

ARCHAEOLOGICAL
SERVICES
DURHAM UNIVERSITY

on behalf of
AECOM

Scotland England Green Link 1 (SEGL 1)
Co Durham

geophysical survey

report 5623
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1. Summary

The project

- 1.1 This report presents the results of a geophysical survey conducted in advance of the proposed Scotland England Green Link 1 (SEGL 1) electricity transmission project. The works comprised approximately 55.5ha of magnetometer survey.
- 1.2 The works were commissioned by AECOM and conducted by Archaeological Services Durham University.

Results

- 1.3 Surveys were carried out at 38 locations. Features with archaeological potential were identified in 15 of those surveys.
- 1.4 The majority of potential archaeological features were occasional soil-filled features, typically parts of probable former ditches and a few possible pits.
- 1.5 Potentially more significant remains were detected at three locations: areas 9.3-9.4, 47.1 and 52.
- 1.6 A series of probable ditches in areas 9.3 and 9.4 could represent an early field system of small fields or enclosures and possibly associated features.
- 1.7 A concentration of ditches in area 47.1 almost certainly represents archaeological trackways and enclosures. The features occupy an area of higher ground in the northern part of the parcel. The ditches typically define rectilinear areas, though some curvilinear features are also present. There appears to be more than one phase of activity represented. The majority of the anomalies are of a strength that would typically be consistent with soil-filled features, however, parts of some of the linear features are strong enough to possibly represent fired materials such as clay brick/tile or accumulations of burnt materials within the ditches. This complex of features may represent a former farmstead, or perhaps part of a more significant settlement. Whilst the date is not known, the features and layout could be consistent with late prehistoric/Romano-British activity.
- 1.8 A probable ring-ditch and other soil-filled features were detected in area 52, on the next high ground south of 47.1. It is possible that the ring-ditch and its internal features could represent the remains of a roundhouse.
- 1.9 In addition to the features mentioned above, traces of probable former ridge and furrow cultivation were recorded in many areas, as well as many former field boundaries, former tracks, the courses of two former railways and an infilled quarry.
- 1.10 The precise nature, function, date, state of preservation and significance of the potential archaeological features presented in this report may only be determined by intrusive investigation.
- 1.11 The presence of green waste in several areas may have hindered the detection and identification of some weak or small anomalies of potential archaeological interest.

2. Project background

Introduction and location (Figure 1)

- 2.1 AECOM, acting on behalf of National Grid Electricity Transmission, commissioned Archaeological Services Durham University to undertake geophysical survey within the proposed English Onshore Scheme boundary (the Scheme), which forms part of the Scotland England Green Link 1 (SEGL 1) electricity transmission project.
- 2.2 The Scheme boundary (the Site) is within County Durham, extending for approximately 10km inland across agricultural fields from the coastline near Seaham to a proposed converter station at Hawthorn Pit (NGR north end, by landfall: NZ 42175 51011; south end NZ 39511 45611).
- 2.3 The survey area comprised a 60m-wide corridor (40m installation corridor and 10m either side to accommodate any minor deviation of the DC cable route), three proposed construction compound locations, and the proposed substation and converter station locations. All permitted and practicable areas within the Site were surveyed. 38 surveys were undertaken within the Scheme boundary; the total area surveyed was approximately 55.52ha. Section 4 of this report provides more information on the survey areas.
- 2.4 It was not possible to conduct survey in four fields due to vegetation cover (in Parcels 6, 53, & 69; though Parcel 69 also contains made-ground) and in one area where the landowner/farmer did not grant permission (Parcel 72).

Development proposal

- 2.5 The development proposal is for a DC cable route, together with an associated converter station, AC cable route, substation and temporary construction compounds.

Objectives

- 2.6 The principal objectives of the geophysical survey were:
- To investigate the archaeological potential of the Site;
 - To assess the presence / absence of potential archaeological anomalies;
 - To determine the level of risk that the archaeological resource would present to the Scheme;
 - To inform the emerging design; and
 - To inform the scope of further evaluation.
- 2.7 The regional research framework *Shared Visions: The North-East Regional Research Framework for the Historic Environment* (Petts & Gerrard 2006) contains an agenda for archaeological research in the region, which is incorporated into regional planning policy implementation. In this instance, the scheme of works was designed to address the following research priorities: Late Bronze Age and Iron Age lli. Settlement, liii. Landscapes, liv. The later prehistoric coastal zone; Roman Rii. Roads and communication, Riii. The Roman military presence, Riv. Native and civilian life; Early Medieval EMi. Landscape, EMii. Settlement; Later medieval MDi: Settlement, MDii. Landscape; Post-medieval PMii. Industrialisation, PMviii. Industrial intensification 1790-1830; 20th century MOvi. Military and defence.

Methods statement

- 2.8 The surveys have been undertaken in accordance with a WSI prepared by AECOM and a Method Statement prepared by Archaeological Services Durham University, both approved by Durham County Council Archaeology Section, and in accordance with national standards and guidance (see para. 5.1 below).

Dates

- 2.9 Fieldwork was undertaken between 28th September and 4th November 2021. This report was prepared for November 2021.

Personnel

- 2.10 Fieldwork was conducted by Cyrus Edgcombe, Duncan Hale, Richie Villis and Mark Woolston-Houshold. Geophysical data processing and GIS were undertaken by Duncan Hale and Richie Villis. This report was prepared by Duncan Hale and Richie Villis, with CAD illustrations by Dr Helen Drinkall. The project manager was Duncan Hale.

Archive/OASIS

- 2.11 The site code is SEG21, for Scotland England Green Link 2021. The geophysical survey archive will be deposited with the Archaeology Data Service (ADS) on completion of the project.
- 2.12 Archaeological Services Durham University is registered with the Online Access to the Index of archaeological investigations project (OASIS). An OASIS form has been completed and the report will be uploaded with permission of the client. The OASIS ID number for this project is archaeol3-502763.

Acknowledgements

- 2.13 Archaeological Services Durham University is grateful for the assistance of AECOM and National Grid personnel and the cooperation of landowners and tenants in facilitating this scheme of works.

3. Historical and archaeological background

- 3.1 The historical and archaeological background of the Site has been set out in detail in a cultural heritage baseline report (AECOM 2021), a summary of which is presented below. A study area of 500m for the identification of non-designated heritage assets was defined from the proposed cable route corridor and proposed converter and substation sites.

Palaeolithic to Mesolithic (1,000,000 BC to 4,000 BC)

- 3.2 The study area is crossed by several streams and burns, which follow a meandering west-east route down to the coast. Watercourses were a focal point during the prehistoric period, providing a sustainable source of water and food. Early prehistoric flint scatters have been recorded along the coasts of Durham and Tyne and Wear and Mesolithic sites have been recorded in the vicinity of the woodland and watercourse at Ryhope Dene. The presence of these scatters, and other finds along the coastline, indicates that Mesolithic groups were utilising the limestone uplands in the Ryhope area.

3.3 The fields at landfall (land parcel 3) fall within a programme of archaeological fieldwalking carried out by Archaeological Services Durham University in 1998. Fieldwalking was undertaken systematically within these fields and the density of material recovered, per hectare, recorded. The flints recovered were Mesolithic and later, but the amount of material recovered, fewer than nine items per hectare, fell below the critical density for the identification of flint scatter sites. The results of the Durham survey did however confirm that flint artefacts, predominantly of Mesolithic date, were present along the Durham coastline. The majority of the flint was of local origin and the coastline was probably an important and easily accessible source of material.

Neolithic to Bronze Age (4,000 BC to 700 BC)

3.4 Neolithic and Early Bronze Age activity is mostly represented in the archaeological record by flint tools and funerary monuments. A flint scatter comprising an arrowhead, chips and cores has been recorded in the fields on both sides of Ryhope Dene, and a Neolithic or Bronze Age stone axe was recovered near to Carr House Farm in Murton. A group of Bronze Age barrows is located within the Scheme boundary within land parcel 68. These comprise the denuded remains of a round barrow, which contained a cremation burial and a flint knife, located approximately 270m north-west of the existing Hawthorn Pit substation, with another barrow approximately 100m to its north-west and another approximately 80m to its east. There is also considerable evidence for Bronze Age activity along the coastal margins, with at least 20 food vessels and cinerary urn burials recorded between Sunderland and Seaham.

3.5 The topography, geology and soils of the Site and study area would have been attractive to prehistoric groups. Pollen samples from within the study area indicate that areas of woodland were cleared across the study area to accommodate the settlement of arable communities. Despite the lack of significant archaeological evidence, the landfall area and coastal margins in particular are likely to have been an important place of activity and occupation during the early prehistoric periods.

Iron Age to Roman (700 BC to AD 410)

3.6 Fieldwork surveys at High Haswell, located beyond the study area, recorded an Iron Age settlement comprising enclosure ditches, a cobbled surface and several pits. Palaeoenvironmental samples from the site produced evidence of cereal processing which indicates the community were farming some part of the land around the settlement. An Iron Age settlement at Pig Hill is located approximately 700m south-west of the study area. The polygonal double-ditched enclosure is located on the summit and southern slope of Pig Hill. Hilltop enclosures are relatively rare and the settlement at Pig Hill is a scheduled monument. Archaeological investigations during the construction of a gas pipeline identified further extensive settlement remains, which extended eastwards from the scheduled hilltop towards the lower slopes adjacent to Coldwell Burn. The site had been occupied for many years and comprised ditched enclosures, roundhouses and rectangular structures.

3.7 There are not many Iron Age sites present within the study area. However, settlements have been identified to the north and south of the study area, at South Shields and at Catcote in Hartlepool and across the Tees lowlands. It is likely therefore that Iron Age sites would have been present in the study area.

- 3.8 Military occupation of the area by the Roman Army did not occur until the campaigns of Agricola in AD 78-79. The landscape probably saw little change during the Roman occupation, with the most notable impacts being the construction of roads, such as Dere Street and Cades Road, which are located beyond the study area, and forts, the nearest being the small forts at Chester-Le-Street (Concangis), which was located more than 10km to the west of the study area, and Arbeia fort and supply base, located approximately 15km north in South Shields. Due to the presence of a chain of late-Roman signal stations along the North Yorkshire coast, it has been suggested there is a possibility that these stations continued along the coast, with suggested locations on promontories at Hartlepool, Seaham and South Shields, with a fort at Sunderland. However, this is as yet unconfirmed by the archaeological record.
- 3.9 The Roman occupation may have influenced settlement patterns in parts of the north-east region, but it is likely that existing Iron Age settlements continued, relatively unchanged, throughout this period. There are no major settlement centres in the study area, but the number of find spots of Roman date in the vicinity of Seaham, which include a burial, several coins, a quern stone and imported Samian pottery, suggests some form of small settlement was present in the area, and a possible Roman road is recorded on Murton Moor in land parcel 68, just outside the Scheme boundary. Further evidence of Roman activity within the study area is suggested by late Roman pottery identified to the north of Ryhope Dene and findspots of Roman coins.
- 3.10 Archaeological sites beyond the study area, such as at Arbeia and in Hartlepool approximately 20km south, demonstrate that Romano-British communities had established extensive trade networks throughout the region and along the east coast of the country.

Early-medieval (AD 410 to 1066)

- 3.11 Early medieval evidence in the study area derives largely from place-name evidence, but also from the archaeological record. The church of St Mary in Seaham has origins in the early medieval period. The site of the early medieval settlement and road, which is thought to be adjacent to the church, was investigated in 2013 by Archaeological Services Durham University alongside Northern Archaeological Associates. The road and settlement were not identified, but the extent of the early medieval cemetery was recorded. St Andrew's church in Dalton-le-Dale also has origins in the early medieval period. The church was built in the 13th century but fragments of a stone cross, dating to the 8th or 9th century, attest to an earlier date of origin.

Medieval (1066 to 1547)

- 3.12 The first documented references to settlements within the study area include an early medieval reference to Ryhope around 930 AD when King Athelstan gave South Wearmouth and its appendages, which included "duas Reofhoppas" (Ryhope), to the see of Durham. The counties of Northumberland and Durham, north of the Tees River, were not included in the Domesday Survey of 1086. A survey of some of Northumberland and most of Durham, which documented a land's worth and its annual return, was commissioned by Hugh de Pudsey in 1183, and became known as the Boldon Book. The Book's records provide a record of settlement patterns and village sizes during the medieval period and demonstrate that early medieval

feudalism was enduring and well-established. Ryhope and other settlements in the study area, including Burdon and Warden Law, are mentioned in the Boldon Book.

- 3.13 From the 11th century northern England was dominated by wars with Scotland. From the 14th to the 16th centuries small-scale raids were also common and resulted in the construction of castles, pele towers and bastles, including the fortified Pele Tower at Dalden, and the fortification of towns such as Hartlepool, Durham and Newcastle. Documentary evidence also records that large tracts of the countryside were devastated by the Scottish raids which, coupled with plague and famine, resulted in a decrease in population and tenure. The vicar of Dalton-le-Dale, in a letter to the Prior in 1337, describes in some detail the poor state and decrease in population in Dalton, Hesledon and Easington. This reduction in the area's population may contribute to the very small quantities of medieval pottery recovered during fieldwalking investigations in the fields adjacent to the coastline.
- 3.14 However, even though there is documentary evidence for population decrease and settlement contraction during and after the 14th century, small settlements and individual farmsteads remained and the agricultural tradition of the area endured. The medieval landscape was likely to be a mixture of woodland, with swathes cleared for settlement and farming. Arable farming was likely to be the dominant lifestyle and whilst the soils were not as fertile as those in some parts of the region, the lowlands of the Tees Valley for example, aerial photography has identified the remains of ridge and furrow cultivation within the Site and study area to the north of Seaham (within land parcels 9 and 12).
- 3.15 The majority of known medieval activity is located within these existing settlement areas and the fields surrounding them. Traces of an earlier settlement, possibly of medieval origin, have been recorded at Cold Hesledon, to the east of Murton, and several churches in the study area have origins in the medieval period.

Post-medieval (1547 to 1900)

- 3.16 Relatively recent agricultural heritage can be identified from the mid-19th century, and later, historic map evidence which illustrates the sites of former and extant structures; including barns, farmhouses and windmills. The industrial heritage of the north-east contributes to its local identity and remnants of non-designated industrial heritage assets may still be extant within the landscape. Former industrial assets within the Scheme boundary include Dobson's Branch of South Hetton Railway, which connected South Hetton Colliery to the mainline of the North Eastern Railway, and features associated with the former colliery (within land parcels 69, 72, 75 and 80). In addition, historic map evidence also illustrates the sites of former heritage assets including quarries, limekilns and the sites of signal posts and buildings associated with the Sunderland and Hartlepool branch of the North Eastern Railway.

Modern (1901 to present)

- 3.17 Within the Scheme boundary (within land parcel 6), linear earthworks, aligned broadly east-west, represent the remains of Second World War aircraft obstructions. Heritage assets dating to this period within the study area include earthworks associated with the site of a Starfish bombing decoy, located on the Durham coast, and two pillboxes located at the western and eastern ends of Seaham Dene.

4. Survey areas: landuse, topography and geology

4.1 At the time of survey the Site predominantly comprised fields of arable and pasture. Additional landuse included car boot sales near landfall (parcels 3 & 6) and scrub at the proposed substation location (parcel 69).

