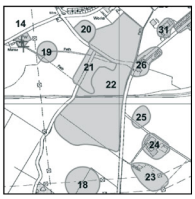
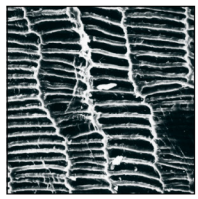
IAMP18










INTERNATIONAL ADVANCED MANUFACTURING PARK, IAMP TWO, SUNDERLAND

GEOPHYSICAL SURVEY REPORT

commissioned by Sunderland City Council

October 2018

HEADLAND ARCHAEOLOGY

REGISTERED ORGANISATION CIfA

INTERNATIONAL ADVANCED MANUFACTURING PARK, IAMP TWO, SUNDERLAND

GEOPHYSICAL SURVEY REPORT

commissioned by Sunderland City Council

October 2018

This report adheres to the quality standard of ISO 9001:2015

PROJECT INFO:

HA Project Code **IAMP18** / NGR **NZ 3323 6012** / District **Sunderland, South Tyneside** / Local Authority **Sunderland City Council** / OASIS Ref. **Headland5-331337**

PROJECT TEAM:

Project Manager **Sam Harrison** / Author **David Harrison, Sam Harrison** / Fieldwork **Glyn Sheldrick, Krasimir Dyulgerski, Mark Evans, Michail-Athanasios Kaikas, Olivier Vansassenbrouck** / Graphics **Caroline Norrman, David Harrison, Rafael Maya Torcelly**

Approved by **Sam Harrison** .....

Headland Archaeology North
Unit 16 | Hillside | Beeston Rd | Leeds LS11 8ND
t 0113 387 6430
e north@headlandarchaeology.com
w www.headlandarchaeology.com

HEADLAND ARCHAEOLOGY

PROJECT SUMMARY

Headland Archaeology (UK) Ltd undertook a geophysical (magnetometer) survey of a 135-hectare site in Sunderland to provide further information on the archaeological potential of the site in advance of the proposed development of an International Advanced Manufacturing Park. This report presents the results of the IAMP TWO survey undertaken, an area of 115 hectares. No anomalies of definite archaeological potential have been identified by the survey with only a single linear anomaly being tentatively identified as being of possible archaeological potential; a possible ditch in the south-west of the site. Broad areas of magnetic disturbance in the south of the site correspond to former structures and infrastructure from the North Camp area of the former RAF Usworth station and airfield (Tyne and Wear Historic Environment Record 1824). Two potential remains of mining activity have been recorded to the north-east of the survey area. The survey has mainly identified anomalies consistent with the former agricultural landscape, with ridge and furrow anomalies present across most of the datasets. Therefore, on the basis of the geophysical survey undertaken to date, the archaeological potential of the site is assessed as low, corroborating the results of the Cultural Heritage Chapter of the Environmental Statement produced for IAMP ONE.

CONTENTS

1 INTRODUCTION 1

1.1 SITE LOCATION, TOPOGRAPHY AND LAND-USE 1

1.2 GEOLOGY AND SOILS 1

2 ARCHAEOLOGICAL BACKGROUND 1

3 AIMS, METHODOLOGY AND PRESENTATION 2

3.1 MAGNETOMETER SURVEY 2

3.2 REPORTING 2

4 RESULTS AND DISCUSSION 2

4.1 FERROUS ANOMALIES 2

4.2 AGRICULTURAL ANOMALIES 4

4.3 GEOLOGICAL ANOMALIES 5

4.4 MINING? ANOMALIES 5

4.5 POSSIBLE ARCHAEOLOGICAL ANOMALIES 5

5 CONCLUSION 5

6 REFERENCES 5

7 APPENDICES 57

APPENDIX 1 MAGNETOMETER SURVEY 57

APPENDIX 2 SURVEY LOCATION INFORMATION 58

APPENDIX 3 GEOPHYSICAL SURVEY ARCHIVE 58

APPENDIX 4 DATA PROCESSING 58

APPENDIX 5 OASIS DATA COLLECTION FORM: ENGLAND 59

LIST OF ILLUSTRATIONS

ILLUS 1 SITE LOCATION VIII

ILLUS 2 F3 LOOKING NORTH 3

ILLUS 3 F8 LOOKING EAST 3

ILLUS 4 F35 LOOKING SOUTH-EAST 3

ILLUS 5 F27 LOOKING EAST 4

ILLUS 6 F33 LOOKING SOUTH-WEST 4

ILLUS 7 F37 LOOKING SOUTH-WEST 4

ILLUS 8 SURVEY LOCATION SHOWING GPS SWATHS (1:10,000) 7

ILLUS 9 SURVEY LOCATION SHOWING GEOLOGY DATA (1:10,000) 9

ILLUS 10 PROCESSED GREYSCALE MAGNETOMETER DATA (1:10,000) 11

ILLUS 11 INTERPRETATION OF MAGNETOMETER DATA (1:10,000) 13

ILLUS 12 PROCESSED GREYSCALE MAGNETOMETER DATA; SECTOR 1 (1:2,500) 15

ILLUS 13 XY TRACE PLOT OF MINIMALLY PROCESSED MAGNETOMETER DATA; SECTOR 1 (1:2,500) 17

ILLUS 14 INTERPRETATION OF MAGNETOMETER DATA; SECTOR 1 (1:2,500) 19

ILLUS 15 PROCESSED GREYSCALE MAGNETOMETER DATA; SECTOR 2 (1:2,500) 21

ILLUS 16 XY TRACE PLOT OF MINIMALLY PROCESSED MAGNETOMETER DATA; SECTOR 2 (1:2,500) 23

ILLUS 17 INTERPRETATION OF MAGNETOMETER DATA; SECTOR 2 (1:2,500) 25

ILLUS 18 PROCESSED GREYSCALE MAGNETOMETER DATA; SECTOR 3 (1:2,500) 27

ILLUS 19 XY TRACE PLOT OF MINIMALLY PROCESSED MAGNETOMETER DATA; SECTOR 3 (1:2,500) 29

ILLUS 20 INTERPRETATION OF MAGNETOMETER DATA; SECTOR 3 (1:2,500) 31

ILLUS 21 PROCESSED GREYSCALE MAGNETOMETER DATA; SECTOR 4 (1:2,500) 33

ILLUS 22 XY TRACE PLOT OF MINIMALLY PROCESSED MAGNETOMETER DATA; SECTOR 4 (1:2,500) 35

ILLUS 23 INTERPRETATION OF MAGNETOMETER DATA; SECTOR 4 (1:2,500) 37

ILLUS 24 PROCESSED GREYSCALE MAGNETOMETER DATA; SECTOR 5 (1:2,500) 39

ILLUS 25 XY TRACE PLOT OF MINIMALLY PROCESSED MAGNETOMETER DATA; SECTOR 5 (1:2,500) 41

ILLUS 26 INTERPRETATION OF MAGNETOMETER DATA; SECTOR 5 (1:2,500) 43

ILLUS 27 PROCESSED GREYSCALE MAGNETOMETER DATA; SECTOR 6 (1:2,500) 45

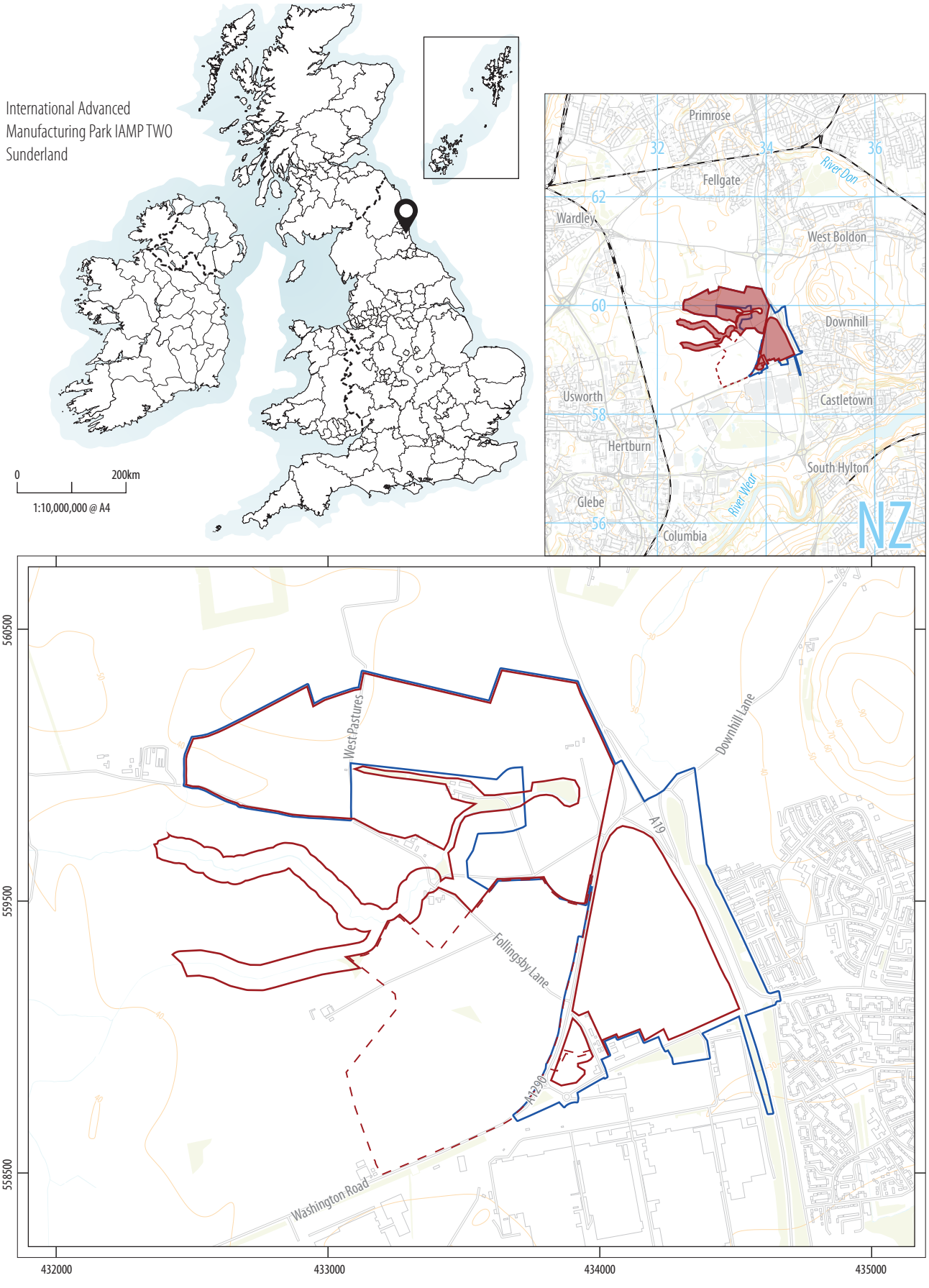
ILLUS 28 XY TRACE PLOT OF MINIMALLY PROCESSED MAGNETOMETER DATA; SECTOR 6 (1:2,500) 47

ILLUS 29 INTERPRETATION OF MAGNETOMETER DATA; SECTOR 6 (1:2,500) 49

ILLUS 30 PROCESSED GREYSCALE MAGNETOMETER DATA; SECTOR 7 (1:2,500) 51

ILLUS 31 XY TRACE PLOT OF MINIMALLY PROCESSED MAGNETOMETER DATA; SECTOR 7 (1:2,500) 53

ILLUS 32 INTERPRETATION OF MAGNETOMETER DATA; SECTOR 7 (1:2,500) 55



HEADLAND ARCHAEOLOGY

Headland Archaeology North
Unit 16 | Hillside | Beeston Rd | Leeds LS11 8ND
t 0113 387 6430
e north@headlandarchaeology.com
w www.headlandarchaeology.com

ILLUS 1 Site location

INTERNATIONAL ADVANCED MANUFACTURING PARK, IAMP TWO, SUNDERLAND

GEOPHYSICAL SURVEY REPORT

1 INTRODUCTION

Headland Archaeology was commissioned by Sunderland City Council (the Client), to undertake a geophysical (magnetometer) survey where the development of an International Advanced Manufacturing Park (IAMP) is proposed. This survey has been requested by Tyne and Wear Archaeology Service (TWAS) to inform on the archaeological potential of the site and to assist in determining appropriate levels of further evaluation (eg trial trenching) and mitigation.

The work was undertaken in accordance with a Specification for Geophysical Survey (TWAS 2018) and in line with current best practice (Chartered Institute for Archaeologists 2016 and Europae Archaeologia Consilium 2015).

The survey was carried out between the 21st of May and the 5th of September 2018.

1.1 SITE LOCATION, TOPOGRAPHY AND LAND-USE

The development consent order (DCO) boundary comprises an irregularly-shaped block of land over 122 hectares, which is bounded to the south by Washington Road, to the east by the A19, to the south-west by the A1290 and to the west by Follingsby Lane (see Illus 1). Hedgerows demarcate the northern edge of the DCO boundary. The geophysical survey area (GSA) covers 135 hectares and extends further to the west to accommodate potential future refinement of the DCO boundary if required. It comprises 39 fields (F1–F39) which were mostly under harvested cereal crops at the time of the survey with occasional small fields containing pasture (see Illus 2–5). A small number of fields were not suitable for survey due to overgrown vegetation, F9–F11, F15, some of F18–F20, F31, F33 (see Illus 6) and F36 (see Illus 7).

The GSA is largely flat at between 35m Above Ordnance Datum (AOD) in the south and 41m AOD in the north-west.

1.2 GEOLOGY AND SOILS

The bedrock geology comprises alternating bands of Pennine Middle and Upper Coal Measures – sandstone, siltstone and mudstone, aligned north-west/south-east across the site (see Illus 9). This is overlain by Pelaw Clay Member with glaciolacustrine and alluvial deposits (clay, silt, sand and gravel) recorded along the course of a minor watercourse which passes north-east/south-west through the north of the site (NERC 2018).

The soils are classified in the Soilscape 18 association, characterised as slowly permeable, seasonally wet loams and clays (Cranfield University 2018).

2 ARCHAEOLOGICAL BACKGROUND

The IAMP TWO GSA falls within the study area for the Cultural Heritage Chapter of the IAMP ONE Environmental Statement (Golder Associates 2018). This included a comprehensive baseline assessment incorporating Desk-Based Assessment (CgMs Consulting 2015), archival research, air photo and LiDAR analysis (Deegan 2017) and geophysical survey (Archaeological Services University of Durham 2017a). The baseline was then verified through intrusive archaeological evaluation (Archaeological Services University of Durham 2017b). IAMP TWO was also subject to air photo and LiDAR analysis (Deegan 2018). Cultural Heritage assets identified within the

IAMP TWO area included ridge and furrow, drainage features and modern features associated with the former RAF Usworth station.

3 AIMS, METHODOLOGY AND PRESENTATION

The general aim of the geophysical survey was to provide sufficient information to establish the presence/absence, character and extent of any archaeological remains within the GSA. This will, therefore, enable an assessment to be made of the impact of the proposed development on any sub-surface archaeological remains if present.

The specific archaeological objectives of the geophysical survey were:

- to provide information about the nature and possible interpretation of any magnetic anomalies identified;
- to, therefore, model the presence/absence and extent of any buried archaeological features; and
- to prepare a report summarising the results of the survey.

3.1 MAGNETOMETER SURVEY

Magnetic survey methods rely on the ability of a variety of instruments to measure very small magnetic fields associated with buried archaeological remains. A feature such as a ditch, pit or kiln can act like a small magnet, or series of magnets, that produce distortions (anomalies) in the earth's magnetic field. In mapping these slight variations, detailed plans of sites can be obtained as buried features often produce reasonably characteristic anomaly shapes and strengths (Gaffney & Gater 2003). Further information on soil magnetism and the interpretation of magnetic anomalies is provided in Appendix 1.

The survey was undertaken using four Bartington Grad601 sensors mounted at 1m intervals (1m traverse interval) onto a rigid carrying frame. The system was programmed to take readings at a frequency of 10Hz (allowing for a 10–15cm sample interval) on roaming traverses (swaths) 4m apart. These readings were stored on an external weatherproof laptop and later downloaded for processing and interpretation. The system was linked to a Trimble R8s Real Time Kinetic (RTK) differential Global Positioning System (dGPS) outputting in NMEA mode to ensure a high positional accuracy for each data point.

MLGrad601 and MultiGrad601 (Geomar Software Inc.) software was used to collect and export the data. Terrasurveyor V3.0.32.4 (DWConsulting) software was used to process and present the data.

