Archaeological Investigation of a Sow Kiln at Pendragon Castle, Mallerstang, Cumbria

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Summary

In 2019 archaeological excavation of an earthwork feature within the curtilage of Pendragon Castle in Mallerstang, Westmorland, was commissioned by the Yorkshire Dales National Park Authority under the Westmorland Dales Landscape Partnership's Monuments at Risk programme. The earthwork had been postulated by this writer in 2011 as a probable clamp lime kiln of the sow kiln type. Pendragon Castle was listed on the YDNPA's Historic Environment Record and Historic England's scheduling document as a fortified tower house from the late twelfth century with later additions and amendments. Excavation confirmed both interpretations, given that the earthwork was proven by excavation to have been a sow kiln, that the radiocarbon dates obtained were coeval with the twelfth century, and that the kiln lies within the historical curtilage of the castle.

Acknowledgements

I wish to record my gratitude to those who made the project possible: in no particular order, Barbara Blenkinship and Jeremy Bradley for analysing the small pot assemblage; and Denise Druce for her analysis and identification of charcoal samples. John Bucknall, the landowner, was instrumental in the excavation happening and Robert Akrigg, grazier, is thanked for permitting our presence and for excluding sheep from the enclosure during the work. Miles Johnson, Senior Historic Environment Officer for the YDNPA, played a major role in ensuring that finance was available for the project; and Douglas Mitcham, Community Heritage Officer for the YDNPA is thanked for handling all logistical matters prior to and during the excavation process; and Hannah Kingsbury, Cultural Heritage Officer for the WDLP, is thanked for her input. Without the band of willing volunteers, drawn from far and wide, the work could not have been done.

All photographs were taken by this writer unless otherwise acknowledged.

1. Introduction

The site in question lies within the wider curtilage of Pendragon Castle in the valley of Mallerstang in Cumbria, at NGR NY78165 02725 and 245m AOD. The feature investigated is within a small walled enclosure between the scheduled area of the castle ruins and the minor unclassified lane called Tommy Road (Fig. 1).

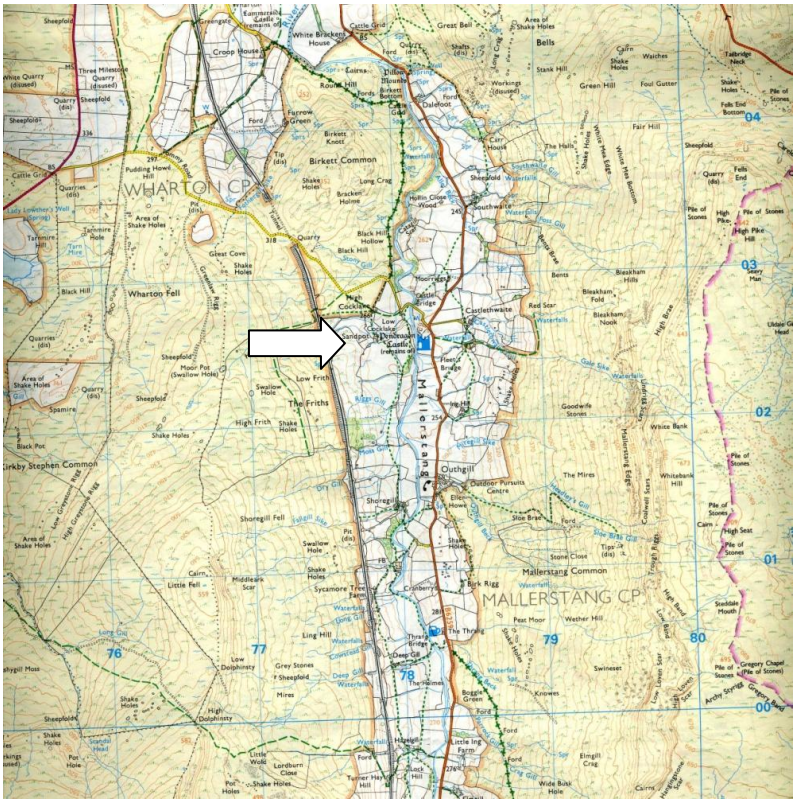

Fig. 1 Site location. The arrow points to the castle site marked with a blue symbol.

The enclosure and castle precinct have been in the ownership of Mr John F. Bucknall of Pendragon Estate since 2014.

The entire site is set on superficial deposits of Quaternary glacial diamicton overlying Carboniferous Limestone and Sandstone bedrock within the Wensleydale/Yoredale Group. The kiln was cut into the lower part of the north-facing slope of a glacial drumlinoid feature.

At the foot of the slope and less than 4m from the kiln is a broad and level area of softrush-dominated (*Juncus* sp.) wetland, separating the slope from Tommy Road but also dissected by the road. The rest of the enclosure is under unimproved grassland currently grazed by sheep.

The proposal enshrined within this project was to undertake archaeological excavation of the lime kiln earthwork feature over a continuous six-day period commencing on Monday 2 September, preceded by geophysical investigation, though in reality eight days were required to complete the process to satisfaction.

The work was commissioned by the Yorkshire Dales National Park Authority (YDNPA) as part of the Westmorland Dales Landscape Partnership's (WDLP) 'Monuments at Risk' programme. The WDLP is hosted by the Friends of the Lake District (FoLD) and the YDNPA is a project partner and the (financially) accountable body for delivery of the scheme, as well as being responsible for delivering a number of WDLP projects.

As the whole complex is covered by a current agri-environment scheme (Countryside Stewardship Mid-tier, 485408) it was necessary for derogation from the Rural Payments Agency (RPA) to be secured before any on-site work could proceed. This was dealt with by the YDNPA.

2. The Earthwork Feature

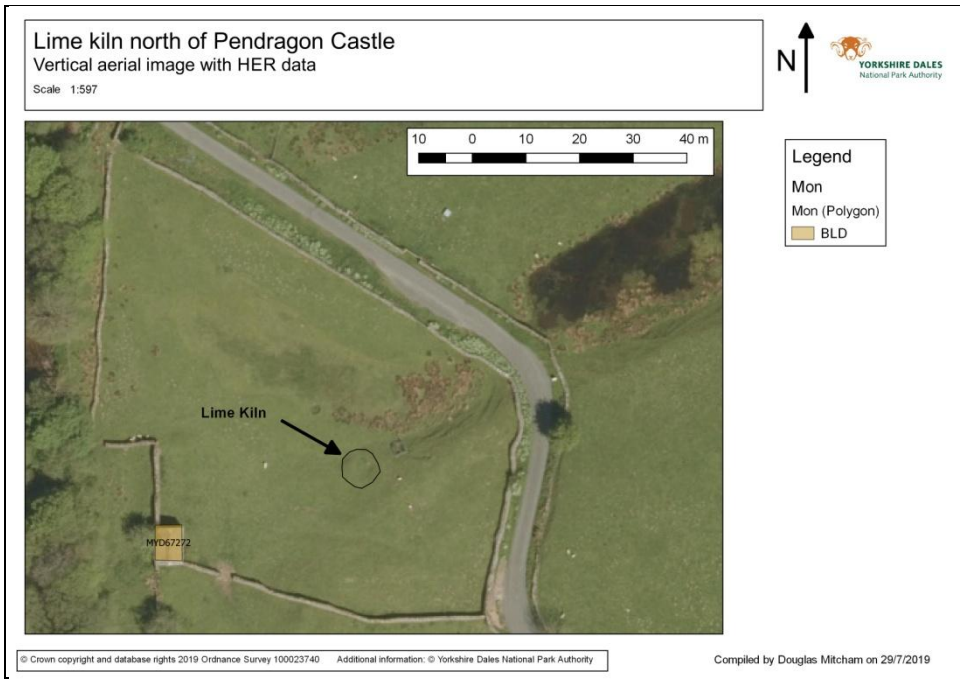

Fig. 2 Aerial photograph showing the putative sow kiln © YDNPA

The feature in question is seen on the ground as a penannular, grassed-over pit or bowl cut into the lower part of the natural slope, at NGR NY78165 02725, as determined by a mapping-grade handheld Garmin 60Cx GPS receiver displaying at the time of logging an error factor of ± 3m. Fig. 2 shows it as a vague feature on aerial photography.

The pit was originally created by digging out material and depositing it as an upcast bank surrounding the pit except on the lowest part of its perimeter where a channel or passage breaks through the upcast bank, orientated to north. As the pit is entirely grass covered, it was not possible, prior to excavation, to state with conviction whether or not the inner side of the bank had any formalised stone revetting or walling.

Fig. 3 The earthwork prior to excavation

Prior to excavation the pit or bowl extended *c*. 4.5m in length, north-south, from the rear rim of the pit to the mid point of the frontal channel (Fig. 3). It extends *c*. 3.3m in width from rim to rim. The frontal channel was estimated prior to excavation at *c*. 1.5m in length, north-south, by *c*.1m in width, east-west. Internal depth at the centre of the pit, measured from the turf layer to the height of the rim, was 800mm. It is stressed that these dimensions were estimates only as whatever structural form the feature has was masked by the turf layer.

The feature was identified by this writer, on 19 January 2011, as a putative clamp lime kiln of the type referred to as a sow kiln (see Section 3 below).

3. Local Archaeological Context

As part of the Yorkshire Dales Lime Kiln Survey, undertaken for the YDNPA in 2005, this writer undertook a Level 1 survey of all identified lime kiln sites in Westmorland, including the civil parish of Mallerstang. In total, twenty-one masonry-built field kilns were surveyed in the parish of which seven were duly classified as complete or near-complete, seven in various stages of ruination, four visible as 'site only' (the structures had gone but the kiln hollows were clearly seen), with no trace visible at three sites. At that time the Pendragon feature was not identified; it was classified and logged as a sow kiln (Mallerstang sow kiln no. 1) on a later visit by this writer, on 19 January 2011.

Whereas field kilns are masonry-fronted, open-topped structures standing proud of the ground surface, with an opening at the base of the front face through which quicklime was drawn after being fired in the vertical bowl, sow kilns were sunken features almost invariably cut into a natural banking. Examination of well over 150 such sites by this writer, and excavation of nearly twenty, has enabled him to produce a typology of sow kilns based on their internal morphology (Johnson 2004, 40-44, 55-57; and see Johnson 2006; 2008a; 2008b, 50-53; 2010a, 50-53; 2014; 2015, 36-42, 68-69, 84-87). No other sow kiln has been

recognised in Mallerstang though a recent visit to Lammerside Castle noted a possible site set within earthworks associated with that tower house, at NY77240 04690.

The results of the survey of the Pendragon sow kiln were submitted to the YDNPA's Historic Environment Record (HER) in 2011.

The castle complex, including the dry moat, is entered on the HER as MYD 62364 (Fig. 4). The record for the castle describes it as a fortified tower-house dating from the twelfth century with later additions and alterations.

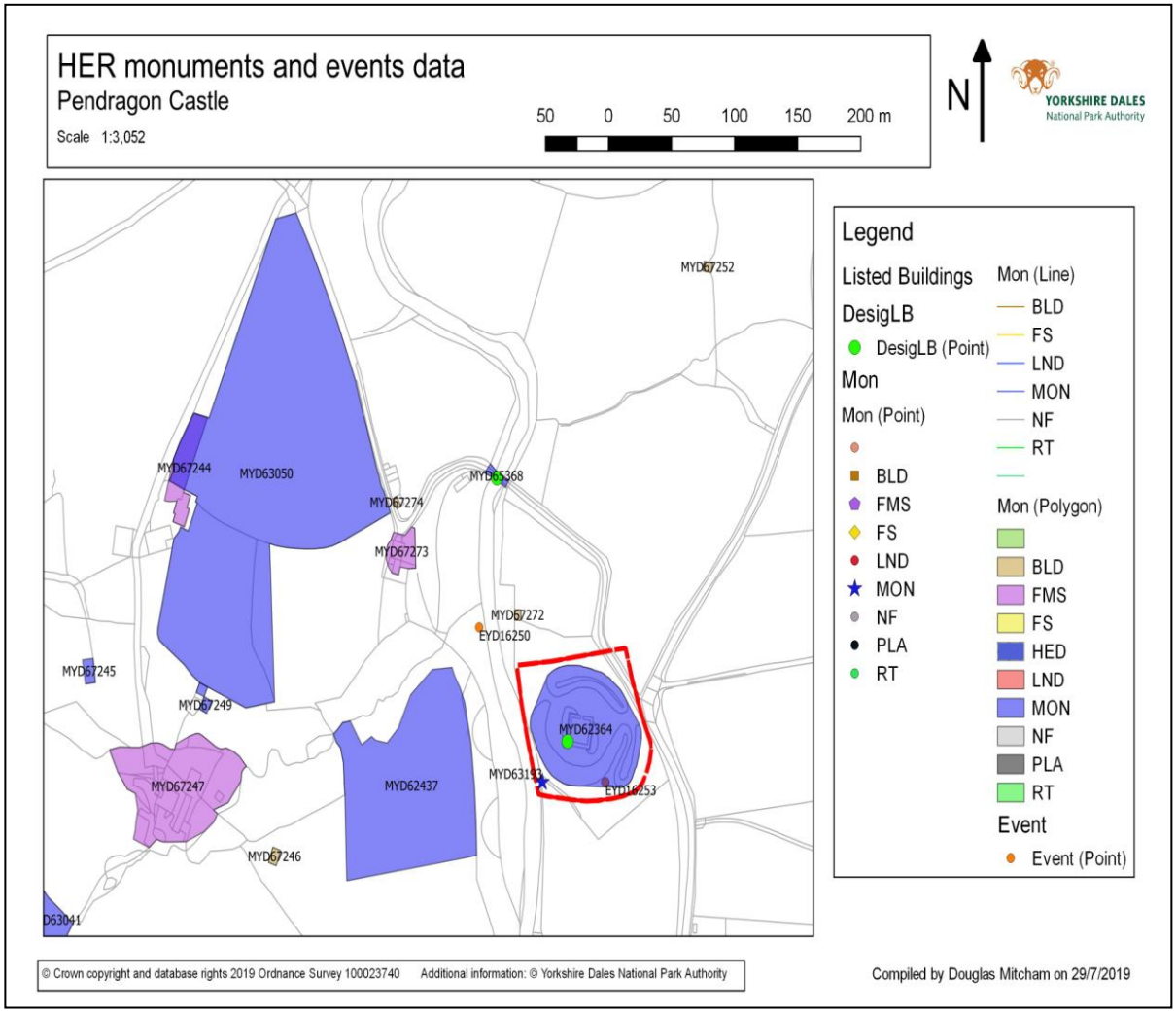

Fig. 4 HER plot, MYD 62634 © YDNPA

The castle is logged as no. 2003 on the Cumbria Sites and Monuments Record (SMR); MYD 62364 on the YDNPA HER; 1007156 on the National Heritage List for England; it is entered on the listed buildings register at Grade 1 as NHLE 1144890; and is scheduled by Historic England as monument CU357.

Immediately east of the earthwork, on the same contour, is a small squared area fenced off and covered over with timber pallets; anecdotally this is said to be a well but it would seem odd to have dug a well on a relatively steep slope. It is not marked on Ordnance Survey six-

inch mapping, surveyed in 1857 (Sheet 30), though a well is shown on the same sheet where the modern gateway from the castle mound to the field barn is now.

