GEOPHYSICAL SURVEY REPORT

Camelford, Cornwall

Client

Cornwall Archaeological Unit

For

Cormac Ltd

OASIS Ref.

sumogeop1-503088

Survey Report

03810

Date

November 2021

Survey Report 03810: Camelford, Cornwall

Survey dates	31 August 2021 1 September – 30 September 2021 1 October – 15 October 2021 20 October - 22 October 2021
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Field Team	Lukasz Krawec BSc Jordan Morris BA Liam Brice-Bateman BA Darcy Hooper MSci Stephen Weston BA
Report Date	29 November 2021
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2. SURVEY TECHNIQUE

Detailed magnetic survey (magnetometry) was chosen as the most efficient and effective method of locating the type of archaeological anomalies which might be expected within the study area. Previous work in the vicinity has demonstrated that the technique works well (GSB 2003).

Bartington Grad 601-2   Traverse Interval 1.0m   Sample Interval 0.25m

3 SUMMARY OF RESULTS

3.1 A magnetometer survey of approximately 170ha of ground was carried out over a study area associated with the proposed construction of a bypass around Camelford, Cornwall. The work was carried out over the course of several phases of fieldwork during Autumn in 2021. A number of features of archaeological interest have been identified including a large, probable circular ditch possibly associated with a number of surrounding ring ditches; three possible rounds or similar enclosures; a few small complexes of probable ring ditches and numerous field system and ditches.

3.2 Former field boundaries, evidence of ploughing, land drains, natural deposits and an igneous dyke have also been mapped. The results can be used to assess the potential impact of the proposed road scheme.

4 INTRODUCTION

4.1 **SUMO Geophysics Ltd** were commissioned to undertake a geophysical survey of a study area associated with the proposed Camelford Bypass. This survey forms part of an archaeological investigation being undertaken by **Cornwall Archaeological Unit** (**CAU**) on behalf of **Cormac Ltd**.

4.2 Site details

NGR / Postcode	Northern Point of A39: SX 12020 8520 / PL32 9XF Southern Point of A39: SX 09230 81501 / PL32 9RJ
Location	Camelford lies on the A39 road approximately 22km west of Launceston and 17km north of Bodmin, Cornwall, and on the northwestern edge of Bodmin Moor. The route of the proposed Camelford Bypass skirts in a loop around the western side of the town. The study area covers a total of 240 hectares, of which 170ha were subjected to detail magnetic survey.
OASIS Ref.	sumogeop1-503088
District	Camelford & Boscastle Electoral Division
Parish	Camelford
Topography	Mainly level or gently undulating with steep gradients in some places
Current Land Use	Pasture and agricultural
Geology (BGS 2021)	Solid: North – Tredorn Slate Formation. South – Trevose Slate Formation South and East – major igneous dyke / other smaller outcrops Superficial: none throughout most of area with exception of occasional Head Deposits and Alluvium along the Rivers Camel and Allen.
Soils (CU 2021)	Soilscale 6 – freely draining loamy soils predominate
Archaeology (CAU 2003)	Camelford lies within a landscape that is rich in archaeological deposits. Many examples of prehistoric and medieval remains survive in the vicinity of the proposed road corridor. However, while several medieval and post medieval field systems cross the proposed route no substantial archaeological sites are noted within the road corridor (based upon a CAU desk-based-assessment in 2003.). Geophysical survey carried out in 2003 along the proposed narrow road corridor also suggested a low level of archaeological activity along the majority of the road route. Most of the anomalies linear responses were remnants of former field divisions though some linear responses indicated remains of ancient field systems and areas of possible occupation activity. However, no clear archaeological patterns representative of substantial occupation were visible in the data

The following sites are recorded in the HER within the study area:

HER Number: 58884
Early Medieval field boundary
A banked field boundary of medieval or later date is visible as low earthworks on aerial photographs.
Grid Reference: SX 1159 8477

HER Number: 58883
Post Medieval quarry
A quarry is marked at this location on the OS 1st Edition 1:2500 scale map.
Grid Reference: SX 1160 8471

HER Number: 17731
Iron Age round, Romano British round
An Iron Age fortification identified by Rowe and noted by Dudley 1953 could not be traced by the OS 1976.
Grid Reference: SX 113 847

HER Number: 2298
Medieval strip field
Long parallel field boundaries at Trefrew appear to be the remains of the enclosed strips of an open-field system.
Grid Reference: SX 1101 8477

HER Number: 177253
Romano British signal station
Geophysical survey by GSB in 2007 as part of an archaeological assessment for proposed school expansion revealed an area of probable IA/RB settlement. This particular feature is a rectilinear single-ditched enclosure approx 30 x 40m with a possible circular ditch within it. It could be interpreted as a Roman signal station, although the surrounding IA settlement evidence perhaps make this less likely (JRS). (GSB survey no 07/72)
Grid Reference: SX 1014 8383 **NB I**mmediately outside the current Study Area

HER Number: 57165
Post Medieval quarry
Quarry partially marked on OS 1st edition map.
Grid Reference: SX 0996 8210

HER Number: 57166
Post Medieval quarry
Three partially plough-levelled quarries are visible as low earthworks and cropmarks on aerial photographs.
Grid Reference: SX 0966 8174

Survey Methods	Magnetometer survey (fluxgate gradiometer)
Study Area	*c.* 170 ha

4.3 Aims and Objectives

To locate and characterise any anomalies of possible interest within the wider study area, in order to place any remains in their broader archaeological context.

5 RESULTS

The survey has been divided into separate survey areas (Areas 1-112) and specific anomalies have been given numerical labels [1] [2] *which appear in the text below, as well as on the Interpretation Figure(s). Because of the large scale of the survey, the results are discussed under the differing interpretation categories and a summary of the potential archaeological features is included in Table 1 below. Detailed gradiometry was undertaken throughout the study area surrounding the proposed Camelford bypass.*

5.1 *Probable / Possible Archaeology*

5.1.1 A number of features of particular archaeological interest have been identified including:-

A large, probable circular ditch [15] possibly associated with a number of surrounding ring ditches [16] Areas 17, 18, 30 and 31.

Three possible Rounds or similar enclosures [23] (Areas 52, 53 and 55); [26] (Area 60) and [29] (Areas 69 and 70).

Small complexes of probable ring ditches (Areas 67, 101, 102 and 107) and numerous field system and ditches (Areas 1-5, 51, 67, 75, 102 and 107).

5.1.2 The HER (17731: SX 113 847) refers to the possible existence of an Iron Age / Romano British Round at the junction of Areas 22 and 37. The fortified site was identified by Rowe and noted by Dudley 1953 but could not be traced by the OS 1976. There are no magnetic responses in the data to indicate that the presence of such a monument.

5.1.3 **Table 1**

Areas	Magnetic responses	Archaeology
1, 2, 3 & 4	Linear / rectilinear [1, 2, 3, 4]	Possible field enclosures, old boundaries
9, 11, 12	Linear responses / trends [5] (See Areas 19, 22 & 37 below)	Boundary ditches
13	L-shaped anomaly [6]	Possibly part of a small enclosure
14	Linear anomaly [7]	Possible field ditch
15	Linear anomalies [8]	Possible tracks associated with old quarry marked on maps west of A39 or an enclosure
17	Linear anomalies [9] Two annular / oval anomalies [10], possibly concentric rings	Originally part of an enclosure Possible ring ditches, maybe barrows Other possible features
18	Poorly defined curved responses [11]	Tentative ring ditches similar to Area 17

19, 22, 37	Linear responses [12] Weaker responses on same alignment as [5] in Areas 9, 11 and 12	Extended ditch length extending across several fields; probably an early boundary ditch
27	Linear response [13]	Field ditch
28	Discrete anomalies, one ring-shaped [14]	Possible archaeological pits and a ring ditch
30 & 31	Curved anomalies [15] extending across two areas	Probably a large ring ditch with an entrance / break on its southern arc.
30, 31 32 & 33	Poorly defined ring responses [16]	Possibly ring ditches which could be aligned in a broad arc and which might extend into Area 17
32	Weak linear responses [17]	Possible enclosure
37	Linear anomaly [19] at right angles to [12] (above).	Ditch which joins longer boundary ditch
51	Possible ring responses at [20] and [21] plus linear trends Conjoined linear anomalies [22]	Possible ring ditches plus poorly defined ditch lengths Possible rectilinear ditched enclosure
52,53,55	Positive ring anomaly with linear responses on exterior and discrete anomalies inside. Anomalies extend from A53 into A52 and possibly into A55.	Large ring ditch measuring 55m n diameter, with tentative concentric inner ditch and possible pits. Ditch lengths extend to the north and south. See Area 26 [43] & [44]
52 & 53	Linear anomalies [24]	Ditches aligned N-S and E-W may join to form a possible enclosure west of the above
57, 60, 61, 62 & 65	Linear anomalies [25]	A series of ditches and possible enclosures, part of an old field system
60	Complex of linear and curvilinear anomalies [26]	A large oval shaped enclosure (55m x 45m) where existing curving field boundaries form the western side of the feature
67	Two ring / arc anomalies [27] Weaker arcs and linear trends [28]	Small ring ditches Possible further ring ditches, ditch lengths the forms of which are not easily identified
69 & 70	Curving linear anomalies and trends [29]	Concentric and segmented ditches appear to form another large oval shaped enclosure, similar to [23] and [26]

70 & 71	Linear anomalies [30]	Field ditches possibly associated with the ring feature [29]
73, 76, 77 & 78	Linear anomalies and trends [31]	A series of ditches indicative of an old field system
78	Small ring anomaly [32]	Possible ring ditch associated with former field system
82, 83, 84, 85	A series of linear anomalies and trends [33]	Stretching across several fields the ditch could be another boundary ditch
100 & 101	Long linear anomaly [34]	Former boundary ditch
101	Two oval anomalies [35] and linear response [36]	Two ring ditches, the smaller one has an opening on its SE. A field ditch may extend to the west
102	Poorly defined rings / arcs [37] plus a linear responses [38]	There are several tentative ring ditches scattered across this field and the suggestion of a former trackway, which may be associated.
107	Weak curved and linear trends [39] Short linear responses and discrete anomalies [40]	Possible ring and field ditches A possible small enclosure with possible pits to the west

5.2 ***Uncertain***

5.2.1 It is inevitable that with a survey on this scale that many magnetic anomalies will be difficult to interpret; in most instances the responses are likely to be agricultural, modern or natural. Some of the responses could be archaeological but this interpretation would be tentative.

5.2.2 Areas 7, 11, 12, 21 and 24 a series of anomalous responses which could be scoops or pits. While the responses in Area 7 might be associated with an earlier course of the A39, another explanation for all the responses is that they reflect test quarry pits. A post-medieval quarry is recorded at the junction of Areas 21 and 24 with the A39.

5.2.3 Areas 77, 86, 87, 88, 98,99, 100, 1001 104 and 105. Well defined, curvilinear responses whose sinuous course appears more natural in origin than archaeological. They could reflect linear dykes or possibly former channels.

5.3 ***Former Field Boundary***

5.3.1 Linear responses associated with former boundaries visible on historic maps or conjectural because of their alignment are visible throughout the survey areas.

5.3.2 A linear magnetic response in Area 21 coincides with HER Number:58884 (*Early Medieval field boundary. A banked field boundary of medieval or later date is visible as low earthworks on aerial photographs. SX 1159 8477).*

5.4 *Agricultural – Ridge and Furrow / Ploughing / Land Drains*

5.4.1 Areas of ridge and furrow cultivation have been mapped, along with more recent ploughing effects and land drains.

5.5 *Natural / Geological*

5.5.1 Areas 103, 104, 106, 102 and 110. Strong magnetic responses follow a band crossing through several fields which coincides with an igneous dyke marked on geological maps. The outcrop has been exploited by a series of quarries which are recorded in the HER.

5.6 *Golf Course*

A range of anomalies along the western boundary of the study area coincide with different golf course features.

5.7 *Ferrous / Magnetic Disturbance*

5.7.1 Ferrous responses close to boundaries are due to adjacent fences and gates. Smaller scale ferrous anomalies (“iron spikes”) are present throughout the data and are characteristic of small pieces of ferrous debris (or brick / tile) in the topsoil; they are commonly assigned a modern origin. Only the most prominent of these are highlighted on the interpretation diagram.

5.8 *Unsurveyable Areas*

5.8.1 A number of areas could not be surveyed due to a unsuitable ground conditions (North of Area 55, Areas 65, 72 and 112) and the inability to arrange access (Areas 74, 79, 80 and 81).

6 DATA APPRAISAL & CONFIDENCE ASSESSMENT

6.1 Historic England guidelines (EH 2008) Table 4 states that the typical magnetic response on the local soils / geology is good. The results from this survey indicate the presence of range of archaeological features; consequently, the technique is deemed to have been effective. However, in places, responses associated with natural variations in the soils and near surface bedrock are likely to be similar to those produced by archaeological features. In addition, disturbance from past ridge and furrow cultivation, deep ploughing and even recent agricultural activity can obscure or mask archaeological features. Each of these agencies has left their mark on the data sets collected during this work

7 CONCLUSION

7.1 The magnetometer survey has identified a number of previously unrecorded archaeological sites and features. Their location and extent have been defined and mitigation strategies, where required, can now be determined. A number of features of archaeological interest have been identified including a large, probable circular ditch possibly associated with a number of surrounding ring ditches; three possible rounds or similar enclosures; a few small complexes of probable ring ditches and numerous field system and ditches. Former field boundaries, evidence of ploughing, land drains, natural deposits and an igneous dyke have also been mapped.