3.2 REPORTING

A general site location plan is shown in Illus 1 at a scale of 1:15,000. Illus 2–7 are site condition photographs. Illus 8 is a 1:10,000 survey location plan showing the direction of survey as GPS swaths. Illus 9 shows the bedrock geology data (NERC 2018), also at a scale of 1:10,000. The processed greyscale data and an overall interpretation plot are also presented at 1:10,000 in Illus 10 and Illus 11. Large-scale, fully processed (greyscale) data, minimally processed data (XY traceplot) and accompanying interpretative plots are presented at a scale of 1:2,500 in Illus 12–32 inclusive.

Technical information on the equipment used, data processing and magnetic survey methodology is given in Appendix 1. Appendix 2 details the survey location information and Appendix 3 describes the composition and location of the site archive. Data processing details are presented in Appendix 4. A copy of the OASIS entry (Online Access to the Index of Archaeological Investigations) is reproduced in Appendix 5.

The survey methodology, report and any recommendations comply with the Specification for Geophysical Survey (TWAS 2018), guidelines outlined by EAC (Europae Archaeologia Consilium 2015) and by the Chartered Institute for Archaeologists (CIfA 2016). All illustrations from Ordnance Survey mapping are reproduced with the permission of the controller of Her Majesty's Stationery Office (© Crown copyright).

The illustrations in this report have been produced following analysis of the data in 'raw' and processed formats and over a range of different display levels. All illustrations are presented to most suitably display and interpret the data from this site based on the experience and knowledge of management and reporting staff.

4 RESULTS AND DISCUSSION

The ground conditions were good (Illus 2–7) and contributed to a high standard of data quality throughout.

Generally, a moderate level of magnetic background variation is visible throughout the datasets. The background variation is relatively uniform, probably due to the homogenous properties of the Pelaw Clay superficial deposits. Against this background, numerous linear and discrete anomalies have been identified and these are discussed below and cross-referenced to specific examples on the interpretive figures, where appropriate.

4.1 FERROUS ANOMALIES

Ferrous anomalies, characterised as individual 'spikes', are typically caused by ferrous (magnetic) material, either on the ground surface or in the plough-soil. Little importance is normally given to such anomalies, unless there is any supporting evidence for an archaeological interpretation, as modern ferrous debris is common on most sites, often being present as a consequence of manuring or tipping/infilling. There is no obvious clustering to these ferrous anomalies which might indicate an archaeological origin. Far more probable is that the 'spike' responses are likely caused by the random distribution of ferrous debris in the upper soil horizons.

High magnitude dipolar linear anomalies (SP1–SP5; Illus 12–20 and Illus 24–26) are identified on varying alignments. The anomalies locate buried service pipes.

ILLUS 2 F3 looking north **ILLUS 3** F8 looking east **ILLUS 4** F35 looking south-east

Several large spikes and more extensive zones of magnetic disturbance across the north of the GSA are due to pylons carrying overhead cables, whilst the large area of disturbance in the south of F3 is due to a livestock feeder.

A broad area of magnetic disturbance dominates the eastern part of F18 (see Illus 24–26). The disturbance is thought to be due to modern tipping/infilling of magnetically enhanced material (eg brick, reinforced concrete, tile etc) and is of no archaeological interest. A second extensive area of magnetic disturbance dominates the south of F35 (see Illus 30–32). The magnetic disturbance does not correspond to any features shown on historic OS mapping but is thought to be modern in origin, probably being associated with the former Usworth airfield to the immediate south.

Magnetic disturbance and high magnetic ferrous spikes are detected throughout F36 and F37. Whilst some of these anomalies can be attributed to the recent use of the land as playing fields (such as goal posts (GP); see Illus 30–32), the majority of these ferrous anomalies are thought to be due to buried remains associated with former structures and infrastructure from the North Camp area of the former RAF Usworth station and airfield (Tyne and Wear HER1824). Several high magnitude dipolar linear anomalies are clearly visible across this area which are thought to locate buried pipes and/or cables.

An unusual east/west linear anomaly, DR1, is identified in the north-west of F35 (see Illus 27–29) and notable for its irregular appearance. The origin of the anomaly is unknown. It may locate an isolated drain.

ILLUS 5 F27 looking east **ILLUS 6** F33 looking south-west **ILLUS 7** F37 looking south-west

Other areas of disturbance around the perimeter of the survey areas and along the field edges are due to ferrous material within, or adjacent to the boundaries, and is of no archaeological interest.

4.2 AGRICULTURAL ANOMALIES

Analysis of historical OS mapping indicates that, road, rail and military infrastructure aside, the pattern and division of land within the GSA has changed little since the publication of the first edition OS map in 1856, albeit with the removal of ten field boundaries from within F1, F16, F25 and F35 to create larger fields. Three of these former boundaries (FB1–FB3; see Illus 27–32) have been identified by the survey as high magnitude linear anomalies. The anomalies are caused by the magnetic contrast between the soil-fill of a ditch and the surrounding soil. At the intersection of FB1 and FB2, a broad high magnitude anomaly (ST1; see Illus 30–32) corresponds to a small square structure or trough which is shown on the 1896 OS map. Two high magnitude linear anomalies (FB4 and FB5; see Illus 27–29) in F23 and F35 respectively, do not correspond to any known historic boundaries but are interpreted as possible former field boundaries based on their alignment parallel with, or at right angles to extant or historic field boundaries. The former north/south boundary within F7 has not been detected by the survey. Assuming that the former boundary comprised a ditch, it is possible that there is insufficient magnetic contrast in this part of the site for the feature to manifest as a magnetic anomaly. Two more former field boundaries (FB6 and FB7) have also been recorded in F1 (Illus 12–14) and F16 (Illus 27–29). Within F25 five linear anomalies have been identified as former field boundaries (FB8–FB12; Illus 18–20) recorded on the first edition OS map. These have been recorded as weakly enhanced anomalies, the weak enhancement probably caused by the presence of alluvial deposits.

Broad, slightly curving parallel anomalies are recorded over the majority of the GSA. These anomalies are characteristic of the medieval and post-medieval practice of ridge and furrow cultivation with the striped appearance being due to the magnetic contrast between former ridges and the soil-filled furrows.

More closely-spaced linear trend anomalies, mostly at the edges of the fields are due to modern ploughing and ploughing headlands.

Series of widely-spaced parallel linear trends within the west of F35 are oblique to the surrounding field boundaries. These anomalies are due to field drains.

A high magnitude linear anomaly has been recorded in the north-west of F2, which corroborates a feature identified in the AP and LiDAR report (Deegan 2018) which was interpreted as a bank or ploughing headland. Based on the magnetic response this anomaly has been interpreted as a field drain. Two discrete anomalies with a similar magnetic response to the drain have been identified slightly to the north. These are thought to be associated with the drain, as such they have been ascribed a modern interpretation.

4.3 GEOLOGICAL ANOMALIES

Discrete areas of magnetic enhancement are identified throughout the GSA, these are due to variations in the depth and composition of the soils and the Pelaw Clay superficial deposits from which they derive. More densely-spaced discrete anomalies within the south of F6/F12 and a sinuous north-west/south-east band of magnetic enhancement across F35 are likely to be due to variation in the Pennine Coal Measures bedrock.

Within F25–28 anomalies indicative of a former watercourse have been recorded. These manifest as magnetically enhanced sinuous anomalies either side of the now channelled watercourse. The former watercourse is recorded on historic OS mapping.

4.4 MINING? ANOMALIES

Two subcircular areas of magnetic enhancement, M1 and M2, have been recorded by the survey within F14 and F16 (Illus 15–17 and 27–29). These anomalies correspond to two features recorded in the AP and LiDAR report (Deegan 2018). These are thought to be associated with post-medieval coal workings.

4.5 POSSIBLE ARCHAEOLOGICAL ANOMALIES

A curvilinear anomaly (D1; see Illus 30–32) aligned east/west across F38 cannot be confidently interpreted as either modern, agricultural or geological in origin and for this reason, is interpreted as possibly archaeological in origin. However, on the balance of probability, it is more likely that this anomaly is probably a boundary feature being at right angles to the road.

5 CONCLUSION

The survey has successfully evaluated the geophysical survey areas and has identified no anomalies of definite archaeological potential with only a single linear anomaly being tentatively identified as of possible archaeological potential; a possible ditch in the south-west of the site. Broad areas of magnetic disturbance in the south of the site correspond to former structures and infrastructure from the North Camp area of the former RAF Usworth station and airfield (Tyne and Wear Historic Environment Record 1824). Two potential remains of mining activity have been recorded in the north-east of the survey area. The survey has mainly identified anomalies consistent with the former agricultural landscape with ridge and furrow anomalies present across most of the datasets. The results corroborate a previous geophysical survey for the adjacent area of IAMP ONE (Archaeological Services University of Durham 2017a) and an aerial photography and LiDAR report for IAMP TWO (Deegan 2018). Therefore, on the basis of the geophysical survey undertaken, the archaeological potential of the site is assessed as low corroborating the results of the Cultural Heritage Chapter of the Environmental Statement completed for IAMP ONE.

6 REFERENCES

Archaeological Services University of Durham 2017a ***IAMP Phase 1 Sunderland Tyne and Wear: Geophysical Survey*** [unpublished client document] ASUD Report 4622

Archaeological Services University of Durham 2017b ***IAMP Phase 1 Sunderland Tyne and Wear: Archaeological Evaluation*** [unpublished client document] ASUD Report 4649

CgMs Consulting 2015 ***Archaeological Desk-based Assessment: Proposed Nissan Windfarm Extension Washington*** [unpublished client document] CgMs Ref: RJC20684/1

Chartered Institute for Archaeologists (CIfA) 2016 ***Standard and guidance for archaeological geophysical survey*** (Reading) http://www.archaeologists.net/sites/default/files/CIfAS%26GGeophysics_2.pdf accessed 24 September 2018

Cranfield University 2018 ***Cranfield Soil and Agrifood Institute Soilscapes*** http://www.landis.org.uk/soilscapes/ accessed 24 September 2018

Deegan A 2017 ***Air Photo and LiDAR Mapping and Interpretation IAMP Phase 1 Sunderland*** [unpublished client document] Alison Deegan project number 1718005

Deegan A 2018 ***Air Photo and LiDAR Mapping and Interpretation IAMP TWO Sunderland*** [unpublished client document] Alison Deegan project number 1819002

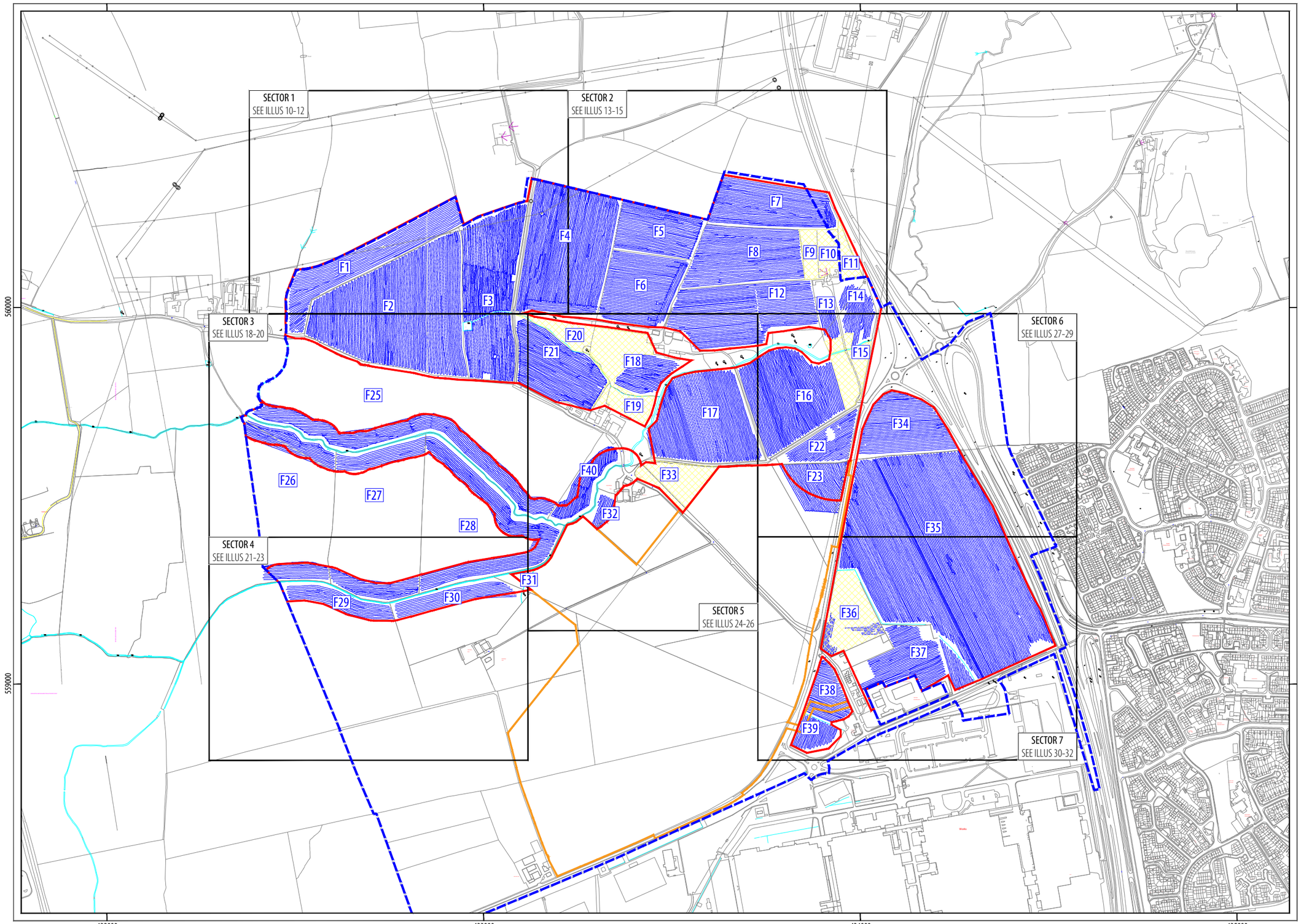
Europae Archaeologia Consilium (EAC) 2015 ***EAC Guidelines for the use of Geophysics in Archaeology*** Archaeolingua 2015

Gaffney C & Gater J (2003) ***Revealing the Buried Past: Geophysics for Archaeologists*** Stroud

Golder Associates 2018 ***IAMP One: Environmental Statement Chapter G: Cultural Heritage*** [unpublished client document] Golder Associates Ref 1785119.617/A.0

Natural Environment Research Council (NERC) 2018 ***British Geological Survey*** http://www.bgs.ac.uk/ accessed 24 September 2018

TWAS 2018 ***Specification for Geophysical Survey at Phase Two of the proposed International Advanced Manufacturing Park (IAMP), Sunderland*** [unpublished client document] Tyne and Wear Archaeology Service Ref MON15720



IAMP TWO scoping boundary
geophysical survey area
IAMP ONE development boundary
GPS swaths
area unsuitable for survey

