



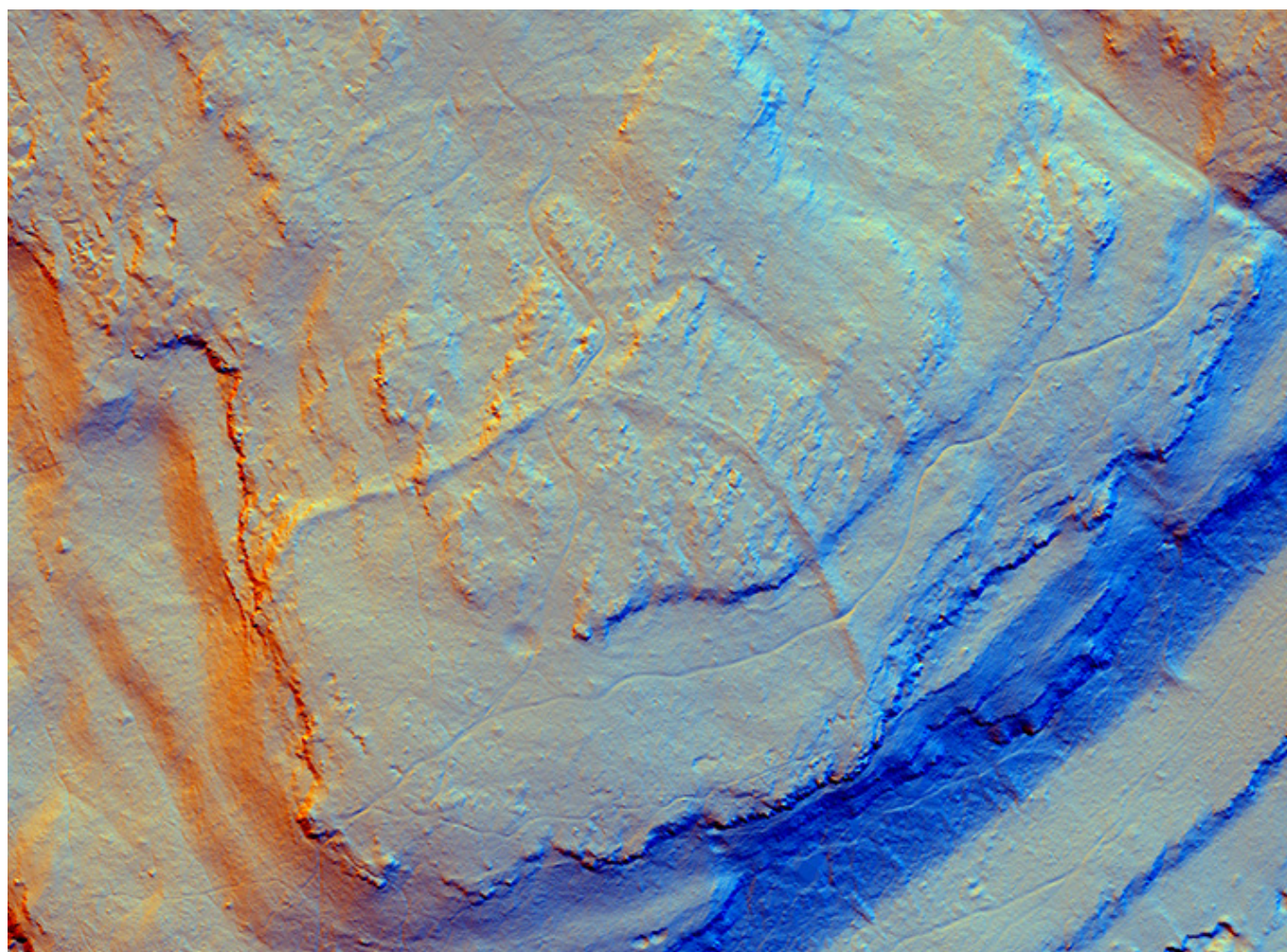
Historic England

Historic Places Investigation

Warton Crag Hilltop Enclosure, Warton, Lancashire: Aerial Mapping and Analytical Field Survey

Sally Evans, Marcus Jecock and Matthew Oakey

Discovery, Innovation and Science in the Historic Environment



Research Report Series 033-2017

**WARTON CRAG HILLTOP ENCLOSURE,
WARTON,
LANCASHIRE:**

Aerial Mapping and Analytical Field Survey

Sally Evans, Marcus Jecock and Matthew Oakey

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SUMMARY

In June 2016 Historic England's Aerial Investigation & Mapping (AIM) and Assessment Teams North (now both part of the Historic Places Investigation Team within Research Group) were approached by Heritage at Risk (HAR) colleagues in the North West Planning Group to undertake mapping and ground-based investigation of fine resolution (0.25m gridded) lidar data of Warton Crag. The lidar had been commissioned jointly by the HAR team and the Headlands to Headspace (H2H) Landscape Partnership Scheme as part of moves to develop a conservation management plan for a small multi-vallate hilltop enclosure that lies on the summit of the Crag. That monument has traditionally been classified (and is scheduled) as an Iron Age hillfort, but is here re-interpreted as some form of non-defensive hilltop enclosure, possibly dating to the Late Bronze Age.

CONTRIBUTORS

Aerial interpretation and mapping was carried out by Sally Evans and Matthew Oakey; field investigation was by Marcus Jecock.

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The authors would like to thank Louise Martin of H2H and Sarah Howard of Historic England for their enthusiasm and support and for arranging capture of the lidar imagery; Sarah Howard also assisted with fieldwork for a day. Dr Sue Stallibrass, Historic England Regional Science Advisor for the North-West, made valuable comments on the report and drew the authors' attention to literature pointing to the possibility of a covering of loess on the Crag in prehistory. Marcus Jecock is especially grateful to Stephen King and John Trippier for granting Historic England access to the researches and photographs of the White Cross Archaeology Group.

ARCHIVE LOCATION

The project archive (ref no. AF00406) has been deposited with the Historic England Archive, The Engine House, Fire Fly Avenue, Swindon, SN2 2EH.

DATE OF INVESTIGATION

Aerial mapping was undertaken in June 2016, analytical field survey in January 2017.

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CONTENTS

| | |
|---|----|
| INTRODUCTION | 1 |
| 2. GEOLOGY, TOPOGRAPHY AND LAND USE | 4 |
| 3. PREVIOUS RESEARCH | 5 |
| 4. AERIAL MAPPING | 12 |
| 4.1 Scope and Method | 12 |
| 4.2 Lidar data | 12 |
| 4.3 Aerial photographs | 12 |
| 4.4 Mapping | 13 |
| 4.5 Recording | 14 |
| 4.6 Results | 14 |
| 5. ANALYTICAL FIELD SURVEY | 20 |
| 5.1 Scope and method | 20 |
| 5.2 Earthwork Description | 20 |
| 5.2.1 Interior | 20 |
| 5.2.2 Inner circuit | 21 |
| 5.2.3 Middle circuit | 28 |
| 5.2.4 Outer circuit | 32 |
| 6. DISCUSSION AND CONCLUSIONS | 40 |
| 7. LIST OF REFERENCES | 44 |
| APPENDIX 1. AERIAL MAPPING LAYERS | 46 |
| APPENDIX 2. HISTORIC ENGLAND ARCHIVE AERIAL PHOTOGRAPHS | 47 |

ILLUSTRATIONS

Cover: Warton Crag hilltop enclosure as revealed by the 16-direction hillshade visualisation of the lidar data

| | |
|---|-----------|
| <i>Figure 1. Location Map.....</i> | <i>2</i> |
| <i>Figure 2. Hutchinson's bird's-eye sketch of Warton Crag.....</i> | <i>6</i> |
| <i>Figure 3. Warton Crag hilltop enclosure as mapped by the OS in 1889.....</i> | <i>7</i> |
| <i>Figure 4. Warton Crag hilltop enclosure as mapped by the VCH.....</i> | <i>8</i> |
| <i>Figure 5. Warton Crag hilltop enclosure as revised by the OS in 1911.....</i> | <i>9</i> |
| <i>Figure 6. Warton Crag hilltop enclosure as mapped by J Forde-Johnstone.....</i> | <i>11</i> |
| <i>Figure 7. The aerial transcription project area.....</i> | <i>13</i> |
| <i>Figure 8. 16-direction hillshade DTM model of the commissioned lidar.....</i> | <i>15</i> |
| <i>Figure 9. Results of the aerial photograph and lidar transcription.....</i> | <i>17</i> |
| <i>Figure 10. The aerial transcription as modified by analytical field survey.....</i> | <i>21</i> |
| <i>Figure 11. View west along the inner circuit towards Beacon Breast.....</i> | <i>23</i> |
| <i>Figure 12. Far view of possible guard chamber in the inner circuit.....</i> | <i>23</i> |
| <i>Figure 13. View north-east along the inner circuit east of the 'guard chamber'.....</i> | <i>24</i> |
| <i>Figure 14. View south-east along the line of the (?robbed) inner circuit.....</i> | <i>25</i> |
| <i>Figure 15. View south along the inner circuit at the end of the 'terraced' section.....</i> | <i>25</i> |
| <i>Figure 16. View north-west along the inner circuit north of Beacon's Breast.....</i> | <i>26</i> |
| <i>Figure 17. The probable eastern entrance in the inner circuit.....</i> | <i>27</i> |
| <i>Figure 18. The inner circuit just north of the eastern entrance.....</i> | <i>27</i> |
| <i>Figure 19. The easternmost of the boulder-walled stock pens adjacent to the inner circuit...28</i> | |
| <i>Figure 20. The gap in the middle circuit followed by the western footpath.....</i> | <i>29</i> |
| <i>Figure 21. The gap in the middle circuit followed by the disused footpath.....</i> | <i>29</i> |

| | |
|--|-----------|
| <i>Figure 22. The middle circuit immediately east of the butterfly ride.....</i> | <i>30</i> |
| <i>Figure 23. View north-east along the middle circuit at SD 49333 72950.....</i> | <i>30</i> |
| <i>Figure 24. View north-east along the middle circuit at SD 49320 72954.....</i> | <i>31</i> |
| <i>Figure 25. The middle circuit continuing through the floor of the eastern footpath.....</i> | <i>32</i> |
| <i>Figure 26. The eastern entrance in the middle circuit.....</i> | <i>33</i> |
| <i>Figure 27. The outer circuit close to the western escarpment.....</i> | <i>33</i> |
| <i>Figure 28. The western entrance in the outer circuit.....</i> | <i>34</i> |
| <i>Figure 29. The outer circuit visible as a grass-covered bank south of the field wall.....</i> | <i>34</i> |
| <i>Figure 30. Possible entrance in the outer circuit at SD 49250 73046.....</i> | <i>35</i> |
| <i>Figure 31. Detail of the external face of the outer circuit at SD 49241 73048.....</i> | <i>36</i> |
| <i>Figure 32. View south-west over the outer circuit at SD 49327 73028.....</i> | <i>36</i> |
| <i>Figure 33. The probable entrance in the outer circuit at SD 49375 73016.....</i> | <i>37</i> |
| <i>Figure 34. View along the line of the outer circuit.....</i> | <i>37</i> |
| <i>Figure 35. The possible easternmost entrance in the outer circuit.....</i> | <i>38</i> |
| <i>Figure 36. The outward-facing scarp marking the southern end of the outer circuit.....</i> | <i>38</i> |

1. INTRODUCTION

In June 2016 Historic England's Aerial Investigation & Mapping (AIM) and Assessment Teams North (now both part of the Historic Places Investigation Team within Research Group) were approached by Heritage at Risk (HAR) colleagues in the North West Planning Group to undertake mapping of fine resolution (0.25m-gridded) lidar data of Warton Crag, followed by ground-based investigation and assessment of the results. The lidar had been commissioned jointly by the HAR team and the Headlands to Headspace (H2H) Landscape Partnership Scheme as part of moves to develop a conservation management plan for a small multi-vallate hilltop enclosure (National Record of the Historic Environment (NRHE) no. 41541; Lancashire HER no. MLA513) that lies on the summit of Warton Crag. It is this work that is reported on here.