8 REFERENCES

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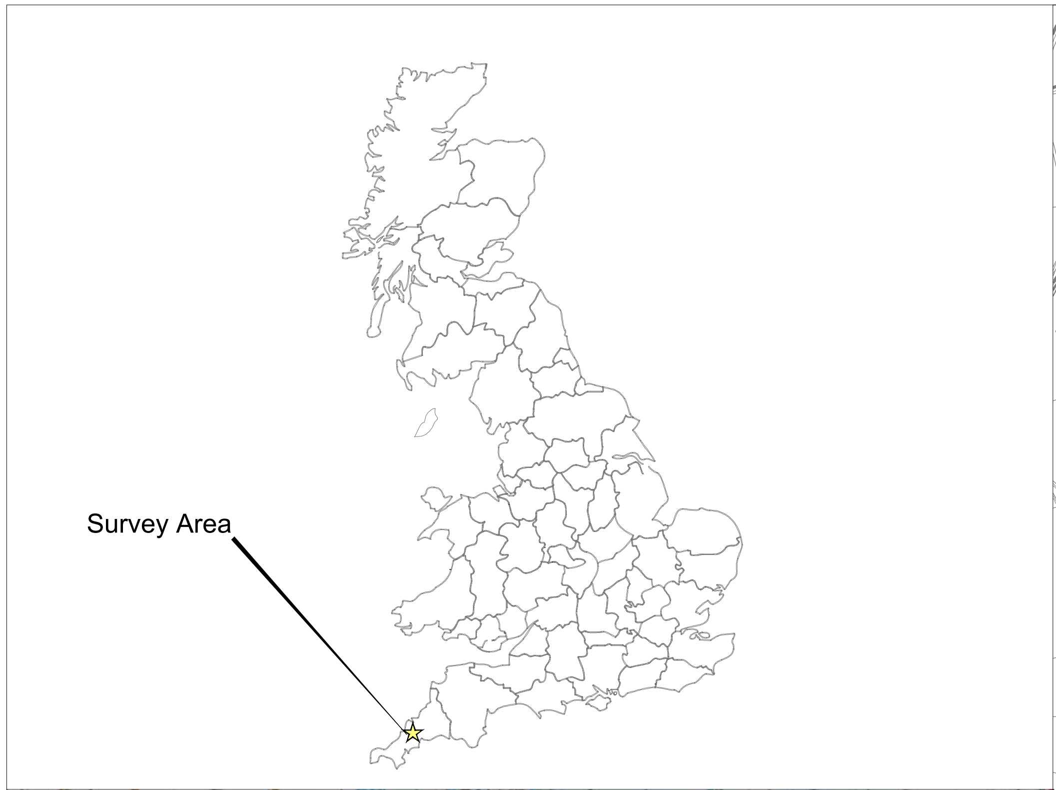

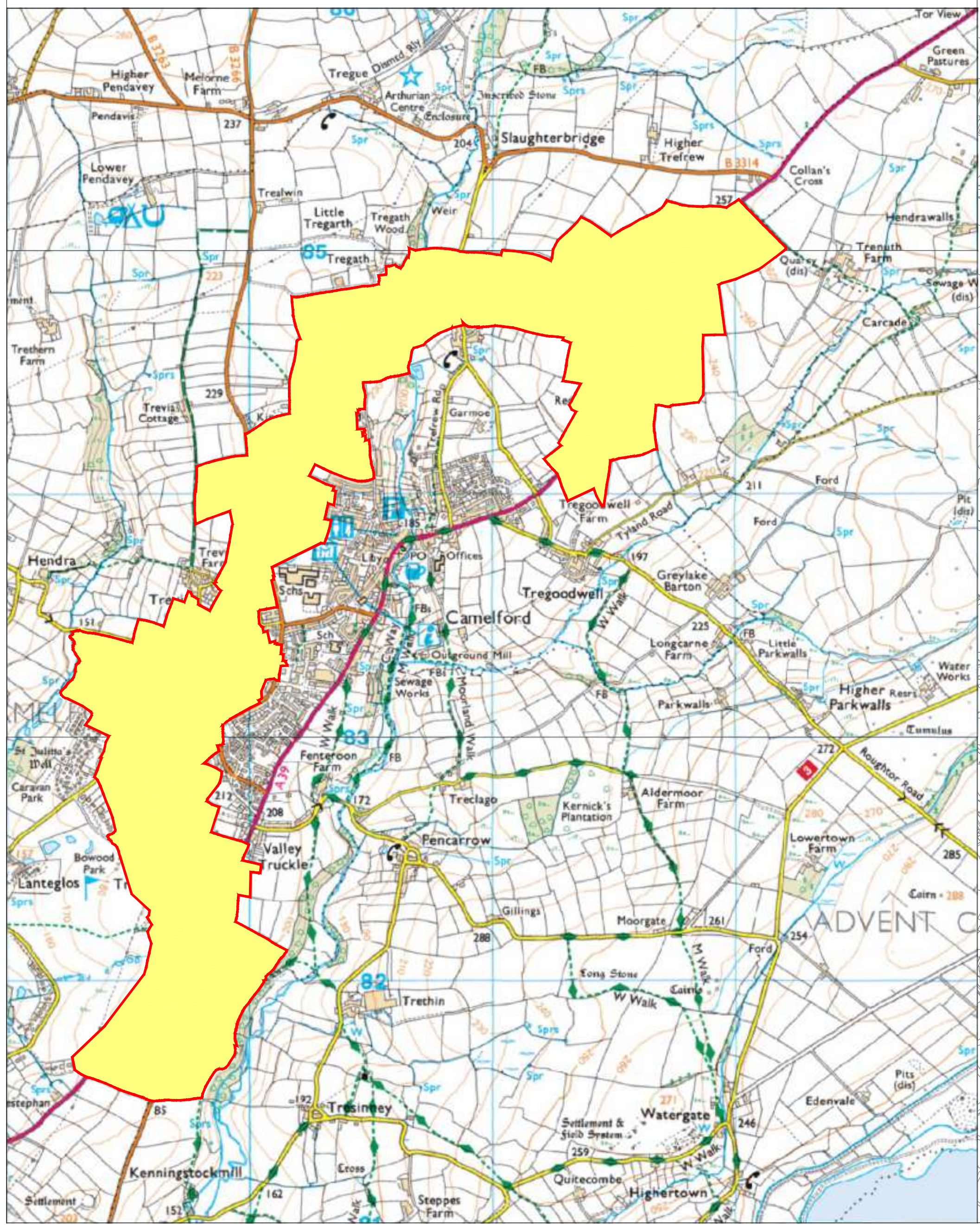

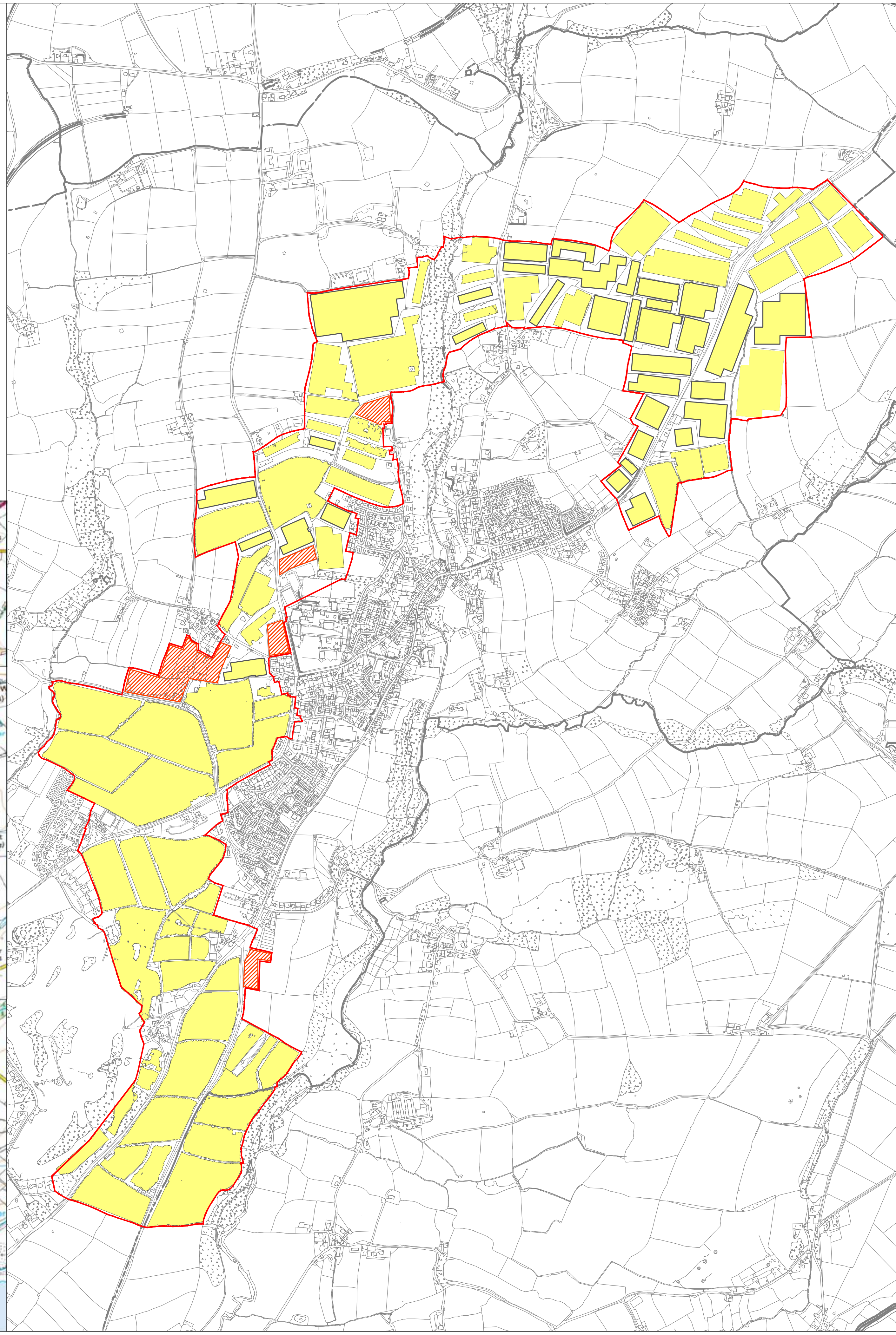

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Survey Areas	N
Unsurveyable	

SUMO Survey
GEOPHYSICS FOR ARCHAEOLOGY & ENGINEERING

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Cornwall Archaeological Unit

Project:
03810 - Camelford, Cornwall

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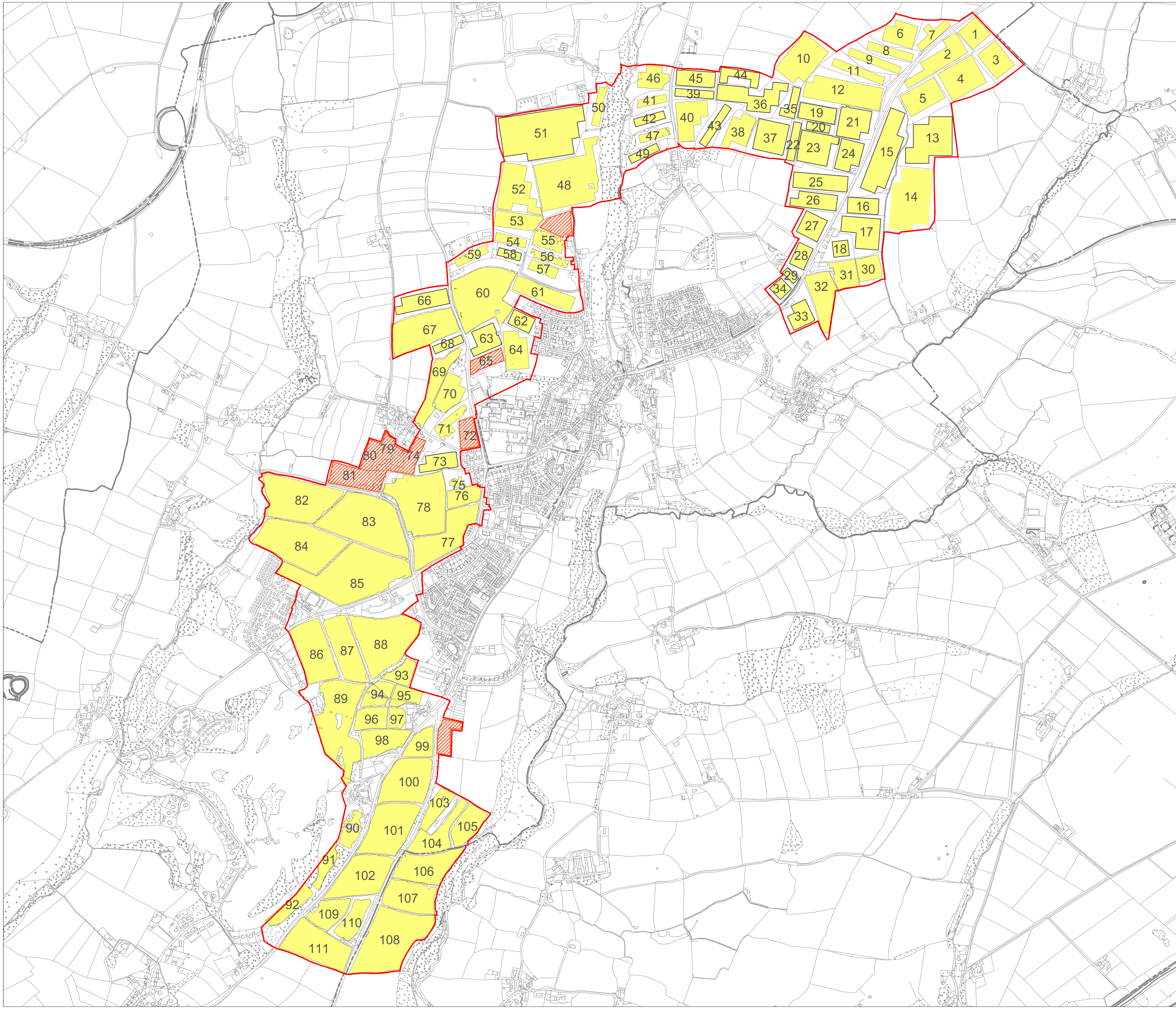

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Survey Areas

Unsurveyable

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Cornwall Archaeological Unit

Project:
03810 - Camelford, Cornwall

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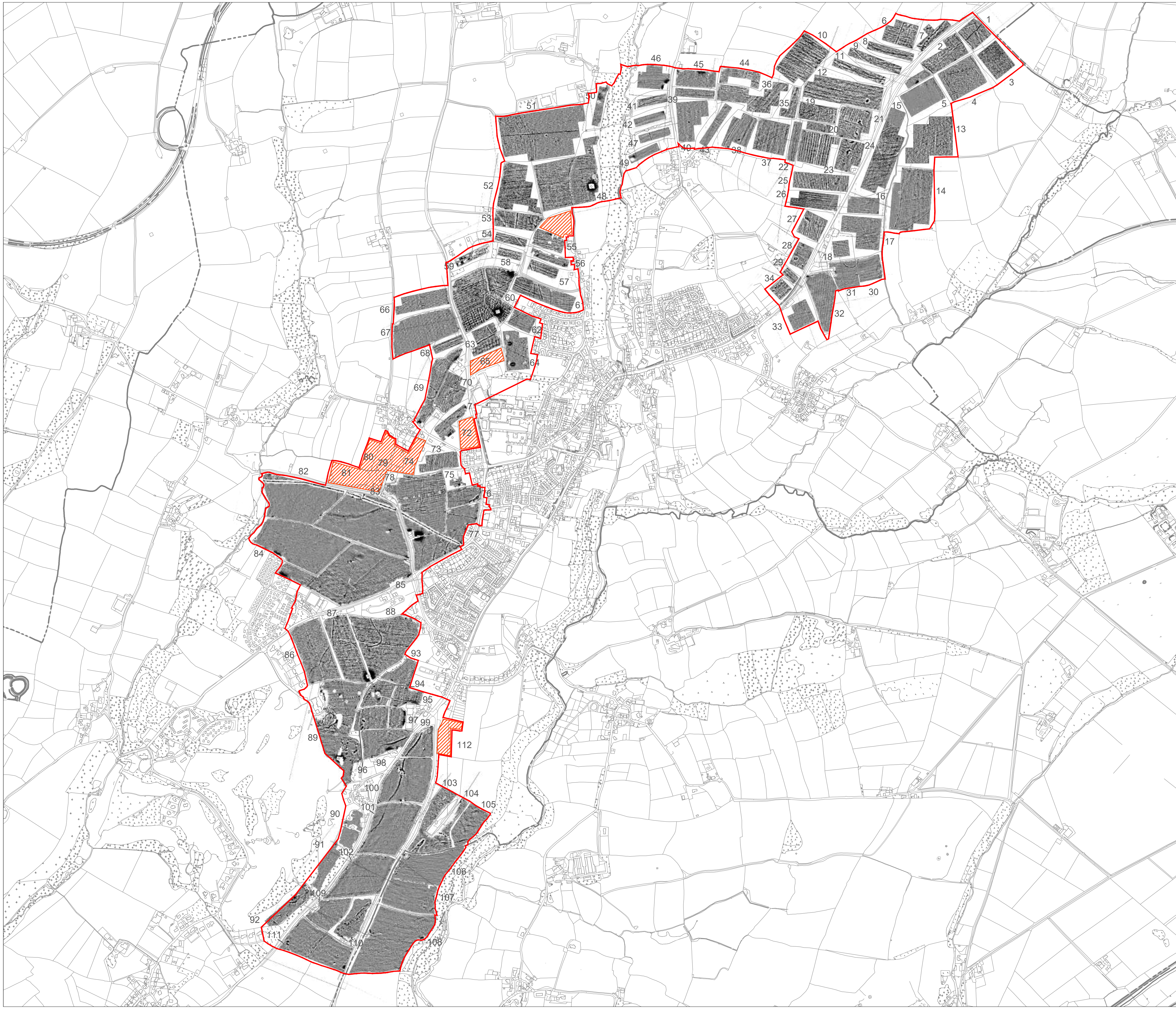

