLW), Aberystwyth; National Monuments Record (NMR), Royal Commission on Ancient and Historical Monuments (RCAHMW), Aberystwyth; and County Records Office, Hawarden (CROH). The results from the desk-top study have been used to provide the historical background, which also draws heavily on the work of Jamie Thorburn (1986) and Pat Frost (1997).

3.2 A total station survey was conducted of the entire area using electronic distance measuring (EDM). The top and base of all surveyable earthworks were recorded, together with surviving masonry and sufficient spot heights to produce a contour model of the area (fig. 8). A photographic survey was conducted of the accessible areas of the interior and exterior of the engine house, using 35mm black and white and colour print and colour slide formats.

3.3 An electrical resistance survey was undertaken by ArchaeoPhysica Ltd, collecting data every 0.5m along lines 1m apart. As much of the area as possible was included, although the vegetation prevented access to some areas, notably those associated with shafts close to the northern boundary. A full description of the techniques and analysis, together with detailed illustrations, is presented in a separate report (ArchaeoPhysica 2002), extracts from which are included in the following text.

3.4 The results from all three stages of the assessment have been used to produce an interpretation of the various structures and features surrounding the Clive Shaft (section 5; fig. 9). A glossary of mining terms has been included in Appendix 3.

4 HISTORICAL BACKGROUND

Prehistory

4.1 Bronze Age finds have been recorded on Graig Fawr to the east of the Talargoch mine. These include a tanged bronze chisel found by a metal detector at SJ 0595 8039 (PRN 103044) and a small bronze socketed knife (PRN 102189) found in 1946, lying on a rocky surface at SJ 0603 8028.

Roman

4.2 It is generally believed that lead has been mined in Flintshire since the Roman period and various finds in close proximity to early workings have attested this. It seems more likely that the early miners would have been attracted by the exposed veins that ran down Graig Fawr, which could have been exploited as open-cut workings, rather than the deeper veins later worked by the Talargoch Mine Company. Any evidence of early mining at Talargoch has been masked by the more intense 18th and 19th-century workings.

4.3 Implied evidence of Roman workings is revealed by a brass coin of Gordian III (AD 243-44), found in *c.* 1883 in a 'long disused washing floor', and between 1887 and 1899 other coins were reportedly picked up on the surface of the mine (Webster 1952-3, 15-16). Other Roman finds from the general area include a bronze bracelet, a wedge, and coins and tools of suggested Roman date, found at the mine site since 1704 (PRN 102194).

4.4 Roman occupation at Prestatyn is well attested. Major excavations at Melyd Avenue during 1984-5 (Blockley 1989) revealed a settlement and bath house dating to the 1st to 4th centuries AD. During the excavations, a number of sizeable lumps of galena (lead ore), recovered from the site, which may suggest that the settlement was associated with nearby mineral deposits.

Medieval

4.5 It is generally assumed that little mining activity occurred in north-east Wales following the Roman period until the 13th century, when the Edwardian campaigns and castle building led to large demands for lead. The first documentary reference to mining in the area dates to 1303, when four German miners were working in 'copper mines at Disard' (Jones 1913, Appendix A). There is, however, no evidence for the location of any medieval workings.

Post-medieval

4.6 The earliest available documentary references relating to the area concern land owned by the Bishop of St Asaph, the Earl of Plymouth (Dyserth Castle Estate) and members of the Mostyn family who owned the Rhyd Estate.

4.7 Mining activity in the parishes of Dyserth and Meliden developed rapidly during the 17th century. The earliest lease identified refers to William ap Robert leasing mineral rights on Carreg Faylon (now known as Graig Fawr) to Sir John Conway. The hill of Graig Fawr seems to have been the main location for early mining activity. Disputes over the mineral rights spanned the mid-17th century, with claimants including the rich land-owning families, the Grosvenors and the Mostyns, who both attested that Graig Fawr was common land, while Thomas Mackworth claimed the hill was in the hundred of Prestatyn and he had been granted the right to all mines and quarries in the hundred in 1651. In 1660 the hill was declared the property of Ralph Hughes, whose family had claimed possession since 1573, after which mining activity in the area developed rapidly.

4.8 Early mining deeds and leases referring to Dyserth and Meliden parishes and dating from 1660 (Plymouth Mss. 210-41, Rhual Mss, 47-8) do not refer directly to the study area, but confirm that new veins were being explored on the lower ground, below Graig Fawr. It seems likely that considerable mining was taking place on the Bishop of St Asaph's Talargoch lands in the 1660s (Plymouth Mss. 1325, 1329).

4.9 In May 1664, Derbyshire miners, Ward, Eyre and Wooley, leased the parcel of land known as Maesyrerwddu along the line of the Talargoch Vein (Plymouth Mss.1213). To work this vein, it was necessary to sink a drainage sough, or adit, and the lease included a clause that Ebule Hughes (a descendent of Ralph Hughes) and the Derbyshire miners should at joint expense make 'a sough and horse engine for drawing water from the works . . . the said sough beginning on a parcel of land known as Tir y Gwynt'.

4.10 Problems of draining the workings continued and it has been suggested that one of the first steam engines in Wales was erected on the Bishop of St Asaph's land at Talargoch around 1716. The 'Fire Engine House', presumably of Newcomen type, is depicted on a map accompanying a 1736 lease (Plymouth Mss. 1586), along the Talargoch Vein on the south side of the Meliden/Dyserth Road on the 'Bishop of St Asaph's Liberty'.

4.11 In 1753, Paul Panton and Reverend Thomas Ince leased land for 21 years on the Earl of Plymouth's Estate between Talargoch and Dyserth (Plymouth Mss. 1551), which included the right to provide an effective means of drainage and construct a watercourse to the works. Sometime in the mid-1750s, Panton constructed a leat (fig. 1), which took water from the Afon Ffydion at SJ 057793, above Dyserth waterfalls, following the natural contours below Graig Fawr to Talargoch.

4.12 Panton and partners, who included John Mostyn, Thomas Slaughter and Ralph Richardson, began to acquire as many mining leases as possible in the area, resulting in the Talargoch Mine extending eastwards through Meliden. Considerable losses were incurred during the development of the mine due to exploration, drainage, maintenance and compensation paid to landowners through whose fields the leat ran. Lord Plymouth's agent expressed dissatisfaction on the payment for 'water trespass' from 1800-1803, when the Plymouth lease was due for renewal (Esgair and Pantperthog Mss 1078, 399). A plan accompanying a 1799 lease (Mostyn Mss. 7048; Thorburn 1986, fig. 6) indicated three waterwheels, known as Engine Issa, Engine Ucha and Engine Canol, worked by the 1750s leat.

19th century

4.13 By the early 19th century the workings under the Plymouth lands had reached a depth of about 60yds but appear not to have been connected to a shaft already sunk in Lletty Mwyn. By the late 1830s the mine workings had extended to the 150yd level.

4.14 The Tithe Map for Dyserth Parish in 1839 (fig. 3) shows the course of the 1750s leat running north towards 'Dalargoch Engine', with its return course flowing south, to the west of the road to Mostyn, towards Plas yn Dyserth. The area to the south of 'Dalargoch Engine' is recorded as 'waste destroyed by miners', as is a parcel of land (no. 106a) south of the road to Newmarket. The remainder of this area (no. 106) is recorded as old pasture called Llety'r Mwyn, owned by Right Hon. Robert Henry Clive and occupied by Pierce J Parry. The area is also shown on a map of 1840 (fig. 4) which is little different from the Tithe Map, except that it has the later addition of the Clive Shaft, sunk between 1842-45.

4.15 Continuing problems with drainage at the southern end of the mine led the mine agent, Ishmael Jones, to advise in 1842 that the only solution was to install a hydraulic engine, which began pumping in July 1845 (see 5.2). The success of the new drainage venture aided the renewal of the lease with the Clives in September 1845, although it was clear that the Clive engine alone was only a temporary solution and that further expenditure on pumping would be required. By this time the mine working extended along a vein 1.5km in length, with several different landlords competing for the resources of the company for investment to increase production within their own sections. At the northern end of the workings, on land owned by the Mostyns, drainage was also a serious problem and a new drainage level was begun in 1838.

4.16 By the 1850s Talargoch was one of the few profitable mines in Flintshire, despite a depression in the industry and a strike in 1856. In March 1857 the Talargoch Mining Company was founded as a joint stock company, raising capital through the sale of shares. The new company invested in the search for new sources of ore and methods of increasing the depth of workings. The hydraulic engine at the Clive Shaft was replaced in 1862 by a 100" cylinder, housed in a new stone-built engine house (see 5.3).

4.17 This was followed by the sinking of a new shaft, the Mostyn Shaft, at the northern end of the workings and in the early 1870s by the sinking of Walker's Shaft. By the 1870s the mine output was dominated by zinc rather than lead and although production was high the cost of drainage forced the Talargoch Mining Company into liquidation in 1874. By this time there were 15 steam engines working on the mine, as well as two water wheels.

4.18 Attempts to float a new company called the Old Talargoch Mining Company Ltd failed and in 1875 the Talargoch Mining Company Ltd was formed. Although lead production continued to fall the output of zinc was still increasing. However, the costs of production were proving to be an increasing problem and in 1883 the company went into voluntary liquidation. The mine was auctioned in September 1883

and bought be Messrs Hughes and Lancaster of Acrefair, Wrexham, although their tenure was short-lived as underground working finally ceased in May 1884. The reworking of spoil tips continued ore production until 1905, although by 1908 the mine was generally in ruins. Most of the Talargoch shafts were filled in and the buildings demolished in the 1960s, the only structure surviving being the Engine House at Clive Shaft.

4.19 By the 1880s the surface workings were concentrated in four main areas (fig. 5). At the northern end of the mine the Mostyn Shaft exploited the deepest workings using two rotary engines for winding and pumping. Walker's Shaft worked the Panton Vein, drained by an 80" pumping engine, with other steam engines for drawing and tools. The central area of Talargoch had been the focus of activity since the 17th century with several shafts, although latterly with only a pumping shaft using an 80" engine with a 9' stroke, together with a horizontal engine for winding. The area also housed the mine office, smithy, joiners' shop. Fitters' shop, changing houses and stables. Finally, the Clive Shaft drained the western workings using a 100" engine and a horizontal winding engine. There were two dressing floors in operation, one at Coetia Llys at the northern end and the other at Maesyrerwddu, between Talargoch and the Clive Shaft. The former used steam to power a Blake's Patent Stone Breaker, while the latter had a 40' x 3' waterwheel which powered a 34" roll crushing mill made by the Sandycroft Foundry, Deeside and a Blake's Patent Stone Breaker made by Marsden of Leeds. A 12' waterwheel was used for dressing slimes.

5 THE CLIVE SHAFT AREA (fig. 9)

History

5.1 Prior to the development of the Clive Shaft in the mid-19th century the area south of the Newmarket road was known as Lletty Mwyn. It is not known at what date mining commenced in this area, but there appears to have been at least some working during the 18th century, if not earlier, and there was certainly a shaft here by 1803 (Thorburn 1986, 34-5). The Dyserth Tithe Map of 1839 (fig. 3) shows mine workings encroaching into the area, but it was not until the sinking of the Clive Shaft between 1842-45 that any major development seems to have taken place.

5.2 Initially, the new shaft was equipped with a hydraulic engine with a 50" cylinder and a 10' stroke, which had been constructed at John Taylor's Rhydymwyn Foundry. This was installed in a stone-lined underground engine house 50yds below Lletty Mwyn, with water for the engine supplied by a new leat (fig. 1) along the 300' contour from the Afon Ffyddion near Marian Mills. A small reservoir was constructed above Lletty Mwyn, from which the water was carried down the hill in 40"-diameter iron pipes. The engine started operations on 28 July 1845 (Thorburn 1986, 26).

5.3 The underground hydraulic engine was later replaced by a steam engine with a massive 100" cylinder and 10' stroke, housed in a new stone-built engine house constructed on the surface next to the shaft by a local man, Thomas Roberts, and his sons in 1860. The engine was built by the Haigh Foundry, Wigan and the pumping beam weight 85 tons and was cast in three pieces. The engine apparently worked 24" and 25" bucket lifts at around 3½ strokes per minute. The boiler house contained seven egg-end boilers supplied with water from the earlier leat and reservoir. A 24" x 4'6" horizontal steam engine was used for the capstan and winding at the nearby Drawing Shaft (Thorburn 1986, 38).

5.4 The 1st edition 6" Ordnance Survey map (fig. 6), surveyed in 1871, shows the Clive Engine House with the boiler house to the east, a flue leading to the chimney and an aqueduct carrying the supply of water from the leat contouring the hill above. Other structures are shown to the west of the engine house and to the south-east. The 2nd edition 25" Ordnance Survey map published in 1899 (fig. 7) shows the site after it fell into disuse in 1884, although the main structures can be clearly identified along with the reservoir (labelled weir) on the leat above.

Clive Engine House

5.5 The massive three-storey engine house is constructed of roughly dressed, local limestone with lime mortar and walls battered slightly inwards towards the top. The building is supported on a substantial stone plinth.

5.6 The south elevation (pl 1) is dominated by the large arched doorway surmounted by a keystone bearing the date 'AD 1860'. A small arched window in the upper floor has two square openings beneath. Both arches are of more finely-dressed stone. The iron fittings for downpipes survive on both southern corners. There is a noticeable crack in the jointing above the arch of the doorway,

although there is no sign of significant movement, and there have been some minor repairs to the pointing using cement mortar.

5.7 The north elevation (pl 2) is open at second-floor level with weatherboarding above. The pumping beam would have been supported and pivoted on the north wall, known as the bob-wall, at second-floor level, with an external platform projecting on either side, supported on joists set on the wall at the base of the opening. An arched window at ground floor level has two large sockets below to either side and a substantial timber set in the wall above with a single central socket above. A large arched opening in the plinth connected the plug rod chamber to the shaft.

5.8 The west elevation (pl 3) also has a door at ground level, with single windows on each floor, vertically aligned, all with flat, stone arches, and a smaller square window between the first and second floors with a timber lintel.

5.9 The east elevation (pl 4), facing the boiler house, is fairly plain with a doorway on the ground floor and windows on the first and second floors. All openings have timber lintels which appear to be iron-bound. At the northern end of the plinth the cast iron plates of three tie-rods are visible, which presumably run the width of the building to provide additional strengthening for the load of the pumping beam on the north, bob-wall. It is not clear where the pipework from the boilers entered the building, but brickwork and rubble at the base of the plinth may indicate a buried opening.

5.10 The interior has been stripped of all fixtures and fittings, although traces of the internal arrangements survive. The huge composite sandstone cylinder base is set in the centre of the ground floor, to the north of which is a large pit to accommodate the plug rods. The first and second floors were originally plastered, the remains of which preserve the position of the stairs on the east wall (pl 5). There are sockets for the floor joists at first and second-floor levels, the floors presumably forming galleries around the cylinder.

5.11 The roof is of simple construction (pl 6) and survives largely intact. The rafters and roofing laths are mostly intact but are likely to be unsound, although most of the slate roofing survives. The ridge is capped with ceramic ridge tiles and the bargeboards on either gable originally had wooden finials, although the southern is now missing.

Boiler house

5.12 The remains of the boiler house lie against the eastern side of the engine house. Little is now visible, save for a small section of brick walling on the northern side, which may not be original, while the eastern side has been buried by recent dumping. Analysis of the Ordnance Survey mapping of the late 19th century (figs 6-7) suggests that the boiler house may have measured up to 24m north-south and 018.5m east-west, although it would appear that the part extending beyond the northern limit of the engine house may have been unroofed. An access road leading to the boiler house from the north would presumably have been used to supply the large quantities of coal which the boilers would have required. The seven egg-end boilers were presumably aligned north-south and stoked from the northern end of the boiler house. The geophysical survey has identified a buried structure within the boiler house which may be the supporting wall for the northern end of the boilers.