Warton Crag forms the southern, scarp end of a faulted ridge of Lower Carboniferous Limestone that lies approximately 0.5km north-west of the village of Warton, near Carnforth in Lancashire (Figure 1) (not be confused with a second Lancashire village of the same name located in the Fylde, west of Preston). The Crag is now heavily overgrown, but was probably semi-open rough pasture in the late 18th century when the remains of three near-concentric arcs of stone walling were first noted on its summit.

The walls have long been interpreted as the defences of a Late Iron Age hillfort (*eg* Hutchinson 1789, 215, Farrer and Brownbill 1908, 508; Ordnance Survey 1913). Indeed, the monument has been scheduled as such since 1925 (National Heritage List for England (NHLE) No. 1007633), although the suggestion has recently been put forward that the site may rather be some kind of hilltop enclosure dating to the Neolithic or Bronze Age (see below). As well as being scheduled, the monument receives protection from a range of other, overlapping, landscape and environmental designations, both statutory and non-statutory (Defra 2017). Statutory designations follow from the site's location within the Arnsdale & Silverdale Area of Outstanding Natural Beauty (AONB), the Warton Crag Site of Special Scientific Interest (SSSI) and the area covered by the Warton Crag and Grisedale Wood Limestone Pavement Order (LPO), while a small part of the scheduled area also lies within the Warton Crag Local Nature Reserve (LNR) administered by the Lancashire Wildlife Trust. Non-statutory designations which overlap with the monument or apply to neighbouring parts of the Crag comprise areas classified as Ancient Woodland and the Leighton Moss and Morecambe Bay Nature Reserve administered by the Royal Society for the Protection of Birds.

In 2012 the monument was placed on Historic England's HAR Register because of concern over the potential for damage from tree and scrub growth (English Heritage 2012, 71). The AONB Authority's quinquennial Statutory Management Plan has likewise contained an objective to develop a specific management plan for the monument since at least 2009, an objective re-stated in the latest iteration (2014-19) of that document (Arnsdale & Silverdale AONB 2014a; Arnsdale & Silverdale 2014b, 11-12). The Authority is currently taking the objective forward through the Morecambe



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Figure 1. General location map of Warton Crag. (D0040612, Hannah Kennedy 2017 © Historic England).

Bay Partnership/Heritage Lottery Fund-backed Headlands to Headspace Landscape Partnership Scheme (Morecambe Bay Partnership 2013).

The site has been investigated and/or surveyed on the ground on a number of occasions since 1845 (section 3 below), but always with difficulty because of the nature of the terrain: moss-covered limestone pavement beneath dense woodland. This has resulted in uncertainty over the precise extent, nature and form of the walls or ramparts. (Indeed it is debatable whether 'rampart' is an appropriate term to use to describe the monument's circuits, and 'wall' or 'circuit' is preferred throughout this report). The tree cover means the walls are largely invisible on conventional aerial photography although they are visible on 2m-resolution Environment Agency lidar data. (Lidar can, in theory, see through vegetation to map slight variations in ground height and therefore the position of archaeological earthworks). The Environment Agency data were used to map the site as part of the aerial mapping component of Historic England's recent National Archaeological Identification Survey (NAIS) Upland Pilot project in 2013 (Oakey *et al* 2015), but the low resolution of the data meant that the resulting plot was unsatisfactory for heritage management purposes. Hence the commissioning of the new, high-resolution, lidar survey and present investigation.

2. GEOLOGY, TOPOGRAPHY AND LAND USE

Warton Crag forms the southern end of a limestone ridge made up of facies of the Great Scar Limestone Group (laid down approximately 343 to 326 million years ago); it rises to a maximum height of 163m above Ordnance Datum (OD). The Crag lies within Natural England's 'Morecambe Bay Limestones' National Character Area (NCA) 20, characterised as 'a lowland landscape arcing round the head of Morecambe Bay consisting of conspicuous limestone hills with prominent scars, cliffs, screes and exposed limestone pavements separated by areas of low-lying undulating farmland ... The character of the landscape is shaped by [the] underlying geology, with areas of flat open grazing marsh framed by dramatic limestone outcrops, extensive salt marshes and sand flats re-profiled by the tides, and intimate mosaics of limestone woodland and limestone grasslands. The dynamic landscape of the coastal fringe is dominated by the intertidal foreshore with extensive areas of mudflat, sand flat and salt marsh backed by low limestone cliffs, pebble beaches or manmade defences' (Natural England 2015, 3).

The Crag lies immediately above the eastern edge of Morecambe Bay (Figure 1), and commands extensive views along the shoreline of the Bay and out over the Irish Sea as well as inland towards the Yorkshire Dales. The western, southern and eastern faces of the Crag are defined by geological faults (British Geological Survey 2017) and consist of a series of steep scars of varying height separated by more gently sloping benches or terraces, the result of differential erosion of the geological strata; this gives these aspects of the Crag a somewhat stepped profile. To the north the terrain falls more gradually as an undulating dip slope. The Crag lies between two low-lying pastoral areas: that to the north-west now occupied by Leighton Moss but at one time presumably a tidal inlet of Morecambe Bay; that to the south-east by the silted, lower reaches of the valley of the River Keer which flows into the Bay just north of Carnforth. In the west the sea approaches the foot of the Crag, but is separated from it by a band of flat, tidal salt marsh some 1km wide.

There is little depth of soil cover on the summit of the Crag, much of which is characterised by large expanses of exposed limestone pavement. Both summit and slopes are now mostly mixed woodland with areas of improved pasture on the lower slopes. Early maps (*eg* Ordnance Survey 1848), however, show that in previous centuries much was open rough pasture. The area of the scheduled monument may always have been more wooded.

The Crag was the subject of an Enclosure Award in 1740, following which an east-west 'Occupation Road' was constructed across it and a series of parallel stone-walled field boundaries laid out from south-west to north-east either side of the road. The road, really no more than a track, runs *circa* 200m north of the scheduled area. One of the Enclosure-period field boundaries cuts across the west end of the monument's outer wall and is maintained in good condition; another formerly followed the edge of the Crag (called Beacon Breast), but is now ruinous or completely missing.

3. PREVIOUS RESEARCH

The earliest mention of an enclosure or encampment on Warton Crag is to be found in a letter written by William Hutchinson to George Allan in January 1788. This was communicated to the Society of Antiquaries of London in November of that year and subsequently printed in the Society's journal, *Archaeologia* (Hutchinson 1789). Hutchinson was a solicitor practising at Barnard Castle in County Durham and also a keen antiquary who published accounts of the history of Durham and Cumberland as well as topographic works on northern England generally; George Allan was a fellow solicitor and antiquary (Fraser 2004; 2015).

Hutchinson had visited this part of Lancashire in 1785, apparently at the invitation of one Robert Gibson who owned copper mines in the area. However, he seems to have been shown the encampment by a local schoolmaster, Mr Jenkinson, whose workmen had recently found two cinerary urns whilst levelling cairns on allotments belonging to him somewhere on the lower slopes of the Crag. In his letter, Hutchinson describes three concentric 'walls' running between the precipitous western and south-eastern ascents of the Crag, cutting off the summit from the much gentler approach from the north. He states that the inner wall was the most substantial, with *in-situ* facing stones 10 feet (*circa* 3m) apart set within a more extensive scatter of stone tumble up to 10 paces (*circa* 8-9m) wide. The outer wall he described as less massive and the middle wall as less massive again. The inner and middle walls are reported as having two entrances each, the outer wall, three, all offset from each other. Hutchinson also remarked on the ruins of a small square hut within the interior where 'a beacon used to be fired', and a circular depression which he thought a reservoir for water (whether contemporary with the monument or the later hut is not made clear in the text). Walls, entrances and other features described are all shown on a semi-bird's-eye perspective view of the enclosure reproduced in the *Archaeologia* article (Figure 2), but this is very much a sketch produced to show the overall disposition of features on the site, not a measured survey. Hutchinson thought the encampment was associated with native British resistance to the Roman conquest of northern England (*ie*, that it dated to what we would now understand as the Late Iron Age).

Half a century later, the Ordnance Survey (OS) surveyed the area of the Crag at 1:10,560 scale (OS 1848). This and the subsequent first edition 1:2500 map (OS 1891) show only the inner circuit plus a short arc of the outer close to its western terminus (Figure 3).

The site was next surveyed by the Victoria County History (VCH) of Lancashire who, using the scheme then recently put forward by the Earthworks Committee of the Congress of Archaeological Societies, identified it as a 'Class A' earthwork (*ie* promontory fort). Only the inner plus short stretches of the middle and outer walls are portrayed on the VCH plan (Figure 4), but the accompanying description does equate the southernmost of three breaks in the inner circuit with one of the entrances reported by Hutchinson. In addition, the authors noted the existence of a 'circular chamber' of about 5 feet (1.52m) internal diameter built in to the thickness



Figure 2. Hutchinson's bird's-eye sketch of Warton Crag. (Reproduced from *Archaeologia* 9, 1789).

of the inner wall close to its north-west terminal (the feature does not appear on the published plan, probably for reasons of scale), and also identified a number of small, stone-walled enclosures built up against the face of a localised limestone scar close to the southern end of the inner circuit, which they thought 'not ... contemporary with the ramparts' (Farrer and Brownbill (ed) 1908, 508-12).

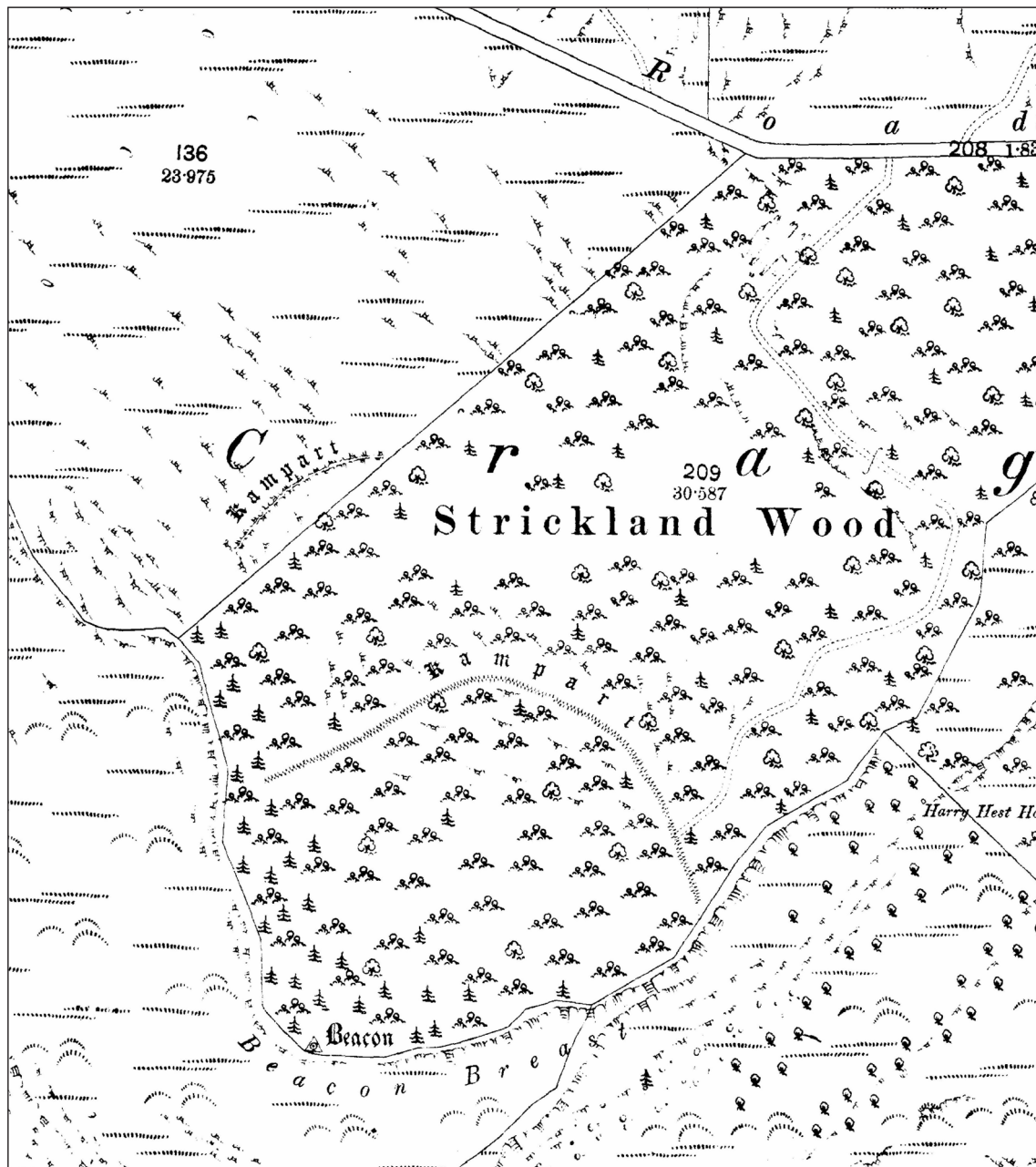


Figure 3. Warton Crag hilltop enclosure as mapped at 1:2500 scale in 1889. (Reproduced from the 1891 Ordnance Survey map).