The entire complex was subject to a detailed topographical survey undertaken in 2017-18 (Dennison 2018, 25-74, which includes full details of other surveys of the castle complex). The putative sow kiln earthwork was included on the resulting survey plan as Feature 208/2 on Fig. 15, p. 99 (Fig. 5). Other surveys had focussed on the scheduled area and did not include the enclosure north of the boundary wall (eg Andrew Faulkner 2017; Wilkins 2017)

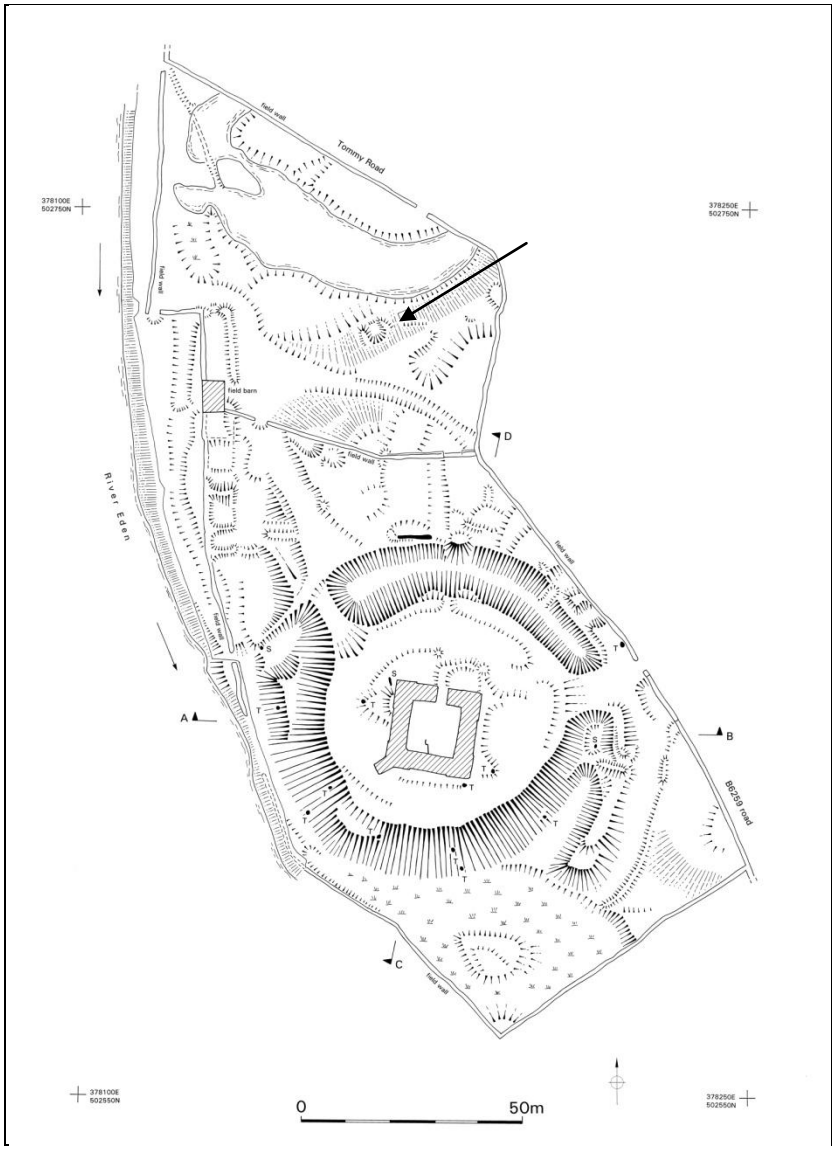

Fig. 5 Topographical survey (Dennison 2018).
The earthwork lies at the head of the arrow

4. Potential Archaeological Significance and Justification: Summary

Despite the work done by this writer on sow kiln sites within and without the Yorkshire Dales National Park (YDNP), there is still a need to build up a larger database of proven sites. Excavation is not always the answer to resolving earthworks but in the case of sunken kiln-like features there is in reality no other means of determining what lies beneath the turf other

than resorting to excavation. Invasive investigation of this feature was designed to resolve once and for all if it was a lime kiln and, furthermore, to enable it to be slotted into the typology referred to earlier. If sufficient evidence were to become apparent through excavation, it would make it possible to date the feature which, in turn, would aid in understanding the sequence of the castle's evolving story.

Prior to excavation, the well-preserved nature of the earthwork was perceived to suggest it was too large and too well preserved to have been associated with the original twelfth-century building of the castle or with the building work connected to the 1309 licence to crennelate or indeed with further restoration work, following on from its being slighted by Scottish raiding parties in 1341, undertaken in the 1360s. The kiln was thought more likely to relate to work during Lady Anne Clifford's programme of reconstruction and rehabilitation in 1660-61.

As no other sow kiln sites have been confirmed in Mallerstang, and very few in Westmorland more generally, the findings from this site clearly add to the overall picture of the development of lime burning technology in the region. In essence, there are no comparative sites in this part of the YDNP. There is a palpable dearth of lime kiln sites from the medieval and early post-medieval periods in the YDNP (and more widely) and detailed examination of the site in question adds significantly to the understanding and chronology of such structures, and of their detailed morphology. In order to strengthen the working model of early lime kiln sites in the Dales it is clearly important to have detailed information from a range of sites.

5. Pendragon Castle: Historical Overview

The origins of Pendragon are shadowy. According to the official Historic England listing (HE 1144890) it is of twelfth-century date 'with later additions and alterations'. Sources have suggested it was initially erected for Sir Hugh de Morville *c*. 1180 (Curwen 1913, 66-67; Salter 2002, 79) but this is arguable since his lands were sequestered after he was implicated in the murder of Thomas Becket, Archbishop of Canterbury in 1170, though he was later pardoned. The earlier reference – Curwen – gives no source for the attribution. The building ruins as seen today do not fully support such an early origin though the degree of decay and collapse masks important detail. Salter noted that Robart de Leyburne, who later held the castle, died in 1283 possessed of the 'castle of Mallerstang' but, again, no supporting sources are quoted.

A Norman attribution was given by Whitaker (1805, 308) who stated that Pendragon was '... manifestly of the same age' as Brough Castle, ie Norman, but is of a 'different type from all the rest ...' of the (later) Clifford castles in Westmorland – Brough, Brougham and Appleby. Whitaker also expressed the view that all these castles had been the '... work of Ranulph de Meschines, in the reign of the Conqueror ...'.

What can be said with some conviction is that there was a building here before 1200 but whether it was a castle or tower house built of stone is a moot point. Indeed, Clark (1883, 49) included Pendragon in a list of Westmorland *castellets*, that is fortified towers too small to be called a castle.

Of much greater historical accuracy are accounts relating to Westmorland in the early fourteenth century when the North was in constant turmoil as the English and Scottish Crowns and their supporters took the conflict across the border in one direction or the other. In 1306, for example, Henry Percy and Robert de Clifford, the two most powerful English magnates in the North, were making real inroads into Scotland against the forces loyal to

Robert Bruce (McNamee 2006, 31).[1] In 1309, fifty-five north Cumbrian landowners were ordered to repair their properties in readiness for an expected counter-attack by the Scots (ibid, 47). According to English State papers, Scottish raiding reached new heights in 1308 (CCR 1307-13, 42).

It is highly likely that this unstable state of affairs was behind the apparent granting by the Crown to Robert de Clifford of a licence to crennelate Brougham and Pendragon Castles but this has not been confirmed for Pendragon between 1302 and 1317 from examination of the Calendars of Patent Rolls, even though other court records stated 'Mandate to Robert [de Clifford] that he may crennelate his castles of Brouham and Pendragon' in July 1309 (CPR 1309). Curwen (ibid, 121) asserted that Robert de Clifford had enlarged and strengthened Pendragon *c*. 1300 though once again no source was given and, indeed, nothing has been found by this writer in the Patent or Close Rolls between 1296 and 1318. Licence to crennelate is often taken to mean consent was given to add battlements to existing towers or houses but is equally likely to have involved major alterations. According to the Calendar of Chancery Warrants (CCW 1927, 291) a mandate 'to make letters to Robert de Clifford that he may crennelate his castle of Brouham and Pendragon, C. Westmorland' was authorised but the fact that the licence is not recorded in the Rolls could suggest that the decision was reversed and the licence not issued. On the other hand, the warrant concerned would have been a privy seal warrant for the making of letters patent and the rate of survival of such privy seal documents is very low so the absence of confirmation in the Pipe Rolls of a licence having been granted does not necessarily indicate one was not issued. To repeat the old adage, absence of evidence is not evidence of absence. Given the turmoil in the Borders in the early fourteenth century, and the high royal favour that Clifford enjoyed – having been appointed captain and chief guardian of Scotland in 1308, and keeper of the march of Carlisle in 1309 – he was a baron Edward could not afford to cross. The Chancery Warrant *can* be taken as evidence that licence to crennelate was indeed granted.[2]

Clifford *was* granted a large estate in Westmorland in 1308, including the castle of Brough-under-Stainmore and the manors of Appleby, Kings Meaburn, Kirkby Stephen and Mallerstang along with the office of hereditary sheriff of Westmorland (CPR 1308); and, later, the Custodianship of the Eastern March. The castle lay at the heart of a large estate in the *Chacea* (Chase) de Mallerstang or *Forestis* (forest) de Mallerstang (WD HOTH/3/34/13).

Clifford apparently neglected his Cumbrian estates to join in hunting down Edward II's hated favourite Piers Gaveston, which laid his estates open to Scottish incursions and in 1314 Clifford met his end at the Battle of Bannockburn. Curwen (ibid, 121) stated that in 1314 there was a 'castle of stone' in Mallerstang, called Pendragon, held by Sir Andrew de

[1] Robert de Clifford was appointed 'captain of the march', for the defence of Cumberland, on 12 July 1297 (25 Edward I) and reappointed captain of Cumberland, Westmorland and other northern parts. on 25 November 1298 (27 Edward I) (Calendar of Patent Rolls, Edward I, A.D. 1292-1301, Membrane 1, p. 314 and Membrane 40, p. 388 respectively.)

[2] I am grateful to Professor Keith Stringer for this clarification.

Harcla, Earl of Carlisle and Sheriff of Cumberland, on payment of a yearly rent of six pence. De Harcla was appointed to the custodianship by Robert de Clifford according to Morris (1902, 316); and Mason (1929, 105) has written that he held it of Idonea de Viteripont. According to Collingwood (1926, 4) the northern (moat) ditch was strengthened by Robert de Clifford *c*. 1300.

Pendragon, and the Clifford's other estates, reverted to the Crown as Robert's heir was a minor, but the Crown handed them back in 1315 unwilling – or financially unable – to maintain them. In 1314 it was found in court that 'the jurors find that in the Vale of Mallerstang there is one castle called Pendragon, with a vaccary' held by de Harcla, but again no historical source was quoted (Nicholls 1883, 24). Curwen also asserted that when Roger de Clifford died in 1327 Pendragon 'could not be extended for that the costs of maintaining the same exceeded the profits thereof' (Curwen 1932, 122-23).

In 1333 Idonea de Viteripont had entertained Edward Balliol, King of the Scots, at Pendragon, shortly before her death; she bequeathed her estates in Westmorland to her great-nephew Roger de Clifford. In 1341 there was a major setback. The Inquisitions of the Ninth, assessments of estates' incomes gathered as the basis of future taxation, painted a grim picture of the border lands. The returns show dramatic declines in estate productivity and income across north-west Yorkshire, Lonsdale and north Lancashire in particular and quite possibly in Westmorland too (McNamee 2006, 248). Domestic political unrest, Scottish raids, a deteriorating climate and concomitant harvest failures, and livestock disease were reasons put forward to explain the decline though, no doubt, shrewd estate stewards would have seen the benefit of exaggerating the problems to reduce future tax liability. It is known that there were serious raids into Cumbria in 1333, 1342 and 1346 and there may have been others in intervening years.

It has been widely said that Pendragon was damaged with its (roofing?) timbers burned in 1341 – 'in the 15th of Edward the Third', ie 1341-42 (Whitaker 1805, 309). Coming only eight years after Balliol's sojourn here raises questions as to why. Curwen suggested an explanation (1932, 123). Balliol was far fromt universally popular in Scotland and the opposing faction was bent on removing him from the throne. To this end, they set out to 'annoy his friends', hence the attack on Pendragon. It is a plausible hypothesis, one that is supported by Lady Anne's own words (WDCAT/16, vol. 2, 200): '... about the year 1341 was the castle of Pendragon in Mallerstang burned, by some Scots that were of the party to the said king ... in an inrode or invasion and since that time it lay waste and desolate till it was repayred' by Lady Anne. In her *Greate Books* she elaborated on Pendragon's level of destruction with the Scots '... totalie destroying itt, and pulling down all the timber, and a great part of the stone building of it' (WDCAT/16, vol. 3, 232).

An escheat of 19 Edw III (1345-46) decreed at Appleby noted that a 'certayne castle which is called Mallerstange ... [was] worth nothing by the yeare beyond the reparacon and susteyning of the same'.[3] An Inquisition held at the death of Thomas Lord Clifford, in 34 Hen VI (May 1455) similarly made note that the castle was 'nothinge worth' (WDCAT/16, vol. 2, 381). [4]

[3] An escheat was a reversion of an estate to the Crown upon the death of the owner with no legal heirs.

[4] An Inquisition was an examination or inquiry held upon the death of notable personages.

It has been suggested that the de Cliffords repaired and restored the castle in the 1360s when the south-west garderobe tower was also added (Curwen 1913, 122-24; Collingwood 1926, 4; Salter 2002, 79): no sources were provided to prove this beyond doubt. It is also at odds with Whitaker's (1805, 309) assertion that after the 1341-42 raid(s) Pendragon '... remained without further change till Lady Anne Pembroke restored it ...' in the 1660s. It also tends to contradict Lady Anne's own assertions in her *Great Books* as noted in the previous paragraph. Visual inspection confirms that the garderobe tower was built of very different masonry from the rest of the castle walls. It is of interest to note that the so-called Gough Map, probably produced 1360-70, named Pendragon not on a through route like most other place-names on the map but in isolation (Bodleian Library). This would suggest that the castle was of sufficient renown and stature to have been considered worthy of inclusion but it does not necessarily mean it was in an inhabitable state.

The story is further complicated with (unsubstantiated) claims that Pendragon was again burned by the Scots in 1541 (Nicholls 1883, 27; Waistell Taylor 1892, 33-35; Curwen 1913, 122-24; Collingwood 1926, 4; Hamilton 1993, 91). Nicholls did add that he could provide no evidence as to why it was allegedly burnt down or by whom. However, there is documentary evidence that all was not well in the North in that year. The alleged event of 1541 may have originated from transcriptions of the celebratory stone plaque that Lady Anne erected over the castle doorway when she had the castle restored. It was repeated in full by Waistell Taylor (1892, 33-35).

> This Pendragon Castle was repayred by the lady Anne Clifford, countess dowager of Pembroke, Dorset and Montgomerie, baronesse Clifford, Westmorland, and Vescie, high sheriffess by inheritance of the County of Westmorland, and lady of the honour of Skipton in Craven in the year 1660; so as she came to lye in it herself for a little while in October, 1661, after it had layen ruinous without timber of any covering, ever since the year 1541. *Isiah* chap. lviii, v.12. God's name be praised.

One has to wonder if he – or whoever he copied it from – had misread 1341 as 1541; otherwise, where did the 1541 date come from?

It is beyond dispute that war had broken out yet again in 1541 initially in the form of cross-border skirmishes but culminating in the all-out Battle of Solway Moss on the first day of the main Scottish invasion (Hoyle and Ramsdale 2004). Diplomacy between the two nations continued through 1540 though in the following year it was noted that the North 'again came to cause concern' (ibid). In spring 1541 the English enhanced their military preparations in Carlisle in the expectation of a Scottish assault and English raids northwards provoked the Scots into retaliation. Thus far in the argument, it could indeed be claimed that Pendragon fell victim to one of these raids in 1541. It is not that simple, though: the Scots were soundly defeated at Solway Moss on the first day of their main invasion and they had neither the desire nor the resources to undertake raids that year. Goading by the English did indeed bring about a change in strategy to resume Scottish raiding southwards but, crucially, only in 1542 and only within the immediate border lands (ibid). In short, there is no apparent historical evidence to support the contention that Pendragon was slighted by the Scots in 1541. Whitaker, it seems, was correct.

The fact that in 1541 the antiquarian John Leland wrote 'Ther standithe yet muche of this Castell' (Toulmin Smith 1907-10, v 146; Curwen 1913, 122-24) would suggest, first, that the situation in Mallerstang in that year cannot have been in a state of turmoil otherwise he

would not have ventured so far north on his mammoth journey; and, second, his wording suggests that the castle was neither a complete ruin nor in sound condition. If it had been burned down in 1541 by Scots raids, Leland would surely have known about it and made much of it. He did not.