5.13 Evidence from the earthwork and geophysical surveys, as well as from the Ordnance Survey 1st edition map, suggest that a flue ran along the southern end of the boiler house, continuing south-east to the base of the chimney (pl 11), of which little now remains. The surviving stonework suggests a square plinth roughly 6.3 x 6.3m with a circular chimney 2.8m diameter internally at the base.

5.14 Water for the boilers was supplied via the aqueduct, composed of 40"-diameter iron pipes, which had originally been constructed in the 1840s to supply the hydraulic engine. There is no trace of any structure leading downslope from the reservoir to the east of the survey area, and in particular there is no evidence to suggest how the aqueduct was carried across the line of the later railway. At the base of the steep slope, within the survey area, the line of the aqueduct can be traced as a shallow gully, leading westwards to join a substantial embankment (pl 12). The geophysical survey has suggested that this may be a masonry structure, rather than a simple rubble bank. At the western end the aqueduct turns north and then west towards the boiler house. It is not known whether the water was supplied to the hydraulic engine via pipework down the main Clive Shaft, or perhaps via a separate 'drop shaft' later obscured by the boiler house.

The Clive Shaft

5.15 The shaft opening is roughly oval in shape, measuring 5.9 x 5.7m and stone-lined, with some brick infill in sections. A small active drain discharges into the shaft on the north-west side, the water from which disappears suggesting that the shaft is not properly capped. The shaft is presently blocked by rubbish but the extent and stability of the blockage is unknown.

5.16 To the west of the engine house the remains of two structures are visible on top of the substantial spoil tip. A stone and brick-lined, arched, drainage culvert (pl 7) lies close to the north-west corner of the engine house, which would have carried water raised to the surface by the pumping engine. Beyond this are the remains of the balance bob-pit (pl 8), consisting of masonry foundations on the east side of a depression, within which are traces of brick lining, although the whole is infilled and overgrown. The geophysical survey has also identified a possible structure immediately to the west of the engine house, although its function is unknown.

The Drawing Shaft

5.17 Lying south-west of the engine house, the Drawing Shaft remains open to some depth, surrounded by a wire fence. There is now no surface evidence for the headgear which would have stood over the shaft, although the remains of the engine base for a horizontal steam engine can still be identified to the south of the boiler house (pls 9-10). Some masonry survives, together with fixing bolts for the engine which would have been powered using steam from the main boilers. The surviving remains, together with evidence from the Ordnance Survey 1st edition map, suggest that the engine bed was originally *c.* 13 x 4m, with the winding drum on the south-east side, aligned to the Drawing Shaft.

5.18 The substantial spoil tip surrounding the shaft has several levelled platforms around its base, particularly on the west side, which may have been for small structures or shelters. The geophysical survey has identified what may be the trace of a fence surrounding the spoil tip to the south and east, together with the buried foundations of a wall to the south-east of the chimney, both presumably enclosing the active mine complex during the mid to late 19th century.

Shafts and earlier workings

5.19 As indicated above, the general area known as Lletty Mwyn may have been worked from the 17th century and a number of shafts and possible shafts have been identified, both as earthworks and geophysical anomalies. The earthwork remains of a whim circle have been identified to the south of the chimney, consisting of a flat area partly surrounded by a roughly circular bank 13.5m in diameter. A central post would have supported a horse-drawn capstan for winding at one of the adjacent shafts. A well recorded by the Ordnance Survey remains open but fenced and appears similar in nature to the Drawing Shaft, although there is no spoil tip surrounding it. None of the shafts appears to be actively subsiding, although this must not be taken as an indication of stability. It is possible that further shafts lie within the area which were not detected by the surveys.

Other features

5.20 The geophysical survey has identified the main access road leading into the site from the north-west. The road leads up a ramp to the main entrance to the engine house, on its south side. It would seem likely that this was the access used to install the engine and pumping beam, and later for their removal.

5.21 A number of narrow linear anomalies have been identified by the geophysical survey which may be drains or gullies. Those areas of the site not occupied by substantial mine workings have faint surface traces of linear ploughing running downslope from east to west. These were too faint to be included in the topographical survey, but have been identified clearly by the geophysical survey.

6 CONCLUSIONS

6.1 The Clive Engine House is the last surviving remnant of what was once an extensive mining complex known as Talargoch, and is the best preserved example of a Cornish style engine house in North Wales. The engine house is surrounded by the remains of other structures and mine workings and represents an important relict mining landscape which evolved during the 18th and 19th centuries.

6.2 Although mining is likely to have taken place in the general area from at least the Roman period, it was not until the 17th century that any significant activity seems to have occurred. The Clive Shaft itself was sunk between 1842 and 1845, although the area had already been worked by at least the 18th century. The Clive Shaft was originally equipped with an underground hydraulic engine to pump water from the southern end of the Talargoch Mine, but this was replaced with a steam engine in 1860-62. The new engine was housed in a purpose-built engine house and remained in operation until the mine closed in 1884.

6.3 The archaeological surveys have identified the main structures associated with the engine house, including the boiler house, flue, chimney, drainage culvert and bob-pit, as well as revealing other mine workings and structures. Some of these were contemporary with the engine house, such as the base of the steam engine winding at the Drawing Shaft, while others, such as a whim circle and numerous shafts, are likely to belong to earlier phases of activity.

6.4 The engine house and associated structures have considerable potential for display and interpretation and could be used to present the area's rich mining history to the general public.

7 RECOMMENDATIONS

Clive Engine House and shaft

7.1 The engine house is protected as a Scheduled Ancient Monument and consent should be obtained from Cadw: Welsh Historic Monuments before undertaking any works which might affect the structure.

7.2 The engine house appears to be in good condition, largely due to the roof having survived. In order to protect the structure for the future the roof should be replaced, using as much of the original materials as possible. The roof timbers should be assessed and while the main trusses may be sound, the purlins, rafters and particularly the laths may need to be replaced. The timber lintels should be assessed and may need to be replaced. There is a significant covering of ivy on all but the south elevation and this should be removed to allow the masonry to be repointed using a sympathetic cement-free, lime putty mortar.

7.3 A detailed building survey should be undertaken once the ivy has been removed, including internal and external elevations and the ground floor plan. The exterior should be inspected for new structural details before repointing, but it may be more appropriate and practical to record the external elevations on completion, once any scaffolding has been removed. The interior retains traces of the original plasterwork which have preserved detail such as the position of the stairs and this, together with other internal features, should be recorded prior to consolidation works being undertaken.

7.4 It may be deemed appropriate to conduct limited cleaning and excavation along the base of the east wall, in the area where a possible brick structure has been identified within the boiler house. The dump of rubbish in the north-east corner of the boiler house should be cleared. Limited excavation should also be considered to expose more of the drainage culvert to the west of the engine house, and in particular the bob-pit. The latter should also be cleared of vegetation and both structures consolidated.

7.5 The stability of the Clive Shaft is unknown and, although the upper part is now filled with rubbish, it is unclear whether the shaft has been capped below this, or is merely blocked. The safety of the shaft will need to be assessed, but in any event the rubbish should be removed and the top of the shaft covered with a metal grate.

Ancillary structures

7.6 The base for the horizontal winding engine should be cleared of vegetation and consolidated. Limited cleaning and excavation should be considered in order to reveal and record more of the structure and the area of the winding drum on the south-east side.

7.7 The Drawing Shaft remains open and vegetation should be cleared from around the shaft to allow it to be securely fenced and covered with a metal grate. The area surrounding the shaft may contain evidence for the headgear and the facility for archaeological recording should be incorporated into the works programme.

7.8 The base of the chimney should be cleared of vegetation and consolidated. Limited cleaning and excavation should be considered to reveal and record more of the structure.

7.9 The Well remains open and vegetation should be cleared to allow it to be securely fenced and covered with a metal grate. The area surrounding the well may contain evidence for a winch and the facility for archaeological recording should be incorporated into the works programme.

7.10 Numerous shafts, or possible shafts, have been identified to the east and south of the engine house, the stability and safety of which are unknown. The whole area to the east of the boiler house and chimney could raise health and safety issues if it were intended to be open to the public. The various mining features within this area do not require any consolidation and future management should consider restricted grazing to control the vegetation.

8 ACKNOWLEDGEMENTS

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Rhual Mss., 47-8 (1660)

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UCNW Mostyn 7048, 1799 Map of Talargoch Mines

UCNW Mostyn 7035, Mine Map

Cartographic Sources

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1736 Map of the Earl of Plymouth's land at Talargoch. Surveyor un-named. Scale 24.2" to 1 mile (CROH NT/M/9, photocopy of NLW Plymouth Deeds 1550)

1778 Map of Meliden Town Field". Scale 35" to 1 mile (CROH NT/M/33, photocopy of UCNW Bangor, Mostyn Mss. 8543)

18th-century Plan of Rhyd Demesne belonging to Edward Pennant of Bagillt. Surveyor un-named. Scale 13.3" to 1 mile (CROH NT/M/29, photocopy of UCNW Bangor, Mostyn Mss. 8578)

1814 Map of Dyserth Hall in the County of Flint, Estate of the Right Honourable Earl of Plymouth. Surveyor un-named. Scale 13.1" to 1 mile (CROH D/DM/540/5)

1834-5 Ordnance Survey Plan 343 2" to 1 mile

1839 Dyserth Tithe Map

1839 Meliden Tithe Map

1840 Map of Dyserth Hall, property of the Right Honourable Mr Clive. Surveyed by R. Piercy. Scale 20" to 1 mile (CROH D/DM/540/6)

1858 Rhyd Estate Map (CROH D/BD/149)

1878 Ordnance Survey 1st edition 6", surveyed 1871, Flintshire Sheet 4

1885 Talargoch Mine Abandonment Plans (CROH AB125/132)

1899 Ordnance Survey 2nd edition 25", Flintshire Sheet 4.4

1913 Ordnance Survey 3rd edition 25", Flintshire Sheet 4.4

Ordnance Survey provisional edition 6", Flintshire Sheet 4NE

1970 Geological Survey of Great Britain.1:63,360, Rhyl Sheet 95 Solid and Drift

Aerial Photographic Sources

CPAT Oblique aerial photographs

CS93/66/06

86-MB-554

935103-53/4 (RCAHMW)

RCAHMW Vertical aerial *photographs*

RAF 108/58/2196/19 to 22, dated 14 June 1957

Geonex 172/92/079, dated 31 October 1992

Meridian 033/74/068, dated 13 June 1974

APPENDIX 1

CLIVE ENGINE HOUSE, TALARGOCH MINE, DYSERTH, DENBIGHSHIRE SPECIFICATION FOR AN ARCHAEOLOGICAL SURVEY BY THE CLWYD-POWYS ARCHAEOLOGICAL TRUST

1 Introduction

1.1 The Contracts Section of the Clwyd-Powys Archaeological Trust has been approached by WS Atkins to prepare a specification and quotation for undertaking a programme of archaeological recording relating to a programme of reconsolidation work on the Clive Engine House, Talargoch Mine, Dyserth (SJ 05637996). A Consultancy Brief has been prepared by Denbighshire County Council which details the work required, of which the archaeological survey forms a part.

1.2 The Clive Engine House is the best preserved example of a Cornish-style engine house in North Wales and is protected as a Scheduled Ancient Monument (SAM FI 136). The engine house was constructed in 1860 and continued in use until 1884. The three-storey engine house is constructed of dressed limestone with fine architectural features externally and internal features including the base of the cylinder. Associated features such as the boiler house, which had seven boilers, and the chimney, no longer survive above ground. Apart from the pumping shaft, two other shafts are known within the area which may also contain further earthwork and buried features relating to the mine.

2 Objectives

2.1 The objectives of the survey are:

2.1.1 to locate and sample, by means of geophysical prospecting and strategic trial trenching, all archaeological features within the area of the route corridor, as indicated in the brief, in so far as these aims are possible;

2.1.2 to prepare a report outlining the results of the evaluation, incorporating sufficient information on the archaeological resource for a reasonable planning decision to be taken regarding the future management of the archaeology.

3 Methods

3.1 Stage one of the study will involve the examination of all the readily available primary and secondary documentary, cartographic, photographic and aerial photographic sources. Repositories consulted will include the following: County SMR, CPAT, Welshpool; the National Monuments Record, RCAHMW, Aberystwyth; the National Library of Wales, Aberystwyth; County Records Office, Hawarden.

3.2 Stage two will involve a survey of the standing structure. Given the present vegetation cover and lack of scaffolding, and following discussions with Fiona Gale, County Archaeologist, it has been decided that any drawn record would at this stage be difficult to undertake and could be better achieved at a later stage. It is therefore proposed that the survey consists of a photographic survey of the standing structure, together with a written description of the fabric. The photographic survey will be conducted in 35mm format, black and white print and colour slide. Annotated copies of the photographs will be included in the report, detailing specific features. All survey work will be subject to the constraints of health and safety which may restrict access to the interior.

3.3 Stage three of the study will involve a detailed topographical survey of the area outlined in the brief, totalling around 1.7ha. This will be undertaken using total station surveying to record all standing structures in plan, together with earthworks and sufficient spot heights to produce a contour model of the site with contours at 1m intervals.

3.4 Stage four will consist of a geophysical survey of the whole area, totalling around 1.7ha, using electrical resistivity. Three options are proposed with further details being provided in the accompanying geophysical specification: electrical resistance survey conducted along lines 1m

apart with readings at 1m intervals; electrical resistance survey conducted along lines 1m apart with readings at 0.5m intervals; ground probing radar with more detailed topographical survey.

3.5 Following the on-site work an illustrated and bound report will be prepared combining the results from the archaeological surveys, as well as a geophysical survey undertaken under separate contract by another agency. This will be in A4 format and contain sections on: Summary; Introduction; Site location; Topography and Geology; Building Survey; Topographical Survey; Geophysical Survey; Conclusions and Recommendations and References.

3.6 The site archive will be prepared to specifications laid out in Appendix 3 in the Management of Archaeological Projects (English Heritage, 1991).

4 Resources and Programming

4.1 Stages 1-3 will be undertaken by members of CPAT's staff experienced in documentary research, building recording and archaeological survey. The geophysical survey will be sub-contracted to ArchaeoPhysica, 77A High Street, Newport, Shropshire. Overall supervision will be by Mr RJ Silvester, a senior member of CPAT's staff who is also a member of the Institute of Field Archaeologists.

4.2 All report preparation will be completed by or with the assistance of the same field archaeologist who conducted stages 1-3 and in conjunction with ArchaeoPhysica.

4.3 The following timing is anticipated:

Desktop study	2 days
Building survey	1 day
Topographical survey	2 days
Geophysical survey	2 days
Report	4 days

4.4 Requirements relating to Health and Safety regulations will be adhered to by CPAT and its staff and sub-contractors.

4.5 CPAT is covered by appropriate Public and Employer's Liability insurance, as well as Professional Indemnity insurance.

N.W. Jones
18th December 2001

APPENDIX 2

SITE ARCHIVE

Photography

Colour slides nos cs02/11/05-31
Black and white negative film no 1161
Colour print film nos 1158 and 1159

Digital ground survey

Penmap 3.5 (raw survey data)
- clive.pts
- clive.dxf

AutoCAD13 (rectified to OS coordinates)
- 979surv.dwg
- 979surv.dxf

Mapinfo (rectified to OS coordinates)

earthwk.tab	earthwork survey
cont05.tab	0.5m contours
interprt.tab	archaeological interpretation

Geophysical survey

geophys.tab	geophysical survey anomalies
clivegeo.jpg	geophysical survey plot

ArchaeoPhysica Ltd 2002. *Geophysical Survey at Clive Engine House, Talargoch Mine, Dyserth, Denbighshire*

APPENDIX 3

GLOSSARY OF MINING TERMS

Balance-beam Beam attached to the pump-rods system.

Bob-pit Pit or box into which the weighted end of the balance-beam rises and falls, thus counteracting the weight of the pump rods.

Boiler house Structure generally attached to the Engine House, containing the boilers which raise steam to power the engine.

Culvert Covered leat or tunnel carrying water.