It is probably this plan and account that caused the OS to revisit the site and revise their depiction prior to issuing their second edition map in 1913: this map (OS 1913) portrays the stone-walled enclosures in the vicinity of the inner wall first noted by the VCH, plus two more not recognised by them attached to the exterior of the outer wall (Figure 5). The VCH account also no doubt provided the OS with the necessary authority for the published description of 'Hill Fort' which appears for the first time on the 1913 map (and has probably influenced how subsequent researchers have viewed the site, although given the state of archaeological knowledge at the time it is difficult to see what other term the OS could have used to describe the monument).

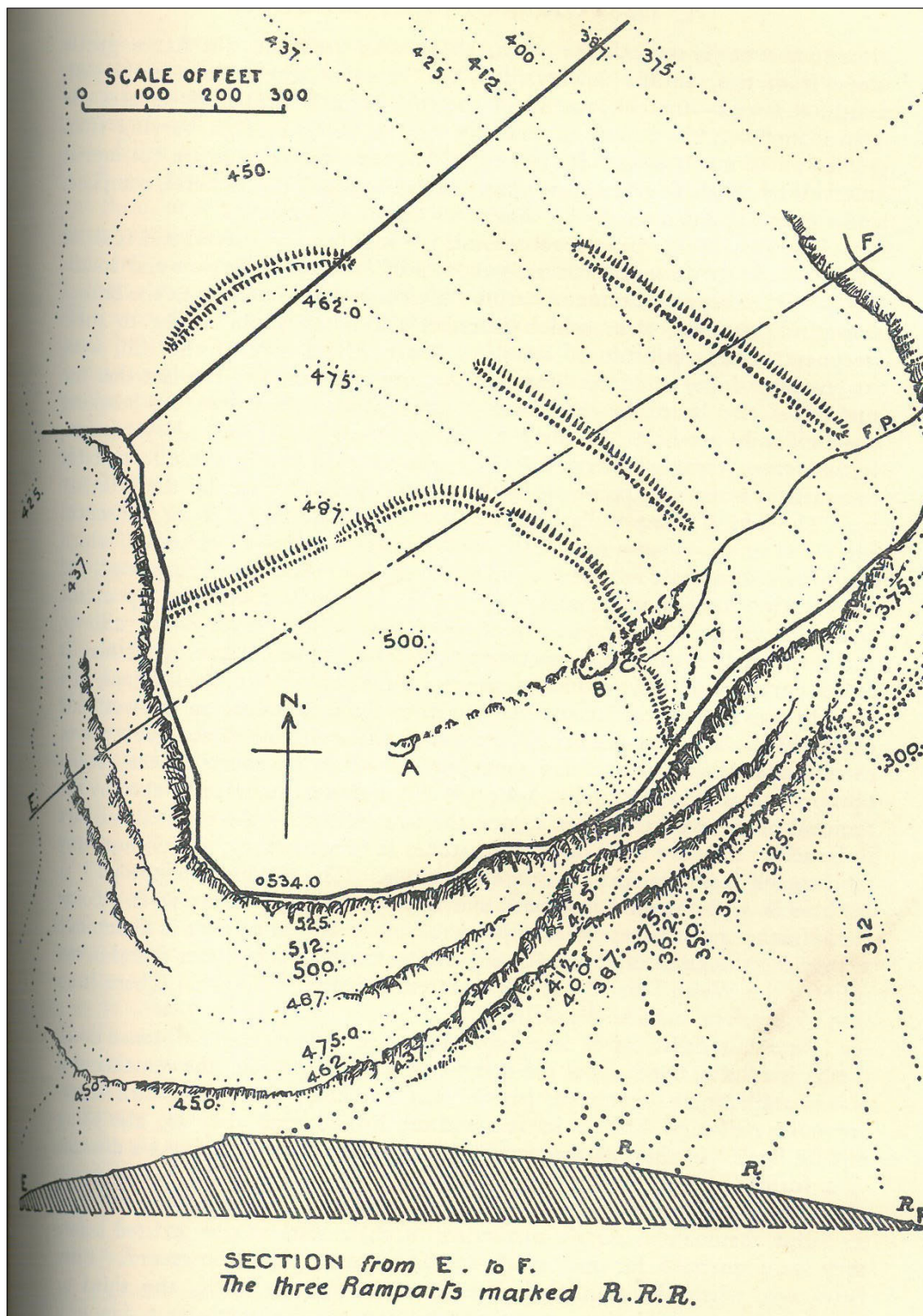


Figure 4. Warton Crag hilltop enclosure as mapped by the VCH. Line E – F diagonally across the middle of the plan is the line of the section drawing shown below the plan. (Reproduced from Farrer and Brownbill (ed) 1908).

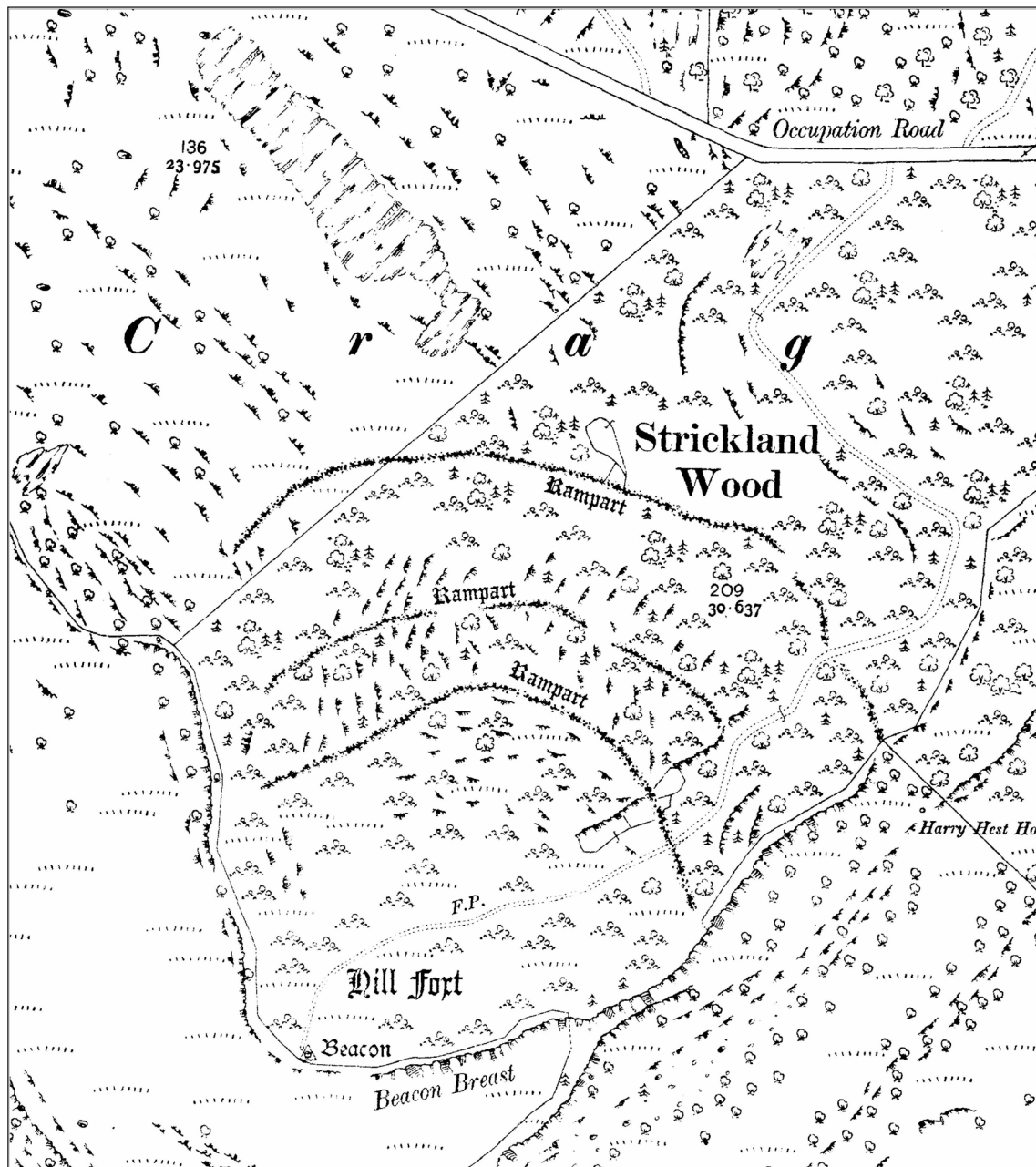


Figure 5. Warton Crag hilltop enclosure as revised at 1:2500 scale in 1911. (Reproduced from the 1913 Ordnance Survey map).

The map depicts a number of breaks in the middle and outer circuits but it is not clear if the OS surveyor thought these were original entrances. Both the 1891 and 1913 maps depict the Enclosure-period stone field wall that cuts across the west end of the outer wall of the monument. The 1891 map shows the hilltop south of this field wall (*ie*, much of the monument interior) as covered by mixed woodland (an extension of Strickland Wood), but by 1913 tree cover on the summit within the line of the enclosure's inner circuit had thinned to more open scrub; the area north of the field wall is depicted as rough open or semi-open pasture on both maps.

Although the site was briefly discussed by subsequent commentators (*eg*, Pedley 1939), no further fieldwork was carried out on site until James Forde-Johnstone surveyed it anew in the early 1960s for a comparative study of the hillforts of Lancashire and Cheshire (Figure 6). Forde-Johnstone admitted that survey and accurate observation were hampered by thick vegetation cover, but clearly viewed the site as lying within the hillfort tradition. He claimed to have traced both inner and outer walls (or ramparts as he described them) the full width of the promontory and suggested that in the south-east the middle wall also continued as far the cliff edge although he was less certain that its western end did likewise. He noted that in places, the inner and outer walls ran across locally raised limestone outcrops and suggested these had been deliberately incorporated into the line of the defences as defensive ‘bastions’. He was less sanguine about identifying entrances, although he agreed with the VCH in thinking that the break towards the south-east end of the inner circuit, followed by the modern footpath, was original (Forde-Johnstone 1962, 29-32).

In 2003, the Lancashire Wildlife Trust produced a pamphlet presenting the then accepted understanding of the site as an Iron-Age hillfort to a popular audience (Lancashire Wildlife Trust 2003). This includes an illustration by the reconstruction artist, John Hodgson, of how the monument may once have looked. The illustration shows three circuits of well-constructed stone rampart enclosing the hill summit, with a number of thatched roundhouses and associated small fields or enclosures within the interior. Whilst these details are entirely speculative, the reconstruction does convey a relatively good idea of the topographic position of both monument and Crag.

More recent attempts to investigate the monument have similarly had to contend with the problem of dense vegetation severely restricting visibility. Field visits were made by Investigators from the OS and English Heritage (now Historic England) in 1967, 1999 and 2009. Because of the poor visibility, these resulted in few new observations although the third of the visits did lead to the suggestion that the monument appeared more akin to northern English enclosures believed to date to the Neolithic or Bronze Age, than to a conventional Iron Age hillfort (NRHE 41541, authorities 4, 9 and 10).