Further evidence, if it is needed, calls into question any notion of the castle having been destroyed by the Scots in 1541. William Camden, in his magisterial work *Britannia*, first published in Latin in 1586, last edited by him in 1607, and translated into English in 1610, wrote of Pendragon thus: '... Pendragon Castle, which hath nothing left to it unconsumed by time besides the bare name and a heape of stones' (Camden 1610).

Assuming it had been slighted in 1541, only forty-five years prior to his publishing *Britannia*, it is difficult to accept that he was unable to distinguish between something that had slowly fallen into disrepair over a considerable period of time and something recently slighted.

Two modern inventories of Westmorland's historical monuments sadly add nothing that could help in deconstructing the discrepancies and contradictions in earlier sources (see RCHME 1936; Perriam and Robinson 1998).

The antiquarian and botanist Thomas Pennant passed through Mallerstang in 1773 on his journey from Downing, his home in North Wales, to Alston Moor. He described the castle as a 'small but strong square building, with great marks of age on all of its parts ... of vast thickness, and with rudeness enough for an early period' (Fig. 6) (Pennant 1801, 131-32). Of this, there is no dispute. He went on to write '... it was burnt in an inroad of the *Scots* about the year 1341, it was restored and sunk again in that of 1541 it having, as the inscription informs us, lain ruinous from that year to 1660 ...' (ibid 133). Sadly, he did not reproduce the inscription and provided no evidence for his latter statement.

Fig. 6 Thomas Pennant's depiction of Pendragon, 1773

Another account asserted that Pendragon had 'lain desolate and ruined for over 100 years' when Lady Anne Clifford effected repairs in 1660, indicating that the 1541 Scottish attack was probably factual (Holmes 1984, 156). Lady Anne's own words show this to be incorrect as in her Diaries she wrote, in 1660, that she had ordered repairs (Clifford 1994, 146; see also Malay 2015, Malay 2018 and WDCAT/16, vol. 3, 227) to the

> ... decayed Castle of Pendraggon ... which had layn waste (as appears in manie Records in Skipton Castle before the late Civill Warres) ever since the 15th of Edward the 3rd when the Scotts did then burne downe the Timber of itt and demolished it ...

She was referring to the 1341 raids. It is worthwhile remembering that the word 'waste' historically referred to something – land or buildings – that lay unused; it did not have the modern meaning of devastation or slighting. Lady Anne also noted (ibid) that she was able to spend three nights in the castle in 1661 'which none of my ancestors had done since Idonea de Viteripont lay in it, who dyed the 8 Edward 3rd without issue', aged 73 (WDCAT/16, vol. 3, 227). Idonea was the wife of Robert de Leyburne, who held the castle until his death in 1283 as joint guardian of Brough and Mallerstang, and daughter of Robert de Viteripont (or Vipont), previous owner of the Mallerstang estates (ibid, 146). The 8th (regnal) year of Edward was 1334-35, so Idonea died six or seven years prior to Pendragon's destruction. Lady Anne was so meticulous in her record keeping, and spent so many years devoted to researching her ancestral heritage that what she wrote, or dictated, must be taken seriously.

When Lady Anne finally took possession of her ancestral estates in June 1649 she found her Westmorland castles in 'varying states of disrepair and neglect' (ibid, 97). In June 1660 she ordered repairs to Pendragon and the work must have proceeded without delay as she was able to spend three nights in residence there in October of the following year (ibid, 146, 148). In 1662 her diaries (ibid, 158) record:

> And this Summer did I cause a Wall of Lyme and Stone to be built around about that piece of Ground which I had taken in about Pendraggon Castle ... being 10 quarters in height and about 90 roodes in compasse with two gates to lett in horses or coaches ... And within the sayd Wall I caused to be built a Stable and Coachhouse, a Brewhouse, Bakehouse, and Washhouse, and a little Chamber over the Gate that is arched (WDCAT/16, vol. 3, 233) (Fig. 7).

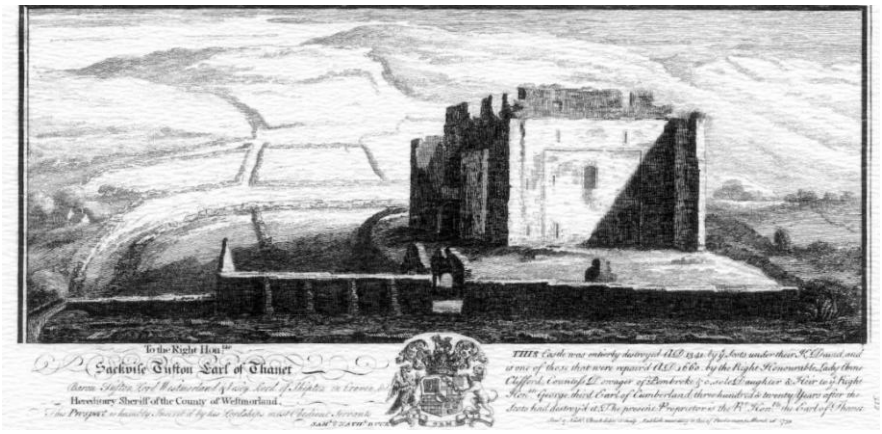

Fig. 7 Reproduction of an engraving of the north-west prospect of Pendragon Castle by Samuel and Nathaniel Buck, 1732. Lady Anne's (unroofed) range of buildings lies at the forefront with the arched gateway beyond, two lengths of her boundary wall leading off the building range, and the internal dividing wall running towards Tommy Lane.

Ten quarters translates into a height of 2.3m (7 ft 5 in.) for her curtilage wall and 90 roods to a total length of 453m (495 yds). This writer and his partner, who is an accepted authority on early stone tooling and building styles, examined all the boundary walls in October 2019 with the intention of determining not only their total length but also looking for evidence in the walls that they were all of one build and not modern (ie post-1750) walls. Using a long tape measure, the total length of the boundary walls – bounding Tommy Road and the main valley road as far as the cross wall down to the river south of the castle, along that wall and the now ruinous wall along the riverside all the way to Castle Bridge – was determined as 524m. However, when the length of the set of building earthworks either side of the standing and later field barn is deducted from this total, the actual length of wall is 470m, less than 20m longer than what Lady Anne's diary stated: 17m – or 2½ roods – for a wall of this length is not a statistically significant discrepancy. It was determined that all of the boundary walls share common characteristics though only one short section, just north of the gate into the castle precinct, meets Lady Anne's '10 quarters' height figure. It is clear from close examination that most of the walls have been reduced in height. Significant sections still retain topstones laid flat, have straight rather than battered sides, are composed of blocky stone, have a width at the top of 700mm, and evidence of a plinth, all of which are typical of pre-1750 walls (Fig. 8).

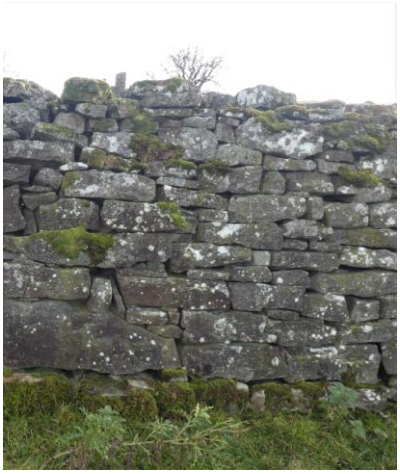

Fig. 8 A length of wall with straight sides, flat topstones, a plinth and a blocky nature

The wall joining the river with the main road, south of the castle, has a corner where both walls are tied in to each other, thus erected at the same time. Similarly, the internal dividing wall north of the castle is tied into the boundary wall alongside Tommy Road. Close examination of this wall shows that the first 2.2m from the roadside wall are much older than the next 5.8m which contains sub-rounded stone of different geology from the shorter section. The remainder of the wall – 54m in length – is the same as the 2.2m. At the point 8m from the (east) wall junction there is a very clear wallhead (Fig. 9); at 2.2m there is a possible wallhead.

Fig. 9 The straight joint in the dividing wall, right of the ranging pole, showing the difference in stone type and characteristics either side

It can be concluded that there had been a gateway 5.8m wide allowing access from the castle to the lower, northern part of the curtilage. It is relevant to add that the clear sunken trackway (Fig. 10), rising from the set of earthworks north of the barn, peters out opposite the former gateway which suggests that these long linear earthworks were the 'Stable and Coachouse' built at Lady Anne's behest. What was not immediately apparent, however, was whether or not the walls had been built 'with Lime and Stone', though it is common to find mortar used as an externally-invisible internal binding agent rather than as external pointing. Two gaps in the roadside wall, at the time of the excavation of the sow kiln, provided the means of examining the interior of the wall. In a very small gap a few metres to the north of the entry gate it is possible to see into the centre of the wall either side of the gap: no lime mortar at all was apparent. A long gap, a few metres south of the gate, has a spread of stone from the wall scattered into the field though the gap itself had been 'singled up'. Several pieces of lime mortar were evident among this spread (Fig. 11). If these two short sections are at all typical of the entire precinct wall, it can only be concluded that the wall builders largely ignored Lady Anne's orders as the amount of lime mortar noted was less than minimal.

Fig. 10 The trackway, looking towards the earthworks to the right of the later barn

Fig. 11 A piece of lime mortar, full of inclusions, from within Lady Anne's 90-rood wall (200mm scale).

Pennant (1801, 133), on his visit in 1773, commented that Lady Anne had caused to be erected 'stables and other offices' adding that already 'their place is only marked by the ruins'. Presumably they had been robbed out by local inhabitants using accessible stone as a convenient quarry.

It is, with the dubious benefit of hindsight, astonishing that so much constructional work was achieved in such a short time and one has to wonder to what extent Pendragon was indeed in a state of utter decay. If the go-ahead was only given by her in June 1660 and she was able to live there only sixteen months later, that hardly gave sufficient time to locate and procure the necessary timber, stone, sand and lime mortar let along the craftsmen and labourers available to undertake the work. The castle cannot have been in a serious state of decay, cannot have been reduced to a 'heape of stones'.

Between October 1660 and September 1674 Lady Anne resided at Pendragon on eleven occasions for varying lengths of time: from three nights in 1660 to four months in 1666 and 1674 (ibid, passim). She enjoyed living in comfort and clearly valued this castle, both of which serve to emphasise the extent to which she must have restored Pendragon between 1660 and 1662. It is also worthy of note that she ordered the widening of Castle Bridge over the Eden on Tommy Road, at the bounds of Pendragon's curtilage.

6. Research Aims and Objectives

First, to undertake detailed gridded geophysical surveying – using magnetometry – across the feature in question, to highlight the presence of buried ferrous objects and/or areas of burnt material, such as would be expected in a lime kiln. This was undertaken prior to excavation. There was a strong argument for also undertaking a resistivity survey between the natural slope and the wetland, and between the walls alongside Tommy Road and the beck, specifically to identify the signatures of possible hidden structures that may relate to the kiln or to the castle. This was also undertaken prior to excavation.

Second, to undertake excavation within the bowl to understand its detailed morphology – bowl construction and design, flooring materials, internal details – which could not be determined without invasive investigation. One trench was delimited to encompass rather more than 50 per cent of the feature, initially measuring 6m north-south by 3m east-west. This enabled investigation of half of the bowl together with a section of the perimeter banking and, crucially, any possible central stokehole. This latter element can be key to placing putative sites within the chronology of this writer's sow kiln typology.

Third, excavation was also designed to reveal the state of survival and preservation of the structure.

Fourth, beyond these practical and research issues, given that it was envisaged as a community excavation, the project also aimed to further the practical skill set of volunteer participants, to extend their knowledge of features such as this one, as well as making available to the wider general public and to researchers the results of this investigation by adding to the existing scant corpus of published material on similar archaeological sites.

7. Methodology

The desk-based assessment had already been covered and details are given in the Full Monument Report held by the YDNPA HER.

Geophysical surveys were undertaken (see Appendix 1 and 2).

A full topographical survey had previously been undertaken, as discussed in Section 3.

Excavation procedures on site adhered to the *General procedure for opening, excavating and closing trenches*, compiled by Mark Hewitt, Wildlife Conservation Officer for the YDNPA, in 2013; and the Chartered Institute for Archaeologists' *Standard and guidance for archaeological excavation* 2014 (www.archaeologists.net/codes/ifa). The trench did not approach HSE's critical shoring depth.

Turf and top soil were removed entirely by hand and stored on Visqueen sheeting. No wheelbarrows or machinery were used. Topsoil and stone were stored separately from subsoil. Turves were stacked around the spoilheap grass-to-grass and soil-to-soil to form a retaining wall for the soil.

The trench was photo-cleaned, digitally photographed and planned using 1m x 1m planning frames or tape-and-string long-sections as excavation progressed. A detailed digital photographic record was compiled at all stages of the project and archived in accordance with CI*f*A guidance. The digital record was enhanced by 3D photogrammetric recording once excavation had been taken to completion.

Excavation was furthered using hand-trowels down to the basal surface.

To inform full interpretation of the structure, the trench was extended in size at the north-east corner by 800mm east-west and 600mm north-south.

Proforma Context recording sheets were compiled and archived as per normal practice.

All artefacts were given a recorded finds (rf) number and logged and bagged according to best practice for post-excavation analysis.

An environmental sample strategy was proposed to take 40-60l bulk samples from each key context where possible, other than from topsoil layers, and 100 per cent bulk samples of very small contexts but, as nothing suitable was revealed within the kiln, this was not adopted (Campbell *et al.* 2011: 12).

The trench was backfilled on completion with turf and stone relaid. Topsoil was replaced after subsoil and stone. Monitoring over ensuing months ensured stock disturbance and weed infestation were minimised.

Any rubble removed from within the kiln was stacked on plastic sheeting during excavation; similarly, any fallen structural stone that needed to be removed to further the excavation process was also stored separately next to the spoilheap.

A Site Book was compiled by the excavation director.

After all on-site work had been completed the excavation director organised laboratory examination of artefacts and ecofacts and liaised with the YDNPA's Historic Environment team to decide how many and which samples were to be submitted to the SUERC radiocarbon dating facility at East Kilbride. The project budget contained provision for a range of post-excavation analysis.

The excavation director also compiled the project archive which includes all photographic records, excavation plans and artefacts. The decision as to where the archive was to be deposited was made by the YDNPA's Senior Historic Environment Officer. The policy regarding dissemination of the results of the project to external audiences is the preserve of the YDNPA and the landowner.

The decision as to where logged artefacts are stored for the long term is also a matter for the landowner and the YDNPA.

8. Excavation Results

The single trench was laid out across the western half of the earthwork initially extending 6m north-south to take in a full longitudinal slice of the feature from behind the rear of the kiln to outside the lowest point at the lower (front) end, by 3m east-west to take in a 60 per cent section of the kiln bowl, external banking and central flue and stokehole (if the latter had existed). During excavation it became imperative to cut a small extension in the north-east corner (see below) 800mm by 600mm. Fig. 12 is a long-section, 8m in length, drawn at a scale of 1:20 east-west across the entire pre-excavation earthwork feature.

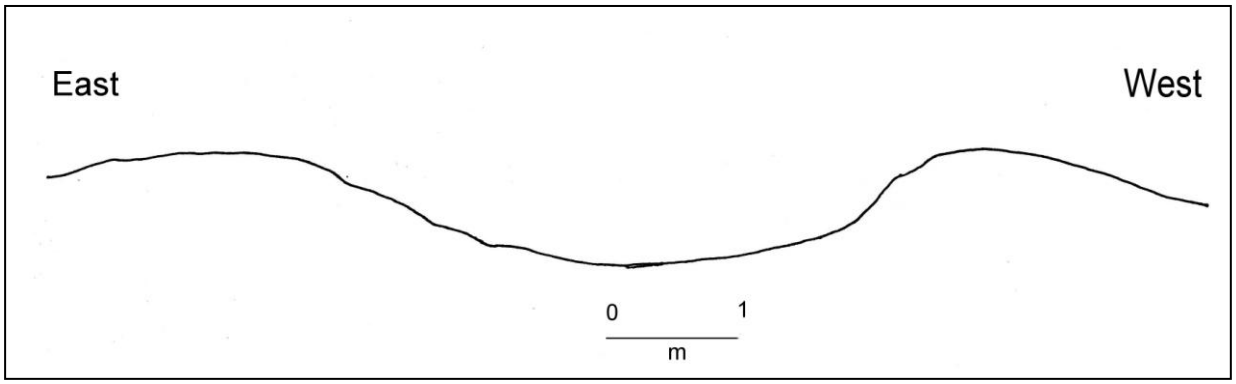

Fig. 12 East-west long section through the earthwork

Nineteen contexts were recognised within the trench: Fig. 13 is the final plan, drawn at 1:20, showing those contexts extant on completion of excavation.