0 250m
1:10,000 @ A3

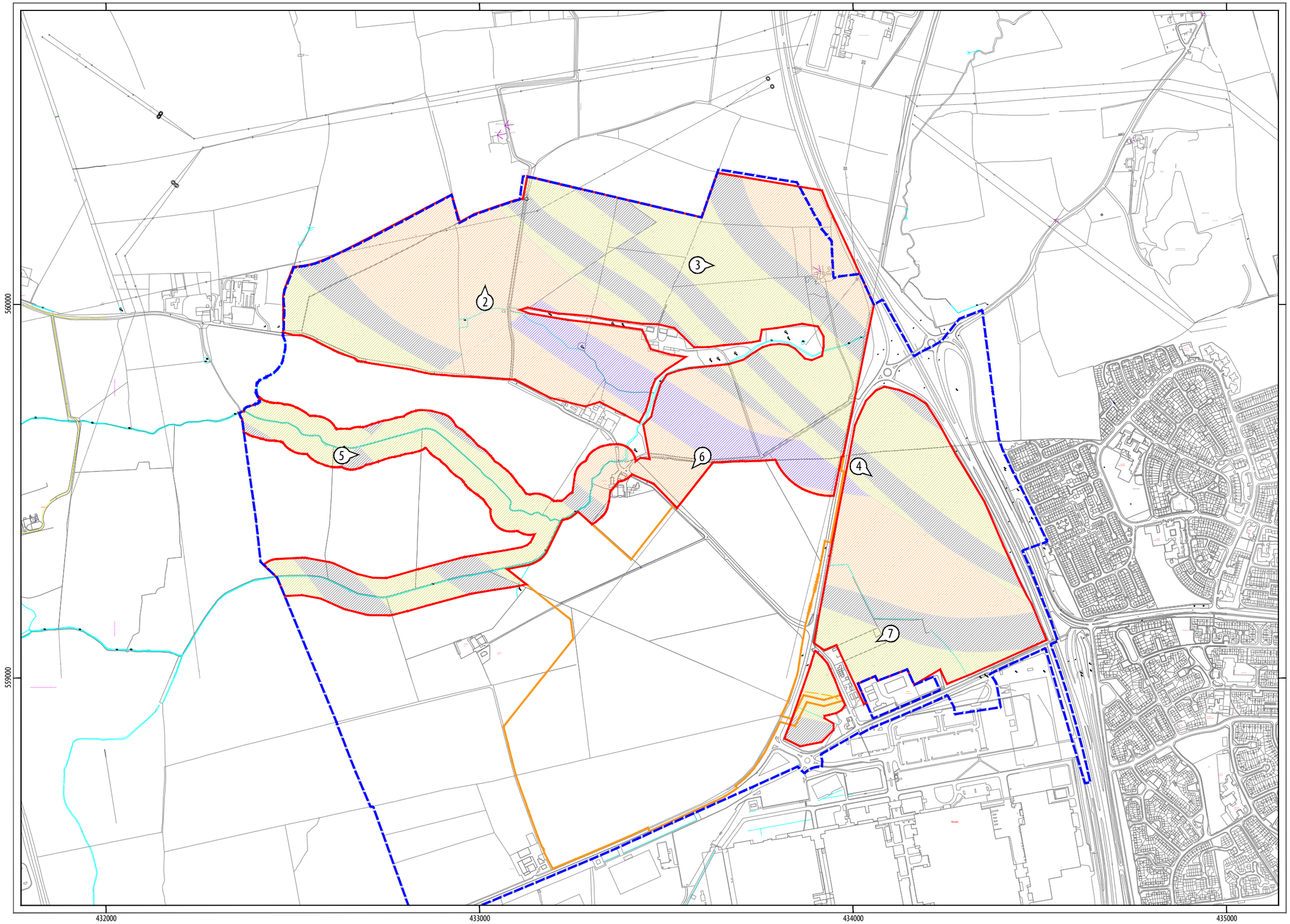
PROJECT IAMP18
International Advanced Manufacturing Park
IAMP TWO
Sunderland

CLIENT Sunderland City Council

HEADLAND ARCHAEOLOGY

NORTH Unit 16, Hillside, Beeston Road
Leeds LS11 8ND
0113 387 6430
www.headlandarchaeology.com

ILLUS 8 Survey location showing GPS swaths (1:10,000)



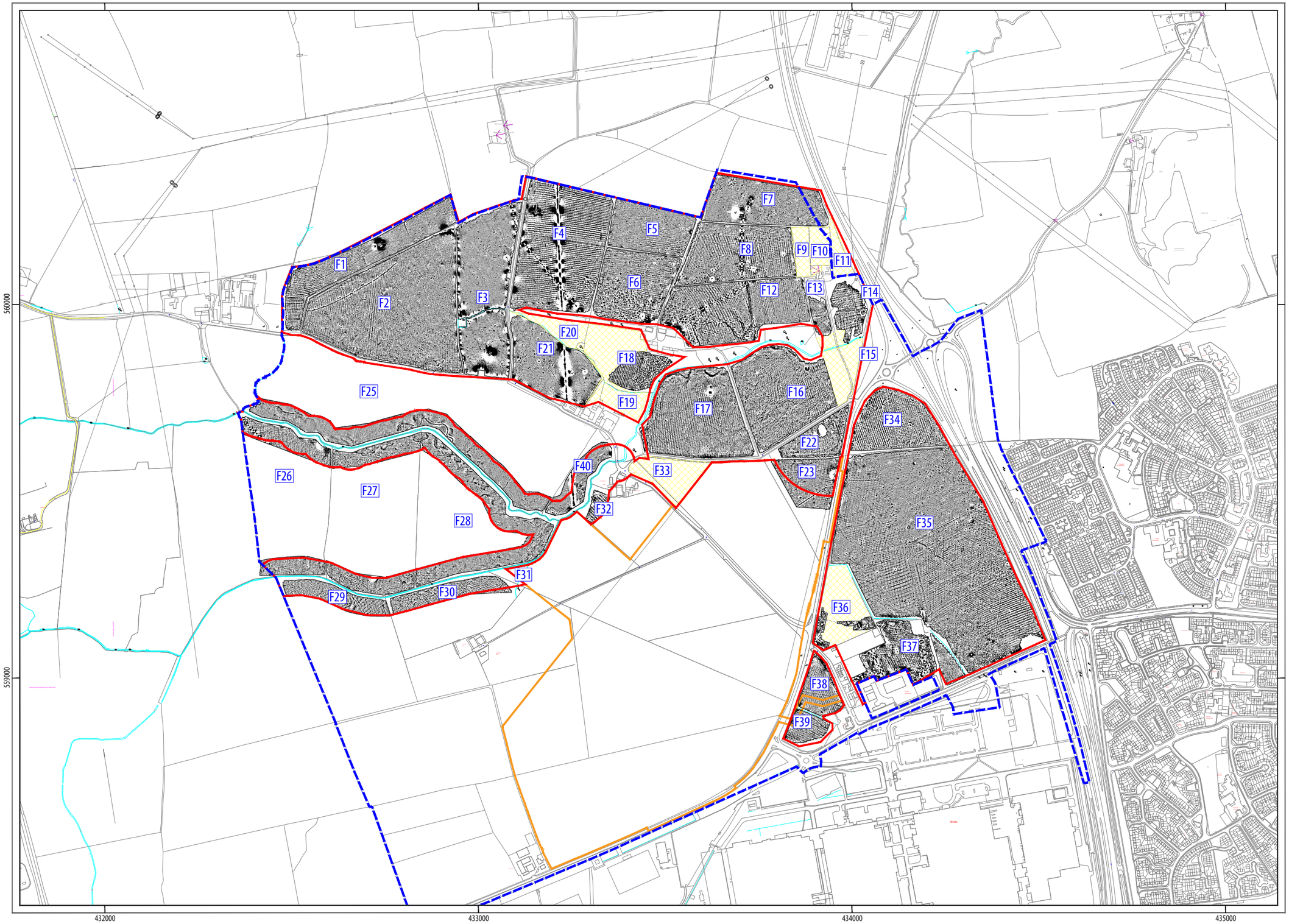
IAMP TWO scoping boundary
geophysical survey area
IAMP ONE development boundary
location and direction of ILLUS 2-7

BEDROCK GEOLOGY
Pennine Middle Coal Measures - Sandstone
Pennine Middle Coal Measures - Mudstone, Siltstone & Sandstone
Pennine Upper Coal Measures - Sandstone
Pennine Upper Coal Measures - Mudstone, Siltstone & Sandstone

PROJECT IAMP18
International Advanced Manufacturing Park
IAMP TWO
Sunderland
CLIENT Sunderland City Council

HEADLAND ARCHAEOLOGY
NORTH Unit 16, Hillside, Beeston Road
Leeds LS11 8ND
0113 387 6430
www.headlandarchaeology.com

ILLUS 9 Survey location showing geology data (1:10,000)



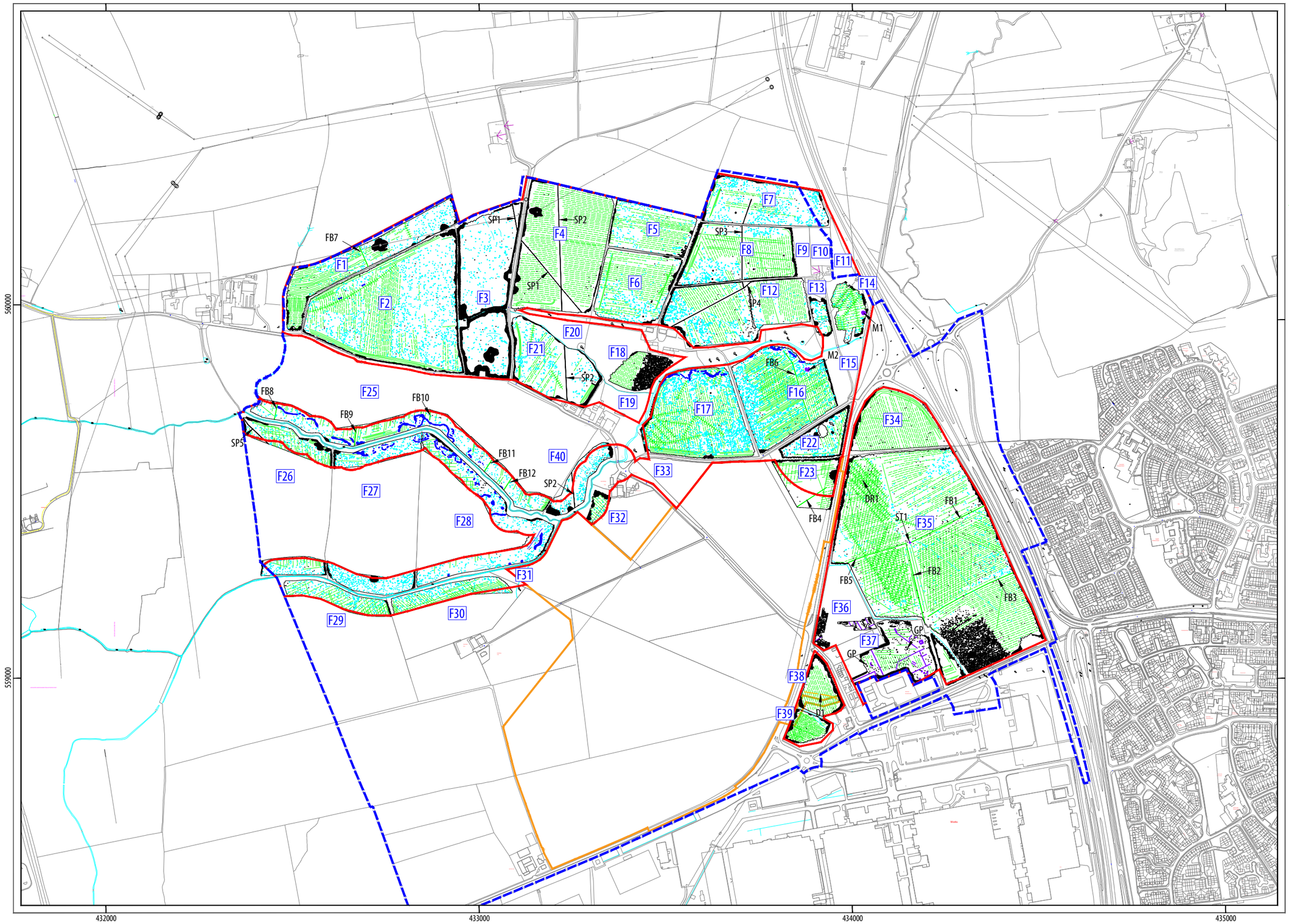
PROJECT IAMP18
International Advanced Manufacturing Park
IAMP TWO
Sunderland

CLIENT Sunderland City Council

HEADLAND ARCHAEOLOGY

NORTH Unit 16, Hillside, Beeston Road
Leeds LS11 8ND
0113 387 6430
www.headlandarchaeology.com

ILLUS 10 Processed greyscale magnetometer data (1:10,000)



IAMP TWO scoping boundary
geophysical survey area
IAMP ONE development boundary

TYPE OF ANOMALY	INTERPRETATION
dipolar isolated	ferrous material
magnetic disturbance	ferrous material
dipolar linear	service pipe
dipolar linear	airfield infrastructure
magnetic enhancement	airfield infrastructure
magnetic enhancement	mining?
linear trend	ridge and furrow
linear trend	agricultural
linear trend	field drain
linear	former field boundary
linear	former field boundary?
linear trend	geological variation
magnetic enhancement	geology
magnetic enhancement	former watercourse
magnetic enhancement	modern
magnetic enhancement	archaeology?

ABBREVIATIONS

D	ditch	SP	service pipe
DR	drain	ST	structure
FB	former boundary	M	mining?
GP	goal posts		

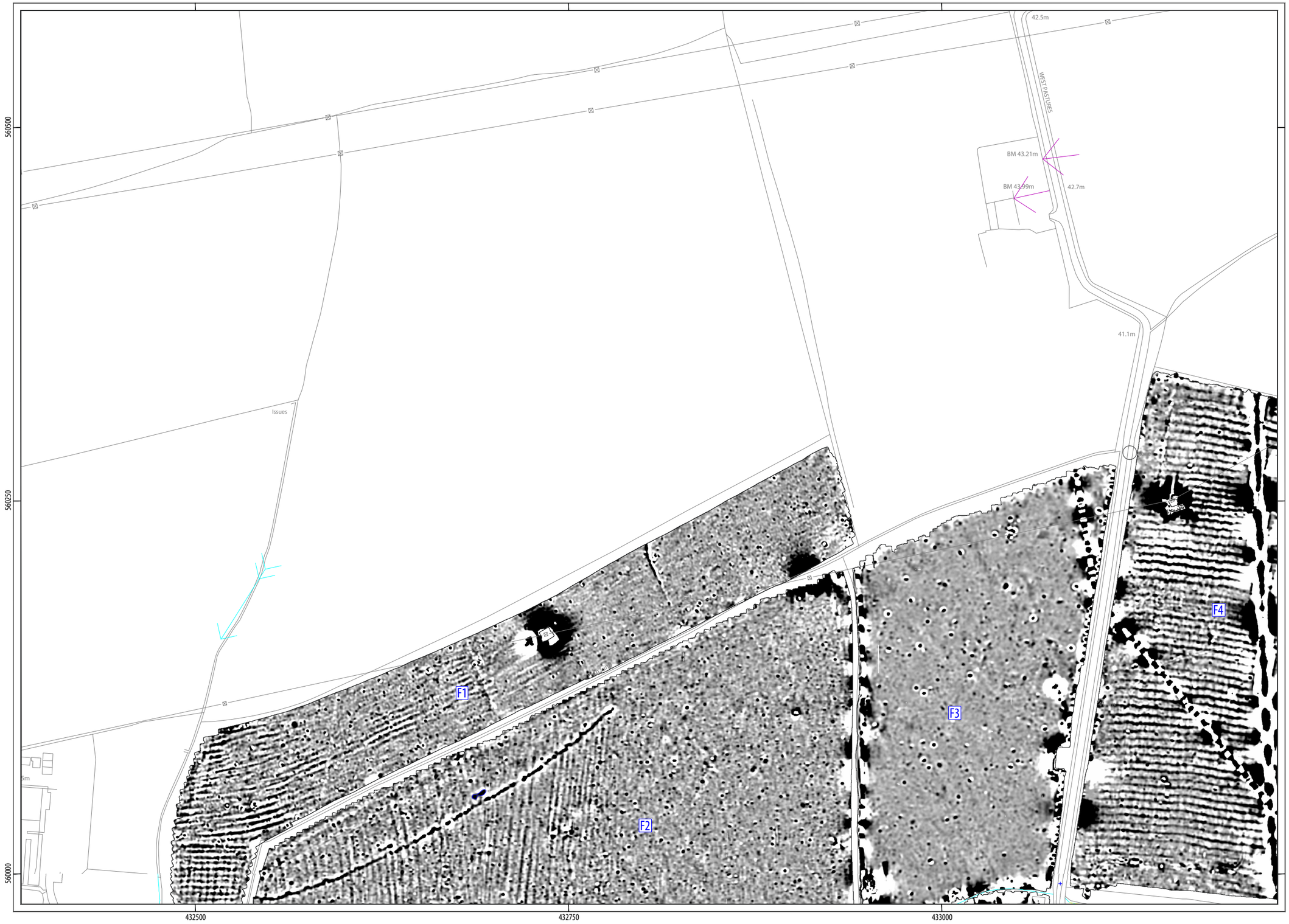
0 250m
1:10,000 @ A3

PROJECT IAMP18
International Advanced Manufacturing Park
IAMP TWO
Sunderland
CLIENT Sunderland City Council

HEADLAND ARCHAEOLOGY

NORTH Unit 16, Hillside, Beeston Road
Leeds LS11 8ND
0113 387 6430
www.headlandarchaeology.com

ILLUS 11 Interpretation of magnetometer data (1:10,000)