In 2013 Historic England’s NAIS Upland Pilot project attempted to map the site for the first time using lidar. Unfortunately, the only lidar available was 2m-resolution gridded data flown by the Environment Agency (Oakey *et al* 2015, 16-18), which did not penetrate the tree cover well and yielded only a partial, very coarse view of the walls. Follow-on, walkover, survey in 2014 as phase 2 of that project was greatly facilitated, however, by use of a copy of the lidar data uploaded to a hand-held mapping-grade Global Navigation Satellite Systems (GNSS) device. This enabled each of the three walls to be followed, and for Investigators to know their position on the ground in relation each of the circuits, much more easily and quickly (NRHE 41541, authorities 11 and 12).

Between 2014 and 2016, members of the White Cross Group, a local archaeological society, made a series of visits to the site, taking photographs of features and locating

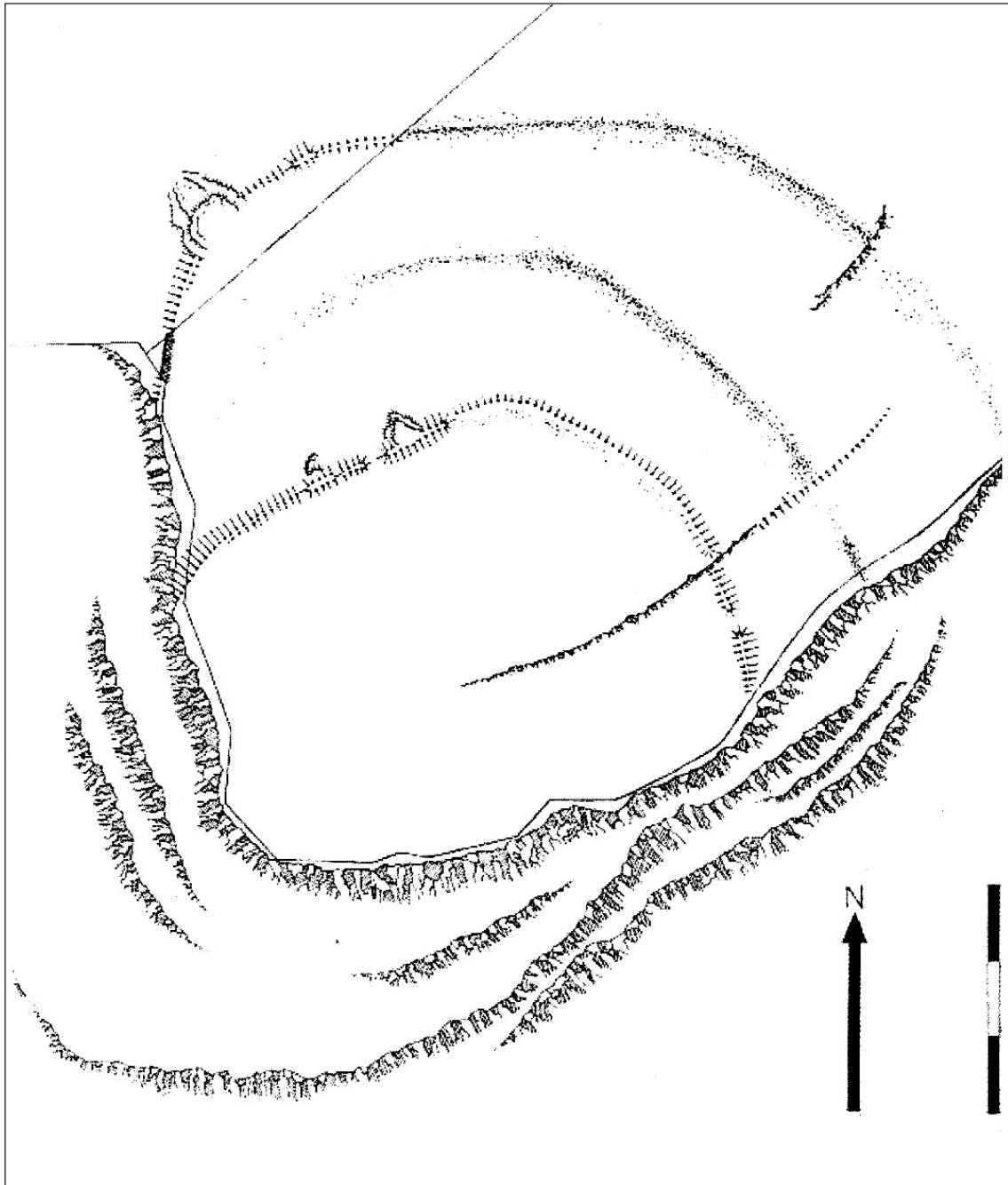


Figure 6. Warton Crag hilltop enclosure as mapped by James Forde-Johnstone.
(Reproduced from Forde-Johnstone 1962).

them within OS National Grid using a mapping-grade GNSS device. Unfortunately their GNSS was accurate to no better than *circa* 5m, but the Group have kindly made copies of their photographs, locations and thoughts available to Historic England to inform the walkover survey stage of the current project.

4. AERIAL MAPPING

4.1 Scope and Method

The scope of the aerial mapping undertaken by Historic England's Aerial Investigation and Mapping (AIM) Team broadly adhered to National Mapping Programme (NMP) standards. It included all feature visible on available lidar and aerial photographs as cropmarks, soilmarks, parchmarks, structures or earthworks. It included archaeology visible as upstanding features on historic photographs but since levelled (including industrial features and evidence of mineral extraction even if depicted on OS mapping), but not field boundaries and trackways marked on OS first edition and later maps.

Mapping was carried out of an area of 0.96 sq km centred on the scheduled monument, as shown in Figure 7. The area so defined (the 'aerial project area') corresponds to that for which lidar imagery was commissioned by the Morecambe Bay Partnership from Bluesky International Ltd.

4.2 Lidar data

The data, collected on a 0.25m grid, were processed in-house by AIM using Quick Terrain (QT) Modeler to produce a Digital Terrain Model (DTM) in .qtt and ASCII format. ASCII data were processed using the Relief Visualization Toolbox v1.1 to produce 2D GeoTIFF images. These included 16-direction hillshade, sky view factor, simple local relief and openness. QT files were viewed in QT Reader alongside AutoCAD where the model could be manipulated.

4.3 Aerial photographs

All available oblique and vertical aerial photographs from the Historic England Archive were viewed under magnification and in stereo where possible. A full list of photographs examined by the project can be found in Appendix 2.

At the time of the assessment, there was no public access to the Cambridge University Collection of Aerial Photography (CUCAP) which remains closed. However, the Cambridge photographs had previously been assessed as part of the NAIS Upland Pilot project in 2013 (sections 1 and 3 above). Aerial photographs held by the Lancashire HER had similarly been examined as part of the NAIS project and so were not reassessed during the current assessment.

Orthorectified vertical photographs were supplied to Historic England by Next Perspectives™ through the Aerial Photography for Great Britain (APGB) Agreement as 1sq km tiles in GeoTIFF format; two runs of photographs cover Warton Crag, dating from 01-SEP-2010 and 27-JUL-2014. Additional photography hosted on Google Earth was also consulted; the stated dates of this imagery are unreliable but are recorded as 2000, 2003 and 2014.

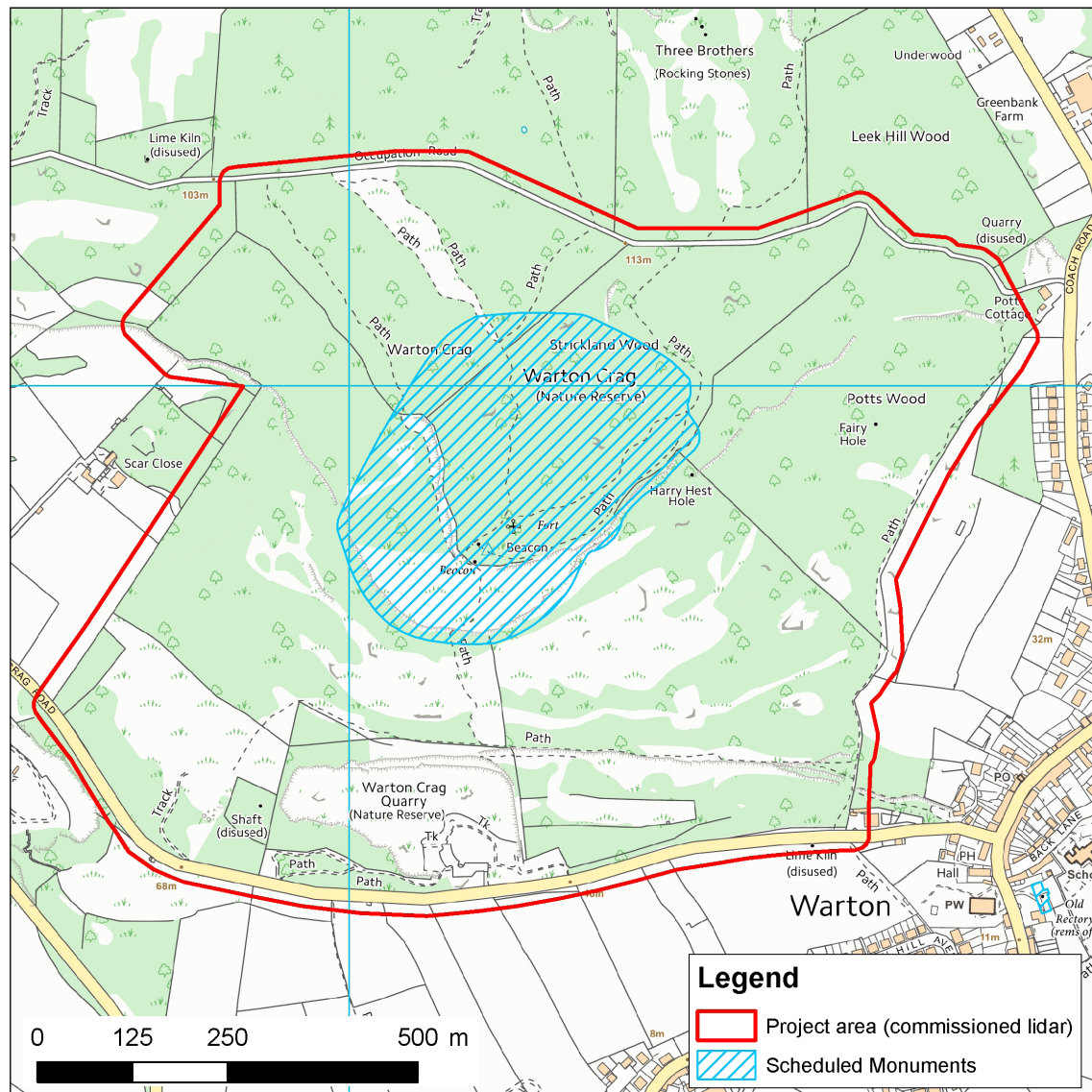


Figure 7: The aerial transcription project area. (D0040619, Sally Evans 2016 © Historic England).

Due to the dense vegetation cover, archaeological features were rarely visible on any of this photography and none was mapped using them, but the photographs were used to inform interpretation of the lidar data.

4.4 Mapping

All archaeological features were transcribed as closed polygons in AutoCAD. The extents of a contiguous block of ridge and furrow were mapped as a closed polygon and a single polyline indicating the form and direction of ploughing.

An object data table which included the following information was attached to all features:

| Attribute | Description | Sample data |
|-------------|--|----------------|
| MONARCH* | NRHE Unique Identifier (UID) | 0 |
| PERIOD | Date of feature (HE Thesaurus). Single or dual indexed terms | POST MEDIEVAL |
| NARROW_TYPE | Monument Type (HE Thesaurus). Specific monument type for individual features | SPOIL HEAP |
| BROAD_TYPE | Monument Type (HE Thesaurus). Broader monument type to enable grouping of individual features | IRONSTONE MINE |
| EVIDENCE_1 | Form of remains (HE Thesaurus) as seen on PHOTO_1 | EARTHWORK |
| SOURCE | Source feature was mapped from (air photograph or lidar) | LIDAR |

**MONARCH is a former name of the National Monuments AMIE database, and now known under the umbrella term National Record of the Historic Environment (NRHE). The table retains the former name to facilitate download into the Historic England GIS and for delivery and use by the relevant HER.*

4.5 Recording

Features have been recorded in the National Record of the Historic Environment (NRHE) database, AMIE. New records have been created and existing records amended.