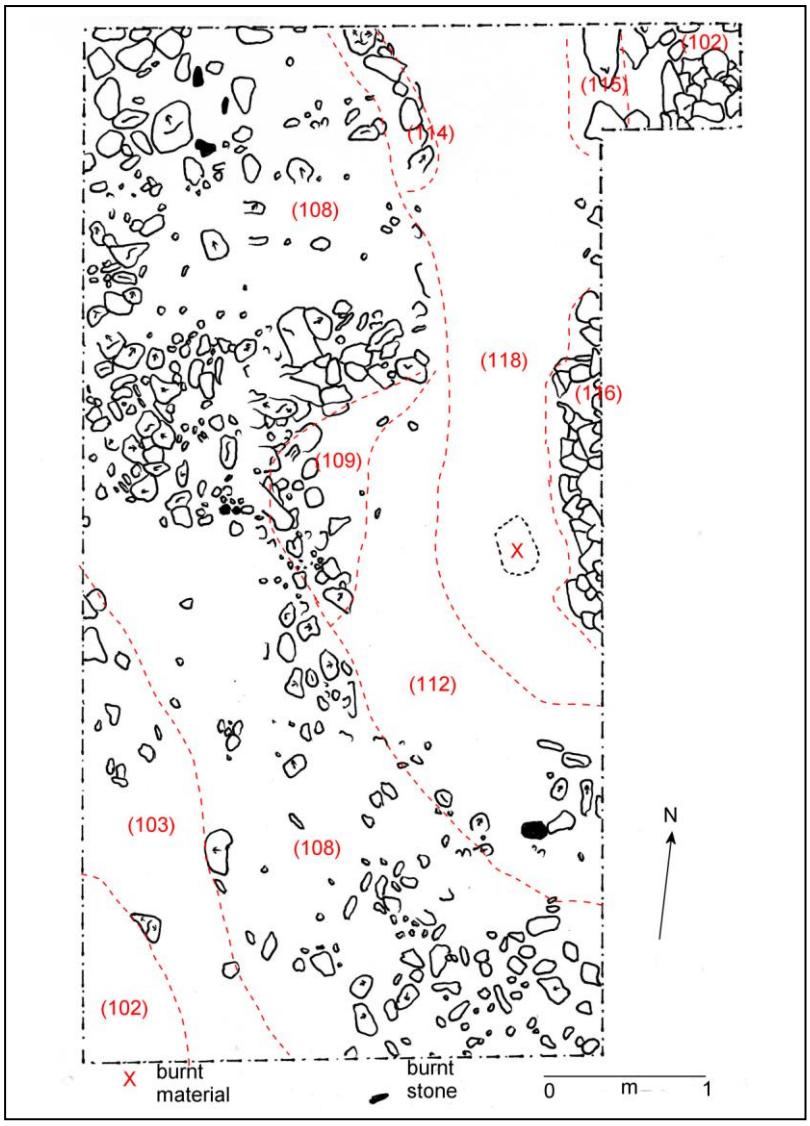

Fig. 13 Final excavation plan

Context **101** was the turf and topsoil layer, 50-120 mm thick, composed of organic deposits of dark greyish-brown clayey silt, firm but friable, covering the whole trench. The topsoil was at its thickest within the bowl and least thick on top of the bank surrounding the bowl. This horizon was interpreted as organic-rich soil that developed by normal edaphic processes after abandonment of the kiln. (101) was largely free of inclusions except for less than 5 per cent content of small sandstone pebbles at the base of the topsoil within the bowl. No finds were recorded from (101).

Below (101), Context **102** was a layer of unconsolidated sandstone cobbles and angular pieces (both with average long axes of 150-200mm) mixed in with topsoil, with the same soil characteristics as (101). It was initially seen across the whole trench, within and without the bowl. It was interpreted as upcast stone from creating the bowl spread out to form a durable working surface for loading and emptying the kiln that over the centuries since abandonment had been loosened and displaced from the surrounding stone bank. Some was seen in situ, other stones had slipped down the bank into the bowl above secondary backfill deposits (107) and (116) so, at the end of excavation, (102) was seen only as a spread on top of the bank. Within (102) seven samples of charcoal were logged, along with part of the front of a corroded iron (pony) horseshoe (rf 101) and two pot sherds (rf 110 and 112).

Below (102) were two discrete secondary backfill deposits. Context **107** was seen on the eastern side of the trench as a hemispherical lens of about eighty sub-rounded sandstone cobbles and angular sandstone pieces 80-120mm in long axis lengths, not in any deliberately laid fashion but haphazardly deposited. The top surface of the lens was only 20mm below the turf layer and was only one stone in thickness; it clearly extended across the bowl beyond the trench edge. Within the lens were some flagstone pieces the largest of which was 360mm in long axis; some were seen lying flat, others at a raked angle. This lens was interpreted as a heap of stone that had been tipped into the kiln from the surrounding bank as part of the sequence of secondary backfilling. It was 1.75m in north-south length with a maximum width of 800mm, with its 'ends' 2.35m from the south edge of the trench and 1.9m from the north edge, thus more or less centrally deposited within the bowl. One find was logged from (107), namely a rim fragment of coloured vessel glass (rf 111).

Associated with (107) was a large quantity of variably-sized angular to sub-angular sandstone pieces (Context **116**), only seen sticking out from the eastern wall of the trench in the centre of the bowl. As with (107) it had no structure but had been tipped in as secondary backfill rubble directly above (107) and below (102). It extended 2m in north-south length with a thickness of 400-800mm visible in the trench for a maximum width of 250mm. No finds were logged in this context.

Plastered against the mid-to-lower part of the bowl wall, at the point where the wall curved round towards the flue passage, was a discrete elongated lens of almost-orange or reddish-yellow compacted and sticky clay (Context **109**) containing highly weathered and degraded sandstone debris. It was 1m in north-south length, 100mm wide at the south end and 460mm at the opposite end.

Butting against (109) was a further discrete deposit, this one of yellowish-brown silty sand (Context **105**), seen in a narrow band along the lower part of the bowl wall. This deposit had almost no inclusions other than a few degraded sandstone fragments. Its origin defied explanation but the presence of charcoal (four samples were logged – rf 113, 115-17) within it suggests this deposit resulted from the firing process, but not the final firing event. It may

well be that when the bowl was being scraped clean after one or more firing events some of the residue of burnt material was left behind plastered against the bowl wall.

Towards the base of the bowl three discrete deposits were all interpreted as primary backfill material, that is, material thrown into the bowl after it had been used for the last time and abandoned; there is no means of tightly determining what time span elapsed between the last firing event and the primary backfilling process. One of these primary backfill deposits – Context **104** – occupied the outermost part of the flue passage, exposed within a sondage in that part of the trench, extending for only 600mm in length and breadth, was seen at a maximum depth below the turf line of 400mm and found to be 90-150mm thick. It was composed of angular and sub-angular sandstone pebbles whose long axes ranged from 70mm to 140mm in length. There was no structure to this deposit – the rubble had been tipped in without ceremony. No finds were logged here.

Also within the flue passage was a second layer of primary backfill, Context **110**, which had clearly been deposited after the kiln went out of use; it was loose rather than friable, weak-red silty sand. The reddish hue resulted from fire-reddened material being cast aside as the bowl was scraped (more or less) clean after one or more firing events but then thrown back in again during backfilling. In north-south length (110) was 900mm in length and 400mm thick. The deposit also had embedded within it angular or sub-rounded pieces of sandstone and one large lump of fossiliferous coral limestone (220x200mm) found lying prone 550mmm below the turf layer and 1.2m in from the western edge of the trench; it was not found in situ. Its basal face was liberally smeared with sooty-black degraded shale indicating it had been affected by fire within the kiln, though it was too large to have been intended for direct firing. No finds were recorded in (110).

Whereas (104) and (110) were interpreted as primary backfill deposits within the flue passage, Context (**113**) was a substantial primary fill deposit within the bowl itself. It measured 1.5m in north-south length by 850mm in maximum width by 600mm in thickness. It was composed of mostly sub-rounded sandstone cobbles set in a greyish-brown silty sand matrix and formed the lowest layer of material thrown in to (partially) fill in the bowl after abandonment. Two pot sherds (rf119 and 122) and one fragment of animal bone (rf121 were logged in (113).

To enable the kiln to operate to maximum efficiency, during its construction the floor of the bowl and flue passage were laid to form a firm and durable surface that facilitated the cleaning out of limeash and burnt lime residue after each firing. Within the bowl itself Context (**118**) was a layer of sandstone pebbles and pea gravel firmly impressed into the natural clay substrate (Context119). While it provided a hard surface, being pebbles would have made it difficult to fully scrape it clean and remove all residue of previous firing events. A concentration of charcoal fragments, arguably from the final firing event, was recovered from the bowl floor, and *c*. 20 per cent of the surface area of (118) comprised shattered coal and carbonaceous shale, again most likely the residue of fuel used in the last firing event. This deposit was seen running down the centre of the bowl 1.3m long by *c.* 200mm wide. Surprisingly, there was an almost total absence of actual quicklime residue on the kiln floor so, presumably, the limeburners had indeed managed to effect a thorough cleanout. Context 118 extended 1.9m north-south by 850mm east-west at maximum width and was 600mm below the turf level but 1.45m below the crest of the surrounding penannular bank. No finds were logged in (118).

Running out of the bowl, slightly downhill and to the north, the flue passage was also seen to be floored with a layer of compacted sandstone pebbles set in a yellowish-brown silty-clay matrix (Context **106** within the sondage; and **111** along the full length of the flue). Unlike within the bowl, the pebbles were not directly set into the glacial substrate. One sample of charcoal (rf 108) was logged in (106), but nothing was logged from (111). Its full length was 1.9m and width increased from 500mm where the flue left the bowl to 1.03m, between the two flanking flue walls at the northern edge of the trench.

Not only did the kiln bowl and flue require a hard basal surface, the outer part of the surrounding bank also needed to be durable. Loading raw limestone and fuel, and drawing the charge (the fired quicklime), would have been both hazardous and very difficult in wet conditions, given how steep the surrounding slope is, so it was essential to lay a firm dry working floor around the entire kiln top. Thus, here a layer of sandstone gravel (Context **103**) had been firmly impressed into the top of the bank and the area beyond it: this extended to the eastern and southern edges of the trench and clearly extended beyond in both directions. If carts were used to deliver stone or fuel to the kiln, backed up as close as possible, a durable surface was an essential feature. No finds were logged in (103).

To create the kiln in the first place the natural hill slope was dug into and the material from what became the bowl was upcast to form the surrounding penannular bank. The bowl had been dug down to the natural layer (**119**); in this case it was glacial diamicton, a mixture of cobble and boulder clasts in a sticky clay matrix as seen in a small sondage (400x200mm) dug into (118), the floor surface of the kiln bowl.

As the bowl was being shaped to the desired curvature and angle of slope, the cut was thus formed (Context **117**) and exposed on its southern and western sides within the trench (Fig. 14). On the latter the angle of slope was 33 degrees on the lower part and 72 degrees on the upper part. On the southern side it averaged 70 degrees throughout.

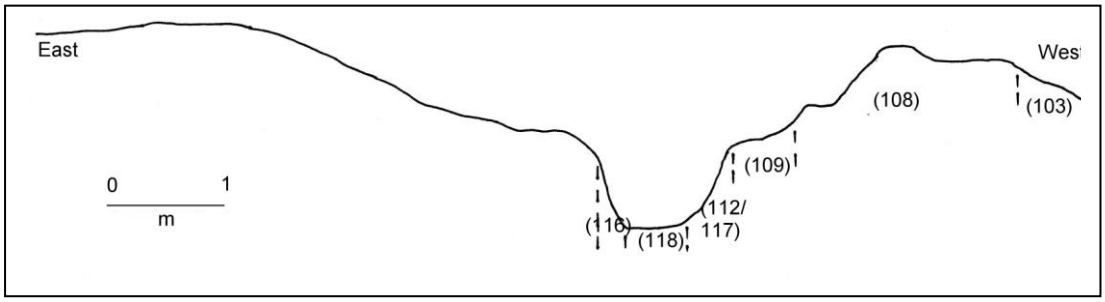

Fig.14 East-west long section of the kiln on completion of excavation

The surrounding bank (Context **108**) was composed of sandstone – some sub-rounded, others angular – haphazardly impressed into a subsoil matrix (102). The stone gave stability and strength to the bank as well as a durable edge to the surface used for loading and drawing the kiln. It was emphatically a bank with stone rather than a stone wall or formal stone bowl lining. Some highly burnt sandstone pieces and fragments of charcoal were seen within (108) but they were not logged due to their position outside the kiln: they had no stratigraphical integrity.

Once the bowl cut had been shaped and finalised the surface so created was given a coating of greyish-brown sandy silt (Context **112**) designed to provide a firm and watertight lining to the lower part of the bowl. Thus, the bowl did not have a stone lining, or even a clay

lining with stones impressed into the clay, but just a hard-packed silty lining. There were no finds in this context.

The final structural work on the kiln prior to its commissioning was the insertion of flanking walls to contain the flue passage as it left the bowl. The first one to be excavated and fully exposed was that on the west side of the flue (Context **114**). This had been constructed as a dry stone wall built with large to very large blocky sandstone. It survives to two courses in height but may well have been higher when the kiln was in use, and was backed by sandstone rubble packed in at the butt end of penannular bank (108). It survives for a length of 1.2m and is only a single block in width; maximum surviving height is 500mm, and it was bedded on the natural (119). Very unusually for excavated sow kilns, this wall curves around the butt end of the penannular bank rather than being rectilinear: why this was preferred cannot be explained.

The opposite side of the flue passage also had a length of containing wall (Context **115**), as seen in the small trench extension in the north-east corner. It was also built as a dry stone wall but survives with only two angular sandstone blocks in place, 620mm in length and 300mm in (single-block) width with a height now of 220mm. It was backed by, and contained, rubble deposit (102) at the butt end of the eastern part of the penannular bank, again set on the natural. Unlike (114), this length of wall is rectilinear.

9. Finds Report

Metal objects

Two metal items were logged. Rf 101 from Context 102 was a very corroded and thinned arcuate iron piece with rivet holes visible. It has been identified by two finds experts as part of the front of a pony horseshoe.

Rf 106, from the same context, is a highly corroded iron hand-forged stud nail.

Glass from Pendragon Castle

Chris Howard-Davis

A single, relatively thick, upright rim fragment was submitted for comment. It came from a secondary fill (107) of the sow kiln. The colourless metal has a distinctive brownish tinge typical of Venetian *cristallo* glass, or glass made elsewhere in Europe in the Venetian manner (*façon de Venise)* (Charleston 1975, 205) and is clearly of good quality (Fig. 15).