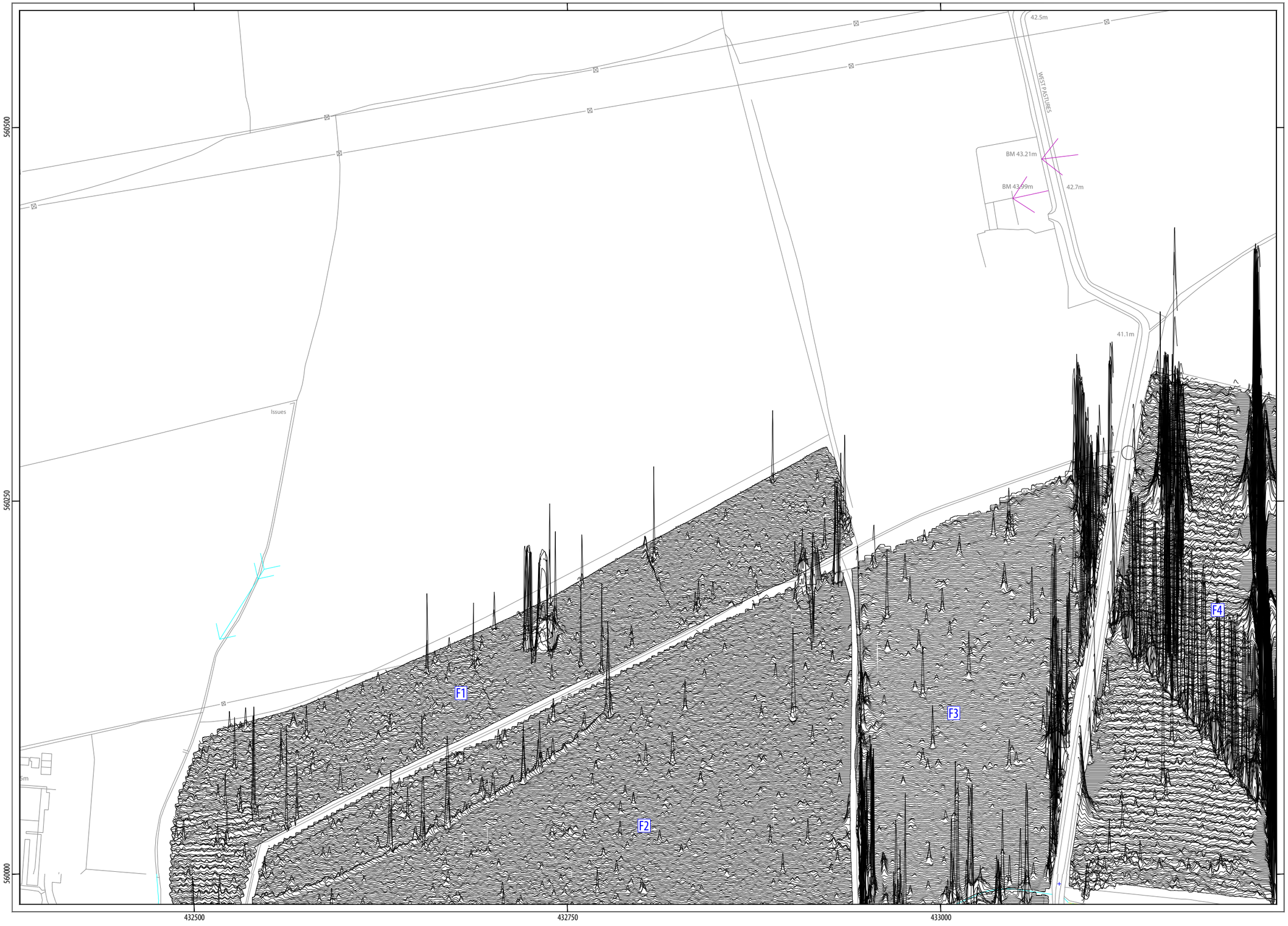
PROJECT IAMP18
International Advanced Manufacturing Park
IAMP TWO
Sunderland

CLIENT Sunderland City Council

HEADLAND ARCHAEOLOGY

NORTH Unit 16, Hillside, Beeston Road
Leeds LS11 8ND
0113 387 6430
www.headlandarchaeology.com

ILLUS 12 Processed greyscale magnetometer data; Sector 1 (1:2,500)



25.0nT/cm

0 50m

1:2,500 @ A3

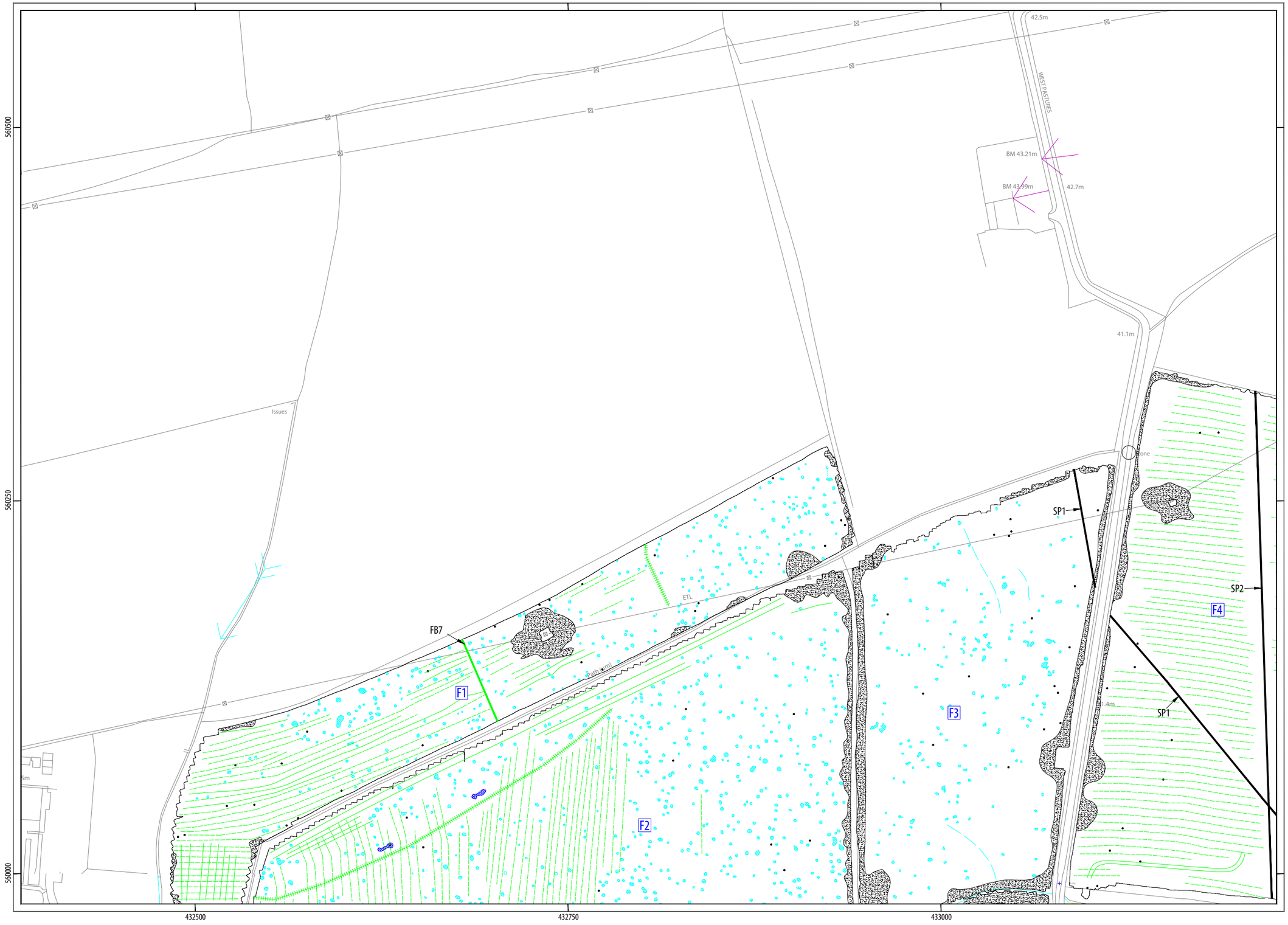
PROJECT IAMP18
International Advanced Manufacturing Park
IAMP TWO
Sunderland

CLIENT Sunderland City Council

HEADLAND ARCHAEOLOGY

NORTH Unit 16, Hillside, Beeston Road
Leeds LS11 8ND
0113 387 6430
www.headlandarchaeology.com

ILLUS 13 XY trace plot of minimally processed magnetometer data; Sector 1 (1:2,500)



TYPE OF ANOMALY	INTERPRETATION
dipolar isolated	ferrous material
magnetic disturbance	ferrous material
dipolar linear	service pipe
linear trend	ridge and furrow
linear trend	agricultural
linear	former field boundary
linear	drain
linear trend	geological variation
magnetic enhancement	geology
magnetic enhancement	modern

ABBREVIATIONS

FB former boundary

SP service pipe

25.0nT/cm

0 50m

1:2,500 @ A3

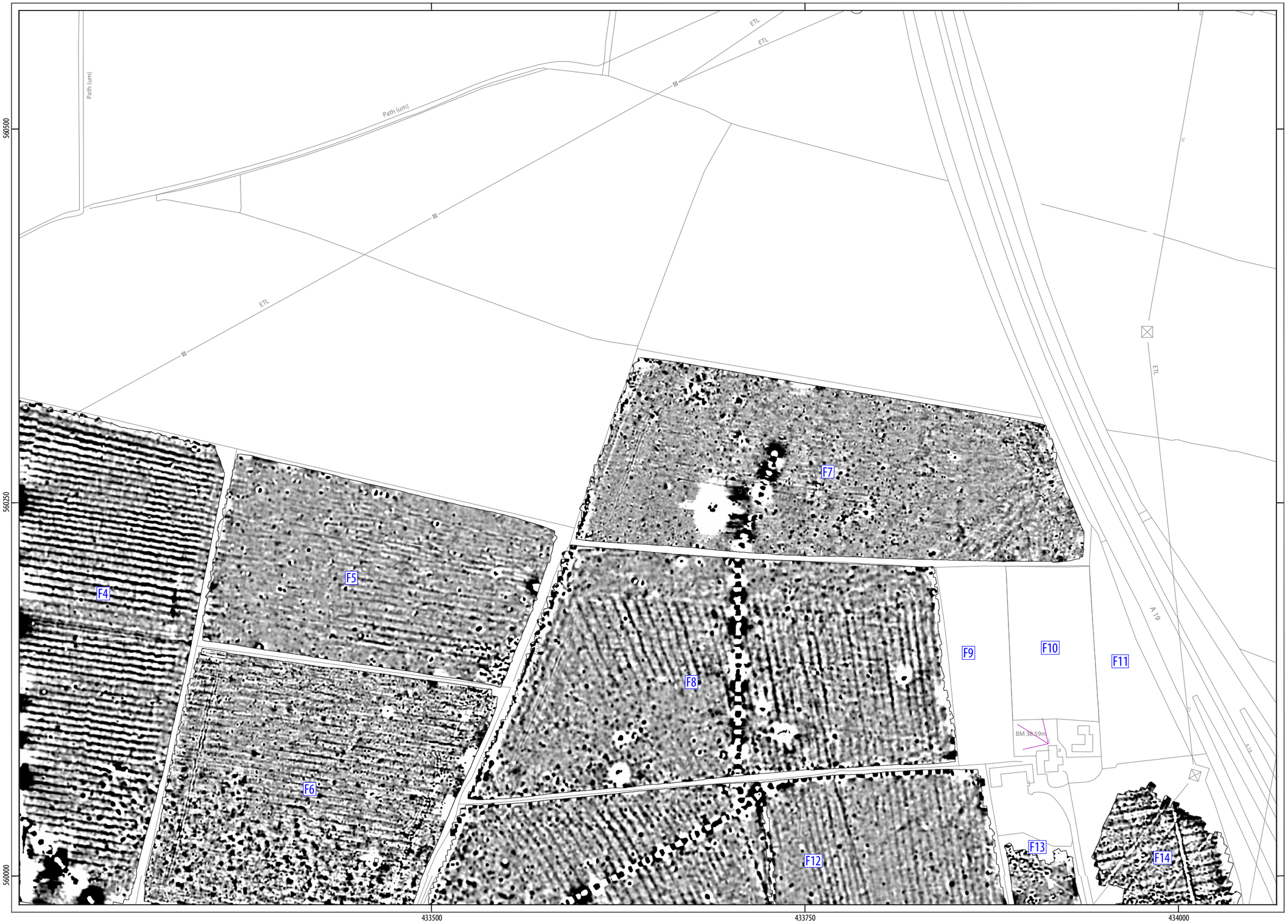
PROJECT IAMP18
International Advanced Manufacturing Park
IAMP TWO
Sunderland

CLIENT Sunderland City Council

HEADLAND ARCHAEOLOGY

NORTH Unit 16, Hillside, Beeston Road
Leeds LS11 8ND
0113 387 6430
www.headlandarchaeology.com

ILLUS 14 Interpretation of magnetometer data; Sector 1 (1:2,500)



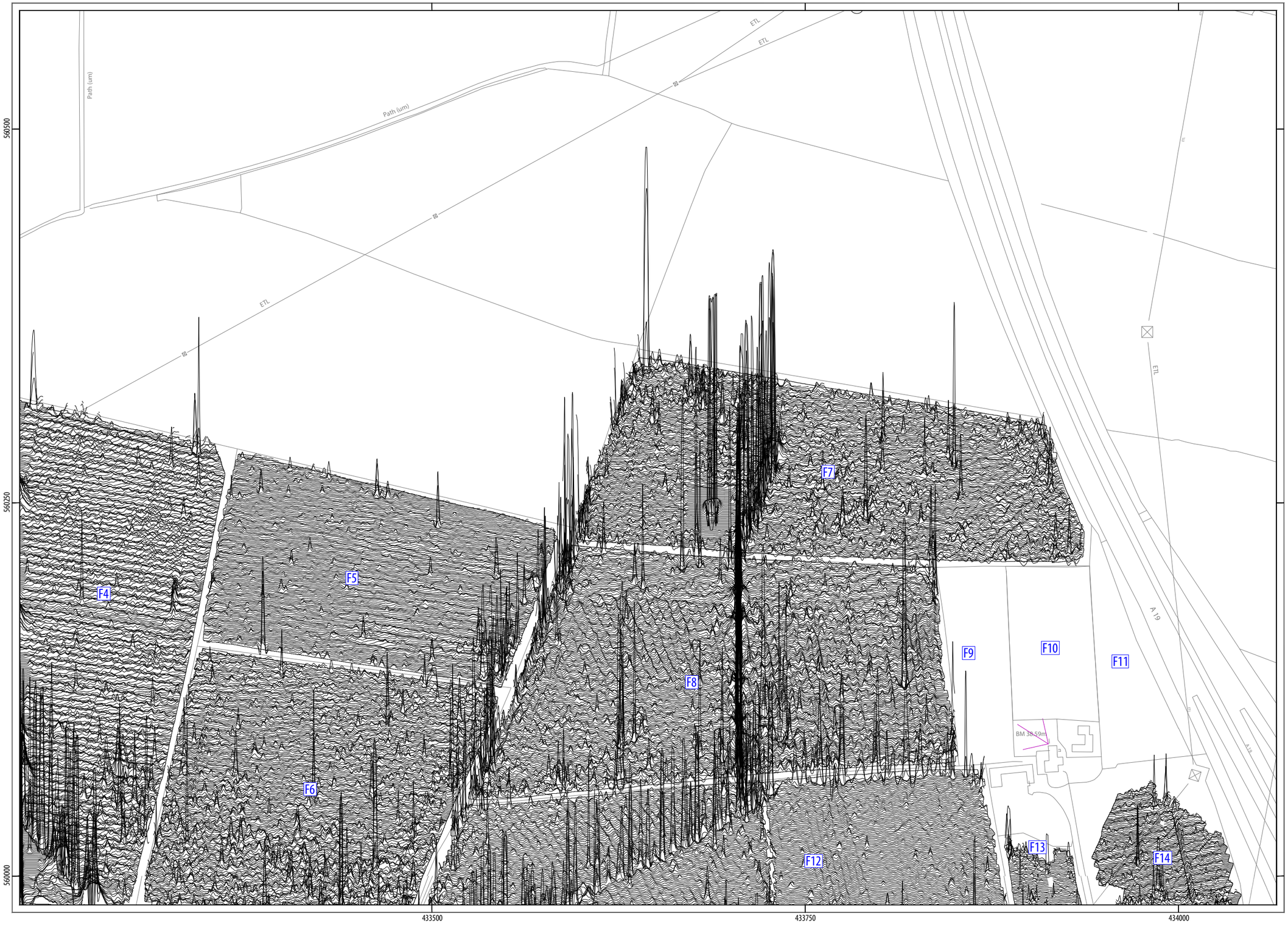
PROJECT IAMP18
International Advanced Manufacturing Park
IAMP TWO
Sunderland