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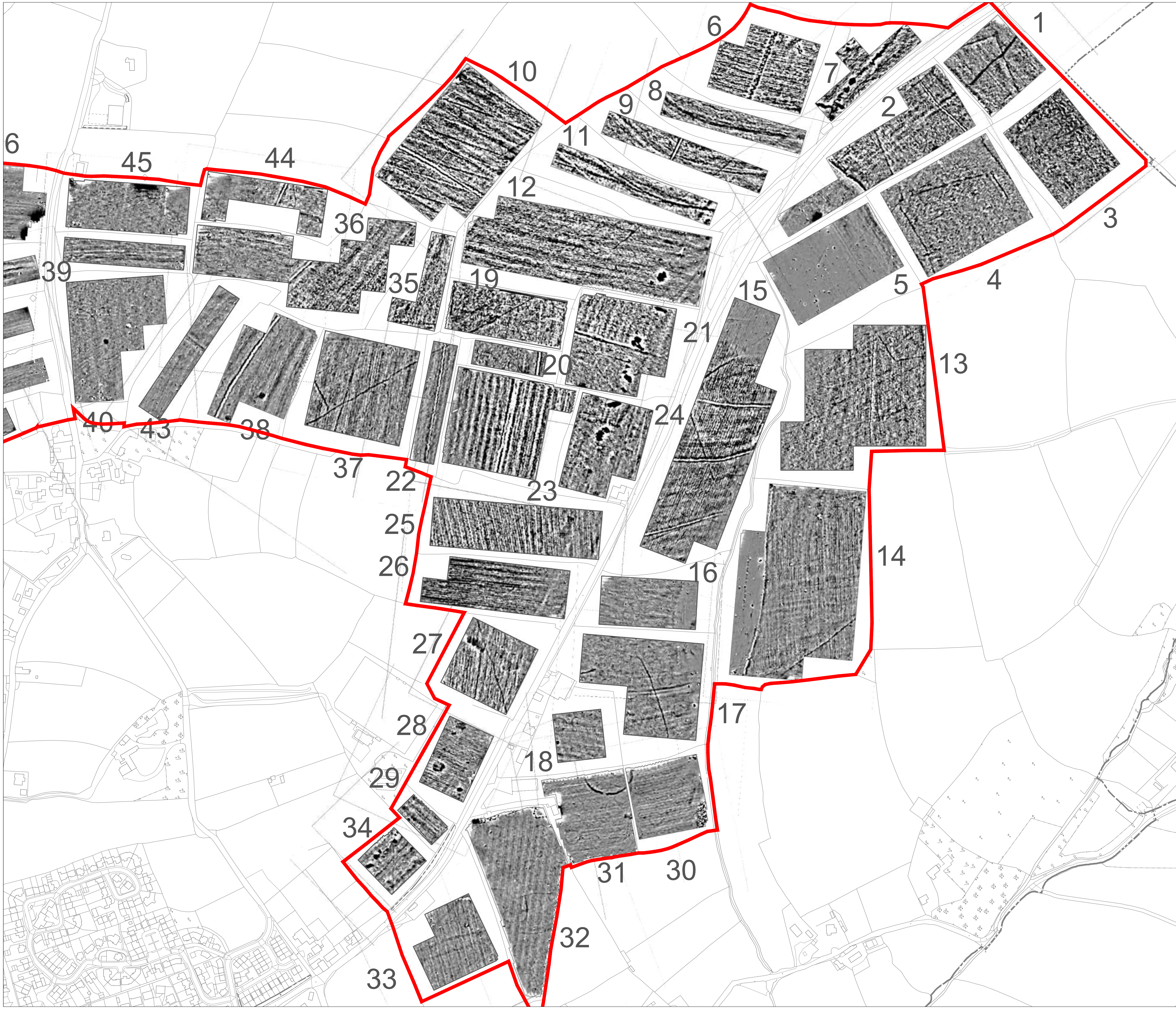
GEOPHYSICS FOR ARCHAEOLOGY & ENGINEERING



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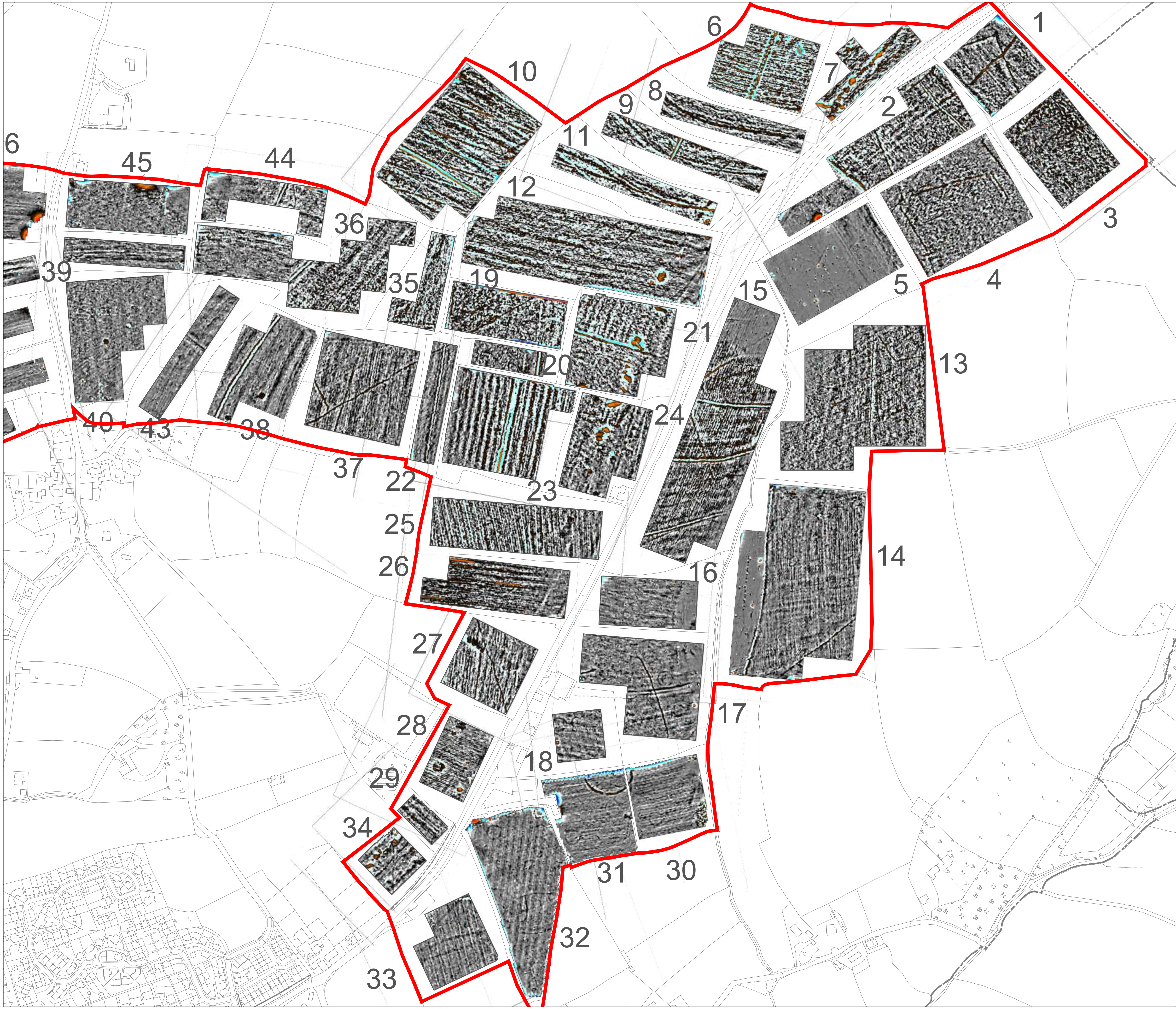

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Project: 03810 - Camelford, Cornwall

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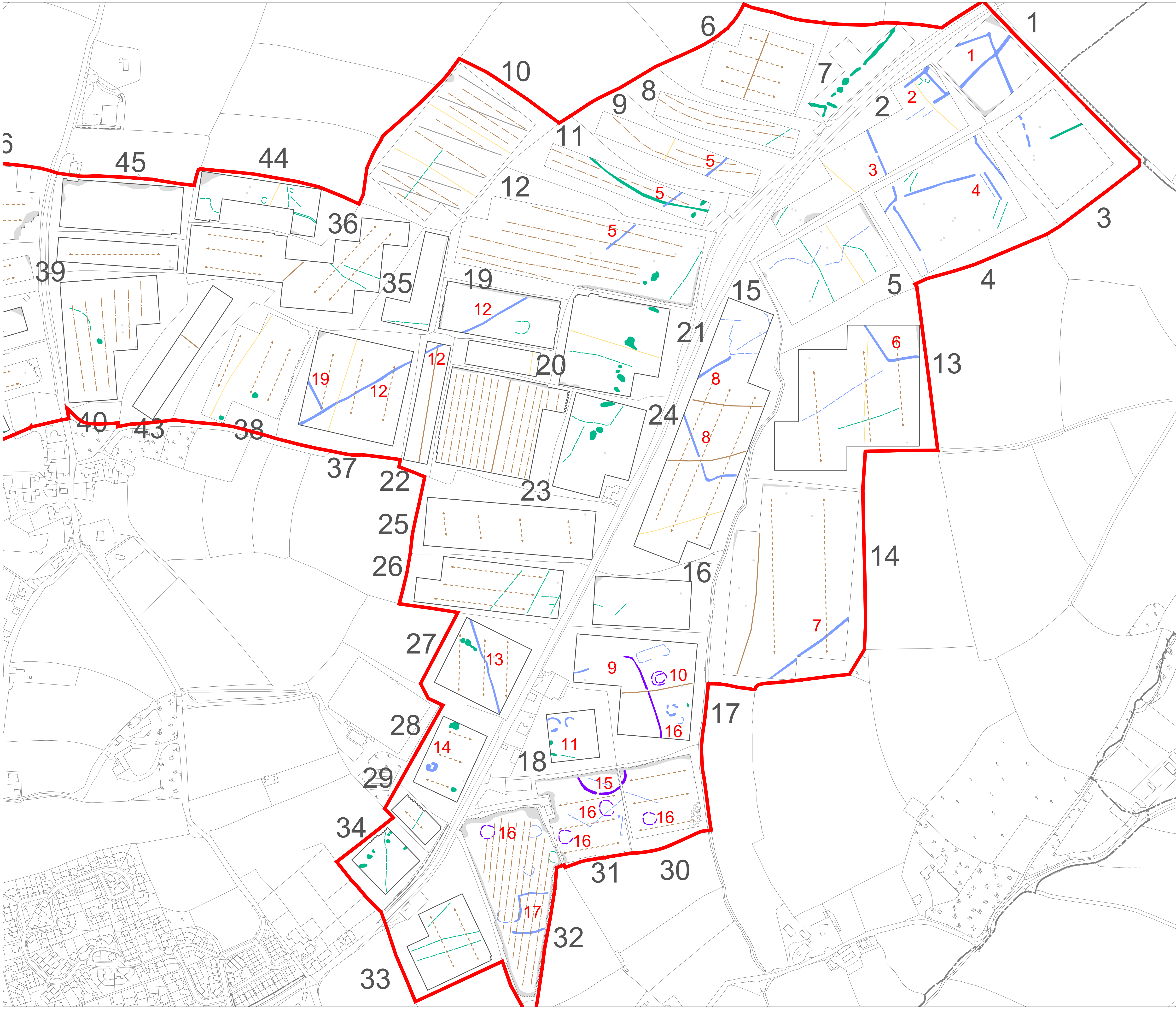

KEY

	Probable archaeology (discrete anomaly / trend)
	Possible archaeology (discrete anomaly / trend)
	Uncertain Origin (discrete anomaly / trend)
	Former field boundary (corroborated)
	Former field boundary (conjectural)
	Agriculture (ridge and furrow)
	Agriculture (plough)
	Land drain
	Natural (e.g. geological / pedological)
	Magnetic disturbance
	Service
	Ferrous
	Modern

GEOPHYSICS FOR ARCHAEOLOGY & ENGINEERING

Title: Magnetometer Survey - Interpretation [Areas 1 - 45]

Client: Cornwall Archaeological Unit

Project: 03810 - Camelford, Cornwall

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Magnetometer Survey - Greyscale Plots
[Areas 39 - 53]

Client:
Cornwall Archaeological Unit

Project:
03810 - Camelford, Cornwall

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GEOPHYSICS FOR ARCHAEOLOGY & ENGINEERING