Table 1: Schedule of survey areas

Land parcel	Survey area	Size (ha)	Landuse	Notes	NGR
3	3.1	0.96	grass/car boot sale	cabins at SW edge	NZ 42098,51000
3	3.2	0.74	grass/car boot sale		NZ 41972,51014
6	6.1	0.85	W harrowed; E grass/car boot sale		NZ 41806,51080
6	(6.2)	(0.63)	overgrown	vegetation prevented survey	NZ 41666,51132
9	9.1	0.64	ploughed/harrowed		NZ 41543,51181
9	9.2	1.06	ploughed/harrowed		NZ 41407,51210
9	9.3	5.21	ploughed/harrowed	includes compound area	NZ 41012,51267
9	9.4	1.78	wheat	additional survey	NZ 41193,51332
9	9.5	1.00	brassica	additional survey	NZ 41015,51458
9	9.6	1.06	brassica	additional survey	NZ 40858,51492
10	10.1	0.63	ploughed/harrowed		NZ 40575,51358
10	10.2	1.63	ploughed/harrowed		NZ 40443,51256
10	10.3	3.04	ploughed/harrowed		NZ 40199,50942
10	10.4	1.87	ploughed/harrowed		NZ 39961,50591
10	10.5	1.00	wheat	additional survey	NZ 40587,51430
17	17.1	0.73	wheat		NZ 39692,50334
17	17.2	2.22	ploughed/harrowed		NZ 39488,50165
17	17.3	0.37	wheat		NZ 39323,50076
24	24.1	2.36	brassica	includes compound area	NZ 39222,49974
24	24.2	1.03	brassica		NZ 39335,49848
24	24.3	2.53	brassica		NZ 39221,49614
29	29	1.03	brassica		NZ 39048,49351
38	38.1	1.44	pasture, horses		NZ 38978,49114
38	38.2	0.35	pasture, horses		NZ 38926,48965
43	43.1	0.54	pasture, horses		NZ 38872,48898
43	43.2	0.40	pasture, horses		NZ 38835,48746
43	43.3	0.78	pasture, horses		NZ 38811,48769
43	43.4	1.16	pasture, horses		NZ 38724,48548
43	43.5	0.66	wheat		NZ 38659,48396
47	47.1	2.59	wheat		NZ 38541,48152
47	47.1 ext	1.48	wheat	additional survey	NZ 38517,48201
47	47.2	2.06	wheat		NZ 38313,47923
52	52	1.65	wheat		NZ 38115,47696
53	(53.1)	(0.80)	overgrown	vegetation prevented survey	NZ 38067,47483
53	(53.2)	(0.66)	overgrown	vegetation prevented survey	NZ 38041,47353
62	62.1	1.65	wheat		NZ 38000,47166
62	62.2	1.29	pasture, horse paddocks	includes compound area	NZ 37909,46983
65	65	4.28	ploughed/harrowed	includes 67.1;	NZ 37952,46571

				field boundary removed	
67	67.2	2.04	brassica		NZ 37890,46047
69	(69)	(5.2)	overgrown/scrub	vegetation prevented survey; made-ground	NZ 38646,45623
72	(72)	(8.74)	ploughed/harrowed	no permission	NZ 39520,545622
75	75	0.94	silage		NZ 39033,45571
80	80	0.47	pasture	large pylon in NE	NZ 38889,45558
Total area surveyed		55.52			

- 4.2 The Scheme sits entirely within Natural England's National Character Area (NCA) Profile 15: Durham Magnesian Limestone Plateau, which comprises an open, agricultural landscape with sharply defined boundaries in the form of a steep limestone escarpment to the west and a dramatic coast of limestone cliffs, headlands and bays to the east. Rural land cover consists of arable land and grazing pasture, with small, isolated areas of wildlife-rich habitat such as Magnesian Limestone grassland and ancient woodland in the narrow valleys (or denes) running down to the coast (Natural England 2013).
- 4.3 The landscape is gently undulating, with elevations across the Site ranging from lows of approximately 25m OD in Parcel 3, near landfall, to highs of approximately 130m OD, for example on Murton Moor.
- 4.4 The underlying solid geology of the area comprises dolostone of the Ford and Roker Formations, which is predominantly overlain by Devensian till, but also by small areas of glaciofluvial sand and gravel.

5. Geophysical survey

Standards

- 5.1 The surveys and reporting were conducted in accordance with the Chartered Institute for Archaeologists (CIfA) *Standard and Guidance for archaeological geophysical survey* (2020); the *EAC Guidelines for the Use of Geophysics in Archaeology* (Schmidt *et al.* 2015); and the *Archaeology Data Service & Digital Antiquity Geophysical Data in Archaeology: A Guide to Good Practice* (Schmidt 2013).

Technique selection

- 5.2 Geophysical survey enables the relatively rapid and non-invasive identification of sub-surface features of potential archaeological significance and can involve a suite of complementary techniques such as magnetometry, earth electrical resistance, ground-penetrating radar, electromagnetic survey and topsoil magnetic susceptibility survey. Some techniques are more suitable than others in particular situations, depending on site-specific factors including the nature of likely targets; depth of likely targets; ground conditions; proximity of buildings, fences or services and the local geology and drift.
- 5.3 In this instance, based on aerial photographic cropmark evidence and previous work, it was considered possible that cut features such as ditches and pits might be

present on the Site, and that other types of feature such as trackways, wall foundations and fired structures (for example kilns and hearths) could also be present.

- 5.4 Given the anticipated nature and depth of targets, and the non-igneous geological environment of the study area, a magnetic technique, fluxgate gradiometry, was considered appropriate for detecting the types of feature mentioned above. This technique involves the use of magnetometers to detect and record anomalies in the vertical component of the Earth's magnetic field, caused by variations in soil magnetic susceptibility or permanent magnetisation; such anomalies can reflect archaeological features.

Field methods

- 5.5 A 30m grid was established across each survey area and related to the Ordnance Survey (OS) National Grid using a Leica GS15 global navigation satellite system (GNSS) with real-time kinematic (RTK) corrections typically providing 10mm accuracy.
- 5.6 Magnetic gradient measurements were determined using Bartington Grad601-2 dual fluxgate gradiometers. A zig-zag traverse scheme was employed and data were logged in 30m grid units. The instrument sensitivity was effectively 0.03nT, the sample interval was 0.25m and the traverse interval was 1m, thus providing 3,600 sample measurements per 30m grid unit.
- 5.7 Data were downloaded on site into a laptop computer for initial processing and storage and subsequently transferred to a desktop computer for processing, interpretation and archiving.

Data processing

- 5.8 Geoplot v.4 software was used to process the geophysical data and to produce both continuous tone greyscale images and trace plots of the raw (minimally processed) data. Trace plots of the data were prepared and examined but are not presented in this report. The greyscale images, geophysical and archaeological interpretations are presented in Figures 2-22. In the greyscale images, positive magnetic anomalies are displayed as dark grey and negative magnetic anomalies as light grey. Palette bars relate the greyscale intensities to anomaly values in nanoTesla.
- 5.9 The following basic processing functions have been applied to the magnetometer data:

<i>clip</i>	clips data to specified maximum or minimum values; to eliminate large noise spikes; also generally makes statistical calculations more realistic
<i>zero mean traverse</i>	sets the background mean of each traverse within a grid to zero; for removing striping effects in the traverse direction and removing grid edge discontinuities
<i>de-stagger</i>	corrects for displacement of magnetic anomalies caused by alternate zig-zag traverses

interpolate increases the number of data points in a survey to match sample and traverse intervals; in this instance the data have been interpolated to 0.25m x 0.25m intervals

Interpretation: anomaly types

- 5.10 Colour-coded geophysical interpretation plans are provided. Three types of magnetic anomaly have been distinguished in the data:

positive magnetic regions of anomalously high or positive magnetic field gradient, which may be associated with high magnetic susceptibility soil-filled structures such as pits and ditches

negative magnetic regions of anomalously low or negative magnetic field gradient, which may correspond to features of low magnetic susceptibility such as wall footings and other concentrations of sedimentary rock or voids

dipolar magnetic paired positive-negative magnetic anomalies, which typically reflect ferrous or fired materials (including fences and service pipes) and/or fired structures such as kilns or hearths

Interpretation: features

General comments

- 5.11 Colour-coded archaeological interpretation plans are provided.
- 5.12 Except where stated otherwise in the text below, positive magnetic anomalies are taken to reflect relatively high magnetic susceptibility materials, typically sediments in cut archaeological features (such as ditches or pits) whose magnetic susceptibility has been enhanced by decomposed organic matter or by burning.
- 5.13 Several series of parallel positive magnetic anomalies have been detected in the surveys, which in some cases almost certainly reflect traces of former ridge and furrow cultivation. In other cases the anomalies may reflect land drains, which are often laid in the former furrows. Where the anomalies are relatively weak, broad and slightly curved they are considered more likely to reflect traces of former ridge and furrow; where the anomalies are relatively strong, narrow and straight they are more likely to reflect land drains. However, as mentioned above, both are often present in the same places.
- 5.14 Series of closely-spaced positive and negative magnetic striations have been detected across many of the survey areas. These anomalies reflect the existing plough regimes and, for clarity, are not shown on the interpretation drawings. In some instances these also have a similar orientation to earlier agricultural practices, such as ridge and furrow cultivation, and field drains.
- 5.15 Features recorded on historic OS maps have been detected in many of the survey areas; these include many former field boundaries, former tracks, the courses of two former railways and an infilled quarry.
- 5.16 Chains of intense dipolar magnetic anomalies have been detected in several of the survey areas; these typically reflect buried services. Occasional inspection chamber

covers have also been noted. Telegraph poles and pylons carrying overhead wires also crossed the Site. Geotechnical monitoring boreholes were also present in some areas.

- 5.17 Small, discrete dipolar magnetic anomalies have been detected in all of the survey areas. These almost certainly reflect near-surface items of ferrous and/or fired debris, such as horseshoes and brick fragments, for example, and in most cases have little or no archaeological significance. A sample of these is shown on the geophysical interpretation plans, however, they have been omitted from the archaeological interpretation plans and the following discussion. Except where stated otherwise, strong dipolar magnetic anomalies detected along the edges of surveys reflect the presence of adjacent metal fences.
- 5.18 Some fields contain a particularly high concentration of small ferrous debris, typically spread across the entire field. In these cases the debris, which also often includes significant quantities of plastic and glass, is almost certainly a result of so-called 'green waste' applied as fertiliser. The application of green waste to the land can have a detrimental effect on magnetic surveys (for example, Gerrard *et al.* 2015), particularly hindering the detection and identification of small and/or weak magnetic anomalies which might otherwise reflect archaeological features, such as gullies, small pits/postholes or hearths, for example.
- 5.19 The following table serves as a summary and quick guide to the types of feature identified in each area. Some of these features are described in more detail below, where the survey results are described by parcel number, from north to south.

Table 2: Summary of survey results

Feature type	Parcel/area number
Soil-filled feature, e.g. ditch/pit	6.1, 9.3, 9.4, 9.5, 9.6, 10.2, 17.1, 29, 38.1, 43.4, 43.5, 47.1, 47.2, 52, 65
Ridge & furrow	3.1, 6.1, 9.1, 9.2, 9.3, 9.4, 9.5, 9.6, 10.3, 10.4, 17.2, 17.3, 24.3, 29, 38.2, 43.1, 43.2, 43.3, 43.4, 43.5, 47.1, 52
Former field boundary	9.2, 9.3, 9.4, 9.5, 10.1, 10.2, 10.4, 17.1, 17.2, 24.3, 29, 43.1, 47.1, 47.2, 52, 62.1, 65, 67.2
Former track	9.3, 9.4, 24.2, 24.3, 52, 75, 80
Former railway	29, 62.1
Former quarry	38.1
Green waste/disturbed ground (magnetically noisy)	3.1, 3.2, 6.1, 9.3, 9.4, 10.1, 10.2, 10.3, 10.4, 10.5, 17.1, 17.2, 17.3, 24.1, 24.2, 24.3, 47.1, 47.2, 62.1, 62.2, 67.2
Gravel, concrete, hardcore	3.1, 3.2
Services & inspection covers	10.3, 24.1, 24.3, 38.2, 43.1, 43.2, 43.4, 47.1, 65, 75
Land drains	9.1, 9.2, 9.3, 9.4, 9.5, 9.6, 10.3, 10.4, 17.1, 17.2, 17.3, 24.1, 24.3, 29, 38.1, 43.4, 43.5, 47.1, 47.2, 52, 65, 75

Feature type	Parcel/area number
Boreholes	9.6, 10.1, 10.4, 17.1,
Geomorphological/geological	10.1, 10.2, 10.5, 65, 67.2

Parcel 3 (Figure 2)

- 5.20 These surveys are characterised by high concentrations of small strong dipolar magnetic anomalies, detected across the west of area 3.1 and all of area 3.2. These anomalies typically reflect ferrous and fired debris, which reflect the land's use for car boot sales. Two bands of anomalies reflect gravel and rubble laid as hardcore tracks across the field.
- 5.21 Parallel, alternate, positive and negative magnetic anomalies were detected in the central part of area 3.1, which almost certainly reflect traces of former ridge and furrow cultivation.

Parcel 6 (Figure 2)

- 5.22 A small area of magnetically disturbed ground was detected in the east of area 6.1. This corresponds to rubble in the entrance to the field, which is used as a car park for the car boot sales to the south-east.
- 5.23 Traces of former ridge and furrow were detected across much of this field.
- 5.24 The County Durham HER records a Second World War aircraft obstruction earthwork in this field, extending into this survey area. This has not been identified in the magnetometer survey, however, the feature is exactly aligned with anomalies representing ridge and furrow remains here. Magnetically, the earthwork would appear very similar to a former agricultural ridge.
- 5.25 Occasional discrete positive magnetic anomalies detected in the west of area 6.1 reflect relative increases in magnetic susceptibility and could represent soil-filled pits, of unknown date or function.
- 5.26 Area 6.2 could not be surveyed due to high vegetation.

Parcel 9 (Figures 3-5)

- 5.27 Areas 9.4-9.6 were surveyed to investigate an alternative cable route to the north of the original route.
- 5.28 Traces of probable former ridge and furrow have been detected across much of this parcel, together with probable land drains on the same alignments.
- 5.29 A former field boundary and adjacent track, together with a band of magnetic disturbance, have been detected across areas 9.3 and 9.4, aligned east-north-east/west-south-west; another former field boundary extends southward. Several probable soil-filled ditches have also been detected in these areas, some of which appear to define an earlier system of small fields or enclosures and possibly associated features. Two possible double-ditched tracks or former headlands and another former field boundary were detected in the west of area 9.3.

- 5.30 Further linear ditches in areas 9.5 and 9.6 could reflect further old field boundaries, and one recorded on early OS maps.

Parcel 10 (Figures 6-9)

- 5.31 Area 10.5 was surveyed to investigate an alternative cable route to the north of the original route.
- 5.32 All of the survey areas in this parcel appear to contain 'green waste', which may have hindered the detection of some features.
- 5.33 Two broad, sinuous positive magnetic anomalies in areas 10.1 and 10.5 may reflect greater depths of magnetically susceptible soil, perhaps derived from further upslope, and are interpreted as probable natural geomorphological features.
- 5.34 Occasional soil-filled features in this parcel could possibly reflect the partial remains of former ditches. Three former field boundaries shown on early OS maps were also identified.
- 5.35 Traces of probable former ridge and furrow were detected in parts of areas 10.3 and 10.4, together with probable land drains.

Parcel 17 (Figures 10-12)

- 5.36 All three survey areas in this parcel appear to contain 'green waste', which may have hindered the detection of some features.
- 5.37 A small group of possible soil-filled pits was detected in area 17.1.
- 5.38 Former field boundaries, probable traces of former ridge and furrow and probable land drains were detected in all parts of this parcel.

Parcel 24 (Figures 10-15)

- 5.39 All three survey areas in this parcel also appear to contain 'green waste', which may have hindered the detection of some features.
- 5.40 A former track has been identified in areas 24.2 and 24.3.
- 5.41 Land drains, ridge and furrow and a service were also detected in the parcel.

Parcel 29 (Figures 13-15)

- 5.42 A broad band of strong magnetic anomalies, measuring up to 11m across, has been detected curving through this area. This corresponds with a former stretch of railway, which once connected the Rainton and Seaham railway to the Sunderland and Hartlepool railway (NER). Linear anomalies detected to the immediate south also reflect the course of the Rainton and Seaham railway.
- 5.43 Parts of two possible former ditches, ridge and furrow and land drains were also detected in this parcel.

Parcel 38 (Figures 13-15)

5.44 A large concentration of intense dipolar magnetic anomalies was detected in the southern part of area 38.1 and northern tip of area 38.2. These anomalies reflect the infill of a former quarry, recorded as 'old quarry' on the 1st edition OS map.

5.45 A strong arcuate positive magnetic anomaly to the north-east of the infilled quarry may represent a former ditch or trench associated with the quarry, though no other features are recorded here on the early OS. The anomaly is stronger than would normally be expected from sedimentary fill and may indicate the presence of brick rubble, clinker or similar. If associated with the quarry this may have been the boundary for a former yard or compound, but its origin and function remain uncertain.