Dressing floor Area set aside for separating ore from the waste, generally indicated by large spoil tips of fine waste. May include a crusher, jiggers, buddles and settling tanks.

Engine bed Solid plinth on which a steam engine or heavy machinery is mounted. May be of stone, brick or concrete.

Engine house Structure housing a steam engine for pumping or winding. Cornish Engine Houses were developed by Richard Trevithick *c.* 1811 and the term is used as a general descriptive term for vertical steam engine houses, although true Cornish engine houses have their chimneys adjoined at a corner. Water heated in large boilers produced steam which was fed into a cylinder within the engine house. A piston within the cylinder was connected to a balance-beam, causing it to move when steam was injected or released. The balance-beam was connected to pump rods, or via a crankshaft to a winding drum. The size of the cylinder bore determined the power of the engine, so that an engine accompanied by an 80 inch cylinder would be known as an 80 inch pumping or winding engine. Vertical steam engines had been developed for mine use by Thomas Newcomen from 1712, with improved patents from Boulton and Watt Engine from 1765.

Flue A tunnel, general of brick-construction, used to carry fumes and smoke from the boilers to a chimney.

Head gear A timber frame constructed above a shaft with a wheel at the apex, over which a rope would run down the shaft to haul ore/waste to the surface, using power from a horse whim, waterwheel or steam engine.

Horizontal Engine A steam engine with the cylinders sited on horizontal beds; the piston rods attached to a crank and flywheel used for winding.

Horse whim Overhead winding drum within a wooden frame powered by a tethered horse; the horse walked around in a circle, thus raising ore from an adjoining shaft. The coiled rope from the wooden frame ran out to an A-frame over the shaft, which held a pulley wheel. Also referred to as a horse gin.

Horse whim circle Level circular earthwork, within which the whim was sited. Commonly there is a small pit at the centre where a vertical post supporting a winding-drum was located

Hydraulic engine An engine powered by high-pressure water, used for pumping mine workings. Usually located underground, above adit level, to allow for natural drainage of the water providing the power and of that pumped from lower workings.

Leat A man-made watercourse.

Level Tunnel driven into the hillside, generally along the course of a vein, to extract ore.

Open-cut Generally an elongated cut, where mining has progressed down from the surface, or where underground stopes have surfaced.

Rotative beam engine Beam engine used for winding, developed from the 1870s in Cornwall. Also referred to as a whim engine. The reciprocative movement of the beam is transferred to rotary motion by a sweep rod, crank and flywheel.

Slimes Slurry formed by waste and water.

Shaft Vertical or sub-vertical working sunk to underground workings to enable extraction of minerals, pumping water out of the mine or ventilation.

Spoil tip Discarded waste material, which may consist of development rock from sinking a shaft, or processing waste from jigs or buddles.

Stone-crusher Portable belt-driven machinery for breaking up rock and ore.

Vein Mineralized beds within the local rock; generally referred to as the lode.

ERRATUM

Section 6.4 General Discussion

The first paragraph reference to the balance bob-pit is in error. Following discussions between N Jones, CPAT and M Roseveare, ArchaeoPhysica, it has been agreed that there is no evidence of a balance bob-pit to the north of the boiler house and that this feature was located to the west of the Engine House and has not been intentionally infilled.

N W Jones
08/04/02

Fig. 2 1814 Map of Dyserth Hall in the County of Flint, Estate of the Right Honourable Earl of Plymouth (CROH D/DM/540/5)

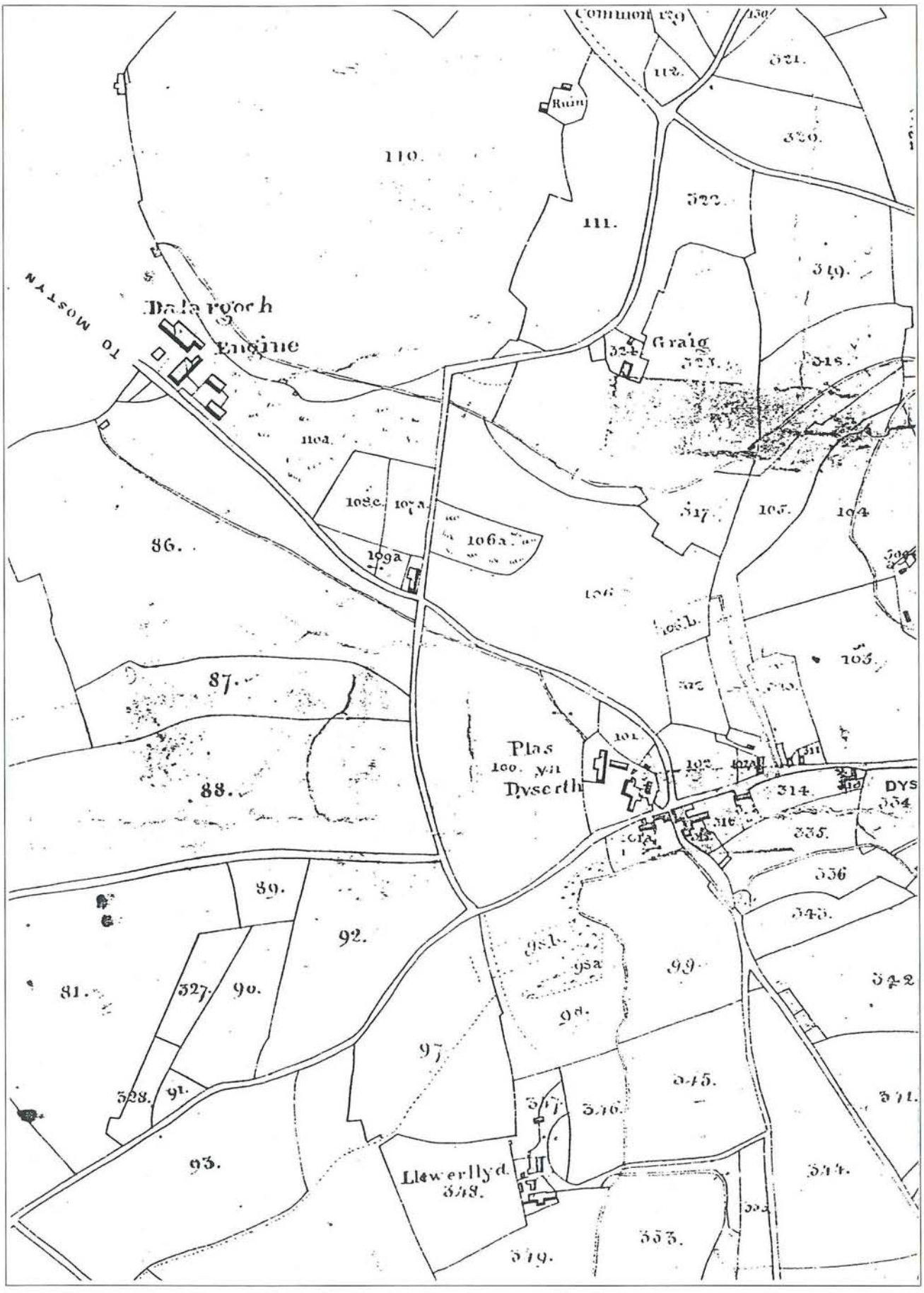

Fig. 3 1839 Dyserth Tithe Map

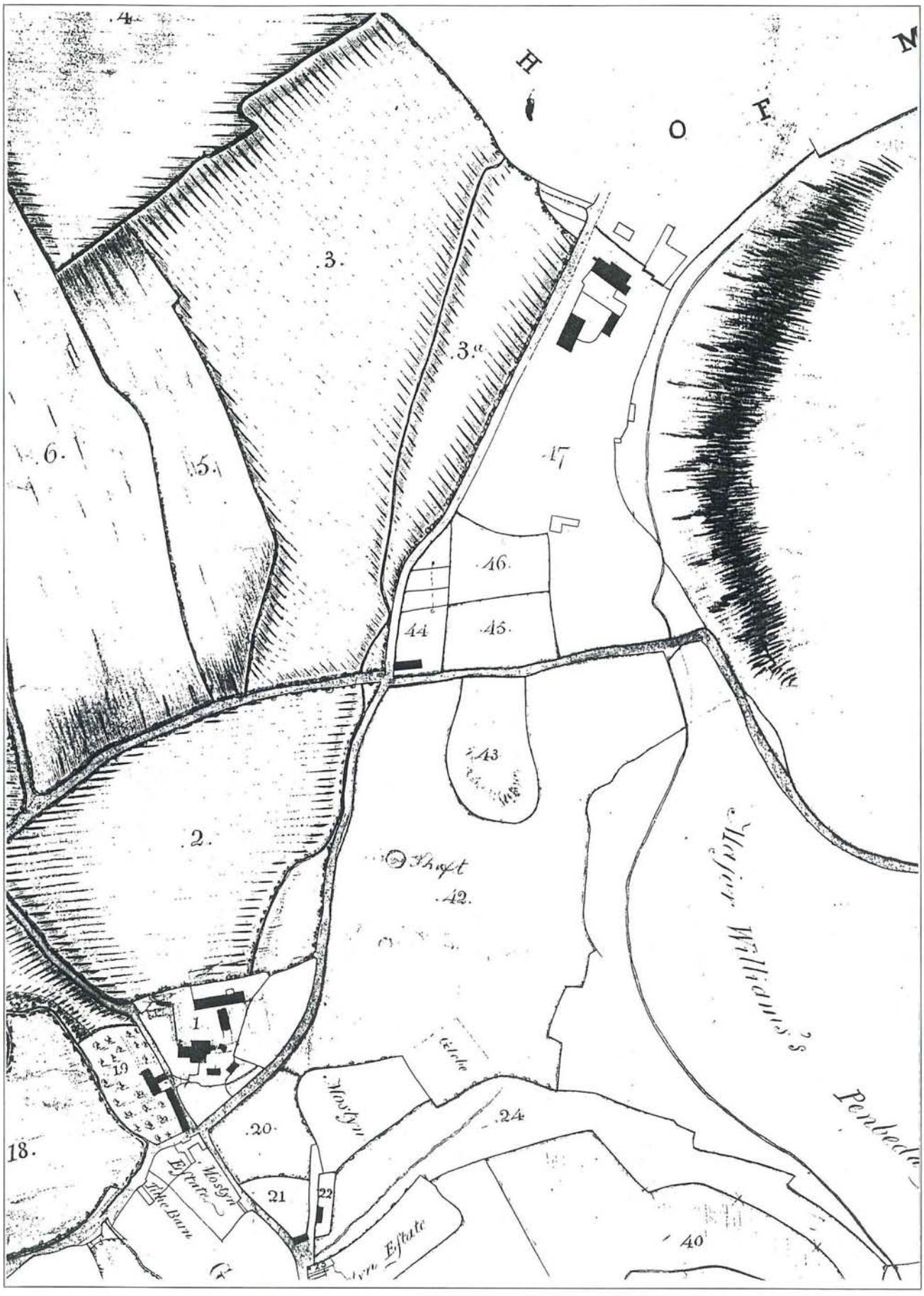

Fig. 4 1840 Map of Dyserth Hall, property of the Right Honourable Mr Clive (CROH D/DM/540/6)

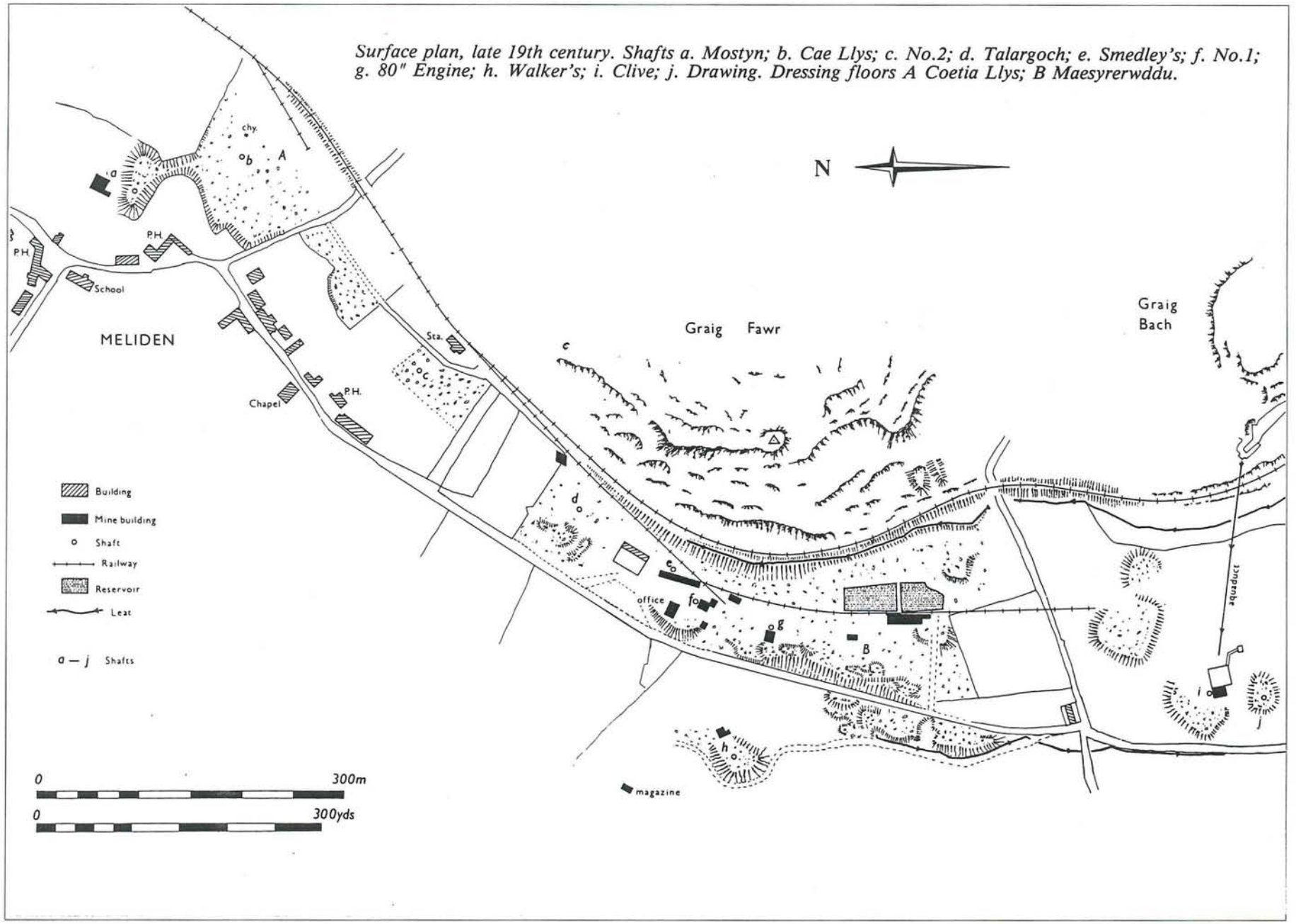

Fig. 5 Late 19th-century surface plan (Thorburn 1986, fig.7)

