



# Kettles Hillfort

Archaeological Geophysical Survey Report

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## Archaeological Geophysical Survey Report

Prepared on behalf of:

Forestry England

Section 42 Licence No:

AA/010657

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## Purpose of document

This document has been prepared as a survey report for an archaeological geophysical survey undertaken at The Kettles Univallate Hillfort and Enclosed Settlement, Scheduled Monument List Entry No. 1006530, in Wooler, Northumberland. The survey and subsequent report has been undertaken on behalf of the Forestry England to inform future management of the site and to gain a better understanding of the extent of the hillfort remains. The purpose of this document is to provide a comprehensive account of the geophysical survey, with specialist assessment of the geophysical results and recommendations for further investigation.

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## Project summary

OASIS ID:	digventu1-512582
DV project code and type:	KET23 – Archaeological Geophysical Survey
National Grid Reference:	NT 98450 27308
County:	Northumberland
Designation:	List Entry No. 1006530
Section 42 Licence:	Case No: SL00234430 Ref: AA/010657
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Project team:	Kimberley Teale and Jodie Hannis
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## Acknowledgements

We'd like to begin with a thank you to Lawrence Shaw at Forestry England for commissioning us to undertake the geophysical survey. Thanks are extended to Mike Collins at Historic England for granting us permission and a Section 42 Licence to undertake the survey. Additional thanks go to Andrew Wright of Forestry England for his assistance with land access permissions for the survey, and also to the landowner for granting us access for the surveys.

The survey was directed and undertaken by Kimberley Teale and Jodie Hannis.

## Non-technical summary

DigVentures was appointed by Forestry England to undertake an archaeological geophysical magnetometer survey of The Kettles Univallate Hillfort and Enclosed Settlement, List Entry No. 1006530, in Wooler, Northumberland (NGR NT 98450 27308). The survey was undertaken to inform Forestry England on management of the asset and to confirm the extents of archaeological remains in relation to the scheduled area. This report details the results of a geophysical magnetometer survey undertaken across 3.69ha of the hillfort between the 8<sup>th</sup> to the 10<sup>th</sup> of March and the 17<sup>th</sup> to the 19<sup>th</sup> of April 2023.

This report conforms with current best practice and to the guidance outlined the Management of Archaeological Research Projects in the Historic Environment (Historic England 2015), the Chartered Institute for Archaeologists (2014), and the Europae Archaeologiae Consilium (EAC) Guidelines for the Use of Geophysics in Archaeology (Schmidt et al. 2016).

The magnetometer survey was undertaken across two areas, one within the hillfort and the scheduled area, and the second across a plateau of land to the north of the hillfort. It was hoped that by surveying the extents of the fort and adjoining land that evidence for settlement or activity outside of the fort could be found.

The survey, in conjunction with a study of LiDAR visualisations of the site, identified a number of previously unknown features of the hillfort. The hillfort survives as imposing extant earthworks – a series of steep enclosure banks and triple ramparts, all visible from the ground and from aerial imagery. The additional surveys have revealed features not necessarily visible on the ground, such as possible structures at the entrance to the innermost hillfort enclosure through the triple ramparts, possible round houses within and outside of the fort, and possible post holes suggestive of further structures. The identification of archaeology within the fort proved difficult due to the presence of an igneous dyke running through the middle of the isthmus, and it is quite likely that this geological trend has masked archaeological remains from detection with magnetometry, and further investigation would be needed to continue telling the story of the hillfort interior.



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# 1 INTRODUCTION

## 1.1 Project background

- 1.1.1 DigVentures were appointed by Forestry England (hereafter “the Client”) to undertake an archaeological geophysical magnetometer survey at The Kettles Univallate Hillfort and Enclosed Settlement, Wooler, Northumberland (hereafter “the site”; [Figure 1](#)). The site is a Scheduled Monument under List Entry No. 1006530.
- 1.1.2 The survey was undertaken under permission granted by Historic England following a Section 42 application to carry out a geophysical survey at the site (Case No. SL00234430; granted on the 1<sup>st</sup> February 2023).
- 1.1.3 The survey team first mobilised on the 8<sup>th</sup> to the 9<sup>th</sup> of March, however survey was called off on the second day due to heavy snow and treacherous conditions. The survey team remobilised from the 17<sup>th</sup> to the 19<sup>th</sup> of April 2023 and successfully completed the survey.
- 1.1.4 This report details an assessment of the results of the geophysical magnetometer survey undertaken over approximately 3.69ha within and adjacent to the scheduled area of Kettles Hillfort, to obtain further information about potential archaeological remains within the hillfort itself and outside of the hillfort on an adjacent plateau. The Roman camp to the south, which is included in the scheduling, was not included in the survey. The report conforms with current best practice and to the guidance outlined in the Management of Archaeological Research Projects in the Historic Environment (Historic England 2015), the Chartered Institute for Archaeologists *standards and guidance for archaeological geophysical survey* (2014), and the Europae Archaeologiae Consilium (EAC) *Guidelines for the Use of Geophysics in Archaeology* (Schmidt et al. 2016).

## 1.2 Site location, topography and geology

- 1.2.1 The scheduled Kettles univallate hillfort and enclosed settlement (List Entry No. 1006530) is located to the south of Common Road on the south-western outskirts of the village of Wooler, Northumberland (NGR NT 98450 27308; [Figure 1](#)). The site is surrounded by agricultural and forestry land, and is accessed by numerous public footpaths including St Cuthbert’s Way pilgrimage route.
- 1.2.2 The site is open grassland, with patches of thick gorse as well as large swathes of ferns which were dead from the winter at the time of survey (see [Appendix 1 – Setting Photographs](#)). Large outcrops of bedrock were visible throughout the northern part of the site, with exposed stones visible in the built ramparts of the hillfort enclosure. Rabbit burrowing was evident across the site as well as within the external hillfort ramparts, with evidence of erosion and collapse in some areas of the site [[Appendix 1 Plate 11](#)]. Hidden burrows and thick vegetation limited full survey in some areas, but a good coverage of the hillfort was obtained [[Appendix 1 Plate 10](#)].
- 1.2.3 The site is situated on top of a plateau created by volcanic bedrock, commanding a vista stretching northwards to Scotland and southwards across Northumberland. The north of the site comprises an area set outside the hillfort with a bi-directional gradient,



sloping north-south from 170m aOD (above Ordnance Datum) to 167m aOD, and west-east from 178.8m aOD to 143m aOD. Within the hillfort enclosure, the ground is relatively level, sitting at 168m aOD in the northern section and 167m in the southern, which then slopes dramatically down to the south from the edge of the fort from a seat-like rock called 'King's Chair, to 132m aOD in the valley bottom. The contours of the site have been obtained from openly available LIDAR data from the Environment Agency to aid with the interpretation (Figure 4).

- 1.2.4 The bedrock geology of the site comprises Devonian Andesite of the Cheviot Volcanic Formation, with an inclusion at the very southern tip of the hillfort promontory comprising Silurian and Devonian Porphyry from the Cheviot Dyke Swarm; no superficial deposits are recorded however Quaternary alluvial deposits are present to the north from a nearby river and Quaternary tills and glaciofluvial deposits are recorded to the east (British Geological Survey, 2023). The soils of the site comprise freely draining acid loamy soils over rock, which are typical of acid upland pastures, dry heath and moor, bracken gorse and oak woodlands (Soilscapes, 2023).
- 1.2.5 Magnetometer survey can sometimes be affected by thermoremanent effects over some igneous rock types, such as basalts, however others such as Cornish granites seem to be unaffected (David et al. 2008). The dataset picked up numerous geological outcrops throughout the site as well as a large igneous intrusion from the Cheviot Dyke Swarm running NNE-SSW across the fort's interior, which may have masked the visibility of some archaeological remains. However, the data across the rest of the site was good and does not appear to have been affected by the underlying bedrock.

## 2 ARCHAEOLOGICAL AND HISTORICAL BACKGROUND

### 2.1 Archaeological background

- 2.1.1 This survey report studies the site of a singular hillfort and land immediately surround the fort, within which no other Historic Environment Records are present. A 2-km search around the site's boundary has been conducted through Heritage Gateway and Historic England's list, and what follows is a summary of this search to provide context to the hillfort and the surrounding landscape.
- 2.1.2 The scheduled remains of '*Kettles univallate hillfort and enclosed settlement, 261m north west and 331m south west of King's Chair*' (List Entry No. 1006530; HER number 1546) are described as the earthwork remains of an Iron Age promontory fort adapted as a Romano-British enclosed settlement.
- 2.1.3 Scheduled in 1934, the site is also known as Greenside Camp and Maiden Castle and is listed as;

*"a univallate hillfort of Iron Age date, situated on a promontory on the east slope of Kenterdale Hill and an enclosed settlement of Romano-British date, situated on the east slope of Earle Whin.*

*[The site] has steep natural slopes to the south, east and north-east with more gradual slopes in other directions. The enclosure is irregularly shaped, reflecting the local topography, and is separated*





*into two parts by triple ramparts which run perpendicular to its long north-west to south-east axis and have an entrance in their centre allowing access between the two parts. The north-west portion of the enclosure measures approximately 108m by 100m and the south-east portion is roughly 70m by 88m. The enclosure is surrounded by earthworks, which comprise a single rampart in areas where the slope is naturally steep... The complex form of the earthwork is understood to partially be the result of later Romano-British reoccupation and elaboration" (Historic England, 2022).*

- 2.1.4 The hillfort is strategically positioned on top of a volcanic outcrop and commands almost a 360 degree vista across the surrounding landscape. The fort has been described as a 'contour fort', whereby the fort exploits the natural qualities of the outcrop following the topography fairly closely, resulting in an irregular overall plan (Oswald et al., 2006). Northumberland contains the greatest concentration of hillforts in Britain and it is not surprising that Kettles lies adjacent to a number of others. Historic England lists 31 scheduled hillforts within the county alone, ranging from univallate to multivallate hillforts, camps, as well as enclosed and defended settlements.
- 2.1.5 A search conducted through Heritage Gateway revealed 366 results within a 2km radius of Kettles Hillfort, ranging from listed buildings, scheduled monuments, excavations and sites recorded in the Northumberland Historic Environment Record (HER). The results paint the picture of the hillfort being situated at the edge of a prehistoric landscape, dominated by hillforts, cairns, defended settlements, field systems and Tumuli. The monument is situated within an area of clustered archaeological sites whose remains are well preserved and forms part of a wider archaeological landscape in the northern Cheviot Hills (Historic England, 1999 3).
- 2.1.6 Approximately 760m north-west of Kettles lies the 'Iron Age defended settlement and cultivation terraces 600m north east of Brown's Law Cottage' (List Entry No. 1019139). According to the listing (Historic England, 1999 1) is it situated on a steep natural outcrop, and the Iron Age defended settlement comprises an oval enclosure defined by two banks and annexes, with evidence for two circular hut circle platforms within the settlement. Cultivation terraces are evident outside of the settlement, which are similar to other terraces found in the north Cheviots of a later prehistoric date.
- 2.1.7 570m to the west of this are located four sub-circular enclosures comprising 'Two Roman period native settlements and associated field system on Coldberry Hill' (List Entry No. 1017043). The listing (Historic England, 1999 2) describes two Roman period settlements comprising the remains of two sets of conjoined enclosures with steep outer banks and hut circles, adjoining field systems with clearance cairns and cord rig cultivation.
- 2.1.8 Approximately 1.7km to the north-west of Kettles lies Humbleton Hill, a 'Prehistoric enclosed settlement, Iron Age hillfort and medieval shielings' (List Entry No. 1016714). According to the listing (Historic England, 1999 3), the monument includes two prehistoric enclosed settlements utilising panoramic views. The inner enclosure is an Iron Age hillfort and the outer enclosure is thought to be Neolithic or Bronze Age in date, with evidence for at least 20 circular house platforms within the fort. The



prehistoric enclosure, Iron Age hillfort and medieval shielings on Humbleton Hill are well preserved and retain significant archaeological deposits.