4.6 Results

As already stated, because of the dense vegetation cover Warton Crag is not well-suited to evaluation by aerial photography. Elements of the site were rarely visible on aerial photographs and when features were identified they were not seen with any clarity. Aerial photographs are, however, essential for informing interpretation of the lidar data and evaluating historic and present vegetation cover.

The following section briefly summarises features mapped from the lidar within the project area (Figures 8 and 9), although a more detailed and nuanced view of those within the scheduled area, derived from field investigation, follows in section 5. The positions of features 'a' to 'm' described below are all shown on Figure 9.

Lidar shows the enclosure 'a' defined by three circuits of bank made up of spread stonework. Several breaks are identifiable in the banks. Some appear to be later breaches but others may be contemporary with the use of the enclosure. A level area of approximately 2.8ha is defined by the innermost circuit of bank on its north-east and north-western sides and a natural scarp to the south-east and south-west. No evidence for an embanked rampart following the scarp was identified.

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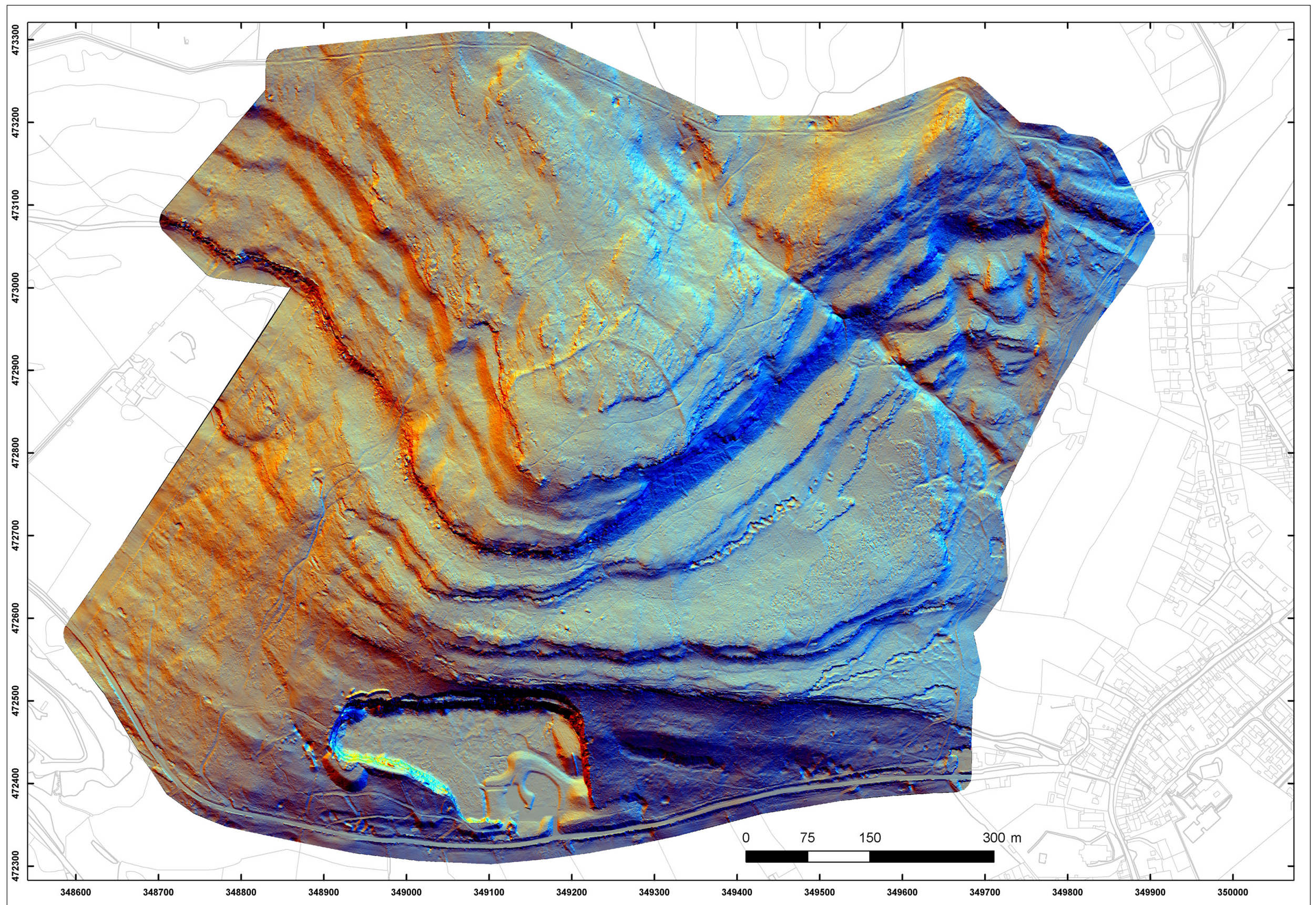


Figure 8. A 16-direction hillshade DTM model of the commissioned lidar overlaid against OS digital mapping. (D0040620, Sally Evans 2016 © Historic England).

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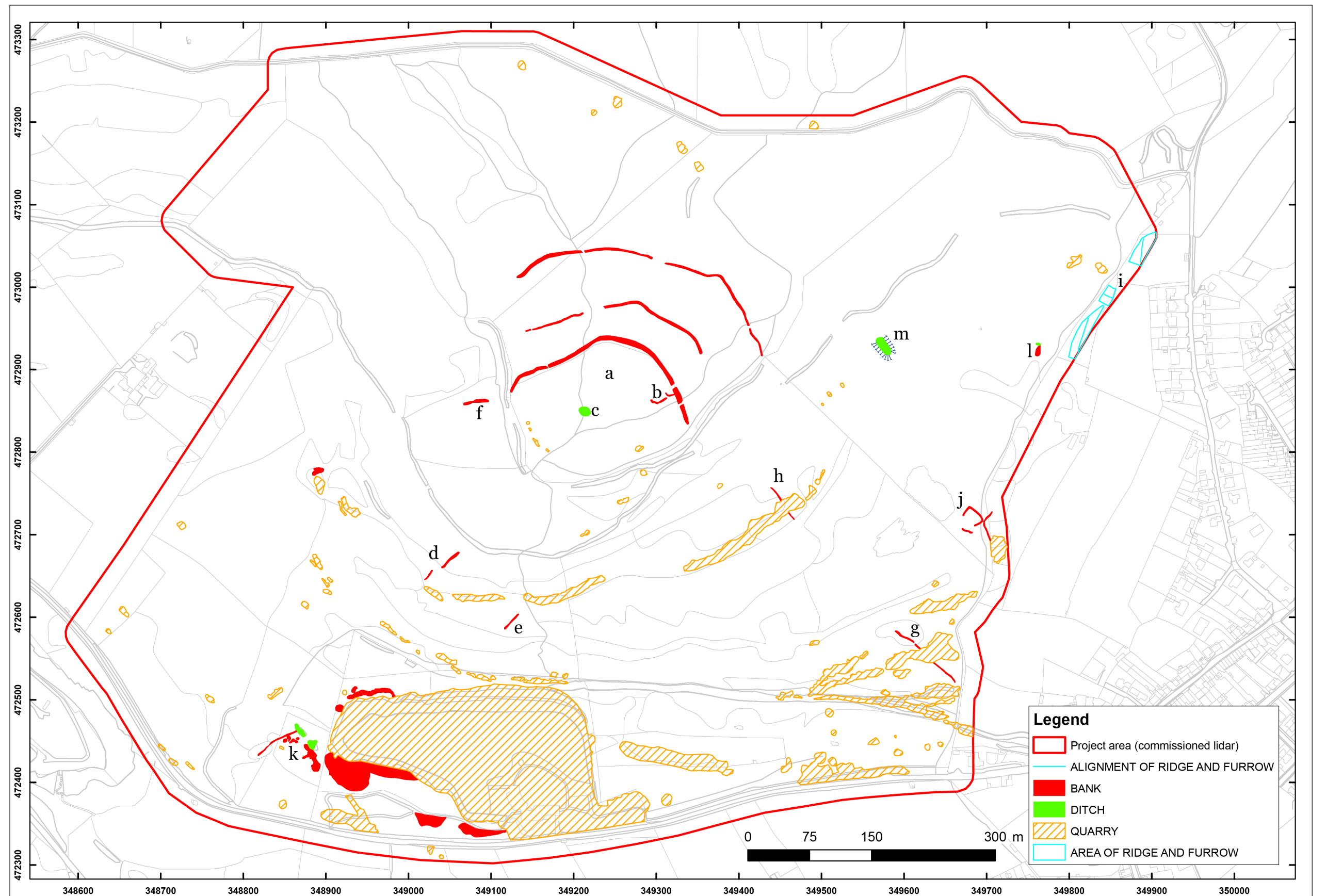


Figure 9. Results of the aerial photograph and lidar transcription overlaid against OS digital mapping. (D0040621, Sally Evans 2016 © Historic England).

Two curving banks ('b') are visible at National Grid Reference (NGR) SD 49309 72865, one of which abuts the inner rampart. These are the collapsed remains of later stock enclosures of probable medieval or post-medieval date and are marked on early edition OS maps.

A large sub-circular hollow 'c' is located at SD 49213 72849 and measures 11.5m by 15m. Its function and date are uncertain but may be elucidated through analytical field survey.

Several fragments of boundary bank ('d'-'h') are visible downslope of the enclosure. While it is possible that some may be contemporary with the enclosure, they are likely to be medieval or post-medieval in date. It is probable that they are formed by the collapsed remains of stone walls. Two of these banks ('g' and 'h') are cut by later limestone quarrying.

Three areas of ridge and furrow 'i' are thought to be medieval or post-medieval in origin. Although the ridges are curved in plan, the width of the ridges is only 2m suggesting a post-medieval re-use of an earlier plough pattern.

An embanked feature 'j', U-shaped in plan, is located at SD 49683 72721 with a short length of bank immediately to the south. This is likely to represent a medieval or post-medieval enclosure. A curving bank adjacent to the enclosure may represent the partial remains of a second enclosure.

Extensive limestone quarrying is visible in the vicinity of the enclosure. From the aerial photographs and lidar alone, it is difficult to date the quarrying but much if not all is likely to be post-medieval.

An ironstone mine 'k' is located at SD 48882 72445 and noted on the OS second edition mapping as 'Old Shaft (Iron Ore)'. Immediately to the north-west at NGR 348868 472462 is a similar depression with spoil and approached by an embanked trackway. This is marked on the OS first edition as the location of a building and probably also relates to ironstone extraction.

Another shaft 'l' is located to the north-east at SD 48868 72462. Although a specific function is not noted on historic OS maps, this may also relate to ironstone extraction.

A regularly shaped hollow 'm' at SD 49575 72927 sits towards the top of a small valley, probably following the line of a geological fault. It measures approximately 10.5m by 25m and has straight sides and rounded ends. The hollow sits within a shallower scooped area which also looks manmade. The most likely interpretation of this feature is a reservoir, probably associated with prospecting for copper- or lead-ore deposits within the limestone. It is possible that the narrow valley downslope of the reservoir may be, at least in part, a prospecting hush.

5. ANALYTICAL FIELD SURVEY

5.1 Scope and method

The scope of the field assessment was more narrowly drawn than the aerial mapping, and was confined to walkover survey of the interior and walls of the scheduled monument only. It was guided by copies of 64-direction hillshade lidar imagery and the derived aerial mapping loaded onto a hand-held Trimble Geo7 GNSS device. This enabled the walls and other features within the monument that are visible on the lidar to be located and followed with reasonable confidence and ease on the ground even through areas of dense vegetation. Although the GNSS device used is classed as mapping grade, it is capable of achieving accuracies of 0.1m if it obtains a differential correction signal broadcast by the European Geostationary Navigation Overlay Service (EGNOS) satellite constellation. In the event, although such accuracy was achieved in the more open areas of the Crag with better satellite visibility, stated accuracy beneath the trees was normally in the range 1–5m. This means that for large areas of the site, the lidar imagery provides more accurate mapping of the monument than is possible on the ground without use of a total-station theodolite. The methodology adopted, therefore, was to map revisions to the aerial interpretation on the GNSS as accurately as possible in the field, and once back in the office use those data to re-examine and re-interpret the lidar imagery within AutoCad software, augmented by photographs and written notes. The resulting field edit of the aerial interpretation (Figure 9) is shown here at Figure 10.