Parcel 43 (Figure 16)

5.46 The northern part of this parcel was divided into areas of horse pasture, typically defined by wire fences. Several services were detected here, almost certainly being water pipes for troughs.

5.47 Probable traces of ridge and furrow and land drains were detected throughout most of this parcel.

5.48 Two probable soil-filled features, one ditch and one pit, were detected in the south of the parcel. These are of unknown date or function.

Parcel 47 (Figures 17-19)

5.49 A number of potentially significant anomalies were detected during the initial survey of the cable corridor in the northern part of this parcel (area 47.1). The 60m wide survey corridor was subsequently extended by a further 40m to the west, in order to more fully understand the nature and extent of the probable archaeological remains.

5.50 Many of the linear positive magnetic anomalies detected here almost certainly reflect archaeological ditches, the majority of which define trackways and enclosures of various sizes. The complex occupies an area of higher ground in the northern part of the parcel and extends westward beyond the survey limit, and possibly eastward also. The ditches typically define rectilinear areas, though some curvilinear features are also present. For example, at the southern end of the complex there are two concentric semi-circular ditches abutting the southern side of some small enclosures. Further north, a curvilinear ditch forms part of a much longer ditch (a possible land boundary), which appears to either cut or be cut by various other ditches. Together with occasional overlapping features on slightly different alignments, there appears to be more than one phase of activity represented.

5.51 The majority of the anomalies are of a strength that would typically be consistent with soil-filled features, however, parts of some of the linear features are strong enough to possibly represent fired materials such as a clay brick/tile or accumulations of burnt materials within the ditches.

5.52 There are many more linear magnetic anomalies present than are shown on the interpretation drawings. Sets of weak, parallel, linear anomalies have been detected across the field, reflecting different plough regimes from perhaps the medieval period to the present day, as well as patterns of land drainage. Many of these

weaker anomalies are on the same alignments as the probable archaeological features and it is likely that some of them will reflect less magnetically susceptible fills within small ditches/gullies or trenches, for example. It is also likely that some of the very small discrete anomalies, which are present in every field, will in this case reflect archaeological features such as small pits, postholes or hearths, for example, as well as possibly ferrous or fired artefacts.

- 5.53 This complex of features may represent a former farmstead, or perhaps part of a more significant settlement. Whilst the date is not known, the features and layout could be consistent with late prehistoric/Romano-British activity.
- 5.54 Five former field boundaries have been identified in this parcel; another former field boundary corresponds to line of the collector drain in the south of 47.1.
- 5.55 Substantial land drains were detected in the lower, southern parts of the parcel.

Parcel 52 (Figures 17-19)

- 5.56 A number of potential archaeological features were detected in this parcel. Several positive magnetic anomalies in the northern part of the survey almost certainly reflect soil-filled ditches. The longer ditches may have been early land boundaries, certainly no longer evident when the tithe maps were prepared in the early-mid 19th century.
- 5.57 One circular anomaly may reflect a ring-ditch, measuring up to approximately 13m in diameter. This type of anomaly could be associated with a roundhouse or possibly a small round barrow. The County Durham HER holds three records for round barrows approximately 1.7km due south of this parcel, each measuring between 37-50m in diameter (though the records may all relate to the same feature). Given the presence of a smaller, incomplete, ring anomaly within the ring-ditch, perhaps a roundhouse is more likely; the internal ring could have housed posts supporting the roof. A small discrete anomaly at the centre of the internal ring could reflect a hearth. However, there are various activities that could create a ring anomaly such as this and its origin and function remain uncertain.
- 5.58 Additional soil-filled anomalies close to the ring-ditch may reflect a sub-circular pit and a small rectilinear feature. It is not known if these features are associated with the ring-ditch.
- 5.59 A probable former double-ditched track has been detected near the southern limit of the survey, parallel to an existing track and field boundary. A former field boundary was detected in the north-east corner of the survey.
- 5.60 Probable former ridge and furrow and land drains were detected in the south of the area.

Parcel 62 (Figure 20)

- 5.61 The northern edge of area 62.1 contained significant quantities of slag and clinker, which would almost certainly have been incorporated in the track bed for the former Murton, Durham and Elvet branch railway (LNER), whose course ran along the northern boundary of this parcel.

- 5.62 The remainder of this northern field is characterised by a lower concentration of ferrous debris, almost certainly 'green waste'. A former field boundary has been identified crossing the southern part of the field, aligned north-west/south-east.
- 5.63 The southern part of this parcel, area 62.2, was sub-divided into four horse paddocks by wire fences. Almost the entire survey area contains a high concentration of intense magnetic anomalies, almost certainly fired and/or ferrous debris. These materials may have been used to fill a large hollow or were perhaps spread as a hardcore surface for some sort of compound.

Parcels 65 and 67 (Figure 21)

- 5.64 The field boundary between these two parcels has been removed, enabling one continuous survey of 65 and 67.1.
- 5.65 Three former field boundaries were identified in this survey and one possible soil-filled feature, an incomplete oval ditch measuring up to 17m across.
- 5.66 Land drains were detected here, mostly within area 65.
- 5.67 Four broad, sinuous positive magnetic anomalies detected in areas 65 and 67.2 may reflect greater depths of magnetically susceptible soil, probably derived from further upslope, and are interpreted as probable natural geomorphological features.
- 5.68 An intense magnetic anomaly detected in the northern part of 67.1 almost certainly reflects a lightning strike.
- 5.69 Area 67.2 is characterised by a relatively high concentration of ferrous debris, almost certainly green waste.
- 5.70 A former field boundary was identified in area 67.3, aligned broadly north-south.

Parcel 75 (Figure 22)

- 5.71 A possible former track has been detected in this area, extending westward into area 80. This possible track is not recorded on any OS maps. A series of land drains was also detected.

Parcel 80 (Figure 22)

- 5.72 As above, a possible former track has been detected in this area, extending eastward into area 75.

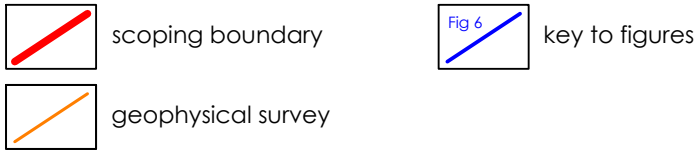
6. Conclusions

- 6.1 Approximately 55.5ha of magnetometer survey was undertaken along the proposed onshore route of the SEGL1 electricity transmission project in County Durham.
- 6.2 Surveys were carried out at 38 locations. Features with archaeological potential were identified in 15 of those surveys.
- 6.3 The majority of potential archaeological features were occasional soil-filled features, typically parts of probable former ditches and a few possible pits.

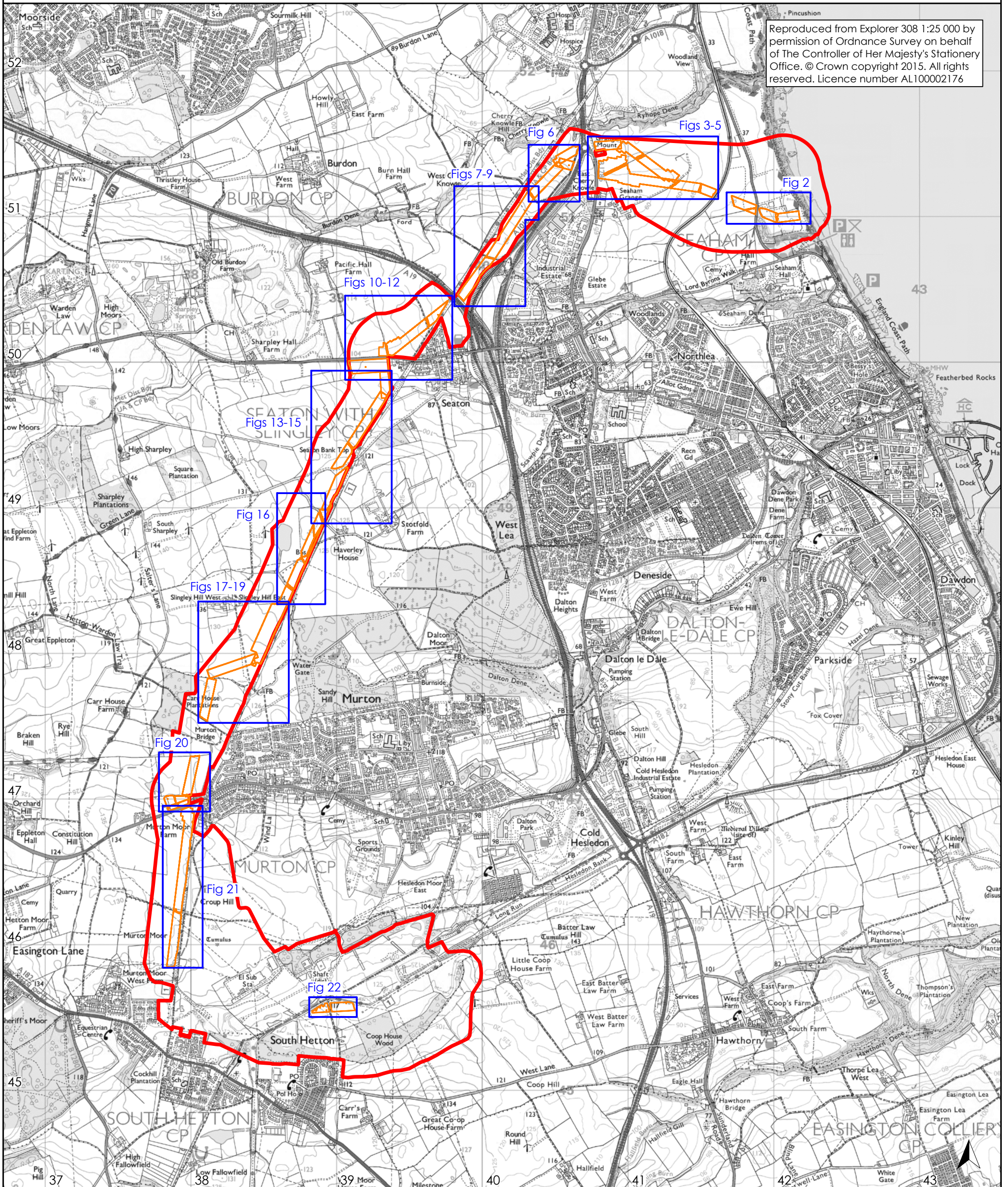
- 6.4 Potentially more significant remains were detected at three locations: areas 9.3-9.4, 47.1 and 52.
- 6.5 A series of probable ditches in areas 9.3 and 9.4 could represent an early field system of small fields or enclosures and possibly associated features.
- 6.6 A concentration of ditches in area 47.1 almost certainly represents archaeological trackways and enclosures. The features occupy an area of higher ground in the northern part of the parcel. The ditches typically define rectilinear areas, though some curvilinear features are also present. There appears to be more than one phase of activity represented. The majority of the anomalies are of a strength that would typically be consistent with soil-filled features, however, parts of some of the linear features are strong enough to possibly represent fired materials such as a clay brick/tile or accumulations of burnt materials within the ditches. This complex of features may represent a former farmstead, or perhaps part of a more significant settlement. Whilst the date is not known, the features and layout could be consistent with late prehistoric/Romano-British activity.
- 6.7 A probable ring-ditch and other soil-filled features were detected in area 52, on the next high ground south of 47.1. It is possible that the ring-ditch and its internal features could represent the remains of a roundhouse.
- 6.8 In addition to the features mentioned above, traces of probable former ridge and furrow cultivation were recorded in many areas, as well as many former field boundaries, former tracks, the courses of two former railways and an infilled quarry.
- 6.9 The precise nature, function, date, state of preservation and significance of the potential archaeological features presented in this report may only be determined by intrusive investigation.
- 6.10 The presence of green waste in several areas may have hindered the detection and identification of some weak or small anomalies of potential archaeological interest.