- 2.1.9 The 'Iron Age multivallate hillfort and prehistoric trackway at Monday Cleugh' (List Entry No. 1015639) lies approximately 3km WNW of Kettles hillfort. Similarly to Kettles, it makes use of the natural geography and crags and commands extensive views to the east, west and north. The listing (Historic England, 1997) describes the hillfort as semi-circular in shape and bounded by three banks to the north and west, two banks to the south and one to the east, with outer and middle ramparts and a deep-set trackway approaching from the west measuring 138m in length.
- 2.1.10 Less than 500m to the north-west is Green Castle Camp or 'ringwork' (List Entry No. 1019926). According to the listing (Historic England, 1935) the ringwork is a D-shaped medieval monument measuring 50m by 46m, which acted as a stronghold for late Anglo-Saxon and Norman military operations and is significant to understanding fortifications from that period.
- 2.1.11 Approximately 1.6km to the north-west lies 'Hut circle 770m south east of White Gables' (List Entry No. 1017380). The listing (Historic England, 2000) describes a prehistoric hut circle with further prehistoric settlements, cairns and field systems nearby. The hut circle, located on a small 7m by 7m platform, is well preserved and is enhanced by the presence of further contemporary settlements nearby.
- 2.1.12 750m to the west of Wooler Common is a 'Prehistoric field system, cairnfield, round cairns and enclosed cremation cemetery on east slopes of Fredden Hill' (List Entry No. 1018375). The listing (Historic England, 1999 4) describes a field system, cairnfield, two burial cairns and enclosed cremation cemetery of a prehistoric date, with at least 20 field clearance cairns.
- 2.1.13 A further field system and prehistoric remains, listed as 'Prehistoric field system and unenclosed hut circle settlement on eastern slopes of Hart Heugh, 550m south west of Earlehillhead' (List Entry No. 1018441) is located 1.7m to the south-west of Kettles Hillfort. According to the listing (Historic England, 1999 5) the field system comprises two enclosures, at least five cultivation terraces, cord rig and a field bank. The cultivation terraces are important as they are one of a few types of prehistoric field system which survive, and the cord rig cultivation is of particular importance as it spans the Bronze Age to Roman period and less than 100 examples have been identified in northern England, and such remains are normally considered as nationally important.
- 2.1.14 Close to this, a 'Bronze Age round cairn on summit of Hart Heugh, 780m south west of Earlehillhead' is located (List Entry No. 1018446). The listing (Historic England, 1999 6) describes a burial cairn in reasonable condition, oval in form measuring 4m by 2m.
- 2.1.15 In 1893, Wooler Golf Club and Wooler Common Course was established. Situated on Wooler Common, it encompassed Kettles Hillfort as part of its course [Appendix 1 Plate 13 - 14]. A clubhouse was constructed on top of the 'British Camp', which was 'comfortable' and comprised several rooms for ladies and improved accommodation for gentlemen (Golf's Missing Links website). The course was extended in 1921, and reportedly closed some years after 1947, though the exact date is not clear. The remains of the clubhouse comprising concrete foundations and a tiled rectangular



chamber are still very visible within the fort [Appendix 1 Plate 8]. It is likely that further features relating to the golf course will be identified in the data following the geophysical survey.

- 2.1.16 A study of historical maps available through the National Library of Scotland map viewer (NLS, 2023) show cartographic depictions of Kettles hillfort, labelled 'Remains of Camp' from as early as 1885. The golf course and clubhouse, depicted as 'Golf House' is visible on OS Six Inch maps from 1888-1913, which also depict the fort's triple / quadruple enclosure banks to the north and three central ramparts through the central section (Figure 12). OS maps from the National Grid Maps 1940s-1970s show the clubhouse building still extant on the hillfort during 1949-1972.
- 2.1.17 After gaining scheduled designation in 1934, the hillfort and neighbouring Wooler Common were acquired by the Forestry Commission in 1960. Active forest management works are present to the west of the site.

## 2.2 LIDAR study

- 2.2.1 A Digital Terrain Model (DTM) multi-hillshade visualisation was created from freely available Environment Agency datasets, and the dataset produced gives a clear depiction of the archaeological and historical remains within and around the hillfort (Figure 3). The Anomaly IDs mentioned below are listed for reference in Appendix 2.
- 2.2.2 Within the scheduled area which encompasses the entirety of the hillfort, three steep oval stepped enclosure banks and a ditch can be seen at the northern end of the fort through which the northern entranceway runs [L1]. A potential fourth bank is visible running NW-SE along the eastern interior edge of the fort [L2] and to the east of this the ground level drops sharply down to the east in a geological crag. At least two of the stepped enclosure banks can be seen to continue around the western perimeter of the fort [L3] however along the eastern edge, the fort utilises the steep drop of the gorge.
- 2.2.3 The three ramparts bisecting the centre of the fort ENE-WSWW are very prominent in the LIDAR visualisation [L4], and the routeway is also clearly visible running through from the northern outer banks through the centre of the three ramparts [L5]. The route through the ramparts appear to be slightly skewed, as if the ramparts have been constructed in a way to prevent a clear line of sight into the inner section of the hillfort. At the northernmost of the three ramparts, a square bank is visible [L8]. This could relate to a structure or stones marking the entranceway into the innermost part of the hillfort.
- 2.2.4 In the southern part of the fort, a large oval enclosure is visible in the data which comes to an end at the double banks enclosing the fort [L6]. The route through the fort continues through this enclosure, exiting at the southern end of the hillfort through one of the enclosure banks into a small annex [L7] and then through the second enclosure bank onto the King's Chair. A rectangular depression measuring 20m by 6m is visible cutting across the west of the oval enclosure bank [L9]. Given its size and its perpendicular positioning across the bank, and that the enclosure bank is not visible within this depression, it is possible that it relates to an unrecorded archaeological trench and investigation.



- 2.2.5 In the centre of the oval enclosure, a sub-square feature is visible [L10]. Measuring 30m by 35m, the four straight banks comprising the feature relate to a Romano-British modification. The southern bank of the enclosure is very prominent and appears to continue eastward right to the edge of the steep cliff edge.
- 2.2.6 To the north-west of the oval enclosure, two oval enclosures can be seen nestled between the oval enclosure and the southernmost rampart [L11] [L12]. Measuring 10-13 m in width, they could be housing platforms or further enclosures within the innermost defended section of the hillfort.
- 2.2.7 Linear trends run across the hillfort from ENE-WSW, parallel to the inner ramparts [L13]. Set at a maximum of 5m apart, these trends could relate to rig cord cultivation which is evident at nearby Coldberry Hill, Hart Heugh, and Hambleton Hill.
- 2.2.8 The remains of the Victorian Golf Clubhouse are evident in the north-west of the fort [L14]. Two rectangular features are visible in the east of the main enclosure, one forming a raised bank [L15] and the other a depression [L16]. These are likely related to bunkers forming part of the Victorian golf course.
- 2.2.9 In the landscape to the north of the hillfort which was covered by the survey, nothing of note was identified apart from further ploughing or forestry cultivation trends. A long bank comprising earth and stone, observed during the survey, is prominent in the LIDAR to the east of the site and likely relates to a boundary of the golf course [L17].
- 2.2.10 Contour data was also extracted from the LiDAR DTM and visualised using the contour creation tool in QGIS, utilising 10m intervals between contour lines. It has been plotted next to the multi-hillshade visualisation (Figure 4). The contours detail the relatively level interior of the fort's northern enclosure, showing the steep drop in the landscape either side of the monument's enclosure banks. The ramparts and banks are very prominent, showing their steep nature and that the third rampart continues into the enclosure bank around the fort's southernmost enclosure.

### 3 PROJECT AIMS & OBJECTIVES

#### 3.1 Project aims

- 3.1.1 The purpose of the geophysical survey was to inform Forestry England on the future management of the site, to better understand the preservation and extent of archaeological remains within and outside of the hillfort enclosure, and to understand if there are any archaeological remains to the north of the hillfort, associated with the listing, that are not currently protected. Information gained from the survey would aid further understanding which could be included in an interpretation strategy for visitors.
- 3.1.2 The hillfort was incorporated into the grounds of a Victorian golf club, of which evidence for two to three structures are present within the scheduled area [Appendix 1 Plate 8, 13 & 14]. The survey will also inform how much of an impact the golf club has made to the interior of the hillfort.



3.1.3 The overarching aim of the geophysical survey is to better understand the extents, character and below ground remains relating to Kettles hillfort. As the monument has never before been investigated using geophysical survey or excavation, a full non-invasive magnetometer survey of the fort and its immediate surroundings was proposed to answer the aims proposed above.

3.1.4 The survey was undertaken following the methods stated in the Written Scheme of Investigation (Teale, 2023) which was written to obtain a Section 42 Licence granting permission to survey at the scheduled site.

## 3.2 Archaeological Research Frameworks

3.2.1 Kettles Hillfort is one of 31 scheduled hillforts within Northumberland alone and sits at the edge of a prehistoric landscape dominated by forts, defended settlements, cairns and field systems. The remains within this landscape are well preserved and often contain rare surviving examples from their period, meaning they are key to understanding the historic environment.

3.2.2 The Archaeological Research Framework for Northumberland National Park (Young et al, 2010) states that north-east England has seen very little archaeological investigation of hillforts, leading to the 'Discovering our Hillfort Heritage' project. The project revealed that many hillforts are complex, multi-period monuments having been modified over centuries. The Framework also suggests that following the recent surveys of Iron Age hillforts in the park, some may overlie earlier enclosures and future excavation could uncover evidence for early Neolithic enclosures.

3.2.3 One of the key research themes of the North-East Regional Research Framework (Petts & Gerrard, 2006), R3, expresses the need to explore the relationship between Roman forts in the North-East and their Iron Age predecessors, as it is poorly understood. Such research has the potential to improve interpretation of the function of forts and patterns of integration between native communities in the early stages of Roman rule in the region.

3.2.4 The geophysical survey at Kettles Hillfort, including the background research and LIDAR analysis contained within this report, has the potential to uncover evidence and deliver insights towards answering some of these research themes.

## 4 METHODOLOGY

### 4.1 Introduction

4.1.1 An archaeological geophysical magnetometer survey was undertaken across 3.69ha of land within and adjacent to Kettles Hillfort. The survey was undertaken by an accredited surveyor and an archaeological assistant and took four days to complete. Thick patches of dead bracken, gorse bushes and rabbit holes presented some obstruction to survey (Figure 2) especially at the outer edges of the fort where the topography turned into a sheer drop.



## 4.2 Magnetometer survey methodology

4.2.1 Magnetometer survey is generally considered as the quickest and most widely used geophysical survey technique for the detection of buried archaeological remains. It is efficient for detecting features that have been thermoremanently magnetised, such as kilns, as well as ditches and pits that have been backfilled, due to the relative presence or absence of enhanced magnetic material due to human activity.

4.2.2 The magnetometer survey was undertaken using a Bartington Grad601-2 magnetic gradiometer. The Bartington Grad601-2 is a dual sensor instrument, incorporating two Grad-01-1000 sensors set 1m apart. The site was surveyed east-west in the southern half and north-south in the northern half in a grid-like pattern within 30m-by-30m grid squares, with readings taken every 0.25m along traverses set 1m apart with a zig-zag patterning. The gradiometer was balanced on a magnetically quiet point within the site before survey commenced and again before the afternoon's survey. If significant drift occurred, the machine was re-balanced.

4.2.3 The survey grids were set out across the site following a pre-determined 30m grid array using a Trimble R10 dGPS utilizing VRS now corrections with an accuracy of <0.10m. The survey grid and intermediary survey guidelines were demarcated using bamboo canes as temporary markers which were removed following completion of the survey. Landmarks and reference points were surveyed with the GPS by way of control points.