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03810 - Camelford, Cornwall

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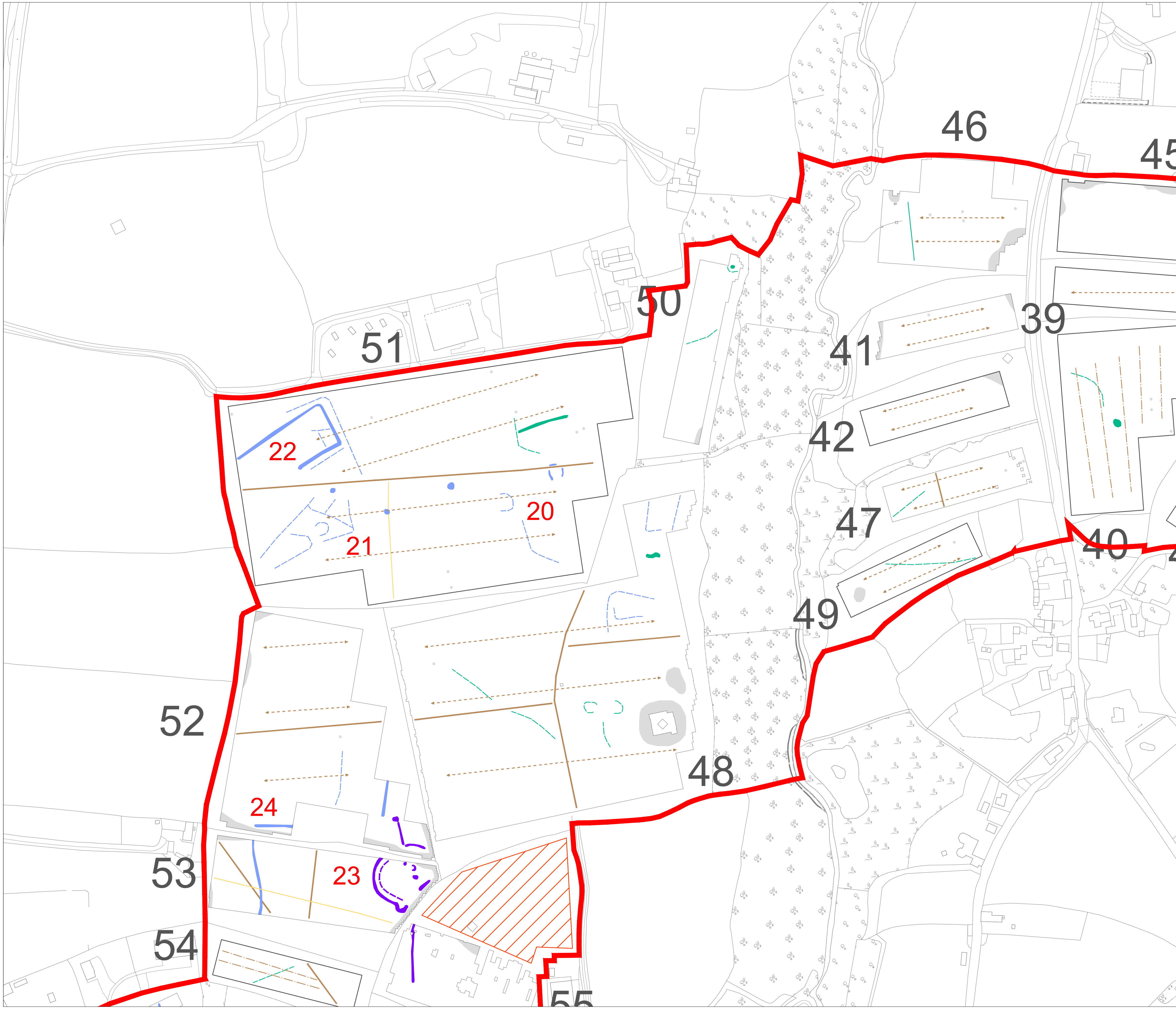

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KEY

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- Possible archaeology (discrete anomaly / trend)
- Uncertain Origin (discrete anomaly / trend)
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- Magnetic disturbance
- Service
- Ferrous
- Modern

GEOPHYSICS FOR ARCHAEOLOGY & ENGINEERING

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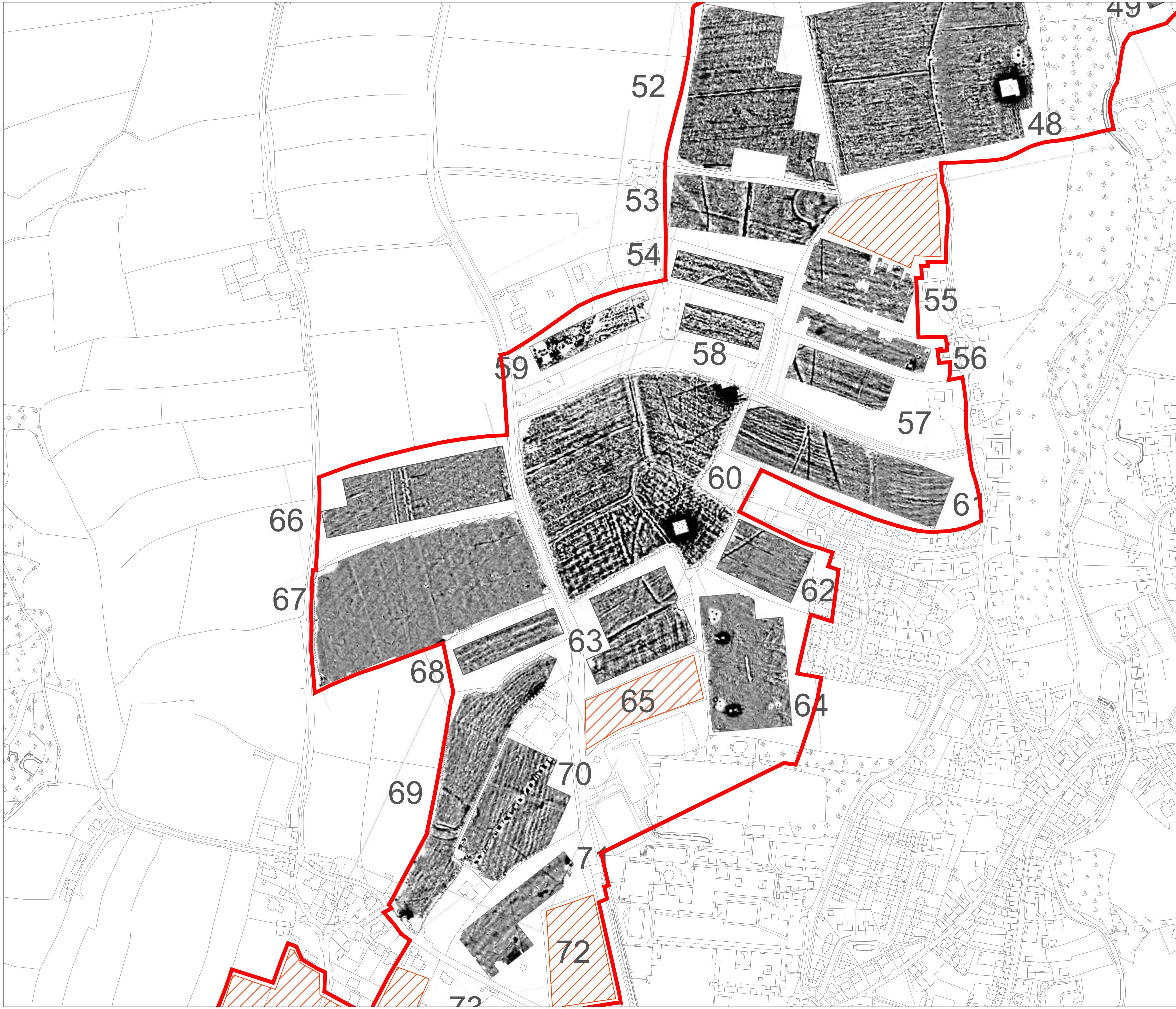

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Survey
GEOPHYSICS FOR ARCHAEOLOGY & ENGINEERING

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Project:
03810 - Camelford, Cornwall

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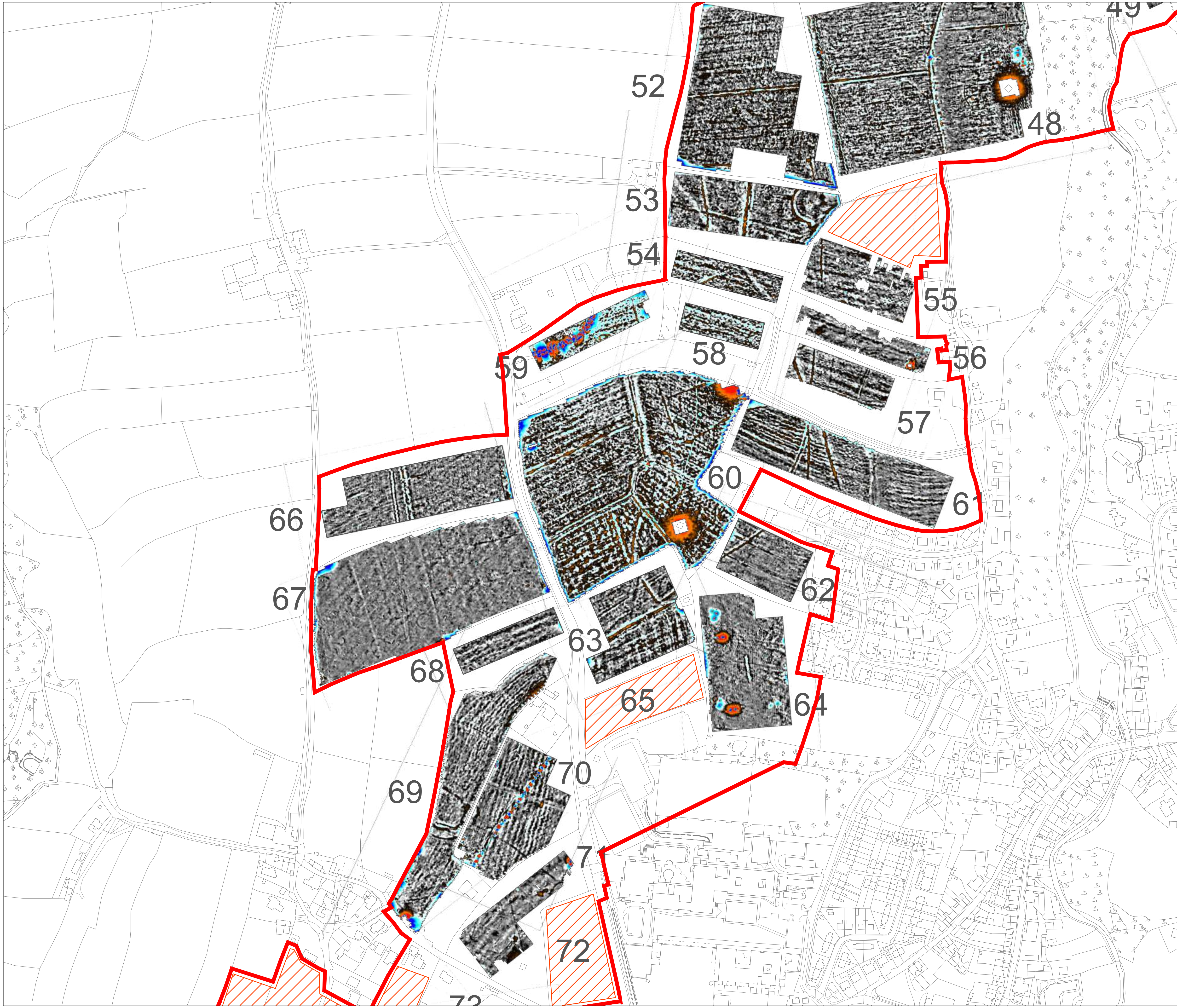

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Client: Cornwall Archaeological Unit

Project: 03810 - Camelford, Cornwall

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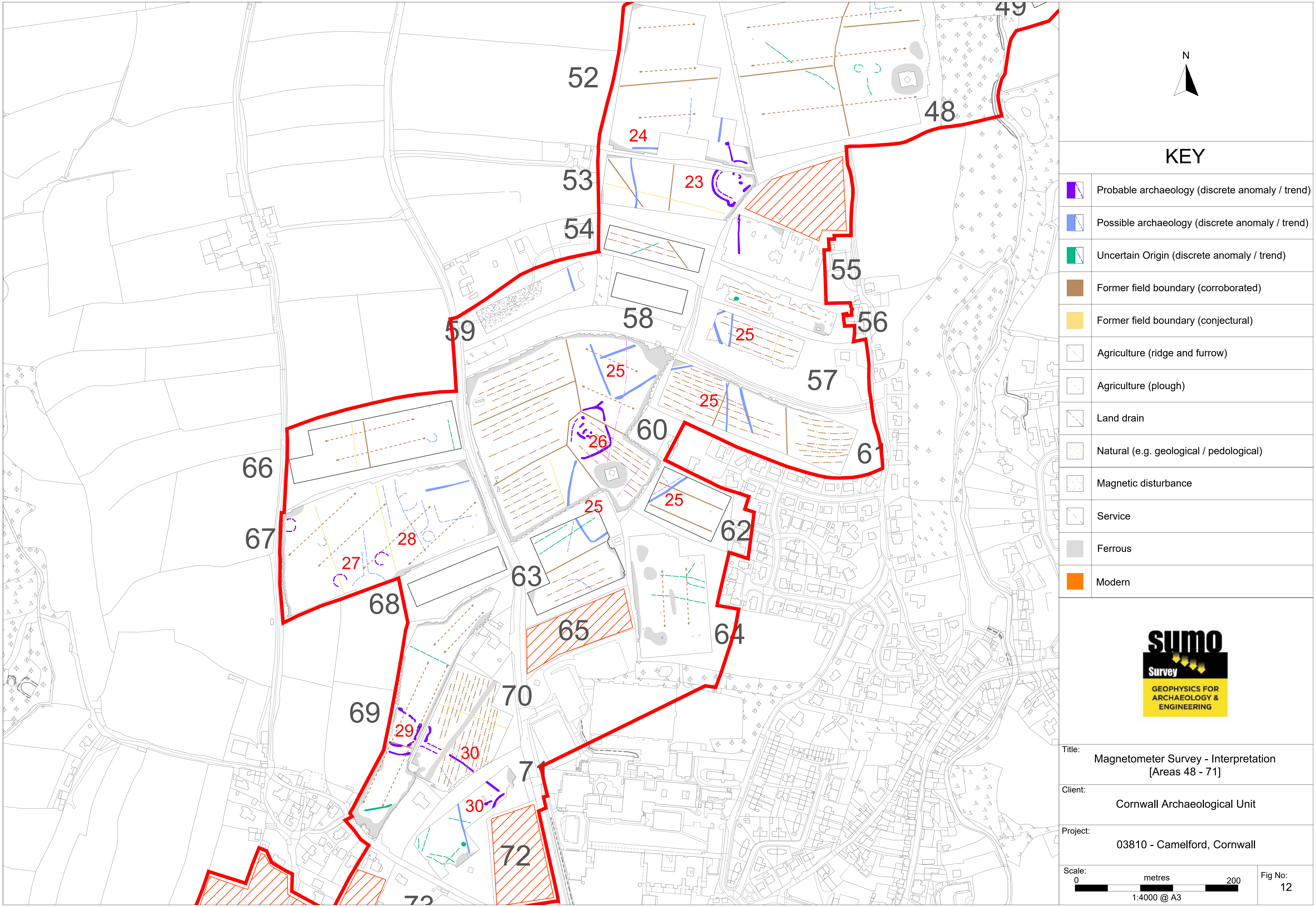