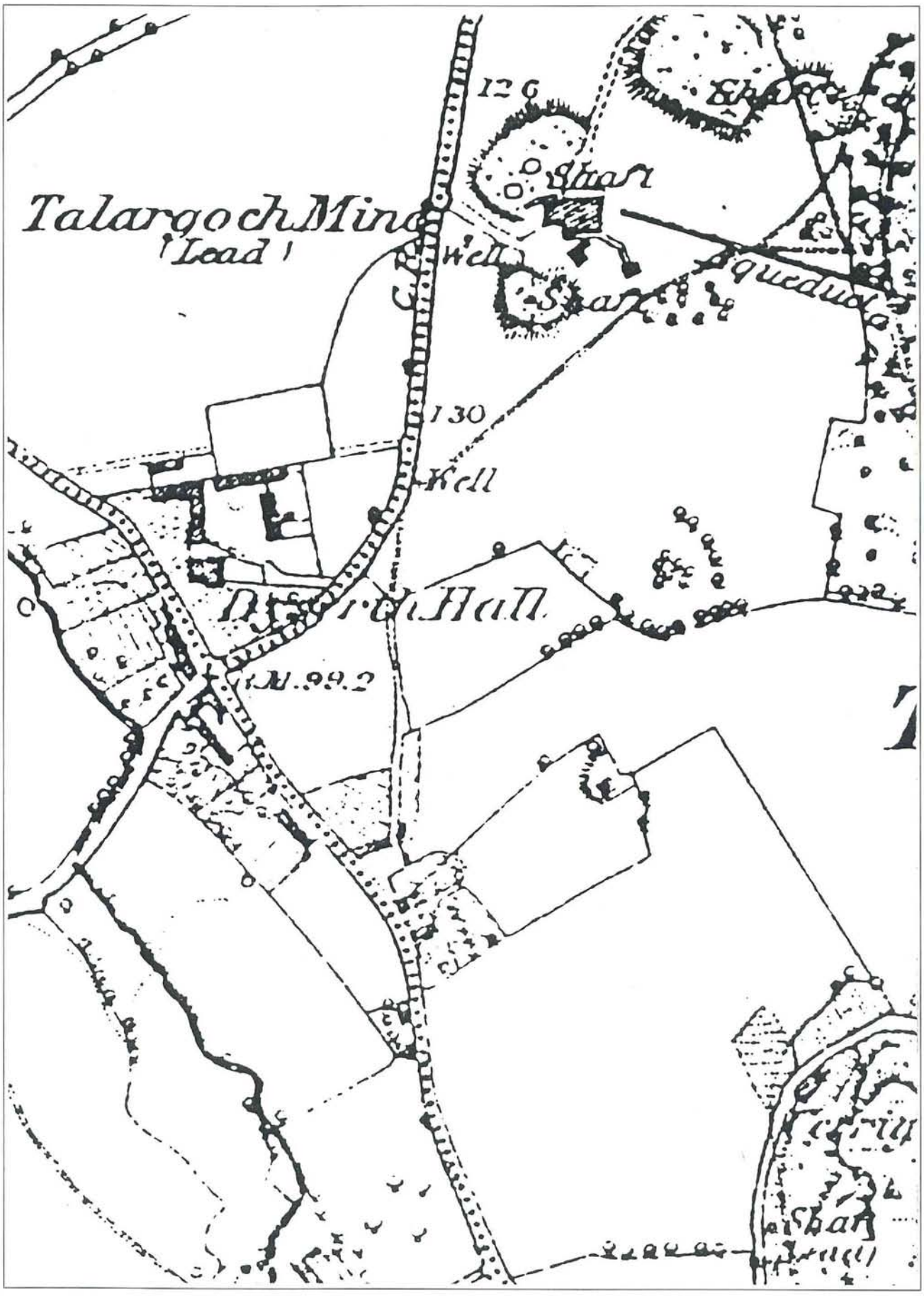

Fig. 6 Ordnance Survey 1st edition 6" map (enlargement), surveyed 1871

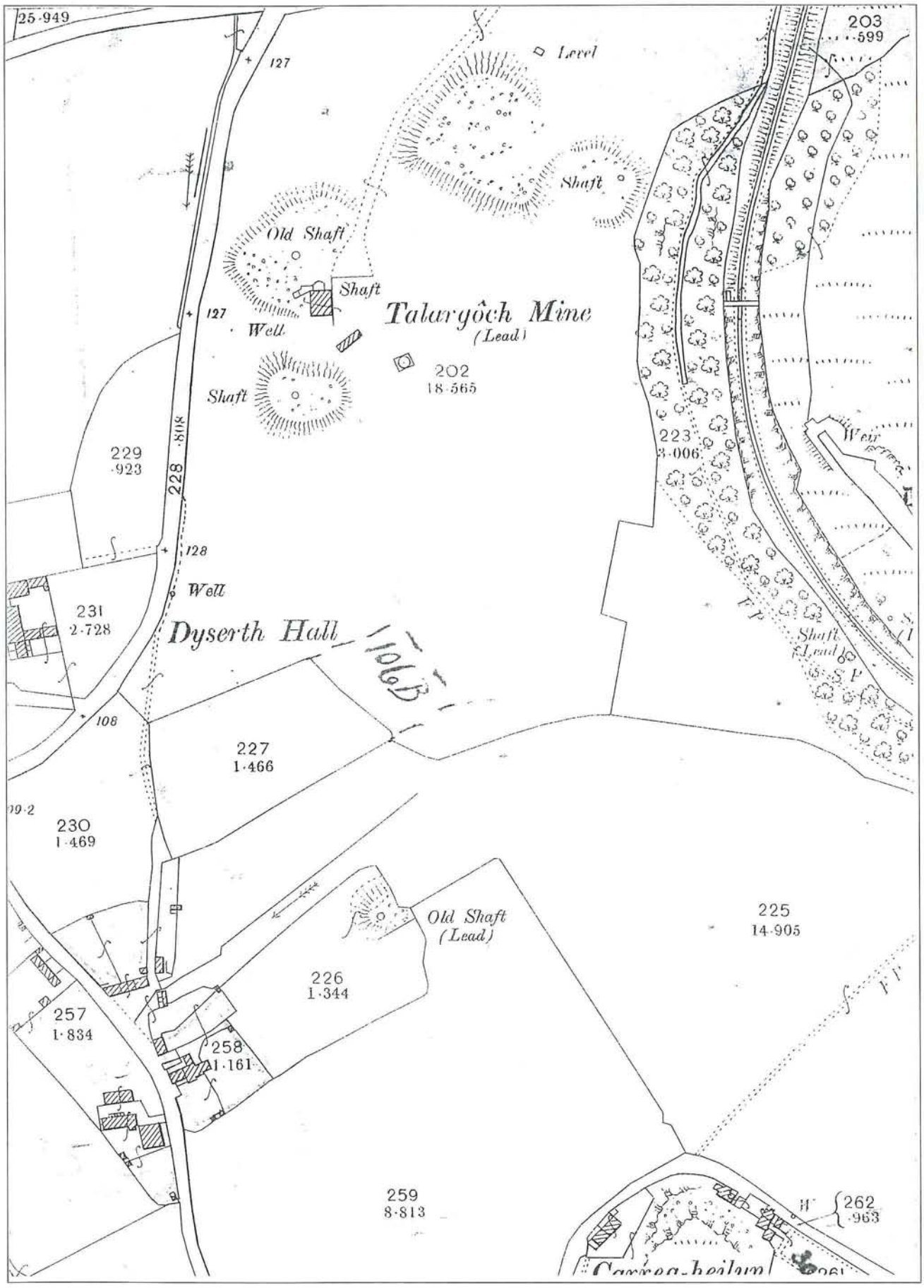

Fig. 7 Ordnance Survey 2nd edition 25" map, published 1899

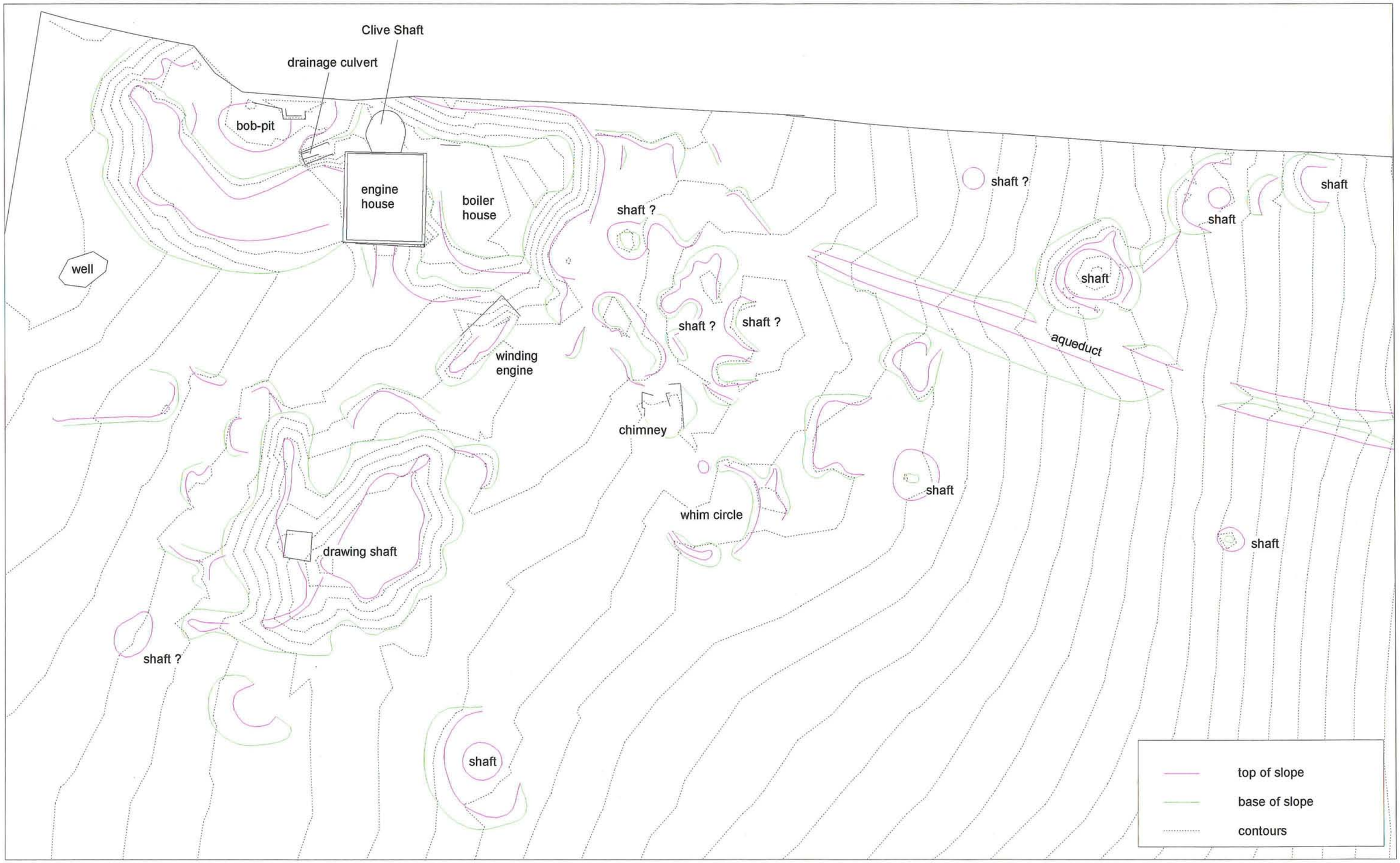

Fig. 8 Topographical survey, contours at 0.5m intervals. Scale 1:500

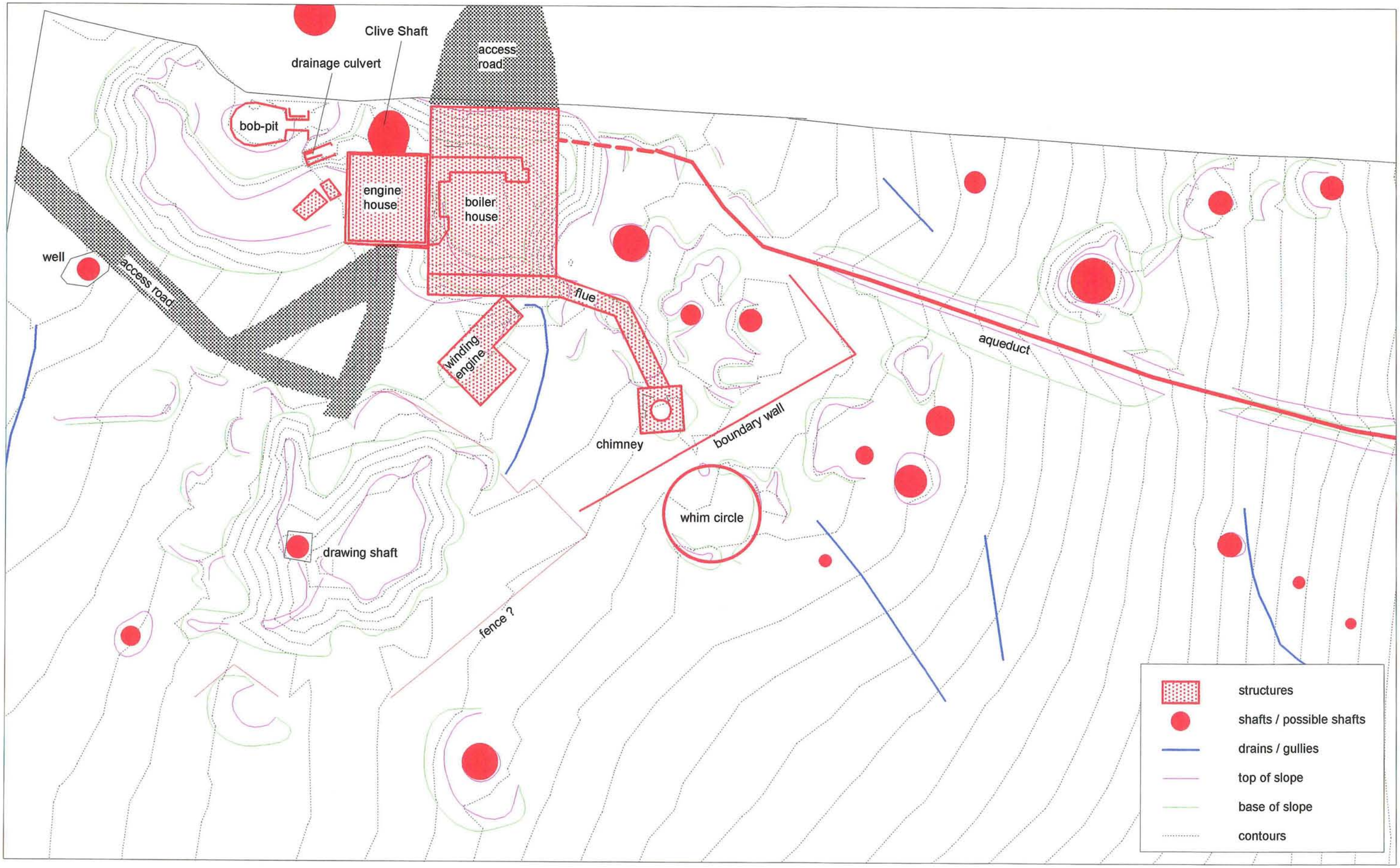

Fig. 9 Archaeological interpretation, contours at 0.5m intervals. Scale 1:500

Plate 1 Clive Engine House from S. Photo CPAT 1158.03

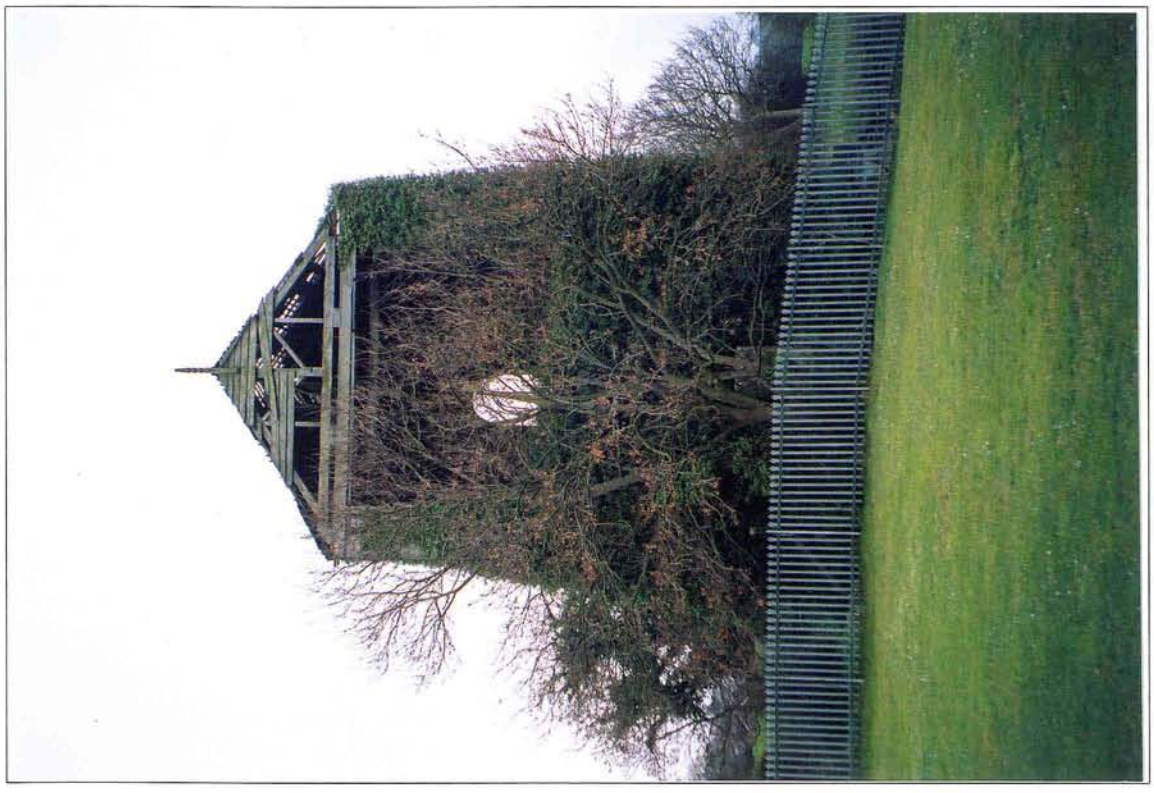

Plate 2 Clive Engine House from N. Photo CPAT 1159.07

Plate 3 Clive Engine House from W. Photo CPAT 1158.02

Plate 4 Clive Engine House from E. Photo CPAT 1158.04

Plate 5 Clive Engine House: interior E wall showing position of stairs. Photo CPAT 1158.12