## 4.3 Data processing

4.3.1 The magnetometer data was downloaded using Bartington's Grad601 download software and then imported into Geoplot v4.0 (Geoscan Research) for data processing. For the raw data plot, no processes were applied, and the data was exported at a scale of -5nT to 20nT due to the strong underlying igneous bedrock (Figure 5). An XY trace plot of the raw data was also exported to aid in identifying anomalies for the interpretation (Figure 6).

4.3.2 For the minimally processed data plot (Figure 7), the data was de-spiked, and a zero mean traverse was applied followed by de-staggering of the data to bring anomalies into alignment. The data was exported at a scale of -3nT to 8nT.

4.3.3 For the processed and filtered data plot (Figure 8), a low pass filter was applied, followed by an interpolation along the X and then the Y axis. The data was also exported at a scale of -3nT to 8nT.

4.3.4 The gradiometer data was combined with the geolocation points and georeferenced in QGIS and is presented in this report as greyscale data plots and XY trace plots. Interpretations of the data have also been created in QGIS as line and polygon data and these interpretive figures are also presented in this report (Figures 9-11). In places where the underlying geology has precluded or slightly masked the geophysical survey results, the results from the LiDAR data have been used to support and enhance the interpretation and associated figures.



#### 4.4 Health and safety

- 4.4.1 All work was carried out following the creation of a Risk Assessment and Method Statement and in accordance with its company Health and Safety Policy, to standards defined in The Health and Safety at Work etc. Act 1974, and The Management of Health and Safety Regulations 1992, and in accordance with the SCAUM (Standing Conference of Archaeological Unit Managers) health and safety manual Health and Safety in Field Archaeology (1996), and DigVentures Health and Safety Policy.

## 5 GEOPHYSICAL SURVEY RESULTS AND DISCUSSION

### 5.1 Data presentation

- 5.1.1 The gradiometer data have been presented as a greyscale plot of the raw data (Figure 5), an XY trace plot of the raw data (Figure 6) a greyscale plot of the minimally processed data (Figure 7), and a greyscale plot of the processed and filtered data (Figure 8). An interpretation of the data has been created (Figures 9 - 11) and key anomalies have been given a unique 'anomaly ID' in the illustrations and report text for the purpose of the discussion. The Anomaly IDs are listed for reference in Appendix 2.

### 5.2 Results – Magnetometer survey (Figures 5 – 11)

- 5.2.1 A number of features comprising the remains of Kettles Hillfort are visible in the dataset, though the most prominent anomaly relates to the magnetically enhanced geological dyke running north-south through the isthmus of the fort. It is likely that the strength of this igneous anomaly has masked some of the hillfort's archaeological remains from being visible in the dataset. By comparison of the data to the LiDAR visualisation in conjunction with the XY trace plot of the raw data, it has been possible to discern what is likely a geological response and what is related to archaeological remains. A discussion of these remains follows.
- 5.2.2 To the north of the northern entrance to the hillfort, two areas of enhanced magnetism are visible [1] [2]. These correspond with a mound in the landscape which drops off steeply to the north and north-east. Its orientation and positioning corresponds with the fort's enclosure banks, and could be a bank designed to shield the entrance to the fort from view from an approach from the north. The easternmost area of enhanced magnetism [2] also corresponded with stones protruding from the surface, suggesting the mound is likely of a compacted earth and stone construction. At the eastern end of this, a circular positive anomaly is visible [3]. Measuring 3m in diameter, this could relate to a small structure on this outermost bank.
- 5.2.3 The outer double banks of the earthwork are visible in the dataset as mixed positive curvilinear anomalies with corresponding negative magnetic halos, as well as enhanced magnetic curvilinear anomalies. The northernmost bank was very steep along its outer profile, which curves around towards the north-west and back down towards the south-west around the left hand side of the fort, and towards the south-east around the right hand side [4]. The second enclosure bank runs parallel to the first bank [5]. These anomalies give the impression of a mixed construction, like the outer



mound. Stones were also observed in this location, exposed in the eroded surface of the banks (Plate 11).

- 5.2.4 Both enclosure banks break at the same northerly point to provide what was likely the main entrance into the fort [6]. The data shows broad negative anomalies in this area which are either a result of compacted ground, as the entrance and path is still in use by the general public, or from a continuation of the dyke anomaly.
- 5.2.5 A large sub-circular positive anomaly is visible on one side of the entranceway at the end of the northernmost bank [7]. Measuring approximately 7m in width, it could relate to a pit or large stone at the entrance into the fort, or perhaps the edge of the enclosure bank was reinforced with stone material.
- 5.2.6 The second enclosure bank [5] can be seen to continue along the western edge of the fort and the dataset as a strong positive anomaly with a corresponding strong negative anomaly. The strength of the trend is likely due to the amount of exposed stone present on the surface of the bank due to erosion.
- 5.2.7 Towards the southern reaches of this bank, the trend is intercepted by the dyke anomaly and the inner triple ramparts of the hillfort. The ramparts appear as linear strips of very subtle enhanced magnetism running ENE-WSW across the hillfort's interior [8]. The data processing step of 'zero mean traverse' has dampened the visibility of the ramparts in the processed dataset, and it is recommended to study the figures detailing the raw data and LiDAR visualisations whilst reading this paragraph. A gap through all three ramparts indicates the entranceway through them and into the inner enclosure of the hillfort. Many exposed stones were visible along the ramparts during the survey, as well as the presence of large boulders in the ditches between the ramparts. The northern two rampart banks appear slightly staggered in alignment. The entranceway through them also appears to be slightly staggered between each pair of ramparts so that there is no clear line of sight through into the inner enclosure, which appears similar in design and intention to the outer enclosure banks.
- 5.2.8 Outside the northernmost rampart is a cluster of anomalies which are suggestive of a structure at the entranceway. The anomalies are mixed magnetic signals; negative to the left [9] and positive surrounded by a large negative halo to the right [10] both containing small circular anomalies of the opposite polarity. These features block the entranceway though the ramparts and could have formed some kind of protective barrier to the inner enclosure. Immediately to the east, a small circular positive anomaly is visible [11]. Measuring 3m in diameter, it is similar in appearance and size to feature [3] at the outer entranceway and could relate to a structure or enclosure with a similar function.
- 5.2.9 Enhanced magnetic readings can be seen between and around the ramparts [12] which likely relate to stone from the ramparts eroding out into the surrounding ditches and ground surface.
- 5.2.10 Inside the southern enclosure of the fort, the eastern curvilinear bank of the fort's inner sub-oval enclosure is just visible in the dataset as a weak positive curvilinear trend [13]. It is possible the makeup of this bank is not as substantial as the ramparts and enclosures and contains less stone. The western curvilinear of the enclosure and the





possible archaeological trench, both observed in the LIDAR data, are not visible due to the magnetic strength of the underlying dyke dominating the dataset.

- 5.2.11 The square Romano-British modification within the sub-oval enclosure is similarly just visible in the dataset [14] having also been affected by the underlying dyke anomaly. Its northern boundary is barely visible in the dataset.
- 5.2.12 The outer enclosure bank is seen to return at the south-western and southern edge of the hillfort [5] though the southern entranceway is unclear due to the underlying geology. It is however apparent on the LIDAR dataset. The outer enclosure bank around the annex is also visible as a mixed positive curvilinear anomaly with negative halo [15]. Within the annex, a sub-circular arrangement of small positive anomalies is visible which could relate to a small structure with an arrangement of post holes [16].
- 5.2.13 To the south of the annex, a sub-circular trend [17] and a pit-like anomaly are visible [18] out on the 'King's Seat', though this part of the fort was sloping and the anomalies could instead relate to displaced material from the rampart's enclosure banks.
- 5.2.14 Within the interior sub-oval-enclosure, a number of sub-rectangular positive trends [19] [20] and pit-like anomalies [21] could be archaeological in origin, given their location within the fort and their encouraging appearance on the XY trace plot, however it is not clear what they could represent.
- 5.2.15 Inside the main fort enclosure, adjacent to the entranceway, a cluster of small circular trends have been identified [22] [23] [24]. All measuring approximately 3m in width, it is possible they could represent the inner ditches of small round houses occupying the outer enclosure of the hillfort. A cluster of pit-like anomalies are visible next to them [25] as well as a couple of tentative linear trends which could represent small enclosure ditches [26]. The trends are magnetically weak, and are interrupted by destruction caused by the construction of the Victorian clubhouse [27].
- 5.2.16 The highly magnetic remains of the Victorian clubhouse, comprising concrete piles and a tiled chamber, are prominent in the dataset [27]. The two bunkers relating to the golf course are also visible in the east of the fort as small areas of magnetic disturbance [28] [29].
- 5.2.17 Outside the hillfort on the plateau of land to the north, the dataset is magnetically quieter and has not been intruded by the dyke swarm. There are some geological outcrops in the northern half of the site, some of which were exposed at the surface. A number of anomalies have been identified adjacent to the fort which could be archaeological in nature.
- 5.2.18 To the north of the outer enclosure banks, small sub-oval anomalies in the dataset could relate to material from the banks having eroded and fallen into the ditch surrounding the fort [30] [31].
- 5.2.19 A sub-circular trend measuring 3m in diameter [32] adjacent to a linear trend [33] could relate to evidence of settlement on the plateau, such as an internal roundhouse ditch and a trackway, but the trends are magnetically weak and the suggestion is tentative.



- 5.2.20 Sub-circular positive anomalies in the north-east of the dataset could be archaeological in origin, such as the outer walls of enclosures, given their location on a small geological plateau [34] [35].
- 5.2.21 A bridleway, visible on 1888 OS mapping and now used as a public footpath, is also visible in the dataset [36] suggesting the presence of either made ground or compacted earth.

## 6 CONCLUSIONS

- 6.1.1 The remains of Kettles Hillfort survive as extant earthworks which are visible on the ground as well as in aerial and LiDAR imagery. The LiDAR data is also suggestive of the presence of below-ground remains which survive as more subtle earthworks not necessarily visible from the ground surface. Study of the LiDAR data combined with the results of the magnetometer survey has revealed previously unknown features within the hillfort and on a plateau of land to the north of the fort.
- 6.1.2 The discoveries within the fort are contemporary with the Iron Age remains – revealing anomalies which are suggestive of possible structures located at the exterior and interior entranceways, possible circular ditches relating to the remains of roundhouses, and areas of stoney rubble from the gradual decline of the internal ramparts and exterior banks. Further features within the inner sub-oval enclosure could date to the Roman period, given their location around the Romano-British modification to the hillfort.
- 6.1.3 Outside of the fort there is evidence to suggest that archaeological remains extend further than previously thought, as possible roundhouses and enclosures are visible to the north-east of the scheduled area.
- 6.1.4 The visibility of further archaeological remains within and outside of the hillfort is, however, hampered by the presence of an igneous intrusion running through the centre of the isthmus, as well as destruction from the former Victorian clubhouse. It is highly likely that further archaeological remains are present within the land enclosed by the hillfort's banks, but magnetometry can not identify them due to the strong magnetic interference of the aforementioned features.
- 6.1.5 The purpose of the survey was to inform Forestry England on the future management of the site, to better understand the preservation and extent of archaeological remains within and outside of the hillfort enclosure, and to understand if there are any archaeological remains to the north of the hillfort, associated with the listing, that are not currently protected. The survey has successfully clarified the extent and preservation of archaeological remains within and outside of the hillfort enclosure where possible, given the effects of the underlying geology and Victorian remains. The data has shown that potential archaeological remains are present outside of the scheduled area, which could be extended to incorporate these tentative features. The survey has also successfully shown how much of an impact the golf club has made to the interior of the fort, with the remains of the clubhouse as well as two bunkers being visible in both the LiDAR and magnetometer data.



- 6.1.6 In terms of the archaeological research frameworks, it is not thought that the data has given us any evidence for the Hillfort being located over earlier Neolithic enclosures, and that anything is present that differs to the Iron Age and Romano-British remains we can see. It is clear that the fort has been subjected to a Romano-British modification, and it is possible that the ramparts or inner sub-oval enclosure could also have been modified and strengthened in line with the construction of the Roman enclosure, but only intrusive investigations could clarify the extents of any modifications that were made and to aid in our understanding of the function of forts and patterns of integration between native communities in the early stages of Roman rule in the region.