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Possible archaeology (discrete anomaly / trend)
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Natural (e.g. geological / pedological)
Magnetic disturbance
Service
Ferrous
Modern
sumo Survey
GEOPHYSICS FOR ARCHAEOLOGY & ENGINEERING
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Magnetometer Survey - Interpretation [Areas 48 - 71]
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Cornwall Archaeological Unit
Project:
03810 - Camelford, Cornwall
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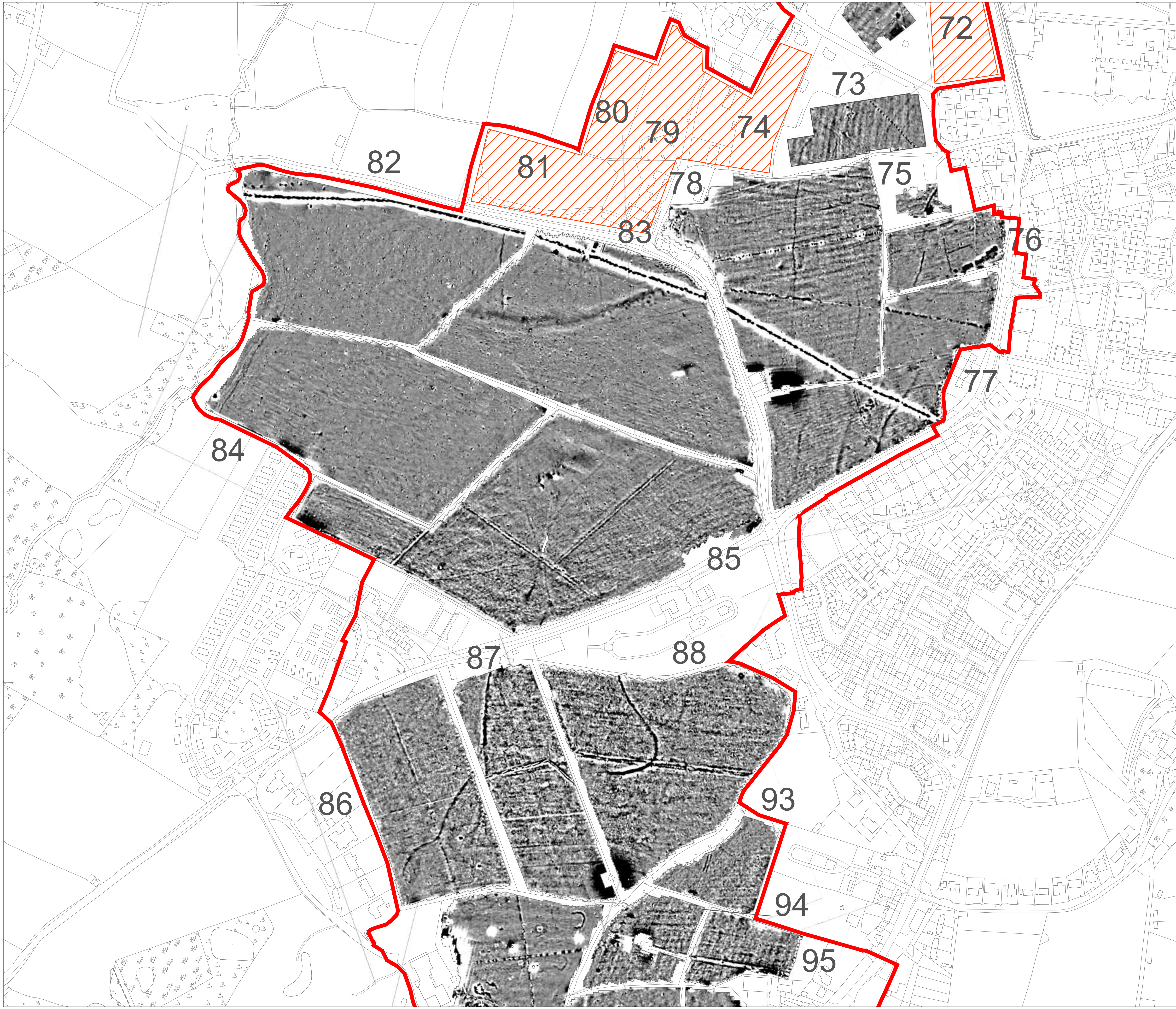

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sumo Survey
GEOPHYSICS FOR ARCHAEOLOGY & ENGINEERING

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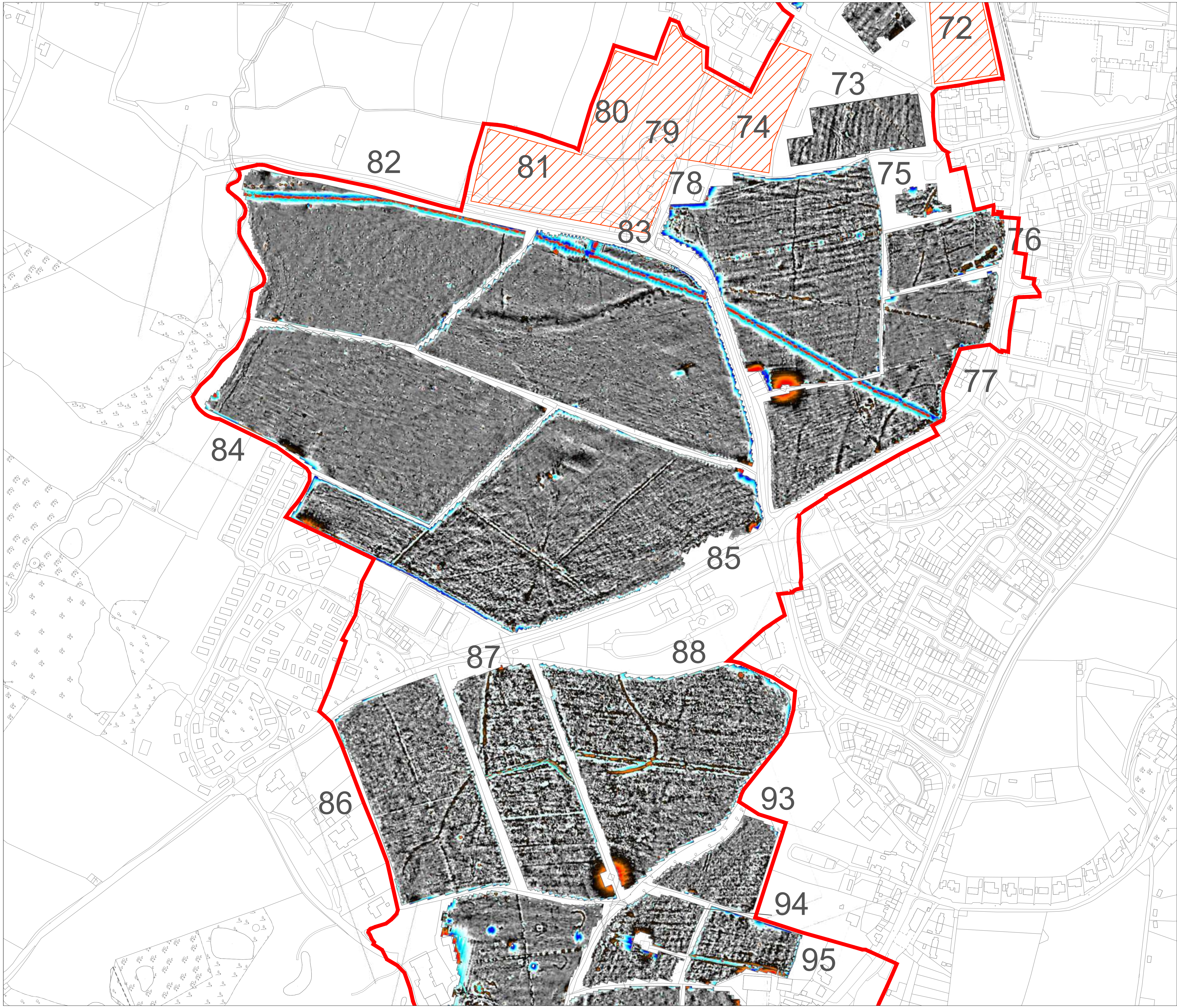

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GEOPHYSICS FOR ARCHAEOLOGY & ENGINEERING

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Magnetometer Survey - Colour Plots
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03810 - Camelford, Cornwall

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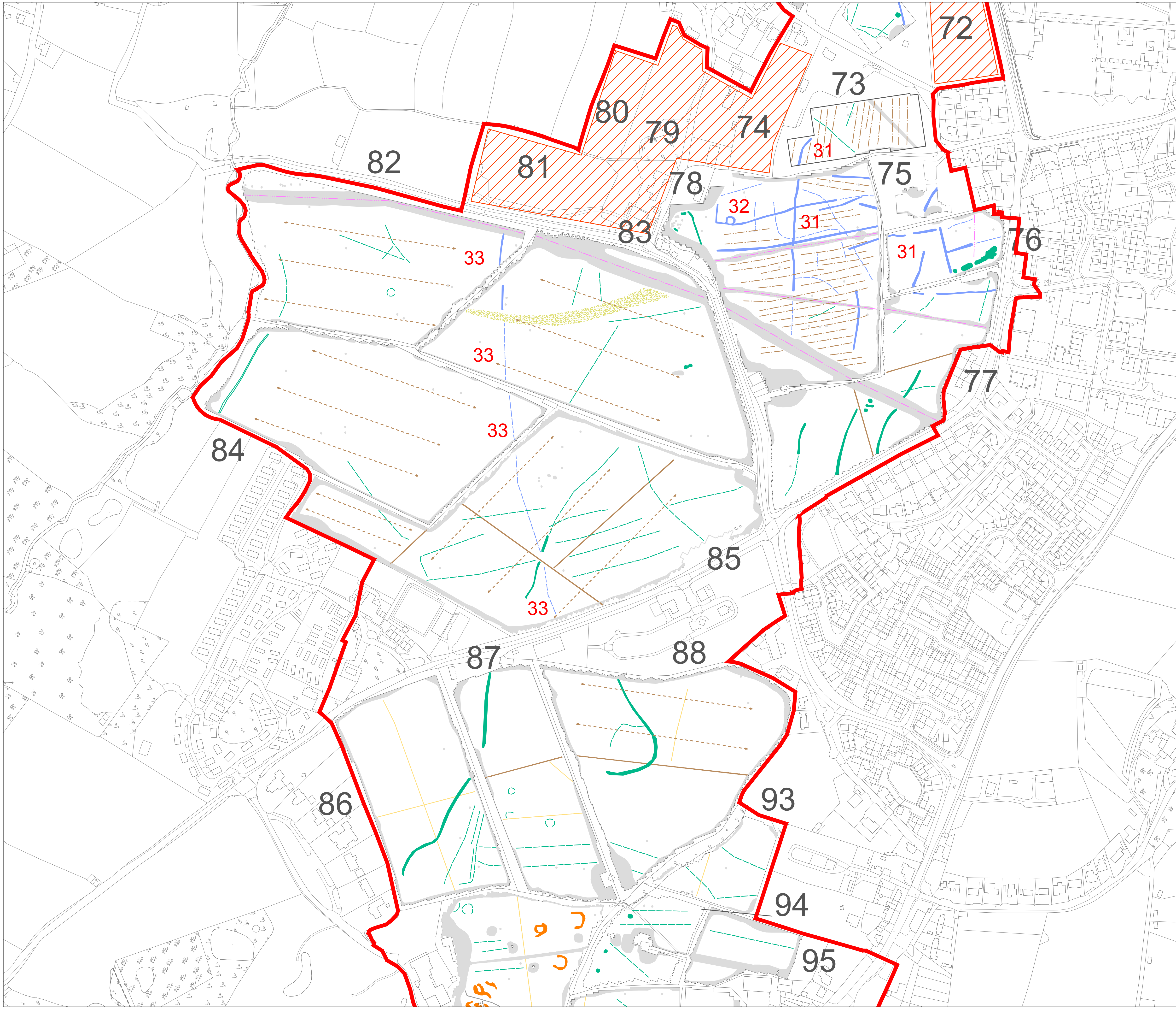

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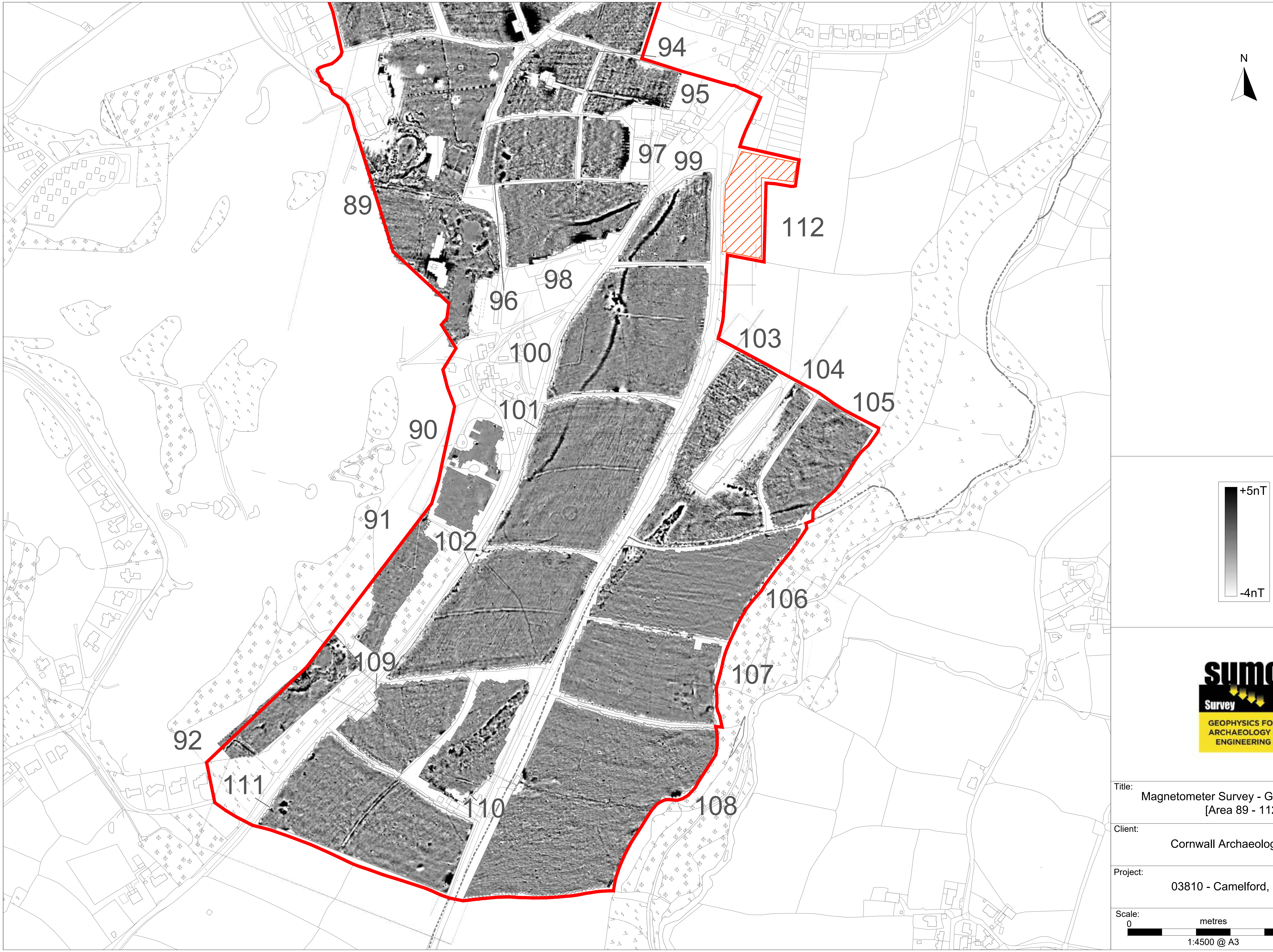