Fig. 15 Rf 111, façon de Venise vessel fragment

The fragment is too small for identification of the form of the vessel from which it derives, but it is blown, and the thickness and potentially large diameter of the rim might suggest a bowl rather than a cup. There is no sign of trailed or applied decoration, which might be expected from *façon de Venise* glass, but this might simply reflect the small size of the fragment. Plain bowls were being made in Venice in the late medieval period (see for instance Tait 1979, Fig. 63, for a late fifteenth-century example) but it is most likely to be marginally later, perhaps made in the late sixteenth or early/mid seventeenth-century. Grey or brownish discolouration is typical of glass made in the *façon de Venise*, by emigré glass-makers from Venice, who began producing in north-western Europe during the sixteenth century, and in London from 1545, with Jacopo Verzelini granted a royal privilege for making drinking glasses in 1575 (Hurst Vose 1980, 107). The development of truly colourless *cristallo* from the mid-sixteenth century (Tait 1979, 49) and then, in the mid-late seventeenth century, lead crystal glass (Hurst Vose 1980, 118), meant that Venetian-style glass swiftly declined in popularity thereafter (Charleston 2005, 215).

Venetian, or *façon de Venise*, glass made elsewhere in Europe was much-prized and appears widely in elite Tudor and Stuart households, for instance Nonsuch Palace (Biddle 2005) or Acton Court (Courtney 2004), as well as in wealthy urban households, for instance in Southampton or Winchester (Charleston 1975; Charleston 1990), and even military contexts (Cropper 2001). Thus it would not be unreasonable to see it arriving at Pendragon Castle, perhaps already a little out-moded, in the household of Lady Anne Clifford, during her rebuild in 1660-61.

Ceramics

Four pot sherds were logged from within the kiln and were analysed by Barbara Blenkinship whose notes are reproduced here. As all are very small, it is difficult to give any a precise date.

Rf 110, from Context 102, is a small sherd of sandy buff fabric with a few relatively large inclusions. The exterior surface of the vessel shows evidence of several lines of a yellowish glaze. It dates from the thirteenth to the sixteenth century.

Rf 112, from the same context, is very similar to rf 110 except that <112> is very abraded and shows no signs of having been glazed. This sherd also dates to between the thirteenth and sixteenth centuries.

Rf 119, from Context 113 (lower primary backfill), is a sherd of reduction-fired buff gritty fabric with splashes of green glaze (Fig. 16). This sherd similarly fits into the thirteenth to sixteenth century date range.

Fig. 16 Rf 119, base sherd with olive-green glaze

Rf 122, also from Context 113, is a portion of the rim of a vessel of oxidised gritty ware which had a maximum diameter of 110mm (Fig. 17). It is unglazed. This sherd has a tighter date range, specifically twelfth or thirteenth century.

Fig. 17 Rf 122, unglazed rim sherd of jar or cook pot

Because these sherds were very similar to an assemblage recovered from excavations in Cumwhinton south-east of Carlisle the four sherds were shown to Jeremy Bradley, the pottery expert on that project.

Medieval Pottery

Jeremy Bradley, Archaeological Consultant

Four sherds of medieval pottery were recovered from two stratified layers within the bowl of the kiln, thought to be associated with abandonment of the structure. Examination of the pottery has suggested there are three distinct fabrics which have broad similarities with pottery traditions originating from both east and west of the Northern Pennines. However, due to the small size of both the pottery fragments and the assemblage itself, it has not been possible to identify a kiln source.

Methodology

The pottery was examined with a x10 hand lens and analysed in accordance with guidance provided by the Medieval Pottery Research Group (2001). Fabric Identification was undertaken with references to published assemblages from Carlisle, Penrith, Appleby-in-Westmorland and sites in the Lune Valley, Yorkshire Dales and Barnard Castle (McCarthy and Brooks 1992; Brooks, McCarthy and Railton 2013; Brooks 2000; Edwards 1967; Moorhouse 2007; and Austin 2007).

Quantification and Fabric Description

The four sherds recovered during the excavation and their fabric descriptions are detailed in Table 1.

Table 1 Fabric descriptions

Fabric	Context No	Description	Weight (g)
1	119 / 113	Abraded, glazed basal sherd with splashed pale olive-green glaze. The fabric is buff coloured with small quartz sand inclusions (2-5%) and a pale blue-grey reduced core.	12
1	122 / 113	Unglazed rim sherd. Everted, square rim likely to be from a jar/cook pot. Rim diameter *c*. 200mm. Fabric is the same buff sandy ware as 119/113, but without the reduced core. Some similarity in terms of rim shape, rather than fabric, to Docker Moor vessel 43 (Fig 5; Edwards 1967) and vessel 22 from Kingsdale Head in the western Yorkshire Dales (Fig. 33; Moorhouse 2007).	9
2	110 / 102	Slightly abraded glazed body sherd. Similar to Fabric 1, but with remnants of a reduced grey exterior and traces of olive-green glaze. Superficial resemblance to Partially Reduced ware from Carlisle (McCarthy and Brooks 1992) and the dominant fabric from Shaw's Wiend, Appleby-in-Westmorland (Brooks, McCarthy and Railton 2013).	2
3	112 / 102	Abraded, unglazed body sherd. Buff-pink fine sandy fabric with light grey core.	3

Discussion

The four sherds were within the primary fills (102 and 113) of the bowl of the kiln, and therefore may provide an approximate TPQ for its abandonment and backfilling. Abrasion was visible on all sherds, and small size also suggests reworking before final deposition. Stylistically, based on the single diagnostic sherd (122 / 113; see Figure 16) and the nature of the sandy buff fabrics, which have affinities with ceramic traditions in Carlisle and the Lune Valley and also with Tees Valley wares (Edwards 1967; McCarthy and Brooks 1992; Austin, 2007), a broad date range of thirteenth to fourteenth century can be attributed. There were no sherds that resemble the typical northern Late Medieval Reduced Greyware, which date from the late fourteenth to the seventeenth century (McCarthy and Brooks 1988, 388; McCarthy and Brooks 1992). Such pottery has been identified in the North West from Morecambe Bay in the South to Carlisle in the North (White 2000; McCarthy and Brooks 1992), and across the Pennines into Northumberland (McCarthy and Brooks 1988, 90).

The single diagnostic sherd with an everted rim, probably from a jar/cook pot (see Figure 15, above) , has as mentioned in Table 1, shows similarities to rims recovered from Docker Moor in the Lune Valley (Edwards 1967, vessel 43, Fig 5) and from Kingsdale Head in the western Yorkshire Dales (Moorhouse 2007, Vessel 23, Fig 33). Jar forms are the dominant form of vessel found in archaeological contexts during this period (McCarthy and Brooks 1988, 122-3). Caution should however be exercised in the discussion of rim types since at Barnard Castle considerable numbers of jar/cook pot forms were recovered, and it was apparent that broadly contemporary potters were using most of the recognised rim forms (Austin 2007, 490).

The small size of the assemblage and limited range of fabrics from the site hinder attempts to identify where the pottery was produced. Sandy fabrics are found in Penrith and Carlisle; however, the Pendragon fragments are not as hard fired as those fabrics. Sherd 110/102 has a superficial resemblance to Carlisle partially reduced Fabrics 15, 17 and 19 and Fabric 4 from Shaw's Wiend, Appleby-in-Westmorland (McCarthy and Brooks 1992; Brooks, McCarthy and Railton 2013), but the fragment is too abraded to draw closer comparisons. Conversely, there is some similarity with Shaw's Wiend Fabric 10, which was considered to be a regional import (ibid).

Given the location of the site there is the possibility of cross-Pennine trade bringing wares from North Yorkshire and from County Durham/Tees Valley. Amongst a very substantial assemblage from Barnard Castle in Teesdale, County Durham, some 30km to the north-east, were a number of wares potentially identified as Tees Valley ware (Types 1, 2, 3, 5, 6, 7, 8 and 17; Austin 2007, 497). This is a pottery tradition found from Durham in the north to Catterick in the south and as far as the coast to the east. At Barnard Castle this type of pottery was thought to have been produced into the thirteenth century, although as yet no kiln sites have been identified to suggest where it was made (Errickson and Daniels 2017). The material from Barnard Castle, although hard fired, has similarities to the Pendragon fragments (Fabric 1 and 2) in terms of colour and inclusions, as well as the type of vessel produced (Austin 2007, 289-92, 393, 497).

Equally, mention has already been made of the material from Docker Moor and, although the rim type found at Pendragon Castle only resembles that from a single vessel from that site, the fabric description does match that of sherd 122/113 (Gibbons 1985/6). But like fabrics from the North West the colour variation can vary, even between sherds from the same vessel (Brooks, McCarthy and Railton 2013).

Ultimately, given the factors stated above only general observations about the assemblage can be made. The limited range of fabric types, small size of the assemblage, and the existence of a single diagnostic sherd all preclude any definitive statement.

Charcoal

Based on laboratory examination and notes by Dr Denise Druce, Project Officer (Environmental), OAN.

Thirteen environmental samples were submitted for laboratory analysis of which all but one were charcoal (Table 2). Two proved to be of indeterminate species thereby reducing the number of samples suitable for radiocarbon dating. It is of interest to note that six of them were Common Alder (*Alnus glutinosa*) and a further three were either alder or Common Hazel (*Corylus avellana*) and one definitely hazel.

Table 2 Charcoal identifications

Sample no	Context no.	Charcoal identification	Old wood error (yrs)[1]
102	102	*Alnus glutinosa*	150+
103	102	Not charcoal	na
104	102	*Alnus glutinosa*	150+
105	102	Indeterminate charcoal	na
107	102	*Alnus glutinosa*	150+
109	102	*Alnus glutinosa/ Corylus avellana*	150+
114	102	*Corylus avellana (roundwood fragment)*	<50
113	105	*Alnus glutinosa / Corylus avellana* (very small fragment)	150+
115	105	Indeterminate charcoal (very small fragment)	na
116	105	*Alnus glutinosa* (small fragment)	150+
117	105	Alnus glutinosa	150+
108	106	*Alnus glutinosa / Corylus avellana*	150+
118	113	*Alnus glutinosa*	150+
120	113	*Alnus glutinosa*	150+

[1] Tree longevity is taken from *Native Tree-Characteristics, Tolerances and Site Suitability.* The Moray Council, Planning & Development, unpublished report, 2008.

The 'old wood effect' applies here (The Moray Council 2008, as above): fragments from what is obviously not round wood could have originated from anywhere within a large branch or trunk. Once a tree lays down a new growth ring, the former years' growth dies. Alder trees can live for up to 150 years (hazel approximately eighty), so a dated alder sample could be 150 years older than the date when the tree was felled. Essentially, dates obtained for alder samples could have a built-in error of that magnitude on top of whatever calibrated date range is obtained.

The absence of long-lived species – oak (*Quercus* sp) and ash (*Fraxinus* sp) – suggests that all the identified charcoal relates to kindling, smallwood timber used to get the fire established for each firing event, rather than to larger timber used as fuel to maintain the fire throughout each calcining process. The presence of significant quantities of coal and degraded carbonaceous shale within the kiln supports the contention that timber was not the dominant kiln fuel.

10. Dating

1. Chronological possibilities

Discussion in Section 5 summarised what is known concerning Pendragon's changing fortunes through five centuries and, crucially, what has been claimed in the literature. From this, there are several episodes of construction of the castle, either new-build or repairs:

a. Initial construction of what may well have been a simple tower house in the late twelfth century.

b. Work ensuing from the granting of a licence to crenellate in 1309, resulting in the plan form of the castle more or less as seen today.

c. Restoration of the castle in the 1360s following probable Scottish depredations in 1341, and the erection of the south-west tower.

d. Documented restoration and new build at the behest of Lady Anne in 1660-62.

The kiln sits within the wider curtilage of the castle, just below a former trackway that runs just above the kiln from within the modern field containing the castle towards the range of buildings set against the riverside, now surviving as earthworks. Construction and use of the kiln must therefore relate to one of these castle-building episodes.

2. Ceramics

Both ceramics experts emphasised that the small size of the assemblage – four small sherds – precludes precise dating with only one sherd (rf 122) being diagnostic and with all having similarities to pottery found on other sites in Cumbria and the Yorkshire Dales. At the broadest date range, all four can be ascribed to the thirteenth to sixteenth centuries though one of the experts has discounted the latter two centuries (pers. comm. Jeremy Bradley) suggesting they date from the thirteenth or fourteenth centuries.

Given that two of the sherds were recovered from backfill of the kiln bowl, they do provide a *terminus post quem* for backfilling of the kiln, in other words a 'time after which' meaning that any material above where the sherds were found can only have been deposited after the sherds were thrown in, and that the backfill containing the sherds may have been deposited no later than the fourteenth century. Whereas one of the ceramics experts suggested sherd rf 122 could date from the twelfth or thirteenth century, the other placed it within the thirteenth or fourteenth. This latter suggestion, however, cannot ascertain precisely when within those two centuries and it could just as well have been, say, in the 1220s as in the 1380s: if the early part of the thirteenth is germane it would not be out of step with a late twelfth-century date for the period of operation of the kiln. Of significance to the dating of the

kiln, rf 110 and 112 were recovered from the subsoil and stone spread on the bank top (Context 102), at depths below the turf of 200mm and 130mm respectively, so they cannot be deemed diagnostic. Rf 119 and 122, on the other hand, were sourced from primary backfill (Context 113), at depths of 730mm and 700mm, so can be considered diagnostic. There is no means, though, of determining what length of time elapsed between the last firing of the kiln and its infilling.

3. **Radiocarbon dating of charcoal**

Of the thirteen charcoal samples, all from short-lived species, submitted for laboratory examination and species identification all but four were discounted for radiocarbon dating owing to their location within Context 102, the subsoil and stone spread layer on the penannular bank top, the very small size of the sample, and/or species identification proving impossible. Three samples were submitted to the SUERC radiocarbon AMS dating facility in East Kilbride: rf 108, from Context 106, failed owing to insufficient carbon in the sample. This was, to a degree, unfortunate as this layer formed the basal level of the kiln flue at a depth of 350mm below the turf line.

Three samples, all alder (*Alnus glutinosa*) proved positive and returned radiocarbon date ranges (Table 3).

Table 3 Radiocarbon dating determinations

SUERC code	Context	rf	Date BP	Error factor	cal AD 95.4%	cal AD 68.2%	$\Delta^{13}C$ [a]
93241 (54686)	105	117	841	±25	1161-1256	1168-1223	-26.9‰
93242 (54687)	113	118	935	±22	1033-1156	1040-1152	-27.6‰
94700 (55677)	113	120	910	±26	1035-1188	1045-1163	-25.1‰

[a] Pronounced ‘delta 13’. For full details of what this means, see Dunbar et al. 2016.

What is immediately apparent from these data is where they fit into the chronological possibilities for construction of Pendragon. Some can definitively be ruled out: the kiln did not contribute lime mortar for work associated with crenellation in 1309 or with repairs and the adding of the south-west tower in the 1360s, or with Lady Anne’s restoration in 1660-62. If the rf 117 result dates use of the kiln, it was between the mid twelfth and mid thirteenth century: the difference between the 1δ (68.2% probability) and 2δ (95.4% probability) ranges is not statistically significant. This would fit in with the assertion that the present castle was preceded by a smaller stone-built tower house or castellet.

On the other hand, if the date ranges for rf 118 and 120 are germane, the kiln was operational between the early eleventh and mid-to-late twelfth century: again, the difference between the two probability levels is not significant.

The key question is which of the two periods represented by the radiocarbon determinations is the one that can with confidence be ascribed to construction work on the castle. According to Whittaker (1805, 308) Pendragon should be seen as a Norman structure, possibly attributable to Ranulph de Meschines, a contemporary of William the Conqueror (see Section 5 above); while Curwen (1913, 66-67) asserted that it had originally been erected for Sir Hugh de Morville *c.* 1180. Clark (1883, 49) in the same vein considered

Pendragon to have been a fortified tower house at a scale smaller than a castle, and probably in existence prior to 1200.

Rf 117 was logged from a discrete yellowish-brown silty-sand layer plastered in a narrow band (400mm thick) around the bowl wall more or less at mid-point between top and bottom. Five charcoal samples were logged within this context. The uncalibrated radiocarbon age for rf 117 was determined as 841±25 years BP (Fig. 18).