## 7 RECOMMENDATIONS

- 7.1.1 There is significant erosion from animal burrows and weathering along the outer enclosure banks of the fort, causing exposure of the makeup of the ramparts. This is causing some degradation of the remains of the fort which would benefit from a structured conservation plan.
- 7.1.2 Due to the strong underlying geology, it is suggested that further geophysical survey be conducted within the hillfort's interior to ascertain the presence of roundhouses and settlement activity which has potentially been masked from detection by magnetometry. Earth resistance survey would help to understand the interior of the fort better as it should not be affected by the underlying geology.
- 7.1.3 It might also be prevalent to undertake small test-pitting excavations over some of the proposed archaeological remains, particularly those within the inner hillfort enclosure and around the northern entranceway, to confirm the presence of possible structures at the entrance to the ramparts and confirm if the suspected Romano-British modification is indeed Romano-British. By conducting intrusive investigations, it would enable archaeologists to gain dating or palaeoenvironmental data which would help to better understand the monument and the archaeological features within and adjacent to it.
- 7.1.4 During the geophysical survey, our surveyors spoke to members of the public and it became apparent almost all local visitors had no idea the Kettles was a hillfort, or a scheduled ancient monument. Almost all visitors knew it had been utilised as a Victorian golf course and presumed the earthworks were a part of the course. It would be very beneficial - for local residents as well as visitors to the area - to erect an interpretation board explaining the fort in the hope that it may be treated with more respect and appreciation which would help aid its conservation.

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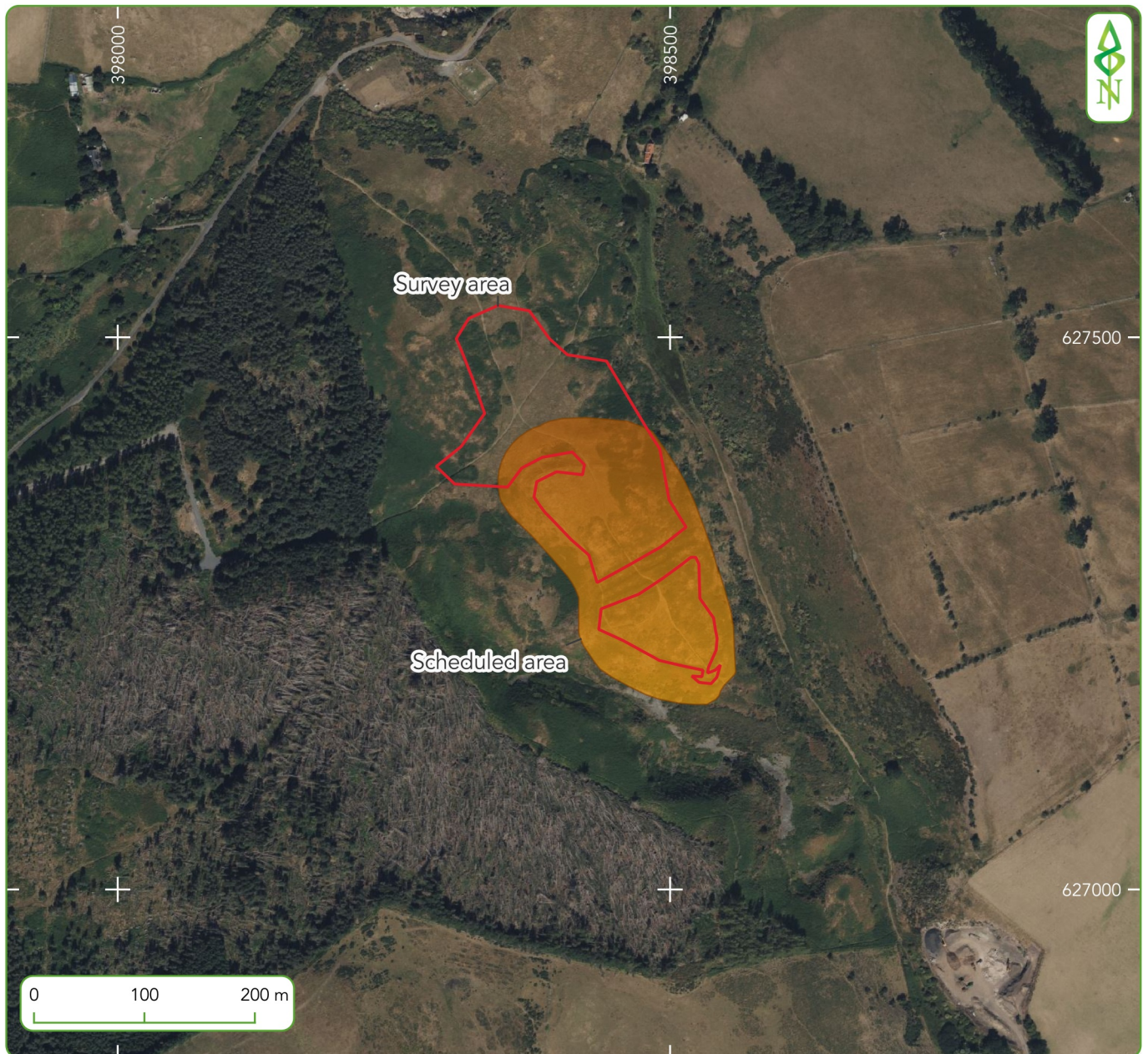
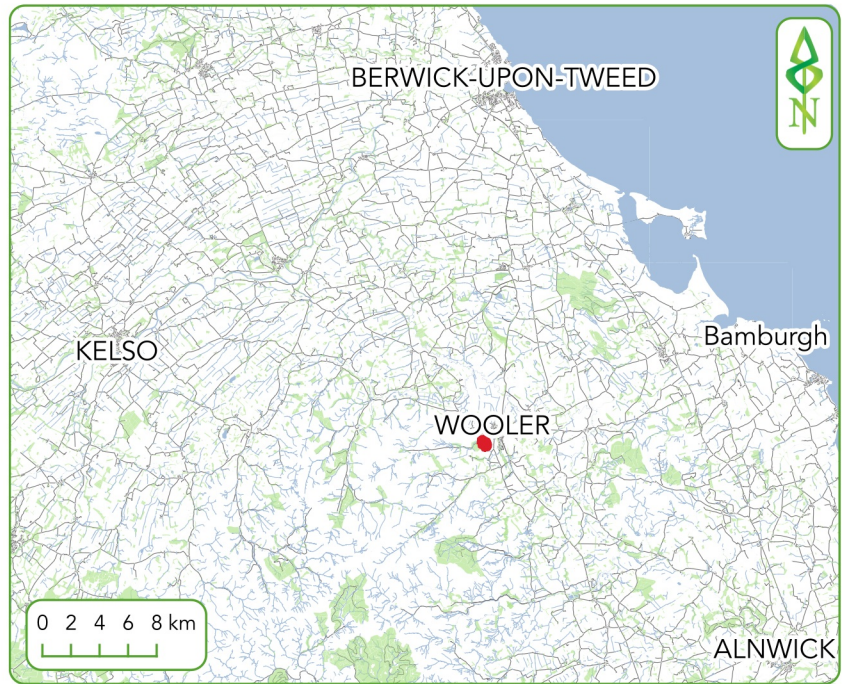