5.2 Earthwork Description

The following detailed description of the enclosure proceeds from the interior of the monument towards the outside. After a brief description of the interior itself, each of the walls or circuits is examined in turn, in a clockwise direction. To help the reader locate themselves on the plan, reference is made in the text to a number of topographical features, namely: Beacon Breast (the main escarpment edge); the Enclosure-period stone field wall that crosses the west end of the outer wall; a temporary plastic-mesh fence defining the edges of an open ride south of this field wall created to encourage butterflies; and the four principal footpaths that traverse the Crag summit, here called the ‘western’, ‘central’, ‘eastern’ and ‘southern scarp-edge’ footpaths (all shown on Figure 10).

5.2.1 Interior

An oval depression lies at SD 49213 72849 at the approximate centre of the enclosed area. It measures *circa* 15m across east-west by 11.5m transversely by 0.8m deep, and is best interpreted as a medieval or post-medieval dewpond. It is presumably the same as the circular depression or ‘reservoir’ reported by Hutchinson in 1785.

No trace was seen of either the square hut mentioned by Hutchinson at the centre of the enclosure or the small pen at ‘A’ on the VCH plan (Figure 4), ie at the west end of the scar that leads away east from the dewpond.

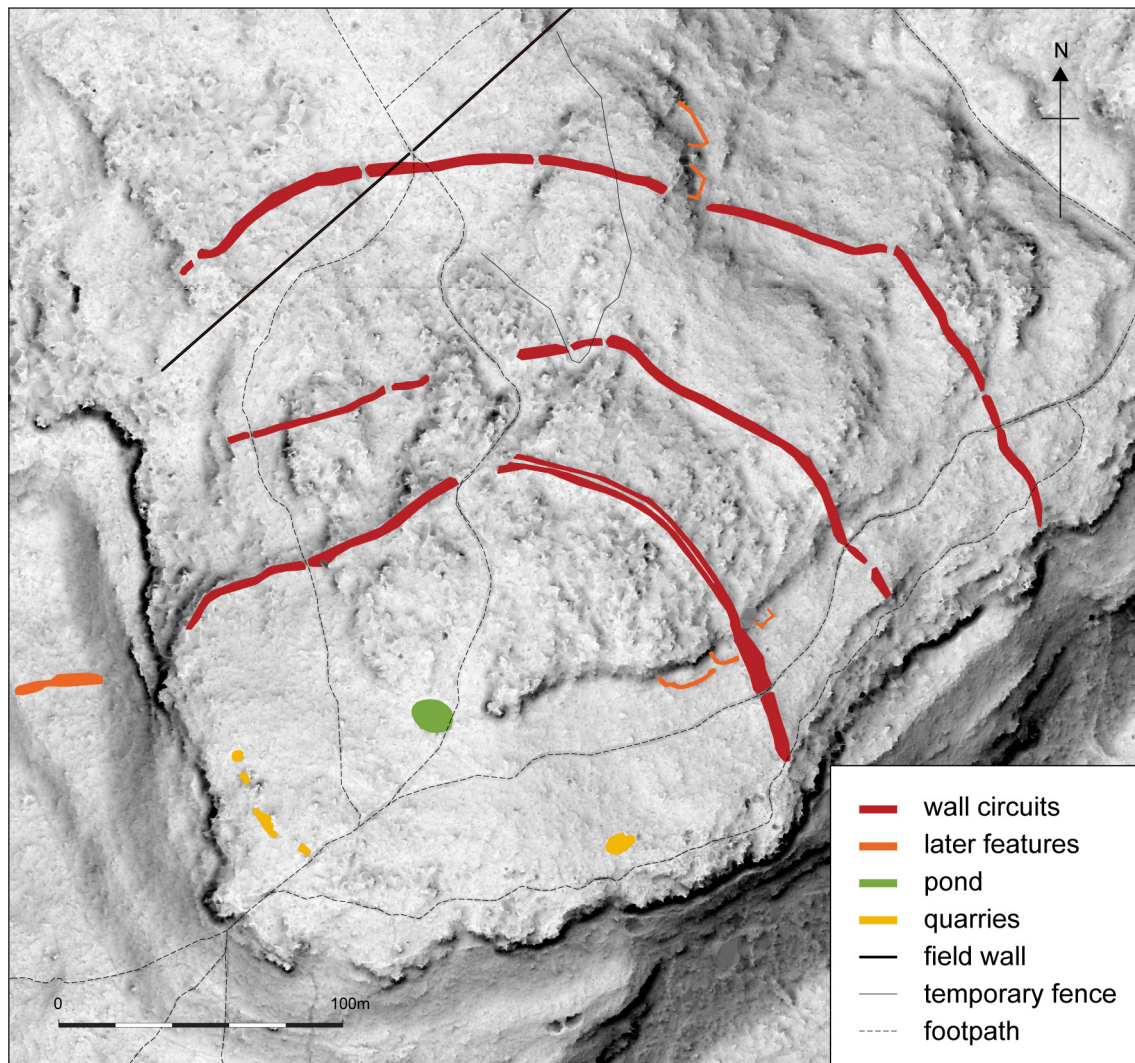


Figure 10. The aerial photographic and lidar mapping of the scheduled monument on Warton Crag as modified by analytical field survey. (D0040622, Marcus Jecock and Sharon Soutar 2017 © Historic England).

5.2.2 Inner circuit

The aerial mapping identified a number of short stretches of bank on the slopes of the Crag ('d'-h' on Figure 9) that might be contemporary with the walls of the enclosure, although on the whole this was thought unlikely (section 4 above, pp19). Strictly speaking these features all lie outside the area of field assessment which was targeted on the area of the enclosure only, but one such bank ('f' on Figure 9) that appears to align with the western terminal of the inner circuit, was briefly examined to elucidate its relationship to that wall.

On the ground a broad, low, linear swelling is visible in the grass sward at the foot of the upper escarpment (Beacon Breast) on which the inner wall terminates, but unfortunately disappears beneath thick scrub after only *circa* 8m and could not be followed further. No stones were visible in the bank through the grass. From the short length available for inspection, it was impossible to determine if the feature seen on the ground and on lidar is

archaeological or natural, and if the former, what date it is and how it relates to the enclosure on the summit. It must be very doubtful that it is contemporary with the enclosure, however.

On the Crag summit above bank 'f', the inner wall survives between Beacon Breast and the western footpath as a low, curving, discontinuous bank composed of moss-covered boulders and smaller stones with seemingly very little or no soil matrix between and beneath. It appears better preserved close to the path and less substantial towards the escarpment edge, but in places is heavily infested with small saplings and the occasional more mature tree making detailed observation problematic. As best as can be observed, all surviving stonework directly overlies limestone pavement, with no intervening buried ground surface. The 64-direction hillshade visualisation of the lidar suggests this stretch of wall survives up to 5m wide, but field inspection reveals that the impression of 'bankiness' on the lidar is attributable to the fact that the wall runs along the crest of a slight north-facing declivity in the underlying limestone pavement, and that its true width - as indicated by intermittent lines of boulders set on edge, suggestive of *in-situ* inner and outer facing stones - is closer to 1.8m. A loose scatter of mostly smaller stones that lies between and beyond the facing stones presumably represents the *in-situ* and *ex-situ* remains of core material. Some of the facing stones stand up to 0.8m tall, but a more typical height for the wall in this section is 0.4m or less (Figure 11).

The western footpath makes use of a clear break in the line of the inner wall. It is impossible to reach a definitive view, but the impression on the ground is that the gap is an original entrance: there is no indication of a swelling continuing through the gap to suggest that the path over-rides *in-situ* material, and immediately east of the path there is a sub-rectangular recess in the rear of the wall (Figure 12). This recess is obscured by vegetation, but measures *circa* 2.1m east-west by 1.5m north-south by 1m high, its eastern side formed by a natural limestone scar of the same height that extends to both north and south. (To the north the scar continues beneath the middle wall also). The state of the vegetation means it is impossible to determine from field inspection whether the recess is original or secondary. In size and general position, however, the feature has clear parallels with structures recorded at the entrances to certain hillforts in southern England and the Welsh Marches, conventionally interpreted as 'guard chambers'. Admittedly, such chambers normally open off the entrance passage itself rather than being set to one side as here, but the existence of a recess at Warton Crag could be construed as corroborating evidence for interpreting the nearby break in the wall as an original entrance (as has been argued by the White Cross Group). Without excavation to test the hypothesis, however, the argument risks becoming circular.

East of the recess and above the localised scar, the wall is traceable for a short distance as a low, *circa* 2m-wide bank with suggestions of inner and outer facing stones (Figure 13), before disappearing into a thicket of young tree growth that again makes detailed observation difficult. However, this is an area of exposed limestone pavement and the overall impression is that there is little or no *in-situ* wall material; certainly very little material is readily apparent immediately either side of the central



Figure 11. Looking west along the inner circuit towards Beacon Breast from near the western footpath. The vertical ranging rod at right of frame marks the base of the natural declivity; the rods are marked in 0.2m intervals. (Image 00406001, Marcus Jecock 2017 © Historic England).



Figure 12. Far view of possible guard chamber in the inner circuit, east of the western footpath. Looking north from the interior of the enclosure. (Image 00406004, Marcus Jecock 2017 © Historic England).

path that lies a short distance further east. A low swelling in the floor of that path on the projected line of the wall suggests the path does not utilise an original entrance, however, but here follows a gap caused by stone-robbing or other disturbance.

East of the central path the wall line re-emerges, but with a very different earthwork form. Instead of being a rubble spread between facing stones, for the next 225m or so, as it arcs from east to south-east, the wall has more the appearance of a 2.9m-wide terrace levelled into the hillside (Figure 14), which here is exposed limestone pavement dipping gently to the north and east. The inner edge of the terrace appears cut into the pavement, the outer edge pushed out over it. It is difficult to account for this change of form. Superficially it suggests the wall has been cleared away and its course re-purposed for a terraced trackway, raising the possibility that in the 18th century the wall began to be remodelled in connection with attempted enclosure and improvement of the hill summit that was never completed. Indeed, about halfway along this stretch of wall course at SD 49287 72923 an upright stone *circa* 1.4m high on the line of the inner scarp is suggestive of an intended gatepost; if so, there is no evidence that a gate ever hung from, or fastened against, it (Figure 14). An alternative and perhaps more likely explanation for the very different form of the wall in this sector is simply that it has been quarried away, and that the 'gatepost' is a piece of limestone pavement abandoned in the process of being levered up and robbed out. Alternatively it may have been intended as a scratching post for cattle.

At SD 49312 72896, the form of the inner wall suddenly changes back to a low rubble spread between intermittent facing stones (Figure 15). From this point as far



Figure 13. View north-east along the inner circuit from just east of the 'guard chamber' (Image 00406007, Marcus Jecock 2017 © Historic England).



Figure 14. View south-east along the line of the (?robbed) inner circuit close to the upright stone, showing the very different earthwork form of the wall in this sector (Image 00406009, Marcus Jecock 2017 © Historic England).



Figure 15. View almost due south along the inner circuit. The GNSS controller on its pole is set at a height of 1.1m and marks the south-eastern end of the 'terraced' section of the inner circuit where it reverts to a stony bank at NGR SD 49312 72896. (Image 00406033, Marcus Jecock 2017 © Historic England).

as a localised but *circa* 4m-high east-west scar that runs parallel to and some 50m back from Beacon Breast (*ie* the area north of the eastern footpath), the base of the wall is again well preserved. As it drops down over the localised scar, the feature becomes more massive, changing in form and increasing in size from a rubbly spread to more of an earthwork bank some 4.3m wide by up to 0.6m high. This may, however, be simply an impression caused by the accumulation of soil and leaf litter over and against stone-faced wall: the tops of large boulders visible within the bank are suggestive of facing stones, in which case the underlying structure and width of the wall is comparable to that of the circuit further west (Figure 16).