Plate 6 Clive Engine House: interior of north, bob-wall and roof. Photo CPAT 1158.17

Plate 7 Culvert W of engine house from NE. Photo CPAT 1159.12

Plate 8 Bob-pit from SE. Photo CPAT 1158.08

Plate 9 Clive Engine House and Winding Shaft from SE. Photo CPAT 1158.05

Plate 10 Winding Engine base from SE. Photo CPAT 1158.07

Plate 11 Chimney base from NE. Photo CPAT 1158.06

Plate 12 Aqueduct embankment from SE. Photo CPAT 1158.18

Geophysical Survey at Clive Engine House, Talargoch Mine, Dyserth, Denbighshire

Survey commissioned
by Clwyd-Powys Archaeological Trust Contracting Section
for W S Atkins Consultants Ltd.

Project CEH20011

March 2002

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ArchaeoPhysica
Reconnaissance and Geophysics for Archaeology

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ArchaeoPhysica
Reconnaissance and Geophysics for Archaeology

CEH20011		
Written	: MJR	:23/5/2002:
Checked	: ACKR	:24/5/2002: ACKR
Approved	: MJR	:28/5/2002:

1) Geophysical Survey Objectives and Design

1.1 The brief

The geophysical survey at Clive Engine House (approximately SJ 056 801) was requested by Fiona Gale, County Archaeologist, as part of an assessment of the surface remains of mining activity at this site. It was hoped that the geophysical survey would shed light on aspects of the existing remains that other work commissioned (including documentary research and topographical survey) might not.

1.2 Expected geophysical survey targets

Among the dumps and other earthworks, the remains of buildings and other structures were expected. Ordnance Survey maps (1871 & 1899) and others show buildings and structures including an aqueduct, the Clive Engine House (extant), boiler house and chimney. From a preliminary understanding of the site and surrounding area, there is the possibility of older mine workings and associated structures. The likely preservation of targets was unknown.

1.3 Sampling intervals for detailed area survey

The sampling intervals used for this survey were chosen because they were felt to be the most effective use of resources with respect to the requirements of the project. As some of the targets could be expected to have brick walls, the sampling interval had to cater for mapping relatively narrow features.

2) Description of Survey Work Undertaken

2.1 Grid set out and base map

On submitting the tender, the geophysical survey was to follow other work including the topographical survey by CPAT. Due to time tabling, the geophysical survey was the first part of the fieldwork to start, so a basic plan was recorded as the survey was set out. The position of the straight southern edge of the survey area was located by measuring the distance down the eastern and western field boundaries from the map supplied. This provided the base line for the set out, which was done as specified in the method statement using a Nikon DTM700 series total station. This base line was also used to set out the topographical survey.

2.2 Electrical resistance detailed area survey

The survey equipment used was as specified in the method statement attached to our tender and appended to this report. Data was collected every 0.5m along lines 1m apart and 30m long, at two apparent depths, using probe spacings of 0.5m and 1m. In order to minimise the need to balance grids at the data processing stage, balance points were used to match grids as closely as possible in the field.

3) Practical Aspects of Survey

3.1 Topography

The field sloped and the dumps and earthworks made for difficult terrain in places. As the

survey was set out with care using the total station, the highly variable topography did not affect the accuracy of the grid.

3.2 Ground conditions, access and weather

The trees and scrub interfered with survey in some parts of the site. Where the stability of the ground was uncertain or survey was impractical for other reasons, such as surface structures, steep slopes and thick vegetation, blank areas were left.

4) Retrospective

4.1 Assessment of survey design

The project design was successful in that anomalies representing a range of archaeological features, including those expected, were clearly defined. Given the surface conditions, a more comprehensive coverage would have only been possible with advance information about the presence and state of shafts and other potentially unstable areas. The information gained from this survey is likely to compliment that available from other sources and lead to a better understanding of the mine at this location, though many questions will remain and others present themselves.

5) Data and Processing

5.1 Data processing and visualisation

To prepare the data for interpretation and further analysis, various stages of data processing are required. These remove any instrument defects, minimise the effect of any survey defects, join separate grids into a seamless sheet of data and enhance anomalies of potential archaeological interest.

Some problems with spiking were encountered with the lower layer of data. This was undoubtedly caused by the width of the probe array interacting unfavourably with the sometimes uneven ground - four probes need to be inserted simultaneously with each making good contact. The 'despiking' algorithm was unable to reduce all these to average values and hence several less than ideal data are present in the images of this layer. These have have not been allowed to interfere with the production of clear images and the rigorous statistical processes used in our software can safely ignore erroneous values like these.

5.2 Electrical resistance data

Processing of the data was kept to a minimum as most features were visible in 'raw' data and adjustment of image contrast was sufficient in many cases for bringing out the detail. Data has been 'despiked' using a selective spike removal algorithm.

For presentation, the data is first interpolated from a 1m line separation to 0.5m, maintaining the 0.5m along-line interval. This reduces visual aliasing due to the asymmetric sampling intervals. To increase the visibility of anomalies of potential interest at the expense of others, a variety of techniques can be used. The range of the data to which the colour scale is applied can be clipped to between the 5th and 95th percentiles of the data; the data can be histogram equalised to spread the data more evenly through the colour scale and the data range can be subjected to arctangent compression which minimises the effect of

outlying data.

6) Survey Results

6.1 Notes concerning the interpretation

The colours in the text below refer to drawing DWG 04 which shows the interpretation of the electrical resistance data. Numbers refer to specific anomalies or features depicted on that drawing.

> *This survey was in response to a need to image small near-surface features for archaeological purposes. It should not be used under any circumstances for the study or monitoring of the various mine workings present in this site. A different form of geophysical investigation is necessary for this purpose.*

Many features have been hard to interpret and the intensive land use associated with extraction sites means that in some cases it has not been possible to offer an interpretation.

6.2 Summary introduction

The survey has shown that the basic elements of the nineteenth century OS mapping are correct and have provided some indications of land divisions prior to the sinking of Clive Shaft in the 1860's. From an industrial perspective clear signs of extraction predating the 1871 OS mapping and potentially rather earlier have been noted, based around what would appear to be a system of closely-spaced prospecting or lode-back pits and (presumably) shallow shafts.

Contrary to the OS mapping, the boiler house has been found to the East of the engine house, not the West. In addition the chimney and an underground flue have been discovered, the latter apparently in good condition.

Several shafts or pits have been freshly discovered in the electrical resistance data; it is not known whether these new ones represent the total sunk within the evaluation area or not. These seem to be clustered mainly around a prominent line of dumps crossing the area diagonally a little East of the engine house, apparently running down from the slopes of Graig Fawr. Some isolated possibilities exist, in many cases apparently unrelated to surface features.

6.3 Electrical resistance anomalies caused by capped or choked shafts

Shafts can be present but hidden in pasture in the following forms detectable by electrical resistance survey:

- lined or unlined, capped at depth
- lined or unlined, capped at surface
- lined, choked to surface
- unlined (or 'run-in'), choked to surface

These can present a variety of different anomalies depending heavily upon their type and local soil humidity. A shaft that has been capped at surface is likely to produce only a small anomaly unless the capping material is close to the surface, causing an anomaly through either the close proximity of the underlying void or the capping material itself. Where the cap is more than perhaps 1m below the surface, this sort of shaft may not be detectable

even with the 1m probe spacing used during this survey.
A shaft capped at depth will alter the drainage potential of the area immediately above the cap; if a masonry lining exists water may be trapped with the fill material in preference to without, creating an apparently low resistance anomaly measured at the surface. It would appear very much like any other (shallower) pit. If no lining exists and rock is not immediately below the surface then this alteration of drainage potential can still exist at depth but may not be detectable at the surface.

This can be confused if the fill of the shaft is rubble not soil; depending upon the relative drainage potentials of the surface soil, the fill and the surrounding material the rubble fill may produce a high resistance anomaly. In addition, the lining may itself produce an anomaly if it extends close enough to the surface and is not buried beneath a cap. In most cases this can be expected to appear in the data as a high resistance ring (and would be virtually undetectable in the case of a rubble fill).

Several anomalies exist within the survey area that could be caused by any of these mechanisms but as there is no *a priori* knowledge of shaft locations or the preferred method of sealing old shafts in the locality it has not been possible to classify them according to type. The reader is advised that all pit-type anomalies noted in the interpretation could be either shallow pits or choked shafts; there are a few possible capped examples but these are very hard to detect with any certainty.

6.4 General discussion
No buildings other than the boiler house and related structures have been found which suggests that they were either of lightweight construction, perhaps lacking foundations, or that no other structures existed. The boiler house was a large structure that projected beyond the engine house to the South and was linked by an underground flue to a square-based chimney stack to the Southeast. To the North of the boiler house would appear to be the in-filled balance bob pit associated with Clive Shaft; as this has been intentionally filled alternative provision for the balance bob must have been made elsewhere, perhaps to the West of the engine and partially reusing a depression in the large dump there.

A former field boundary appeared with the evaluation area just to the East of the hedge above the road, implying that although the road has clearly been altered since the construction of the workings it may not have impinged in any way upon the industrial site.

To the Northwest of the boiler house, at approximately (1070, 1080), there is a large pile of dumped rubbish and the collapsed railing around what would appear to be a shaft. The position of this shaft implies it to be the one sunk for the operation of the water engine, fed by the aqueduct which terminates immediately to the East. The stability of this shaft is uncertain and the railing implies that in recent times it was open, even though it is now at least partially concealed beneath scrap metal.

Strong anomalies exist that seem related to changes in the near-surface geology, particularly in the Eastern half of the survey. One set seem to define a rectangular area centred on (1140, 1020) which is probably natural although there is a chance that it is the site of a dump cleared away by reworking or agricultural improvements. As most of these dumps seem directly associated with pits or shafts there is a possibility of a further working in this area that has not been detected by this survey. Another set of very strong anomalies are present as two sets of parallel disturbances, East and West of the large tip around Drawing Shaft.

These are most likely to relate to agricultural improvements and may be the reason why no ephemeral structures have been detected.

The footpath that is depicted on the 1871 OS mapping crosses the field diagonally with a slight bend towards the centre of the survey area. This path has not been detected directly but its course has been found to coincide with a set of pronounced linear anomalies (including wall feature 20) marking former land divisions East and South of the engine house. This implies that these boundaries must have been established prior to 1871 and must be at least contemporary with the working of Clive Shaft if not before. The Southern part of this boundary is marked by an abrupt linear change in apparent resistance that partially encloses the large dump around the mouth of Drawing Shaft. This is thought to be caused by a thin layer of material that has built up against a fence or wall after eroding from the face of the dump. This area of higher resistance values extends beyond the dump to the West and may indicate a surfaced yard. The footpath seems to follow the East side of the boundary which, from the proximity of the dump, encloses the surface works of the mine. It may be relevant to note that the 1871 mapping shows other workings further East to be tree-covered and therefore probably disused. These were also East of the boundary and were therefore probably outside the enclosed area containing Clive and Drawing Shafts, perhaps indicating an earlier phase of working.

The OS have indicated that a well existed West of the engine house. This would, however, appear to be the top of a masonry-lined shaft identical to Drawing Shaft. A narrow passage led into the top of this shaft from the direction of the Engine house and continued beyond to towards the road. This would appear to have taken water from the rising main in Clive Shaft and allowed it to drop into the shaft, presumably to provide a simple form of ventilation. This particular method has been noted on fairly early sites where ventilation was required and the exhaust from pneumatic rock drills was not suitable or available. It may be relevant that no compressor house has been located during this evaluation which would imply that any shot holes for blasting were hand-bored.

Various discrete low resistance anomalies have been recognised in the data that do not appear to correlate with any known structures and in some cases conflict, e.g., feature 1 which is below the dump West of the engine house and feature 2 which is within the boiler house but circular in contrast to the rectangular structure around it. These may be old surface workings that have been filled in before the construction of the engine house or earlier.

6.5 Specific anomalies and features

6.5.1 Features 1, 2, 3 & 4

As noted briefly above, these are discrete low resistance features, possible in-filled surface workings predating the 1860's engine or earlier. There is little that can be said about them.

6.5.2 Features 5 & 6

The structure of the boiler house is indicated by feature 5 and is a rectangular building projecting a little beyond the engine house to the South and extending as far North as the bob wall. In the middle of the engine house wall there is a brick structure, probably an opening below the present ground level, through which it is presumed steam pipes were conducted to the engine. There is no sign of this within the engine house but it would be below the level of the cylinder loading. The dimension of the boiler house East to West is unknown but it is clear from its position that it must have been intended to power the horizontal engine immediately to the South and winding from Drawing Shaft. The loading

of this survives and the drum would appear to have been on the West side of the loading. Two bolts project from top and there is a socket for an 8" square timber set vertically into its West face.

A large deposit of rubble, feature 6, buries and obscures the Southern end of the boiler house where there is a slight terrace which seems to have formed the ends of the individual boiler flues and connected them with a curving underground flue, feature 12, that connects with an isolated chimney, poorly resolved in the data but visible on the surface as a square-based stone stack. This flue would seem to be intact, with the possible exception of its Southern end against the chimney where a slight bifurcation in the anomaly suggests that the side walls have been detected rather than the covering slabs which might therefore be missing.

6.5.3 Feature 7
This appears to be a small masonry structure adjacent to the West door into the engine house and at the end of what could be a paved access up the side of the dump against the engine house plinth. Its purpose and exact interpretation are unknown.

6.5.4 Complex 8
These broad and approximately linear high resistance anomalies are heavily metalled road surfaces, one leading into the site from the road as depicted on the 1871 OS mapping. Some traces of this metalled surface are visible, hence the certainty of interpretation. An important element of this complex is the road leading from the cylinder door of the engine house towards Drawing Shaft. This was almost certainly constructed as part of the engine house and would have been the way that heavy articles, e.g., the cylinder and bob, were brought into the house. This angle demonstrates how wagons would have been brought in from the road and then turned to face towards the cylinder door to be unloaded. A particular point to note is that the North face of the dump around Drawing Shaft seems to have been recessed to accommodate the end of this road, either to allow access by wagons during construction or removal of the engine. This also demonstrates that the bob was brought into the engine house through the cylinder door and not winched onto the bob wall across the shaft which was an alternative system in use.