7. Sources

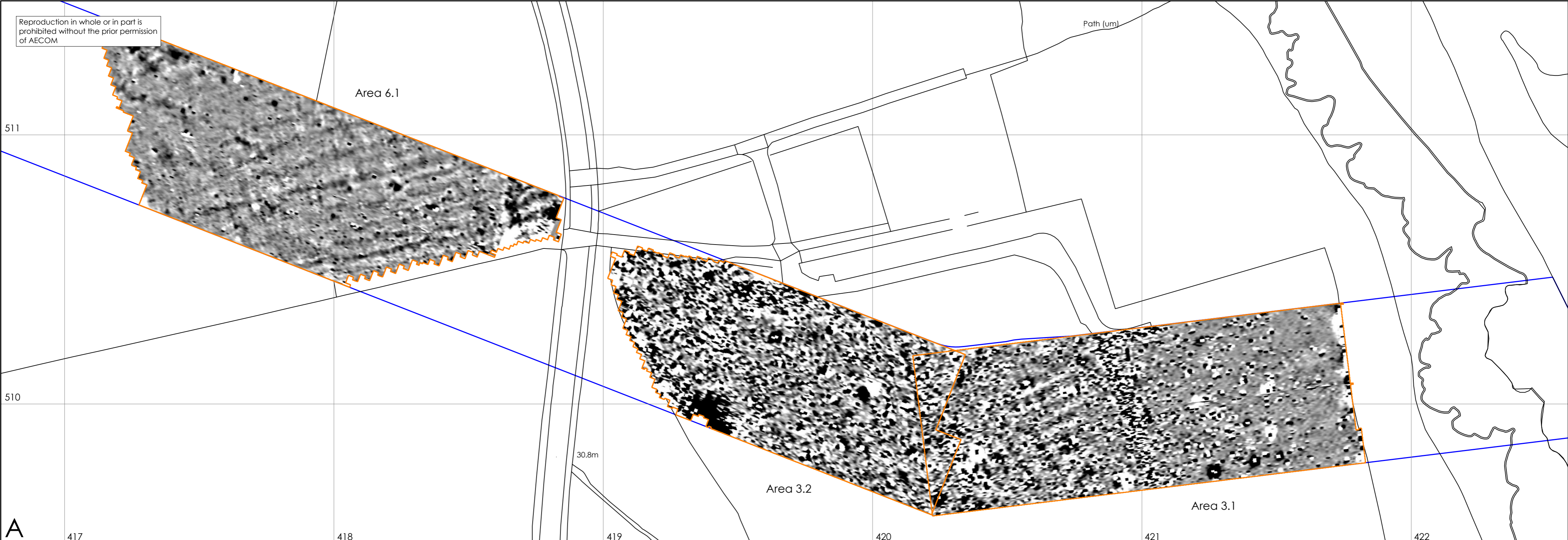
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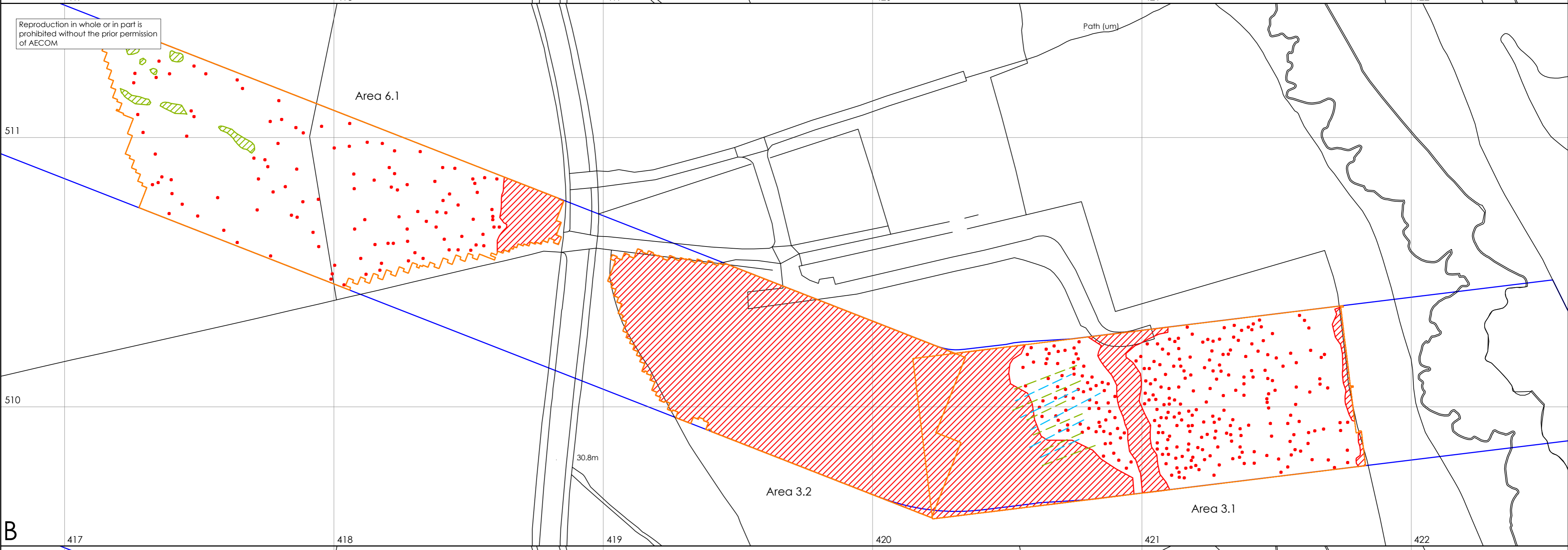
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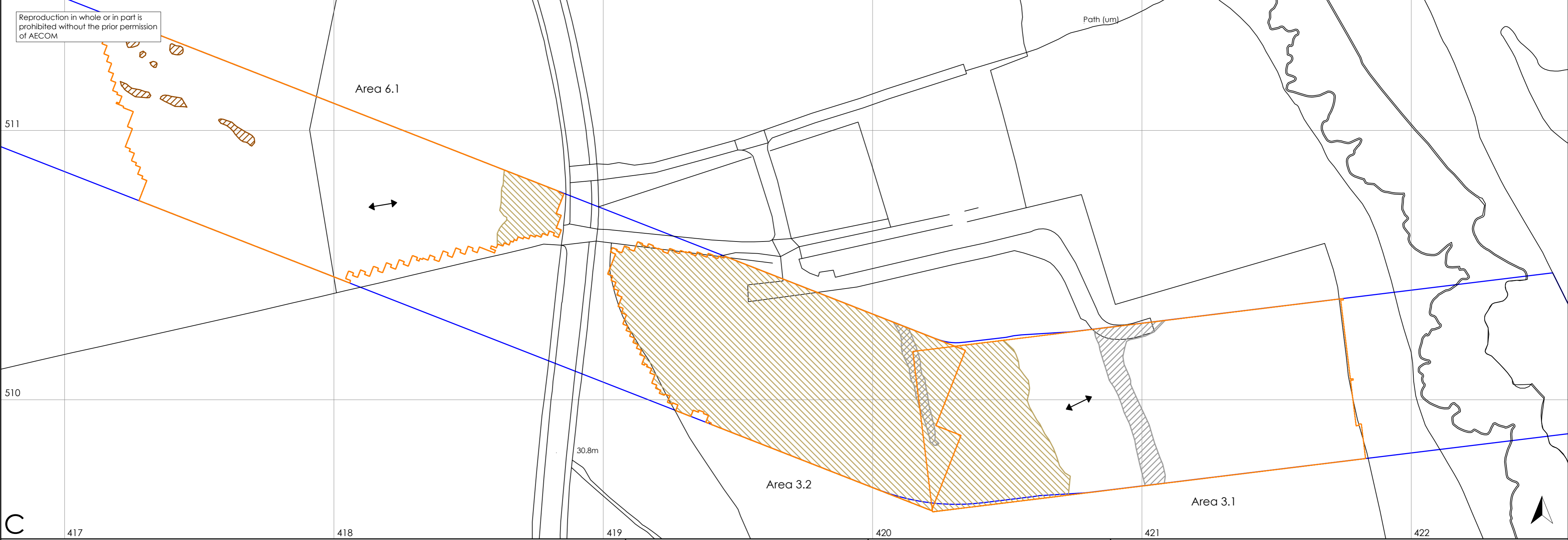
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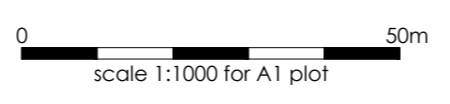
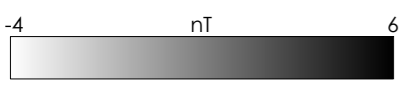
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- site boundary
- SEGL1 preliminary geophysics area
- magnetometer survey
- dipolar magnetic anomaly
- positive magnetic anomaly
- negative magnetic anomaly
- possible soil-filled feature
- gravel and concrete
- disturbed area
- ridge and furrow



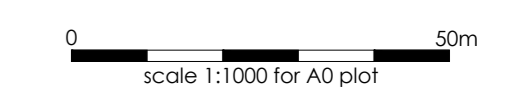
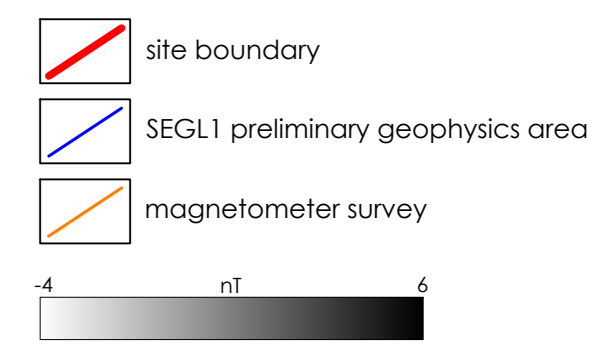
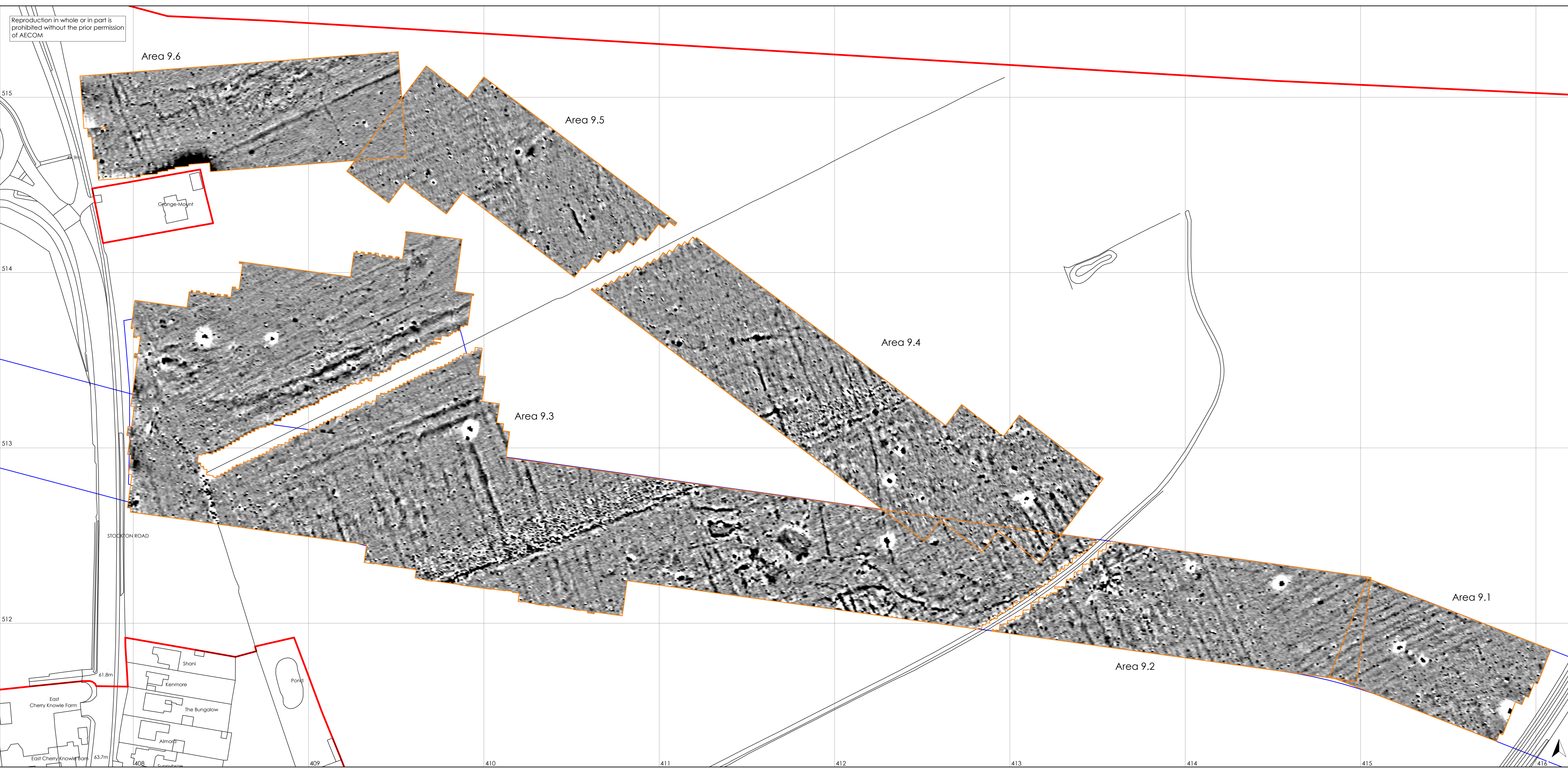
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County Durham

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Figure 2: Areas 3.1, 3.2, & 6.1 - Magnetometer survey (A), geophysical (B) and archaeological (C) interpretations

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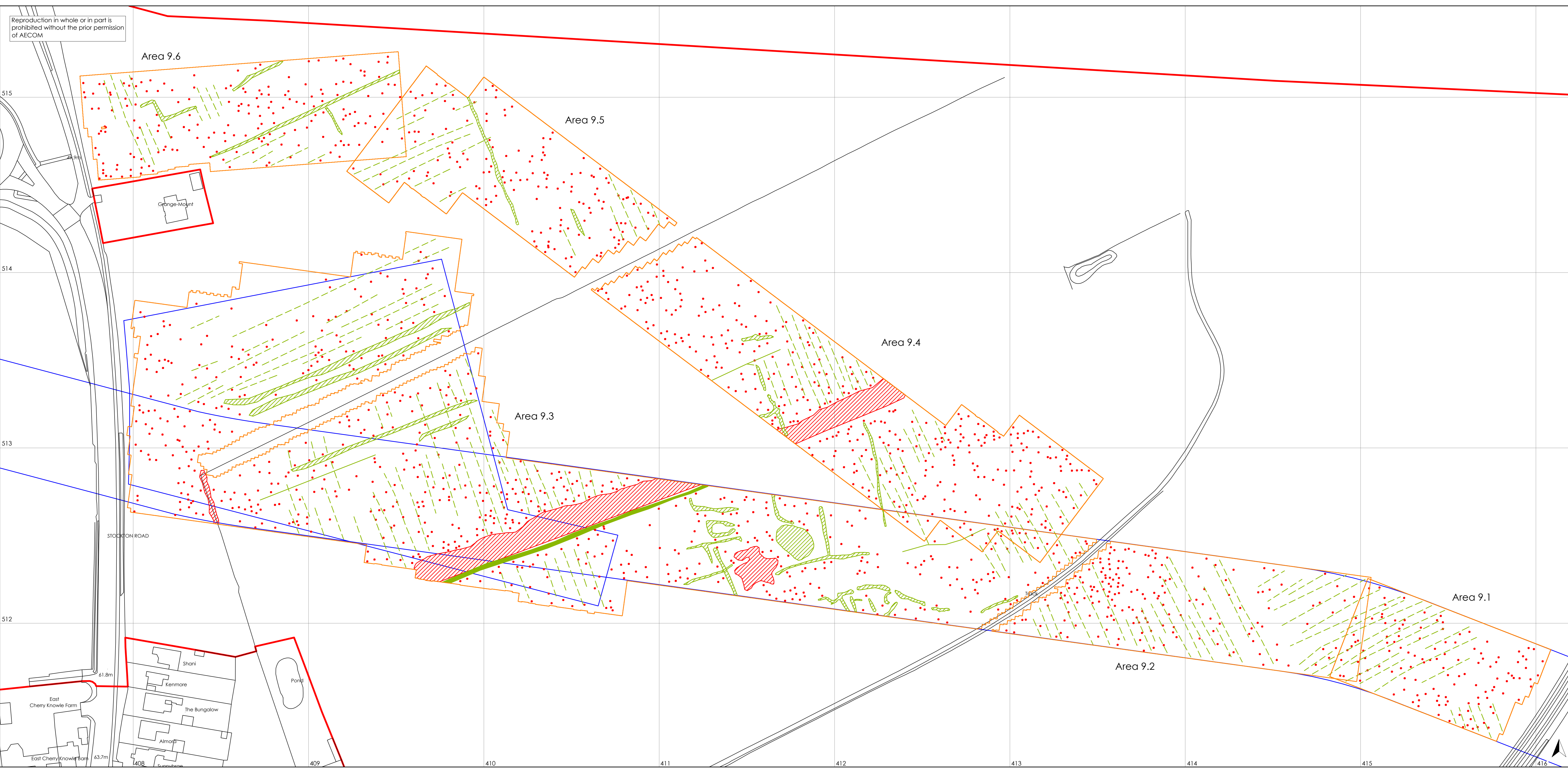


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Figure 3: Areas 9.1-9.6 - Magnetometer survey

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- SEGL 1 preliminary geophysics area
- magnetometer survey
- dipolar magnetic anomaly
- positive magnetic anomaly

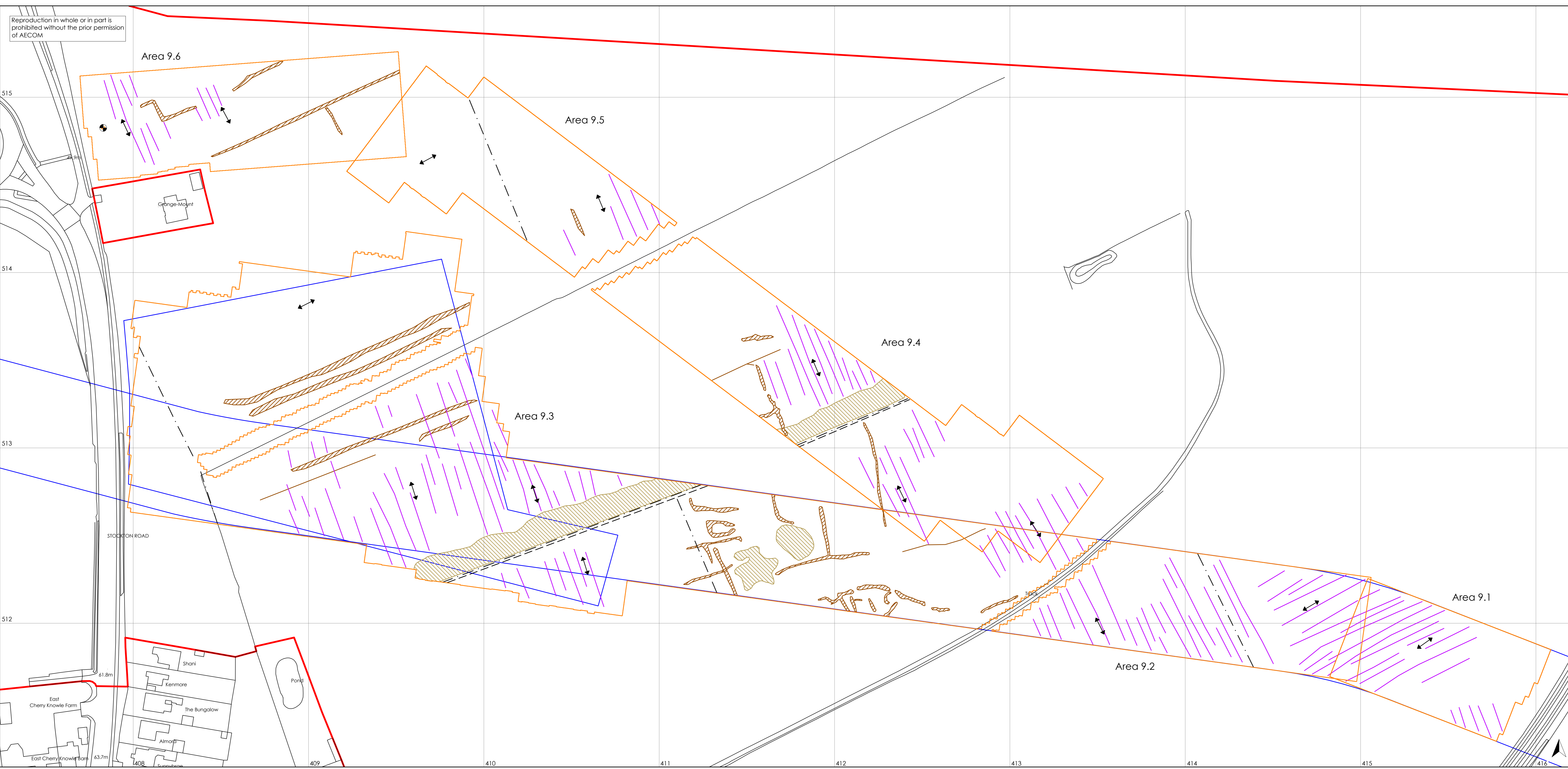
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Figure 4: Areas 9.1-9.6 - Geophysical interpretation

