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# Preliminary Assessment for Archaeology and Cultural Heritage

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## Archaeology and cultural heritage

### Introduction

The preliminary environmental information within this chapter includes the results of a preliminary desk-based study and geophysical survey to assess archaeological potential and the setting of cultural heritage assets at a site proposed by Augean South Ltd for use as a hazardous waste facility at the East Northants Resource Management Facility, Stamford Road, PE8 6XX. The preliminary assessment has been undertaken by Andrew Josephs Associates.

The potential for effects upon the setting of heritage assets has also been considered. Such indirect effects can occur as a result of significant changes to the setting of a cultural heritage landscape or asset, whether permanent or temporary. This is particularly relevant to designated assets.

The site comprises previously undeveloped land which is under arable cultivation. Soils are slowly permeable and seasonally wet loam and clay based with impeded drainage.

There are not thought to be any current alternative or significant developments proposed for the site or for the land immediately surrounding it.

### Methodology

The study aims to provide an initial assessment of the potential effects upon archaeological and heritage resources within the site and its hinterland that would result from the proposed development. The report will:

- Identify and define the extent of known heritage assets within the study area;

- Establish, from existing evidence, the likely archaeological potential of the site;
- Provide a preliminary assessment of the importance of the known archaeological resource;
- Make a preliminary assessment of the potential for indirect effects on offsite designated heritage assets;
- Assess the potential impact of the proposed development on known or potential heritage assets and resources; and
- As necessary, make recommendations on the need for (and scope of) further evaluation and mitigation.

Sources consulted in preparing this desk-based study include:

- Northamptonshire Historic Environment Record
- Historic England Archive
- DEFRA Magic Database
- Reports from studies and excavation within the currently permitted site

*Statutory Legislation*

Table 12.1 summarises the statutory legislation relating to the historic environment relevant to this study.

**Table 12.1 Statutory protection for archaeological and heritage sites**

| **Legislation** | **Key Issues** |
|---|---|
| Burial Act (1857) | Under Section 25 of the 1857 Act, it is a criminal offence to remove human remains from any place of burial without a licence from the Ministry of Justice. |

| | |
|---|---|
| Ancient Monuments and Archaeological Areas Act (1979) | It is a criminal offence to carry out any works on or near to a Scheduled Ancient Monument without a Scheduled Monument Consent. |
| Protection of Military Remains Act (1986) | The Act outlines the criteria for designating a military crash site. Certain activities are prohibited at protected sites, without the authority of the Secretary of State. |
| Planning (Listed Buildings and Conservation Areas) Act (1990) | No works can be carried out in relation to a listed building without listed building consent. Designation of an area as a 'conservation area' introduces general controls over demolition and development within that area. |
| Treasure Act (1996) | The 1996 Act defines 'Treasure' as any object that is at least 10% gold or silver, associated coins or groups of coins which are over 300 years old, objects formerly classed as 'treasure trove' (i.e. deliberately deposited items with a high content of gold or silver) and any objects found in association with the above. Any find of 'Treasure' must be reported to the local Coroner. |
| Hedgerow Regulations (1997) | It is against the law to remove most countryside hedgerows without permission. A local authority can prohibit the removal of an 'important' hedgerow. The 1997 Regulations define the criteria for determining whether a hedgerow is important, and these include historical and archaeological criteria. |

**Non-Statutory Protection**

Table 12.2 summarises the relevant non-statutory protection relating to the historic environment.

**Table 12.2 Non-statutory protection for archaeological and heritage sites**

| Legislation | Key Issues |
|---|---|
| The National Planning Policy Framework (NPPF) | Sets out the Government's planning policies for England and how these are expected to be applied. The Framework includes a section detailing requirements to conserve and enhance the historic environment. |
| National Policy Statement for Hazardous Waste | Provides guidance on consideration of the generic impacts of nationally significant, hazardous waste infrastructure projects, including the assessments to be made of the effects on the historic environment. |
| Register of Parks and Gardens of Special Historic Interest in England | The Register is maintained by Historic England and identifies important historic parks and gardens, which should be considered by the local planning authority in planning decisions or consultations. |
| Register of Historic Battlefields | Historic England's Register identifies 46 important English battlefields and allows their protection through the planning system. |

*Relevant guidance*

**Historic England Guidance**

The guidance below, produced by Historic England, has been identified as relevant to this study:

- Historic England 2008. Conservation Principles: Policies and Guidance for the Sustainable Management of the Historic Environment.
- Historic England 2017. The Setting of Heritage Assets (GPA3)
- Historic England 2020. Mineral Extraction and Archaeology (HE Advice Note 13)

**Other Guidance**

- Design Manual for Roads and Bridges (DMRB) LA 104 Environmental Assessment and Monitoring and LA 106 Cultural Heritage Assessment (Both 2020)
- Standard and Guidance for Historic Environment Desk-Based Assessment (Chartered Institute for Archaeologists 2014, revised 2017)

## BASELINE INFORMATION

### The site development area (western extension area)

People value the historic environment as part of their cultural and natural heritage, and as such, decisions about change in the historic environment must be reasonable, transparent and consistent.

There is no surviving archaeology within the existing ENRMF site as all areas of the site have been disturbed and were subject to previous investigation and recording. The western extension area has no upstanding heritage assets. It has been under arable cultivation for at least 150 years and prior to that at least part of it was within

Rockingham Forest. Ploughing has removed the surface evidence of any archaeology, such as earthwork remains.

**Scope of Cultural Heritage**

Cultural heritage is represented by a wide range of assets that result from past human use of the landscape. These include historic structures, many still in use, above ground and buried archaeological monuments and remains of all periods, and artefacts of anthropological origin. In its broadest form cultural heritage is represented by the landscape and townscape itself. Less tangible aspects of cultural heritage include language, literature, music, religion, customs, crafts, art, folklore, place names and traditions.

Sites and areas of cultural heritage include World Heritage Sites, listed buildings and other structures of architectural or historic importance, scheduled monuments, conservation areas, archaeological sites, battlefields, historic parks and gardens, and historic landscapes.

**Designated Heritage Assets**

An initial study area of 2km was assessed. However, a combination of topography and woodland will prevent any effects upon assets at this distance. Indeed, based upon the ZTVI and assessment of views from designated assets or groups of assets (such as within conservation areas) there would be no visual effects from the proposed development, nor effects upon their historical context. Furthermore, given the distance involved and the intervening woodland, no adverse effects (such as from noise and dust) are predicted upon the setting of any designated asset. The rationale behind this

conclusion is discussed in **Table 12.3**. The locations of designated heritage assets are shown on **Figure 12.1**.

**Table 12.3 Designated Assets within approximately 2km of the western extension area**

| Asset or Group of Assets | Grade - sensitivity | National Heritage List reference | Rationale for scoping out of assessment |
|---|---|---|---|
| **Within 2km** | | | |
| Duddington Bridge | Scheduled Monument/High | 1006613 | Situated to the west of the village at a distance of 1.6km WNW of the Site. No views due to intervening development, topography and woodland. |
| Church of St Mary, Duddington | Grade II*/High | 232955 | Situated within the village at a distance of 1.4km WNW of the Site. No views, even from Belfry, due to topography. |
| Duddington Village: 27 Grade II listed structures within a Conservation Area | II/Medium | | All assets lie to the west of the A43 at a distance of >1.2km. There is no intervisibility with the Site due to topography and dense woodland (The Assarts). A working quarry also separates the village from the Site. |
| RAF Wittering: nuclear fissile core stores and buildings (and three associated Grade II structures) | II*/High | 1402763 | Situated 1.5km NE of the Site. No views due to intervening woodland (Collyweston Great Wood) which is over 675m wide |
| Huskissons Lodge | II/Medium | 422127 | 1.85km SE of the Site. No views due to topography. |
| **Over 2km** | | | |
| Kings Cliffe Village: Over 50 Grade II listed structures within a Conservation Area | II/Medium | | Over 2km south of the Site. No views from any assets due to topography. |
| Church of All Saints, Kings Cliffe | I/High | 422104 | 2.3km SE No views due to topography. |
| Hall Farmhouse, Kings Cliffe | II*/High | 422100 | 2.4km SE. No views due to topography |
| Collyweston village. 25 Grade II listed structures within a Conservation Area | II/Medium | | Over 2km NNW of the Site. No views due to topography. |
| Collyweston: site of manor house and gardens | Scheduled monument/High | 1003632 | Over 2km NNW of the Site. No views due to topography. |
| Collyweston: Church of St Andrew | II*/High | 232904 | 2.1km NNW of the Site. No views due to topography. |

**Archaeological Features**

The Northamptonshire Historic Environment Record (NHER) was consulted.

Those records located within the western extension area and 1500m of its boundary are listed in **Table 12.4** below and key sites are shown on **Figures 12.2A and 12.2B**. This was chosen as being an appropriate area of search in order recover information on archaeological sites, monuments and events which can place the western extension area into its local context, and to help identify the potential for further, previously unrecorded features within the western extension area.

In the discussion below, HER entries have been grouped together where relevant.

Within the western extension area

Three entries are recorded within the western extension area (9152/0/2, 9173/0/1 and 9173/0/7). They comprise an area on the enclosure award map that was probably lawn, a fieldname and a crop mark of a field boundary that appears on the 1950s Ordnance Survey mapping.

Archaeological investigations within the western extension area

No archaeological investigations are known to have taken place within the western extension area prior to the current project, although it is considered likely that the western extension area was fieldwalked by David Hall during his extensive fieldwalking programme of the local landscape between 1960 and 1999.

Aerial photographs of the western extension area were examined as part of the National Mapping Programme, and the field boundary that used to cross the centre of the western extension area was identified.

## Archaeological investigations in the vicinity

The vicinity of the western extension area has been extensively examined, in particular by David Hall. Numerous archaeological sites have been located, in particular of Roman date, and including possible settlements, buildings and ironworking located by fieldwalking. The National Aerial Photographic Mapping Programme has covered the area.

A large number of landscape features were identified from the Rockingham Forest Project. Supported by the Heritage Lottery Fund and English Heritage its aim was to track the evolution of the Forest from the 10th to 20th centuries. This followed work by David Hall in locating earthwork enclosure banks and ditches.

One excavation is recorded in Collyweston Great Wood, 900m north-north-east of the western extension area. This took place in 1953-4 and identified a Romano-British temple of several periods of construction including hexagonal and octagonal stone buildings, and associated finds.

An archaeological watching brief was undertaken during soil removal in advance of development of the current ENRMF in 2008. No archaeological deposits or artefacts were identified.

## Archaeological background

Few parts of England have been examined in as much detail as this part of Northamptonshire. The combined efforts of David Hall and the former County Archaeologist, Glen Foard, ensured that programmes of desk-based research and field-based examination mapped large numbers of sites and possible sites.

Prehistoric sites are rare. A possible cooking site identified during fieldwalking 340m north of the western extension area is marked by burnt and cracked pebbles. In addition, two possible Bronze Age ring ditches approximately 1km northwest limit of the western extension area. One (1276/0/1) was identified by geophysical survey. It was subsequently excavated revealing a large pit in the middle that was probably a result of an antiquarian excavation. The other (1276/0/2) comprised a ring ditch containing pottery, animal bone and charcoal which was cut by a pit containing about 1kg of cremated bone. In this same area there is evidence for an Iron Age smelting site 7181/1/1).

A further possible prehistoric barrow (9395/0/1) was identified in Westhay Wood to the south of the western extension area comprising a low mound about 15m in diameter. Two linear crop marks on the southern margin of the search area (9402/0/1 and 9402/0/2) were also interpreted as potential prehistoric boundaries.

Despite fieldwalking and aerial photographic assessment, there are no known Roman sites nearer than 500m from the western extension area (9389), where a significant find scatter of Roman date including building stone and pottery was located by David Hall.

About 900m to the northeast of the western extension area there is the Romano-British temple complex (2868), referred to above and a further probable settlement and ironworking site (2846) lies 1200m south-east of the western extension area. A similar Roman settlement including evidence for a building from aerial photographs and ironworking lies to the north-east of 2846 (2486 and 9400) and may be a continuation of 2846. Both sites lie to the east of Westhay Lodge. A Romano-British iron smelting furnace (2886/1) was found in a 1977 watching brief 1.25km north west of the western

extension area and a possible section of a Roman road (3010/1) are also recorded. The latter was identified by a 1982 aerial survey, 1.2km west of the western extension area.

In addition to the iron slag from defined sites, further undated surface finds in might reflect the more extensive nature of metal working in the Roman period.

The medieval and post-medieval periods have been intensively examined, both in the field by David Hall who mapped earthwork enclosure banks and ditches, and more recently by the Rockingham Forest Project. The landscape of these periods has been re-created with some success.

Given that this is an area of historic woodland it is of no surprise that woodland activities are present within the study area, and in particular the production of charcoal. Five locations scattered across the study area produced evidence suggesting charcoal production (2830/0/11, 2830/0/12, 2894/0/1, 9394/0/0, 9686/1 and 9686/1/1) of which only the last is dated, in that case to the post- medieval period.

**Table 12.4 Northamptonshire Historic Environment Record**

| NHER NO | FEATURE AND BRIEF DESCRIPTION | DISTANCE (M) FROM THE WESTERN EXTENSION AREA BOUNDARY |
|---|---|---|
| 195 – MNN160137 | THE JURASSIC WAY - POSSIBLE PREHISTORIC ROUTEWAY | 975 |
| 983/1/1 – MNN139436 | PROBABLE C20 QUARRY PITS | 450 |
| 1276/0/1 – MNN201 | POSSIBLE ROUND BARROW INVESTIGATED BY GEOPHYSICS AND EXCAVATION. NO FINDS | 830 |
| 1276/0/2 | RING DITCH OF POSSIBLE LBA/EIA BARROW. UNURNED CREMATION PIT DUG INTO DITCH | 850 |
| 1846 –MNN114796 | EASTON HORNSTOCKS WOOD SHOWN ON 1820 MAP | 850 |

| | | |
|---|---|---|
| 1846/0/1 - MNN134540 | DITCH & BANK EARTHWORK | 1320 |
| 2486/0/2 - MNN128890 | POSSIBLE ROMAN BUILDING IDENTIFIED FROM AERIAL PHOTOGRAPHY (SEE ALSO 9400) | 1400 |
| 2830/0/10 – MNN149097 | LAW'S LAWN, AN EARLY FOREST LAWN | 1050 |
| 2830/0/11 - MNN132014 | POSSIBLE CHARCOAL BURNER'S SITE OF UNKNOWN DATE | 1400 |
| 2830/0/12 - MNN132013 | POSSIBLE CHARCOAL BURNER'S SITE OF UNKNOWN DATE | 1420 |
| 2830/0/17 – MNN134539 | UNDATED DITCH AND BANK | 1250 |
| 2845 - MNN4982 | POSSIBLE SETTLEMENT SITE OF UNKNOWN DATE | 720 |
| 2845/0/1 - MNN22409 | UNSTRATIFIED ROMAN FINDS | 720 |
| 2846 - MNN4983 | POSSIBLE SETTLEMENT SITE OF UNKNOWN DATE | 1230 |
| 2846/0/1 - MNN22410 | POSSIBLE ROMANO-BRITISH SETTLEMENT | 1400 |
| 2846/0/2 - MNN22411 | POSSIBLE STONE BUILDING OF UNKNOWN DATE IDENTIFIED FROM AERIAL PHOTOGRAPHY | 1400 |
| 2846/0/3 - MNN27529 | SLAG FOUND DURING FIELDWALKING OF UNKNOWN DATE (SEE ALSO 9399/0/0) | 1200 |
| 2847/0/1 - MNN32458 | POSSIBLE RECTANGULAR ENCLOSURE OF UNKNOWN DATE IDENTIFIED FROM AERIAL PHOTOGRAPHY IN1982 | 740 |
| 2847/0/2 - MNN128886 | POSSIBLE ENCLOSURE OF UNKNOWN DATE IDENTIFIED FROM AERIAL PHOTOGRAPHY | 680 |
| 2847/0/3 – MNN128887 | POSSIBLE LINEAR BOUNDARY OF UNNOWN DATE IDENTIFIED FROM AERIAL PHOTOGRAPHY | 700 |
| 2848/0/1 – MNN148 | SLAG REPORTED HERE BY ADAM BROS | 900 |
| 2868 - MNN5000 | ROMAN RELIGIOUS RITUAL AND FUNERARY SITE (KNOWN AS SITE NN5000) | 900 |
| 2868/1 - MNN12247 | ROMAN TEMPLE (SAME GRID REFERENCE AS ABOVE) | 900 |
| 2868/1/0 - MNN28710 | UNSTRATIFIED ROMAN FINDS (SAME GRID REFERENCE AS ABOVE) | 900 |
| 2868/1/1 - MNN22442 | EXCAVATION; 1953-4; ROMANO-BRITISH TEMPLE; SEVERAL PERIODS OF CONSTRUCTION INCLUDING HEXAGONAL & OCTAGONAL STONE BUILDINGS; LATTER WITH OPUS SIGNINUM FLOOR; ALSO PAVED AREAS & HEARTH & BURNT AREAS; PROBABLE ADDITIONAL STRUCTURES NEARBY; PARTLY | 900 |