CLIENT Sunderland City Council

HEADLAND ARCHAEOLOGY

NORTH Unit 16, Hillside, Beeston Road
Leeds LS11 8ND
0113 387 6430
www.headlandarchaeology.com

ILLUS 15 Processed greyscale magnetometer data; Sector 2 (1:2,500)



25.0nT/cm

0 50m

1:2,500 @ A3

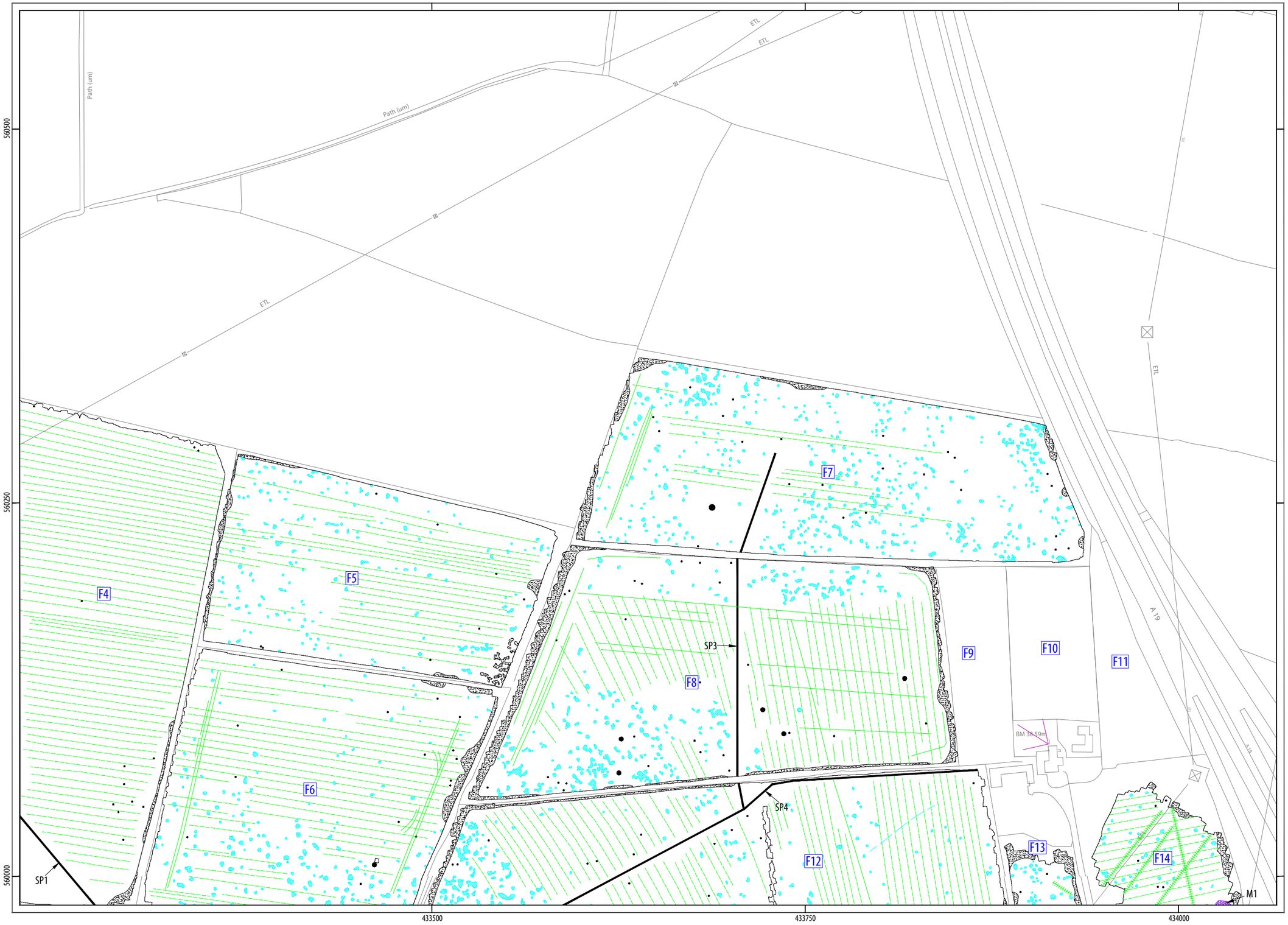
PROJECT IAMP18
International Advanced Manufacturing Park
IAMP TWO
Sunderland

CLIENT Sunderland City Council

HEADLAND ARCHAEOLOGY

NORTH Unit 16, Hillside, Beeston Road
Leeds LS11 8ND
0113 387 6430
www.headlandarchaeology.com

ILLUS 16 XY trace plot of minimally processed magnetometer data; Sector 2 (1:2,500)



TYPE OF ANOMALY	INTERPRETATION
dipolar isolated	ferrous material
magnetic disturbance	ferrous material
dipolar linear	service pipe
linear trend	ridge and furrow
linear trend	agricultural
linear	drain
magnetic enhancement	geology
magnetic enhancement	modern

ABBREVIATIONS

SP	service pipe
M	mining?

0 50m
1:2,500 @ A3

PROJECT IAMP18
International Advanced Manufacturing Park
IAMP TWO
Sunderland

CLIENT Sunderland City Council

HEADLAND ARCHAEOLOGY

NORTH Unit 16, Hillside, Beeston Road
Leeds LS11 8ND
0113 387 6430
www.headlandarchaeology.com

ILLUS 17 Interpretation of magnetometer data; Sector 2 (1:2,500)

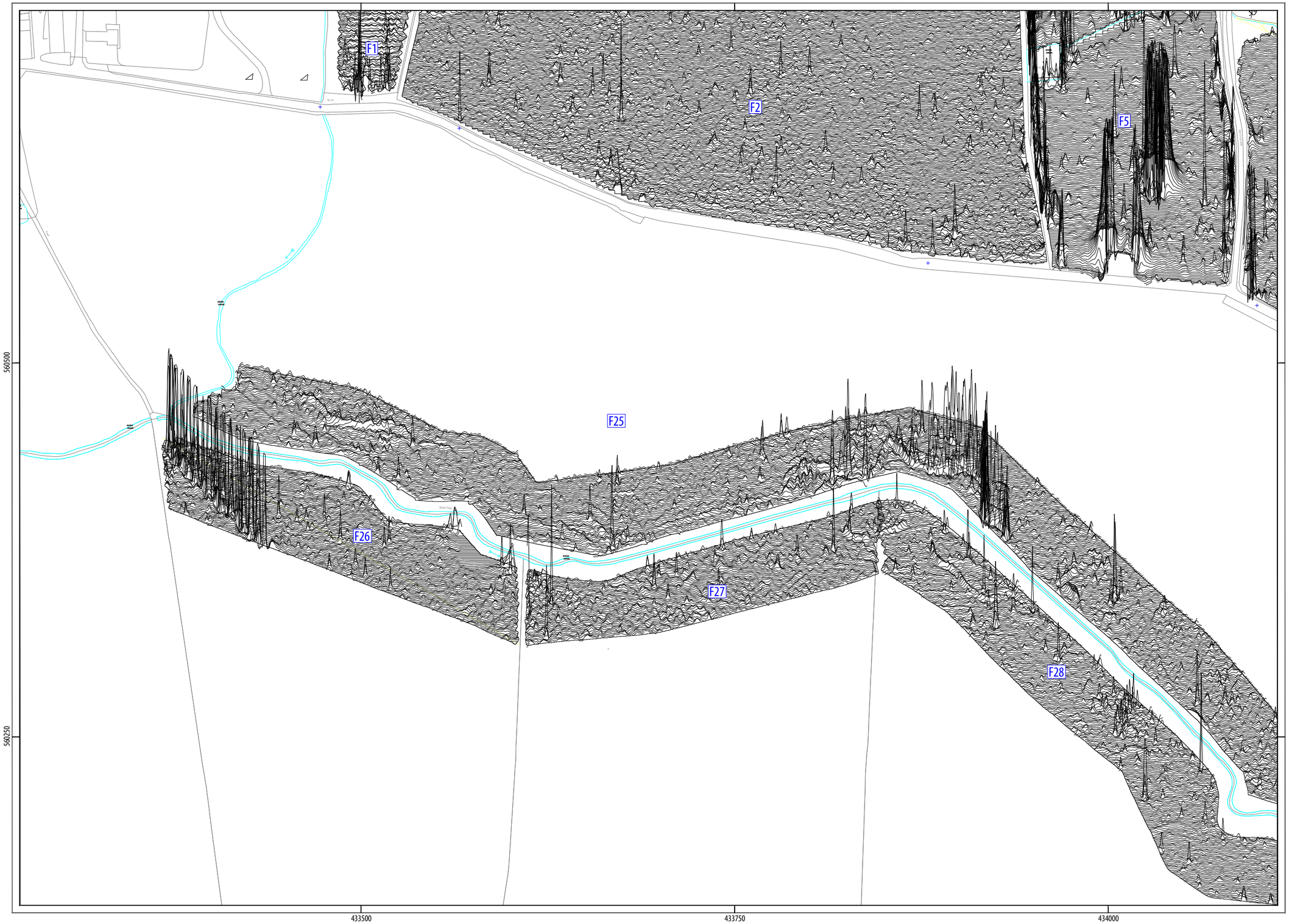
PROJECT IAMP18
International Advanced Manufacturing Park
IAMP TWO
Sunderland

CLIENT Sunderland City Council

HEADLAND ARCHAEOLOGY

NORTH Unit 16, Hillside, Beeston Road
Leeds LS11 8ND
0113 387 6430
www.headlandarchaeology.com

ILLUS 18 Processed greyscale magnetometer data; Sector 3 (1:2,500)



25.0nT/cm

0 50m

1:2,500 @ A3

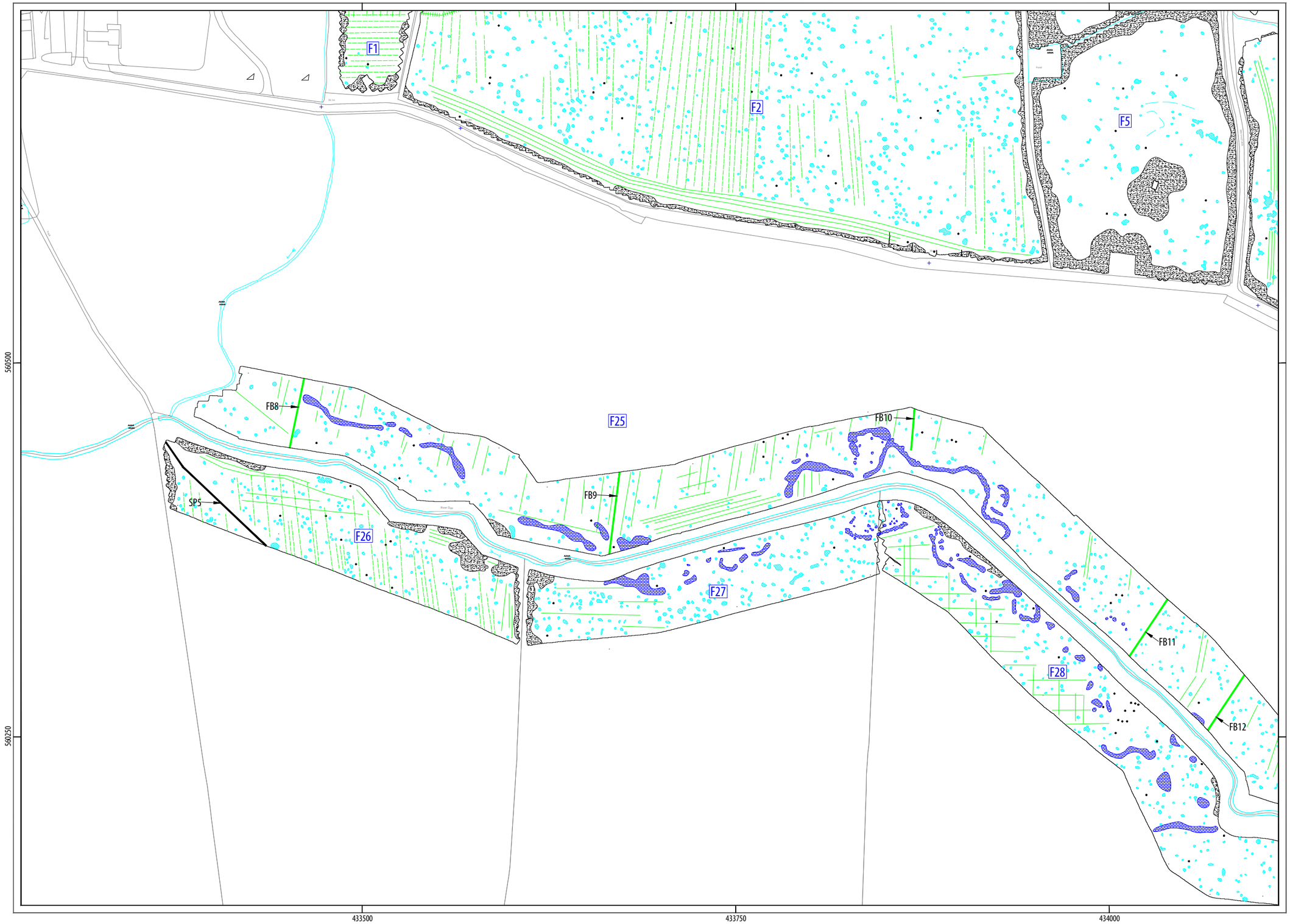
PROJECT IAMP18
International Advanced Manufacturing Park
IAMP TWO
Sunderland

CLIENT Sunderland City Council

HEADLAND ARCHAEOLOGY

NORTH Unit 16, Hillside, Beeston Road
Leeds LS11 8ND
0113 387 6430
www.headlandarchaeology.com

ILLUS 19 XY trace plot of minimally processed magnetometer data; Sector 3 (1:2,500)



TYPE OF ANOMALY	INTERPRETATION
dipolar isolated	ferrous material
magnetic disturbance	ferrous material
dipolar linear	service pipe
linear trend	ridge and furrow
linear trend	agricultural
linear	former field boundary
linear	drain
linear trend	geological variation
magnetic enhancement	geology
magnetic enhancement	former watercourse