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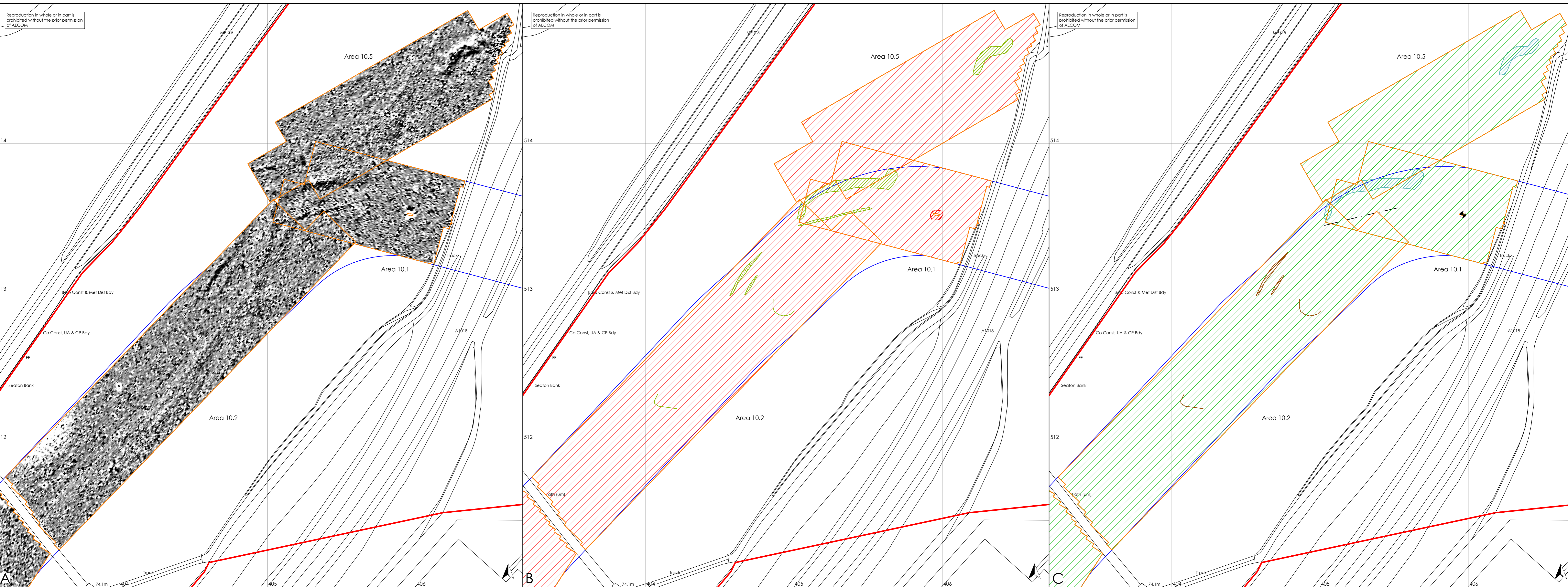
- site boundary
- SEGL1 preliminary geophysics area
- magnetometer survey
- possible soil-filled feature
- disturbed area
- ridge and furrow
- former track
- former field boundary
- land drain
- borehole

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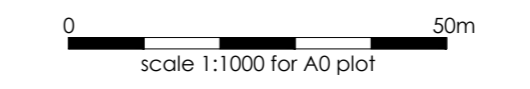
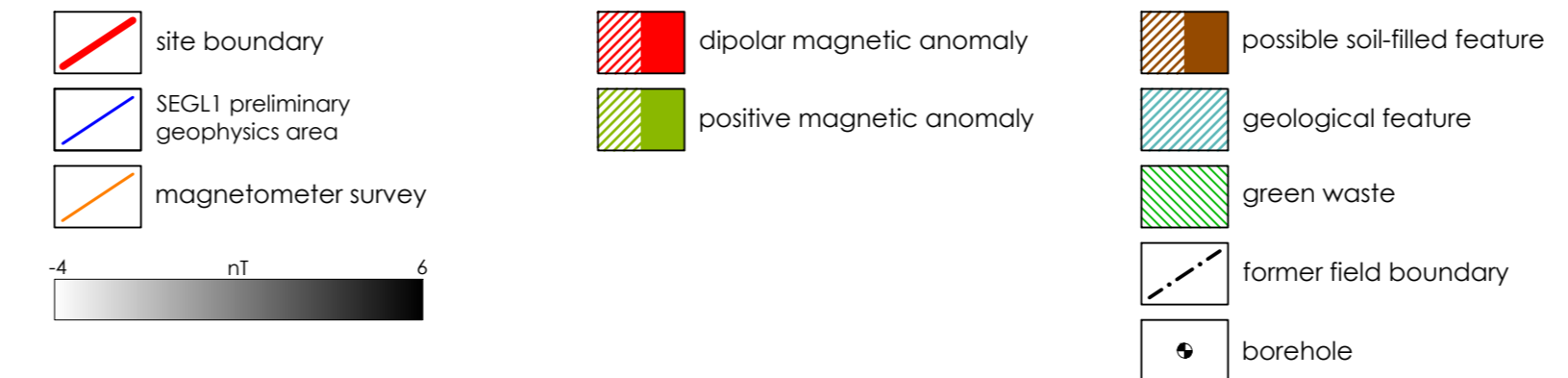
Figure 5: Areas 9.1-9.6 - Archaeological interpretation



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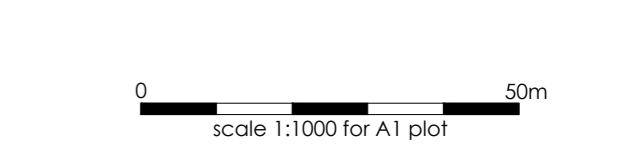
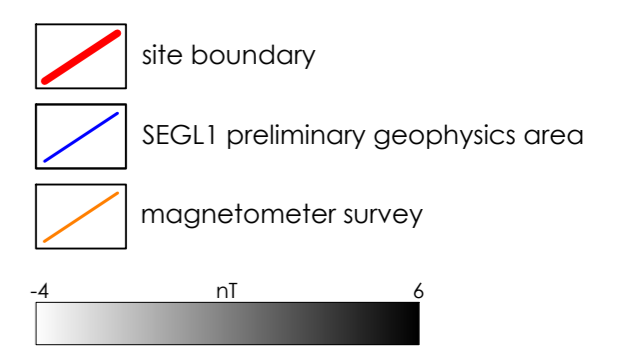
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Figure 6: Areas 10.1, 10.2 & 10.5 - Magnetometer survey (A), geophysical (B) and archaeological (C) interpretations



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Figure 7: Areas 10.3 & 10.4 -
Magnetometer survey



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- site boundary
- SEGL1 preliminary geophysics area
- magnetometer survey
- dipolar magnetic anomaly
- positive magnetic anomaly

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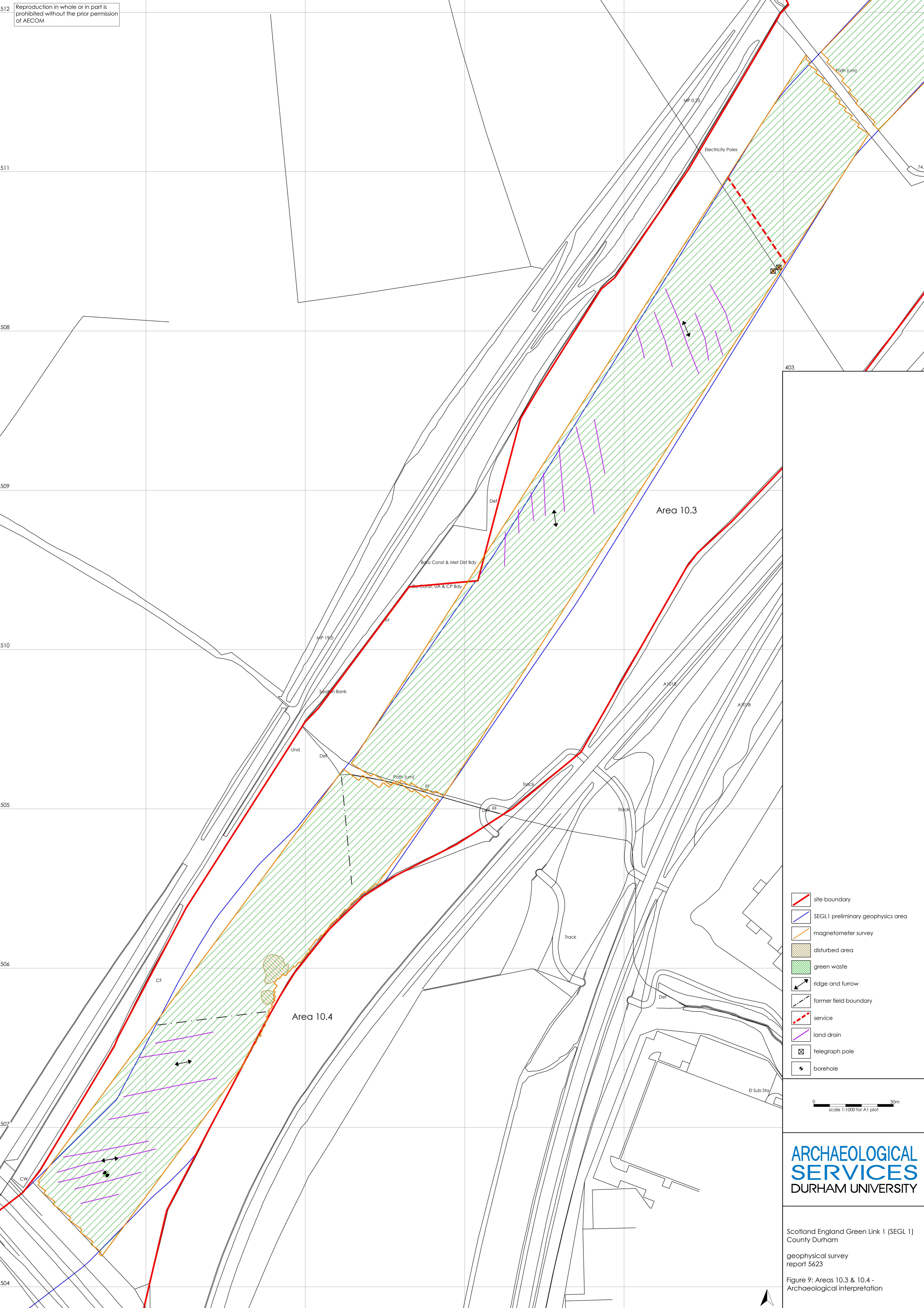
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- site boundary
- SEGL1 preliminary geophysics area
- magnetometer survey
- disturbed area
- green waste
- ridge and furrow
- former field boundary
- service
- land drain
- telegraph pole
- borehole

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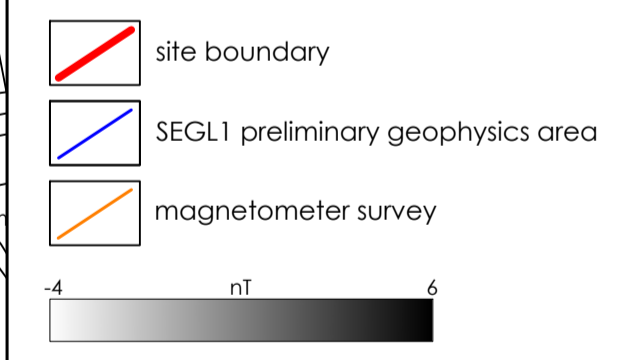
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Figure 9: Areas 10.3 & 10.4 -
Archaeological interpretation





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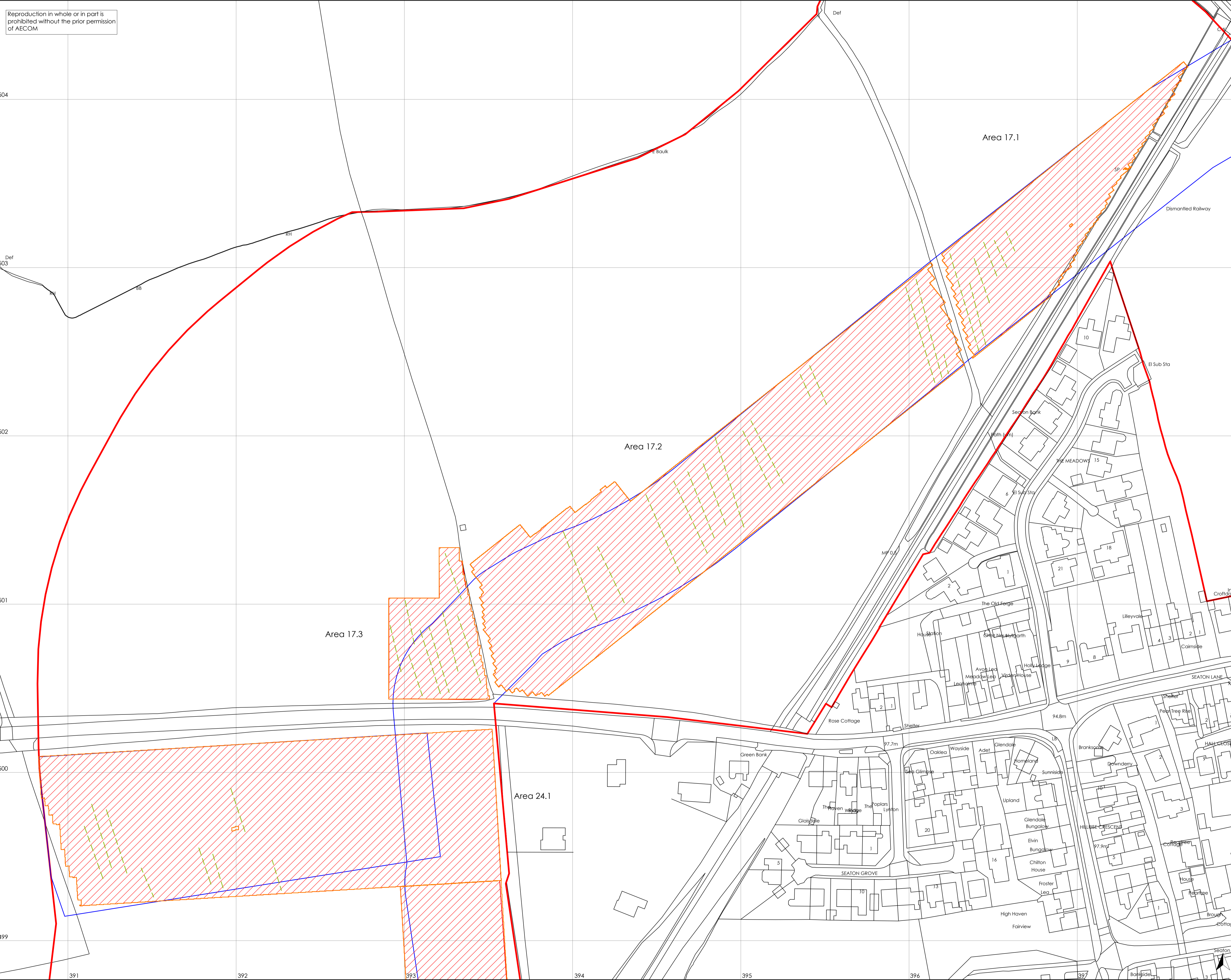
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Figure 10: Areas 17.1-3 & 24.1 -
Magnetometer survey