| | | |
|---|---|---|
| | BULLDOZED FOR RAF DEVELOPMENT<br>FINDS INCLUDE ANIMAL BONES & OYSTER SHELLS & BURNT STONES & SAMIAN POT SHERDS & C1ST-C4TH<br>POTSHERDS & IRON SLAG & WORKED STONE & INSCRIBED STONE (SAME GRID REFERENCE AS ABOVE) | |
| 2886/1 – MNN9705 | WATCHING BRIEF IDENTIFED A ROMANO-BRITISH IRON SMELTING FURNCE | 1200 |
| 2894 - MNN5020 | SITE NN5020 (NO DESCRIPTION) | 340 |
| 2894/0/1 - MNN224 | CHARCOAL FILLED PIT IDENTIFIED DURING PIPELINE DEVELOPMENT IN 1977 (SAME GRID REFERENCE AS ABOVE) | 340 |
| 3010/1 – MNN12289 | POSSIBLE ROMANO-BRITISH ROAD ROUTE SEEN AS SOIL MARKS AND A POSS ANCIENT HEDGE LINE | 1200 |
| 3010/1/1 | POSSIBLE ROMANO-BRITISH ROAD AGGER | 1200 |
| 5086 - MNN137059 | POSSIBLE SITE OF POST-MED DATE (NO DESCRIPTION) | 820 |
| 4158/0/1 – MNN138671 | LIBERTY BOUNDARY WALL | 1400 |
| 5086/0/1 - MNN114613 | POSSIBLE BUILDING OF POST-MED DATE (NO DESCRIPTION) | 820 |
| 5087 | ASSART FARM VISIBLE ON MAP OF 1798 AND ASSOCIATED BUILDINGS. IN RUINS ON 1950 OS MAP | 80 |
| 5087/1 – MNN135110 | ASSART FARM | 80 |
| 5087/1/5 – MNN163986 | POND ASSOCIATED WITH ASSART FARM | 80 |
| 5178 – MNN160668 | POSSIBLE IA/RB ACTIVITY | 975 |
| 5178/0/1 – MNN160667 | POSSIBLE IA/RB ENCLOSURE CROP MARK | 975 |
| 6585 – MNN113067 | COLLYWESTON GREAT WOOD | 0 |
| 6585/0/1 | POSSIBLE LAWN. CLEARING IN THE WOOD SHOWN ON 1$^{ST}$ ed OS | 300 |
| 6700 – MNN166196 | UNDATED ROAD ROUTE | 920 |
| 6700/0/1 – MNN138695 | HOLLOW WAY | 920 |
| 7101 – MNN143292 | WESTHAY LODGE, HUNTING LODGE | 370 |
| 7101/0/1 – MNN143293 | WESTHAY LODGE, LODGE | 370 |
| 7101/1/1 – MNN143294 | REMAINS OF DEMOLISHED WESTHAY LODGE | 370 |
| 7101/1/2 – MNN143295 | POSSIBLE WALLED GARDEN | 370 |

| | | |
|---|---|---|
| 7180/0//1 - MNN374 | LINEAR FEATURE PROBABLY NATURAL | 900 |
| 7180/0/2 – MNN374 | NATURAL FEATURES COLLEYWESTON QUARRY | 900 |
| 7180/0/3 – MNN374 | PIT ANOMALIES POSSIBLY NATURAL COLLEYWESTON QUARRY | 900 |
| 7180/0/4 – MNN374 | LINEAR FEATURES PROBABLY NATURAL | 900 |
| 7180/0/5 – MNN374 | ARCHAEOLOGICAL FEATURES COLLYWESTON QUARRY | 900 |
| 7180/0/6 – MNN115266 | UNDATED SHALLOW PITS | 760 |
| 7181/1/1 – MNN374 | POSSIBLE IRON AGE SMELTING SITE COLLYWESTON QUARRY IDENTIFIED IN A TRIAL TRENCH | 900 |
| 7181/1/2 – MNN115264 | POSSIBLE LATE BRONZE AGE/EARLY IRON AGE ACTIVITY FOUND IN A TRENCH, INCLUDED POTTERY BONE AND SLAG | 900 |
| 7246 – MNN164554 | DUDDINGTON WOODS | 10 |
| 7246/5 – MNN11449 | UNNAMED COPPICE | 1100 |
| 7246/6 – MNN114490 | UNNAMED COPPICE | 720 |
| 7246/7 – MNN11448 | ASSART LANDS IN THE PARISH OF DUDDINGTON | 80 |
| 7713 –MNN136217 | WESTHAY WOODS | 10 |
| 7713/0/14 - MNN134519 | DITCH & BANK EARTHWORK | 540 |
| 7713/16 – MNN114702 | CORNER GREEN. COMMON LAND ON 1798 MAP | 10 |
| 7713/0/54 - MNN134439 | DITCH & BANK EARTHWORK | 370 |
| 7713/8 – MNN164549 | STOCKINGS WOOD | 1200 |
| 7713/8/2 – MNN134432 | MED/POST MED BOUNDARY DITCH AND BANK | 800 |
| 7713/8/3 – MNN134431 | MED/POST MED BOUNDARY DITCH AND BANK | 1000 |
| 7713/8/4 – MNN134430 | MED/POST MED BOUNDARY DITCH AND BANK | 1000 |
| 7713/9 – MNN164546 | BUXTON WOOD | 450 |
| 7713/9/1 – MNN134519 | MED/POST MED BOUNDARY DITCH AND BANK | 530 |
| 7713/9/2 – MNN134439 | MED/POST MED BOUNDARY DITCH AND BANK | 400 |
| 7713/9/3 – MNN134494 | MED/POST MED BOUNDARY DITCH AND BANK | 500 |
| 8232 - MNN136254 | UNCERTAIN ACTIVITY (NO DESCRIPTION) | 520 |

| | | |
|---|---|---|
| 8232/0/1 - MNN114614 | GREGORY'S LODGE PRESENT FROM 1775 TO 1950 BUT NOT STANDING NOW | 640 |
| 8293/0/1 – MNN166193 | POSSIBLE PIT (UNDATED) | 450 |
| 8510/0/1 – MNN362 | DUDDINGTON ROC OBSERVER POST | 1070 |
| 8678/1/6 - MNN116745 | REMOTE MUNITIONS STORES, RAF WITTERING AND ASSOCIATED BUILDINGS | 620 |
| 8678/1/7 – MNN116755 | YARNOLD SANGER CONCRETE GUARD POST | 1000 |
| 8927/1/1 – MNN128891 | PROBABLE MED/POST MED BOUNDARY DITCH CROP MARK | 1100 |
| 8942/0/2 – MNN115267 | POST MEDIEVAL SLATE QUARRY | 760 |
| 9150/0/1 - MNN113064 | POSSIBLE LAWN. CLEARING IN WOOD THOUGH NOT LABELLED AS LAWN | 760 |
| 9151/0/2 – MNN113066 | WOOD SHOWN ON 1841 ENCLOSURE MAP | 400 |
| 9152/0/2 - MNN113069 | PRECINCT OF WESTHAY" ON ENCLOSURE MAP. PROBABLY LAWN | WITHIN |
| 9152/0/3 – MNN113070 | COW WOOD ON ENCLOSURE AWARD BUT NO TREES. PROBABLY AN ENCLOSURE | 900 |
| 9152/0/4 – MNN113071 | CORNER GREEN SHOWN ON ENCLOSURE AWARD MAP. COMMON LAND? | 350 |
| 9152/0/5 –MNN113 | HEATH AND DROVE OVERLAPS CORNER GREEN | 900 |
| 9169/0/1 – MNN114488 | HEATH ON ENCLOSURE MAP, NO EXTENT MARKED | 750 |
| 9169/0/2 – MNN134435 | UNDATED DITCH AND BANK EARTHWORK | 850 |
| 9169/0/8 – MNN138540 | UNDATED DITCH | 1000 |
| 9170/0/28 – MNN138546 | UNDATED DITCH | 1000 |
| 9170/0/29 – MNN138547 | UNDATED DITCH | 1000 |
| 9170/0/101 – MNN13443 | MED/POST MED BOUNDARY DITCH AND BANK | 750 |
| 9170/0/102 MNN13443 | UNDATED DITCH AND BANK | 900 |
| 9172 | ROCKINGHAM FOREST PROJECT – ENCLOSURES, WOOD, HEDGES AND COMMON LAND RECORDED WITHIN PARISH OF DUDDINGTON | - |
| 9172/0/21 – MNN138683 | HEDGE | 900 |
| 9172/0/22 – MNN134437 | UNDATED DITCH AND BANK | |

| | | |
|---|---|---|
| 9172/0/23 – MNN166655 | PROBABLE MED/POST MED RIDGE AND FURROW | 720 |
| 9172/0/24 – MNN166666 | PROBABLE MED/POST MED RIDGE AND FURROW | 450 |
| 9173/0/1 - MNN114729 | 'THE SHORT' – FIELDNAME | WITHIN |
| 9173 | ROCKINGHAM FOREST PROJECT – LAWN, ENCLOSURES, WOOD, RECORDED WITHIN PARISH OF DUDDINGTON | - |
| 9173/0/7 - MNN128888 | CROPMARK INTERPRETED AS PART OF NATIONAL MAPPING PROGRAMME AS A FOOTPATH BUT SHOWN AS FIELD BOUNDARY ON 1ST EDITION OS MAP AND ON 1950S OS MAP | WITHIN |
| 9173/0/8 – MNN160666 | PROBABLE C18TH OR EARLIER WOODLAND TRACKWAY/RIDE | 10 |
| 9174 | ROCKINGHAM FOREST PROJECT – ENCLOSURES RECORDED WITHIN PARISH OF DUDDINGTON | - |
| 9174/0/33 – MNN134434 | MED/POST MED BOUNDARY DITCH AND BANK | 1600 |
| 9175 | ROCKINGHAM FOREST PROJECT – COMMON LAND AND WOODS RECORDED WITHIN PARISH OF EASTON ON THE HILL | - |
| 9175/0/29 – MNN114795 | ROGUE SALE WOOD SHOWN ON 1820 MAP | 1300 |
| 9316/0/1 - MNN263 | AREA OF BURNT PEBBLES, SHATTERED, AND CHARCOAL. REALLY OF UNKNOWN DATE-PREHISTORIC COOKING SITES? | 340 |
| 9383/1 – MNN135332 | LEICESTER TO PETERBOROUGH TURNPIKE | 760 |
| 9389/0/0 - MNN191 | SIGNIFICANT FIND SCATTER OF ROMAN DATE INCLUDING BUILDING STONE AND POTTERY. | 500 |
| 9394/0/0 - MNN197 | CHARCOAL BURNING SITE | 1150 |
| 9395/0/1 – MNN198 | BARROW EARTHWORK WITH HOLE IN TOP 15M DIAM 1M HIGH. LIKELYTO BE A CAIRN | 860 |
| 9397/1/0 - MNN199 | CHARCOAL BURNING SITE | 540 |
| 9399/0/0 - MNN115 | BLACK SLAG FROM IRONWORKING SITE (SEE ALSO 2846/0/3 | 1200 |
| 9400/0/0 - MNN126 | POTTERY SHERDS, OCCUPATION DEBRIS, CHARCOAL AND SLAG PATCHES. POSSIBLE ROMAN IRONWORKING (SEE ALSO 2486) | 1400 |
| 9402/0/1 – MNN128882 | POSIBLE PREHISTORIC LINEAR FEATURE FROM AP | 1000 |
| 9402/0/2 – MNN128884 | POSSIBLE PREHISTORIC BOUNDARY FEATURE FROM AP | 1000 |
| 9402/0/3 – MNN12885 | POSSIBLE PITS (UNDATED) FROM AP | 1000 |
| 9576 – MNN116786 | SITE | 400 |

| | | |
|---|---|---|
| 9576/0/1 – MNN1116788 | STONE FEATURE ON N SIDE OF GREEN LANE | 400 |
| 9576/0/2 - MNN116789 | POUND IN NE CORNER OF BUXTON WOOD | 400 |
| 9686/1 – MNN136435 | POSSIBLE POST MEDIEVAL CHARCOAL PRODUCTION SITE | 10 |
| 9686/1/1 - MNN128889 | POSSIBLE CHARCOAL BURNING PLATFORM AND MACULA (POST MEDIEVAL - 1540 AD TO 1749 AD) IDENTIFIED FROM AERIAL PHOTOGRAPHY | 180 |

A survey has also been undertaken within Fineshade Wood that lies to the west and south west of the western extension area as part of David Hall's Rockingham Forest project. Some of the entries may duplicate those already recorded in the NHER but have been given new numbers, as set out in **Table 12.5.**

**Table 12.5 Fineshade Wood Survey results in the NHER**

| NHER no | DESCRIPTION |
|---|---|
| MNN138535 | DITCH |
| MNN13944-8 | QUARRY PITS |
| MNN166529 | VETERAN TREES |
| SN9 – MNN167006 | FINESHADE WOOD PROJECT |
| MNN167418-167425 | DITCH AND BANK |
| MNN167427 | DITCH AND BANK |
| MNN167514 | DITCH AND BANK |
| MNN167543 | DITCH AND BANK |
| MNN167924 | DITCH |
| MNN167925 | DITCH |
| MNN167929 | DITCH |
| MNN167937-167939 | DITCH |
| MNN168050-168055 | POND |
| MNN 168022 | POND |

The Peterborough HER (PHER) was also consulted online as it includes records within Northamptonshire where they are the result of cross-county investigations, such as pipelines, or where there may be some doubt as to the precise location. At its nearest point the county boundary lies 1400m east of the PDA.

Two records are within 1500m of the western extension area.

- Knocker's Temple 900m east of the western extension area. Approximate position of stone foundations of possible Roman temple found in 1953-54 by Captain Knocker. The description is the same as the Northants HER entry 2868/1/1 - MNN22442

- Pipeline watching brief (PHER 51109) 700m east of the western extension area. No features were observed.

**Geophysical Survey**

Geophysical survey was carried out by Tigergeo in November 2019 and May 2020 before the crop matured. Interpretation is shown on **Figures 12.3A-D** and the report is appended (**Appendix 12.1**).

There is very little that can described, with certainty, as of archaeological interest, most of the suitable anomalies being non-connected linear examples with weak magnetic enhancement and no coherent layout. Some may be ditch fills, others could be drains or former paths and some contrast so weakly with their surroundings as to be only tentatively identified.

The main feature are the ditch fills [4][1] that define the western part of a small rectilinear enclosure. It lacks internal features but the strength of magnetic enhancement associated with the fills, relative to other ditch fills on site, might suggest the presence of materials commonly associated with intensive use. These can include cultural debris and heated soils.

[1] Numbers in *[n]* refer to numbers of Figures 12.3A-D

Other fairly definite linear fills include [1], which, if not a former (unknown) field boundary, could be associated with [4]. Other likely ditch fills [7], [13], [14] are isolated and magnetically lack diagnostic characters.

A possible group of linear fills at [18] may be a palimpsest of enclosures, but in this context it is impossible to discount features related to drainage.

All the other linear anomalies are too weak to be sure of identification.

The southern part of the western extension area is dominated by services pipelines and under-drainage.

**Archaeological Trial-Trenching**

The Museum of London's Northampton Office has been appointed to carry out trial-trenching across the western extension area. A trench layout and Written Scheme of Investigation has been approved by the County Archaeological Officer and the work will start in October 2020.

## PRELIMINARY ASSESSMENT OF EFFECTS

The following activities associated with the construction of the proposed development could impact on known or potential archaeological or cultural features:

- Topsoil stripping
- Creation of peripheral screening bunds and creation of overburden stockpiles
- Pre-construction infrastructure works
- Movement of heavy machinery
- Mineral extraction.

Potential effects from the proposed development on heritage assets can be assessed by combining the sensitivity of the asset (**Table 12.6**) with the magnitude of change that would occur should the development proceed (**Table 12.7**). A matrix of the inter-relationship of sensitivity with magnitude – i.e. the overall effect - is shown in **Table 12.8**) and how that should be interpreted in decision making at **Table 12. 9**.

