Appendix 17.1 Geographical Survey Report

Geophysical Survey Report

Lands in Cork Little & Shanganagh Townlands, South County Dublin

Detection License
18R0223

Author
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Client
IAC Ltd.

On behalf of
Castlethorn Ltd.

Date
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Project
TAG1800IE41

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TARGET REPORT 1800IE41
LANDS IN CORK LITTLE & SHANGANAGH TOWNLANDS, SOUTH COUNTY DUBLIN

PROJECT BACKGROUND

Geophysical survey was undertaken in Cork Little and Shanganagh townlands, South County Dublin, in connection with proposed development of lands located on the northern outskirts of Bray town, to the E of the M11 Motorway and R119. The site of the proposed development extends over c.16.7 hectares and comprises of 2 land parcels located W and E of the Dart Railway. The western land parcel extends over parts of 6 adjacent arable fields bound to the N by Shanganagh Cemetry and to the S and E by Woodbrook Golf Club. The eastern land parcel lies directly E of the Dart Railway and extends over 2 adjacent pasture fields situated in Shanganagh Park to the SE.

This geophysical survey forms part of a pre-planning archaeological assessment, and it was commissioned by IAC Ltd. on behalf of Castlethorn Ltd. The survey aims were to identify the location, form and extent of buried archaeological remains within the site boundary, and to advise further works prior to the proposed development.

Coordinates 725830 720359 and 726156 721022 (ITM)

Townlands Cork Little and Shanganagh

County South County Dublin

Landuse Mixed arable and pasture land

Landscape, soils geology Gently undulating lowland occupied by fine loamy drift of the Crosstown 1030a association, with bedrock comprising of Maulin Formation dark blue-grey slate, phyllite and schist (Irish National Soils Map, 1:250,000k, V1b, 2014; Geological Survey Ireland Spatial Resources, Public Data Viewer Series).

Archaeology No recorded monuments and places (RMPs) are located within the boundary of the proposed development, nor within a 0.4km radius. The following extract from the National Monuments Service SMR Database provides details of RMPs situated within 1km of the site:

SMR No.	Class	Townland	ITM Easting	ITM Northing
DU026-054001-	Church	Shanganagh	725266	721184
DU026-054002-	Graveyard	Shanganagh	725287	721181
DU026-054003-	Cross	Shanganagh	725278	721188
DU026-054004-	Cross	Shankill	725220	721208
DU026-054005-	Building	Shanganagh	725266	721196
DU026-055001-	Martello tower	Shanganagh	726277	721822
DU026-055002-	Defensive redoubt	Shanganagh	726276	721825
DU026-066001-	Church	Old Connaught	724831	719254
DU026-066002-	Graveyard	Old Connaught	724831	719267
DU026-067----	Burial	Old Connaught	725244	720028
DU026-068001-	Church	Cork Great	726103	719600
DU026-068002-	Graveyard	Cork Great	726103	719598
DU026-069----	Ritual site - holy well	Cork Great	726102	719510
DU026-070----	Martello tower	Cork Great	726637	719865
DU026-116----	Fulacht fia	Shanganagh	725388	721220
DU026-120----	Castle - unclassified	Shanganagh	725603	721202
DU026-124----	Linear earthwork	Cork Great	726560	719491
WI004-005----	Linear earthwork	Ravenswell	726457	719446

Fieldwork	19th & 29th November, 3rd December 2018, 9th february 2019
Report issue	7th March 2019
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Detection license	18R0223
Client	IAC Ltd. on behalf of Castlethorn Ltd.
Technique	Magnetometry

1 SURVEY METHODOLOGY

1.1 Survey methodology, terrain coverage and data collection

1.1.1 Magnetometer survey was undertaken at the site of the development investigating all available lands within the proposed development, completing a total 18 hectares of survey to the W (M1-M6) and E (M7-M8) of the Dart Railway. The survey employed an advanced multichannel magnetometer system combined with precision GPS. Magnetometer and GPS data were recorded simultaneously at rates of 75Hz and 1Hz respectively, conducting parallel instrument traverses 3.2m in width across the site.

1.2 Survey instrumentation

1.2.1 Details of the instrumentation employed for this geophysical survey are provided below:

Technique	Sensor spacing	Sample rate	Instrumentation	Sensitivity/precision
Magnetometry	0.40m	75Hz	Vallon VX1 advanced multi sensor fluxgate gradiometer system and VFC2 field computer	0.03nT
GPS	3.60m	1Hz	Trimble R10 GPS (VRS system)	<0.1m (vertical/horizontal)

1.3 Data processing

1.3.1 Survey data were processed using in-house, open-source and commercial software. Post fieldwork GPS and magnetometer data were processed as follows:

Process	Description
1	Drift correction
2	Gridding -inverse distance weighted interpolation
3	Greyscale generation at optimum range & export to tiff-format (.tiff & .wld)

1.3.2 To assure integrity of the processed data, and maintain close correlation with the original raw on-site measurements, no additional smoothing, low or high pass filters were applied proceeding steps 1-3.