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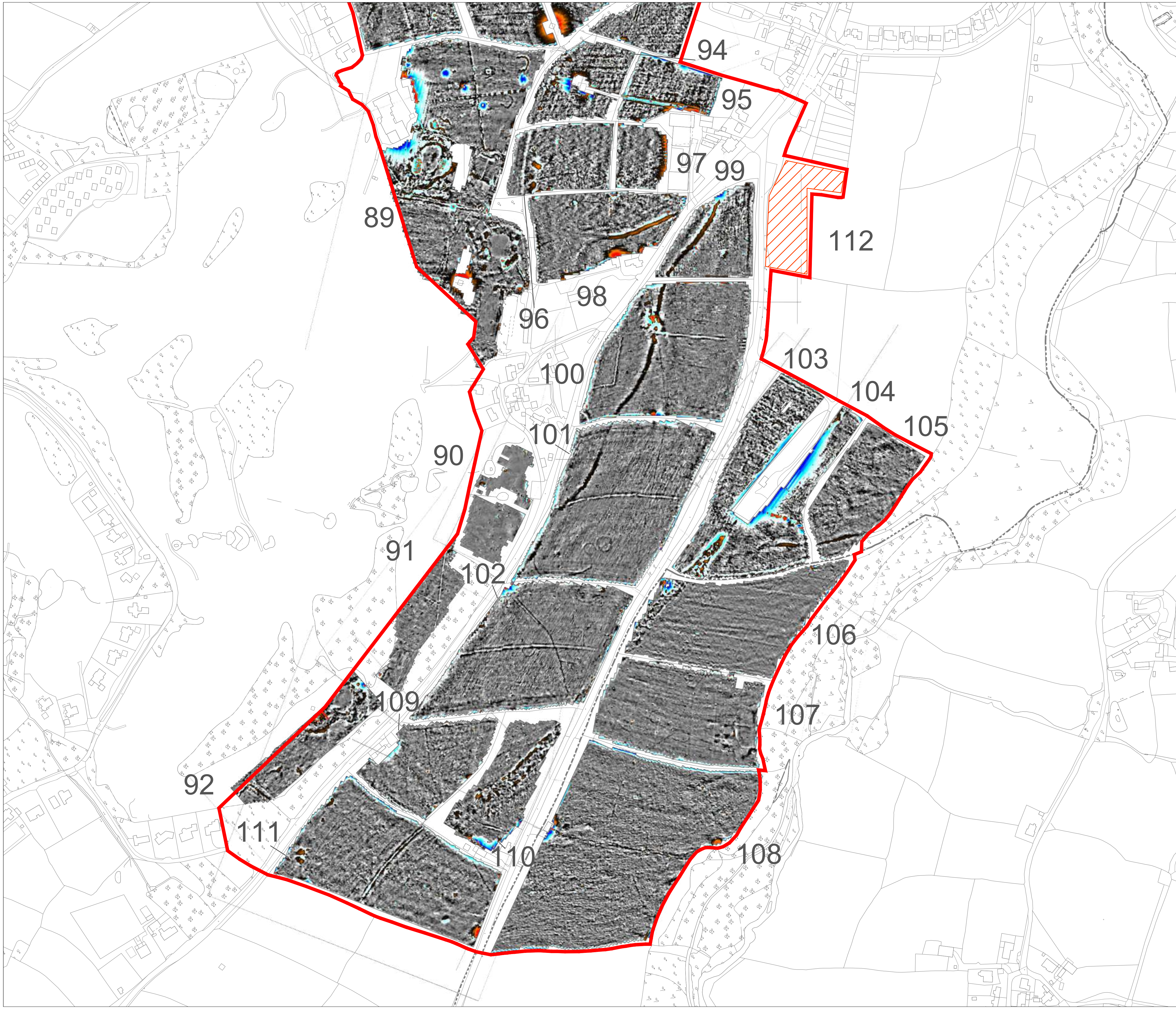

SUMO Survey
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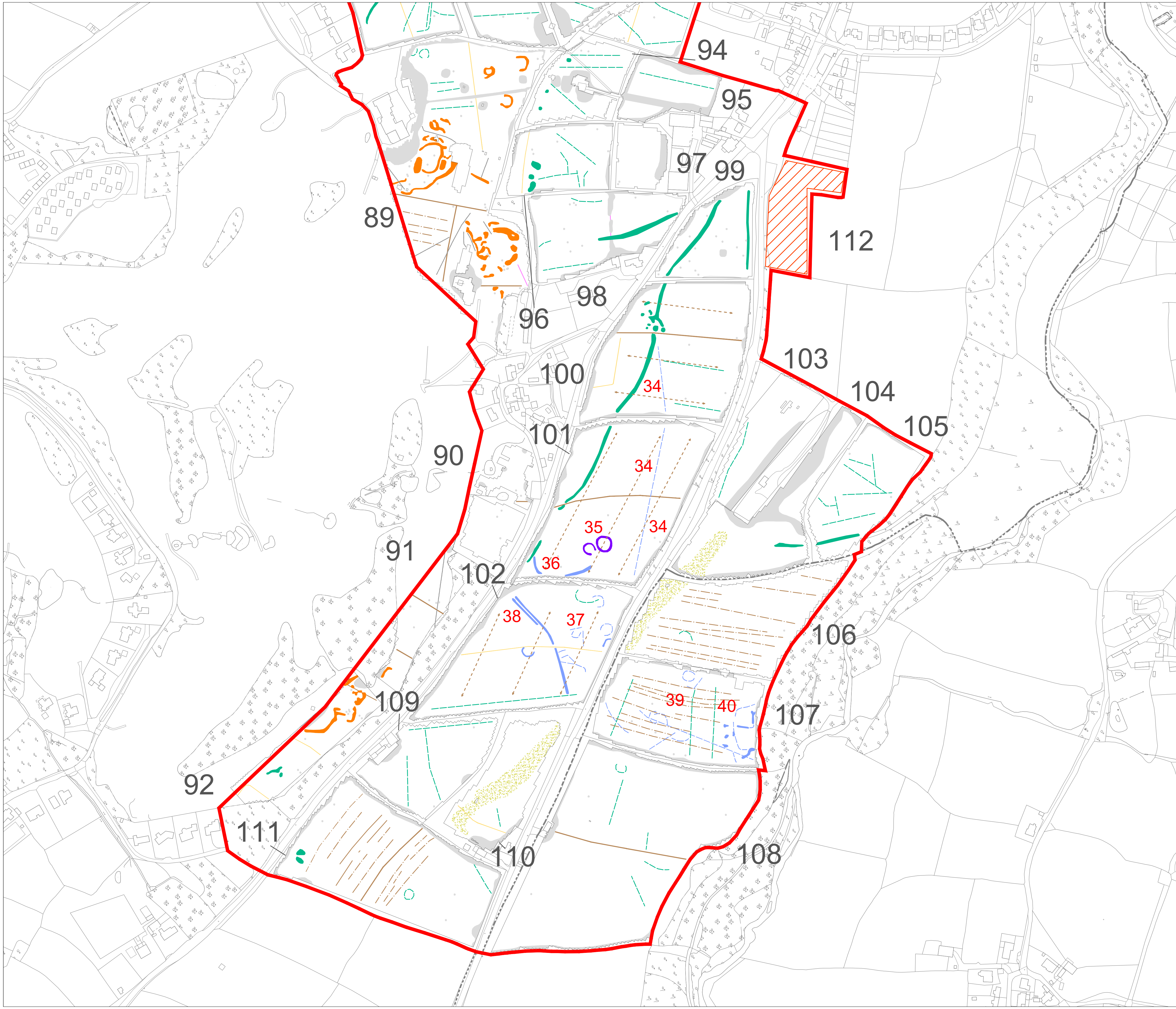

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- Service
- Ferrous
- Modern

SUMO Survey
GEOPHYSICS FOR ARCHAEOLOGY & ENGINEERING

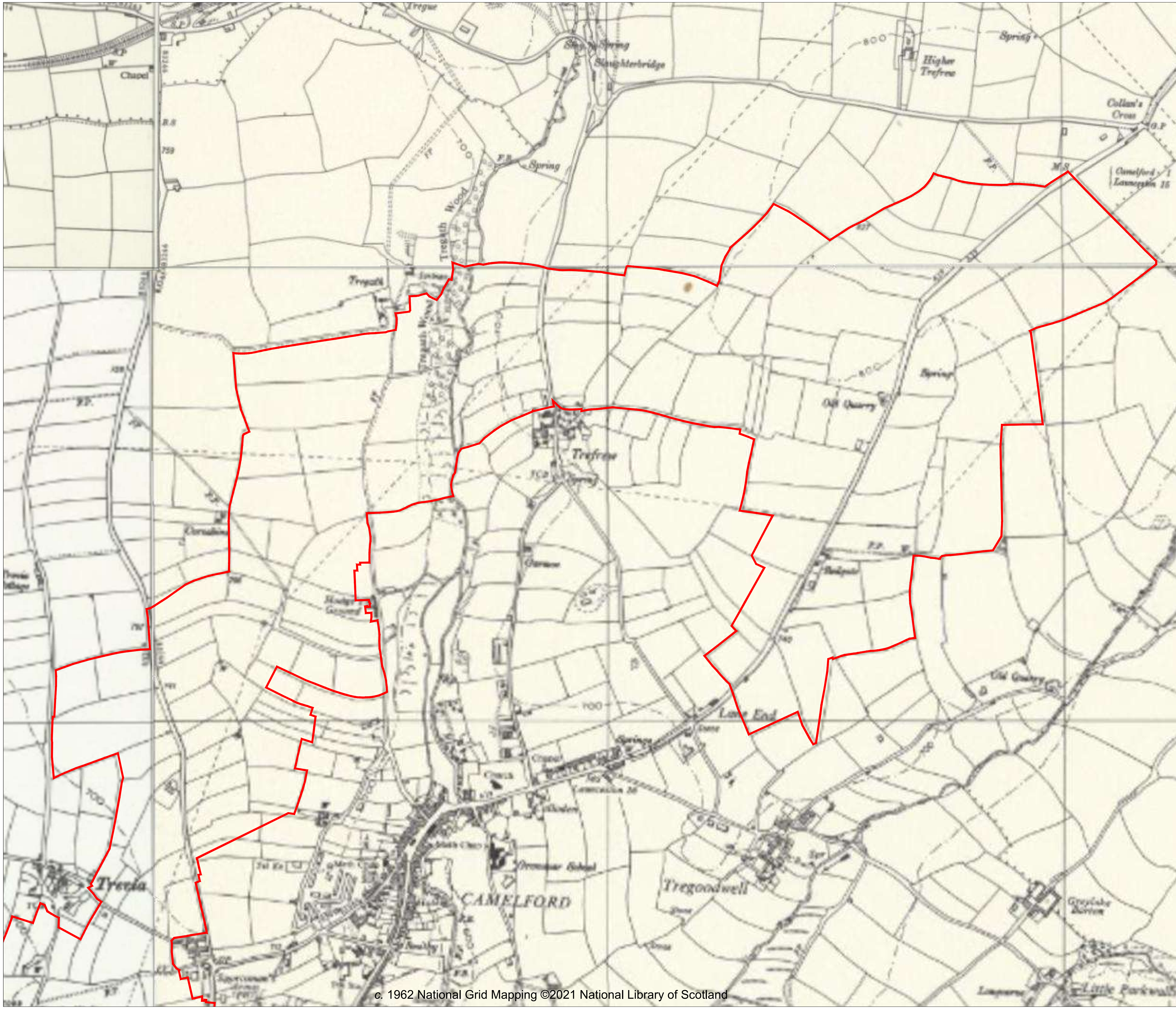
Title: Magnetometer Survey - Interpretation [Area 89 - 112]