**Table 12.6 Definitions of sensitivity**

| **Value (Sensitivity) of receptor/resource** | **Definition** |
|---|---|
| Very high | Sites and settings of *international importance*, for example World Heritage Sites. |
| High | Sites and settings of *national importance*. Scheduled Monuments. Registered Battlefields. Grade I and Grade II* Listed Buildings and Registered Historic Parks and Gardens. Sites may also be discovered as a result of new research that are also of national importance and are candidates for scheduling. |
| Medium | Sites and settings of *regional importance*. Archaeological sites and features that are not considered sufficiently important or well-preserved to be protected as Scheduled Monuments. Grade II Listed Buildings and Grade II Registered Historic Parks and Gardens. Conservation Areas. |
| Low | Archaeological sites and structures, and other components of the historic environment that contribute to the local landscape. Locally designated assets. |
| Negligible | Archaeological sites and structures, and other components of the historic environment of very low importance. |

## Table 12.7 Criteria for Assessing Magnitude of Change[2]

| Magnitude of impact (change) | | Typical description |
|---|---|---|
| Major | Adverse | Loss of resource and/or quality and integrity of resource; severe damage to key characteristics, features or elements. |
| | Beneficial | Large scale or major improvement of resource quality; extensive restoration; major improvement of attribute quality. |
| Moderate | Adverse | Loss of resource, but not adversely affecting the integrity; partial loss of/damage to key characteristics, features or elements. |
| | Beneficial | Benefit to, or addition of, key characteristics, features or elements; improvement of attribute quality. |
| Minor | Adverse | Some measurable change in attributes, quality or vulnerability; minor loss of, or alteration to, one (maybe more) key characteristics, features or elements. |
| | Beneficial | Minor benefit to, or addition of, one (maybe more) key characteristics, features or elements; some beneficial impact on attribute or a reduced risk of negative impact occurring. |
| Negligible | Adverse | Very minor loss or detrimental alteration to one or more characteristics, features or elements. |
| | Beneficial | Very minor benefit to or positive addition of one or more characteristics, features or elements. |
| No change | | No loss or alteration of characteristics, features or elements; no observable impact in either direction. |

## Table 12.8 Inter-relationship of sensitivity with magnitude[3]

| | Magnitude of impact (degree of change) | | | | | |
|---|---|---|---|---|---|---|
| | | **No change** | **Negligible** | **Minor** | **Moderate** | **Major** |
| **Environmental value (sensitivity)** | **Very high** | Neutral | Slight | Moderate or large | Large or very large | Very large |
| | **High** | Neutral | Slight | Slight or moderate | Moderate or large | Large or very large |
| | **Medium** | Neutral | Neutral or slight | Slight | Moderate | Moderate or large |
| | **Low** | Neutral | Neutral or slight | Neutral or slight | Slight | Slight or moderate |
| | **Negligi-ble** | Neutral | Neutral | Neutral or slight | Neutral or slight | Slight |

[2] Source: Design Manual for Roads and Bridges, 2020, LA104 *Environmental Assessment and Modelling,* page 14

[3] Source: Design Manual for Roads and Bridges, 2020, LA104 *Environmental Assessment and Modelling,* page 15

**Table 12.9 Significance categories and decision making**

| Significance category | Typical description |
|---|---|
| Very large | Effects at this level are material in the decision-making process. |
| Large | Effects at this level are likely to be material in the decision-making process. |
| Moderate | Effects at this level can be considered to be material decision-making factors. |
| Slight | Effects at this level are not material in the decision-making process. |
| Neutral | No effects or those that are beneath levels of perception, within normal bounds of variation or within the margin of forecasting error. |

The preliminary review of heritage information would indicate that there are no adverse effects upon designated assets, due to a combination of topography, distance, intervening woodland and built development.

No significant archaeological finds have been made on the western extension area itself and the geophysical survey, whilst identifying a handful of anomalies, positively identified only one enclosure as being of archaeological interest.

Trial-trenching is scheduled to take place in October 2020.

**PRELIMINARY MITIGATION**

Following trial trenching discussions will be held with the Northamptonshire Archaeological Officer regarding the archaeological potential of the western extension area. Where sites of national importance are identified by the trial-trenching there is a presumption in favour of their preservation *in situ*.

It is proposed that soil stripping is supervised by an archaeologist followed by mapping and excavation as appropriate, where archaeological features of lesser importance are identified.

## PRELIMINARY ASSESSMENT OF RESIDUAL EFFECTS

Based upon current information, and subject to further review after the results of the trenching, it is considered that there would be no significant residual effects as a result of the proposed development.

## PRELIMINARY CONCLUSIONS

The preliminary conclusion of this review of archaeology and cultural heritage is that the proposed development will have neutral effects upon the setting of designated heritage assets and slight or moderate effects upon on-site archaeology.

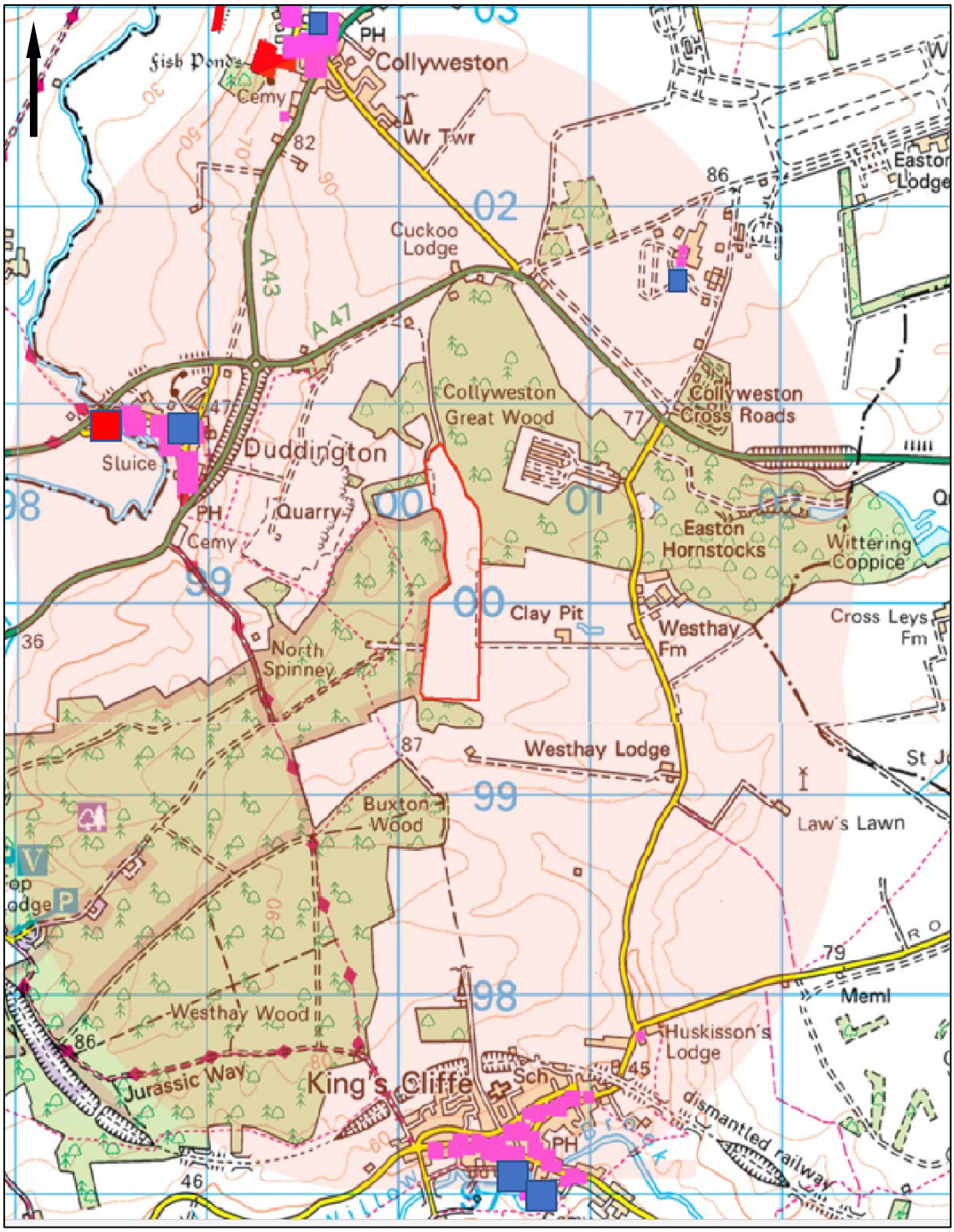
## PRELIMINARY CUMULATIVE EFFECTS

From the preliminary information available it is considered that there will be no cumulative effect on the setting of cultural heritage or upon archaeology.

## ONGOING ASSESSMENTS

Discussions will be held with the Northamptonshire Archaeological Officer and Historic England to discuss the scope of the assessment. Any further work that is identified as necessary by the statutory consultees will be undertaken and included in the cultural heritage assessment as part of the Environmental Statement that will support the application to PINS.

**FIGURES**

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Western Extension Area

Scheduled Monument

Grade 1/II* Listed Building

Grade II Listed Building

AJA
andrew josephs associates

| | |
|---|---|
| Site | ENRMF |
| Client | Augean plc |
| Ref | Figure 12.1 |
| Rev | Date October 2020 |
| Title | Designated Heritage Assets within 2km of the Site |

Northamptonshire County Council

Title: **HER search: Monuments (north)** **Figure 12.2A**

N

**Date:** 14-05-2020 **Scale:** 1:10,000

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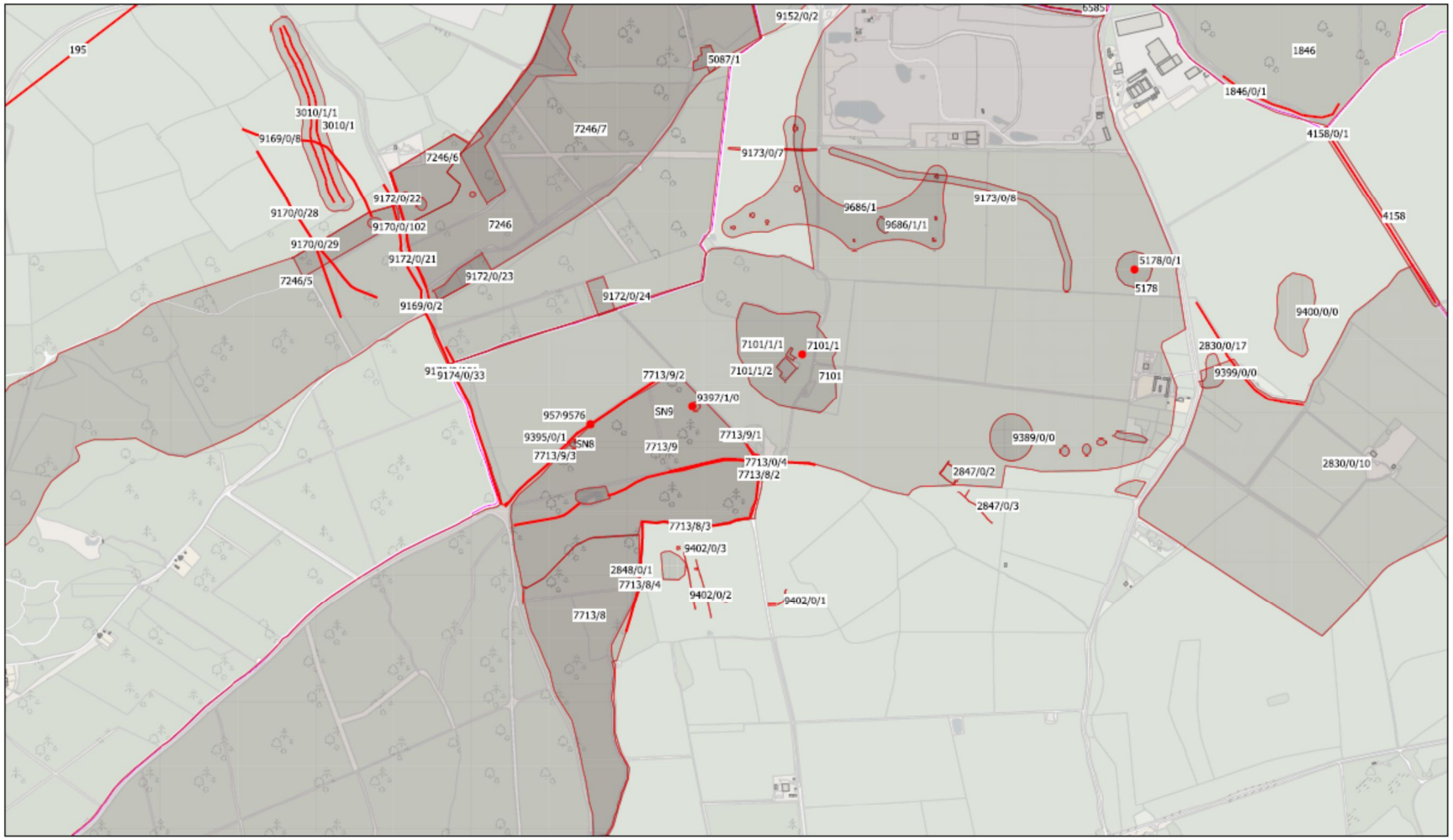


Northamptonshire County Council

Title: **HER search: Monuments (south)** **Figure 12.2B**

N

**Date:** 14-05-2020 **Scale:** 1:10,000

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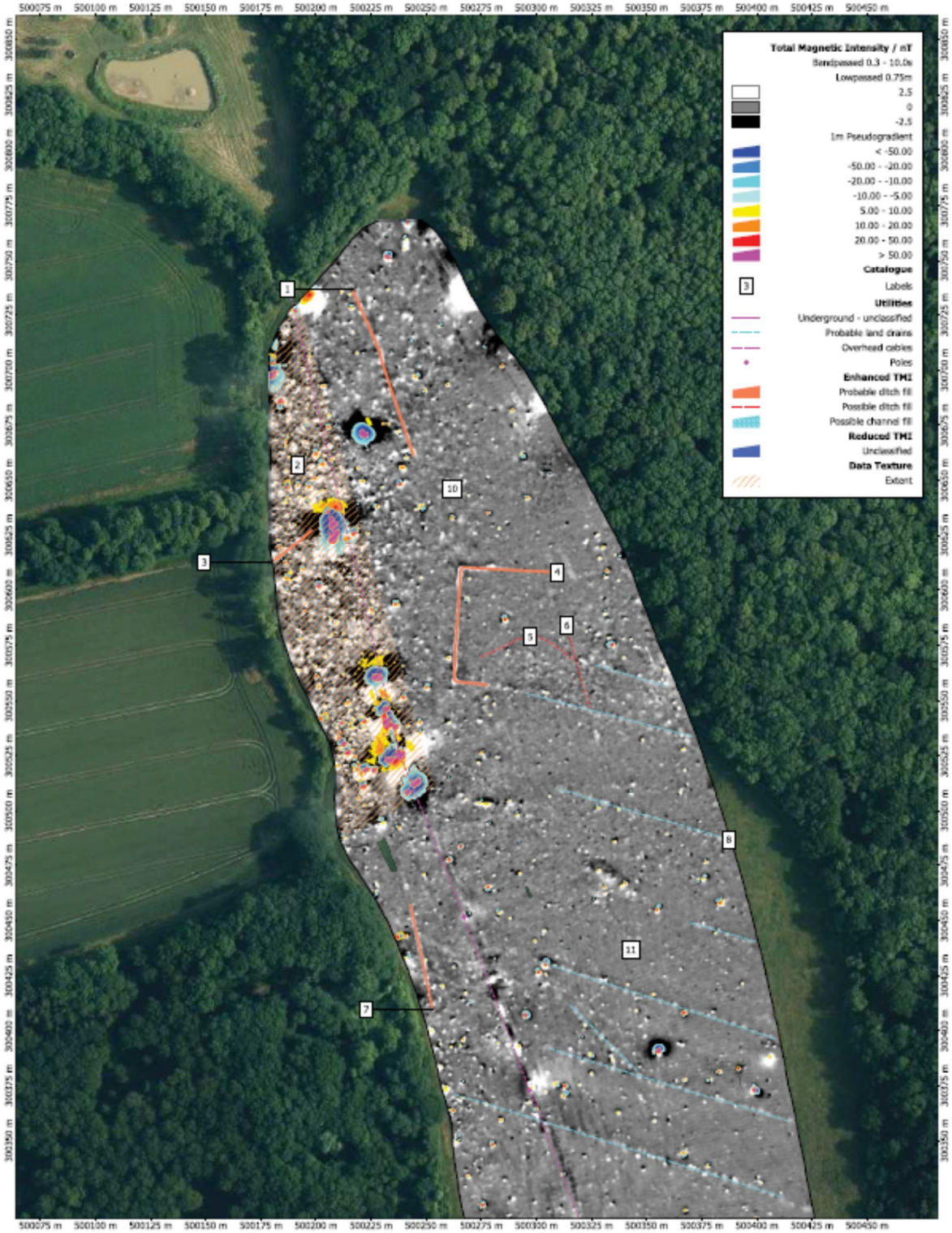


KCP191 Kings Cliffe, Northamptonshire
DWG 04a - Interpretation - A

Orthographic Scale: 1:1500 @ A3 Spatial Units: Meter. Do not scale off this drawing
File: KCP191.map Copyright TigerGeo Limited 2020

AJA andrew josephs associates

| | |
|---|---|
| Site | ENRMF |
| Client | Augean plc |
| Ref | Figure 12.3A |
| Rev | Date: Oct 2020 |
| Title | Geophysics North |