Figure 1. Site location

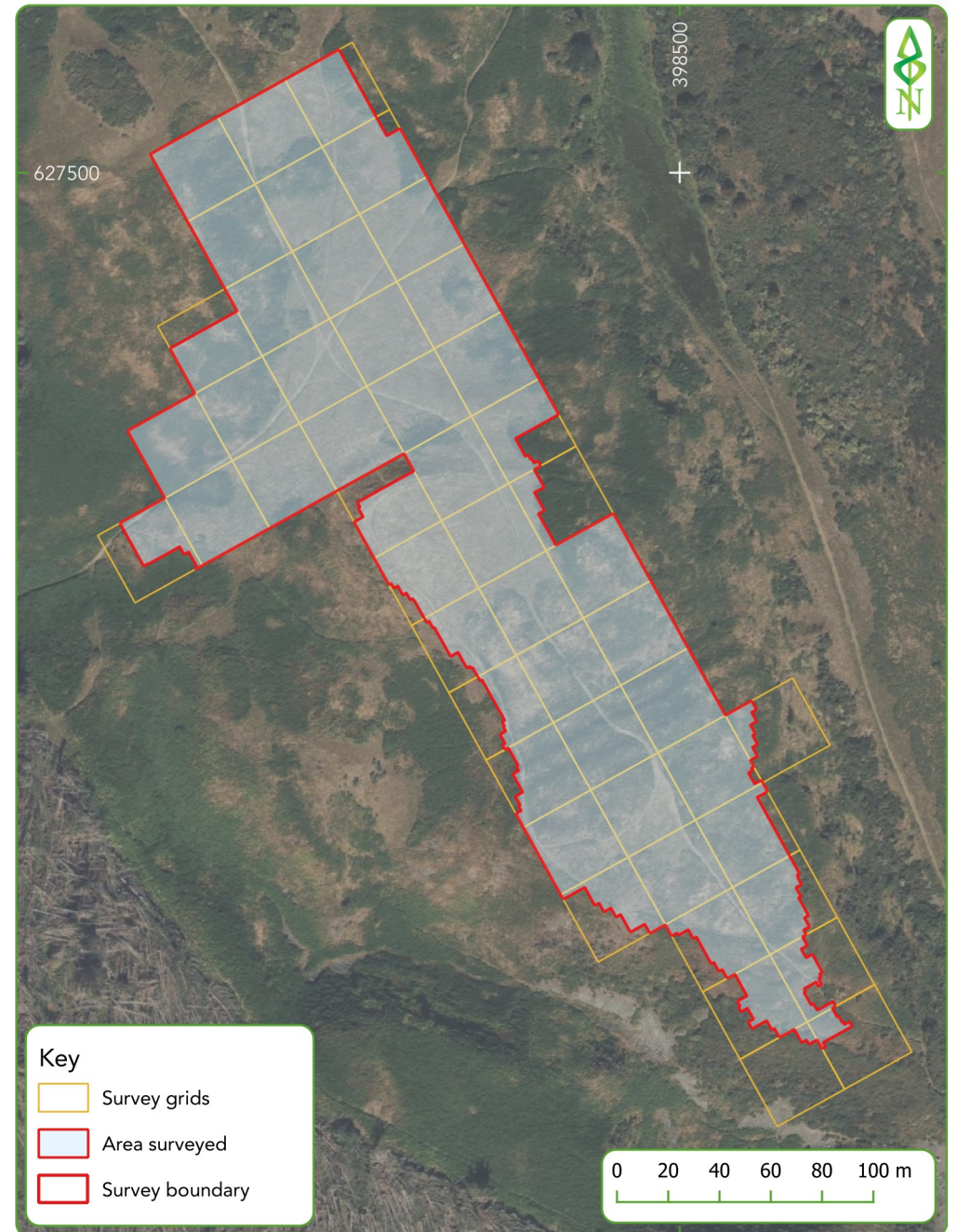


Figure 2. Location of geophysical survey

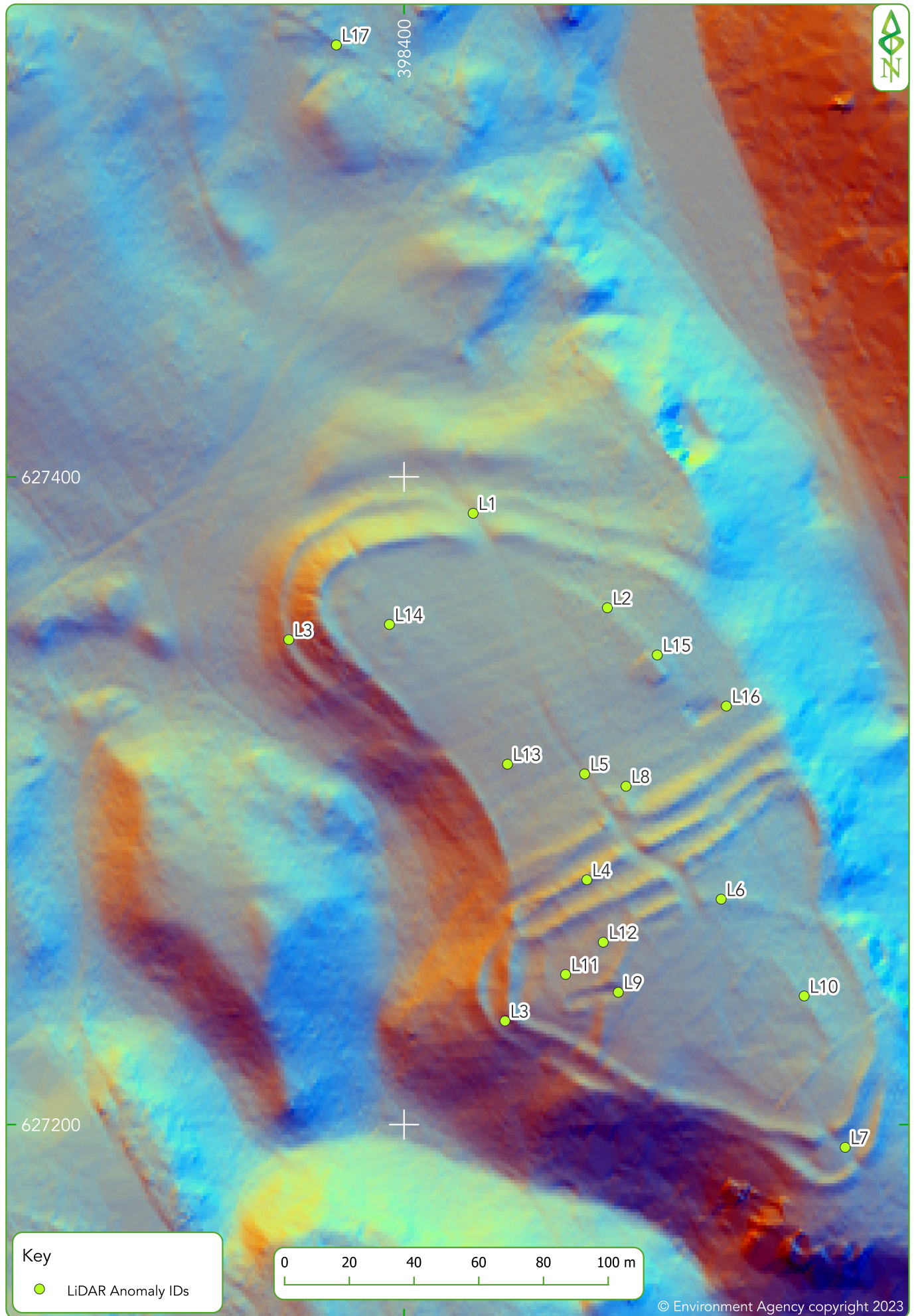


Figure 3. LiDAR 1m DTM multi-hillshade visualisation



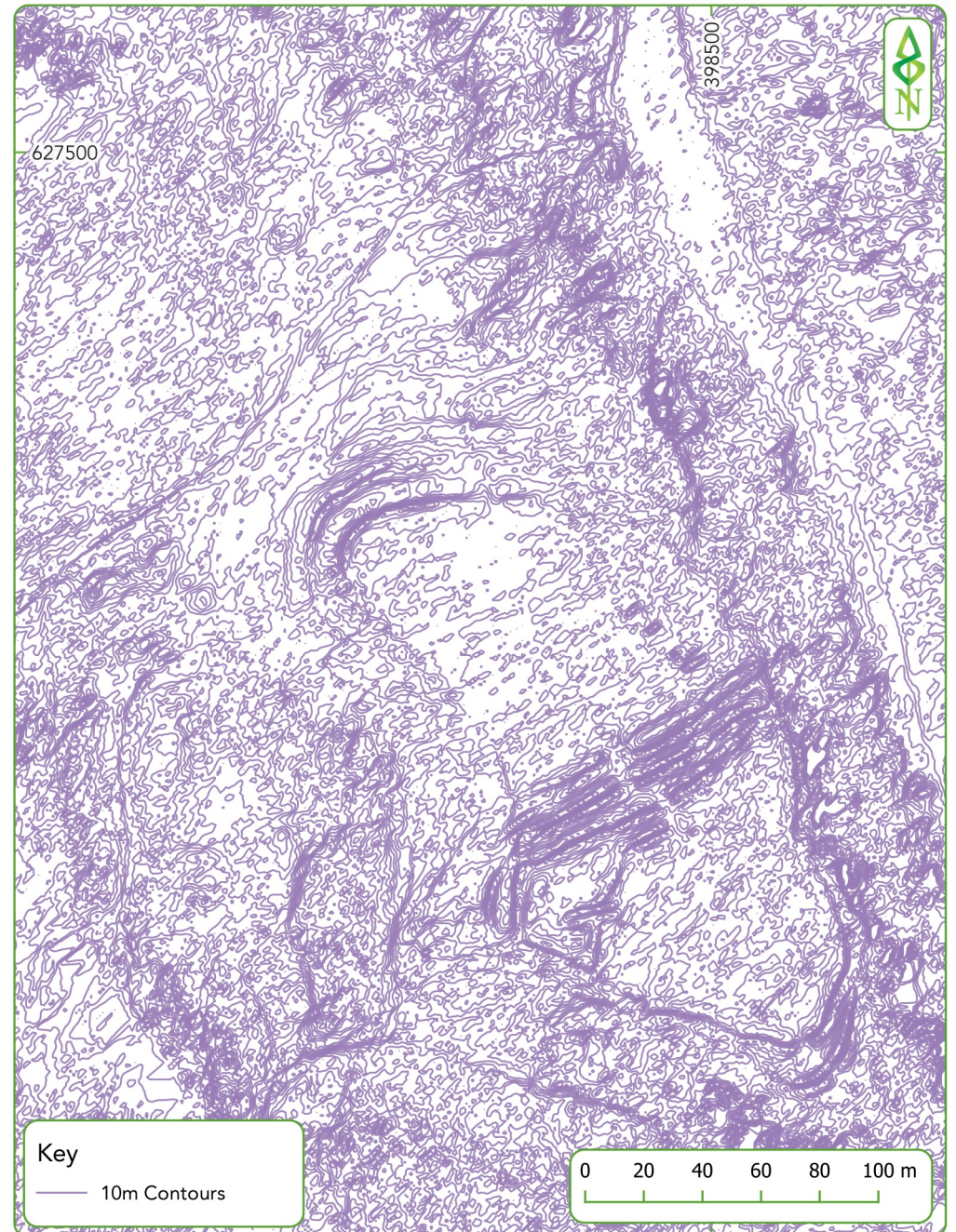
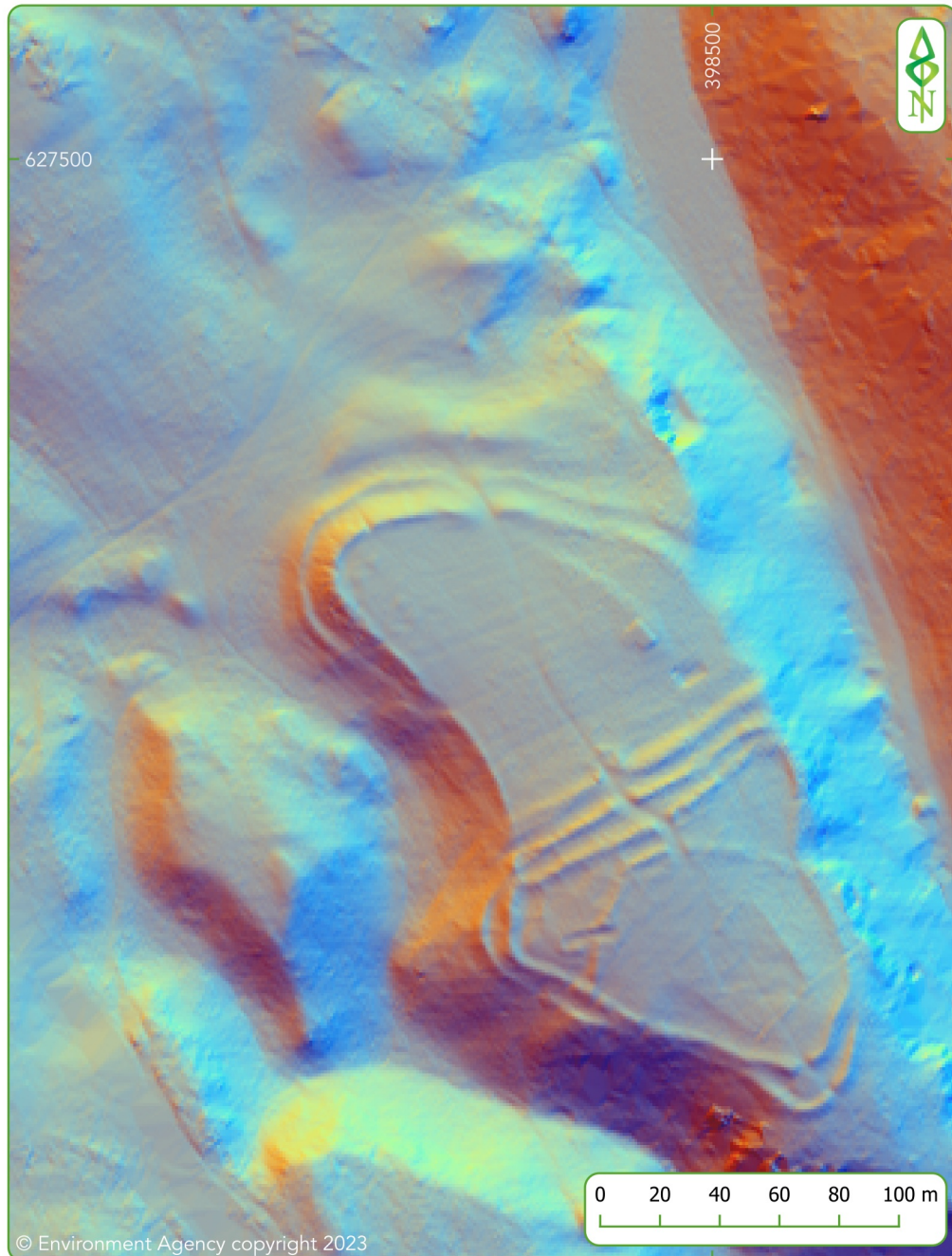