South of the scar, the feature continues straight for 50m as far as Beacon Breast where it terminates on the southern scarp-edge footpath. The ground here is not bare limestone pavement but exhibits a thin soil cover, raising the possibility that a buried soil horizon might survive beneath the wall.

Midway along this stretch is a gap, *circa* 1.5m wide, utilised by the eastern footpath. The wall/bank either side of the path is *circa* 7.5m wide and over 1m high externally (Figure 17) suggesting that the gap is unlikely to be a modern break and is much more probably an original entrance (as has been suggested previously by both the VCH and Forde-Johnstone (section 2 above) and indeed the White Cross Group).

A number of mature trees are rooted in the wall-line in this sector, especially between the localised scar and eastern footpath. These should be felled before they



Figure 16. View north-west along the inner circuit as it drops down over the localised scar north of Beacon's Breast. The vertical ranging rods indicate the possible inner and outer wall facing stones within the overall width of the bank. (Image 00406015, Marcus Jecock 2017 © Historic England).



Figure 17. View east from within the monument of the probable eastern entrance in the inner circuit, now followed by the eastern footpath. (Image 00406016, Marcus Jecock 2017 © Historic England).



Figure 18. The inner circuit just north of the eastern entrance, showing one of the wind-thrown trees and other mature trees marked up for felling. Looking north. (Image 00406017, Marcus Jecock 2017 © Historic England).



Figure 19. The easternmost of the three boulder-walled stock pens adjacent to the inner circuit. Note the fallen yew tree at left of frame that has prevented the feature being picked up by lidar. (Image 00406011, Marcus Jecock 2017 © Historic England).

fall or are blown down and their roots disturb surviving archaeology; there are a number of wind-thrown trees in this area already (Figures 18 and 19).

A complex of three stone-walled animal pens lies up against the vertical face of the localised east-west scar: two pens lie contiguous and in line immediately inside the enclosure wall, a third just outside (Figure 10). All are defined by low boulder walls and are entered through narrow breaks in their circuits. All, however, are heavily overgrown and obscured by moss and scrub vegetation making it impossible to see fine detail; indeed the, third, external pen does not show at all on the lidar because the branches of a fallen yew tree have prevented lidar pulses penetrating to ground level (Figure 19). The pens are undatable from surface inspection, but post-date the enclosure and are therefore presumably medieval or later.

5.2.3 Middle circuit

In common with previous surveys of the monument, the present investigation has found little or no trace of the middle wall immediately above the western escarpment edge. Suggestions of wall (a few grass- and moss-covered boulders vaguely in line) are discernible either side of the western footpath, but it is only *circa* 13m east of the path as it rises up over a localised low north-south scar (the same scar that forms the east side of the ‘guard-chamber’ in the inner circuit) that the middle wall becomes particularly evident on the ground. The western footpath passes through a *circa* 1.7m-wide gap in the line of the wall so defined (Figure 20), while approximately



Figure 20. View south towards the enclosure interior through the gap in the middle circuit followed by the western footpath. (Image 00406025, Marcus Jecock 2017 © Historic England).



Figure 21. View south towards the enclosure interior through the gap in the middle circuit followed by the disused footpath at NGR SD 49198 72964. (Image 00406024, Marcus Jecock 2017 © Historic England).



Figure 22. The middle circuit immediately east of the butterfly-ride fence. Looking west towards the fence. (Image 00406023, Marcus Jecock 2017 © Historic England).



Figure 23. View north-west along the middle circuit at NGR SD 49333 72950. (Image 00406021, Marcus Jecock 2017 © Historic England).



Figure 24. View north-west along the middle circuit at NGR SD 49320 72954 (Image 00406022, Marcus Jecock 2017 © Historic England).

mid-way between it and the central footpath, an occasional or disused footpath follows another gap (Figure 21), but it is impossible to determine from surface inspection whether either gap is original.

Shortly after the second break, the wall dies out on the edge of an area of raised limestone pavement and does not pick up again until some distance beyond the central footpath. Survival is intermittent after this, with further gaps in evidence (all probably modern breaks) particularly in the area of the mesh-fence that defines the edge of the butterfly ride. However, between the eastern return of that fence and the eastern footpath, the wall is readily traceable as a jumble of mossy boulders between 1.5 and 3m wide and up to 1m high overall (Figure 22), with in places clear suggestions of *in-situ* facing stones inside and out (Figures 23 and 24). The lidar (Figure 9) suggests the wall terminates before the eastern footpath, but on the ground it can be readily traced as an area of exposed stonework continuing across the floor of the path (Figure 25) and thereafter as a stony bank running through an area of very scrubby young tree growth as far as Beacon Breast (as reported in Forde-Johnstone 1962). Mid-way between the footpath and the escarpment edge a gap, 2-3m wide, in the wall with a tall, transverse, upright stone marking the northern side (Figure 26) looks very much like an original entrance (although scrubby vegetation again makes it impossible to observe fine detail). The existence of an entrance here has not been recognised by previous investigators.



Figure 25. Close-up of the base of the middle circuit continuing through the floor of the eastern footpath (Image 00406019, Marcus Jecock 2017 © Historic England).

5.2.4 Outer circuit

According to the lidar (Figure 9), the western end of the outer wall begins just short of Beacon Breast. With the eye of faith, very slight indications of stony bank material suggest the wall did originally extend all the way to the edge, but again ground vegetation (thick brambles) hinders accurate observation and assessment. As one moves east, however, the vegetation becomes more open and the ground correspondingly more visible, so that at a point some 30m in from Beacon Breast the wall line is clearly recognisable as a grass-covered, stony bank *circa* 3.2m wide by 0.5m high (Figure 27). The boulders in the bank seem to directly overlies limestone pavement meaning there is unlikely to be a pre-wall buried ground surface preserved beneath them; furthermore, there are suggestions, particularly on the inner (*ie* southern) edge of the bank, of disturbance to both pavement and wall from stone grubbing.

The wall thereafter passes into an area of light deciduous tree cover but is still clearly traceable on the ground. After a further 30m (*ie* just prior to the point where it is crossed by the Enclosure-period field wall) there is a 1.5m-wide break in its course. The east side of the break is marked by a transverse upright stone suggesting the gap is probably an original entrance (Figure 28); certainly the break already existed when the outer circuit was mapped by the OS in 1913 (Figure 5).



Figure 26. View north-east through the eastern entrance in the middle circuit (that just south of the eastern footpath). The vertical ranging rod at left of frame marks a tranverse orthostat that probably denotes the actual north side of the entrance passage. (Image 00406020, Marcus Jecock 2017 © Historic England).



Figure 27. View of the disturbed stony bank defining the outer circuit about 30m in from the western escarpment. Looking north. (Image 00406026, Marcus Jecock 2017 © Historic England).



Figure 28. View south through the western entrance in the outer circuit (that in the woods north of the field wall). The vertical ranging rod at left of frame marks a possible transverse orthostat forming the east side of the entrance passage. (Image 00406027, Marcus Jecock 2017 © Historic England).



Figure 29. The outer circuit visible as a grass-covered bank immediately south of the field wall. Note how the field wall rises up and over the line of the prehistoric wall. (Image 00406028, Marcus Jecock 2017 © Historic England).



Figure 30. View south through the possible entrance in the outer circuit at NGR SD 49250 73046. The ranging rod at left of frame marks a possible fallen transverse orthostat. (Image 00406030, Marcus Jecock 2017 © Historic England).

The circuit then passes beneath the field wall which clearly rises up and over it (Figure 29), and continues in to the area of the butterfly ride. Immediately south of the field wall (in the area of the junction of the western and central footpaths) the wall line is apparent on the ground as a low grassy swelling 3m wide by 0.3m high (Figure 29). Further east, vegetation cover whilst still fairly open becomes higher and denser (a mixture of brambles and very coarse grass) which again hinders detailed observation, but the line of the wall is traceable as a stony bank, with suggestions of facing stones, as far as SD 49198 72998 where there is another break in its course, 1.8m wide (Figure 30). A large horizontal stone on the further (eastern) side of the break is suggestive of a fallen transverse stone; if so, it indicates that the break is likely to be another previously unrecognised entrance. Immediately prior to this point, the wall survives *circa* 1.5m high and seems to comprise large boulders piled up over other boulders. This is the only point on any of the three circuits where there is any real evidence that the enclosure's walls ever stood more than a single boulder-course high (Figure 31).

From the entrance, the wall runs broadly due east for almost 50m to the top of a localised, high but not vertical, limestone scar. It resumes at the foot of the scar, but there is now little or no evidence for it on the scar itself. This is probably due to the effects of erosion and gravity, but may also be due in part to stone robbing: two boulder-walled stock pens (akin to those close to the southern end of the inner wall) lie against the face of the scar immediately outside the wall line. Both pens are heavily overgrown and obscured by trees and are invisible on the lidar for that



Figure 31. Detail of the external face of the highest-standing stretch of the outer circuit at NGR SD 49241 73048. (Image 00406029, Marcus Jecock 2017 © Historic England).



Figure 32. Looking south-west over the outer circuit into the interior of the enclosure from NGR SD 49327 73028 (just east of the boulder-walled stock pens). Note the level terrace immediately behind the wall with the ground rising up in the middle distance beyond. (Image 00406035, Marcus Jecock 2017 © Historic England).



Figure 33. View south through the gap - a probable entrance - in the outer circuit at NGR SD 49375 73016. Note the large boulder 1.5m high at left of frame (behind the vertical ranging rod), which probably marks one side of the entrance passage. (Image 00406036, Marcus Jecock 2017 © Historic England).



Figure 34. View south-east along the line of the outer circuit from NGR SD 49401 72976. (Image 00406037, Marcus Jecock 2017 © Historic England).



Figure 35. View south-west through the easternmost gap or possible entrance in the outer circuit at NGR SD 49407 72963. towards the interior of the monument. The vertical ranging rods mark the edges of the gap. (Image 00406038, Marcus Jecock 2017 © Historic England).



Figure 36. View south towards Beacon Breast of the outward-facing scarp marking the southern end of the outer circuit. (Image 00406040, Marcus Jecock 2017 © Historic England).

reason. They are, however, depicted on the 1913 OS map (Figure 5). Their plan on Figure 10 is somewhat at odds with that shown on the map and should therefore be taken as indicative only: GNSS precisions here were no better than 5m due to the dense tree cover, and ground observation was also hampered by the thick vegetation.

From the foot of the scar, the wall is traceable on the ground as a double band of stones *circa* 1.8m wide (Figure 32) heading away just south of east. It is noticeable that this stretch does not follow the most defensible course (*ie* the top of the localised scar, which here lies parallel with, but some 20m to the rear of, the wall line) but rather heads across a near-level shelf in the limestone. This suggests defence against attack was probably not the wall's primary purpose.

After 60m or so the line kicks to the east and then back south-east creating a small, bastion-like kink, at the centre of which at SD 49241 72996 a 2.3m-wide break looks very much like an original entrance: a large boulder defines the eastern side of the entrance passage (Figure 33).

East of the 'bastion' and probable entrance, the wall runs in an almost straight line as far as Beacon Breast. Its course in this sector initially takes it across an area of exposed limestone pavement where it survives *circa* 2m wide by 0.6m high (Figure 34). At the southern edge of the pavement, 10m or so north of the eastern footpath, another break in its course may likewise be original (Figure 35) although the wall is less well preserved from this point on and identification as an entrance is at best tentative. An increased density of small stones visible in the floor of the eastern footpath on the line of the wall suggests that the footpath over-rides the latter. The wall is increasingly poorly preserved south of the path, so much so that between the southern scarp-edge footpath and Beacon Breast its line is suggested by no more than an outward-facing scarp *circa* 0.8m high (Figure 36).

6. DISCUSSION AND CONCLUSIONS

The exercise here reported has successfully combined mapping from high-resolution lidar data with detailed ground observation to produce a far more nuanced appreciation of the form and nature of the enclosure on Warton Crag than has hitherto proved possible.