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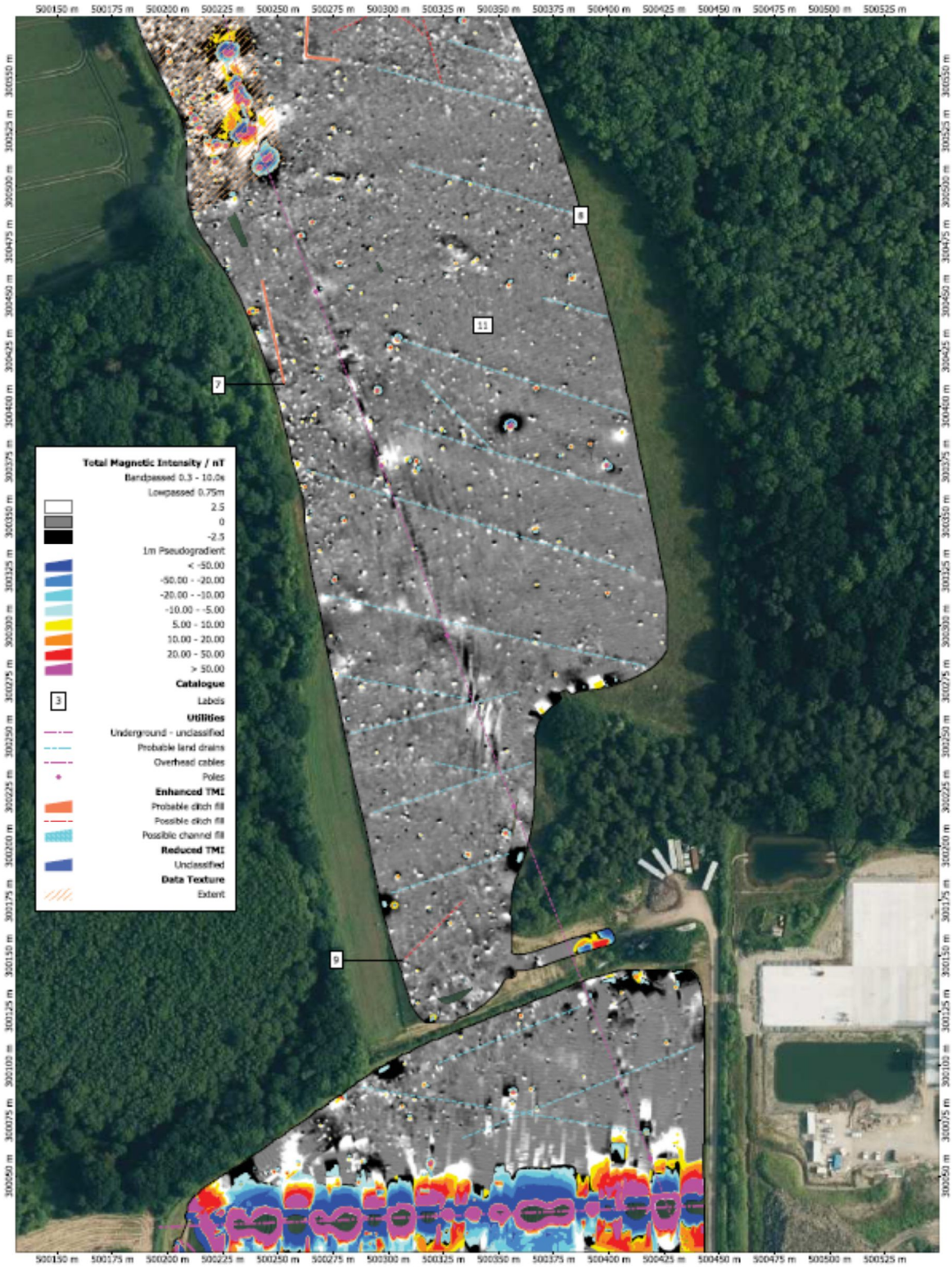


KCP191 Kings Cliffe, Northamptonshire
DWG 04b Interpretation - B

Orthographic Scale: 1:1500 @ A3 Spatial Units: Meter. Do not scale off this drawing
File: KCP191.map Copyright TigerGeo Limited 2020

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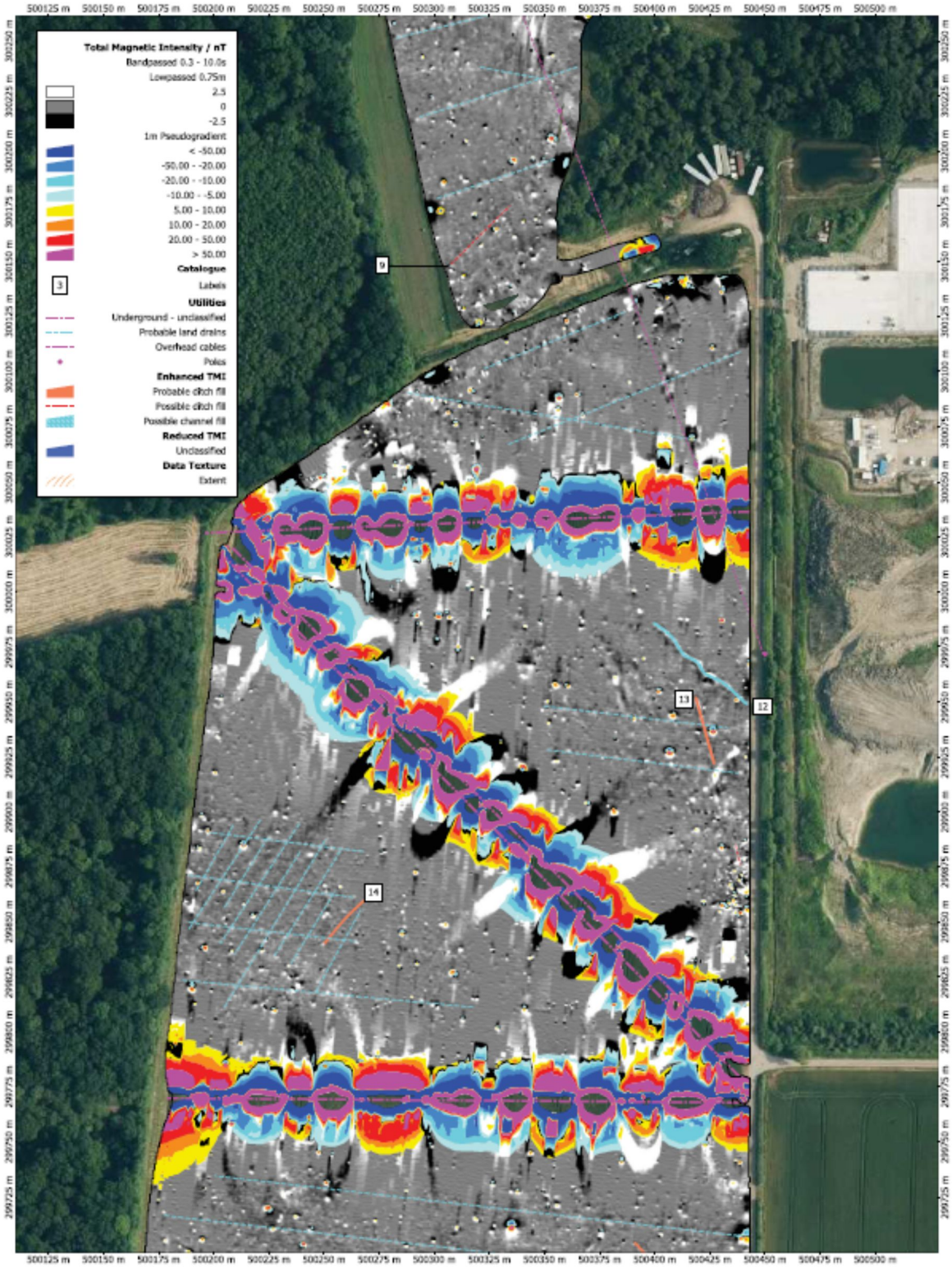
| | | | |
|---|---|---|---|
| Site | ENRMF | | |
| Client | Augean plc | | |
| Ref | Figure 12.3B | | |
| Rev | | Date | Oct 2020 |
| Title | Geophysics Centre/N | | |

TIGERGEO




KCP191 Kings Cliffe, Northamptonshire
DWG 04c Interpretation - C

Orthographic Scale: 1:1500 @ A3 Spatial Units: Meter. Do not scale off this drawing
File: KCP191.map Copyright TigerGeo Limited 2020

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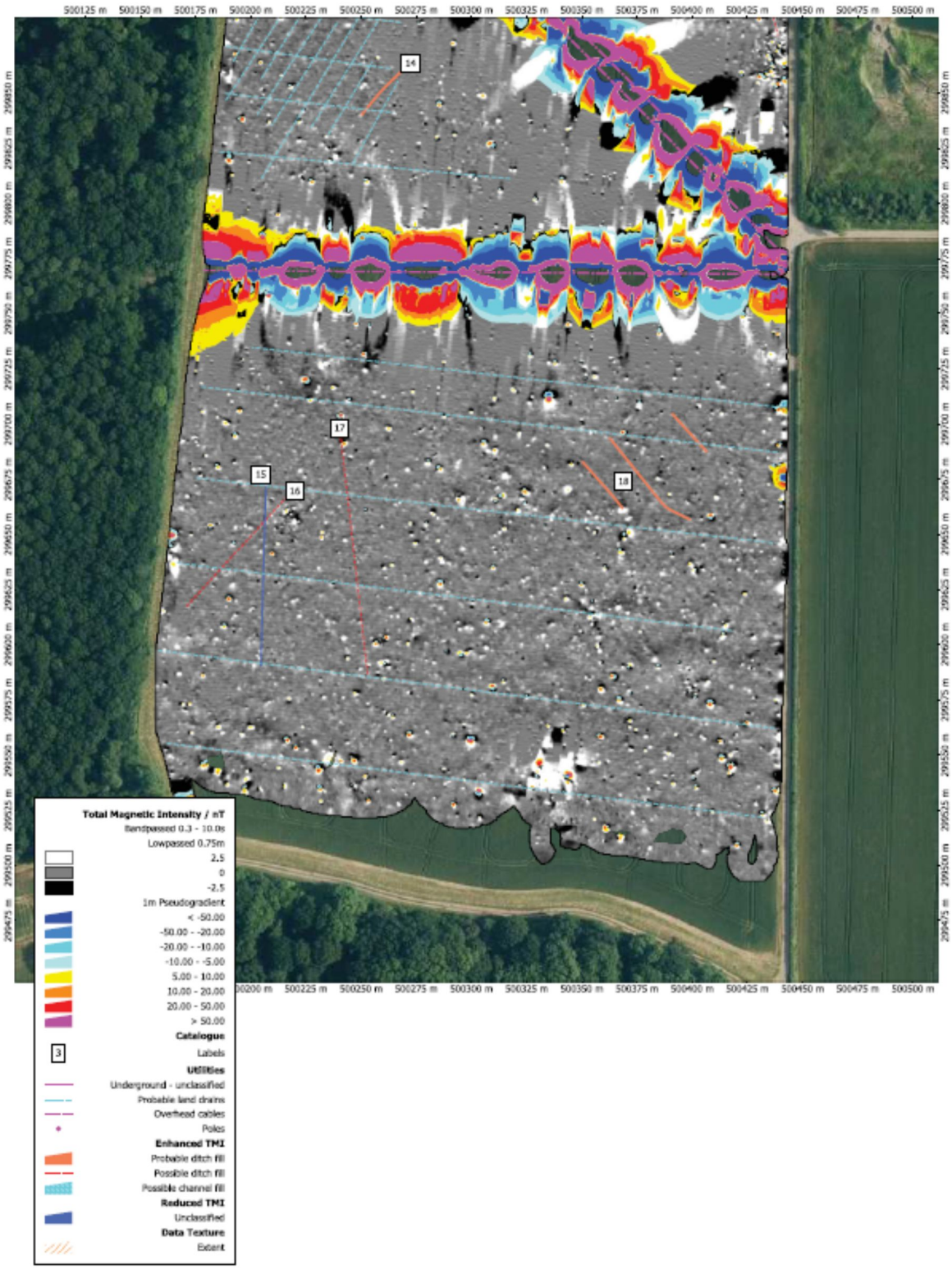
| | | | |
|---|---|---|---|
| Site | ENRMF | | |
| Client | Augean plc | | |
| Ref | Figure 12.3C | | |
| Rev | | Date | Oct 2020 |
| Title | Geophysics Centre/S | | |

TIGERGEO




KCP191 Kings Cliffe, Northamptonshire
DWG 04d Interpretation - D

Orthographic Scale: 1:1500 @ A3 Spatial Units: Meter. Do not scale off this drawing
File: KCP191.map Copyright TigerGeo Limited 2020

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| | | | |
|---|---|---|---|
| Site | ENRMF | | |
| Client | Augean plc | | |
| Ref | Figure 12.3D | | |
| Rev | | Date | Oct 2020 |
| Title | Geophysics South | | |

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# APPENDIX 12.1

# LAND NEAR KING'S CLIFFE, NORTHAMPTONSHIRE GEOPHYSICAL SURVEY REPORT 18TH JULY 2020

TIGERGEO

# Land near King's Cliffe, Northamptonshire

**Geophysical Survey Report**
(Caesium Vapour Magnetic – Archaeology)

Version 1.0

**Project code:** KCP191

**Produced for:**

Andrew Josephs Associates

**Lead Author:**

MJ Roseveare, Senior Geophysicist

BSc(Hons) MSc MEAGE FGS MCIfA

REGISTERED ORGANISATION CIfA

**18th July 2020**

**Environmental Geophysics – Survey, Research and Consultancy**

TIGERGEO

# Land near King's Cliffe, Northamptonshire

## Digital data

| Item and version | Sent to | Sent date |
|---|---|---|
| CAD – Vector Elements 1.0 | Andrew Josephs | 18th July 2020 |
| | | |

## Audit

| Version | Author | Checked | Date |
|---|---|---|---|
| Interim | | | |
| 1.0 | MJ Roseveare | ACK Roseveare | 18th July 2020 |

## Project metadata

| | |
|---|---|
| **Project Code** | KCP191 |
| **Client** | Andrew Josephs Associates |
| **Fieldwork Dates** | 11th - 13th November 2019, 15th -16th May 2020 |
| **Field Personnel** | ACK Roseveare, A Gerea, MJ Roseveare |
| **Data Processing Personnel** | ACK Roseveare, A Gerea |
| **Reporting Personnel** | MJ Roseveare |
| **Report Date** | 18th July 2020 |
| **Report Version** | 1.0 |

# TigerGeo Limited

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# Non-Technical Summary

A survey was commissioned by Andrew Josephs Associates to prospect land near King's Cliffe, Northamptonshire for buried structures of archaeological interest. Survey was undertaken using an ATV-towed and GNSS-tracked non-gradiometric array of caesium vapour magnetometers on a non-magnetic platform. This configuration allowed the total magnetic intensity to be measured and from this was then modelled a 1m vertical pseudogradient data set and the two used to generate the interpretation presented in this report.

Overall the survey seems to have revealed little of archaeological interest, with a thin scatter across the site of possible ditch fills although most are too weakly magnetic to be sure of their identification. A small rectilinear enclosure in the north of the area, on the highest ground, is the clearest evidence for past human activity. There is no evidence for former cultivation or other agrarian activity and indeed, the dominant elements with the data are various sets of land drains.


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| Drawing | Title |
|---|---|
| DWG 01 | Site Location |
| DWG 02a-d | Magnetic Data – Total Magnetic Intensity |
| DWG 03a-d | Magnetic Data – 1m Vertical Pseudogradient |
| DWG 04a-d | Interpretation |


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# 1 Introduction

TigerGeo was commissioned by Andrew Josephs Associates to undertake a geophysical survey of land near King's Cliffe, Northamptonshire as part of an archaeological evaluation of the land and also to accurately locate a pair of water mains. An area of approximately 24 hectares was surveyed across two field visits, the first being the northern field and the second being the southern, once the ground had dried out. It was undertaken using an array of six caesium vapour magnetometers, GNSS tracked and towed by an ATV. Advanced processing was undertaken to allow use of the resulting total magnetic intensity data plus a modelled vertical pseudogradient to assist interpretation.

| | |
|---|---|
| **Country** | England |
| **County** | Northamptonshire |
| **Nearest Settlement** | King's Cliffe |
| **Central Co-ordinates** | 500330, 300158 |

# 2 Context

## 2.1 Environment

| | |
|---|---|
| **Soilscapes Classification** | Slowly permeable seasonally wet slightly acid but base-rich loamy and clayey soils (18) |
| **Superficial 1:50000 BGS** | Till, Mid Pleistocene - Diamicton (TILMP), recorded in southern field only |
| **Bedrock 1:50000 BGS** | Blisworth Limestone Formation - Limestone (BWL) in northern field, northern part, Lower Lincolnshire Limestone Member - Limestone (LLL) in a broad band crossing the southern field, the remainder Rutland Formation - Argillaceous Rocks With Subordinate Sandstone And Limestone (RLD) |
| **Topography** | Southern field level, slight northwards dip, before rising again to a higher level in the northern field |
| **Hydrology** | Impeded drainage |
| **Current Land Use** | Agricultural - Mixed |
| **Historic Land Use** | Agricultural - Mixed |
| **Vegetation Cover** | Grass in southern part of north field, stubble and young crop elsewhere |
| **Sources of Interference** | Potential ferrous interference from adjacent quarry plant/machinery and agricultural and other debris, buried services etc. |

## 2.2 Archaeology

A rapid review of the Northamptonshire Historic Environment Record (HER), via the Heritage Gateway website, revealed that the records within the survey area relate to field names on the Duddington Enclosure Map of 1775 and possible post-medieval charcoal burning platforms observed from aerial photographs.

There are no other records within the area, although those in the wider environs hint at further post-medieval and medieval activity, extensive Roman period activity including settlements, industrial activity and religious sites (temples) and earlier prehistoric activity in the form of burnt mounds.

The area immediately to the east has been subject to several phases of archaeological investigation, including a Heritage Impact Assessment (Andrew Josephs Ltd, 2011). The assessment sums up the archaeological work undertaken at the site, concluding that no features of archaeological interest were observed across several phases of archaeological monitoring.


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# 3 Discussion

## 3.1 Character & Principal Results

### 3.1.1 Introduction

The following paragraphs represent an interpretive summary of the survey. The numbers in square brackets refer to individual anomalies described in detail in the catalogue below and shown on DWG 04.