Figure 4. LiDAR 1m DTM multi-hillshade visualisation and 10m contour data

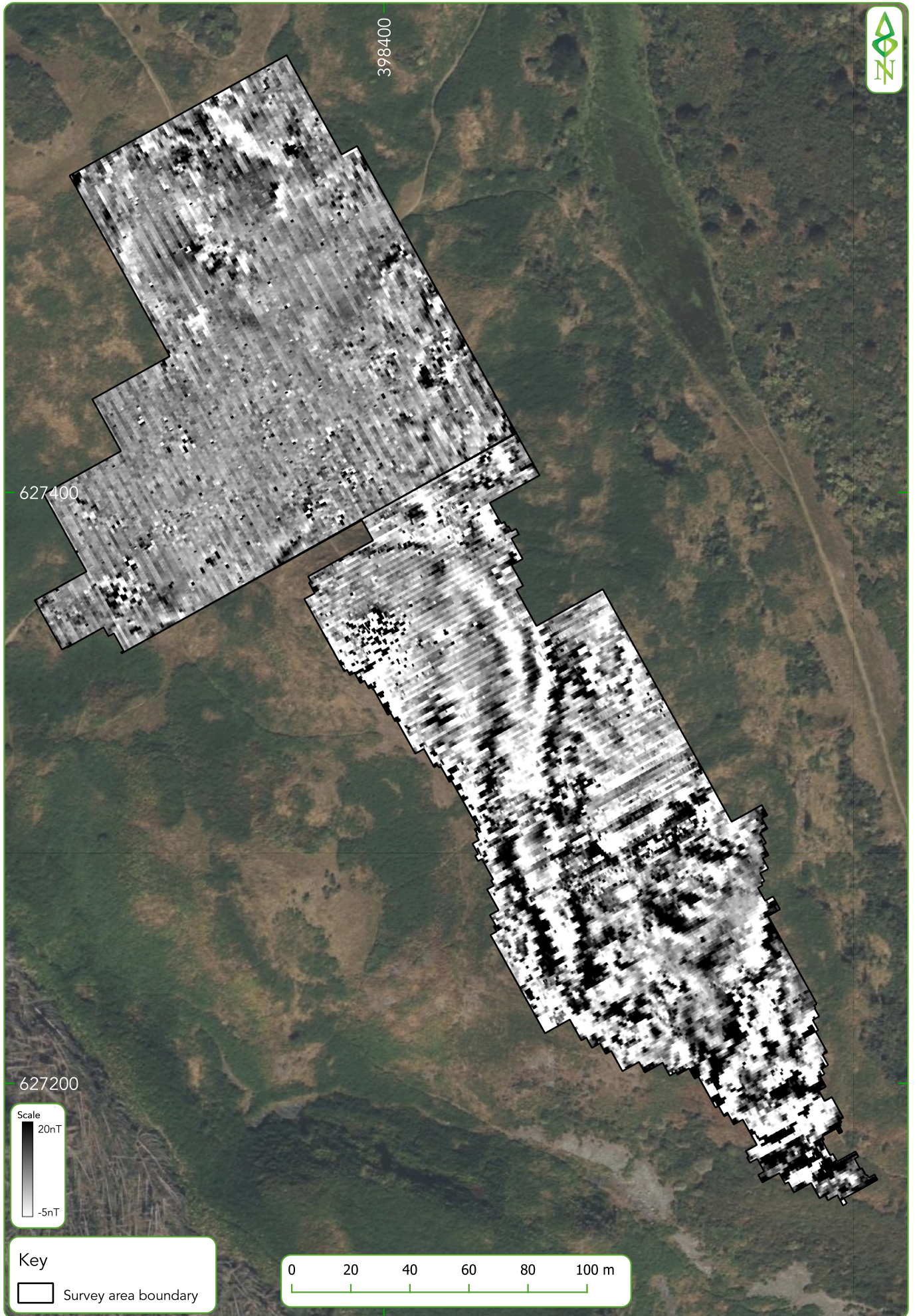


Figure 5. Raw magnetometer survey results - greyscale plot

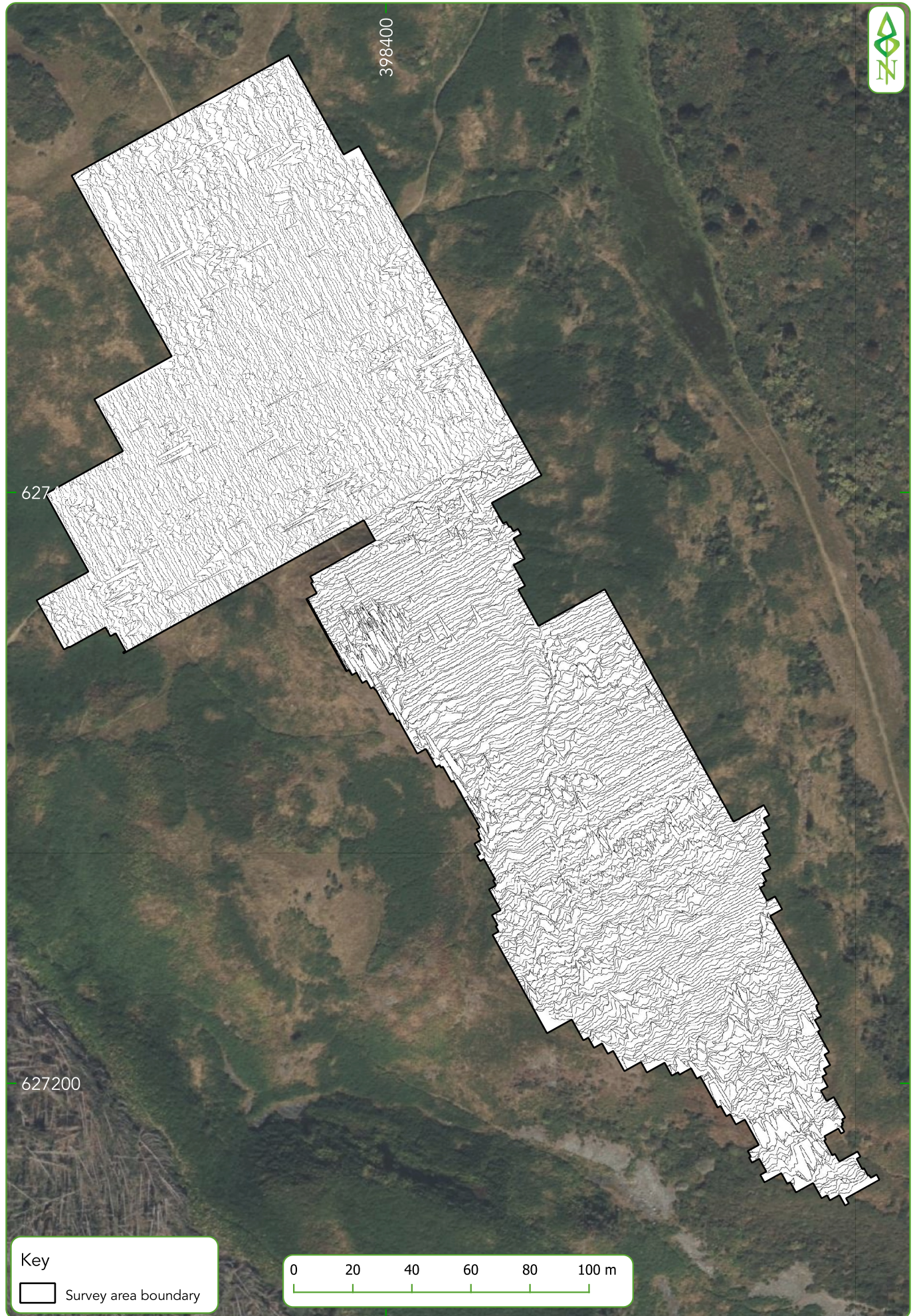


Figure 6. Raw magnetometer survey results - XY trace plot

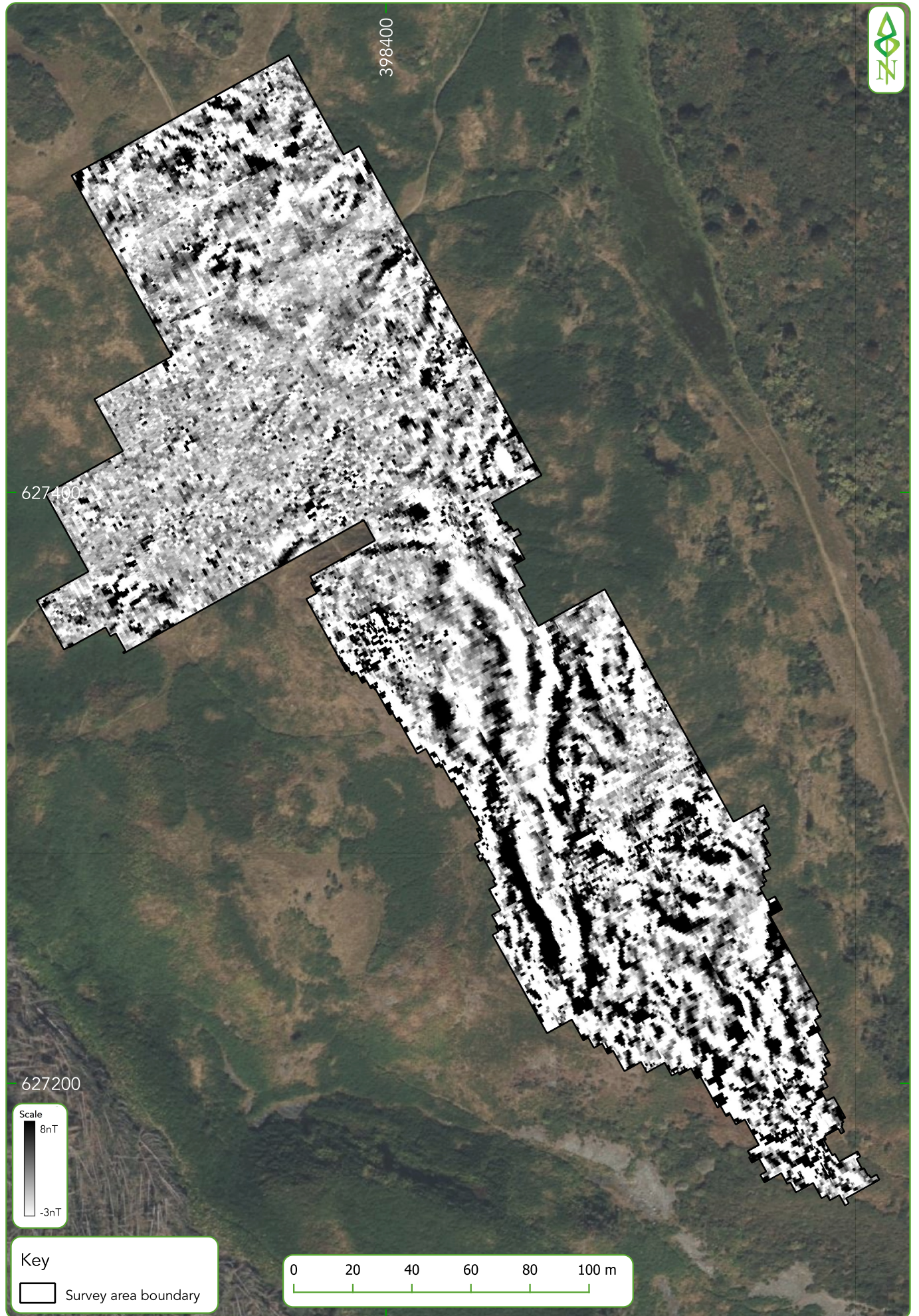


Figure 7. Minimally processed magnetometer survey results - greyscale plot

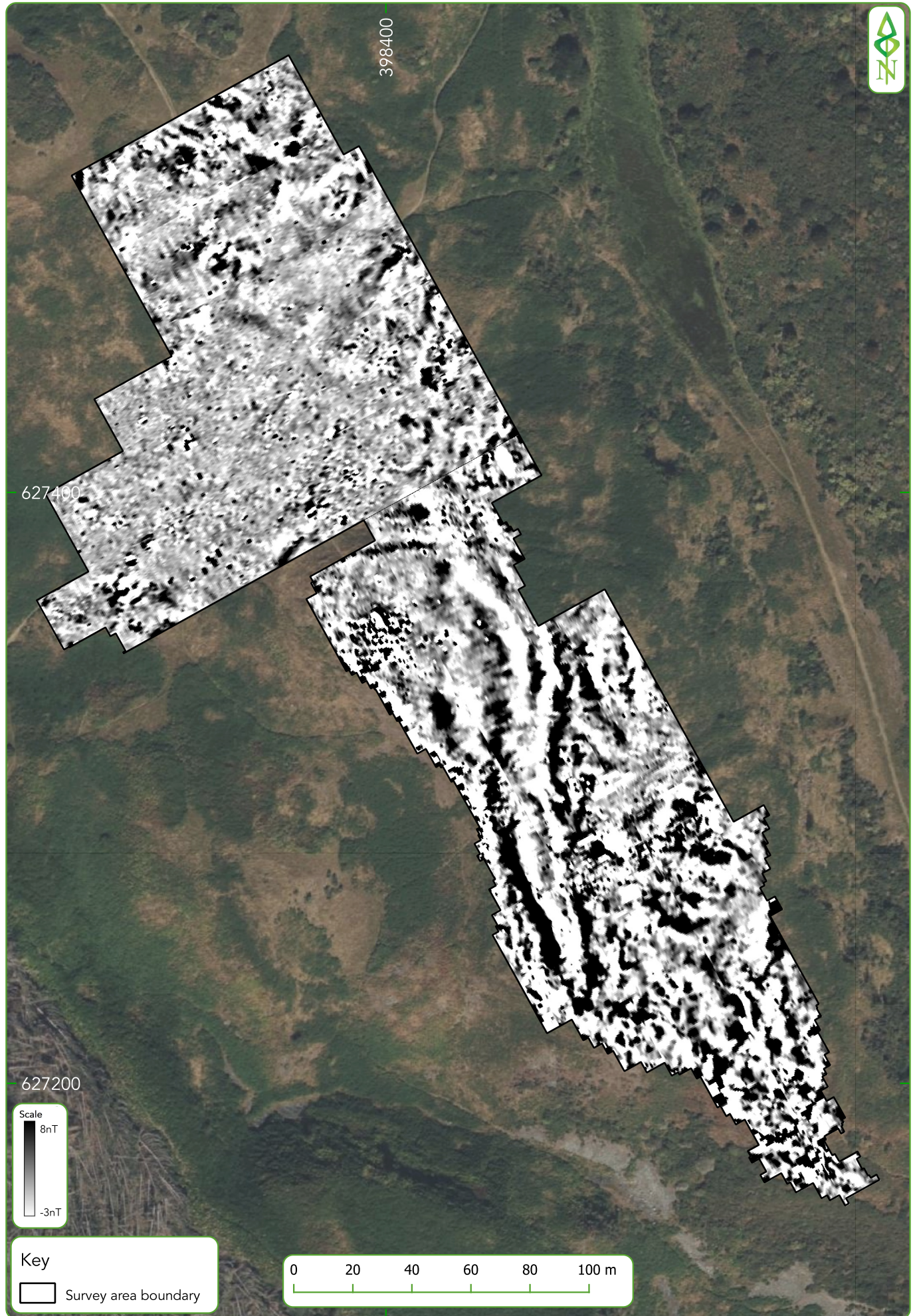


Figure 8. Processed magnetometer survey results - greyscale plot

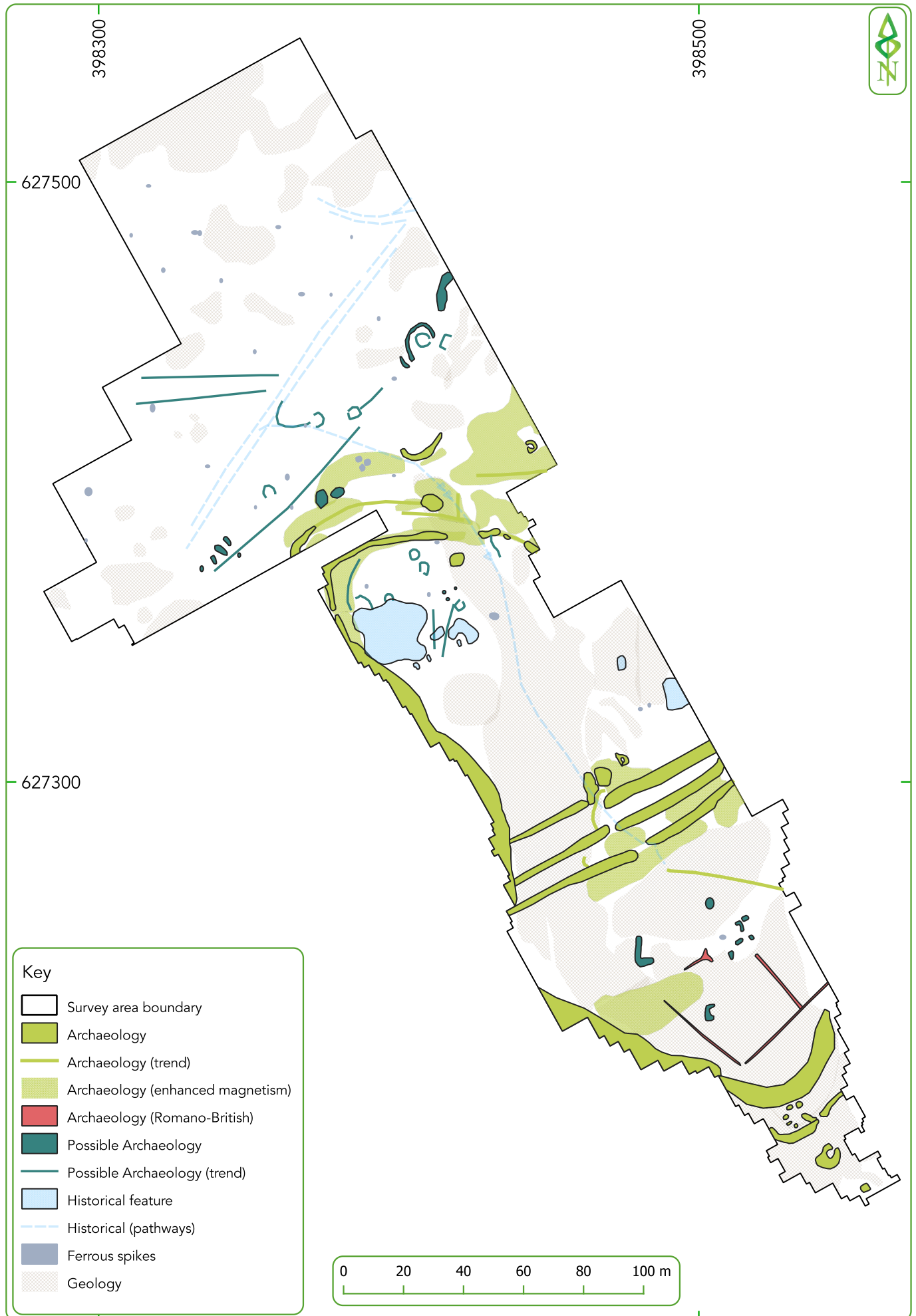


Figure 9. Interpretation of the survey data - overall plot

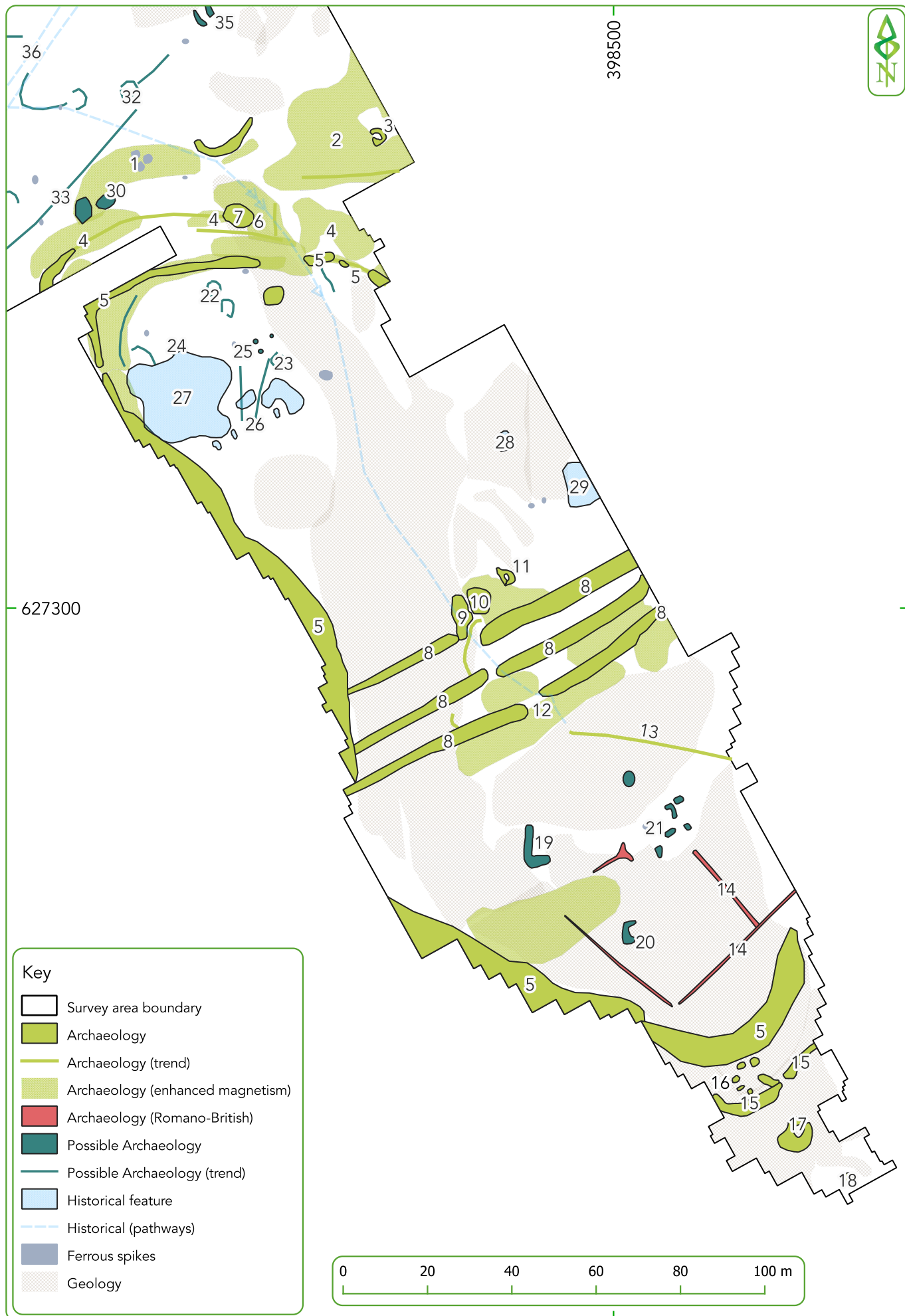


Figure 10. Interpretation of the survey data - southern half of the fort

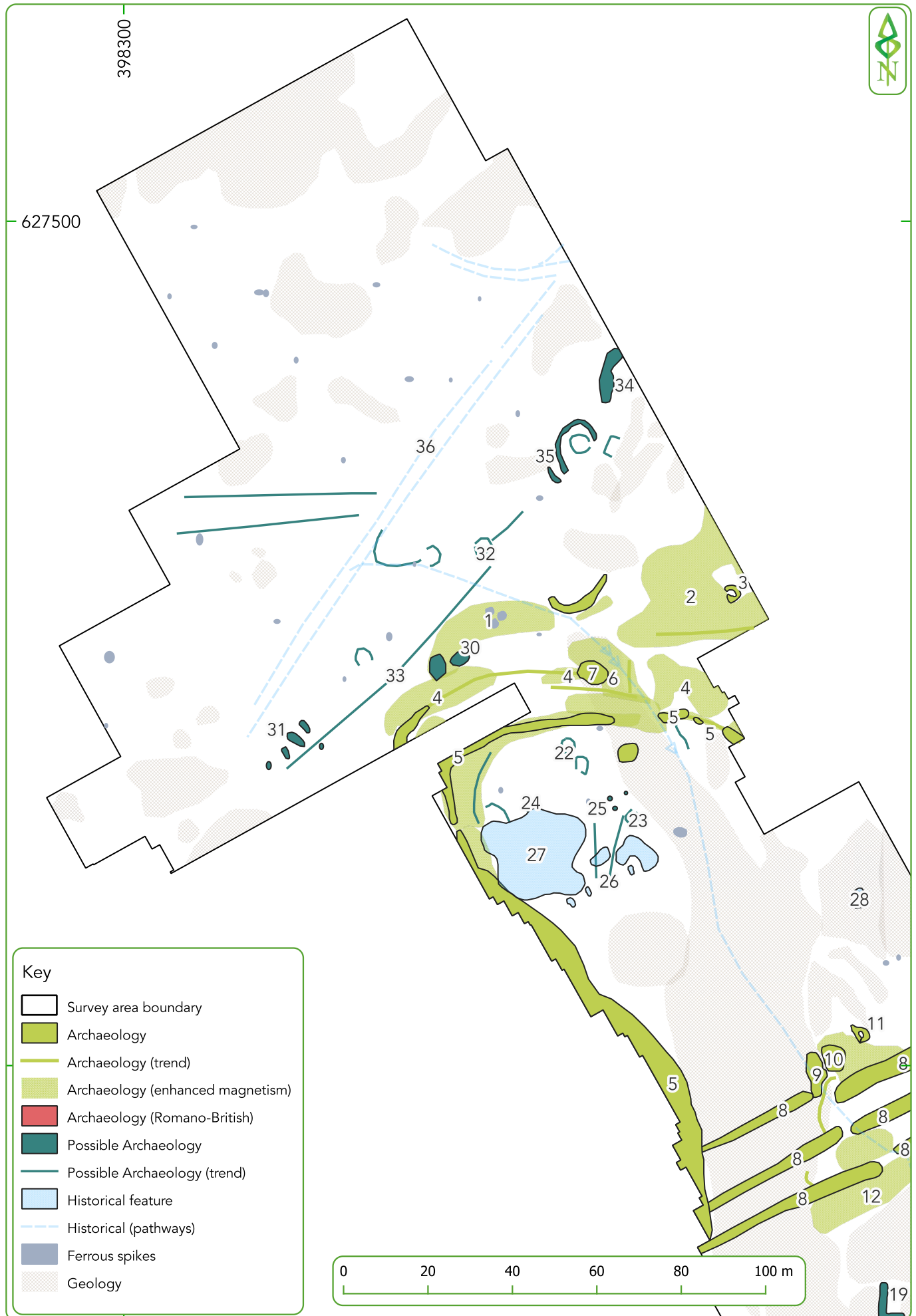


Figure 11. Interpretation of the survey data - northern half of the fort



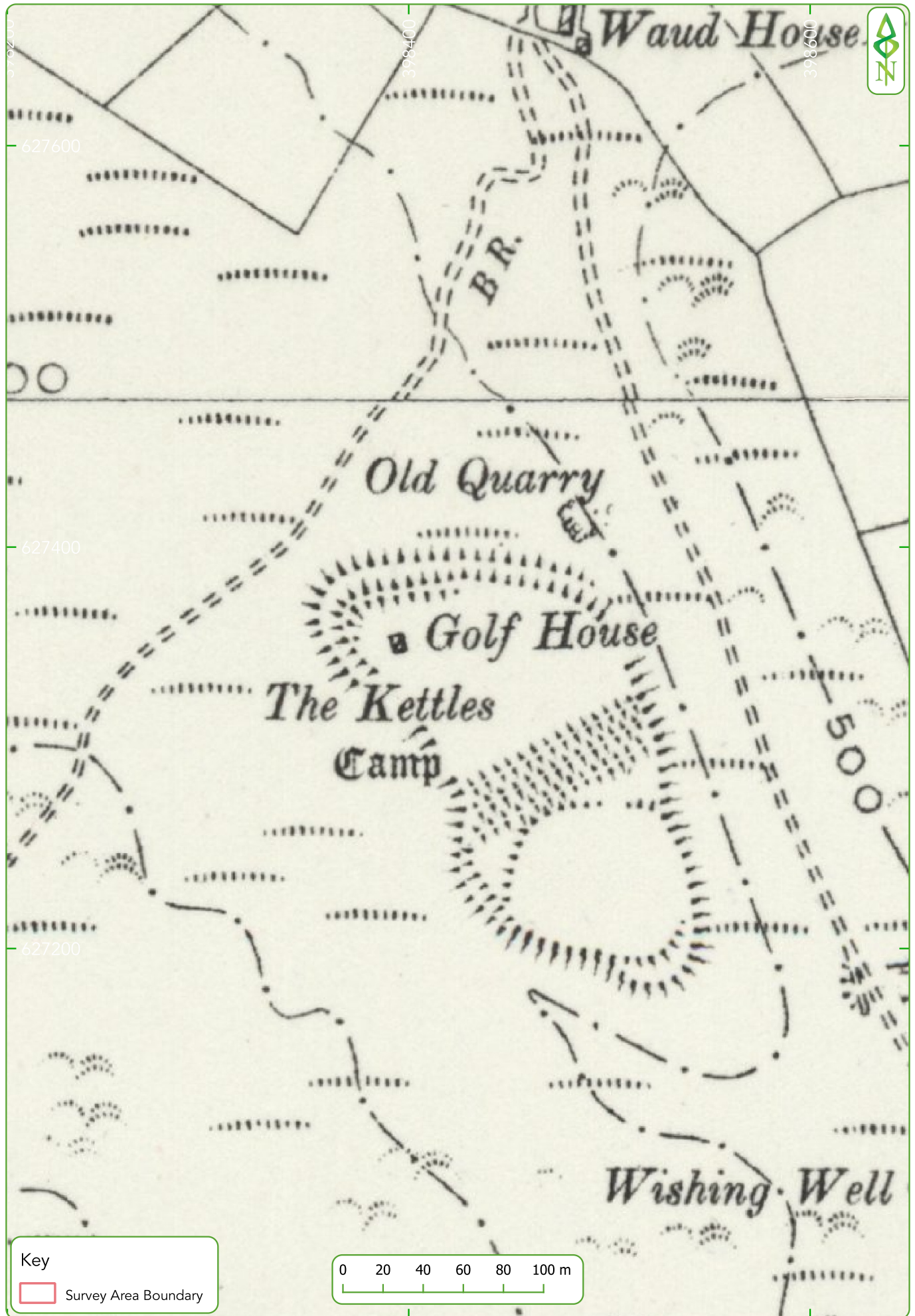


Figure 12. Kettles Hillfort on OS mapping 1888-1913

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## Appendix 1. Site Photographs



Plate 1: The approach to Kettles Hillfort from the north along public footpath, looking S



Plate 2: the vista from the 'King's Chair' at the southern end of the hillfort, looking S



Plate 3: The interior of the northern end of the fort, looking south towards the internal ramparts



Plate 4: The interior of the northern end of the fort, looking south towards the ramparts



Plate 5: the interior of the southern end of the fort, with overgrown vegetation, looking S



Plate 6: The interior of the fort, looking north towards the outer banks



Plate 7: the steep outer enclosure banks at the north of the fort with the entranceway to the left hand side, looking S