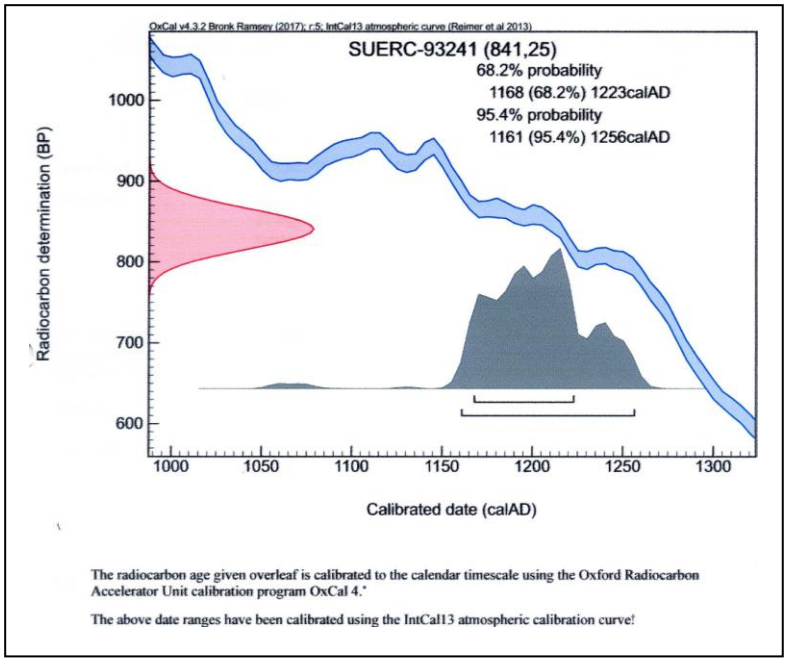

Fig. 18 Rf 117: calibrated date ranges

At the 2δ probability level the date range spans the period cal AD 1161-1256, though close examination of the graph shows that the 1δ determination focuses on the 'higher' part of the graph, namely cal AD 1168-1223. Notwithstanding the caution expressed earlier concerning the longevity 'old wood' effect of tree life (see Table 2), it is plausible to conclude that this narrower date range should be favoured. In other words this sample of charcoal most likely relates to the final third of the twelfth century and the first quarter of the thirteenth. Thus, the date range does not imply work for Meschines in the Norman era but does point to construction under de Morville's tutelage.

Samples 118 and 120 were both logged from Context 113, the primary backfill layer on the basal surface of the bowl and flue passage; three charcoal samples were logged, including these two. Their uncalibrated date ranges were determined as 935±22 and 910±26 years BP respectively, the difference again being statistically insignificant (Figs. 19 and 20).

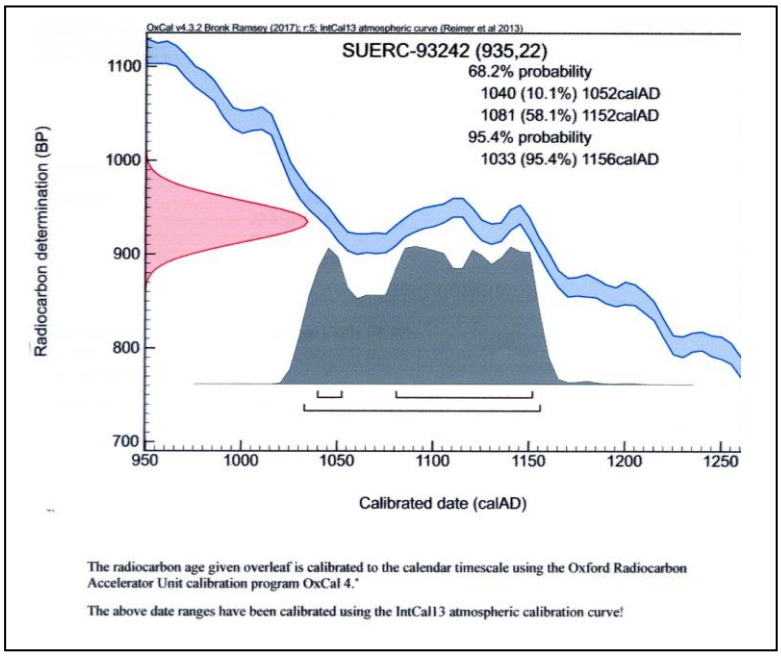

Fig. 19 Rf 118: calibrated date ranges

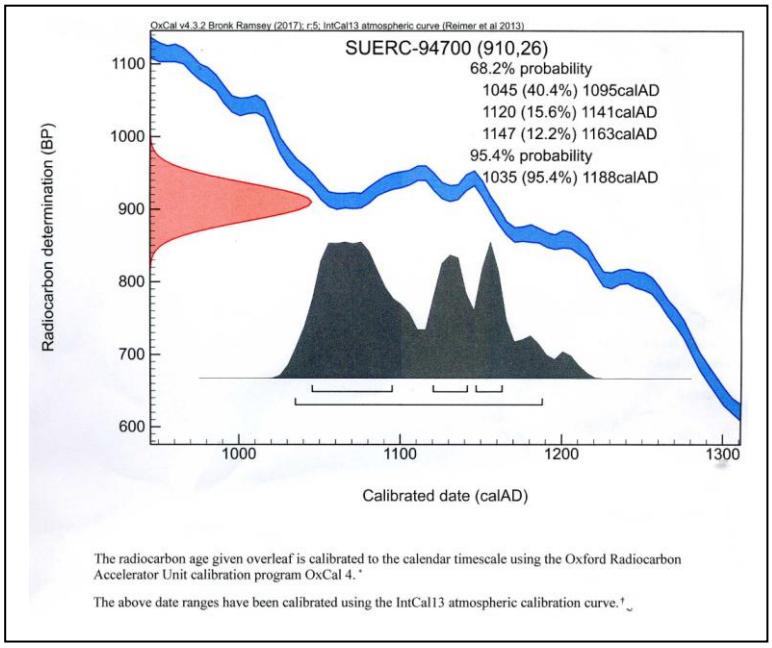

Fig. 20 Rf 120: calibrated date ranges

At the 2δ probability level these date ranges span the period cal AD 1033-1156 (rf 118) and cal AD 1035-1188 (rf 120) though, again, close examination of the graphs shows that the 1δ determination focuses on the 'higher' part of the graphs, namely 1040-1152 and 1045-1163 respectively. The difference between the two samples is definitely of no statistical significance. Here too, it is plausible to conclude that these narrower date ranges should be favoured. In other words these two samples relate to the period from the second quarter of the eleventh century to the middle/third quarter of the twelfth. Thus, these two date ranges

do *not* rule out work for Meschines in the Norman era but (rf 120 in particular) could point to construction under de Morville's tutelage.

11. Analysis and Interpretation

1. **Dating**

To return to the key question posed in Section 10 – which of the two periods represented can be ascribed to construction at Pendragon – the answer has to be both. The two samples from Context 113 (rf 118 and 120), the primary backfill layer on the base of the bowl and flue, most likely relate to one firing episode early in the kiln's life whereas that from Context 105 (rf 117), the layer plastered part-way down the bowl wall, must relate to a later firing episode. Excavation evidence in other sow kilns points to often (or occasional?) 'untidiness' at the base of the bowl or within the external flue which left some of the residue from one firing either on the floor or stuck to the lower sides. This project's excavation was very thorough – meticulous even – in working right down to the basal layer of the kiln meaning material that had been covered over in later firings was 'disturbed' by the excavators for the first time since that particular firing event.

The discrepancy in the date ranges between the two early samples and that from the single later sample is, in one respect, small: that for rf 118 ended in cal AD 1156 and for rf 120 in cal AD 1188 – both overlap the start date for rf 117 in cal AD 1161. It is perfectly valid not to discount the possibility that all three firing events happened within just a few decades of each other. Even at the widest discrepancy level (ie cal AD 1256 minus cal AD 1156) the time span would not necessarily rule out reuse of the kiln. If it had remained open and intact, why build another one?

In conclusion, the YDNPA HER listing (see Section 3 above), that Pendragon is a fortified tower house of the twelfth century, with later additions and alterations, corresponds to the radiocarbon dating results of this excavation.

2. **Sow kiln comparanda**

Excavation showed the kiln to have a rim to rim width of 4.7m, the same as the pre-excavation measurement; length (from the back to the front) was proved to be *c.* 5.4m contrasting with the pre-excavation reading of 4.7m; and maximum internal depth proved to be 1.7m as opposed to the estimated earthwork depth of 800mm. For comparative purposes the pre-excavation readings are used.

a. Of seventy-seven sow kilns surveyed, but not excavated, by this writer across about thirty parishes in and around the YDNP only a small proportion were as large as the Pendragon kiln (Table 4).

Table 4 Comparative dimensions of surveyed sow kilns

Metres	Length	Width
<2	5%	14%
2-2.9	48%	47%
3-3.9	32.5%	28.5%
4-4.9	8%	8%
>5	6.5%	2.5%

Pendragon fits into the 4-4.9m row for length and bottom row 5 for width: only one of the total survey sample was wider than Pendragon and only only one longer. From this single raw statistic it is indisputable that the Pendragon kiln was constructed for a major project.

Using the mathematical formula $V = 0.75\pi(d^2h \div 4)$ where V is bowl volume, d is bowl diameter and h is bowl height measured at the centre point below the turf line, the Pendragon kiln had an estimated volume – excluding whatever height may have been reached by doming the firing charge above the horizontal bank top to bank top level – of 25.5m^3. This is directly comparable to the standard-size, masonry-fronted farmer's field kilns to be seen so widely across Cumbria and the Yorkshire Dales: one, at Hartlington in Upper Wharfedale, had a computed volume of 26.4m^3 (Johnson 2010b, p. 246). Of a sample of seventeen field kilns in Westmorland, whose bowls are fully accessible, the average volume was computed as 15m^3 with the range being 6-34m^3 (Johnson 2013, p. 205).

b. The very fact that the kiln is located within the curtilage of the castle can be taken as proof that it was intended for the production of quicklime destined for lime mortar and probably also lime plaster, lime render and limewash for use on the twelfth-century tower house. Had it been producing quicklime for spreading on surrounding farmland it is inconceivable that permission would have granted to do so within the curtilage.

c. This writer's clamp kiln model, based on typological parameters, suggested it is possible to place clamp kilns into a chronological sequence (Johnson 2008b, 138-39). Among these was the way in which the bowl was lined. All fifteen excavated kilns this writer had been involved in up to that year comprised a bowl cut into a natural slope or bank with the upcast from digging the bowl use to create a bank around the bowl rim. The model postulates the earliest forms having a clay-lined bowl with no signs of structural strengthening; slightly later ones had angular stone pieces impressed into the clay to provide added consolidation; with the latest forms seen having a fully lined stone lining. The Pendragon kiln only had a silt/clay lining (Context 112) with no convincing evidence of impressed stone: this confirms the early radiocarbon date sequences.

d. A second variable is the presence and nature of an internal stokehole arrangement designed to ensure oxygen from outside the kiln could penetrate to the rear of the bowl. The earliest forms did not have such an arrangement and later ones had increasingly sophisticated structures. No evidence at all of an internal stokehole, not even remnants of one, was seen in the Pendragon kiln.

e. A third germane variable is the form of an external flue passage, leading out from the open part of the bowl wall (Fig. 21). As with stokeholes flues became more sophisticated (and sometimes longer) over time. In the earliest kilns the flue passage was short and crude. Pendragon's is the only kiln this writer has seen which had a flue passage curving on

one side (the west, Context 114) and rectilinear on the other (east, Context 115). The western flue passage wall was wrapped round the base of the penannular bank and was only 1.2m long; the eastern was only 620mm in length. There was no obvious reason why the two walls had different alignments. The nature of the combined flue walls also confirms an early date for this kiln.

It should be noted that excavated sow kilns this writer has seen since 2008 conform to the model.

f. Context 118, on the basal surface of the bowl, contained a high proportion of burnt material compressed into the floor, consisting of charcoal fragments, carbonaceous shale fragments and some coal fragments. As all the charcoal samples identified to species proved to be *Alnus glutinosa* (Common Alder) or *Corylus avellana* (Common Hazel), both relatively short-lived species compared to oak or ash, it is beyond doubt that the wood had been used as kindling to get each firing event going. The presence of coal and carbonaceous shale, which latter was extensively mined as a low-quality coal substitute in the Pennines, strongly suggests that coal was the preferred fuel, at least at the end of the kiln's life. Coal is known to have been used in lime kilns elsewhere in England from the twelfth/thirteenth centuries though this writer has not located any references to coal extraction in Mallerstang prior to the early seventeenth century: the Cliffords leased coal pits on Fells End below High Pike Hill (NY803 036) in Mallerstang during that period and there is no reason not to assume workings stretched further back in time (Spence 1991, 101); in a straight line the distance from the extraction site to Pendragon is just over 2km, most easily accessed from Castlethwaite via Bleakham Hills. In Lady Anne's time, however, coal for Pendragon (as well as for Appleby and Brough Castles) was purchased in large quantities from Stainmoor (Spence 1991, 102).

g. Of the nine sow kiln excavations this writer has conceived and supervised, Pendragon is second in the chronological sequence (Table 5).

Table 5 Chronological sequence of sow kilns excavated by this writer

Project code	**Location**	**NGR**	**Calibrated date range (95.4%)**
CRD 13	Crummack Dale, Austwick	SD77720 72420	1026-1216
PC19	Pendragon Castle	NY78165 02725	1033-1256
HH 09	Dalehead, Bowland	SD74518 59451	1185-1280
NC 05/3	Newby Cote, Clapham	SD73660 70820	1440-1640
FN 05	Feizor Nick, Austwick	SD78870 68080	1470-1660
KY 07	Kilnsey, Wharfedale	SD97282 67795	1620-70
CHF 16	Chapel Fell, Malham Moor	SD88490 67530	1636-90
BBW 03	Broadwood, Ingleton	SD69190 73475	1650-95
TC 05	Threapland,	SD98620 60680	1660-1700

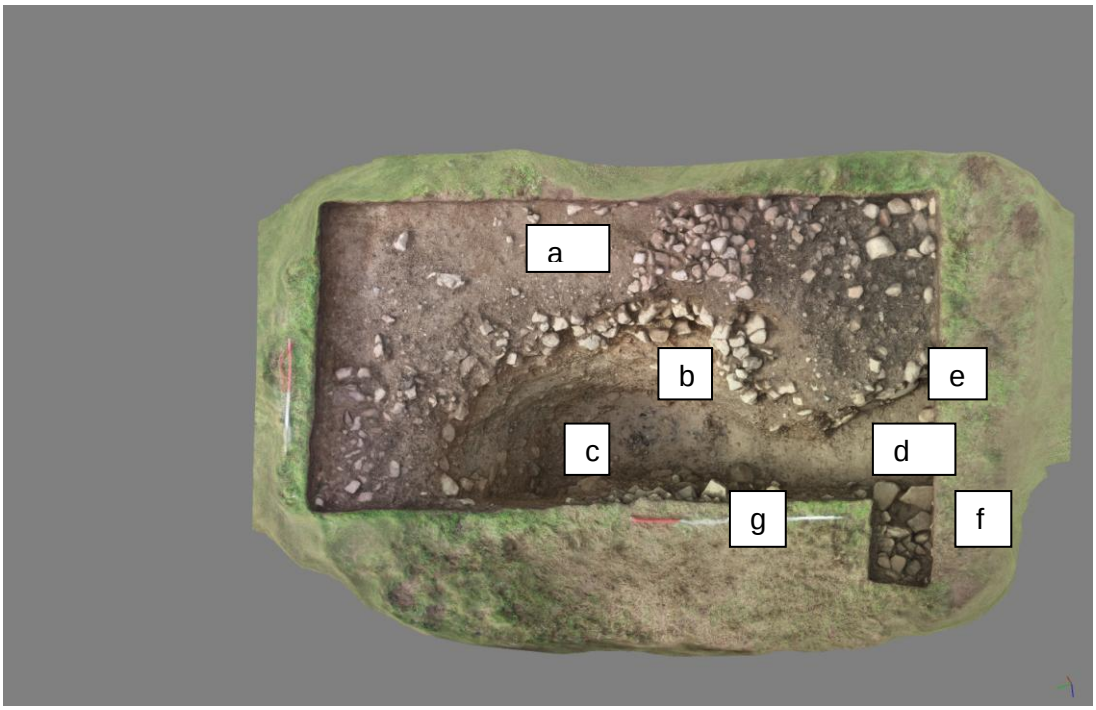

Fig.21 Orthostatic view of the kiln on completion of excavation. North is to the right. (Douglas Mitcham)

Figure 21. an orthostatic view compiled by photogrammetry, shows the following Contexts:

a. Context 102 – stone spread (and subsoil) on the bank top (108) to provide a hard loading and unloading surface

b. Context 117 – the cut for the bowl with silt/clay lining (112)

c. Context 118 – the base layer of the bowl

d. Context 106 – the base layer of the flue

e. Context 114 – west flue revetment wall

f. Context 115 – east flue revetment wall

g. Context 116 – secondary backfill in the bowl

12. References

Note: *CW – Transactions of the Cumberland & Westmorland Antiquarian & Archaelogical Society.*

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Appendix 1

Resistivity survey of probable sow kiln, Pendragon Castle

2019

Jan Hicks (Lunesdale Archaeology Society) and Douglas Mitcham (YDNPA Community Heritage Officer)

Summary

Lunesdale Archaeology Society (LAS) undertook a geophysical survey using resistivity of a suspected lime kiln of unknown date. The work was undertaken by LAS in support of the Westmorland Dales Landscape Partnership (WDLP) Monuments at Risk project. This is being delivered by the YDNPA on behalf of the Friends of the Lake District, who are leading the WDLP scheme funded by the National Lottery Heritage Fund. The results revealed a discrete high resistance feature that was consistent with the interpretation that this feature may be a kiln.