### 3.1.2 Data

Data quality is good with no significant defects and only limited disturbance from overhead power cables in the northern field. Significant disturbance from underground water mains was seen in the southern field and was expected.

There is low background variation, mostly less than 0.5 nT across a few metres and contrast is weak to moderate. Natural sources contribute about 2-3 nT at the spatial scale of interest, which is similar to or slightly more than the anomaly strength from features of archaeological interest. In the southern field some weak linear anomalies are less than 0.3 nT strength and are only apparent through their plan form. Land drains contribute up to about 1 nT and are apparent throughout the survey.

### 3.1.3 Geology

The British Geological Survey (BGS) G-Base database (5 km resolution) states total soil iron within the site is 6.6% and at 15 km regional level, 4.8%, which is notably high. However, not all soil iron is available for conversion to more magnetic forms by processes associated with past human activity and a high soil iron proportion is not a guarantor of strong anomalies from buried features of archaeological interest.

Much of the variation within the data is here due to the Till deposits, as both a plethora of small relatively magnetic point sources (e.g. near [10]) but also as broader variations that reflect local changes in soil depth and the composition of the Till, e.g. the smoother texture at [11]. These are present across the entire survey which would suggest that the overall topography of the site is dependent more upon the bedrock than the superficial deposits, i.e. the Till seems likely to extend further north than plotted by the BGS. There are also no textural variations due to the different limestone formations. Boreholes driven as part of the wider environmental assessment have confirmed a fairly thick cover of superficial deposits within the northern field.

Although the soils are seasonally wet, hydrological effects are not especially apparent within the data and there are no convincing signs of changes in magnetic character in the region of known solution features towards the middle of the site.

At [12] there are signs of a former stream channel although insufficient is visible to determine how this relates to the wider landscape.

### 3.1.4 Land use

The dominant agricultural character is of arable cultivation and there is an extensive series of networks of land drains (e.g. [8]) throughout the site. There is little sign of the modern cultivation and no indications of past cultivation and it is possible that this is due to survival or to low magnetic susceptibility.

In the northwest part of the survey the former extent [2] of an area of woodland is apparent as a strongly variable magnetic region which is likely to be a consequence of the removal of trees rather than any natural process.

A long reduced magnetic intensity linear anomaly at [15] seems unlikely to be of archaeological interest and may be more properly considered to relate to land management in some way.


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### 3.1.5 Archaeology

There is very little that can described as of archaeological interest with any certainty, most of the suitable anomalies being non-connected linear examples with weak magnetic enhancement and no coherent layout. Some may be ditch fills, others could be drains or former paths and some contrast so weakly with their surroundings as to be only tentatively identified.

The main feature is the ditch fills [4] that define the western part of a small rectilinear enclosure. It lacks internal features but the strength of magnetic enhancement associated with the fills, relative to other ditch fills on site, might suggest the presence of materials commonly associated with intensive use. These can include cultural debris and heated soils.

Other fairly definite linear fills include [1], which, if not a former (unknown) field boundary, could be associated with [4]. Other likely ditch fills [7], [13], [14] are isolated and magnetically lack diagnostic characters.

A possible group of linear fills at [18] may be a palimpsest of enclosures, but in this context it is impossible to discount features related to drainage.

All the other linear anomalies are too weak to be sure of identification.

## 3.2 Catalogue

| ID | Data Class | Anomaly Class | Form Class | Feature Class | Feature Sub-Class | Comments |
|---|---|---|---|---|---|---|
| 1 | TMI | Enhanced | Linear - continuous | Ferrous | Ditch | |
| 2 | TMI | Texture | Area | Agricultural | | This is the former extent of an area of woodland; why this should have modified the magnetic texture of the ground is uncertain |
| 3 | TMI | Enhanced | Linear - continuous | Fill | | Possible ditch |
| 4 | TMI | Enhanced | Linear - continuous | Fill | Ditch | Three sides of a small rectilinear enclosure are defined by a narrow ditch fill but much of the southern side is not magnetically visible and the eastern extent is unknown |
| 5 | TMI | Enhanced | Linear - continuous | Fill? | ? | |
| 6 | TMI | Enhanced | Linear - continuous | Fill? | ? | |
| 7 | TMI | Enhanced | Linear - continuous | Fill | Ditch | |
| 8 | TMI | Enhanced | Linear - continuous | Agricultural | Drain | One of many drains beneath much of the surveyed area and representing different episodes of drainage |
| 9 | TMI | Enhanced | Linear - continuous | Fill? | ? | One of a large number of weak linear anomalies that could be ditch fills or land drains. In this case a land drain seems more likely but in most cases there is insufficient diagnostic information |
| 10 | TMI | Texture | Area | Natural | | |
| 11 | TMI | Texture | Area | Natural | | |


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| ID | Data Class | Anomaly Class | Form Class | Feature Class | Feature Sub-Class | Comments |
|---|---|---|---|---|---|---|
| 12 | TMI | Enhanced | Linear - discontinuous | Fill | | Possible natural channel fill as if a small stream once flowed here |
| 13 | TMI | Enhanced | Linear - continuous | Fill | Ditch | |
| 14 | TMI | Enhanced | Linear - continuous | Fill | Ditch | |
| 15 | TMI | Reduced | Linear - continuous | Structure? | ? | Uncertain, this could be a land drain or similar structure but if so being less magnetic than the surrounding ground implies a void or quantities of relatively non-magnetic materials like stone |
| 16 | TMI | Enhanced | Linear - continuous | Fill? | ? | |
| 17 | TMI | Enhanced | Linear - continuous | Fill? | ? | |
| 18 | TMI | Enhanced | Linear - continuous (group) | Fill | Ditch | A small cluster of probable narrow ditch fills implies a possible focus of past activity, however, land drainage is also possible |

## 3.3 Conclusions

The clearest evidence for past human activity is the enclosure [4] in the northern field but elsewhere there is a palimpsest of very weakly magnetic linear sources that could be ditch fills, although lacking an overall coherent layout.

Extensive land drains show how the land has a history of being wet and indeed, the survey had to be conducted in two halves to accommodate ground conditions. It may not be coincidence that enclosure [4] is situated on the higher and drier land to the north.

## 3.4 Caveats

Geophysical survey is reliant upon the detection of anomalous values and patterns in physical properties of the ground, e.g. magnetic, electromagnetic, electrical, elastic, density and others. It does not directly detect underground features and structures and therefore the presence or absence of these within a geophysical interpretation is not a direct indicator of presence or absence in the ground. Specific points to consider are:

- some physical properties are time variant or mutually interdependent with others;
- for a buried feature to be detectable it must produce anomalous values of the physical property being measured;
- any anomaly is only as good as its contrast against background textures and noise within the data.

TigerGeo will always attempt to verify the accuracy and integrity of data it uses within a project but at all times its liability is by necessity limited to its own work and does not extend to third party data and information. Where work is undertaken to another party's specification any perceived failure of that specification to attain its objective remains the responsibility of the originator, TigerGeo meanwhile ensuring any possible shortcomings are addressed within the normal constraints upon resources.


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# 4 Methodology

## 4.1 Magnetic Principles

### 4.1.1 Physical concepts

Magnetic survey for any purpose relies upon the generation of a clear magnetic anomaly at the surface, i.e. strong enough to be detected by instrumentation and exhibiting sufficient contrast against background variation to permit diagnostic interpretation. The anomaly itself is dependent upon the chemical properties of a particular volume of ground, its magnetic susceptibility and hence induced magnetic field, the strength of any remanent magnetisation, the shape and orientation of the volume of interest and its depth of burial. Finally the choice and configuration of measurement instrumentation will affect anomaly size and shape.

Sites present a complex mixture of these factors and for some the causative affects are not known. However, depth of burial and size are usually fairly constrained and background susceptibility can be estimated (or measured). The degree of remanent magnetisation is harder to predict and depends on both the natural magnetic properties of the soil and any chemical processes to which it has been subjected. Fortunately heat will raise the susceptibility of most soils and topsoil tends to be more magnetic than subsoil, by volume.

It is hard to draw reliable conclusions about what sort of geology is supportive of magnetic survey as there are many factors involved and in any case magnetic response can vary across geological units as well as being dependent upon post-deposition and erosional processes. In general a relatively non-magnetic parent material contrasting with a magnetisable erosion product, i.e. one which contains iron in the form of oxides and hydroxides, will allow archaeological structures to exhibit strong magnetic contrast against their surroundings and especially if the soil has been heated or subjected to certain processes of fermentation. In the absence of either, magnetic enhancement becomes entirely reliant upon the geochemistry of the soil and enhancement will often be weaker and more variable.

Analysis of the British Geological Survey (BGS) Geochemical Atlas (G-Base) for total soil iron reveals that for England and Wales 50% of the samples (the interquartile range) lie between 1.9% and 3.6% percentage iron with the median at 2.7%.

The principal magnetic iron mineral is the oxide magnetite which sometimes occurs naturally but is more often formed during the heating of soil. Subsequent cooling yields a mixture of this, non-magnetic oxide haematite and another magnetic oxide, maghaemite. Away from sources of heat, other magnetic iron minerals include the sulphides pyrite and greigite while in damp soils complex chemistry involving the hydroxides goethite and lepidocrocite can create strong magnetic anomalies. There are thus a number of different geochemical reaction pathways that can both augment and reduce the magnetic susceptibility of a soil. In addition, this susceptibility may exhibit depositional patterns unrelated to visible stratigraphy.

Most structures of archaeological interest detected by magnetic survey are fills within negative or cut features. Not all fills are magnetic and they can be more magnetic or less magnetic than the surrounding ground. In addition, it is common for fills to exhibit variable magnetic properties through their volume, basal primary silt often being more magnetic than the material above it due to the increased proportion of topsoil within it. However, a fill containing burnt soil may be much more magnetic than this primary silt and sometimes a feature that has contained standing water can produce highly magnetic silts through mechanical depositional processes (depositional remanent magnetisation, DRM).

A third structural factor in the detection of buried structures is the depth of topsoil over the feature. As fills sink, the hollow above accumulates topsoil and hence a structure can be detected not through its own magnetisation but through the locally deeper topsoil above it. The volume of soil required depends upon the magnetic susceptibility of the soil but just a few centimetres are often sufficient. Such a thin deposit can, however, easily be lost through subsequent erosion by natural factors or ploughing.

### 4.1.2 Instrumentation

The use of the magnetic sensors in non-gradiometric (vertical) configuration avoids measurement sensitisation to the shallowest region of the soil, allowing deeper structures, whether natural or otherwise to


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be imaged within the sensitivity of the instrumentation. This also allows the detection of shallow broad variations in magnetic susceptibility that might have archaeological significance. Suppression of ambient noise and temporal trends is reduced and therefore need reduction during processing.

The theoretical slightly reduced lateral resolution inherent to using non-gradiometric sensor arrays is practically not an issue and especially if processing includes a vertical pseudo-gradient conversion. The non-gradiometric system is thus overall a more capable configuration than the short gradiometers often used for archaeological studies.

Caesium instrumentation has a greater sensitivity than fluxgate instruments, however, at the 10 Hz sampling rate used here this increase in sensitivity is limited to about one order of magnitude. Greater benefit is obtained from a better signal-to-noise ratio meaning that sub-nanoTesla measurement is more practically achieved.

The array system is designed to be non-magnetic and to contribute virtually nothing to the magnetic measurement, whether through direct interference or through motion noise.

## 4.2 Magnetic Survey

### 4.2.1 Technical equipment

| | |
|---|---|
| **Measured variable** | Magnetic flux density / nT (Total Magnetic Intensity / nT after removal of regional trend) |
| **Instrument** | Array of Geometrics G858 Magmapper caesium magnetometers |
| **Configuration** | Non-gradiometric transverse array (4 & 6 sensors, ATV towed) |
| **Sensitivity** | 0.03 nT @ 10 Hz (manufacturer's specification) |
| **QA Procedure** | Continuous observation |
| **Spatial resolution** | 1.0m between lines, 0.25m mean along line interval |

### 4.2.2 Monitoring & quality assessment

The system continuously displays all incoming data as well as line speed and spatial data resolution per acquisition channel during survey. Rest mode system noise is therefore easy to inspect simply by pausing during survey, and the continuous display makes monitoring for quality intrinsic to the process of undertaking a survey. Rest mode test results (static test) are available from the system.

## 4.3 Magnetic Data Processing

### 4.3.1 Procedure

All data processing is minimised and limited to what is essential for the class of data being collected, e.g. reduction of orientation effects, suppression of single point defects (drop-outs or spikes) etc. The processing stream for this data is as follows:

| **Process** | **Software** | **Parameters** |
|---|---|---|
| Measurement & GNSS receiver data alignment | Proprietary | |
| Temporal reduction, regional field suppression | Proprietary | Bandpassed 0.3 – 10.0s |
| Gridding | Surfer | Kriging, 0.25m x 0.25m |
| Smoothing | Surfer | Gaussian lowpass 3x3 data (0.75m) |
| Pseudo-gradient conversion | Proprietary | 1m vertical |

Potential field processing procedures are used where possible on gridded data from the above processing, allowing simulation of vertical gradient data, separation of deep and shallow magnetic sources, etc. The initial processing uses proprietary software developed in conjunction with the multisensor acquisition system. Gridded data is ported as data surfaces (not images) into Manifold GIS for final imaging, contouring and detailed analysis. Specialist analysis is undertaken using proprietary software.


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## 4.4 Magnetic Interpretation

### 4.4.1 Introduction

Numerous sources are used in the interpretive process, which takes into account shallow geological conditions, past and present land use, drainage, weather before and during survey, topography and any previous knowledge about the site and the surrounding area. Old Ordnance Survey mapping is consulted and also older sources if available. Geological information (for the UK) is sourced only from British Geological Survey resources and aerial imagery from online sources. LiDAR data is usually sourced from the Environment Agency or other national equivalents, SAR from NASA and other topographic data from original survey.

Information from nearby surveys is consulted to inform upon local data character, variations across soils and near-surface geological contexts. Published data from other surveys may also be used if accompanied by adequate metadata.

Interpretation of magnetic data is undertaken using total intensity data, vertical pseudo-gradient and where relevant, shallow field, component models in parallel although for clarity only a subset of these may be presented in the report.

### 4.4.2 The contribution from geology and soils

On some sites, e.g. some gravels and alluvial contexts, there will be anomalies that can obscure those potentially of archaeological interest. They may have a strength equal to or greater than that associated with more relevant sources, e.g. ditch fills, but can normally be differentiated on the basis of anomaly form coupled with geological understanding. Where there is ambiguity, or relevance to the study, these anomalies will be included in this category.

Not all changes in geological context can be detected at the surface, directly or indirectly, but sometimes there will be a difference evident in the geophysical data that can be attributed to a change, e.g. from alluvium to tidal flat deposits, or bedrock to alluvium. In some cases the geophysical difference will not exactly coincide with the geological contact and this is especially the case across transitions in soil type.

Geophysical data varies in character across areas, due to a range of factors including soil chemistry, near surface geology, hydrology and land use past and present. These all contribute to the texture of the data, i.e. a background character against which all other anomalies are measured.

### 4.4.3 Agricultural inputs

Coherent linear dipolar enhancement of magnetic field strength marking ditch fills, narrow bands of more variable magnetic field or changes in apparent magnetic susceptibility, are all included within the category of former field boundaries if they correlate with those depicted on the Tithe Map or early Ordnance Survey maps. If there is no correlation then these anomaly types are not categorised as a field boundaries.

Banded variations in apparent magnetic susceptibility caused by a variable thickness of topsoil, depositional remanent magnetisation of sediments in furrows or susceptibility enhancement through heating (a by product of burning organic matter like seaweed) tend to indicate past cultivation, whether ridge-based techniques, medieval ridge and furrow or post medieval 'lazy beds'. Modern cultivation, e.g. recent ploughing, is not included.

In some cases it is possible to identify drainage networks either as ditch-fill type anomalies (typically 'Roman' drains), noisy or repeating dipolar anomalies from terracotta pipes or reduced magnetic field strength anomalies from culverts, plastic or non-reinforced concrete pipes. In all cases identification of a herring bone pattern to these is sufficient for inclusion within this category.

### 4.4.4 Features of archaeological interest

Any linear or discrete enhancement of magnetic field strength, usually with a dipolar character of variable strength, that cannot be categorised as a field boundary, cultivation or as having a geological origin, is classified as a fill potentially being of archaeological interest. Fills are normally earthen and include an often


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invisible proportion of heated soil or topsoil that augments local magnetic field strength. Inverted anomalies are possible over non-earthen fills, e.g. those that comprise peat, sand or gravel within soil. This category is subject to the 'habitation effect' where, in the absence of other sources of magnetic material, anomaly strength will decrease away from sources of heated soil and sometimes to the extent of non-detectability.

Former enclosure ditches that contained standing water can promote enhanced volumetric magnetic susceptibility through depositional remanence and remain detectable regardless of the absence of other sources of magnetic enhancement.

Anything that cannot be interpreted as a fill tends to be a structure, or in archaeological terms, a feature. This category is secondary to fills and includes anomalies that by virtue of their character are likely to be of archaeological interest but cannot be adequately described as fills. Examples include strongly magnetic bodies lacking ferrous character that might indicate hearths or kilns. In some cases anomalies of ferrous character may be included.