Client: Cornwall Archaeological Unit

Project: 03810 - Camelford, Cornwall

Scale: 0 metres 225
1:4500 @ A3

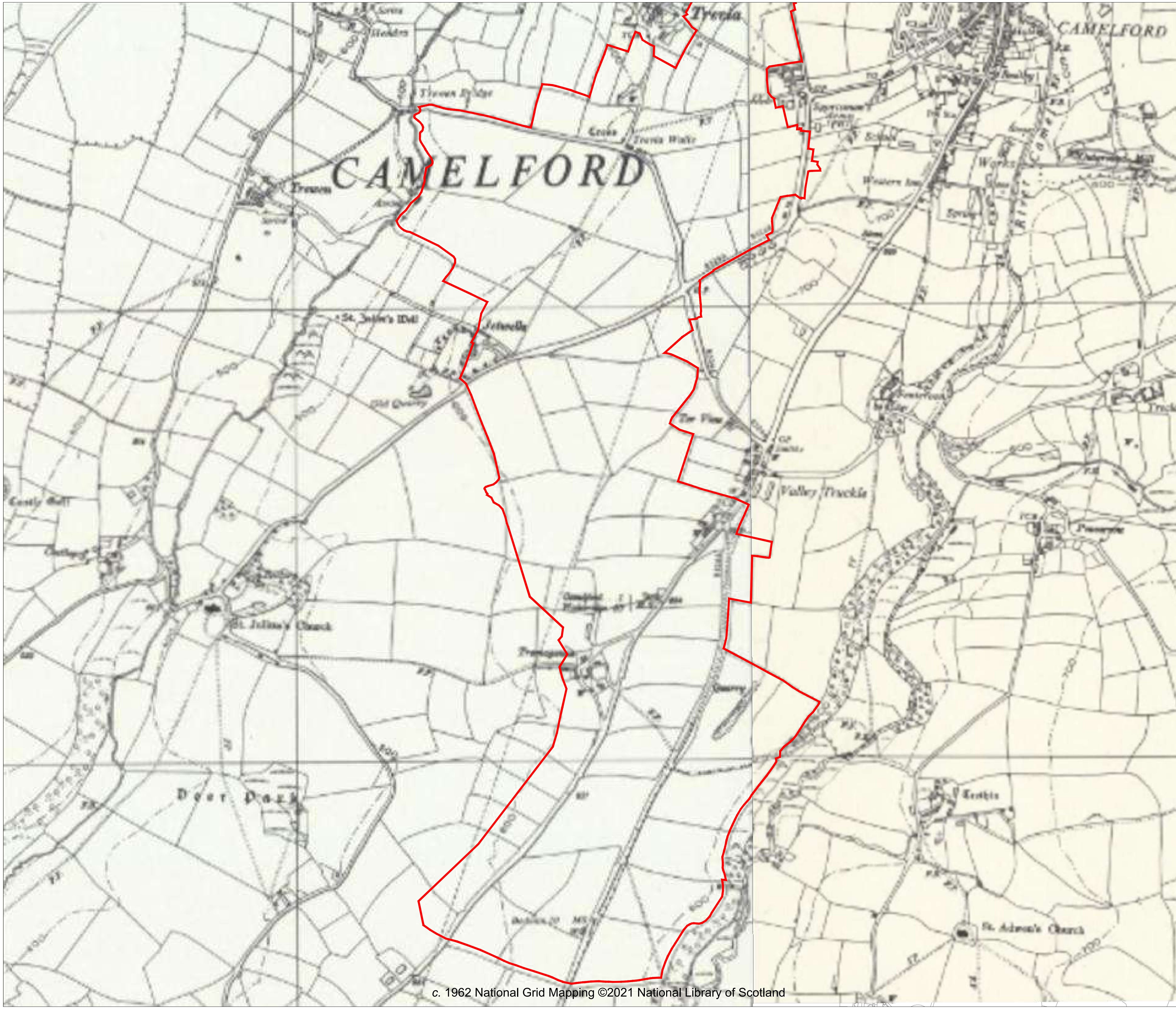
Fig No: 18



N

SUMO Survey
GEOPHYSICS FOR ARCHAEOLOGY & ENGINEERING

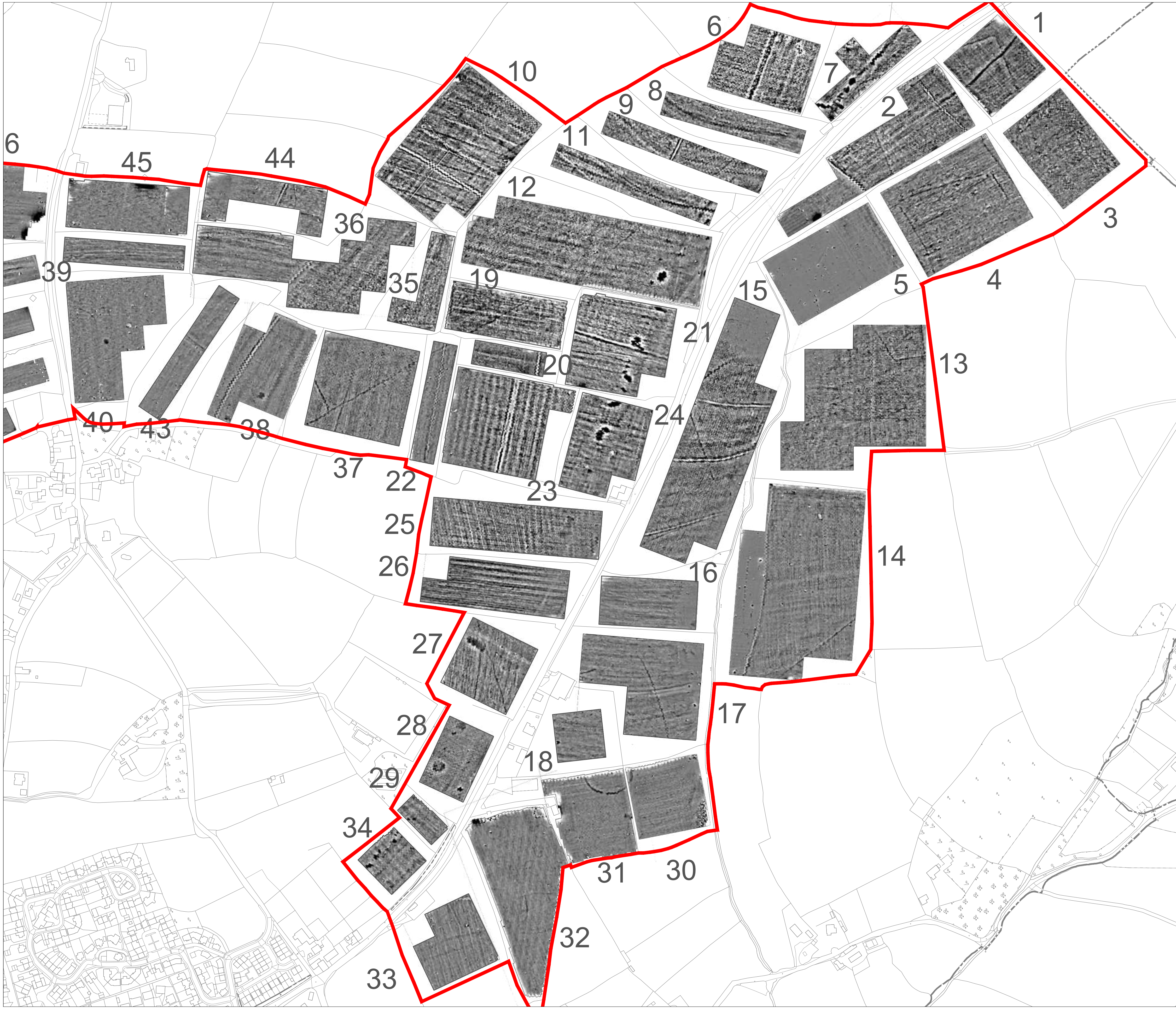
Title:	1962 National Grid Mapping [Areas 1 - 71]
Client:	Cornwall Archaeological Unit
Project:	03810 - Camelford, Cornwall
Scale: 0 metres 400, 1:8000 @ A3	Fig No: 19



N

Sumo Survey
GEOPHYSICS FOR ARCHAEOLOGY & ENGINEERING

Title:	1962 National Grid Mapping [Areas 73 - 112]
Client:	Cornwall Archaeological Unit
Project:	03810 - Camelford, Cornwall
Scale: 0 metres 400, 1:8000 @ A3	Fig No: 20



SUMO Survey
GEOPHYSICS FOR ARCHAEOLOGY & ENGINEERING

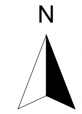
Title:
Minimally Processed Data - Greyscale Plots [Areas 1 - 45]

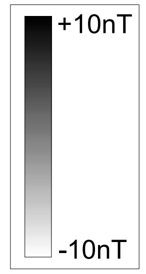
Client:
Cornwall Archaeological Unit

Project:
03810 - Camelford, Cornwall

Scale: 0 metres 225
1:4500 @ A3

Fig No:
21





SUMO Survey
GEOPHYSICS FOR ARCHAEOLOGY & ENGINEERING

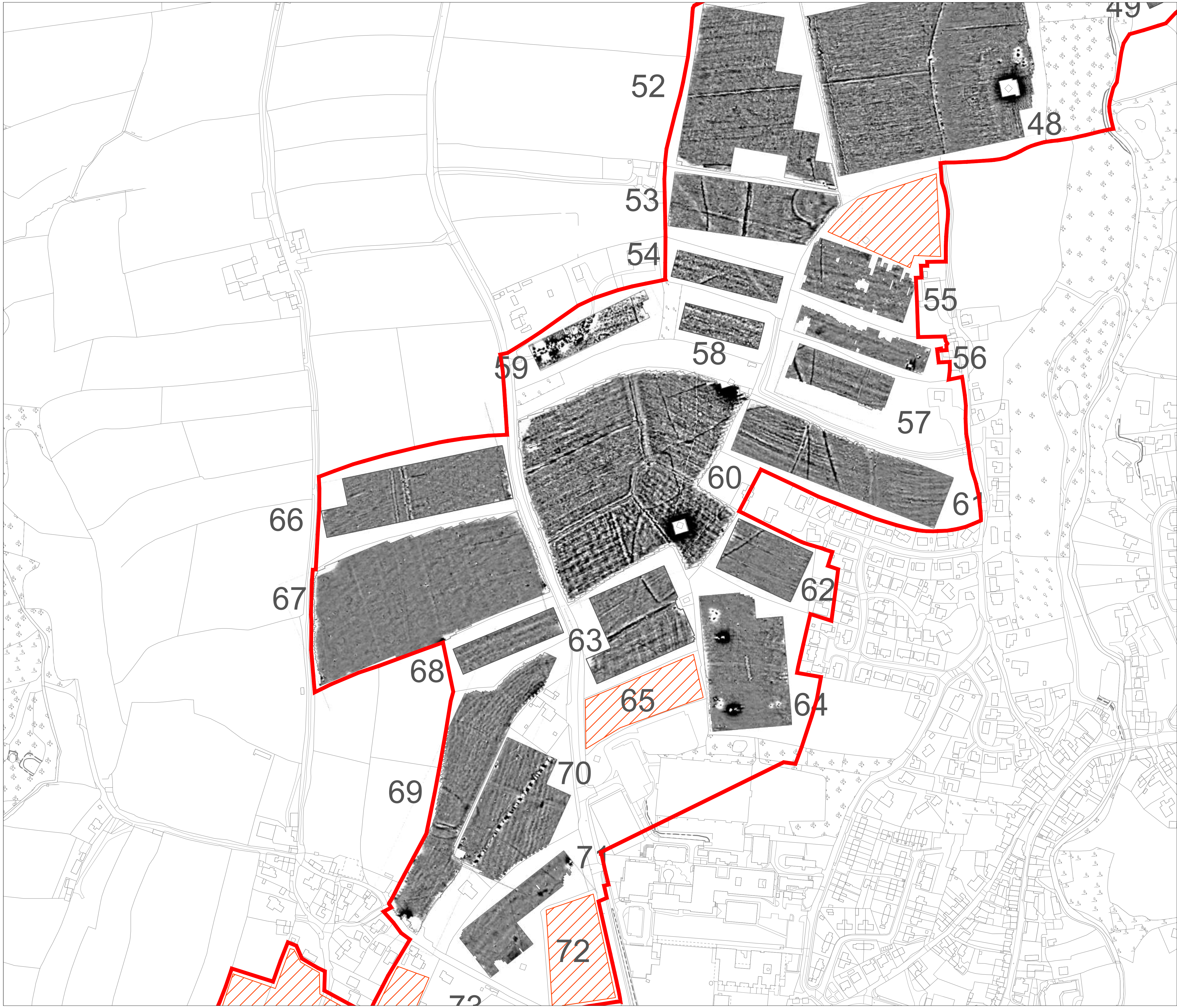
Title:
Minimally Processed Data - Greyscale Plots
[Areas 39 - 53]

Client:
Cornwall Archaeological Unit

Project:
03810 - Camelford, Cornwall

Scale:
0 metres 150
1:3000 @ A3

Fig No:
22



sumo Survey
GEOPHYSICS FOR ARCHAEOLOGY & ENGINEERING

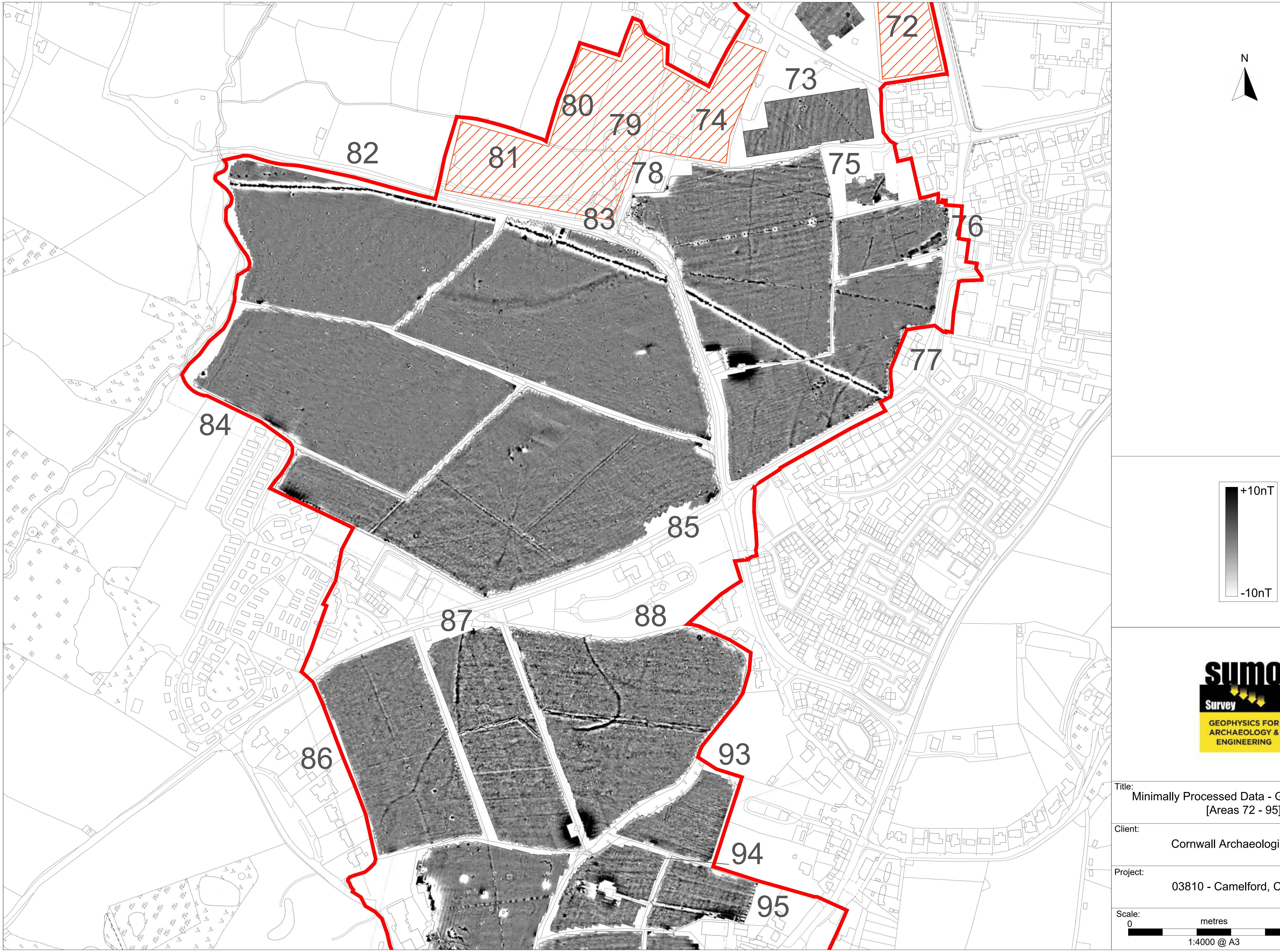
Title:
Minimally Processed Data - Greyscale Plots
[Areas 48 - 71]