Survey site

The survey was undertaken on 13 August 2019 over a feature thought to be a sow kiln in the field to the north of Pendragon castle (NY784027 approx). Although there had been some wet weather and the low lying ground in the field was waterlogged, the bank where the feature is located and the ground around it were well drained and dry. Two adjoining grids were laid out, the first 30m x 30m, over the feature itself, and the second 20m x 20m over the bank above and to the south of the feature.

Equipment

The survey used an M.M. Resistivity Meter; Model 216M, with a bespoke frame set to single twin mode. Probe separation was 0.5m; gain set to 1. Data were collected at a sampling resolution of 1m intervals along traverses spaced 1.0m apart and walked in the 'zig-zig' traverse pattern. Data were downloaded at the end of each survey session from the instrument's data logger directly into Geoplot v.3 software held on a portable computer. The grid was surveyed using a Trimble GeoXH GeoExplorer 6000 series GNSS unit.

Data processing

Data processing was carried out manually using Geoplot v.3 software on a portable computer. Processing of the GPS survey data was carried out using Trimble GPS Pathfinder Office v.5.10 software, with post-processing using correction data obtained from Ordnance

Survey to an accuracy of *c*. 10cm. Georeferencing of the geophysical survey was undertaken using QGIS Essen v.2.14 and the locations of the grid points are shown in metres in Figures 1 and 2. Table 1 shows the grid points transformed into OS NGR 10-figure format.

Table 1 Grid locations in OS NGR format

Grid point	NGR
1	NY78142 02733
2	NY78171 02728
3	NY78166 02699
4	NY78137 02703
5	NY78170 02718
6	NY78189 02716
7	NY78186 02696

Results and discussion

Fig. 1 shows a plot of the raw data for the two grids, with low resistance values shown in white and high resistance values shown in black. The blue polygon in Figure 2 corresponds to the earthwork feature on the ground. Its high resistance suggests that the earthworks contain large amounts of stone, making it likely that this is a built structure. The very low resistance area to the north is standing water at the bottom of the field. There was some speculation during the project that this flooded low lying area of the field may have been a deliberately constructed shallow pond, although this is not known.

Fig. 2 is the resistivity data overlaid with the HER monument polygon for lime kiln, showing that the kiln corresponds to a discrete U-shaped high resistance anomaly, with the high resistance areas around the edge of the feature corresponding with the earthwork banks. A discontinuous high resistance band south of the kiln, running on a north east-south west alignment and running through both grids may reflect a vague feature. However, this may simply reflect higher resistance readings being encountered generally towards the top of the slope where the soil cover is likely to be thinner. Finally, a semi-circular and partially discontinuous low resistance anomaly can be seen in the smaller grid. This curving arc may partially reflect archaeological features such as pits or ditches, or natural negative features such as tree throw pits. Some of these low resistance areas could also simply reflect further areas of wetter ground.

Acknowledgements

The geophysical survey and processing of this data was carried out by Jan Hicks, Jackie Hooley, Graham Hooley and Andrew Wallis of Lunesdale Archaeology Society. The GPS survey of the grid was undertaken by Luke Bassnett Barker (YDNPA Countryside Archaeological Advisor). Processing of the GPS data and georeferencing of the geophysics

were done by Douglas Mitcham (YDNPA Community Heritage Officer) who also produced the attached figures. Finally thanks must go to the landowner and the tenant for allowing the work to take place.

Figures

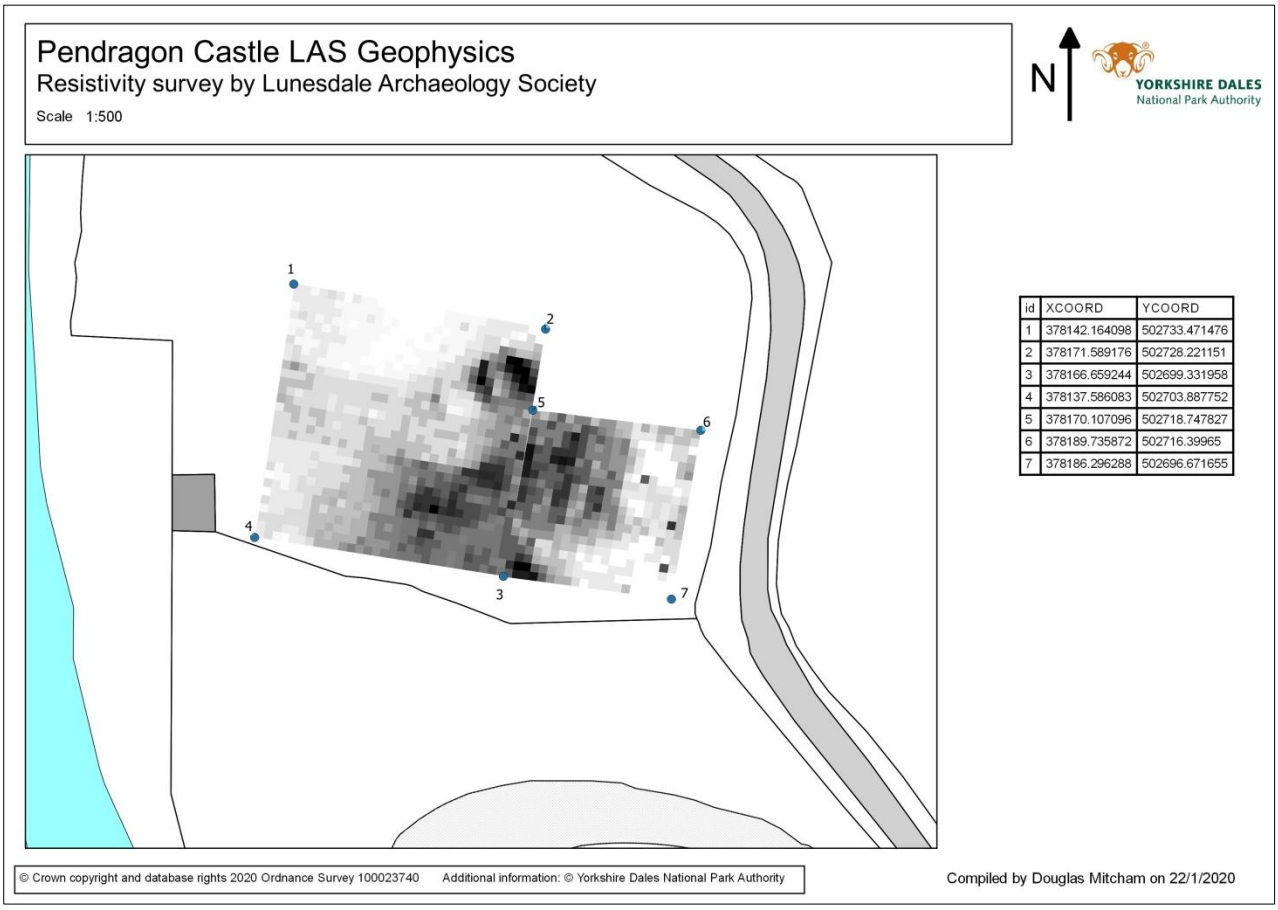

Figure 1 Resistivity survey results georeferenced with grid point locations shown in metres

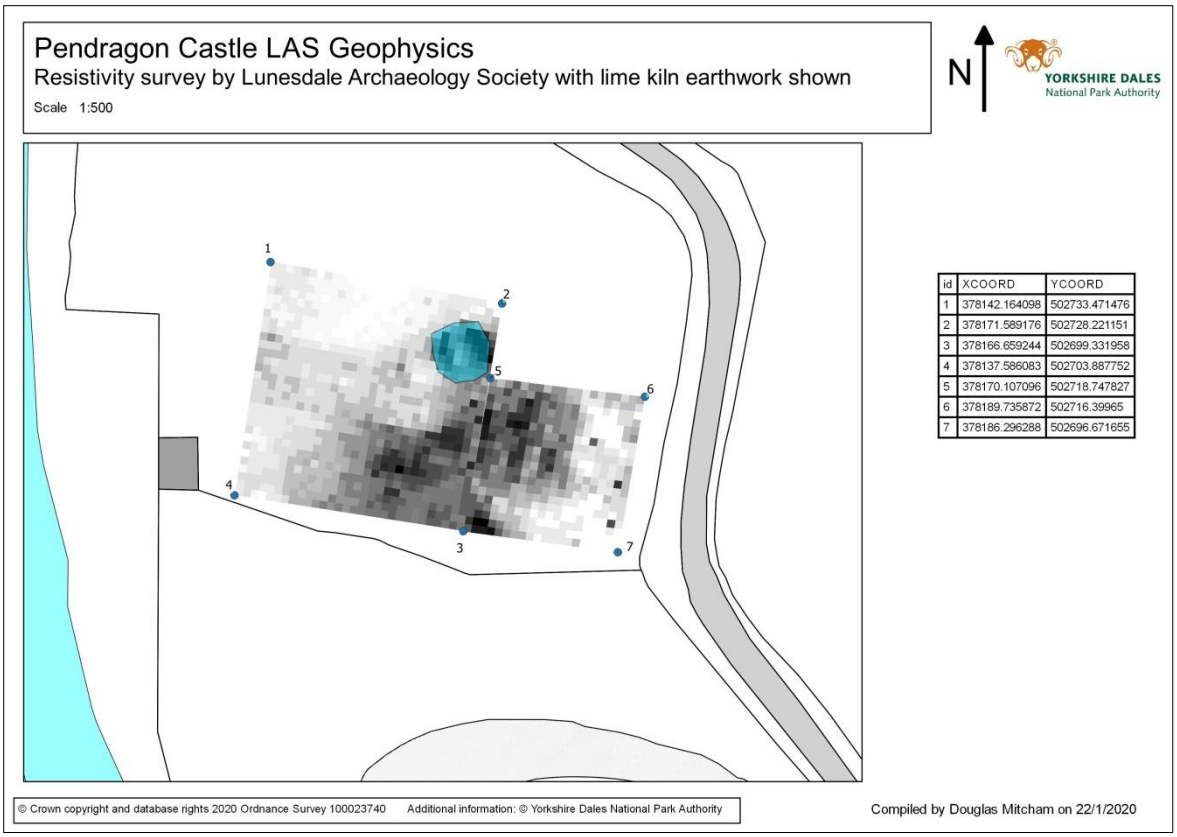

Figure 2 Resistivity survey results, overlain with the HER monument polygon for the lime kiln

Appendix 2:

Pendragon Castle. Geophysical Survey Report (P19-01136)

Thomas Worthington, Met Geo Environmental Ltd

Contents

1. Revision Record

Report Ref: P19-01136 Written Scheme of Investigation					
Rev	Description	Date	Originator	Checked	Approved
0	Final	30/10/20	T Worthington	SR	JPR

Prepared For:	Prepared By:
Yorkshire Dales National Park Authority Yoredale Bainbridge Leyburn North Yorkshire DL8 3EL	Met Geo Environmental Ltd Southgate House Pontefract Road Leeds West Yorkshire LS10 1SW

1. Introduction

This document describes the investigation undertaken for the Monuments at Risk project on land at Pendragon Castle, hereafter referred to as the 'survey area'. This survey comprised a magnetic gradiometer survey.

The purpose of the geophysical investigation is to inform the planning process with regards to the potential for archaeological remains to exist within the survey area.

The survey area is centred on NGR NY78159 02720. It comprises pastoral land, and measures approximately 0.5ha. The survey area is bounded by Tommy Road to the north and east, an enclosed field containing the site of Pendragon Castle to the south and the Eden River to the west.

The underlying geology of the survey is Limestone overlain by deposits of glacial till. Due to its non-magnetic nature, this geology is generally suitable for geophysical investigation using magnetic methods.

The image below from Google Earth shows the general state of the site at the time of the survey.

2. Aims and Objectives

The survey is to facilitate the Monuments at Risk Project, as part of the Westmorland Dales Landscape Partnership (WDLP). The main target of interest is a supposed kiln located in the centre of the site area. This is to be surveyed for the record and to inform further excavation to be carried out.

The site has not been subject to development within the modern period, and there is potential for as-yet unknown archaeological features to survive within the survey area. Pendragon Castle lies just south of the surveyed area, and a known kiln lies within the confines of the site. The kiln is the main target of the investigation.

An archaeological evaluation by geophysical survey was carried out. The geophysical instrument used was a magnetic gradiometer. A magnetic gradiometer detects sensitive changes in the earth's magnetic field caused by the relative presence or absence of enhanced magnetic material, and is one of the most widely used geophysical instruments in archaeology.

The aims of the evaluation are to gather sufficient information to establish the presence or absence, character, and extent of any archaeological remains within the specific areas, and to inform further evaluation or mitigation strategies should they be necessary.

The objectives of the survey were:

To provide information about the nature and possible interpretation of any geophysical anomalies encountered

To therefore determine the presence and extent of any buried archaeological features

To provide a report detailing the findings of the survey.

3. Methodology

All geophysical surveys were carried out according to the recommendations outlined in the English Heritage Guideline (2008) 'Geophysical survey in archaeological field evaluation', and the Chartered Institute for Archaeologists Standard and Guidance for archaeological geophysical survey (CIFA 2014).

Survey Location and Positioning

Geophysical survey grids were set out using a Topcon Hiper SR GNSS system operated in Real-Time Kinematic mode, in conjunction with a standard tape measure. The main grid points were set out electronically, at 20m intervals, with intermediate points established using tapes as required.

The survey grid is usually aligned to best fit in with the site boundaries. In this instance, waterlogging within the site imposed constraints on the positioning of grids, and therefore the location of the grid was chosen so as to maximise survey coverage.

Grid corners were located using GNSS to OS national grid coordinates to an accuracy of ± 50mm.

Magnetic Gradiometer Survey

A Bartington Grad 601-2 magnetic gradiometer with data logger was used for the detailed gradiometer survey. A magnetic gradiometer detects sensitive changes in the earth's magnetic field caused by the relative presence or absence of enhanced magnetic material. Over and above its ability to detect ferrous metals, the sensitivity of the instrument allows it to detect materials that have become magnetically enhanced due to human activity. This technique is proven to be able to identify cut and filled features such as pits and ditches; burnt or fired features such as hearths, kilns, clay tile etc.; and can also detect stone features (usually as areas of relative negative enhancement).