On some sites the combination of plan form and anomaly character, e.g. rectilinear reduced magnetic field strength anomalies, might indicate the likely presence of masonry, robber trenches or rubble foundations. Other types of structure are only included if the evidence is unequivocal, e.g. small ring ditches with doorways and hearths. In some circumstances a less definite category may be assigned to the individual anomalies instead.

It is sometimes possible to define different areas of activity on the basis of magnetic character, e.g. texture and anomaly strength. These might indicate the presence of middens or foci within larger complexes. This category does not indicate a presence or absence of discrete anomalies of archaeological interest.

## 4.5 Glossary

| Term | Type | Definition |
|---|---|---|
| A | Physical quantity | SI unit Amp of electric current |
| BGS | Organisation | British Geological Survey |
| CIfA | Organisation | Chartered Institute for Archaeologists |
| dB | Physical quantity | Decibel, unit of amplification / attenuation |
| DRM | Process | Depositional Remanent Magnetisation |
| EAGE | Organisation | European Association of Geoscientists and Engineers |
| EGNOS | Technology | European Geostationary Navigation Overlay Service |
| ERT | Technology | Electrical resistivity tomography |
| ETRS89 | Technology | European Terrestrial Reference System (defined 1989) |
| ETSI | Organisation | European Telecommunications Standards Institute |
| EuroGPR | Organisation | European Ground Penetrating Radar Association, the trade body for GPR professionals |
| G-BASE | Data | British Geological Survey Geochemical Atlas |
| GeolSoc | Organisation | Geological Society of London, the chartered body for the geological profession |
| GNSS | Technology | Global Navigation Satellite System |
| GPR | Technology | Ground penetrating radar |
| GPS | Technology | Global Positioning System (US) |
| inversion | process | A combination of forward and backward modelling intended to construct a 2D or 3D model of the physical distribution of a variable from data measured on a 1D or 2D surface. It is fundamental to ERT survey |
| IP | Physical quantity | Induced polarisation (or chargeability) units mV/V or ms |
| m | Physical quantity | SI unit metres of distance |
| mbgl | Physical quantity | Metres below ground level |
| MHz | Physical quantity | SI unit mega-Hertz of frequency |
| MS | Physical quantity | Magnetic susceptibility, unitless |
| mS | Physical quantity | SI unit milli-Siemens of electrical conductivity |
| nT | Physical quantity | SI unit nano-Tesla of magnetic flux density |
| OFCOM | Organisation | The Office of Communications, the UK radio spectrum regulator |


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| Term | Type | Definition |
|---|---|---|
| Ohm | Physical quantity | SI unit Ohm of electrical resistance |
| OS | Organisation | Ordnance Survey of Great Britain |
| OSGB36 | Data | The OS national grid (Great Britain) |
| OSTN15 | Technology | Current coordinate transformation from ETRS89 to OSGB36 co-ordinates |
| RDP | Physical quantity | Relative Dielectric Permittivity, unitless |
| RTK | Technology | Real Time Kinematic (correction of GNSS position from a base station) |
| s | Physical quantity | SI unit seconds of time |
| TMI | Physical quantity | Total magnetic intensity (measured flux density minus regional flux density) |
| TRM | Process | Thermo-Remanent Magnetisation |
| V | Physical quantity | SI unit Volt of electric potential |
| WGS84 | Data | World Geodetic System (defined 1984) |

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## 4.7 Archiving and dissemination

An archive is maintained for all projects, access to which is permitted for research purposes. Copyright and intellectual property rights are retained by TigerGeo on all material it has produced, the client having full licence to use such material as benefits their project. Where required, digital data and a copy of the report can be archived in a suitable repository, e.g. the Archaeology Data Service, in addition to our own archive.

The archive contains all survey and project data, communications, field notes, reports and other related material including copies of third party data (e.g. CAD mapping, etc.) in digital form. Many are in proprietary formats while report components are available in PDF format.

The client will determine the distribution path for reporting, including to the end client, other contractors, local authority etc., and will determine the timetable for upload of the project report to the OASIS Grey


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# 5 Supporting information

## 5.1 Standards and quality (archaeology)

TigerGeo is developing an Integrated Management System (IMS) towards ISO certification for ISO9001, ISO14001 and OHSAS18001/ISO45001. For work within the archaeological sector TigerGeo has been awarded CIfA (Chartered Institute for Archaeologists) Registered Organisation status.

A high standard of client-centred professionalism is maintained in accordance with the requirements of relevant professional bodies including the Geological Society of London (GeolSoc) and the Chartered Institute for Archaeologists (CIfA). Senior members of TigerGeo are professional members of the GeolSoc (FGS), CIfA (MCIfA & ACIfA grades) and other appropriate bodies, including the European Association of Geoscientists and Engineers (EAGE) Near Surface Division (MEAGE) and the Institute of Professional Soil Scientists (MISoilSci).

In addition TigerGeo is a member of EuroGPR and all ground penetrating and other radar work is in accordance with ETSI EG 202 730.

The management team at TigerGeo have almost 50 years of combined experience of near surface geophysical project design, survey, interpretation and reporting, based across a wide range of shallow geological contexts. Added to this is the considerable experience of our lead geophysicists in a variety of commercial and academic roles. All geophysical staff have graduate and in many cases also post-graduate relevant qualifications pertaining to environmental geophysics from recognised centres of academic excellence.

During fieldwork there is always a fully qualified (to graduate or post-graduate level) supervisory geophysicist leading a team of other geophysicists and geophysical technicians, all of whom are trained and competent with the equipment they are working with. Data processing and interpretation is carried out by a suitably qualified and experienced geophysicist under the direct supervision and guidance of the Senior Geophysicist. All work is monitored and reviewed throughout by the Senior Geophysicist who will appraise all stages of a project as it progresses.

Data processing and interpretation adheres to the scientific principles of objectiveness and logical consistency. A standard set of approved external sources of information, e.g. from the British Geological Survey, the Ordnance Survey and similar sources of data, in addition to previous TigerGeo projects, guide the interpretive process. Due attention is paid to the technical constraints of method, resolution, contrast and other geophysical factors.

There is a strong culture of internal peer-review within TigerGeo, for example, all reports pass through a process of authorship, technical review and finally proof-reading before release to the client. Technical queries resulting from TigerGeo's work are reviewed by the Senior Geophysicist to ensure uniformity of response prior to implementing any edits, etc.

Work is undertaken in accordance with the high professional standards and technical competence expected by the Geological Society of London and the European Association of Geoscientists and Engineers.

All work for archaeological projects is also conducted in accordance with the following standards and guidance:

- David et al, "Geophysical Survey in Archaeological Field Evaluation", English Heritage, 2008;
- "Standard and guidance for Archaeological Geophysical survey", Chartered Institute for Archaeologists, 2014 (Updated 2016);

and TigerGeo meets with ease the requirements of English Heritage in their 2008 Guidance "Geophysical Survey in Archaeological Field Evaluation" section 2.8 entitled "Competence of survey personnel".


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## 5.2 Key personnel

| | |
|---|---|
| **Martin Roseveare, MSc BSc(Hons) MEAGE FGS MCIfA** | **Senior Geophysicist, Director** |
| Martin specialised (MSc) in geophysical prospection for shallow applications and since 1997 has worked in commercial geophysics. Elected a GeolSoc Fellow in 2009 he is now working towards achieving CSci. A member of the European Association of Geoscientists & Engineers, he has served on the EuroGPR and CIfA GeoSIG committees and on the scientific committees of the 10th and 11th Archaeological Prospection conferences. He has reviewed papers for the EAGE Near Surface conference, was a technical reviewer of the Irish NRA geophysical guidance and is a founding member of the ISSGAP soils group. Professional interests include the application of geophysics to agriculture and the environment, e.g. groundwater and geohazards. He is also a software writer and equipment integrator with significant experience of embedded systems. | |
| **Anne Roseveare, BEng(Hons) DIS MISoilSci** | **Operations Manager, Environmental Geophysicist - Data Analyst** |
| On looking beyond engineering, Anne turned her attention to environmental monitoring and geophysics. She is a Member of the British Society of Soil Science (BSSS) and has specific areas of interest in soil physics & hydrology, agricultural applications and industrial sites. Amongst other contributions to the archaeological geophysics sector over the last 18 years, Anne was the founding Editor of the International Society for Archaeological Prospection (ISAP) and is a founding member of the ISSGAP soils group. Specifications, logistics, safety, data handling & analysis are integral parts of her work, though she is happily distracted by the possibilities of discovering lost cities, hillwalking and good food. | |
| **Daniel Lewis, MA BA(Hons) ACIfA** | **Consultant Archaeologist** |
| Daniel studied archaeology at the University of Nottingham and worked in field archaeology for many years, managing urban and rural fieldwork projects in and around Herefordshire. When the desk became more appealing he jumped into the world of consulting, working on small and large multi-discipline projects throughout England and Wales. At the same time, he returned to University, gaining an MA in Historic Environment Conservation. With over 15 years' experience in the heritage sector, Daniel has a diverse portfolio of skills. Here he ensures that geophysical work within the heritage sector is well grounded in the archaeology. His spare time includes much running up mountains | |
| **Alexandra Gerea, MSc, BSc, PhD Candidate** | **Geophysical Processor & Analyst** |
| Alexandra has a BSc in Geophysics and an MSc in Applied Geo-biology and started a PhD in the UK after living in Portugal for six months working on her master's degree. Since 2008 she has used most mainstream processing applications across electrical, magnetic and radar methods. She combines a love of nature and science and is currently studying plant roots in agricultural environments using geophysical methods. When not doing that she enjoys travelling, hiking, nature, yoga, books, foreign languages and cats. Two years ago she found a passion for electronics and started building different devices including intelligent gardening systems and coding in Python. | |


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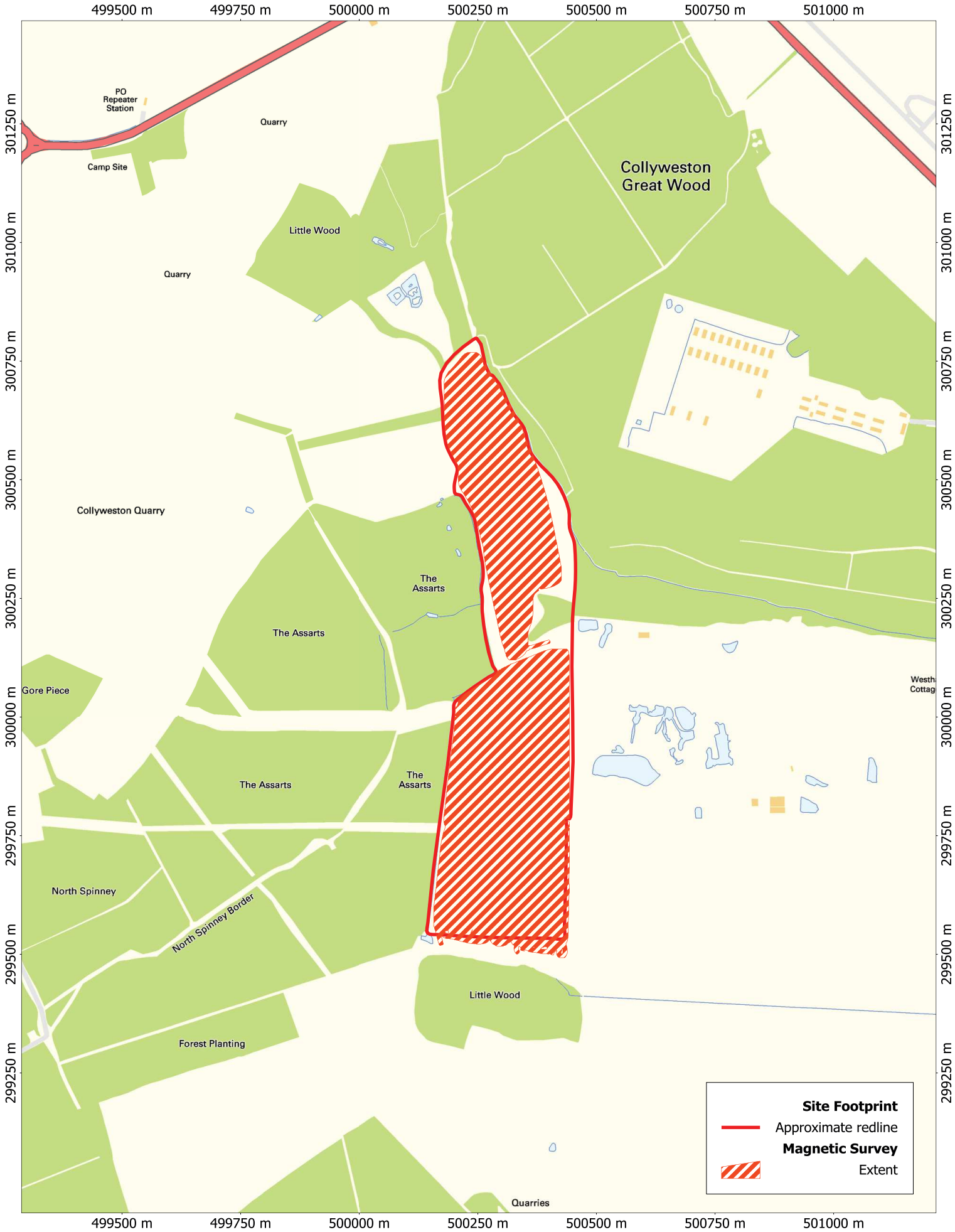


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## DWG 01 Site Location

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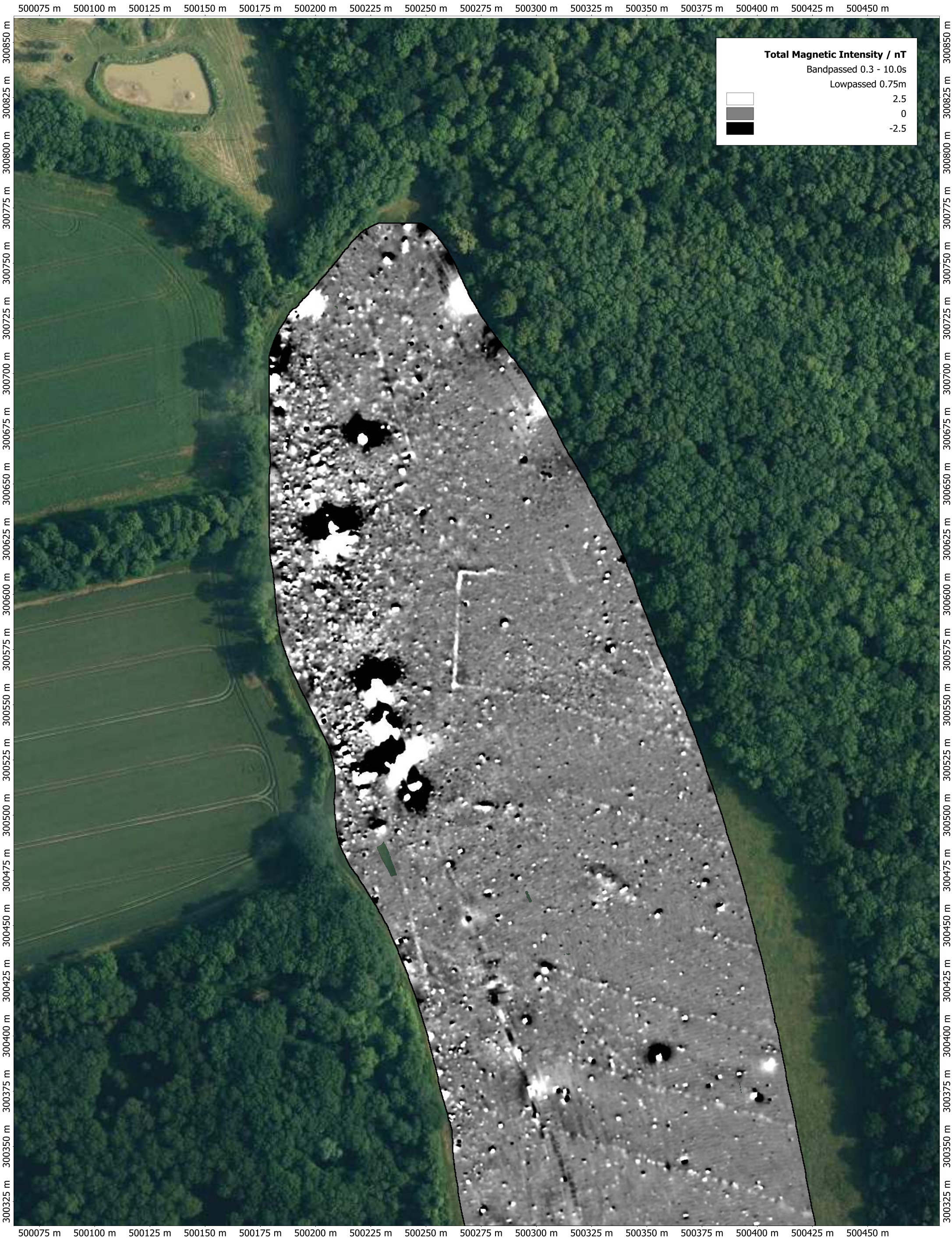