6.5.5 Pit features, 9
These two features are enigmatic. The Northeastern one is marked on the surface by a shallow depression and is likely to be a choked shaft or deep pit but the other is harder to understand and may be just be the edge of the possible yard surface noted in section 6.4, above.

6.5.6 Unclassified feature 10
This could not be interpreted. It would appear to be a small discrete high resistance feature similar to another about 15m to the Northeast. These seem to be associated with slight earthworks adjacent to the edge of the dump and may be footings for ancillary structures. It is also possible that they are rubble-filled pits.

6.5.7 Ditch feature 11
This is a faint anomaly that is difficult to assign a purpose to. It may have been a drain.

6.5.8 Complex 13, 14 & 15
These are the remains of the aqueduct built in the 1840's to feed a water engine in a shaft near the later boiler house but is now lost. The aqueduct comprised an iron pipe on a

masonry footing that extend most of the way down the hillside. The geophysical survey has discovered three significant aspects of its appearance and function. It was constructed on a masonry base rather than a rubble footing so the appearance of the present earthwork is deceptive. This continues up the hillside until the masonry is replaced by a narrow ditch that runs most of the way to the Eastern field boundary but then stops. This demonstrates that the builders maintained a constant slope for the pipe rather than simply following the shape of the hillside and the uphill end of the pipe was likely therefore to be a little below ground level. There are no signs of masonry footings or other structure continuing up the hillside beyond to the leat so the pipe was apparently fed from a shallow adit somewhere near the field boundary, either drainage from the mine or taking water from a drop shaft connected to the leat. This may be supported by a non-prompted comment from a bystander that there used to be an opening in the hillside somewhere in this vicinity from which a dog once had to be rescued. It contradicts the OS 1871 mapping, however, that mapping also incorrectly identifies a well so it is possible that there are errors.

At the other end of the masonry is a diffuse structure that appears to be a rubble bank which connects with the splayed end of the masonry which has turned Northwards here. This bank would appear to turn Westwards again towards a shaft that seems to have existed just Northwest of the boiler house and presumably supported a launder or pipe entering the top of the shaft. The masonry splay was probably part of a bypass system that allowed water to be channelled away from the water engine shaft during maintenance, etc..

6.5.9 Complex 16

This is a problematic set of anomalies to interpret. It may coincide with a shaft marked on recent OS maps (e.g. the copy supplied with the brief) but there is open no shaft there now. The earthworks enclose a small almost circular area and contain rubble walls or banks with a masonry structure set into the Northern arc. In the centre of this enclosure there is a discrete high resistance anomaly, surrounded by an area of low resistance, itself defined within another high resistance ring. This could be the top of a large shaft but the anomalies are hard to understand if this is the case. A potentially more likely interpretation is that it is the remains of a horse whim, possibly part of the disused workings immediately to the Northeast or a precursor to the steam whim on Drawing Shaft (or both). Immediately to the Northwest of this feature there is a small conical depression that did not produce a distinct geophysical anomaly but may be the shaft that the recent OS maps refer to.

6.5.10 Complex of dumps and workings, 17 to 19

These are a very interesting group of low earthworks in the form of mounds and cresent-shaped banks that were apparently covered by trees in 1871 and are therefore likely to be early workings, perhaps predating the 1840's expansion of Talargoch Mine into this area. The geophysical data shows three discrete stony dumps with noticeably straight-sided sections in places suggesting that they are reveted in masonry. 17 and 18 both have pit-type anomalies in their tops which are almost certainly shafts while 18 and 19 have additional anomalies marking curving stony banks immediately adjacent to them. These both include more pit-type anomalies and are therefore probably collars around more shafts or lode-back pits. Further pit-type anomalies are features 27 and 28 which may be part of this group. All these lay on a diagonal line passing through the site which includes the massive collar around the plugged shaft at approximately (1150, 1070) which does not appear on any maps we have seen. Beyond this to the Northeast further, much smaller collars, exist on the same alignment but curving slightly more to the East towards an extant early openwork cut into the lower slopes of Graig Fawr. It is tempting to regard these workings as an attempt to follow a lode exposed by the openwork deeper underground and some of these workings

may be of considerable antiquity.

6.5.11 Wall 20
This thin linear feature was thought to be a rubble bank but close inspection of the deeper electrical resistance data shows the anomaly to have a very distinct core and therefore the feature is more likely to be a wall, part of the series of enclosures referred to in section 6.4.

6.5.12 Drains 21 and 29
Two thin deeply buried high resistance linear features cross the slope, one passing through or beneath tip 17. They are likely to be stone culverts, presumably early field drains.

6.5.13 Ditches 22 & 23
22 is a short and very faint section of ditch of unknown purpose. It may be a relic of a lost field system and may be associated with ditch 23 which is more substantial and curves to the Southeast after running parallel with 22 for about 15m. Neither can be traced further North than this and if they ended in a transverse ditch this would be completely obscured by the heavy agricultural striation.

6.5.14 Pit complex 24 to 26
These three discrete pit-type anomalies are intriguing but again hard to interpret. One, 24, corresponds with a very sharp conical depression suggesting the presence of a choked shaft and this implies that the other two may also be shafts. None are associated with earthworks apart from 24 so their interpretation must remain uncertain.

Acknowledgments

- Nigel Jones of CPAT for supplying the digital base map and for passing on background information about the site
- The landowner and tenant for permission to enter the property

Bibliography

- Thorburn, J., 1986. "Talargoch Mine", British Mining No.31. Sheffield: Northern Mines Research Society
- OS 1st edition 6" 1871 & 1899

Appendix 1) List of Illustrations

- DWG 01 - Electrical resistance data plotted between 5th & 95th percentiles
- DWG 02 - Plots selected for the clarity of their response
- DWG 03 - 3D Examples of presentation processes and their visual effect upon the data

(image co-ordinates are the geophysics local grid not that of CPAT; direction is the same however)

- DWG 04 - Elements of the interpretation

Appendix 2) Publication and Archiving

The survey archive is primarily digital but also contains paper material in the form of correspondence, copies of reports, etc.. Digital storage is on magnetic tape, updated over the duration of the project as part of an integrated back-up system. Copies of reports are passed to the client for further dissemination; copies are forwarded to the local SMR, etc., directly if requested.

This issue is as specified by the local archaeological curator in agreement with the client. Publication of results may proceed if it can be demonstrated that they are of sufficient benefit to the wider archaeological community, after discussion with the client and the curator. Smaller summaries can be provided by inclusion in annual fieldwork summaries, etc.. Un-located images may from time to time appear on our website; if the project has been cleared for publication and is not subject to any remaining confidentiality arrangements a small report may also be published using this medium.

ArchaeoPhysica

Reconnaissance and Geophysics for Archaeology

Method Statement for Electrical Resistance Techniques

1) General issues

a. All archaeological magnetic field strength surveys in archaeology should be conducted at a minimum resolution of 1m along lines no more than 1.0m apart. A line and sample separation of 0.5m is better though and for detailed analysis is essential.

b. ArchaeoPhysica always conducts fieldwork using a clean site policy; i.e., the site is always left as found with the minimum of disturbance. For a copy of the environmental policy please ask.

2) Set out

a. All surveys are set out using a total station within a guaranteed tolerance of 0.05m. The exact grid layout will depend upon the individual project but in general a coarse site grid anchored to staked datums is initially set out. This usually comprises 30m or 60m squares, depending upon the size of the evaluation area, the topography and whether any other survey methods are to utilise the same grid. Each square is then subdivided into 30m squares which form the basis of the spatial coordination. Each survey line is taped out to indicate the position for each measurement. This guarantees the minimisation of long and short-range spatial errors across the evaluation. Where topographical features may distort this grid or survey has to be fitted into small perhaps awkwardly shaped areas a finer mesh still, perhaps 20m, is employed. Survey extends to the edges of the evaluation wherever possible and the edges are usually composed from short stepped sections to fit the boundaries.

b. Full quality assurance data for set-out stations is automatically logged and archived for each project.

3) Georeferencing

a. This can be achieved in more than one way. Every survey is accompanied by a detailed and high-resolution base plan that documents extant field boundaries, prominent features and anything that might either contaminate the survey data or enhance its interpretation. The exact position of the survey grid within the evaluation area is therefore precisely known. Results can be superimposed upon the OS grid if specifically required. This is always aided by any digital mapping data the client can provide.

4) Survey

a. Survey can proceed in a number of ways depending on the requirements of the survey. The different configurations allow measurements to made at different and sometimes multiple depths which can offer significant advantages when interpreting the data. Examples of configurations suitable for routine use in archaeological evaluations are:

'standard twin'	0.5m probe separation
'parallel twin'	2 x 0.5m probe separation
'double twin'	0.5m & 1.0m probe separations
'1m parallel twin'	2 x 1m probe separation
'triple twin'	0.5m & 1.0m & 2.0m probe separations

All of these can typically be deployed at along-line resolutions of between 0.25m and 1m. The longer probe arrays have limited transverse spatial resolution due to the large separation of the probes. Where the small-scale detail of features is important it may be necessary for the survey to be done twice in orthogonal directions to maximise resolution in both directions to provide sufficient detail for the adequate interpretation of archaeological features. The double and triple twin are the default configurations used by ArchaeoPhysica as they allow some comparisons to be made between the apparent depths of features which can be an advantage on complex sites.

b. The survey is conducted using a square 20m or 30m grid. Data is collected at a maximum along-line spacing of 1m but 0.5m gives much better results. In favourable conditions between 0.3

hectares and 0.5 hectares can be surveyed per instrument per day although this area decreases as the slope of the ground increases or vegetation lengthens.

c. Current instrumentation is based around the Geoscan Research RM15 full system with MPX module and extended array.

5) Data analysis

a. Survey is optimised for speed and to minimise errors and this latter ensures that the raw data is usually of very high quality, something which is paramount to ArchaeoPhysica and a measure of our commitment to high standards, recognised both within and outside the archaeological discipline. Very occasionally environmental parameters may mean that we do not consider data to be adequate for presentation and in these cases it is our standard practice to resurvey. This means that our data can, at the simplest level, be presented as almost raw although the small grid size invariably means that some 'balancing' i.e.. matching of 'background' resistance levels is necessary between adjacent grids, especially for projects that extend over multiple days or are conducted during variable weather. Some 'despiking' of the data is almost always required due to small distortions caused by abnormal contact resistance values where probes are close to small surface stones or where the ground is very uneven. This is usually a problem that affects the larger probe arrays with the effect most prominent in the data collected using the outermost probes, usually corresponding to the deepest current paths. High-pass filtering can be of value for removing variations of large spatial extent caused by variations in the near-surface geology. At the 1m survey interval this has to be applied with extreme care as many narrow archaeological features, e.g., walls, are not sufficiently well sampled to permit this operation to proceed without introducing distortions in the data.

However many depth-dependent measurements are made at a point the uppermost is the one used most often for the main archaeological interpretation as it tends to contain traces of most features of archaeological interest. The deeper levels are very important for characterising features once they have been identified from the uppermost level. One of the properties of the deeper levels is that major features can sometimes be identified more clearly because there is less variation from near-surface objects like large stones or weather-induced effects. They also tend to highlight the geological variation and this can then be identified and removed from the interpretation of data from nearer the surface.