Plate 8: The concrete remains of the Victorian clubhouse, looking north



Plate 9: The steep outer banks of the hillfort and the northern entranceway, looking southwest



Plate 10: Thick un-surveyable patches of dead bracken, looking NNW



Plate 11: An area of erosion on the north-western outer banks of the hillfort, showing the exposed stones forming the makeup of the banks



Plate 12: A profile of Kettles Hillfort from the north, looking across the pasture to the north of it, and detailing its northern entranceway and steep outer banks and ditches



Plate 13: the Victorian Golf House / Clubhouse situated on the top of Kettles Hillfort, looking south. Image taken from Golf's Missing Links website.

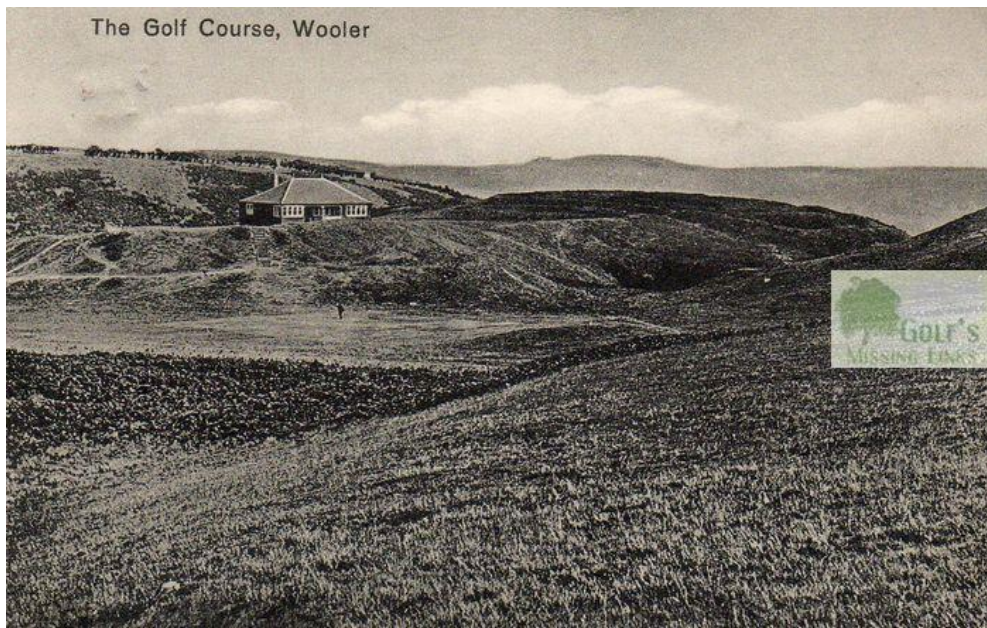


Plate 14: the Victorian Golf House / Clubhouse situated on the top of Kettles Hillfort, looking south-east. Image taken from Golf's Missing Links website.



## Appendix 2. Table of anomalies

### LIDAR anomalies

Anomaly ID	Description
L1	Triple enclosure banks
L2	Possible fourth enclosure bank / rampart
L3	Enclosure banks
L4	Triple interior ramparts
L5	Routeway through the fort
L6	Large interior oval enclosure bank
L7	Southern annex
L8	Square bank – structure?
L9	Possible archaeological trench
L10	Romano-British square enclosure
L11	Small oval enclosure
L12	Small oval enclosure
L13	Possible cord rig cultivation / ridge and furrow cultivation
L14	Victorian Clubhouse building remains
L15	Raised rectangular platform (Victorian golf course?)
L16	Sunken rectangular platform (Victorian golf course bunker?)
L17	Linear bank – possible boundary wall