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-  SEGL 1 preliminary geophysics area
-  magnetometer survey
-  dipolar magnetic anomaly
-  positive magnetic anomaly

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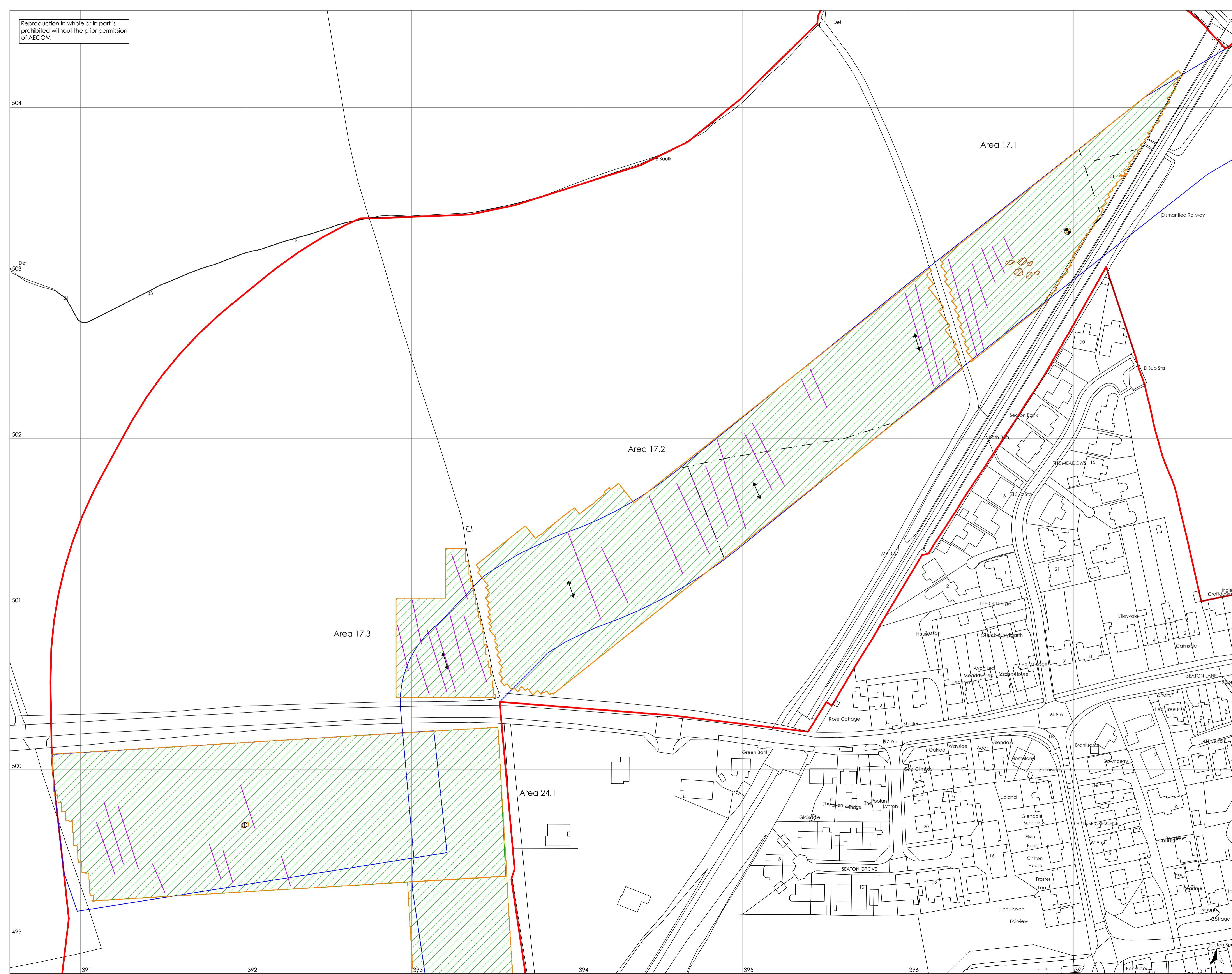
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Figure 11: Areas 17.1-3 & 24.1 -
Geophysical interpretation

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- site boundary
- SEGL 1 preliminary geophysics area
- magnetometer survey
- possible soil-filled feature
- green waste
- ridge and furrow
- former field boundary
- land drain
- inspection cover
- borehole

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Figure 12: Areas 17.1-3 & 24.1 -
Archaeological interpretation

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-  site boundary
-  SEGL1 preliminary geophysics area
-  magnetometer survey

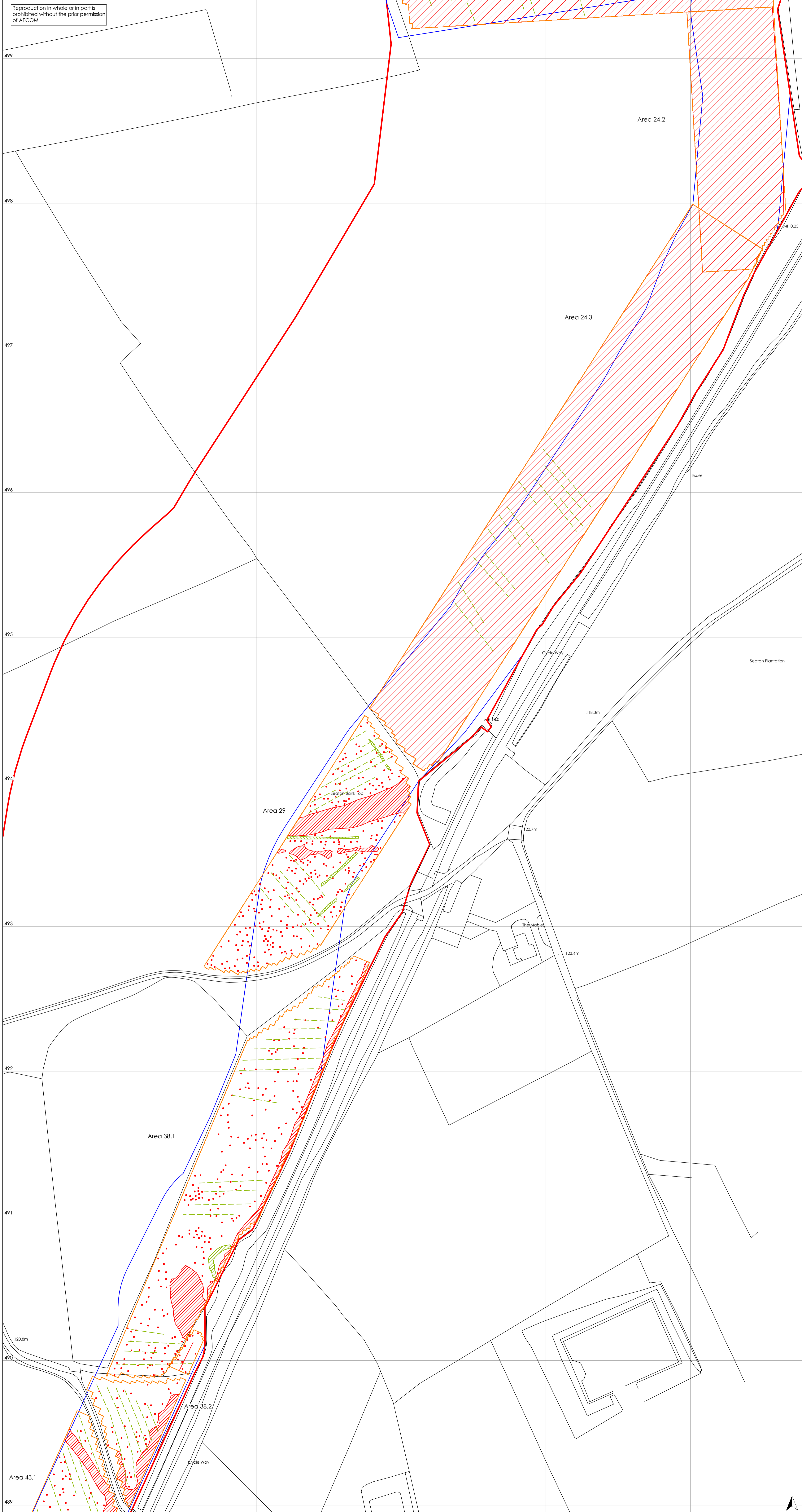
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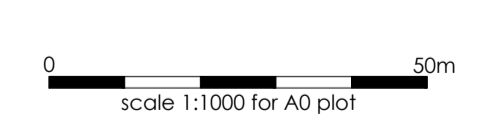
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Figure 13: Areas 24.2, 24.3, 29, 38.1 & 38.2 -
Magnetometer survey





- site boundary
- SEGL1 preliminary geophysics area
- magnetometer survey
- dipolar magnetic anomaly
- positive magnetic anomaly

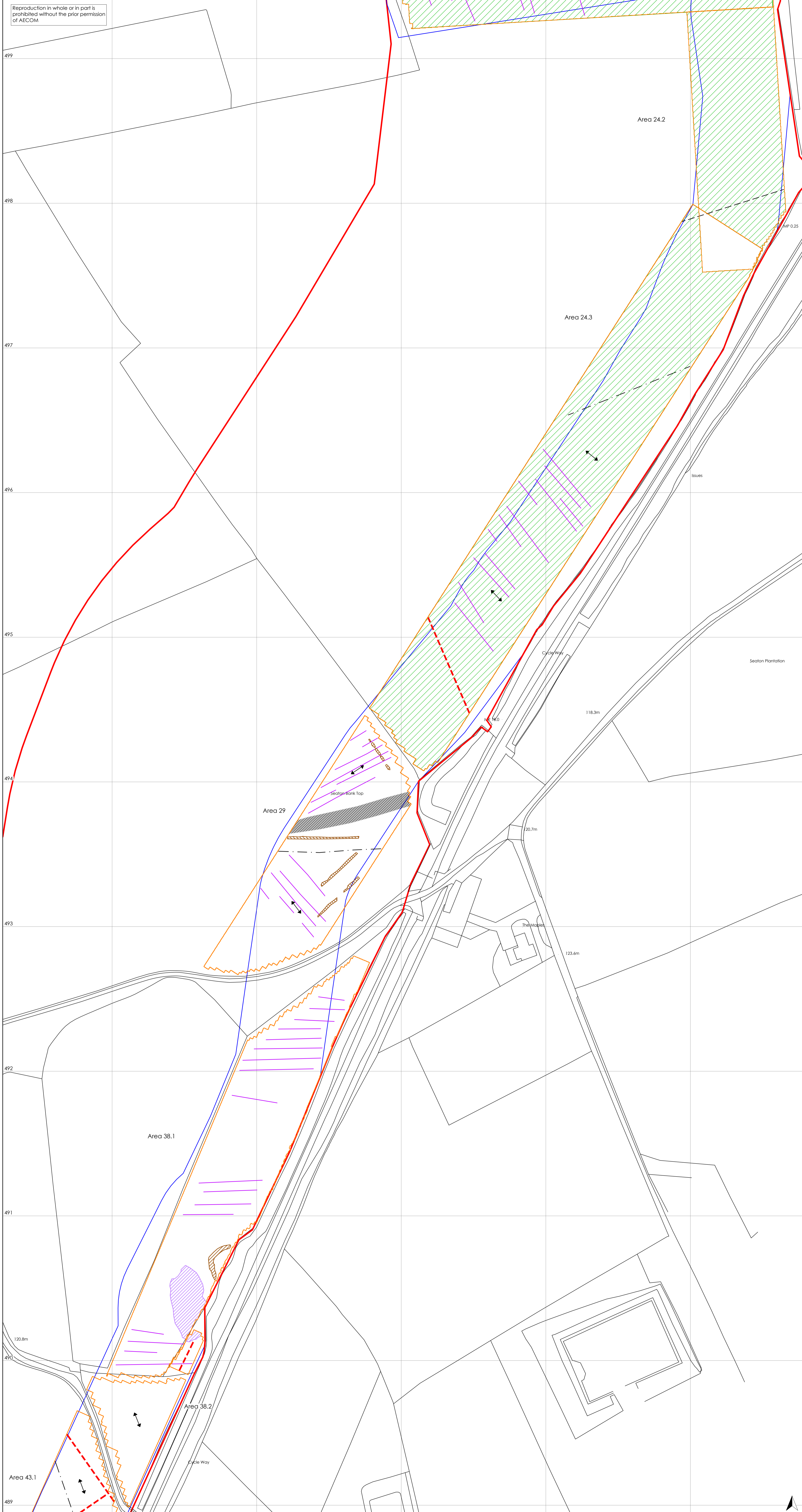





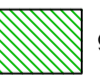


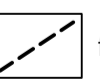


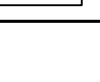

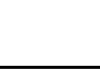
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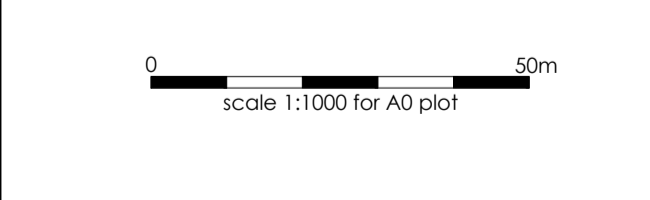
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Figure 14: Areas 24.2, 24.3, 29, 38.1 & 38.2 - Geophysical interpretation





-  site boundary
-  SEGL1 preliminary geophysics area
-  magnetometer survey
-  possible soil-filled feature
-  green waste
-  former quarry
-  ridge and furrow
-  former rail track bed
-  former track
-  former field boundary
-  service
-  land drain