The Bartington Grad 601-2 is a dual sensor instrument, incorporating two Grad-01-1000 gradiometers set at a distance of 1m apart. The sensors within each gradiometer are also spaced 1m apart, rather than the 0.5m found in most fluxgate gradiometers. The configuration of the Grad601-2 provides an increased depth penetration and weaker anomalies are detected with greater resolution, as well as reducing both the time taken and distance walked compared to a conventional fluxgate gradiometer survey.

The Grad-01-1000 sensor is a high-stability fluxgate gradient sensor with a resolution of 0.1nT/m when used on the 100nT/m range and 1nT when used on the 1000nT range. The exceptional temperature stability of this sensor ensures minimal drift during surveys and reduces the need for adjustment and consequently survey time.

Readings were taken, on the 100nT range (0.1nT sensitivity), at 0.25m intervals on zig-zag traverses 1m apart within a 20m grid. This equates to 1600 readings per grid.

The instrument is checked for electronic and mechanical drift at regular intervals and calibrated as necessary.

The data were downloaded using Bartington's Grad601 download software and then imported into Geoplot v3.0 (Geoscan Research) in XYZ format for data processing and display.

Limitations

All geophysical techniques depend on there being a measurable contrast (anomaly) in the physical properties of a feature and the surrounding material. It is not always possible therefore to identify all sub-surface features using geophysical techniques.

The success of a geophysical survey will depend on the target properties and the site-specific sub-surface conditions. The anomaly caused by a feature may not necessarily correspond with the exact location or dimensions of a feature so even if a feature is detected it is not always possible to accurately locate or define its extents.

4. Restrictions

At the time of the survey, and due to the recent heavy rain, a pond of considerable size had formed across the northern part of site area and there were some places where it was not feasible to conduct the survey.

Located close to the feature of interest there is a depression in the ground. The depression has been surrounded by a metal fence to keep out livestock or members of the public from injuring themselves. This has metallic interference which has affected the data at an integral part of the survey.

Part of site consisted of a steep slope with the pond located at the bottom. These features combined to render part of the area too difficult and unsafe to traverse, therefore a full survey was not achievable.

5. Results & Interpretation

Positive Responses

There are multiple positive anomalies ranging across the site, one of these **[Anomaly A]** coincides with the location of the supposed kiln, and close to a large dipolar anomaly. While the dipolar feature may be associated (to a large degree) with the modern metallic fencing situated nearby, the positive response detected here may be associated with the kiln feature and be indicative of an area that has experienced heating within the earthwork.

To the east are three discrete circular positive anomalies located on the brow of the slope. These could be the location of soil filled features such as post holes or pits. A discrete positive anomaly located towards the west of the survey area may also indicate a soil-filled feature, possibly another pit **[Anomalies B]**.

There is strong positive anomaly on the eastern boundary of site, running north to south **[Anomalies C]**. This is probably caused by interference from metal fencing placed on top of the wall that marks the edge of the site.

There is a cluster of positive responses associated with negative responses that may correspond to a feature of interest. It is possible that these anomalies may be associated with materials or land-use associated with the kiln, or its dilapidation **[Anomalies D]**.

Negative Responses

There are few negative responses on site which mainly seem to be associated with positive anomalies, though they are not entirely typical of bipolar responses. The negative readings can be found to the centre of the surveyed area, located to the south of the kiln structure. They have no discernible shape or pattern. It is possible that these may be associated with the kiln, and for example may be part of the construction material that has been scattered over time as the kiln became dilapidated and derelict **[Anomalies E]**.

Dipolar Responses

Dipolar anomalies are the most common form of magnetic response detected across the area, with multiple anomalies ranging in shape and size. Many of these are considered modern interference or related to metallic objects situated on site.

A large dipolar anomaly **[Anomaly F]** is found coincident and extending to the west and east of the earthwork suspected to relate to a kiln on the site. This anomaly increases in intensity to the east of the supposed kiln position. It is likely that this anomaly is largely caused by interference due to the position of metal fencing around the depression situated to the north-east; however, there may be some contribution from the kiln feature.

An area of scattered bipolar responses **[Anomaly G]** is located to the south of the survey area at the entrance to the field containing Pendragon Castle. This anomaly extends to the north-west from the opening towards the River Eden. The strongest readings are around the entryway area and seem to coincide with a rise in ground level. This may relate to deposited material associated with traffic through the entrance or activities associated with the barn situated nearby.

There are is a scatter of small discrete bipolar responses across the site. These are most likely to reflect fired and ferrous debris contained within the topsoil. Some of these may be related to the dilapidation process of the suspected kiln, while others are most likely modern material **[Anomalies H]**.

To the north-east of the survey there is a small area of bipolar response at the very top of the slope of the site. There are not enough data to show an accurate depiction of this anomaly as it appears on the very edge of the surveyed grid. This anomaly may reflect the start of a linear anomaly and it is possible that it reflects a modern service such as a pipe or similar **[Anomaly I]**.

Interference

Two obvious areas of interference can be located on site, both represented by large bipolar anomalies. One anomaly is located on the northern boundary of the field **[Anomaly J]**, and another is coincident with the suspected kiln location **[Anomaly F]**.

The anomaly to the north of the site is caused by the gate into the field from Tommy Road, and barbed wire fencing located on this part of the boundary **[Anomaly J]**.

The second anomaly **[Anomaly F]** is due to a metal fence surrounding an area of depression located directly north-east of the earthwork associated with the suspected kiln. This anomaly has obscured a fairly large area around the kiln. It is possible that the supposed kiln feature itself may be contributing to this dipolar anomaly; however, without removing the metallic fencing and carrying out a re-survey we cannot quantify to what extent this is occurring.

6. Conclusion

The survey identified a number of anomalies within the survey area, some of which may be associated with the suspected kiln feature.

The main area of importance for the survey is obscured by interference in the data. The restrictions on the survey from waterlogging and metallic objects on the site have made the findings incomplete and difficult to interpret.

A cluster of positive and negative anomalies detected to the south of the suspected kiln may be associated with dilapidation processes affecting the kiln, although they may also be of a different origin and unrelated.

Three discrete positive anomalies located on the brow of the slope may reflect pit-like features. A further discrete feature situated to the west also shares the characteristics of a soil filled feature.

The most common anomalies are of a dipolar variety and many of these relate to modern metallic features on site or have not been fully defined. One feature may relate to previous land-use activity associated with the barn at the corner of the site.

7. References

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FIGURE 1: GEOPHYSICAL DATA

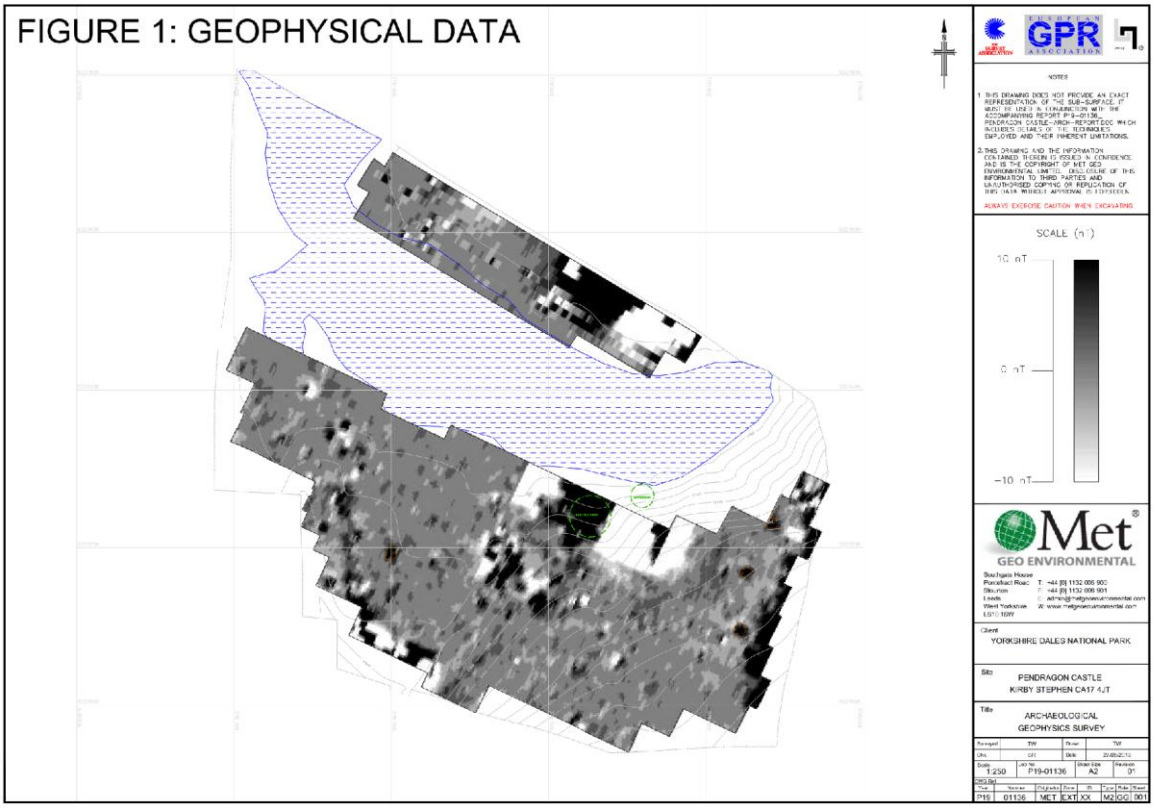
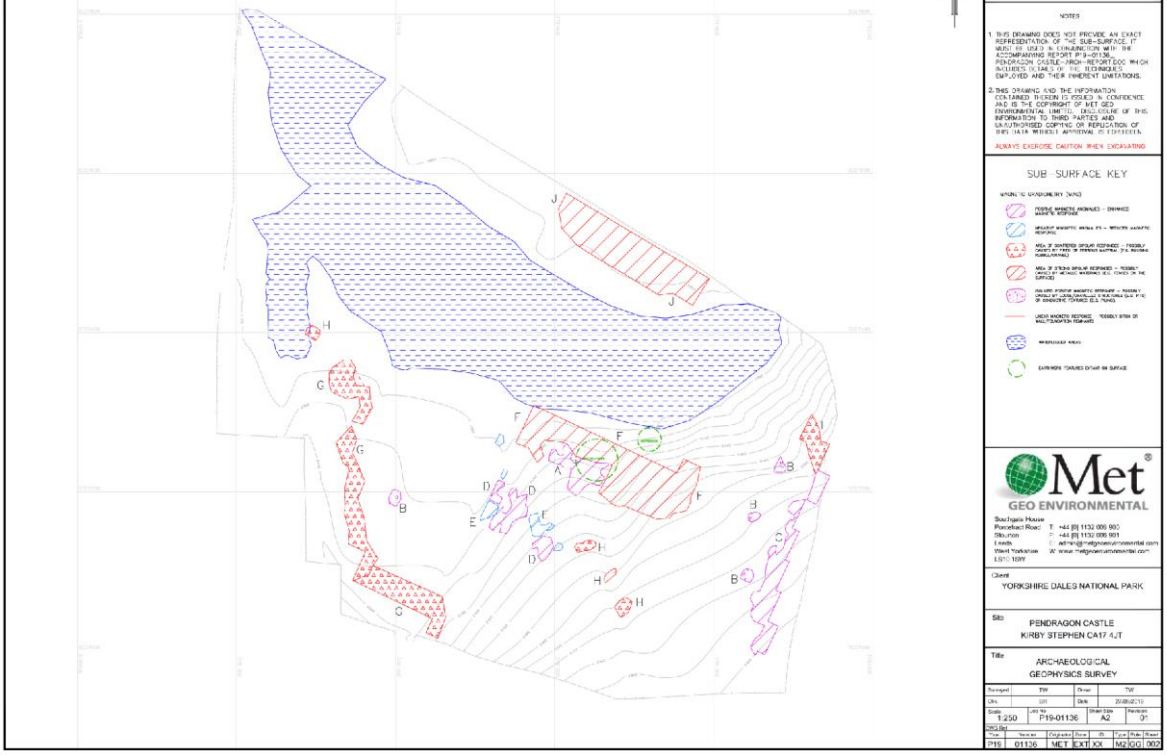
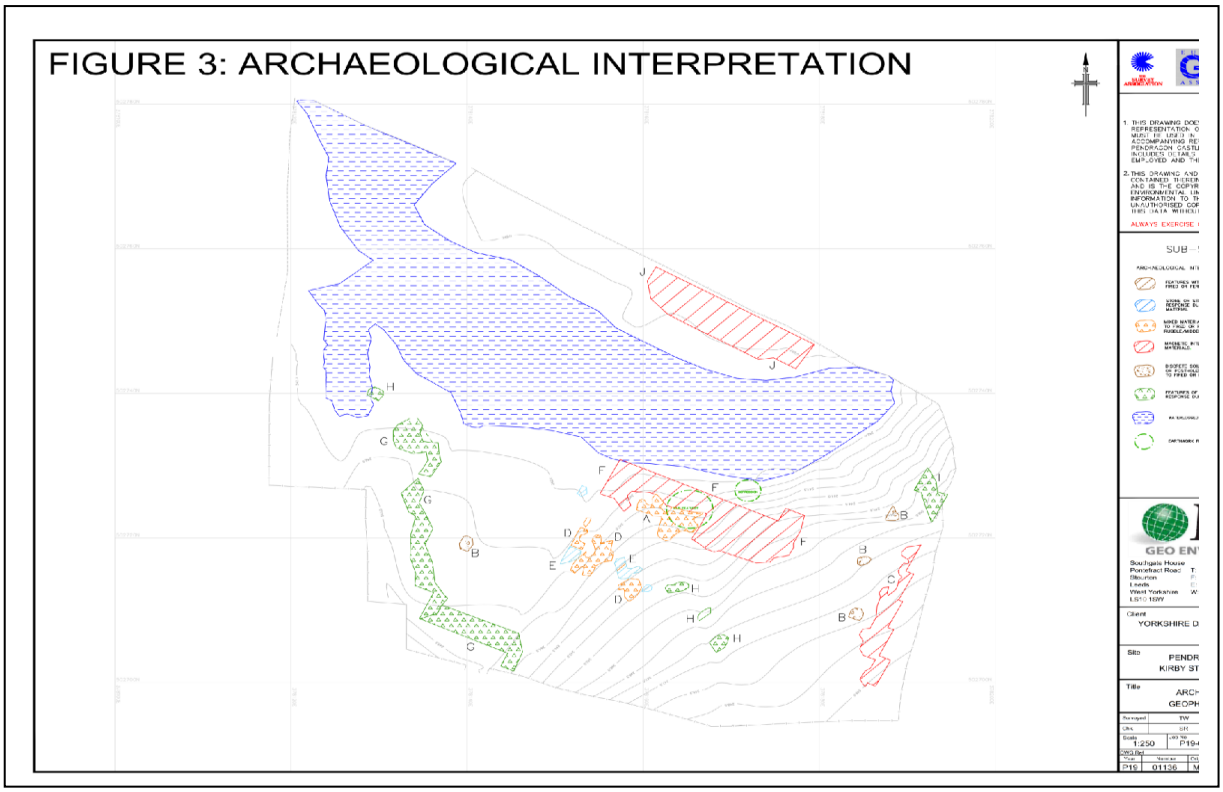


FIGURE 2: GEOPHYSICAL INTERPRETATION



Key to Figure 2, top to bottom

Purple hatching – positive magnetic anomalies
Blue hatching – negative magnetic anomalies
Orange triangles – area of scattered dipolar responses
Red hatching – area of strong dipolar responses
Purple dots – isolated dipolar responses
Red line – linear magnetic response
Blue stippling – waterlogged area
Green – earthwork features



Key to Figure 3, top to bottom

Brown hatching – features with enhanced response
Blue hatching – low response from stone due to fired or ferrous material
Orange triangles –mixed response due to fired or ferrous material (rubble/midden debris)
Red hatching – magnetic interference from modern materials
Brown dots – discrete soil-filled features (postholes?)
Green triangles – features of uncertain origin with enhanced responses
Blue stippling – waterlogged area
Green – earthwork features extant on the surface