### Magnetometer survey anomalies

Anomaly ID	Description
1	Archaeology - area of enhanced magnetism – enclosure bank
2	Archaeology - area of enhanced magnetism – enclosure bank
3	Archaeology – possible structure / enclosure
4	Archaeology – outermost enclosure bank
5	Archaeology – second enclosure bank
6	Archaeology – entrance through the enclosure banks
7	Archaeology – pit / stone at entrance
8	Archaeology – triple ramparts
9	Archaeology – structure at entrance to ramparts
10	Archaeology – structure at entrance to ramparts



11	Archaeology – possible structure / enclosure
12	Archaeology – enhanced magnetism around the ramparts
13	Archaeology – sub-oval inner enclosure
14	Archaeology – Romano-British modification
15	Archaeology – enclosure bank
16	Archaeology – possible post holes in the annex
17	Archaeology – sub-circular trend
18	Archaeology – pit-like anomaly
19	Possible archaeology – sub-rectangular trends
20	Possible archaeology – sub-rectangular trends
21	Possible archaeology – pit-like anomalies
22	Possible archaeology – round houses
23	Possible archaeology – round houses
24	Possible archaeology – round houses
25	Possible archaeology – cluster of pit-like anomalies
26	Possible archaeology – linear trends
27	Victorian Clubhouse remains
28	Victorian golf course - bunker
29	Victorian golf course - bunker
30	Possible archaeology – fallen stones from the enclosure banks
31	Possible archaeology – fallen stones from the enclosure banks
32	Possible archaeology – round house
33	Possible archaeology – linear trend
34	Possible archaeology – possible enclosures / structures
35	Possible archaeology – possible enclosures / structures
36	Historic bridleway