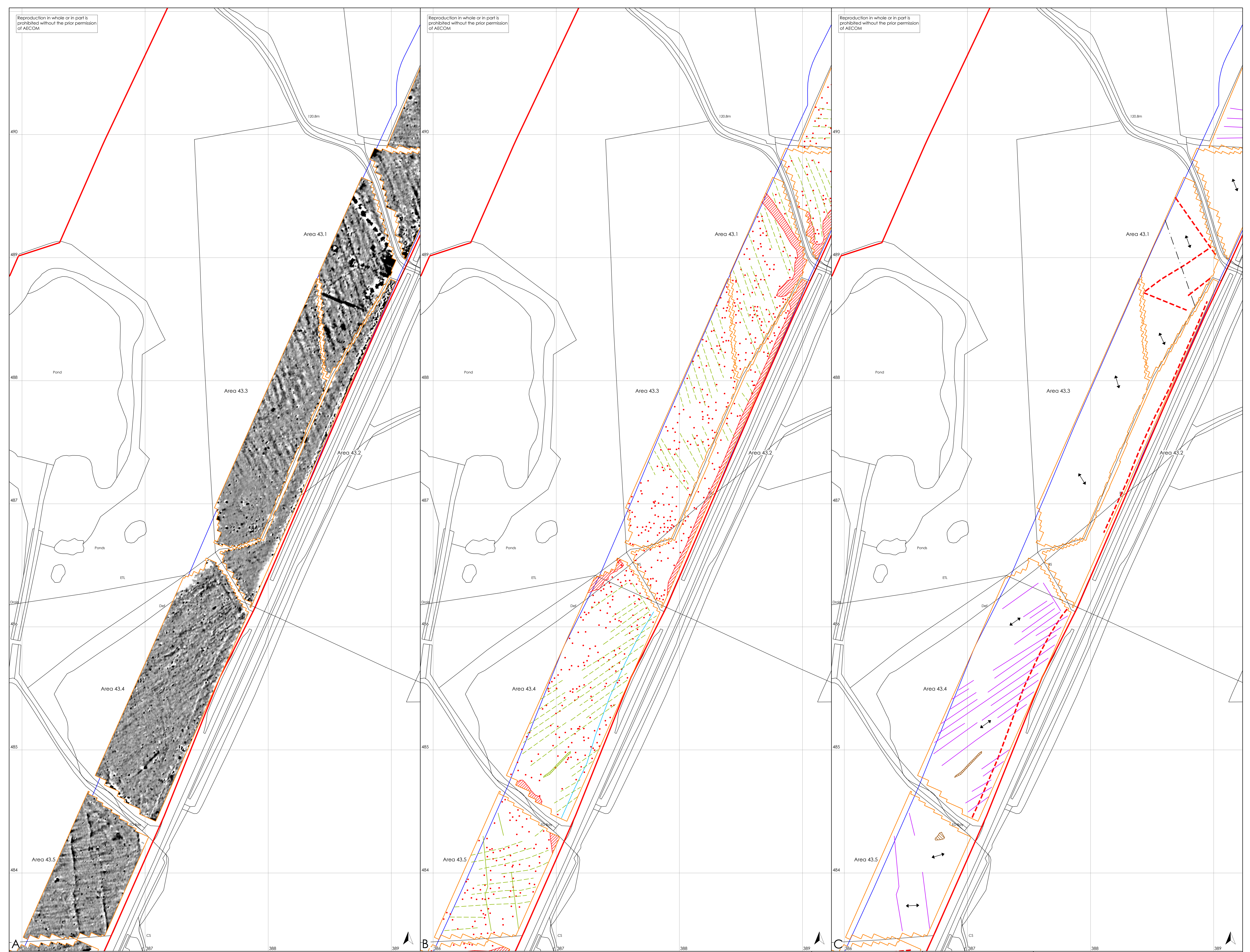


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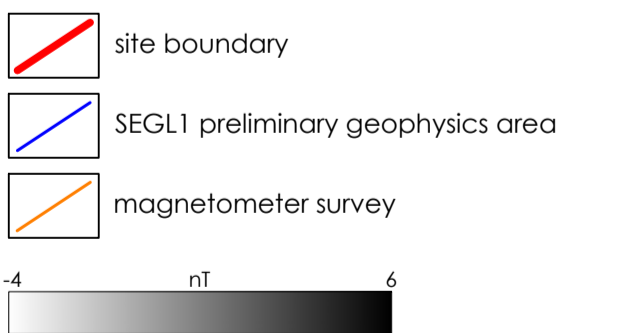
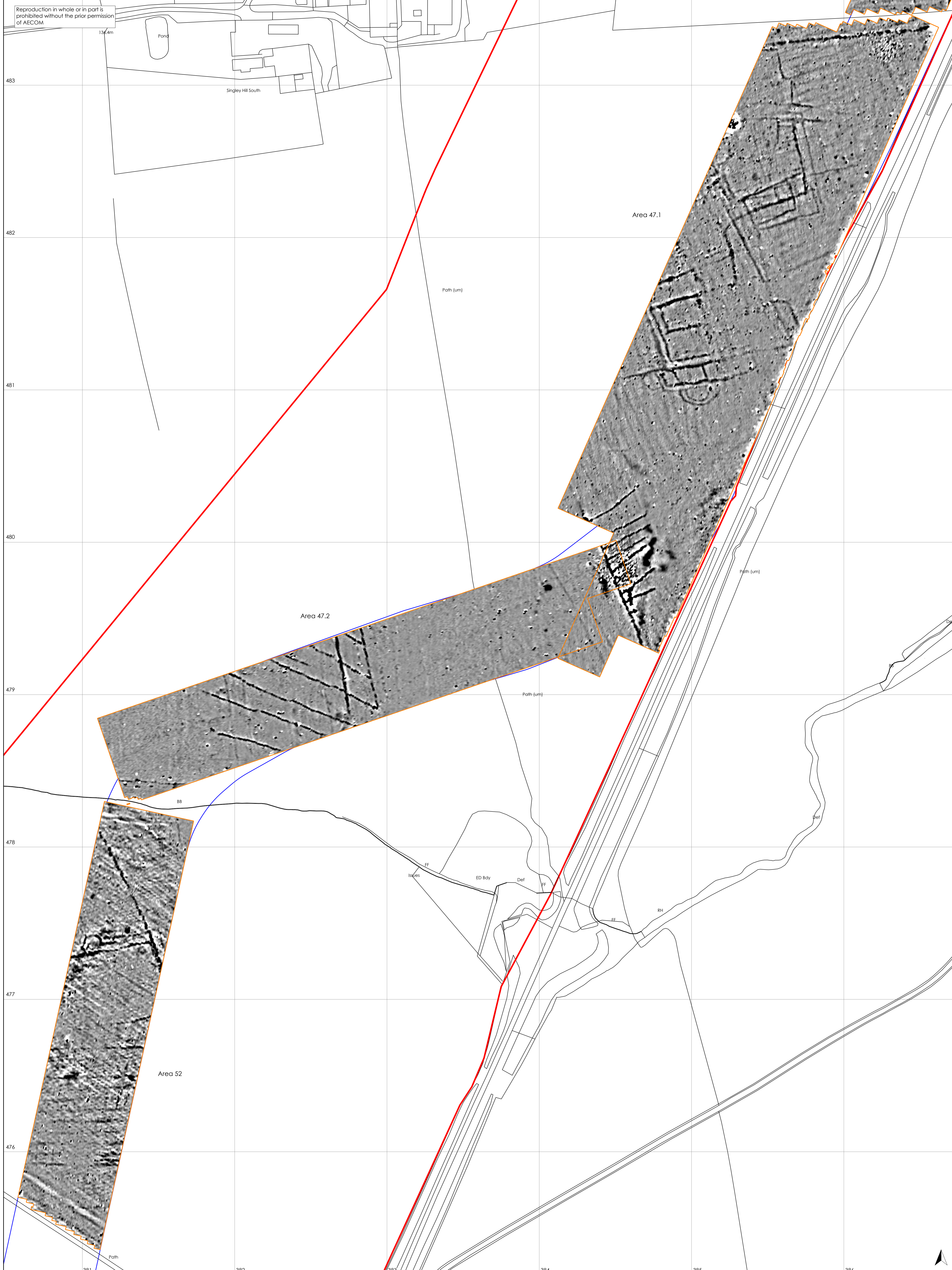


- site boundary
- SEGL1 preliminary geophysics area
- magnetometer survey
- dipolar magnetic anomaly
- positive magnetic anomaly
- negative magnetic anomaly
- possible soil-filled feature
- ridge and furrow
- former field boundary
- service
- land drain

scale 1:1000 for A0 plot

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Figure 16: Areas 43.1-5 - Magnetometer survey (A), geophysical (B) and archaeological (C) interpretations



0 50m
scale 1:1000 for A0 plot

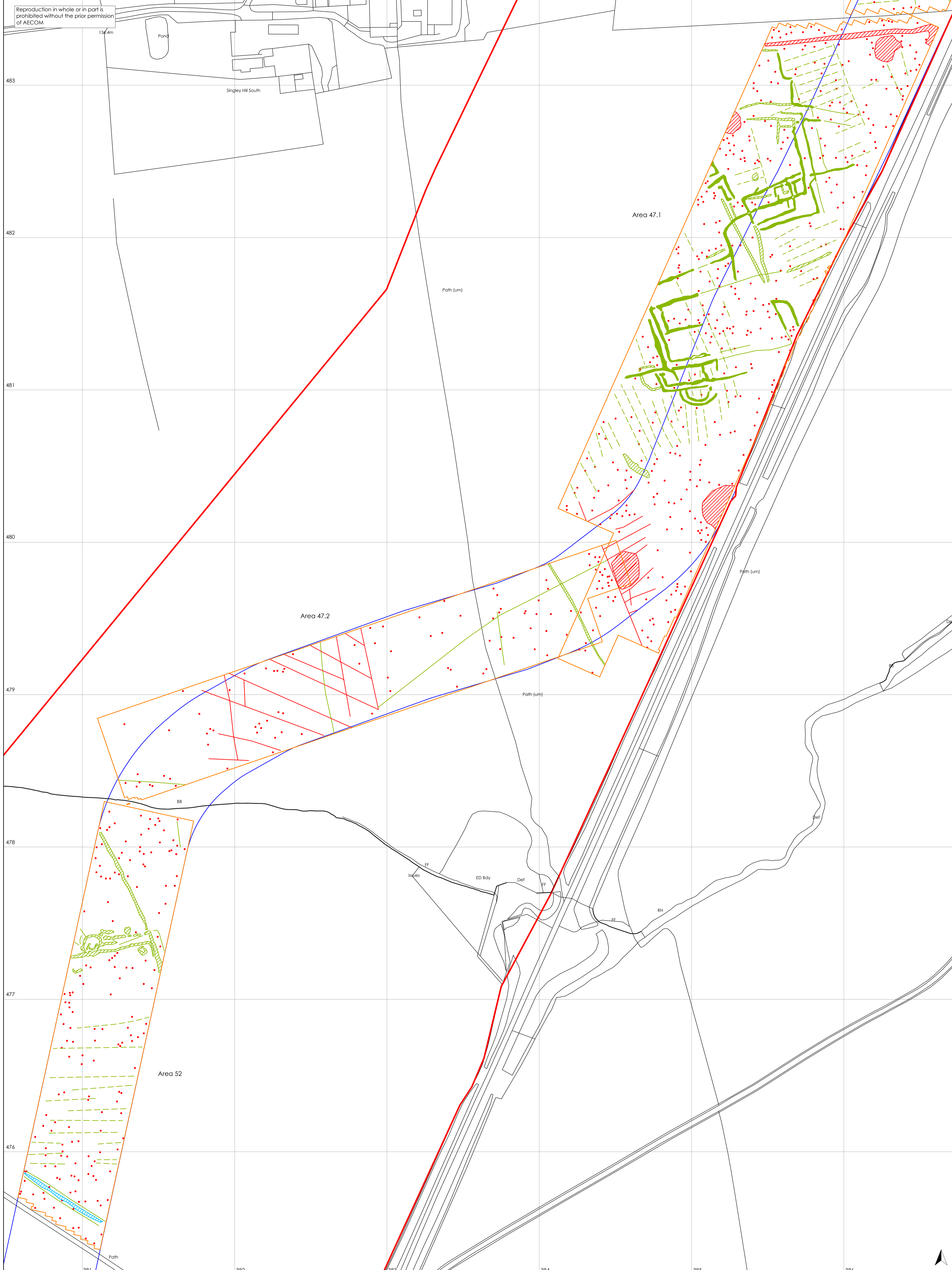
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Figure 17: Areas 47.1, 47.2 & 52 -
Magnetometer survey





- site boundary
- SEGL1 preliminary geophysics area
- magnetometer survey
- dipolar magnetic anomaly
- positive magnetic anomaly
- negative magnetic anomaly

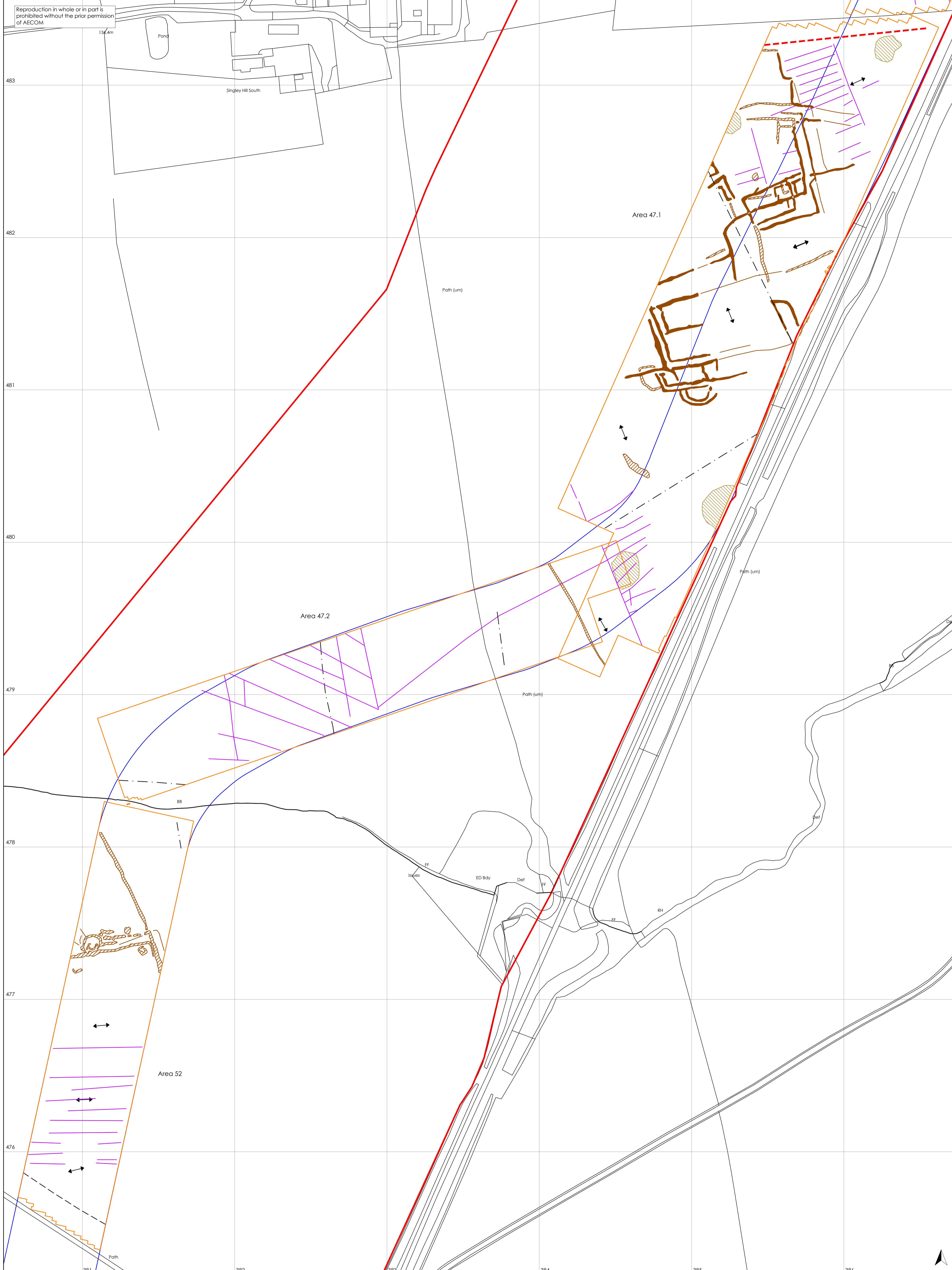
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scale 1:1000 for A0 plot

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Figure 18: Areas 47.1, 47.2 & 52 -
Geophysical interpretation



- site boundary
- SEGL1 preliminary geophysics area
- magnetometer survey
- possible soil-filled feature
- disturbed area
- ridge and furrow
- former track
- former field boundary
- service
- land drain