ABBREVIATIONS

FB	former boundary
SP	service pipe

0 50m
1:2,500 @ A3

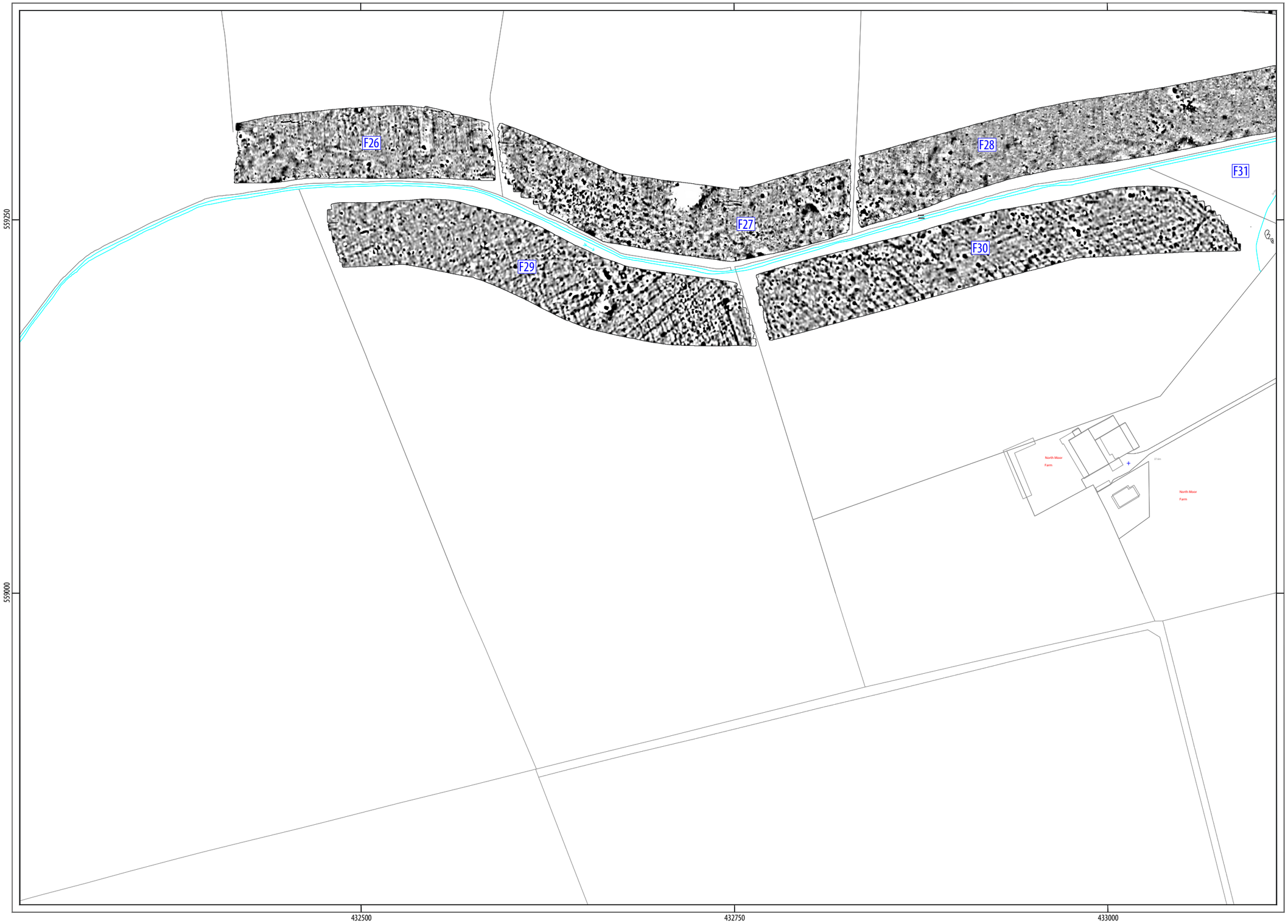
PROJECT IAMP18
International Advanced Manufacturing Park
IAMP TWO
Sunderland

CLIENT Sunderland City Council

HEADLAND ARCHAEOLOGY

NORTH Unit 16, Hillside, Beeston Road
Leeds LS11 8ND
0113 387 6430
www.headlandarchaeology.com

ILLUS 20 Interpretation of magnetometer data; Sector 3 (1:2,500)



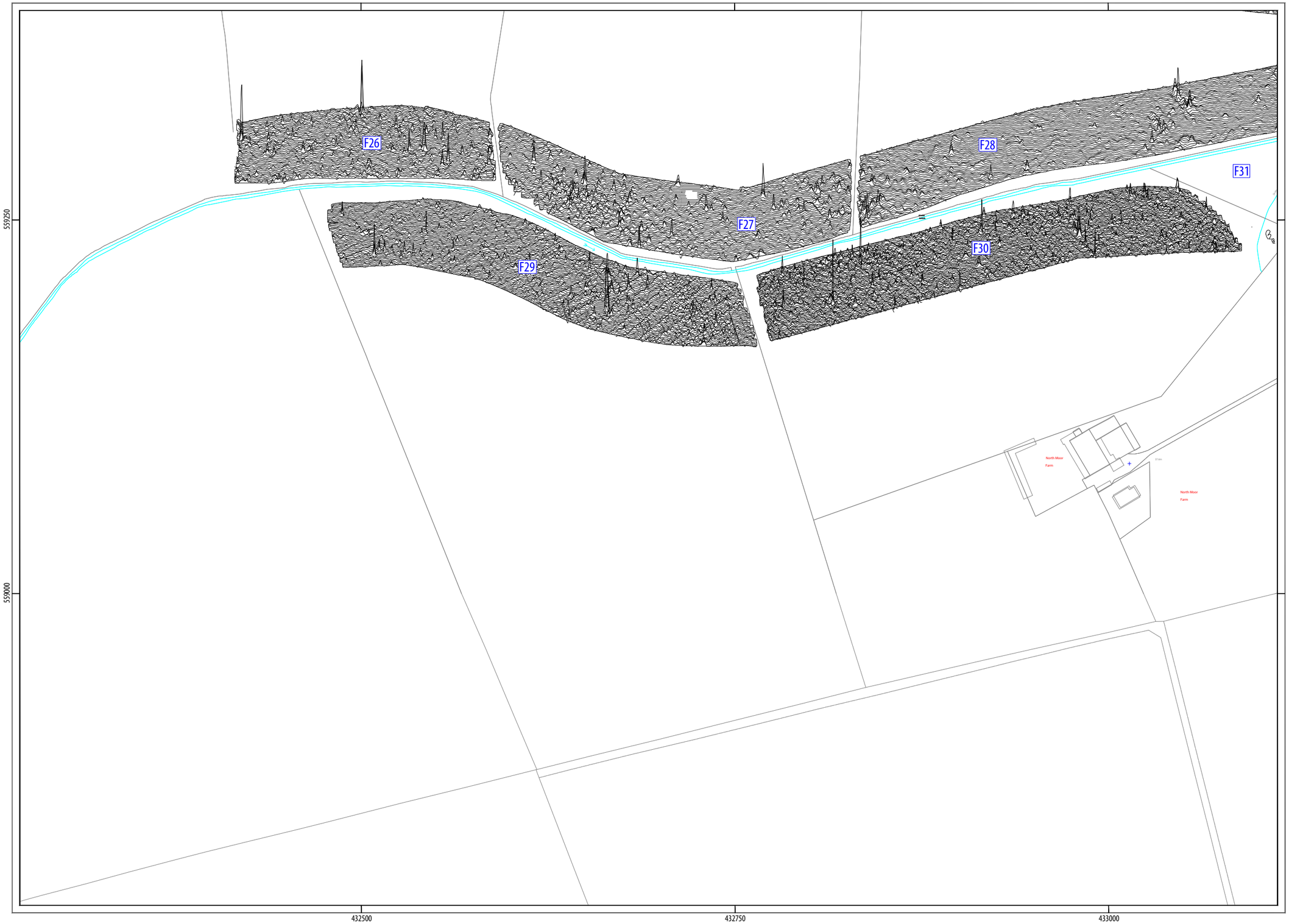
PROJECT IAMP18
International Advanced Manufacturing Park
IAMP TWO
Sunderland

CLIENT Sunderland City Council

HEADLAND ARCHAEOLOGY

NORTH Unit 16, Hillside, Beeston Road
Leeds LS11 8ND
0113 387 6430
www.headlandarchaeology.com

ILLUS 21 Processed greyscale magnetometer data; Sector 4 (1:2,500)



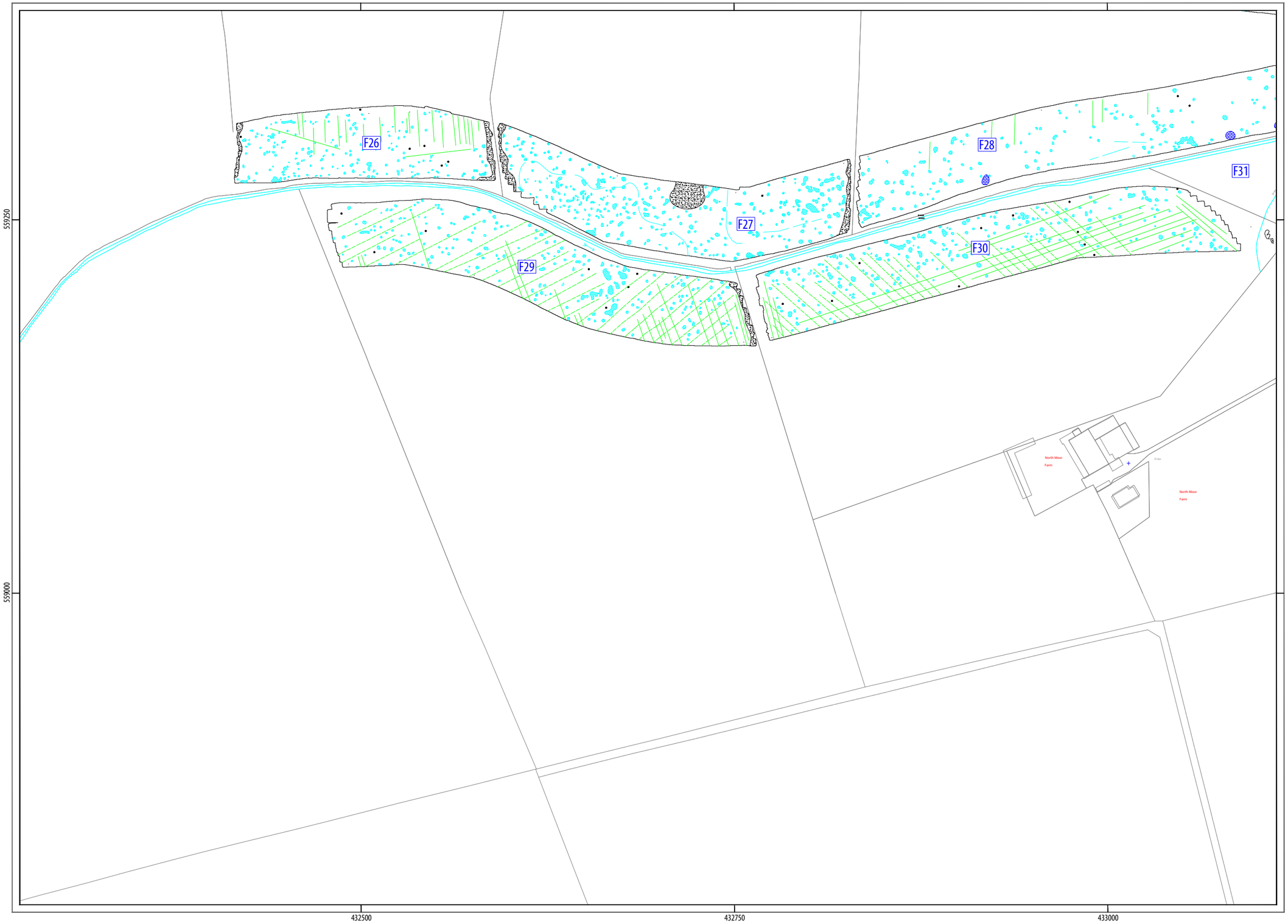
PROJECT IAMP18
International Advanced Manufacturing Park
IAMP TWO
Sunderland

CLIENT Sunderland City Council

HEADLAND ARCHAEOLOGY

NORTH Unit 16, Hillside, Beeston Road
Leeds LS11 8ND
0113 387 6430
www.headlandarchaeology.com

ILLUS 22 XY trace plot of minimally processed magnetometer data; Sector 4 (1:2,500)



0 50m
1:2,500 @ A3

PROJECT IAMP18
International Advanced Manufacturing Park
IAMP TWO
Sunderland

CLIENT Sunderland City Council

HEADLAND ARCHAEOLOGY

NORTH Unit 16, Hillside, Beeston Road
Leeds LS11 8ND
0113 387 6430
www.headlandarchaeology.com

ILLUS 23 Interpretation of magnetometer data; Sector 4 (1:2,500)

F4
F6
F12
F20
F21
F18
F16
F17
F40
F33
F25
F32
F28
Hylton Bridge
Farm
559750
559500
559250
433250
433500

nT
-1.0
2.0
0
50m
1:2,500 @ A3

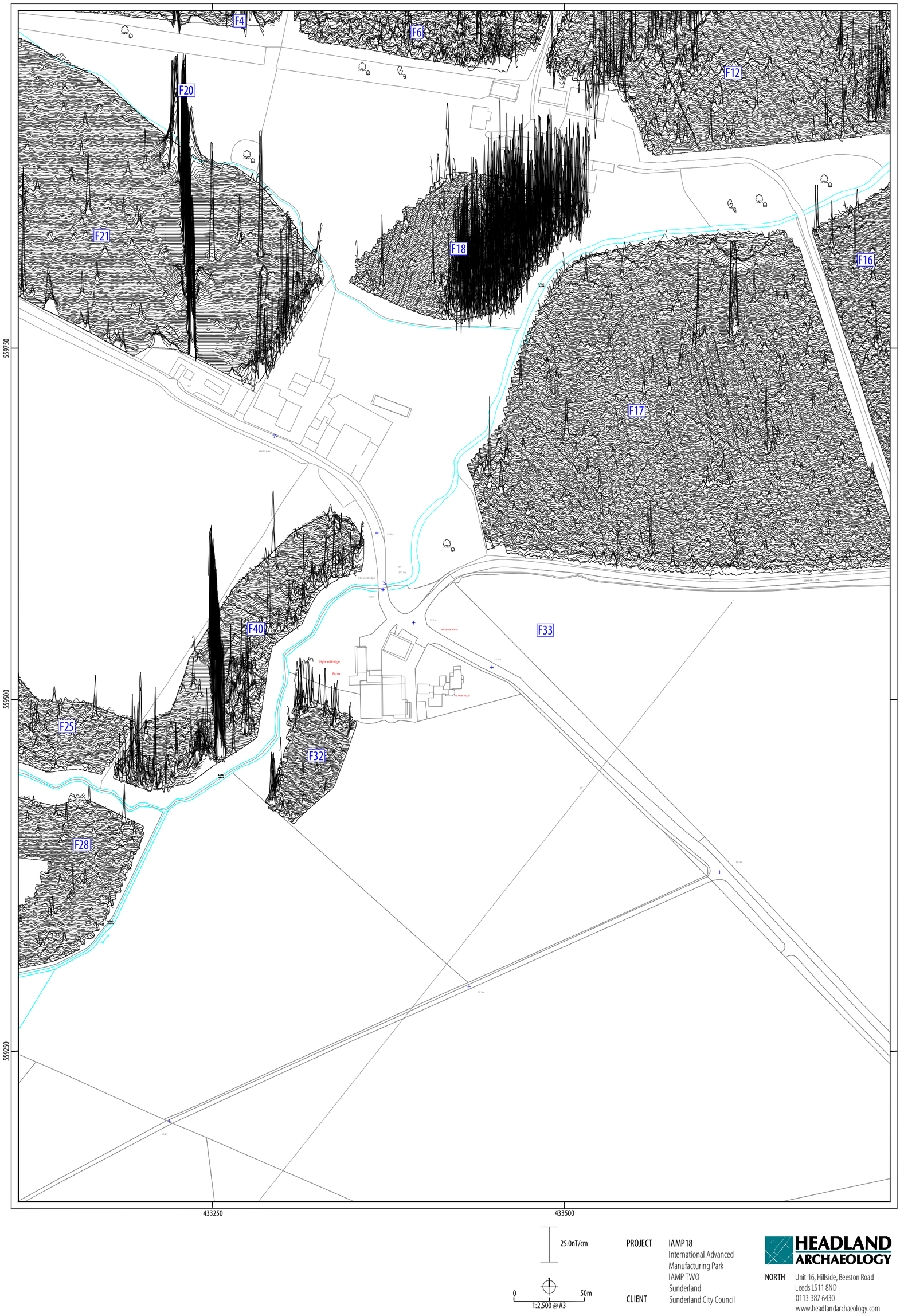
PROJECT IAMP18
International Advanced Manufacturing Park
IAMP TWO
Sunderland

CLIENT Sunderland City Council

HEADLAND ARCHAEOLOGY

NORTH Unit 16, Hillside, Beeston Road
Leeds LS11 8ND
0113 387 6430
www.headlandarchaeology.com

ILLUS 24 Processed greyscale magnetometer data; Sector 5 (1:2,500)