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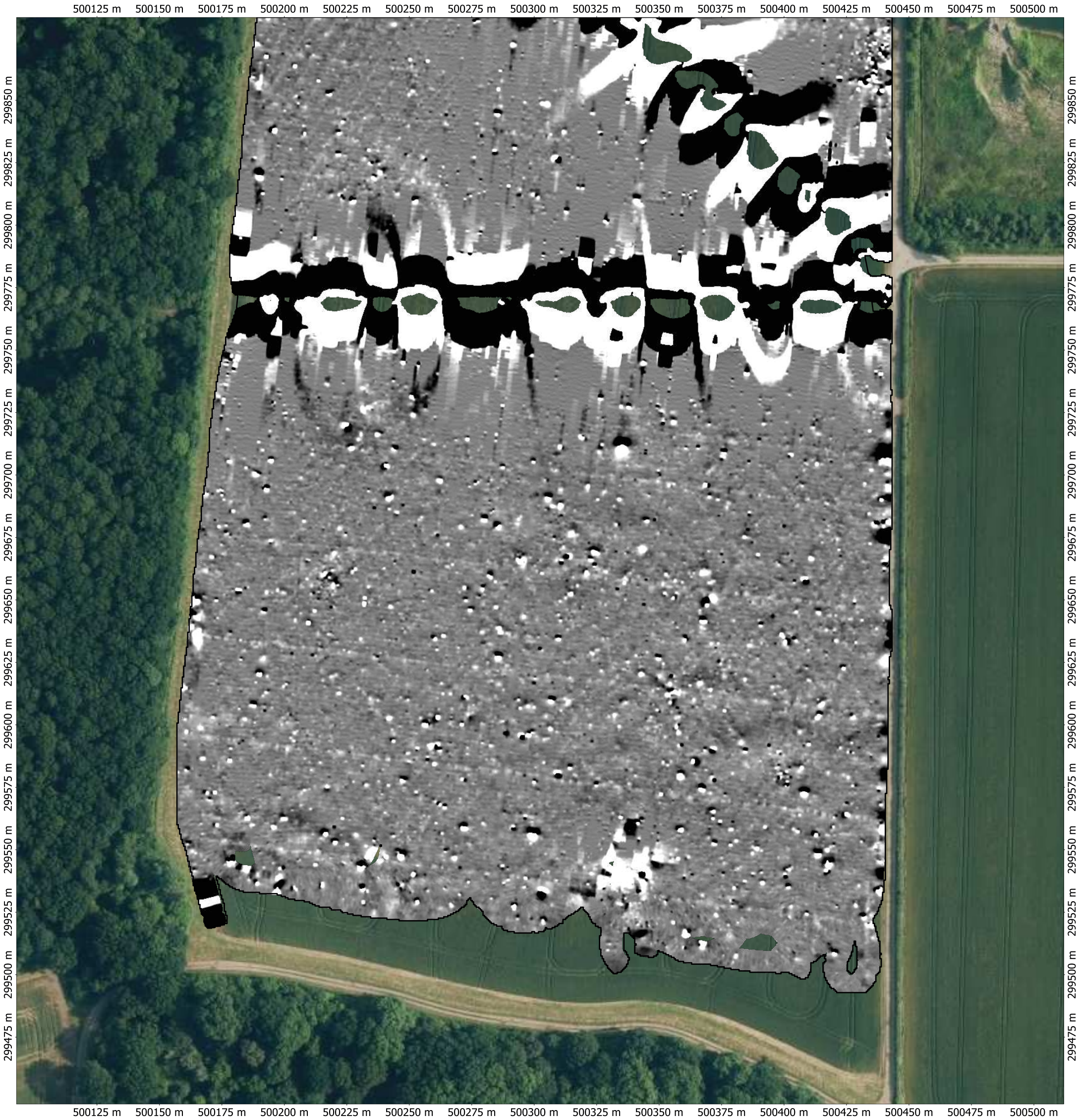


**Total Magnetic Intensity / nT**
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Lowpassed 0.75m
2.5
0
-2.5

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DWG 02d Magnetic Data - Total Magnetic Intensity - D

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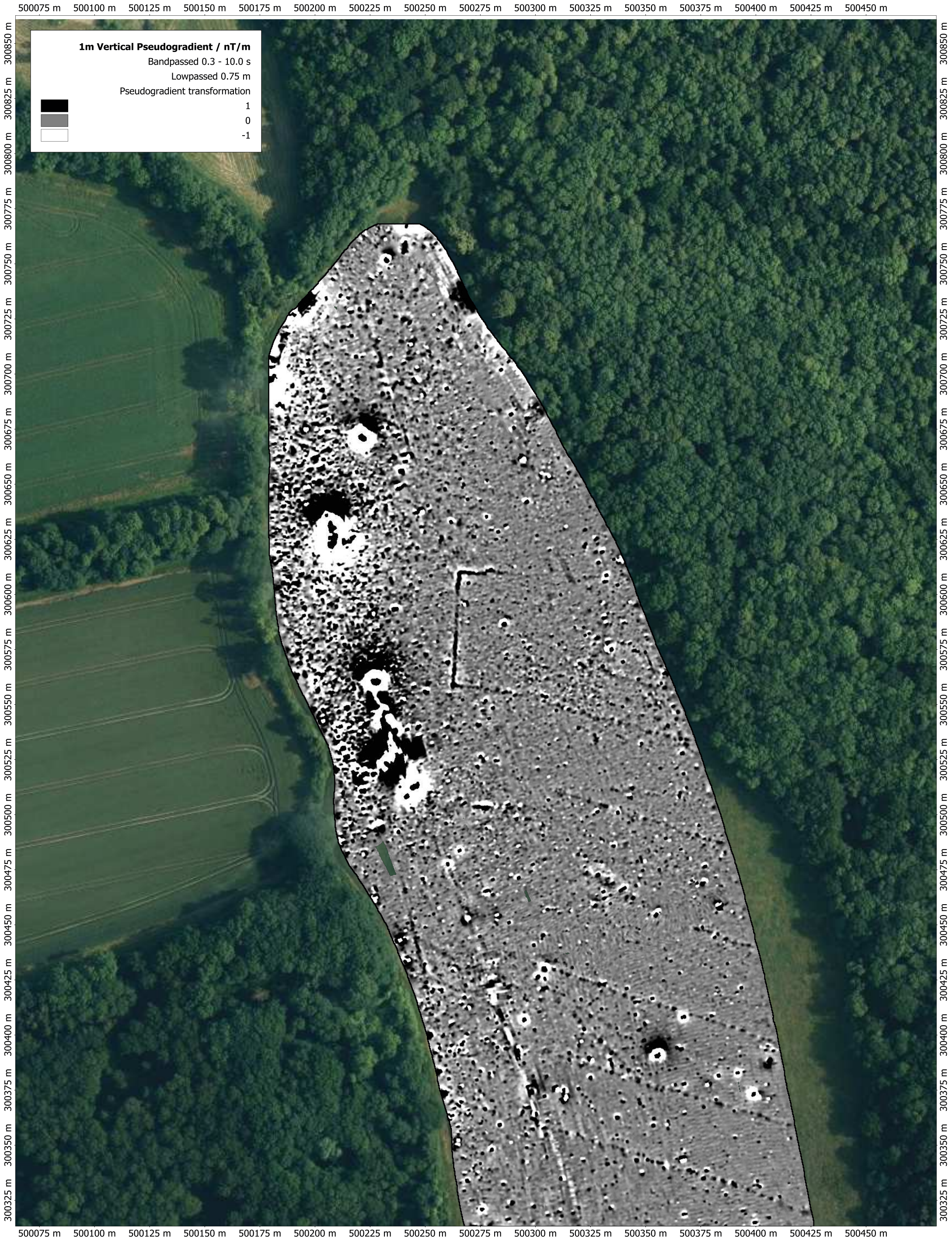


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DWG 03a Magnetic Data - 1m Vertical Pseudogradient - A

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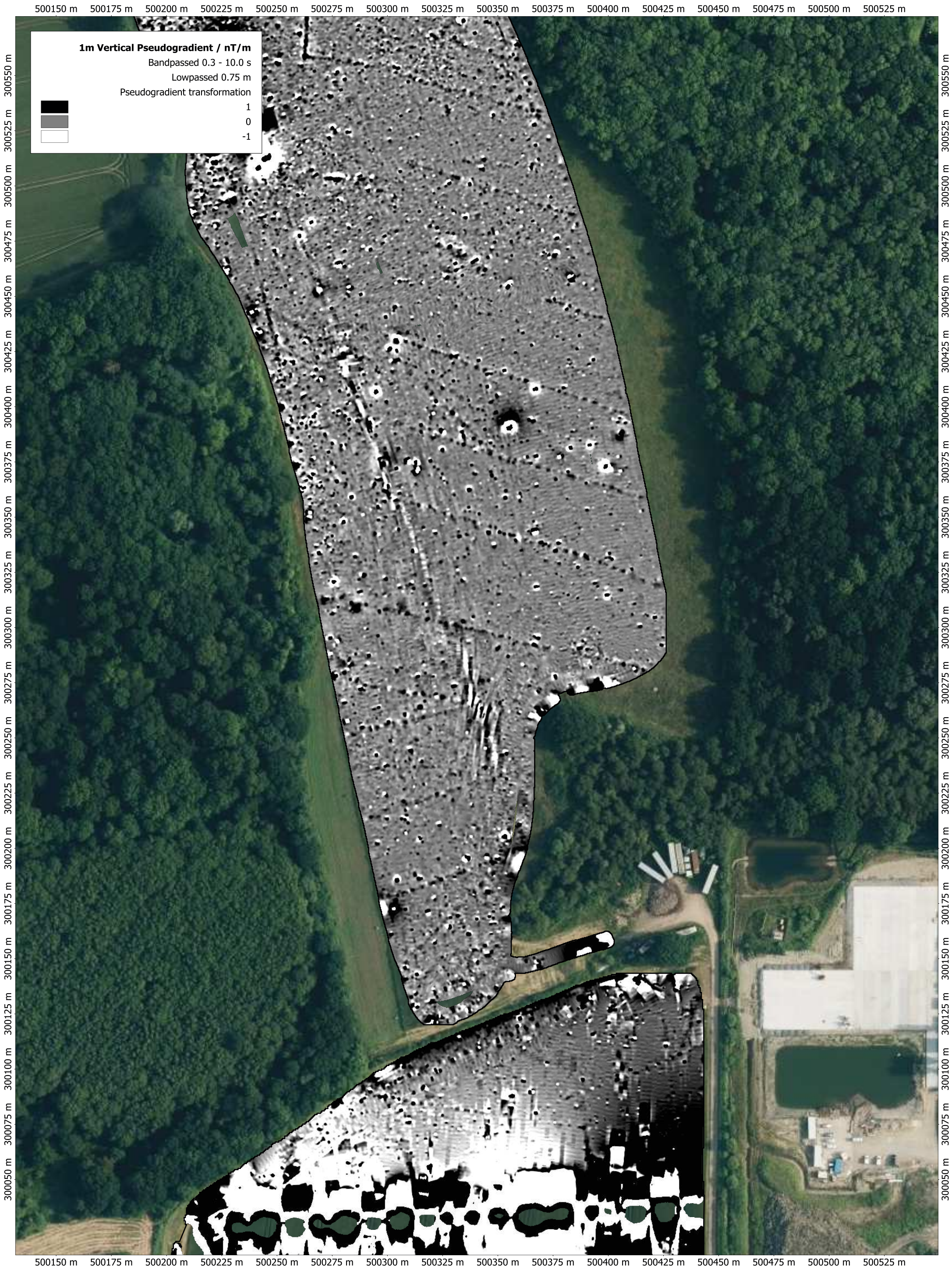


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DWG 03b Magnetic Data - 1m Vertical Pseudogradient - B

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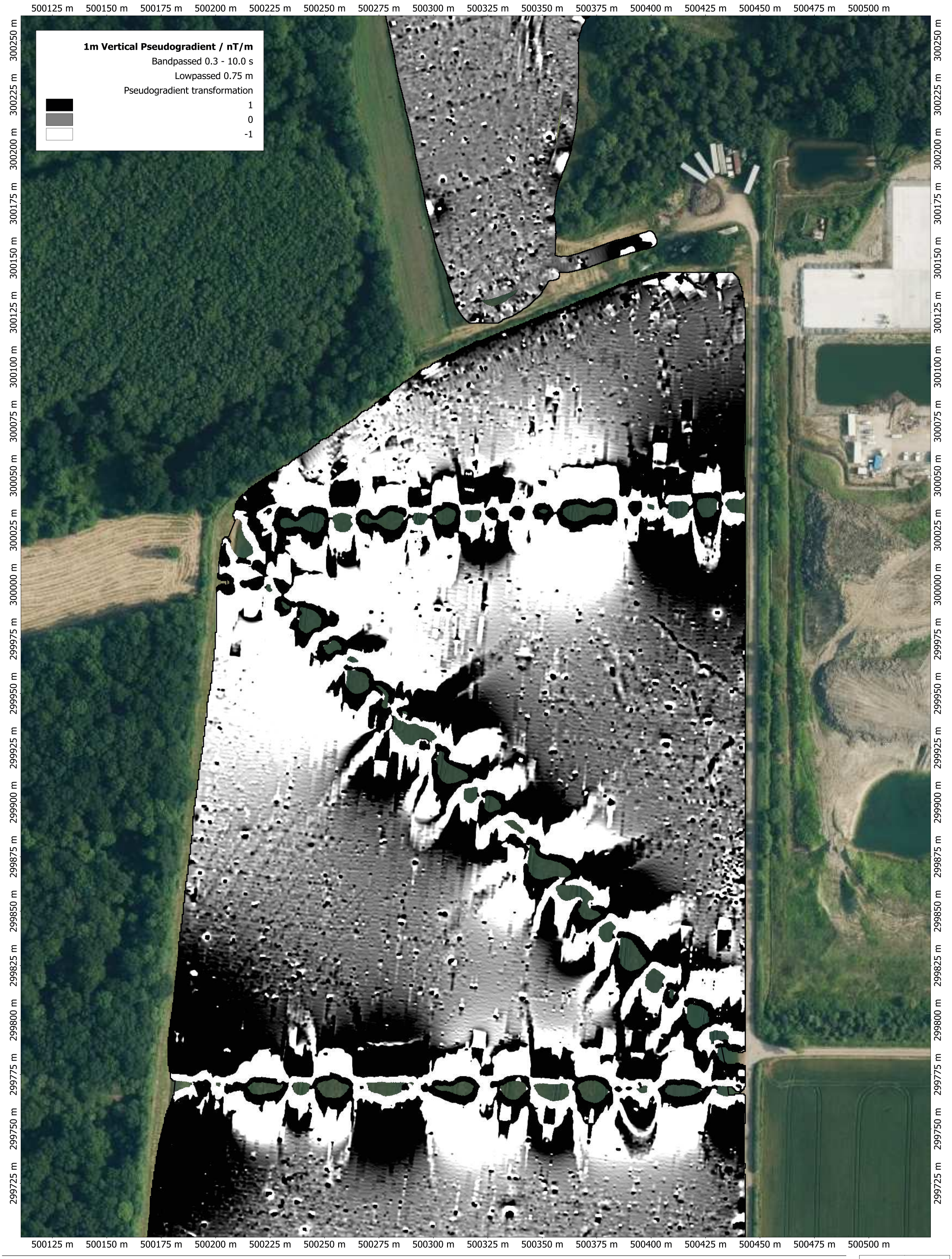


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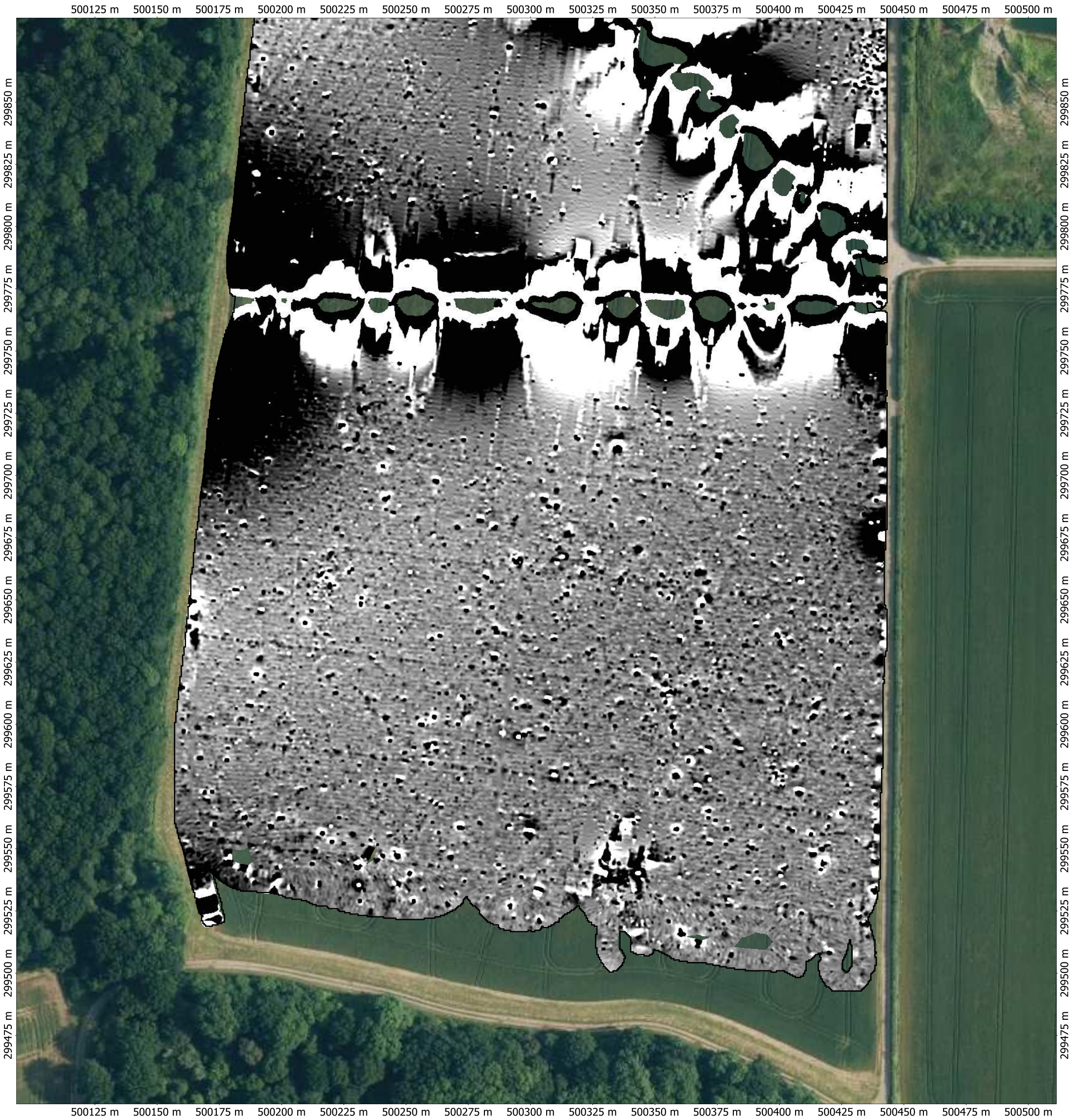