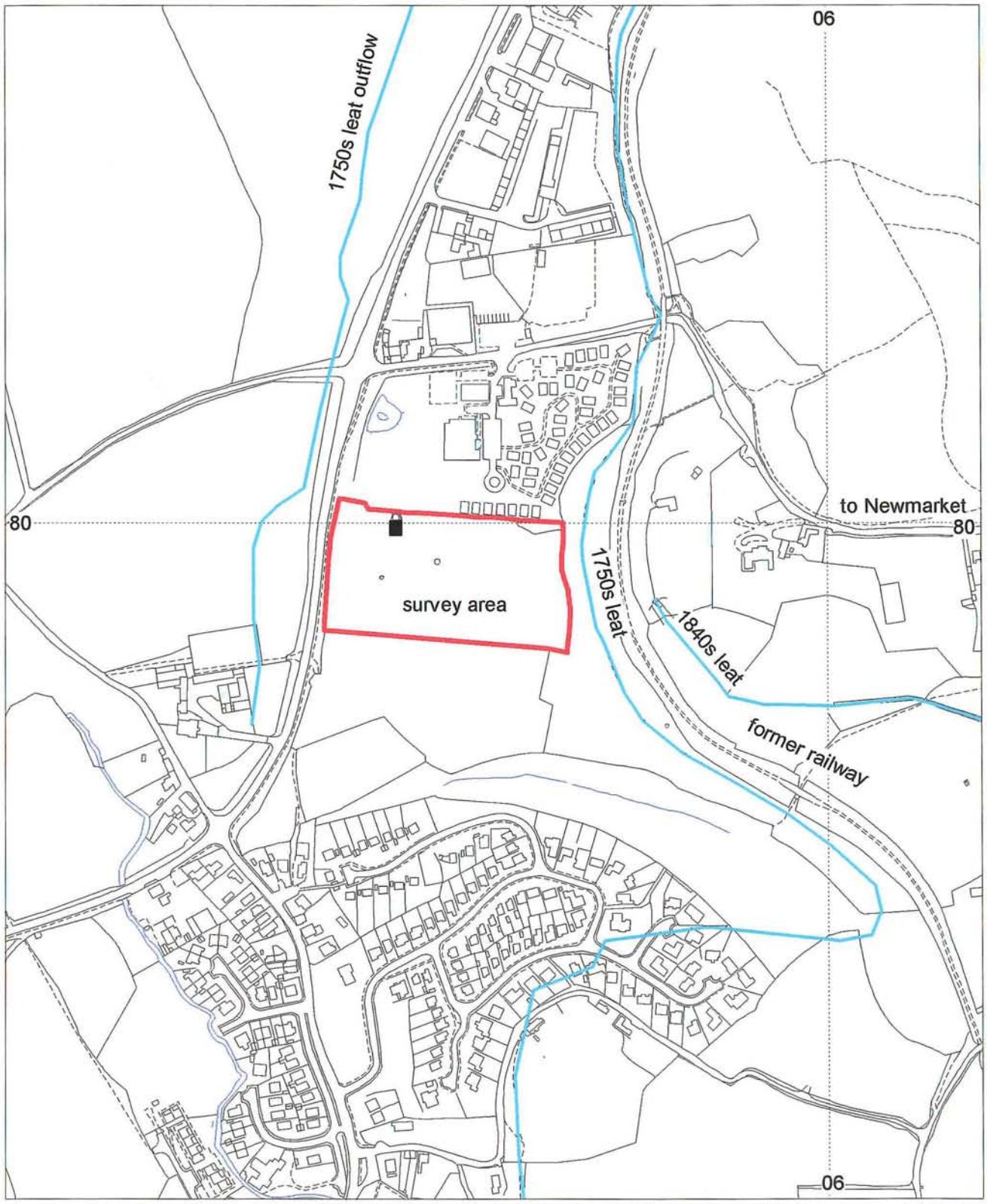
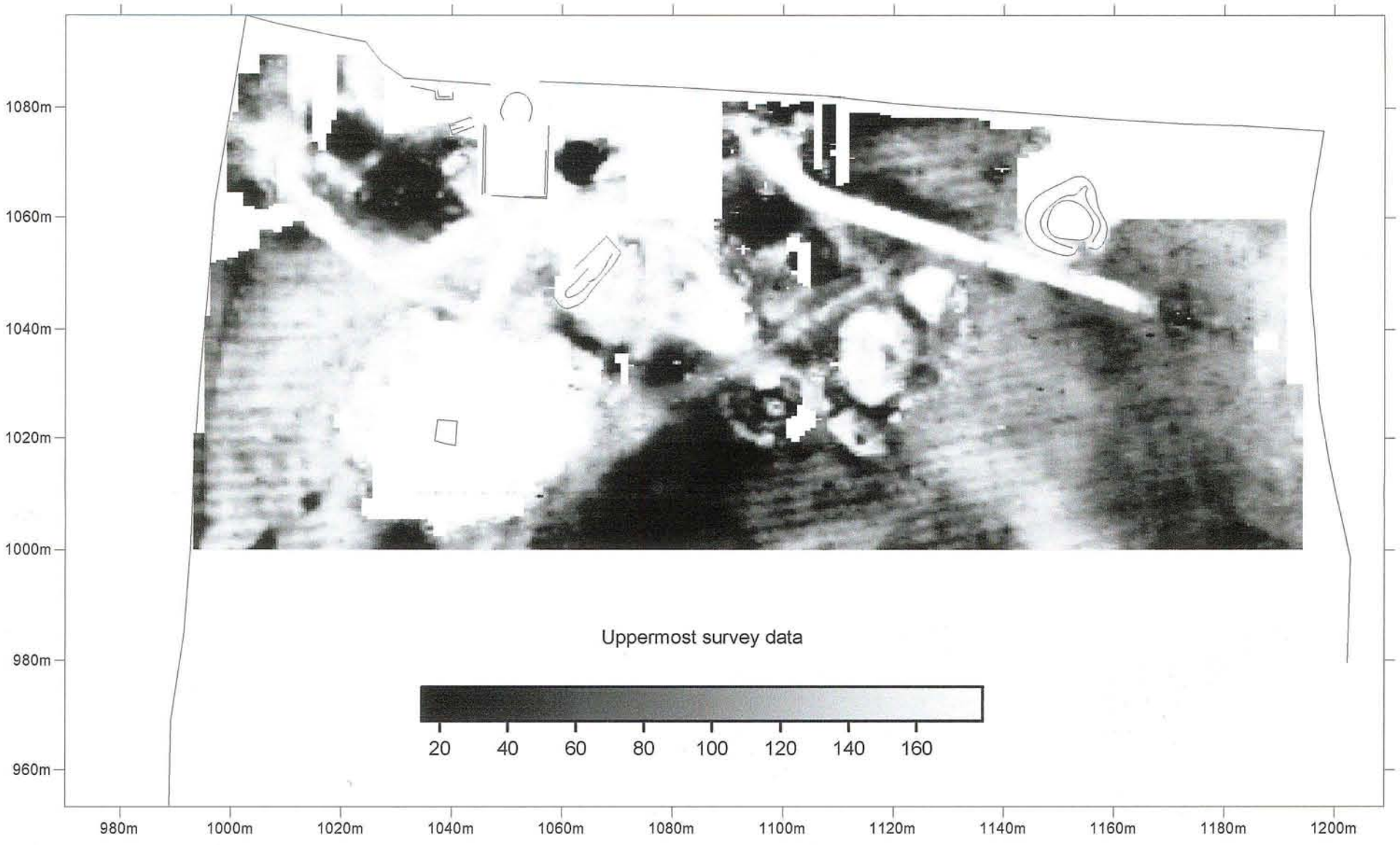
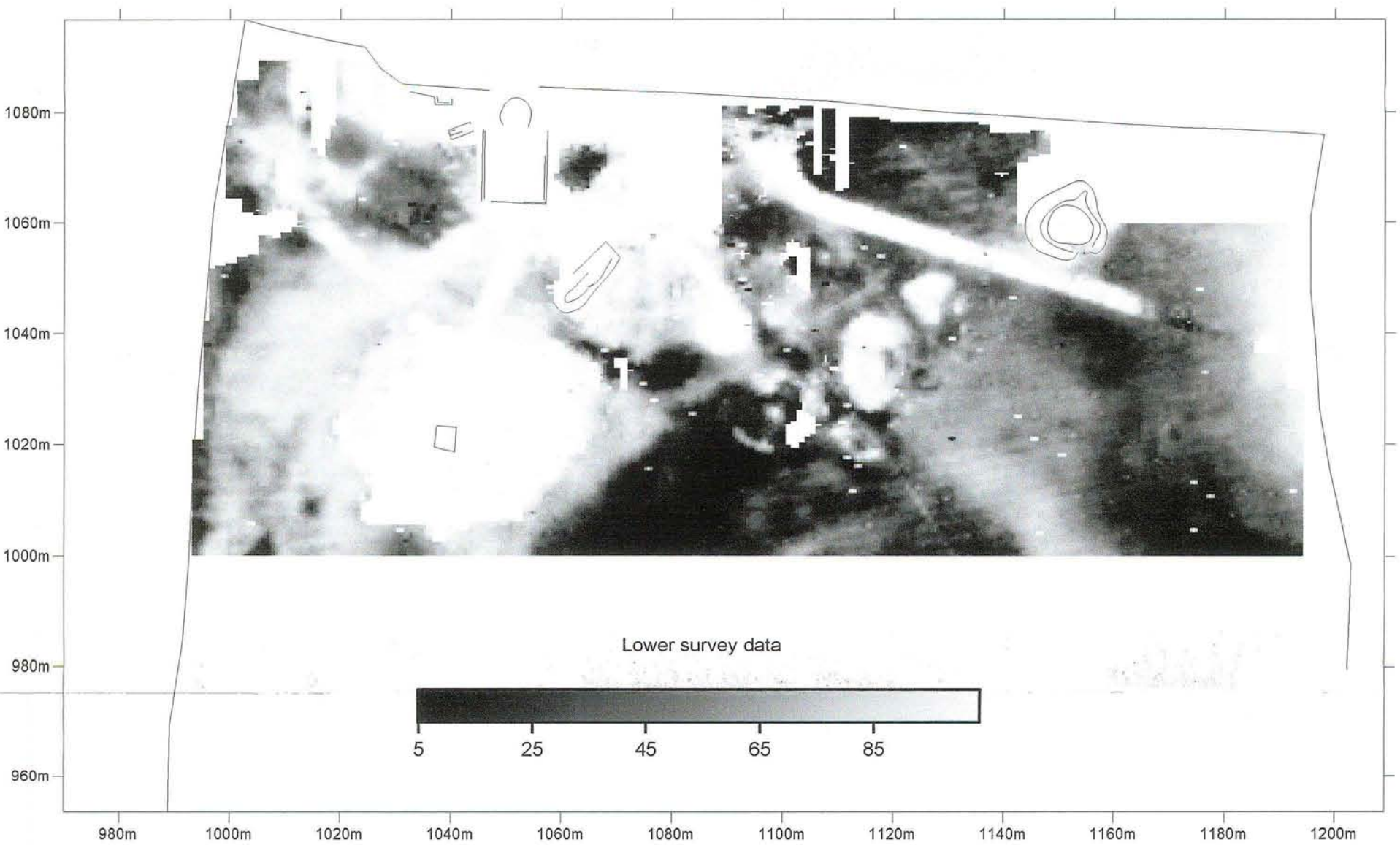


Fig. 1 Site location 1:5,000



Uppermost survey data

20 40 60 80 100 120 140 160



Lower survey data

5 25 45 65 85

N

1:1000

Base plan extracted from CPAT survey

Project Code: CEH20011
Project Name: Clive Shaft, Talargoch Mine
Drawing No.: DWG 01 Author: MJR Date: 28/03/2002
Drawing Title: Electrical resistance data plotted between 5th & 95th percentiles

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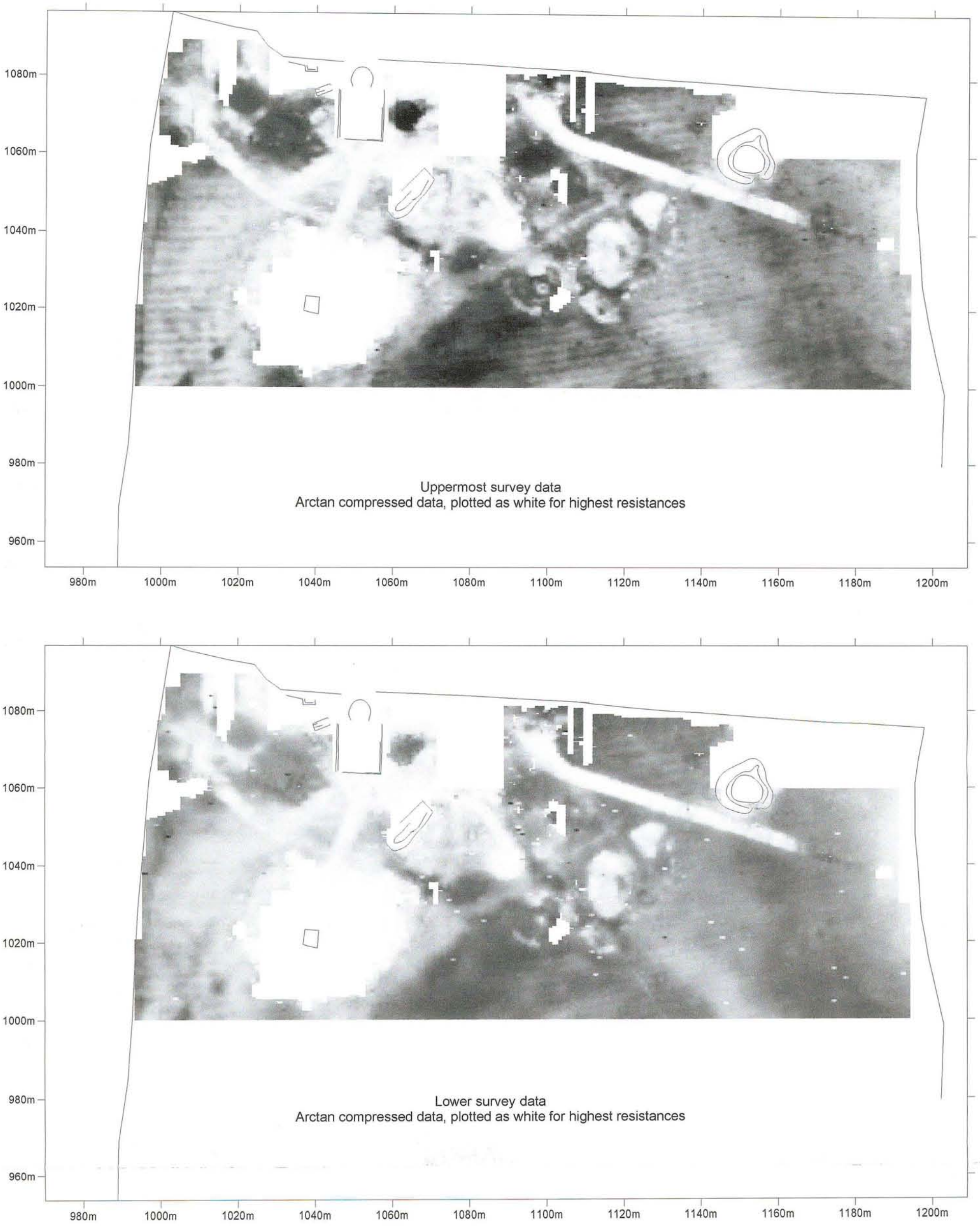

Uppermost survey data
Arctan compressed data, plotted as white for highest resistances

Lower survey data
Arctan compressed data, plotted as white for highest resistances

N

1:1000

Base plan extracted from CPAT survey

Project Code: CEH20011
Project Name: Clive Shaft, Talargoch Mine
Drawing No.: DWG 02 Author: MJR Date: 28/03/2002
Drawing Title: Plots selected for the clarity of their response

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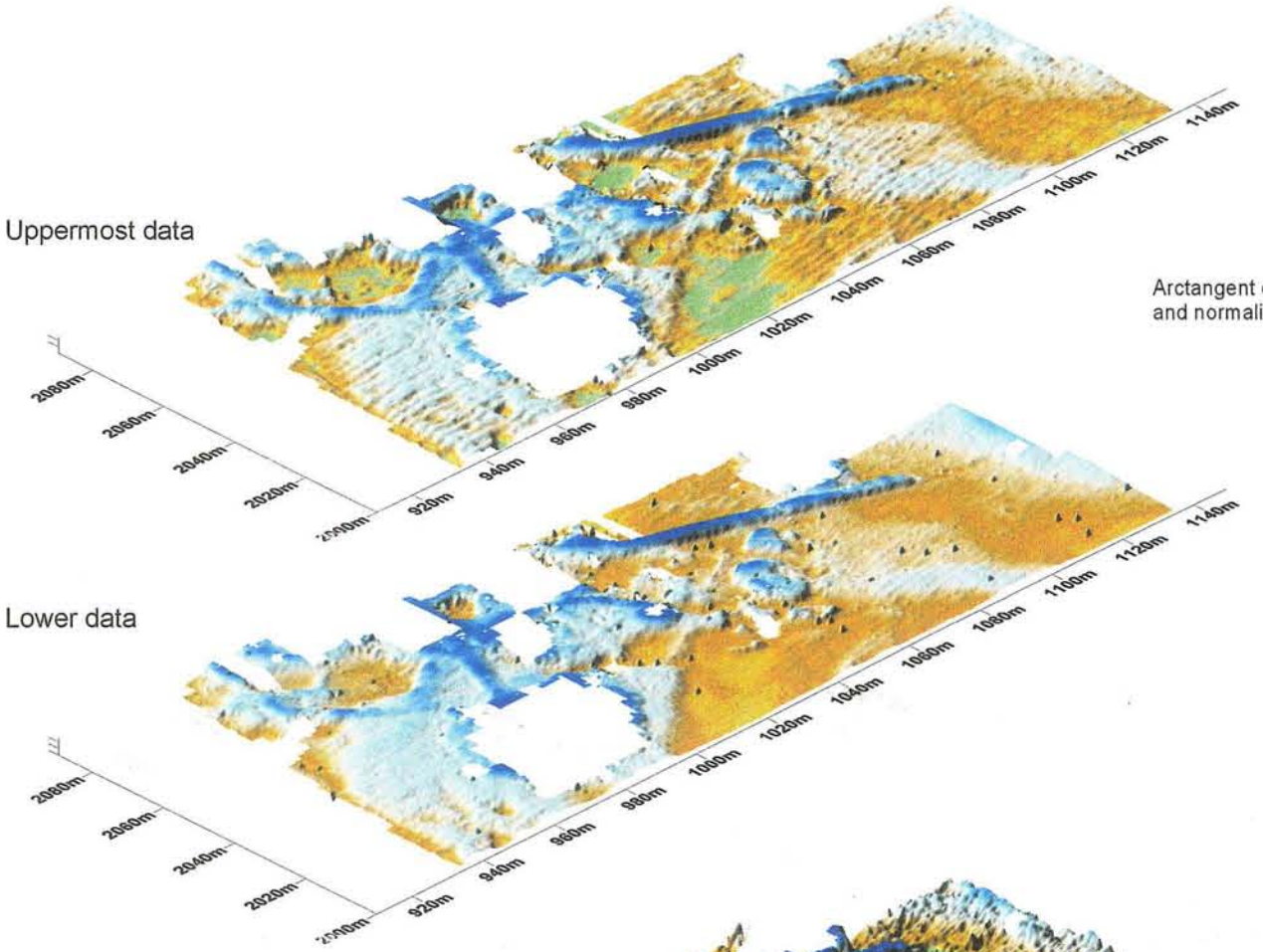
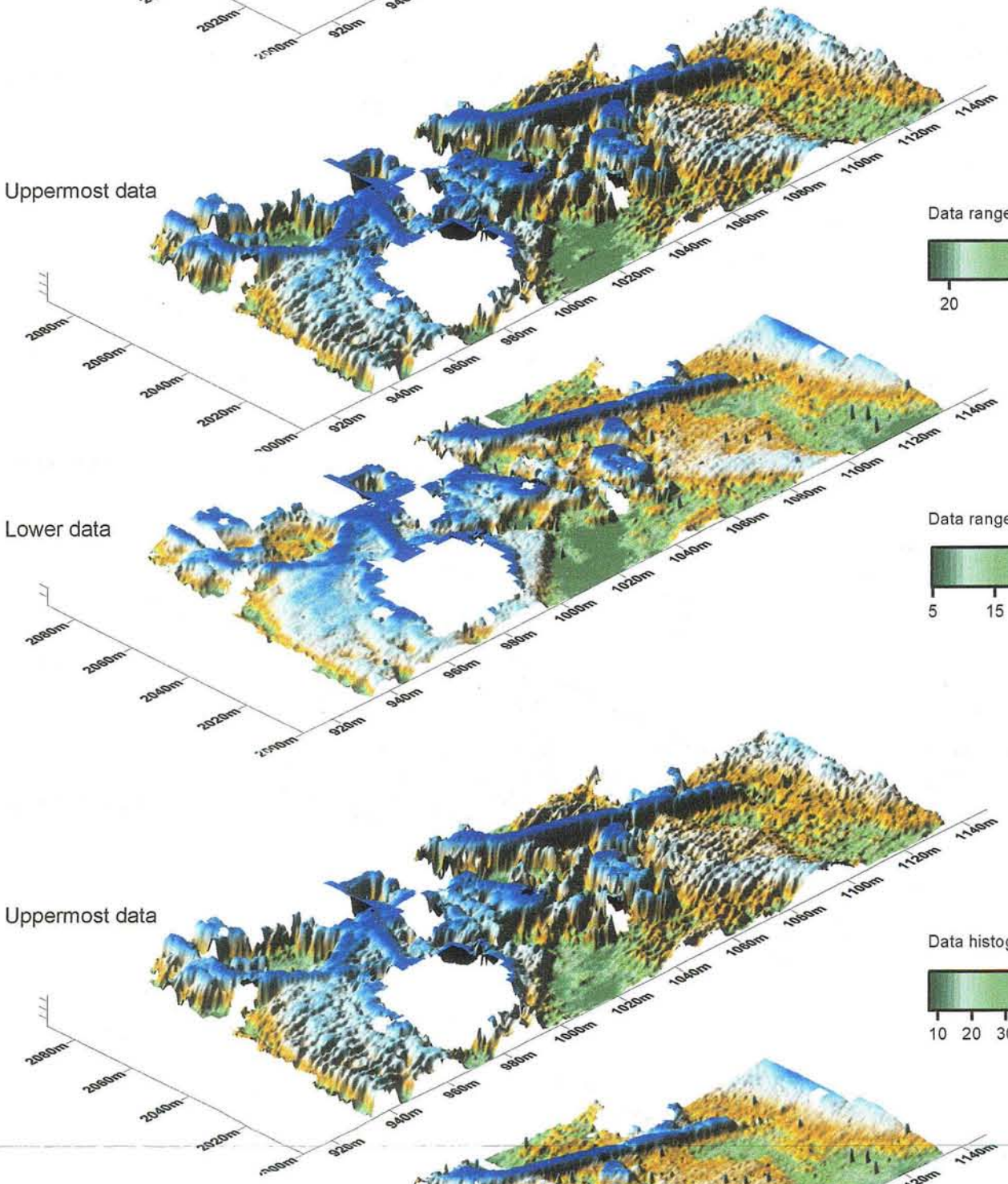
Uppermost data