Client:
Cornwall Archaeological Unit

Project:
03810 - Camelford, Cornwall

Scale:
0 metres 200
1:4000 @ A3

Fig No:
23



sumo Survey
GEOPHYSICS FOR ARCHAEOLOGY & ENGINEERING

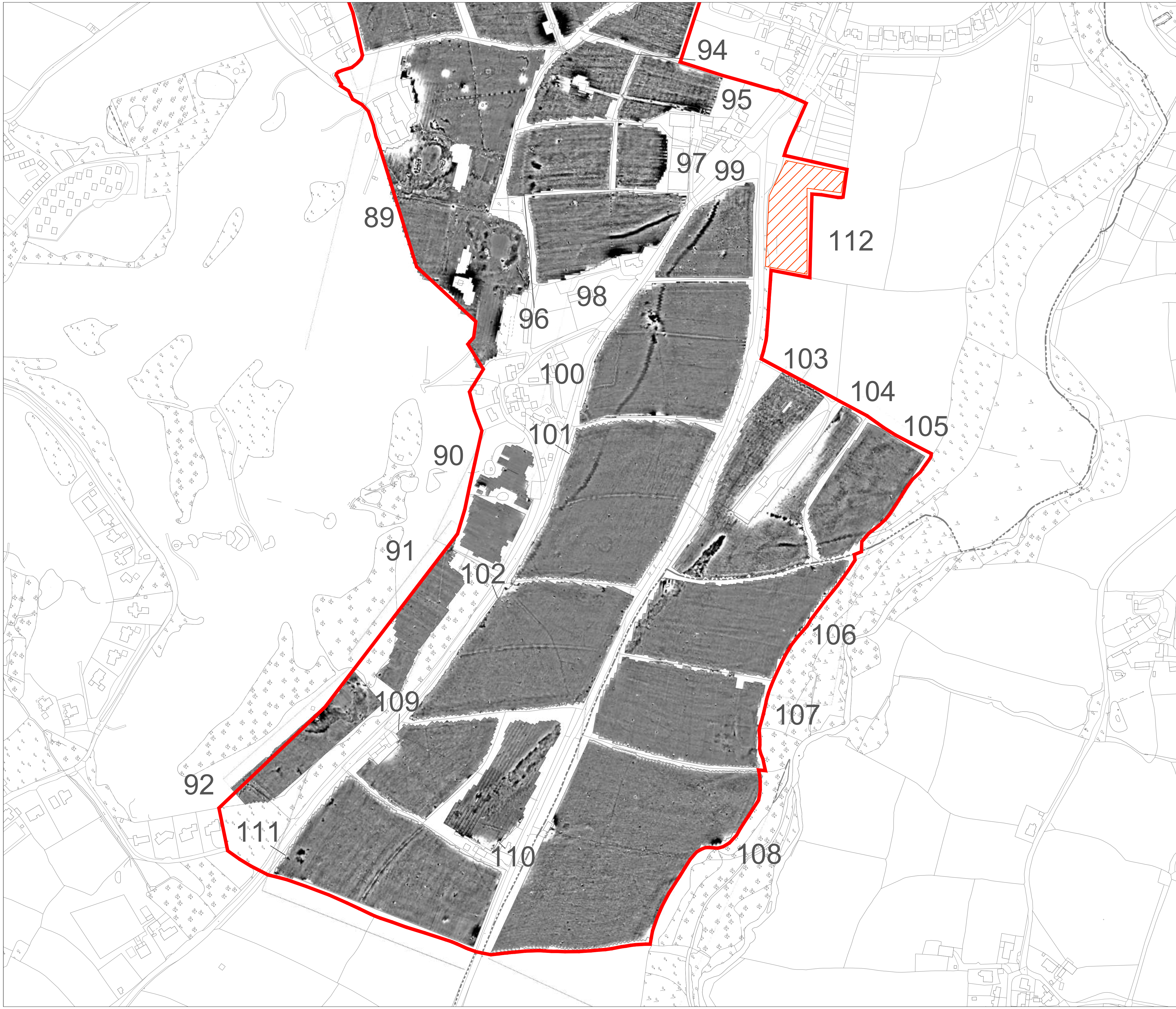
Title:
Minimally Processed Data - Greyscale Plots
[Areas 72 - 95]

Client:
Cornwall Archaeological Unit

Project:
03810 - Camelford, Cornwall

Scale:
0 metres 200
1:4000 @ A3

Fig No:
24



Title:
Minimally Processed Data - Greyscale Plots
[Area 89 - 112]

Client:
Cornwall Archaeological Unit

Project:
03810 - Camelford, Cornwall

Scale:
0 metres 225
1:4500 @ A3

Fig No:
25

Standards & Guidance

This report and all fieldwork have been conducted in accordance with the latest guidance documents issued by Historic England (EH 2008) (then English Heritage), the Chartered Institute for Archaeologists (CIfA 2014) and the European Archaeological Council (EAC 2016).

Grid Positioning

For hand held gradiometers the location of the survey grids has been plotted together with the referencing information. Grids were set out using a Trimble R8 Real Time Kinematic (RTK) VRS Now GNSS GPS system.

An RTK GPS (Real-time Kinematic Global Positioning System) can locate a point on the ground to a far greater accuracy than a standard GPS unit. A standard GPS suffers from errors created by satellite orbit errors, clock errors and atmospheric interference, resulting in an accuracy of 5m-10m. An RTK system uses a single base station receiver and a number of mobile units. The base station re-broadcasts the phase of the carrier it measured, and the mobile units compare their own phase measurements with those they received from the base station. This results in an accuracy of around 0.01m.

Technique	Instrument	Traverse Interval	Sample Interval
Magnetometer	Bartington Grad 601-2	1m	0.25m

Instrumentation: Bartington *Grad* 601-2

Bartington instruments operate in a gradiometer configuration which comprises fluxgate sensors mounted vertically, set 1.0m apart. The fluxgate gradiometer suppresses any diurnal or regional effects. The instruments are carried, or cart mounted, with the bottom sensor approximately 0.1-0.3m from the ground surface. At each survey station, the difference in the magnetic field between the two fluxgates is measured in nanoTesla (nT). The sensitivity of the instrument can be adjusted; for most archaeological surveys the most sensitive range (0.1nT) is used. Generally, features up to 1m deep may be detected by this method, though strongly magnetic objects may be visible at greater depths. The Bartington instrument can collect two lines of data per traverse with gradiometer units mounted laterally with a separation of 1.0m. The readings are logged consecutively into the data logger which in turn is daily down-loaded into a portable computer whilst on site. At the end of each site survey, data is transferred to the office for processing and presentation.

Data Processing

Zero Mean Traverse	This process sets the background mean of each traverse within each grid to zero. The operation removes striping effects and edge discontinuities over the whole of the data set.
Step Correction (De-stagger)	When gradiometer data are collected in 'zig-zag' fashion, stepping errors can sometimes arise. These occur because of a slight difference in the speed of walking on the forward and reverse traverses. The result is a staggered effect in the data, which is particularly noticeable on linear anomalies. This process corrects these errors.

Display

Greyscale/ Colourscale Plot	This format divides a given range of readings into a set number of classes. Each class is represented by a specific shade of grey, the intensity increasing with value. All values above the given range are allocated the same shade (maximum intensity); similarly, all values below the given range are represented by the minimum intensity shade. Similar plots can be produced in colour, either using a wide range of colours or by selecting two or three colours to represent positive and negative values. The assigned range (plotting levels) can be adjusted to emphasise different anomalies in the data-set.

Presentation of results and interpretation

The presentation of the results includes a ‘minimally processed data’ and a ‘processed data’ greyscale plot. Magnetic anomalies are identified, interpreted and plotted onto the ‘Interpretation’ drawings.

When interpreting the results, several factors are taken into consideration, including the nature of archaeological features being investigated and the local conditions at the site (geology, pedology, topography etc.). Anomalies are categorised by their potential origin. Where responses can be related to other existing evidence, the anomalies will be given specific categories, such as: Abbey Wall or Roman Road. Where the interpretation is based largely on the geophysical data, levels of confidence are implied, for example: Probable, or Possible Archaeology. The former is used for a confident interpretation, based on anomaly definition and/or other corroborative data such as cropmarks. Poor anomaly definition, a lack of clear patterns to the responses and an absence of other supporting data reduces confidence, hence the classification Possible.

Interpretation Categories

In certain circumstances (usually when there is corroborative evidence from desk-based or excavation data) very specific interpretations can be assigned to magnetic anomalies (for example, *Roman Road, Wall,* etc.) and where appropriate, such interpretations will be applied. The list below outlines the generic categories commonly used in the interpretation of the results.

Archaeology / Probable Archaeology	This term is used when the form, nature and pattern of the responses are clearly or very probably archaeological and /or if corroborative evidence is available. These anomalies, whilst considered anthropogenic, could be of any age.
Possible Archaeology	These anomalies exhibit either weak signal strength and / or poor definition, or form incomplete archaeological patterns, thereby reducing the level of confidence in the interpretation. Although the archaeological interpretation is favoured, they may be the result of variable soil depth, plough damage or even aliasing as a result of data collection orientation.
Industrial / Burnt-Fired	Strong magnetic anomalies that, due to their shape and form or the context in which they are found, suggest the presence of kilns, ovens, corn dryers, metal-working areas or hearths. It should be noted that in many instances modern ferrous material can produce similar magnetic anomalies.
Former Field Boundary (probable & possible)	Anomalies that correspond to former boundaries indicated on historic mapping, or which are clearly a continuation of existing land divisions. Possible denotes less confidence where the anomaly may not be shown on historic mapping but nevertheless the anomaly displays all the characteristics of a field boundary.
Ridge & Furrow	Parallel linear anomalies whose broad spacing suggests ridge and furrow cultivation. In some cases, the response may be the result of more recent agricultural activity.
Agriculture (ploughing)	Parallel linear anomalies or trends with a narrower spacing, sometimes aligned with existing boundaries, indicating more recent cultivation regimes.
Land Drain	Weakly magnetic linear anomalies, quite often appearing in series forming parallel and herringbone patterns. Smaller drains may lead and empty into larger diameter pipes, which in turn usually lead to local streams and ponds. These are indicative of clay fired land drains.
Natural	These responses form clear patterns in geographical zones where natural variations are known to produce significant magnetic distortions.
Magnetic Disturbance	Broad zones of strong dipolar anomalies, commonly found in places where modern ferrous or fired materials (e.g. brick rubble) are present.
Service	Magnetically strong anomalies, usually forming linear features are indicative of ferrous pipes/cables. Sometimes other materials (e.g. pvc) or the fill of the trench can cause weaker magnetic responses which can be identified from their uniform linearity.
Ferrous	This type of response is associated with ferrous material and may result from small items in the topsoil, larger buried objects such as pipes, or above ground features such as fence lines or pylons. Ferrous responses are usually regarded as modern. Individual burnt stones, fired bricks or igneous rocks can produce responses similar to ferrous material.
Uncertain Origin	Anomalies which stand out from the background magnetic variation, yet whose form and lack of patterning gives little clue as to their origin. Often the characteristics and distribution of the responses straddle the categories of *Possible Archaeology* / *Natural* or (in the case of linear responses) *Possible Archaeology* / *Agriculture*; occasionally they are simply of an unusual form.

Where appropriate some anomalies will be further classified according to their form (positive or negative) and relative strength and coherence (trend: weak and poorly defined).

Appendix B - Technical Information: Magnetic Theory

Detailed magnetic survey can be used to effectively define areas of past human activity by mapping spatial variation and contrast in the magnetic properties of soil, subsoil and bedrock. Although the changes in the magnetic field resulting from differing features in the soil are usually weak, changes as small as 0.1 nanoTeslas (nT) in an overall field strength of 48,000 (nT), can be accurately detected.

Weakly magnetic iron minerals are always present within the soil and areas of enhancement relate to increases in *magnetic susceptibility* and permanently magnetised *thermoremanent* material.

Magnetic susceptibility relates to the induced magnetism of a material when in the presence of a magnetic field. This magnetism can be considered as effectively permanent as it exists within the Earth's magnetic field. Magnetic susceptibility can become enhanced due to burning and complex biological or fermentation processes.

Thermoremanence is a permanent magnetism acquired by iron minerals that, after heating to a specific temperature known as the Curie Point, are effectively demagnetised followed by re-magnetisation by the Earth's magnetic field on cooling. Thermoremanent archaeological features can include hearths and kilns; material such as brick and tile may be magnetised through the same process.

Silting and deliberate infilling of ditches and pits with magnetically enhanced soil creates a relative contrast against the much lower levels of magnetism within the subsoil into which the feature is cut. Systematic mapping of magnetic anomalies will produce linear and discrete areas of enhancement allowing assessment and characterisation of subsurface features. Material such as subsoil and non-magnetic bedrock used to create former earthworks and walls may be mapped as areas of lower enhancement compared to surrounding soils.

Magnetic survey is carried out using a fluxgate gradiometer which is a passive instrument consisting of two sensors mounted vertically 1m apart. The instrument is carried about 30cm above the ground surface and the top sensor measures the Earth's magnetic field whilst the lower sensor measures the same field but is also more affected by any localised buried feature. The difference between the two sensors will relate to the strength of a magnetic field created by this feature, if no field is present the difference will be close to zero as the magnetic field measured by both sensors will be the same.

Factors affecting the magnetic survey may include soil type, local geology, previous human activity and disturbance from modern services.

Summary for sumogeop1-503088

OASIS ID (UID)	sumogeop1-503088
Project Name	Geophysical Survey at Camelford, Cornwall
Activity type	Geophysical Survey, MAGNETOMETRY SURVEY
Project Identifier(s)	03810
Planning Id	
Reason For Investigation	Planning requirement
Organisation Responsible for work	SUMO Geophysics Ltd.
Project Dates	31-Aug-2021 - 22-Oct-2021
Location	Camelford, Cornwall NGR : SX 10429 83726 LL : 50.6223434741971, -4.68138408773423 12 Fig : 210429,83726
Administrative Areas	Country : England County : Cornwall District : Cornwall Parish : Camelford Parish : Advent
Project Methodology	A temporary grid system will be established over the site and marked out using canes. The location of the grid will be set out using an RTK GPS system theoretically accurate to some 0.01m and referenced to OS co-ordinates. Hand Held: Data will be collected using a Bartington Grad 601-2. The instrument consists of two paired sensors (see below) and readings are logged at 0.25m centres along traverses 1.0m apart across 30m grids. The collection of data at 0.25m centres provides an appropriate methodology balancing cost and time with resolution as per Historic England guidelines. Two sensors mounted 1m horizontally apart and very accurately aligned to nullify the effects of the earth's magnetic field. Readings relate to the difference in localised magnetic anomalies compared with the general magnetic background.

Project Results	A magnetometer survey of approximately 170ha of ground was carried out over a study area associated with the proposed construction of a bypass around Camelford, Cornwall. The work was carried out over the course of several phases of fieldwork during Autumn in 2021. A number of features of archaeological interest have been identified including a large, probable circular ditch possibly associated with a number of surrounding ring ditches; three possible rounds or similar enclosures; a few small complexes of probable ring ditches and numerous field system and ditches. Former field boundaries, evidence of ploughing, land drains, natural deposits and an igneous dyke have also been mapped. The results can be used to assess the potential impact of the proposed road scheme.
Keywords	Ridge And Furrow - POST MEDIEVAL - FISH Thesaurus of Monument Types Plough Marks - 20TH CENTURY - FISH Thesaurus of Monument Types Drain - 20TH CENTURY - FISH Thesaurus of Monument Types Field Boundary - POST MEDIEVAL - FISH Thesaurus of Monument Types Ditched Enclosure - UNCERTAIN - FISH Thesaurus of Monument Types Pit - UNCERTAIN - FISH Thesaurus of Monument Types Ring Ditch - UNCERTAIN - FISH Thesaurus of Monument Types
HER	Cornwall and Scilly HER - unRev - STANDARD
HER Identfiers	
Archives	

- Archaeological
- Geophysical
- Laser Scanning
- Measured Building
- Topographic
- Utility Mapping

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