25.0nT/cm

0 50m

1:2,500 @ A3

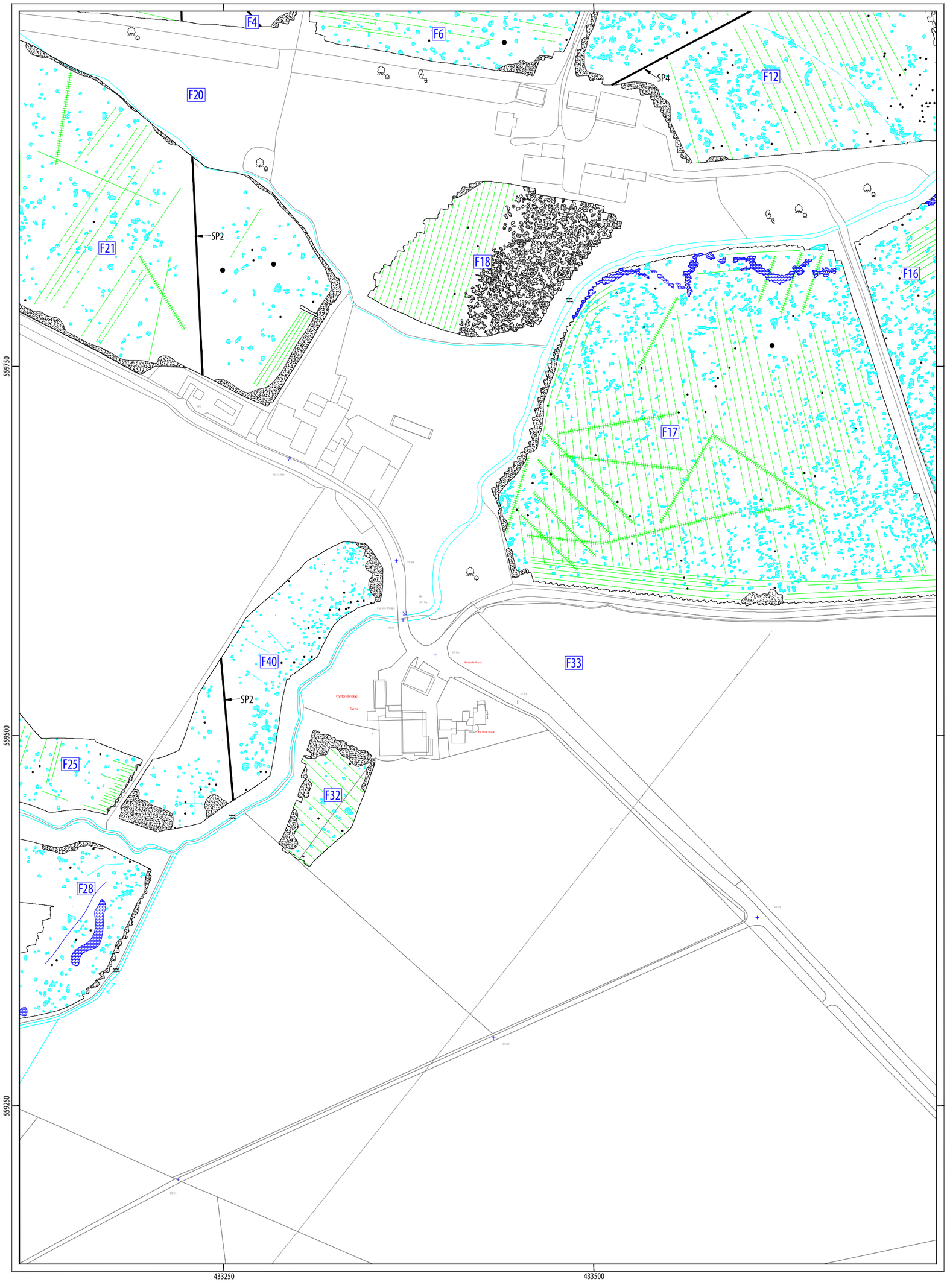
PROJECT IAMP18
International Advanced Manufacturing Park
IAMP TWO
Sunderland

CLIENT Sunderland City Council

HEADLAND ARCHAEOLOGY

NORTH Unit 16, Hillside, Beeston Road
Leeds LS11 8ND
0113 387 6430
www.headlandarchaeology.com

ILLUS 25 XY trace plot of minimally processed magnetometer data; Sector 5 (1:2,500)



TYPE OF ANOMALY	INTERPRETATION
dipolar isolated	ferrous material
magnetic disturbance	ferrous material
dipolar linear	service pipe
linear trend	ridge and furrow
linear trend	agricultural
linear trend	field drain

TYPE OF ANOMALY	INTERPRETATION
lineartrend	geology
magnetic enhancement	geology
magnetic enhancement	former watercourse

ABBREVIATIONS

SP service pipe

0 50m

1:2,500 @ A3

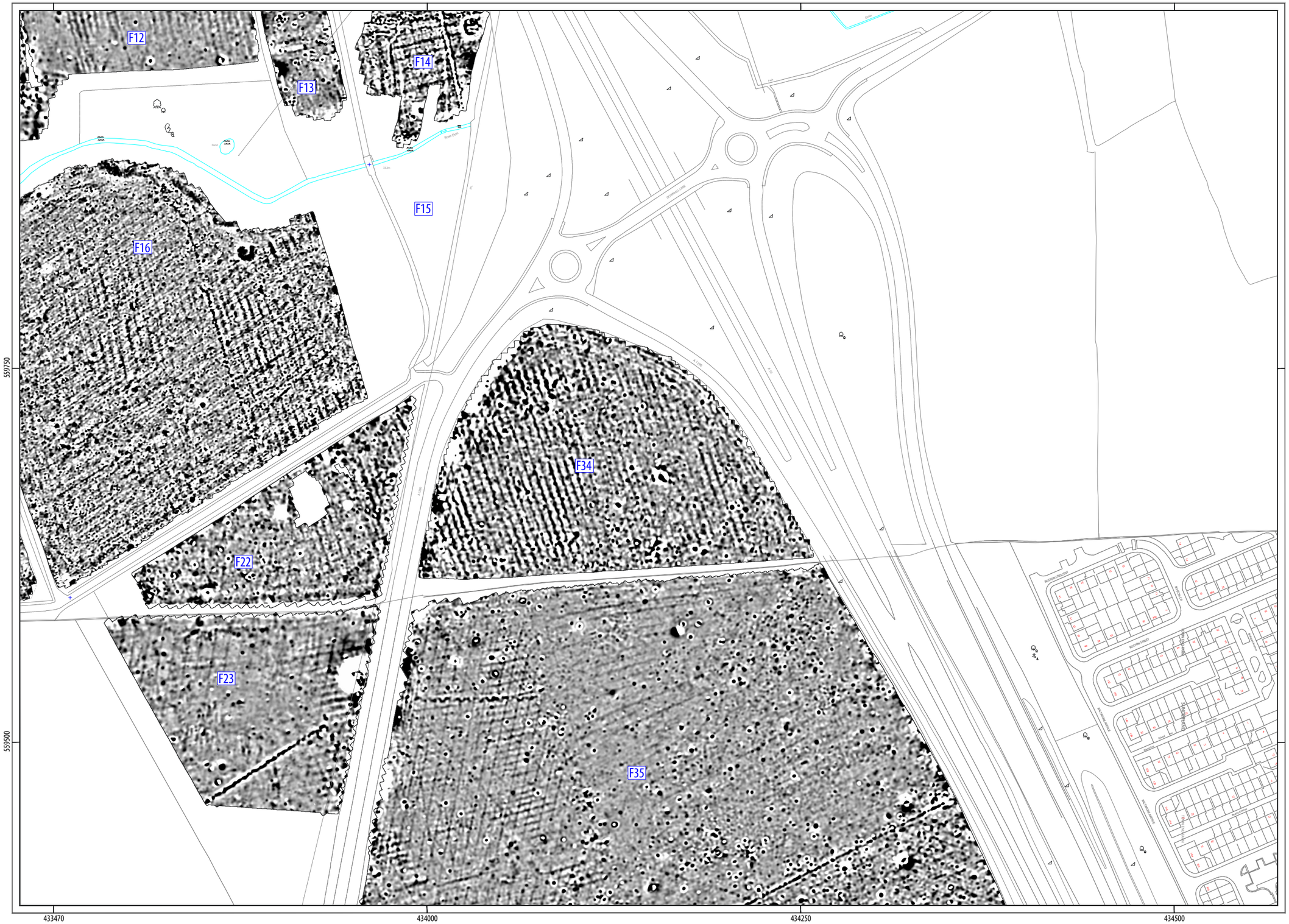
PROJECT IAMP18
International Advanced Manufacturing Park
IAMP TWO
Sunderland

CLIENT Sunderland City Council

HEADLAND ARCHAEOLOGY

NORTH Unit 16, Hillside, Beeston Road
Leeds LS11 8ND
0113 387 6430
www.headlandarchaeology.com

ILLUS 26 Interpretation of magnetometer data; Sector 5 (1:2,500)



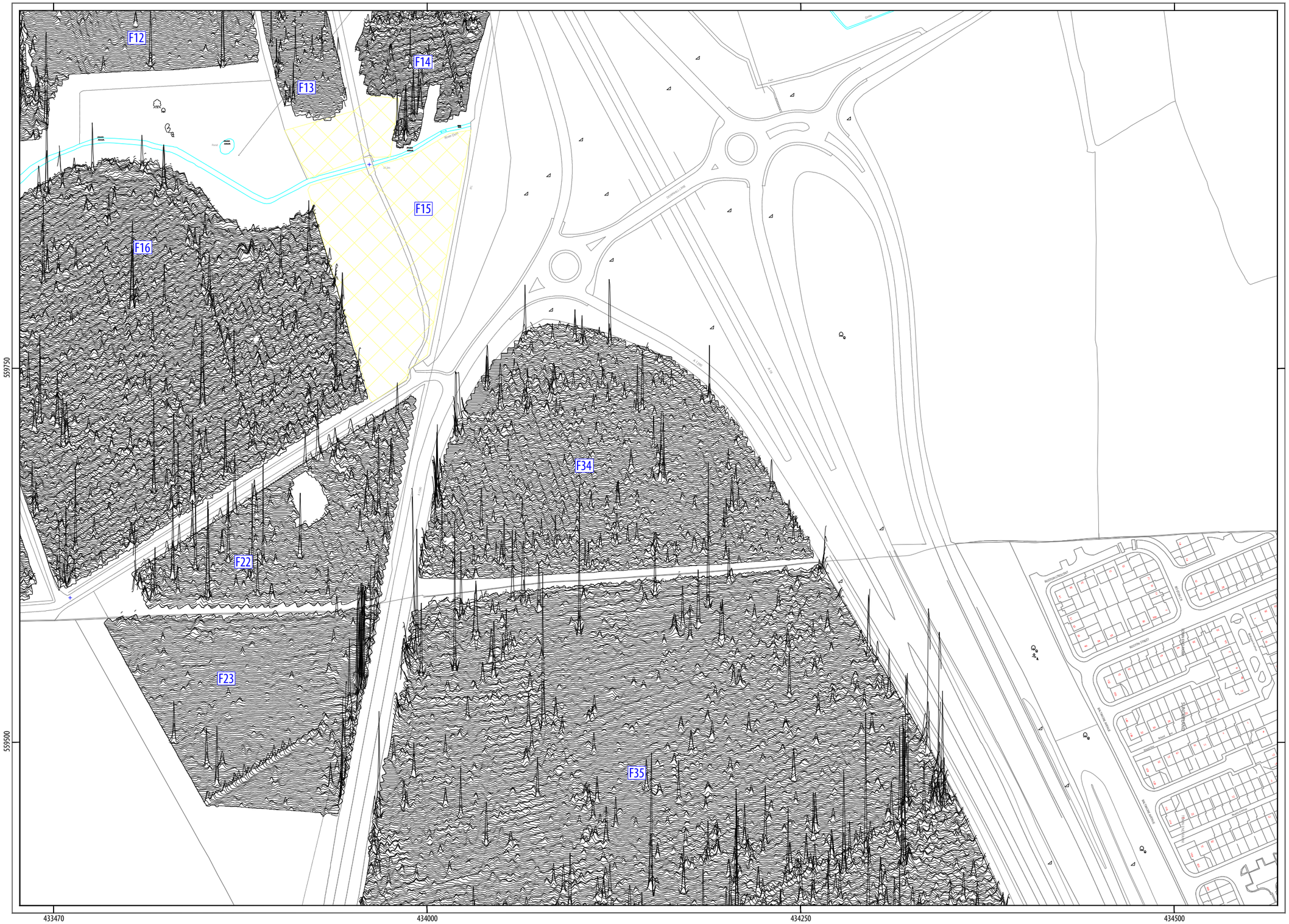
PROJECT IAMP18
International Advanced Manufacturing Park
IAMP TWO
Sunderland

CLIENT Sunderland City Council

HEADLAND ARCHAEOLOGY

NORTH Unit 16, Hillside, Beeston Road
Leeds LS11 8ND
0113 387 6430
www.headlandarchaeology.com

ILLUS 27 Processed greyscale magnetometer data; Sector 6 (1:2,500)



25.0nT/cm

0 50m

1:2,500 @ A3

PROJECT IAMP18
International Advanced Manufacturing Park
IAMP TWO
Sunderland

CLIENT Sunderland City Council

HEADLAND ARCHAEOLOGY

NORTH Unit 16, Hillside, Beeston Road
Leeds LS11 8ND
0113 387 6430
www.headlandarchaeology.com

ILLUS 28 XY trace plot of minimally processed magnetometer data; Sector 6 (1:2,500)

F12
F13
F14
F15
F16
F22
F23
F34
F35
M1
M2
FB6
FB4
DR1
FB1

559750
559500
433470
434000
434250
434500

TYPE OF ANOMALY	INTERPRETATION
dipolar isolated	ferrous material
magnetic disturbance	ferrous material
linear trend	ridge and furrow
linear trend	agricultural
linear	former field boundary
linear	drain
magnetic enhancement	geology
magnetic enhancement	former watercourse
magnetic enhancement	modern

ABBREVIATIONS

DR	drain
FB	former boundary
M	mining?

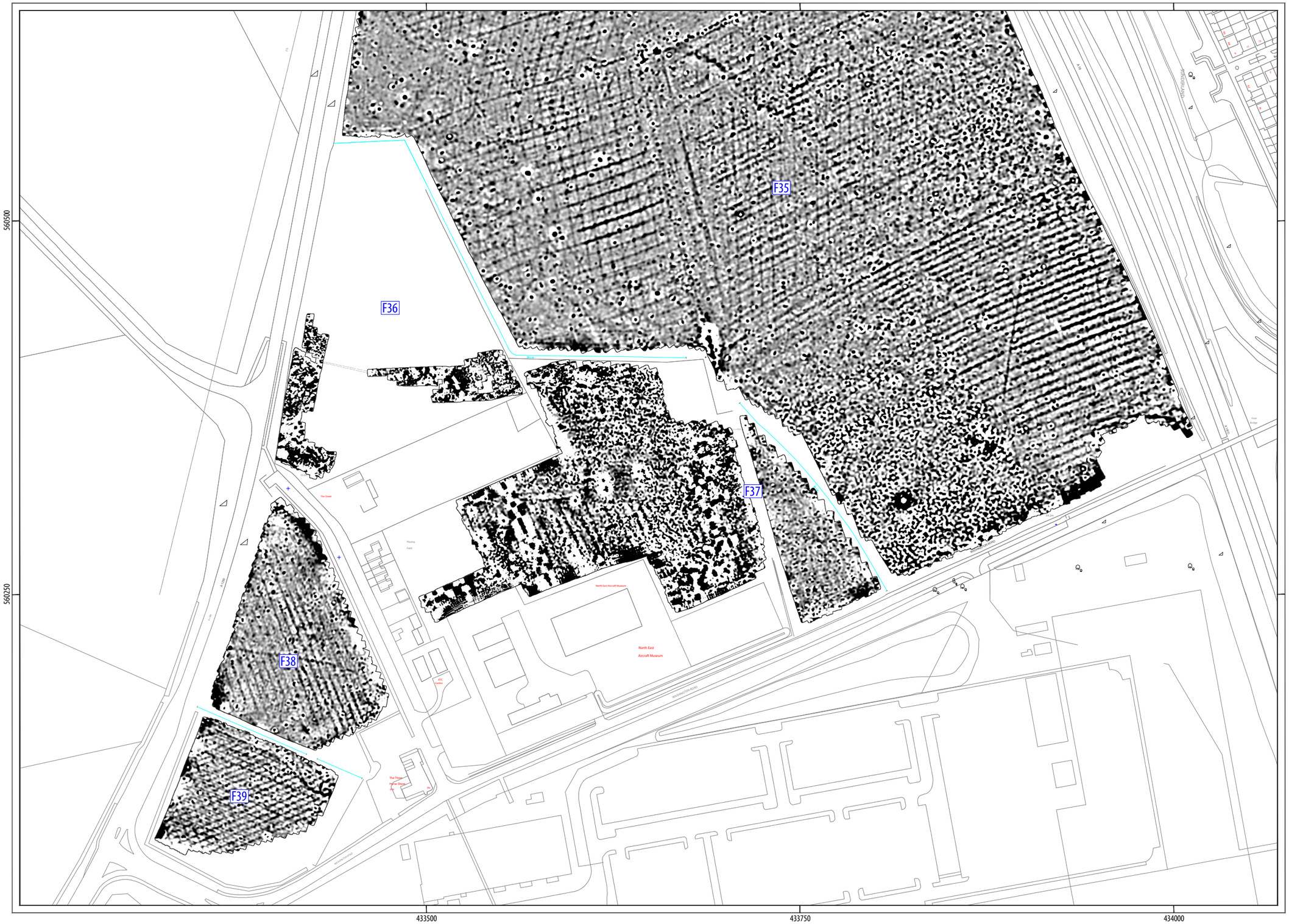
0 50m
1:2,500 @ A3

PROJECT IAMP18
International Advanced Manufacturing Park
IAMP TWO
Sunderland

CLIENT Sunderland City Council

HEADLAND ARCHAEOLOGY
NORTH Unit 16, Hillside, Beeston Road
Leeds LS11 8ND
0113 387 6430
www.headlandarchaeology.com