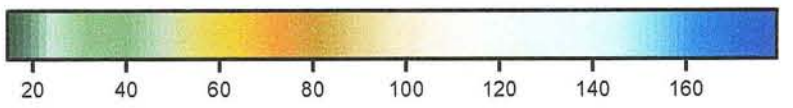
Arctangent compression applied after data is centred on the mode and normalised to the inter-quartile range

Lower data

Uppermost data

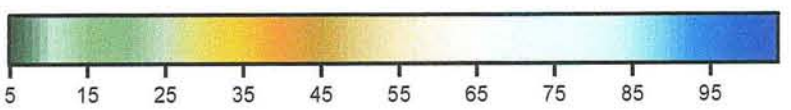


Data range-clipped between 5th & 95th percentiles



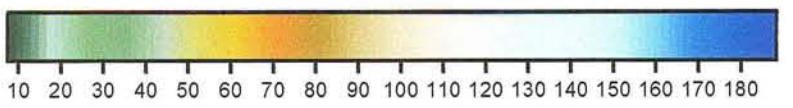
Lower data

Data range-clipped between 5th & 95th percentiles

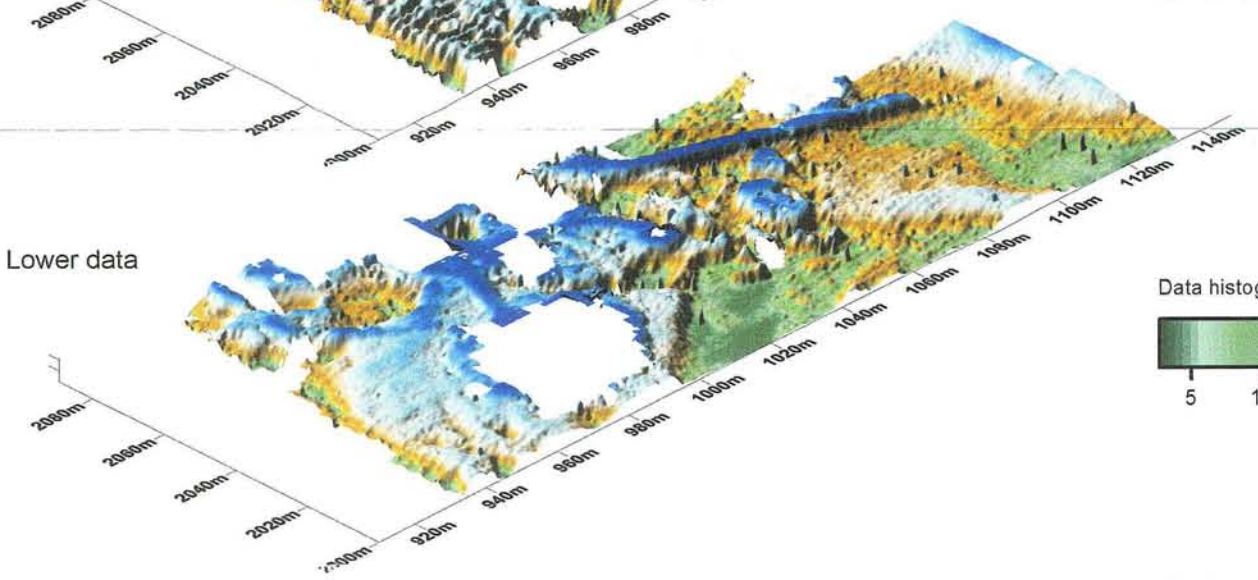


Uppermost data

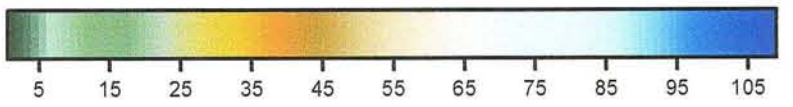
Data histogram equalised (contrast stretch)



Lower data



Data histogram equalised (contrast stretch)



All data depicted in isometric view lit from the Northwest at 45 degrees to the vertical

Project Code: CEH20011
Project Name: Clive Shaft, Talargoch Mine
Drawing No.: DWG 03 Author: MJR Date: 28/03/2002
Drawing Title: 3D Examples of presentation processes and their visual effect upon the data

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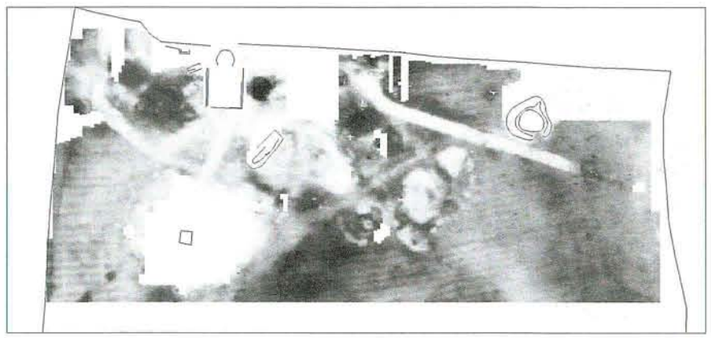

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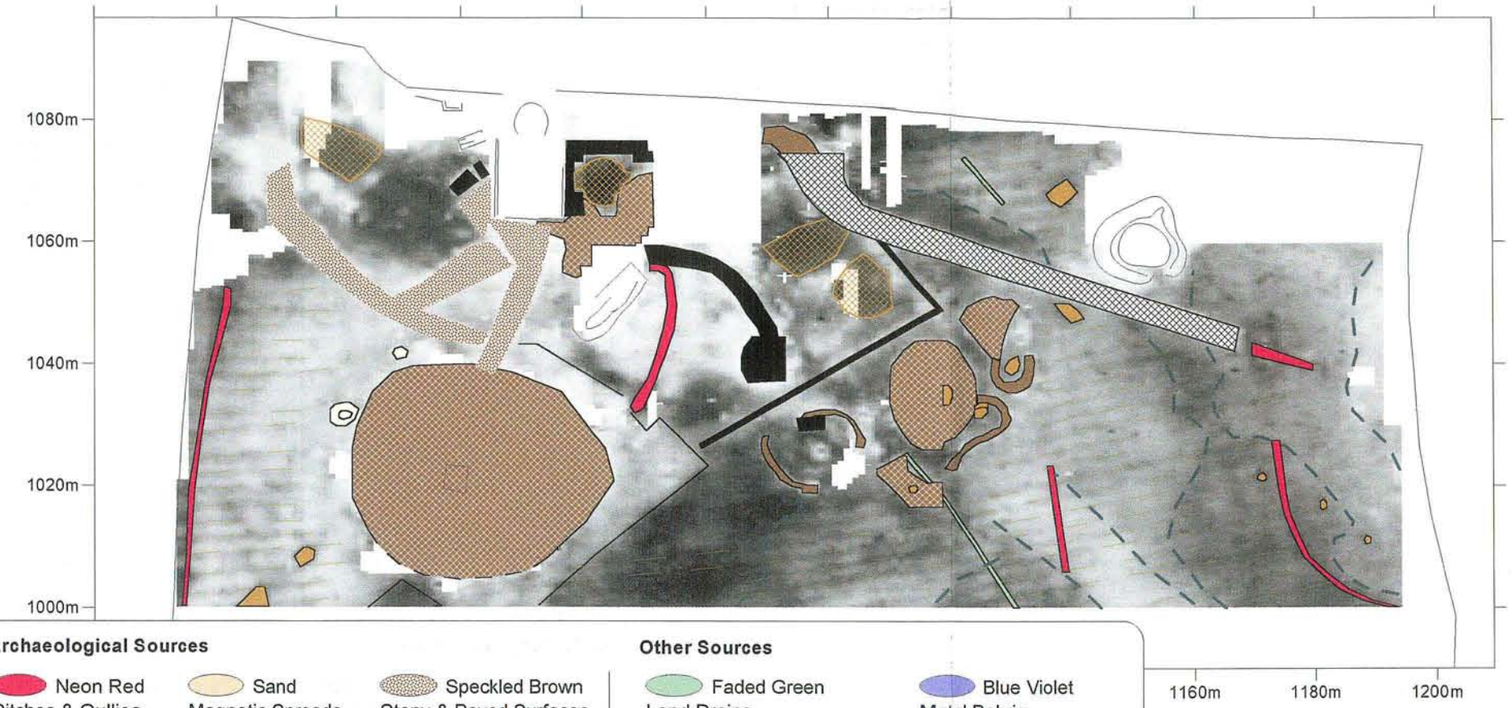


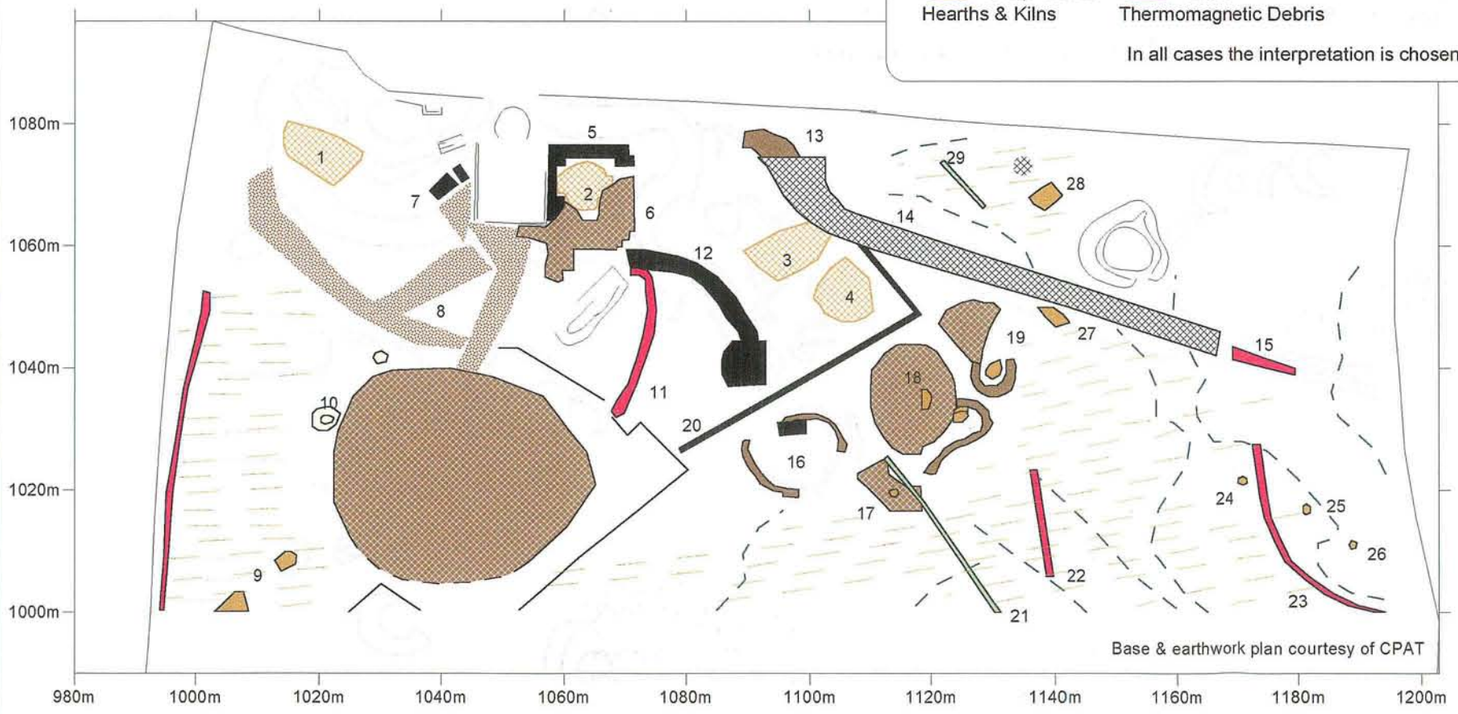
Archaeological Sources

- Neon Red — Ditches & Gullies
- Sand — Magnetic Spreads
- Speckled Brown — Stony & Paved Surfaces
- Gold — Pits & Hollows
- Brown — Earth & Stone Banks
- Hatched Brown — Quantities of Rubble
- Peach — Small Pits & Holes
- Mid Grey — Masonry
- Faded Pink — Voids
- Deep Yellow — Hearths & Kilns
- Violet — Thermomagnetic Debris

Other Sources

- Faded Green — Land Drains
- Blue Violet — Metal Debris
- Olive — Agricultural Disturbance
- Ice Blue — Pipes & Cables
- Black Outline — Anomalous Edges
- Pastel Blue — Surface Contamination
- Moss Green Outline — Geological Sources
- Pale Yellow — Uncharacterised

In all cases the interpretation is chosen as indicative of the most likely in that context



Base & earthwork plan courtesy of CPAT

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1:1000

ArchaeoPhysica

Reconnaissance and Geophysics for Archaeology

Project Code: CEH20011
Project Name: Clive Shaft, Talargoch Mine
Drawing No.: DWG 04
Drawing Title: Elements of the interpretation

Author: MJR

Date: 28/03/2002