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Lowpassed 0.75 m

Pseudogradient transformation

1

0

-1

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DWG 03d Magnetic Data - 1m Vertical Pseudogradient - D

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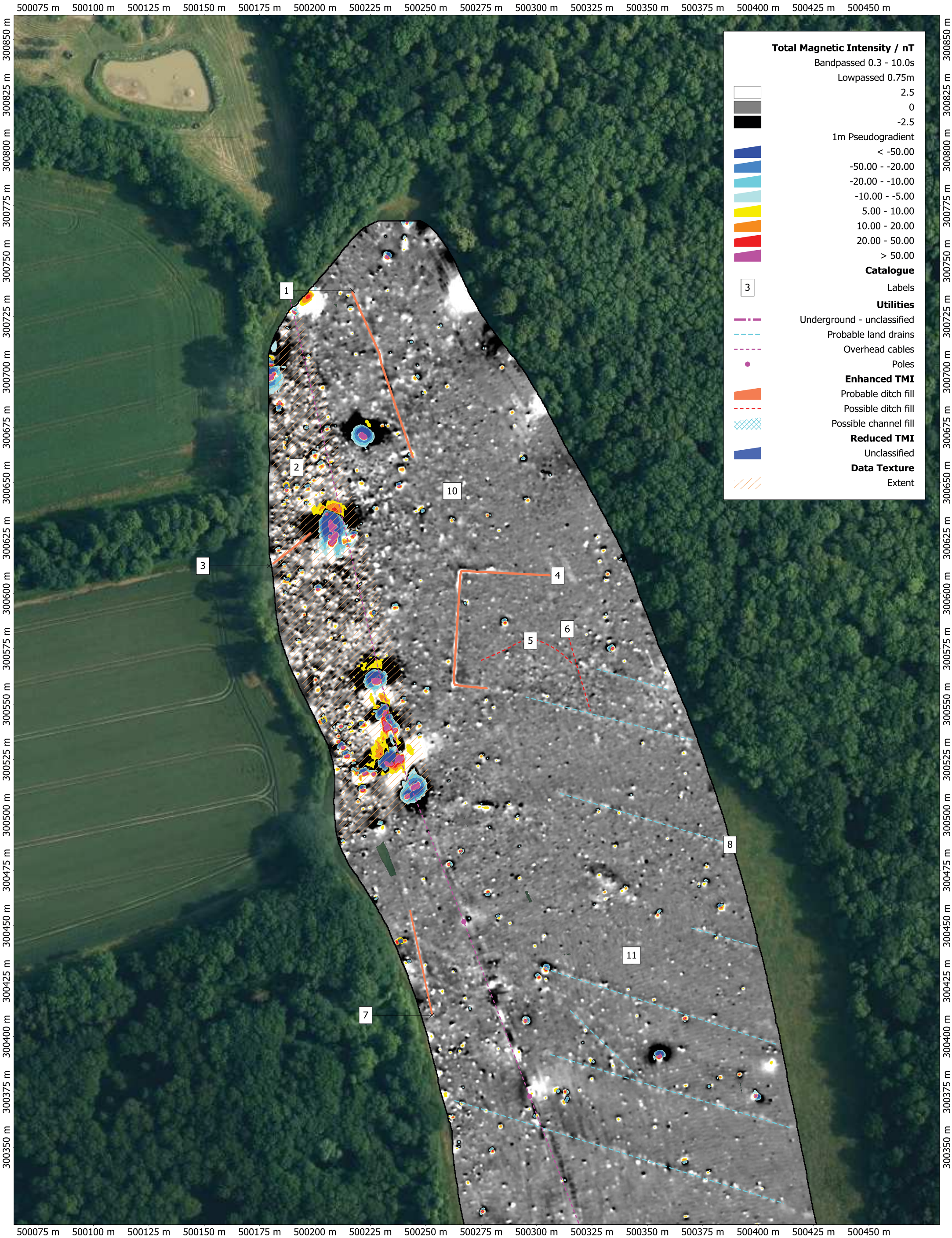


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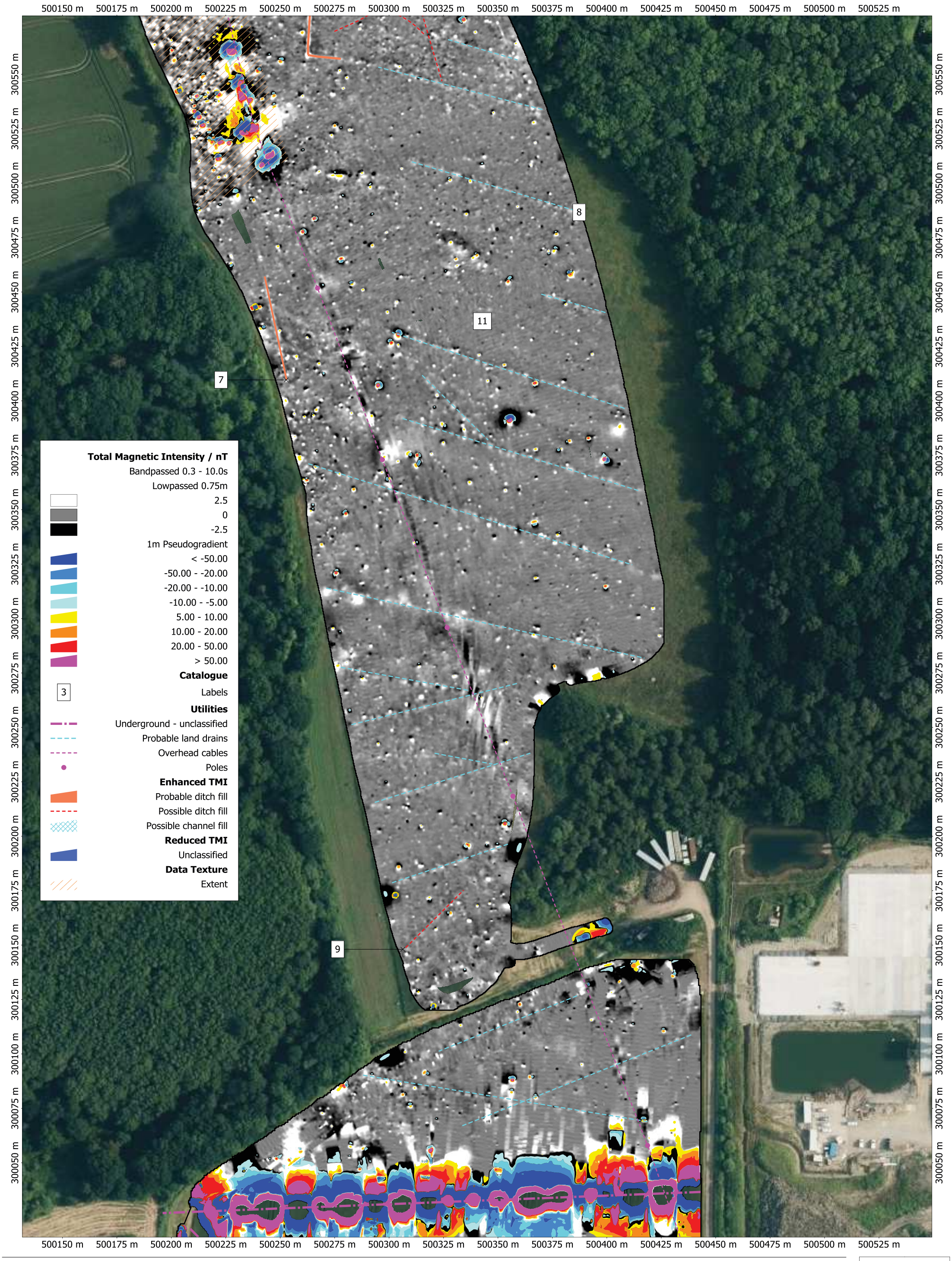


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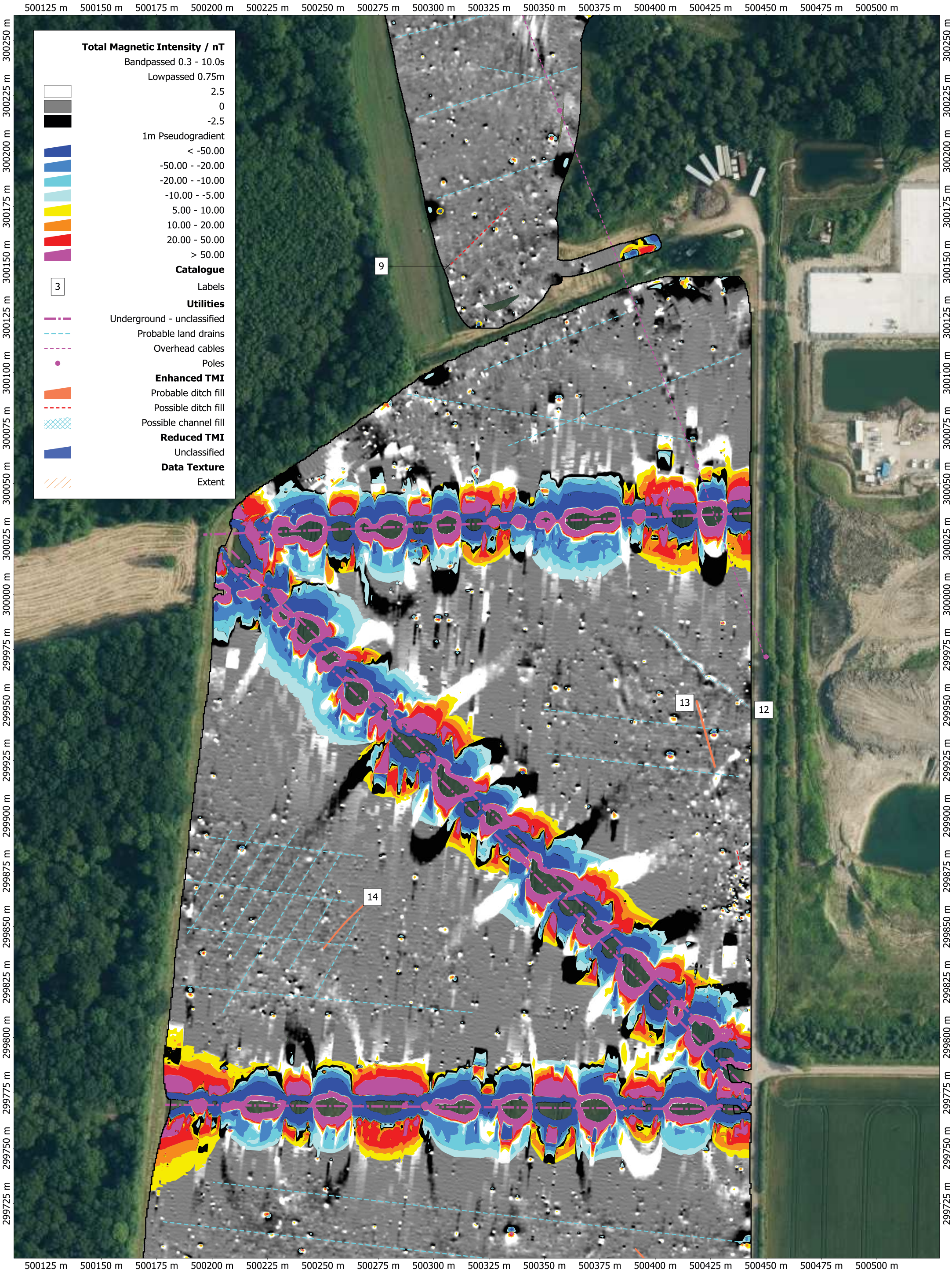


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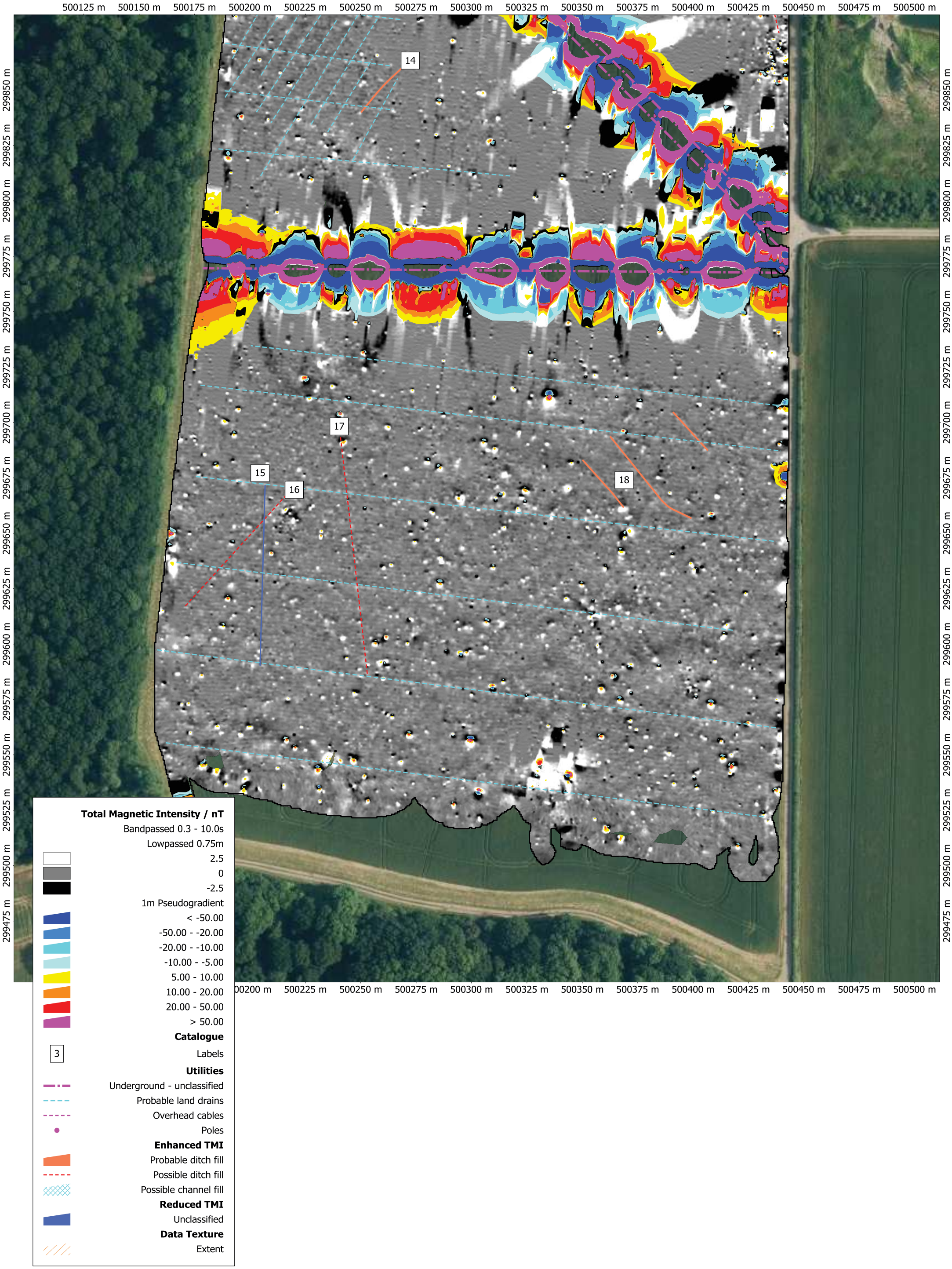


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Orthographic Scale: 1:1500 @ A3 Spatial Units: Meter. Do not scale off this drawing
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