0 50m
scale 1:1000 for A0 plot

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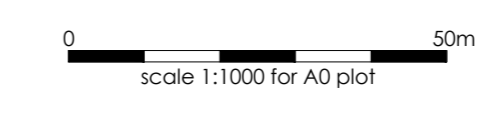
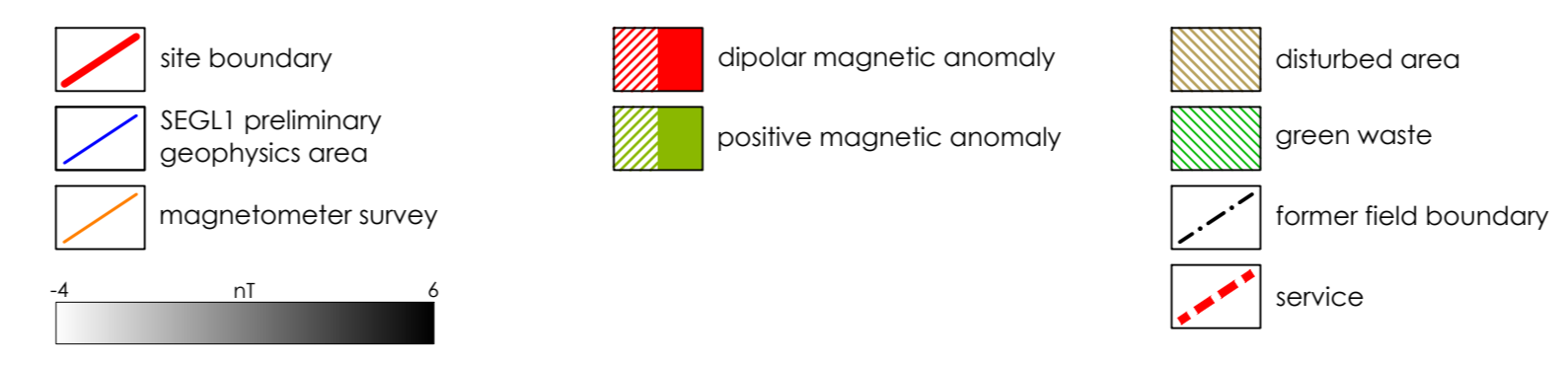
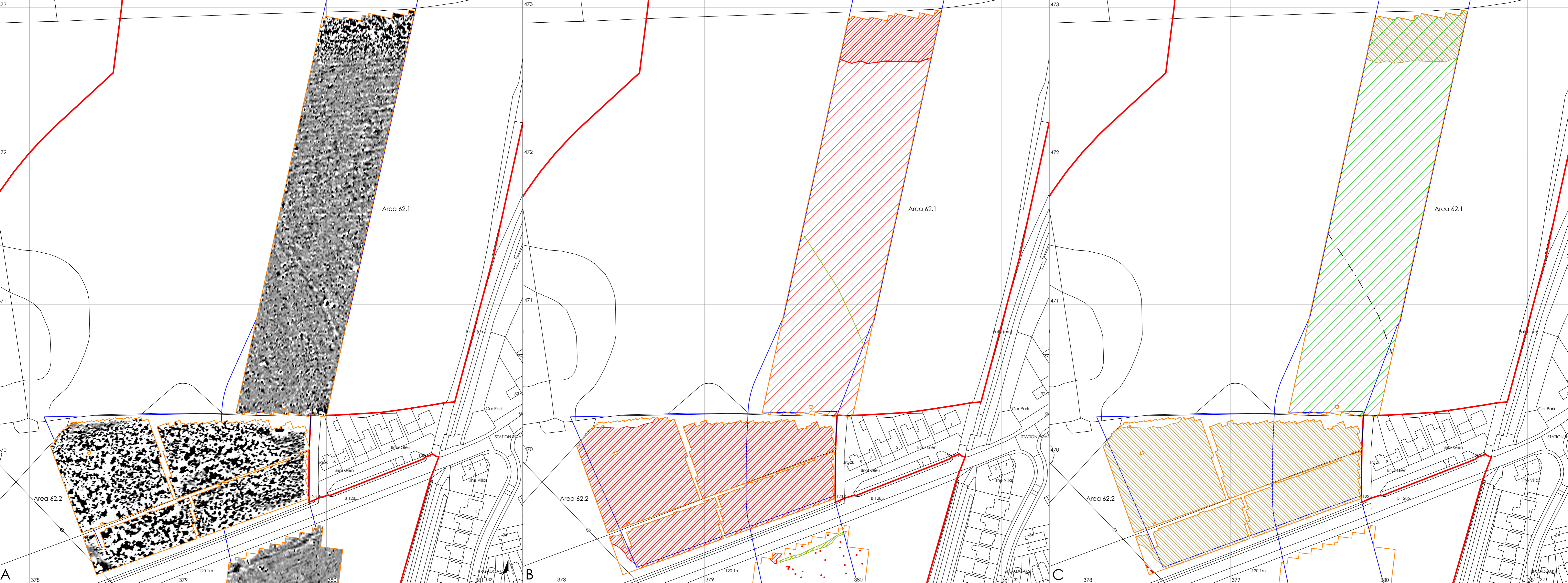
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Figure 19: Areas 47.1, 47.2 & 52 -
Archaeological interpretation

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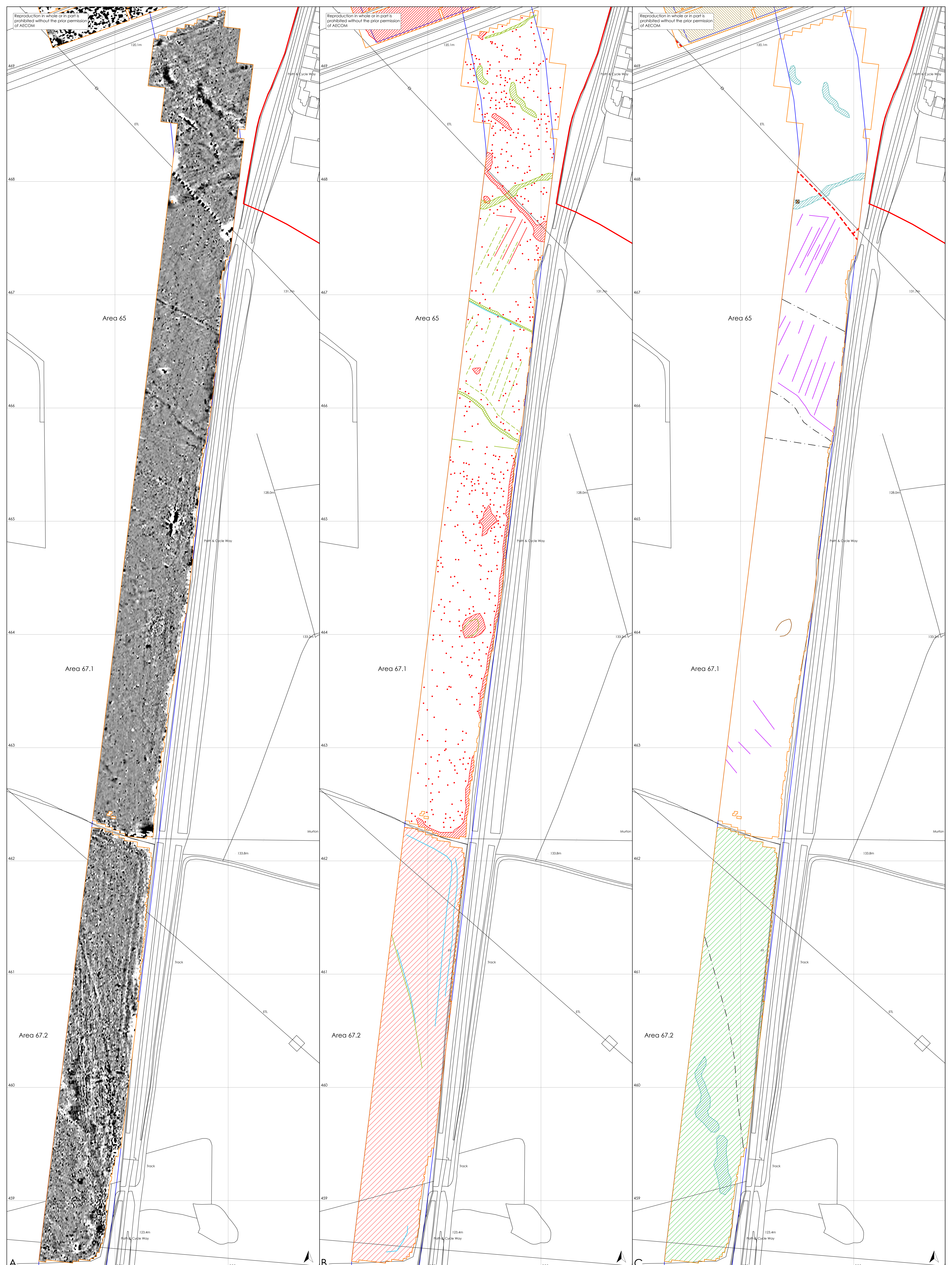
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Figure 20: Areas 62.1 & 62.2 - Magnetometer survey (A), geophysical (B) and archaeological (C) interpretations

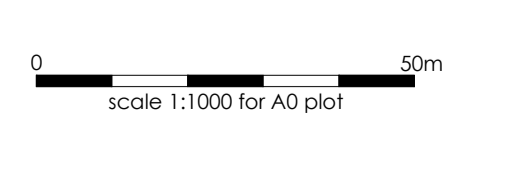


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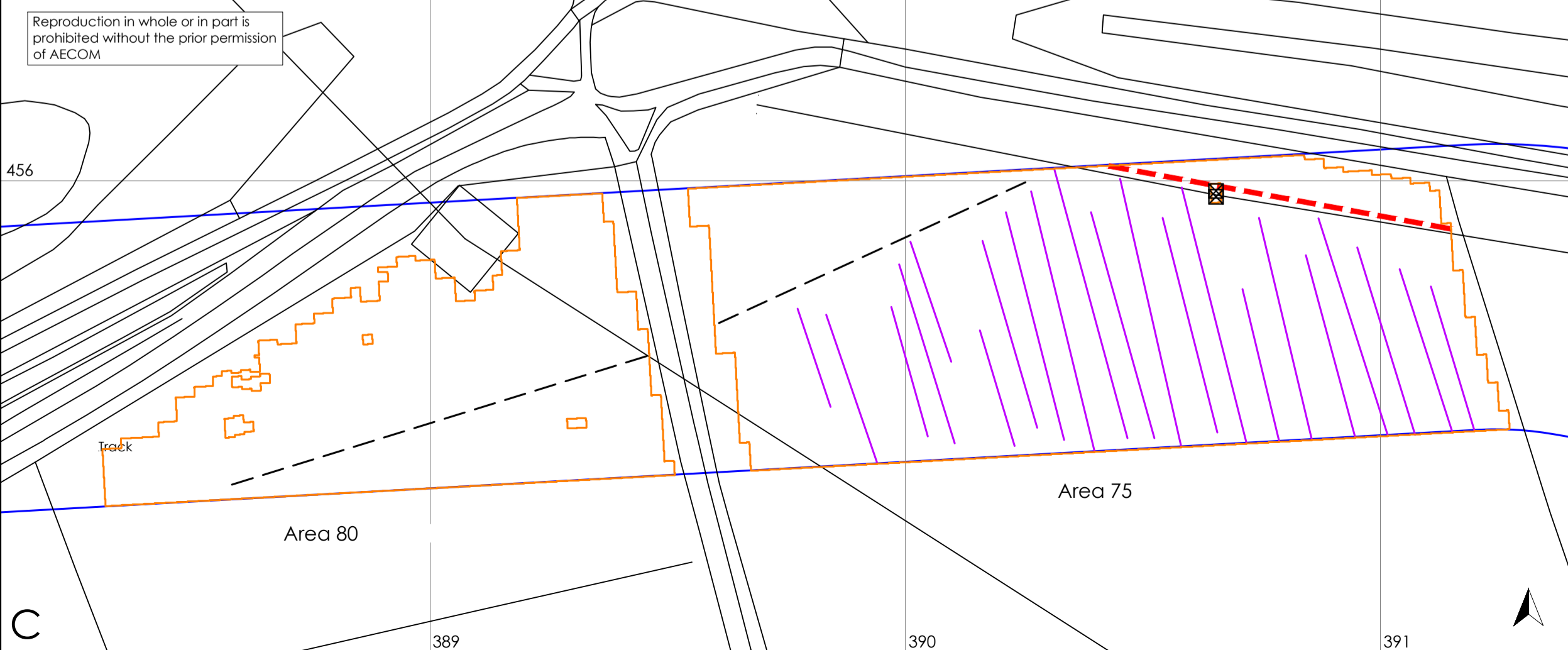
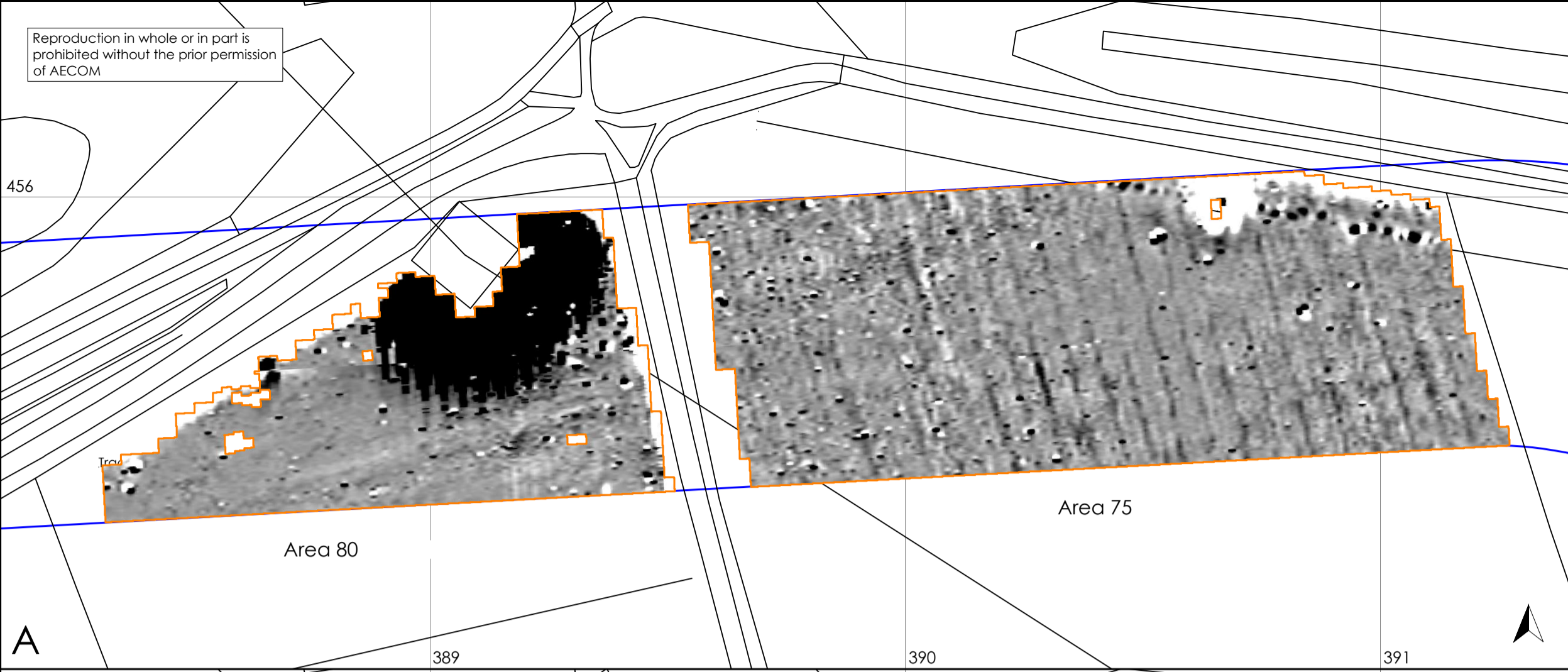
- | | | | |
|----------------------------------|---------------------------|------------------------------|----------------|
| site boundary | dipolar magnetic anomaly | possible soil-filled feature | service |
| SEG1 preliminary geophysics area | positive magnetic anomaly | disturbed area | land drain |
| magnetometer survey | negative magnetic anomaly | geological feature | telegraph pole |
| | green waste | former field boundary | |



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









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Figure 21: Areas 65, 67.1 & 67.2 - Magnetometer survey (A), geophysical (B) and archaeological (C) interpretations

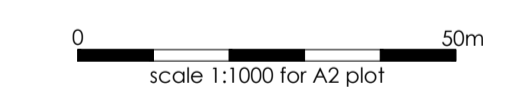
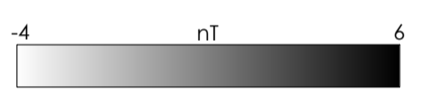
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-  site boundary
-  SEGL1 preliminary geophysics area
-  magnetometer survey
-  dipolar magnetic anomaly
-  positive magnetic anomaly
-  negative magnetic anomaly
-  track
-  service
-  land drain
-  telegraph pole



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Figure 22: Areas 75 & 80 - Magnetometer survey (A), geophysical (B) and archaeological (C) interpretations