ILLUS 29 Interpretation of magnetometer data; Sector 6 (1:2,500)



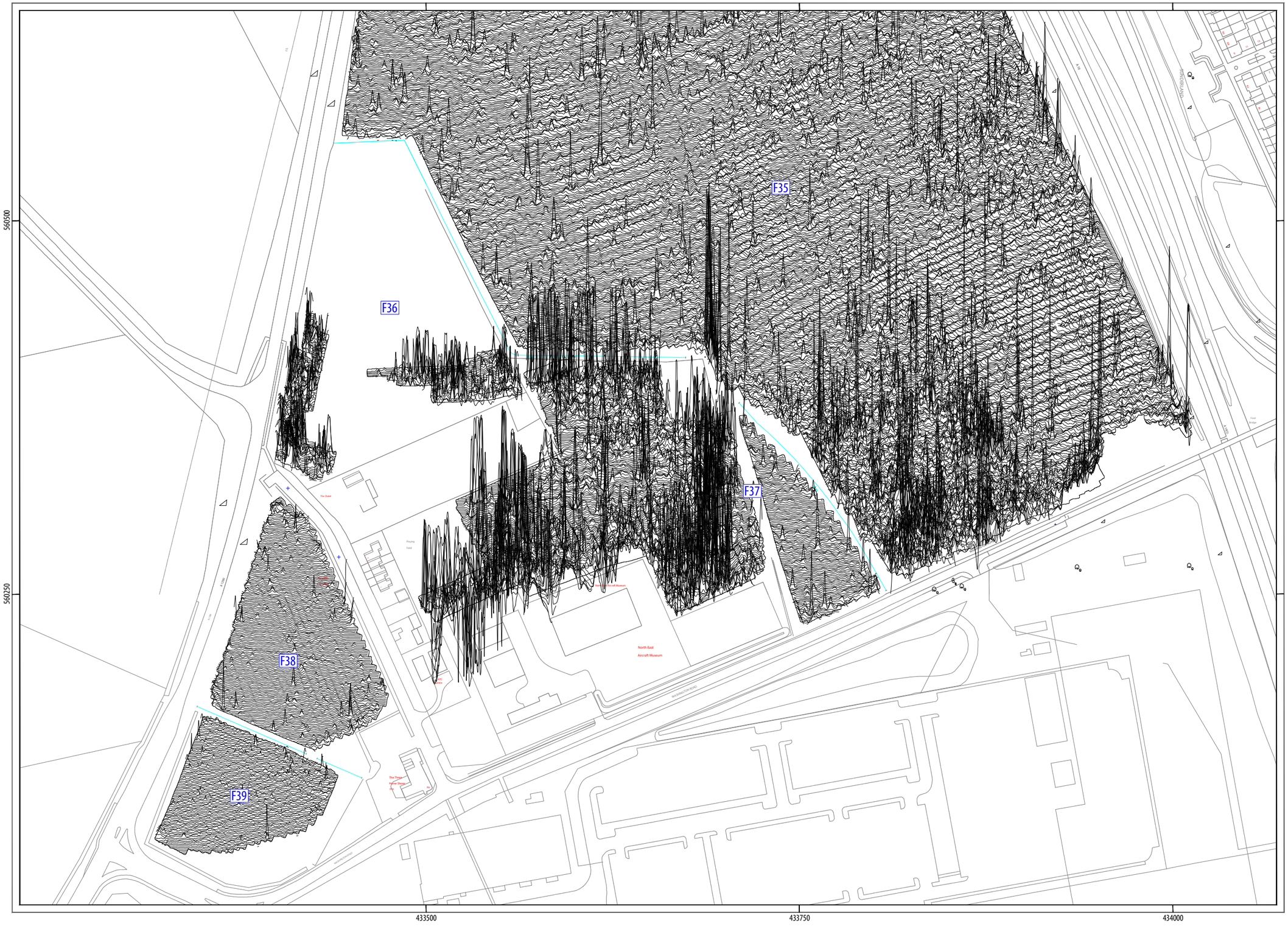
PROJECT IAMP18
International Advanced Manufacturing Park
IAMP TWO
Sunderland

CLIENT Sunderland City Council

HEADLAND ARCHAEOLOGY

NORTH Unit 16, Hillside, Beeston Road
Leeds LS11 8ND
0113 387 6430
www.headlandarchaeology.com

ILLUS 30 Processed greyscale magnetometer data; Sector 7 (1:2,500)



PROJECT IAMP18
International Advanced Manufacturing Park
IAMP TWO
Sunderland

CLIENT Sunderland City Council

HEADLAND ARCHAEOLOGY

NORTH Unit 16, Hillside, Beeston Road
Leeds LS11 8ND
0113 387 6430
www.headlandarchaeology.com

ILLUS 31 XY trace plot of minimally processed magnetometer data; Sector 7 (1:2,500)

TYPE OF ANOMALY	INTERPRETATION
dipolar isolated	ferrous material
magnetic disturbance	ferrous material
linear trend	ridge and furrow
linear trend	agricultural
linear	former field boundary
linear	drain
magnetic enhancement	geology
magnetic enhancement	modern
magnetic enhancement	possible archaeology

D	ditch
FB	former boundary
GP	goalpost
SP	service pipe
ST	structure

0 50m
1:2,500 @ A3

PROJECT IAMP18
International Advanced Manufacturing Park
IAMP TWO
Sunderland

CLIENT Sunderland City Council

HEADLAND ARCHAEOLOGY

NORTH Unit 16, Hillside, Beeston Road
Leeds LS11 8ND
0113 387 6430
www.headlandarchaeology.com

ILLUS 32 Interpretation of magnetometer data; Sector 7 (1:2,500)

7 APPENDICES

APPENDIX 1 MAGNETOMETER SURVEY

Magnetic susceptibility and soil magnetism

Iron makes up about 6% of the earth's crust and is mostly present in soils and rocks as minerals such as maghaemite and haematite. These minerals have a weak, measurable magnetic property termed magnetic susceptibility. Human activities can redistribute these minerals and change (enhance) others into more magnetic forms so that by measuring the magnetic susceptibility of the topsoil, areas, where human occupation or settlement has occurred, can be identified by virtue of the attendant increase (enhancement) in magnetic susceptibility. If the enhanced material subsequently comes to fill features, such as ditches or pits, localised isolated and linear magnetic anomalies can result whose presence can be detected by a magnetometer (fluxgate gradiometer).

In general, it is the contrast between the magnetic susceptibility of deposits filling cut features, such as ditches or pits, and the magnetic susceptibility of topsoils, subsoils and rocks into which these features have been cut, which causes the most recognisable responses. This is primarily because there is a tendency for magnetic ferrous compounds to become concentrated in the topsoil, thereby making it more magnetic than the subsoil or the bedrock. Linear features cut into the subsoil or geology, such as ditches, that have been silted up or have been backfilled with topsoil will therefore usually produce a positive magnetic response relative to the background soil levels. Discrete feature, such as pits, can also be detected.

The magnetic susceptibility of a soil can also be enhanced by the application of heat. This effect can lead to the detection of features such as hearths, kilns or areas of burning.

Types of magnetic anomaly

In the majority of instances, anomalies are termed 'positive'. This means that they have a positive magnetic value relative to the magnetic background on any given site. However, some features can manifest themselves as 'negative' anomalies that, conversely, means that the response is negative relative to the mean magnetic background.

Where it is not possible to give a probable cause of an observed anomaly a '?' is appended.

It should be noted that anomalies interpreted as modern in origin might be caused by features that are present in the topsoil or upper layers of the subsoil. Removal of soil to an archaeological or natural layer can, therefore, remove the feature causing the anomaly.

The types of response mentioned above can be divided into five main categories that are used in the graphical interpretation of the magnetic data:

Isolated dipolar anomalies (iron spikes) These responses are typically caused by ferrous material either on the surface or in the topsoil. They cause a rapid variation in the magnetic response giving a characteristic 'spiky' trace. Although ferrous archaeological artefacts could produce this type of response, unless there is supporting evidence for an archaeological interpretation, little emphasis is normally given to such anomalies, as modern ferrous objects are common on rural sites, often being present as a consequence of manuring.

Areas of magnetic disturbance These responses can have several causes often being associated with burnt material, such as slag waste or brick rubble or other strongly magnetised/fired material. Ferrous structures such as pylons, mesh or barbed wire fencing and buried pipes can also cause the same disturbed response. A modern origin is usually assumed unless there is other supporting information.

Linear trend This is usually a weak or broad linear anomaly of unknown cause or date. These anomalies are often caused by agricultural activity, either ploughing or land drains being a common cause.

Areas of magnetic enhancement/positive isolated anomalies Areas of enhanced response are characterised by a general increase in the magnetic background over a localised area whilst discrete anomalies are manifest by an increased response (sometimes only visible on an XY trace plot) on two or three successive traverses. In neither instance is there the intense dipolar response characteristic exhibited by an area of magnetic disturbance or of an 'iron spike' anomaly (see above). These anomalies can be caused by infilled discrete archaeological features such as pits or post-holes or by kilns. They can also be caused by pedological variations or by natural infilled features on certain geologies. Ferrous material in the subsoil can also give a similar response. It can often, therefore, be very difficult to establish an anthropogenic origin without intrusive investigation or other supporting information.

Linear and curvilinear anomalies Such anomalies have a variety of origins. They may be caused by agricultural practice (recent ploughing trends, earlier ridge and furrow regimes or land drains), natural geomorphological features such as palaeochannels or by infilled archaeological ditches.

APPENDIX 2 SURVEY LOCATION INFORMATION

An initial survey base station was established using a Trimble VRS differential Global Positioning System (dGPS). The magnetometer data was georeferenced using a Trimble RTK differential Global Positioning System (Trimble R8s model).

Temporary sight markers were laid out using a Trimble VRS differential Global Positioning System (Trimble R8s model) to guide the operator and ensure full coverage. The accuracy of this dGPS equipment is better than 0.01m.

The survey data were then super-imposed onto a base map provided by the client to produce the displayed block locations. However, it should be noted that Ordnance Survey positional accuracy for digital map data has an error of 0.5m for urban and floodplain areas, 1.0m for rural areas and 2.5m for mountain and moorland areas. This potential error must be considered if coordinates are measured off hard copies of the mapping rather than using the digital coordinates.

Headland Archaeology cannot accept responsibility for errors of fact or opinion resulting from data supplied by a third party.

APPENDIX 3 GEOPHYSICAL SURVEY ARCHIVE

The geophysical archive comprises an archive disk containing the raw data in XYZ format, a raster image of each greyscale plot with associate world file, and a PDF of the report.

The project will be archived in-house in accordance with recent good practice guidelines (http://guides.archaeologydataservice.ac.uk/g2gp/Geophysics_3). The data will be stored in an indexed archive and migrated to new formats when necessary.

APPENDIX 4 DATA PROCESSING

The gradiometer data has been presented in this report in processed greyscale and minimally processed XY trace plot format.

Data collected using RTK GPS-based methods cannot be produced without minimal processing of the data. The minimally processed data has been interpolated to project the data onto a regular grid and de-striped to correct for slight variations in instrument calibration drift and any other artificial data.

A high pass filter has been applied to the greyscale plots to remove low frequency anomalies (relating to survey tracks and modern agricultural features) in order to maximise the clarity and interpretability of the archaeological anomalies.

The data has also been clipped to remove extreme values and to improve data contrast.

APPENDIX 5 OASIS DATA COLLECTION FORM: ENGLAND

OASIS ID: headland5-331337

PROJECT DETAILS	
Project name	International Advanced Manufacturing Park IAMP TWO
Short description of the project	Headland Archaeology (UK) Ltd undertook a geophysical (magnetometer) survey of a 135 hectare site in Sunderland to provide further information on the archaeological potential of the site in advance of the proposed development of an International Advanced Manufacturing Park. This report presents the results of the IAMP TWO survey undertaken, an area of 115 hectares. No anomalies of definite archaeological potential have been identified by the survey with only a single linear anomaly being tentatively identified as being of possible archaeological potential; a possible ditch in the south-west of the site. Broad areas of magnetic disturbance in the south of the site correspond to former structures and infrastructure from the North Camp area of the former RAF Usworth station and airfield (Tyne and Wear Historic Environment Record 1824). Two potential remains of mining activity have been recorded to the north-east of the survey area. The survey has mainly identified anomalies consistent with the former agricultural landscape, with ridge and furrow anomalies present across most of the datasets. Therefore, on the basis of the geophysical survey undertaken to date, the archaeological potential of the site is assessed as low, corroborating the results of the Cultural Heritage Chapter of the Environmental Statement produced for IAMP ONE.
Project dates	Start: 21-05-2018 End: 05-09-2018
Previous/future work	Yes / Yes
Any associated project reference codes	IAMP18 - Contracting Unit No.
Type of project	Field evaluation
Site status	None
Current Land use	Cultivated Land 4 - Character Undetermined
Monument type	N/A None
Monument type	N/A None
Significant Finds	N/A None
Significant Finds	N/A None
Methods & techniques	"Geophysical Survey"
Development type	Extensive green field commercial development (e.g. shopping centre, business park, science park, etc.)
Prompt	National Planning Policy Framework - NPPF
Position in the planning process	Between deposition of an application and determination
Solid geology (other)	Pennine Middle and Upper Coal Measures – sandstone, siltstone and mudstone
Drift geology (other)	Pelaw Clay Member with glaciolacustrine and alluvial deposits (clay, silt, sand and gravel)
Techniques	Magnetometry
PROJECT LOCATION	
Country	England
Site location	TYNE AND WEAR SUNDERLAND SUNDERLAND International Advanced Manufacturing Park IAMP TWO: Geophysical Survey
Study area	115 Hectares
Site coordinates	NZ 3323 6012 54.934566141942 -1.481316938086 54 56 04 N 001 28 52 W Point
PROJECT CREATORS	
Name of Organisation	Headland Archaeology
Project brief originator	Tyne and Wear Archaeology Service
Project design originator	Tyne and Wear Archaeology Service
Project director/manager	Harrison, S
Project supervisor	Evans, M
Type of sponsor/funding body	District Council

PROJECT ARCHIVES	
Physical Archive Exists?	No
Digital Archive recipient	In house
Digital Contents	"other"
Digital Media available	"Geophysics"
Paper Archive Exists?	No

PROJECT BIBLIOGRAPHY 1	
Publication type	Grey literature (unpublished document/manuscript)
Title	International Advanced Manufacturing Park IAMP TWO: Geophysical Survey
Author(s)/Editor(s)	Harrison, D. and Harrison, S.
Other bibliographic details	IAMP18
Date	2018
Issuer or publisher	Headland Archaeology
Place of issue or publication	Edinburgh
Description	A4 Glue bound report and PDF/A
Entered by	Sam Harrison (sam.harrison@headlandarchaeology.com)
Entered on	19 October 2018

Headland Archaeology South & East
Building 68C | Wrest Park | Silsoe | Bedfordshire MK45 4HS
t 01525 861 578
e southandeast@headlandarchaeology.com

Headland Archaeology Midlands & West
Unit 1 | Clearview Court | Twyford Rd | Hereford HR2 6JR
t 01432 364 901
e midlandsandwest@headlandarchaeology.com

Headland Archaeology North
Unit 16 | Hillside | Beeston Rd | Leeds LS11 8ND
t 0113 387 6430
e north@headlandarchaeology.com

Headland Archaeology Scotland
13 Jane Street | Edinburgh EH6 5HE
t 0131 467 7705
e scotland@headlandarchaeology.com

www.headlandarchaeology.com