The study has revealed that all three walls are broadly similar in form: each comprises faces formed of large boulders or upright slabs (orthostats) set approximately 1.8-2m apart, the space in between originally filled by other stones, many of a size comparable to the facing orthostats. Although incapable of final proof without excavation to recover dating evidence (which seems problematical given the apparent absence of buried soil horizons over much of the site or of 'cut' features that could act as repositories of artefactual material or organic matter suitable for radiocarbon-dating), this similarity suggests that the walls are broadly all of the same date and that the monument is, therefore, most likely to be single-phased.

The original height of the walls is unclear. In most places they survive no more than 0.5m high; nowhere do they stand more than 1.5m high and even here (in the centre of the outer circuit within the area of the butterfly ride) moss, lichen and other obscuring vegetation prevents fine observation of structural detail (Figure 31). However, the irregular shape and large size of many of the limestone boulders used to form the walls, the orthostatic construction technique employed and the relatively narrow width of each, all combine to make it extremely unlikely they could ever have stood much higher. Although it is possible the walls were originally surmounted by some form of timber breastwork, in practice it is difficult to envisage how timbers could have been fixed securely to the stonework beneath; moreover, such a breastwork would have had to have been accompanied by some kind of wall-walk if the builders were to be able to see out over it and 'defend' it effectively. This suggests that the monument was not built with defence primarily in mind.

Additional evidence in support of a non-defensive purpose for the enclosure comes from the observation that the walls do not always follow the most defensible line in terms of maximising the advantages of the natural topography. This is particularly the case with the outer circuit (above pp39). Furthermore, the builders must have obtained material to construct the walls by breaking up adjacent areas of limestone pavement. If the purpose of the walls was to withstand attack, then it would seem logical for such quarrying to have been concentrated within the area immediately outside each wall, thereby increasing defensibility through the creation of associated ditches, even if only shallow. There is no evidence for rock-cut ditches anywhere on site.

In the late 18th century, Hutchinson (1789, 214) observed three entrances in the outer wall and two each in the other two. The current investigation has identified four breaks in the outer circuit as definite or possible entrances, three in the middle circuit and two in the inner. Whatever the true number of entrances at Warton Crag, entrances are obvious weak points in any defensive system, and the existence of multiple examples is an additional pointer that the monument's main role was

probably not one of defence. Rather, the diminishing number of points of entry through each of the circuits in turn, if genuine, seems better interpreted as indicating an increasing emphasis on controlling and limiting access to the enclosure the further people progressed towards the interior. It may be for this reason that the inner wall has evidence of a recess within its width close to the probable western entrance. This was likened in section 5 above to features on hillforts conventionally interpreted as 'guard-chambers', but the reality is we have no evidence for how such chambers were used; a myriad of other uses are possible, including as porters' lodges, cloakrooms, storerooms for weapons (perhaps because of a taboo on wearing weapons inside an enclosure), 'tollbooths' (for payment of 'market' dues) or spirit houses to name but a few (Bowden 2006). Although there is no surface indication of a similar recess associated with the south-eastern entrance in the inner wall (*ie* that followed by the eastern footpath), it must be a possibility that one lies buried here beneath later soil accumulation and leaf litter.

There is no other evidence of structures or occupation of any kind within the enclosure that can be considered to be contemporary with the walls. Indeed, large parts of the interior are today - and presumably were in later prehistory also - characterised by bare limestone pavement. (Evidence for a loess covering of northern English karst landscapes, including specifically at Warton Crag, prior to *circa* 8200 BC is discussed in Vincent *et al* 2011, but does not bear on the question of how widespread the cover remained after this date). Such areas are clearly unsuited to being the sites of houses or animal pens because of the fractured and irregular nature of their surfaces, and must be considered to have been equally unsuitable to domestic occupation or the corralling of animals in the past. It is therefore extremely improbable that the interior was ever permanently occupied. It might be argued from this that the enclosure was instead constructed as a place of refuge or last resort, but the defensive shortcomings of the walls already outlined militate against this. Furthermore, there is no source of permanent water within the enclosure unless the dewpond at its centre is contemporary. This dewpond is undatable from surface evidence, but given the presence at two places on the summit of a number of crude, boulder-walled animal pens which post-date the enclosure, is best viewed as medieval or later.

If not a place of permanent occupation, a defensive stronghold or a place of refuge, therefore, what is the Warton Crag enclosure? It has previously been called a hillfort probably as much as anything on account of it being defined by multiple walled circuits, but its lack of defensibility, small scale of the enclosing walls and multiple entrances militate against such a label: hillforts have ramparts that are more substantial and better constructed, and the majority typically have only one, or at most two, entrances. Indeed, there seems no obvious exact parallel for the monument. Recent work, however, has begun to identify a number of other sites in the north of England which provide possible analogues in terms of position (constructed against escarpment edges), technique of construction (stone walls, sometimes involving orthostats) and/or in having multiple entrances.

The best excavated parallel is probably the Gardom's Edge enclosure in Derbyshire. This consists of a *circa* 600m-long wall that describes an arc above the escarpment

edge after which it is named (one of the gritstone edges of the East Moors in the Peak District National Park). The wall encloses an area of 6ha up against the edge and, as it survives on the ground, is *circa* 4-10m wide by up to 1.5m high. The enclosed area is therefore somewhat larger than that at Warton Crag and the enclosing boundary also more substantial, but the latter does bear comparison in having stretches faced by orthostats. (Admittedly other stretches consist solely of linear dumps of gritstone). Moreover, the site has multiple entrances: at least three are known, two are suspected, and there may originally have been more since a length of the wall has been destroyed by medieval/post-medieval agricultural improvement. As with Warton Crag, there is no sign of permanent occupation within the enclosure, much of the interior being unimproved ground covered in bare rock and earthfast boulders. Where early land clearance is in evidence (at the southern end of the enclosure) this is actually part of a field system dating to the late 2nd/early 1st millennium BC that visibly overlies the enclosing wall. In the absence of precise dating evidence, enclosures such as Gardom's Edge that possess multiple entrances (*ie* are of a causewayed nature) have traditionally been viewed by archaeologists as dating to the Neolithic, but the recent excavations (Barnatt *et al* 2017, 39-58) have showed that the Gardom's Edge enclosure was in fact constructed towards the end of the 2nd millennium BC (*ie* is Late Bronze Age in date).

Two other possible parallels (one mentioned in the Gardom's Edge excavation report; *ibid*, 54) have also recently been investigated by various forms of survey and excavation: Helsby Hill and Woodhouse Hill in Cheshire. Both enclosures occupy similar scarp-edge locations to Warton Crag and Gardom's Edge in that they utilise the scarp-edge of the northern end of the mid-Cheshire Sandstone Ridge, overlooking the Mersey Estuary; in fact they lie only *circa* 1.8km apart although they are not intervisible with each other. Both also consist of a relatively narrow stone-revetted bank defining an area of *circa* 1.5ha although the construction technique is different to that at Warton Crag and Gardom's Edge - at both Cheshire sites the primary enclosures consist of an earthen bank behind a drystone revetment. In the case of Helsby Hill, the bank is now overlain by a later remodelling of the site's defences and so it is not known how many gaps or entrances there might originally have been; at Woodhouse Hill, the bank exhibits multiple breaks in its circuit, but it is far from certain that they are all original. Both sites, however, have been dated to the second half of the second millennium BC, and are therefore broadly contemporaneous with at least Gardom's Edge (Garner 2017b; 2017c; Pollington 2017 contrary to Jecock 2006 and Garner 2017b, 110).

The excavators of Gardom's Edge suggested two other sites as possible parallels for that site: Rough Haw in West Yorkshire and Boltby Scar in North Yorkshire (Barnatt *et al* 2017, 57). Both are superficially similar in being scarp-edge enclosures, but on closer examination dissimilar in style of rampart construction and number of entrances. Rough Haw appears to be defined by a rubble bank but as yet has been neither surveyed in detail nor excavated and at present very little more can usefully be said about it. Boltby Scar can probably be safely dismissed from consideration, however. It was largely bulldozed as an earthwork in 1961 for reasons of agricultural improvement, but investigations of the remains between 2009 and 2011 as part

of the North York Moors National Park Authority's Lime and Ice project, although still to be fully published, have shown that its method of construction (a palisade slot succeeded by dump ramparts) is very different from both Gardom's Edge and Warton Crag, whilst the indicated date (early 1st millennium BC) is also somewhat later (Powlesland 2011).

Given the current state of knowledge, it is not at all clear whether the parallels here drawn between Warton Crag and other scarp-edge enclosures across northern England are valid in terms of either date or function. What is plain, however, is that Warton Crag – despite its triple circuits – is not an enclosure constructed with defensibility as a major consideration, and for that reason should be dismissed as an Iron Age hillfort. The excavators of Gardom's Edge suggested that that site was primarily connected with livestock and acted as a central place for the gathering of local herdsman where animals could be sorted, exchanged or served, feuds settled or simply bonds between different communities renewed and celebrated. It seems implausible that sites as close together as Helsby Hill and Woodhouse Hill, if contemporary with each other as the current dating evidence suggests, could both have served a similar function. However, an explanation of Warton Crag as some kind of meeting place for local communities whose ways of life predominantly centred around livestock, seems far more credible than continuing to interpret its role as primarily one of defence.

The date of the Warton Crag monument will only be finally determined (if at all) by excavation, but on present evidence the best parallels point to it having been constructed in the second half of the 2nd millennium BC.

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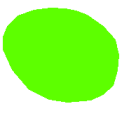
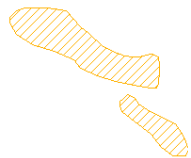
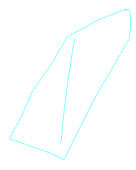
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APPENDIX 1. AERIAL MAPPING LAYERS

| Name | Content | | |
|---------------------|--|-------|---|
| LAYER | Layer name to enable symbology in GIS | - | - |
| BANK | Embanked features such as banks, mounds and spoil heaps | Red |  |
| DITCH | Cut features such as ditches and pits | Green |  |
| EXTENT_OF_FEATURE | Polygon outlining groups of features or areas of extraction or quarrying | |  |
| RIG_AND_FURROW_AREA | Polygon outlining the extent of an area of ridge and furrow ploughing | Cyan |  |
| RIG_AND_FURROW_LINE | Polyline indicating the form and direction of ridge and furrow ploughing | Cyan | |

APPENDIX 2. HISTORIC ENGLAND ARCHIVE AERIAL PHOTOGRAPHS

Verticals

RAF/106G/UK/1205 4043-4046 07-MAR-1946

RAF/106G/UK/1334 5200-5204 29-MAR-1946

RAF/106G/UK/1487 3088-3092 09-MAY-1946

RAF/106G/UK/1487 4088-4092 09-MAY-1946

RAF/541/522 3034-3038 12-MAY-1950

RAF/541/525 3034-3038 14-MAY-1950

RAF/58/884 5147-5152 25-MAY-1952

RAF/58/884 5234-5241 25-MAY-1952

RAF/540/844 5107-5111 22-AUG-1952

OS/66120 176-178 01-JUN-1966

OS/66120 204-208 01-JUN-1966

HSL/UK/67658 4676-4679 17-AUG-1967

HSL/UK/67671 4874-4877 08-SEP-1967

OS/68188 148-151 09-JUN-1968

OS/68188 164-168 09-JUN-1968

OS/68188 190-194 09-JUN-1968

OS/70313 157 27-AUG-1970

OS/70313 164-165 27-AUG-1970

MAL/71091 41-42 01-JUN-1971

MAL/74027 210-211 06-MAY-1974

MAL/82024 57 22-JUL-1982

MAL/82024 59 22-JUL-1982

OS/91073 71-75 09-MAY-1991

OS/91073 83-87 09-MAY-1991

OS/95518 25-28 12-APR-1995

OS/95685 13-14 05-AUG-1995

Obliques

CLU 3951/46 06-MAY-1988

CLU 9209/390-392 04-MAR-1978

CLU 9224/2242-2243 25-JUL-1984

CLU 2539/65-69 1984

CLU 3951/40 06-MAY-1988

CLU 3951/42 06-MAY-1988

CLU 3951/44 06-MAY-1988

CLU 3951/48 06-MAY-1988

CLU 3956/66-68 06-MAY-1988

NMR 17760/34-35 02-SEP-2002

NMR 20766_004-007 07-MAY-2008

NMR 20768_008 07-MAY-2008

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