1.4 Data display

1.4.1 Figure 1 presents a site location diagram at a scale of 1:7500, detailing the extent of proposed development W and E of the Dart Railway, and RMPs within a c.1km radius.

1.4.2 Figure 2 provides a summary greyscale diagram of the results from survey completed in M1-M6 and M7-M8 (scale 1:2500).

1.4.3 Figures 3-5 present greyscale images of the results from survey in M1-M6 and M7-M8 at a scale of 1:1500.

1.4.4 Figure 6 provides a summary interpretation diagram of the results from survey completed in M1-M6 and M7-M8 (scale 1:2500).

1.4.5 Figures 7-9 provide an interpretation of the results from survey in M1-M6 and M7-M8 at a scale of 1:1500. Anomalies of significance/potential interest are highlighted on Figures 7-9 and referred to in the discussion of results included in this report.

2 GENERAL CONSIDERATIONS & COMPLICATING FACTORS

2.1 Access & ground conditions

2.1.1 Survey in M1-M6 and M7-M8 proceeded over gently undulating arable and pasture land following clearance of dense vegetation to the W in M1-M6. Small sections of ground at survey centre in M5, to the W in M6, and NW in M8 were excluded from survey due to poor terrain.

2.2 Modern interference

2.2.1 Numerous small-scale ferrous responses are evident throughout the results from M1-M6 and M7-M8. Ferrous responses are a common occurrence in magnetic survey data, and in most cases represent modern metal debris contained within the topsoil.

2.2.2 Large-scale ferrous responses are also evident in the results and derive mainly from survey in proximity to existing field boundaries, geo-technical borehole covers, metal fencing and modern debris at the perimeter of M1-M8.

2.2.3 A buried modern service has been recorded in M7 to the S-SW.

2.2.4 A narrow band of magnetic disturbance extending NW-SE through M1 and M6 derives from interference caused by high voltage overhead power cables. Large-scale magnetic disturbance at the western perimeter of M7-M8 derives from interference caused by the proximity of the Dart Railway. Subtle magnetic responses associated with buried archaeological activity, if present in these zones of magnetic disturbance, will most likely remain beyond detection due to the range of interference encountered.

2.3 Former landuse

2.3.1 Remnants of former boundaries have been recorded as a result of this survey and are evident in M1-M2 traversing the centre of survey N-S and NE-SW, and to the E in M3.

2.4 Natural soil geological variation

2.4.1 Poorly defined positive/negative trends apparent in M1 and M3, M4 and M7 in most cases derive from weakly magnetic natural soil/geological variations, which are within a range of approximately +/-1nT.

3 RESULTS FROM MAGNETIC GRADIOMETER SURVEY

3.1 M1 (1:1500 scale diagrams, figures 4 & 8)

3.1.1 No responses of definite archaeological character are indicated by the results from survey in M1. Extending N-NW of survey centre zones of increased response (1-2), discrete positives (3-4), linear responses (5-6) and weak trends (7-8) have been recorded. These display no clear archaeological patterns. The potential that responses 1-4 may, however, represent levelled building remains, and that anomaly 5 reflects a possible drain, should not be ignored. A natural soil/geological, former landuse, or modern ferrous origin should also be considered for anomalies 1-8.

3.1.2 Further small-scale anomalies and weakly magnetic linears are indicated in M1 to the SW (9) and SE (10). These are expected to be of limited archaeological potential, and likely represent effects from former landuse, modern ferrous debris and natural soil/geological variation.

3.1.3 No further responses of note are indicated by the results from survey in M1.

3.2 M2 (1:1500 scale diagrams, figures 4 & 8)

3.2.1 No responses of archaeological character are indicated by the results from survey in M2. Small scale positives (11) are indicated to the W-SW and a poorly defined linear (12) has been recorded to the NE. These anomalies are deemed to be of limited significance.

3.3 M3 (1:1500 scale diagrams, figures 3-7)

3.3.1 The remains of a circular enclosure (13) c.32m in diameter, are indicated within the site boundary in M3 shortly E of field centre. Small-scale positives and weak linear responses (14-17) are also apparent to the N, NE and SE of enclosure 13, and the potential that a number of these represent associated remains should not be ignored. Interpretation of anomalies 14-16 is, however, tentative given their proximity to responses from two former boundaries aligned approximately NE-SW.

3.3.2 Remnants of an early field system, potentially associated with enclosure 13 are indicated throughout M3.

3.3.3 Responses 18-20 to the S and SE in M3 may also be significant. However, a natural soil/geological origin for 18-20 should not be discounted.

3.3.4 No further responses of note are indicated by the results from survey within the site boundary in M3.

3.4 M4 (1:1500 scale diagrams, figures 4 & 8)

3.4.1 The probable remains of 2 weakly magnetic circular enclosures (21-22), c.5m-8m in diameter are evident to the SW in M4. These border a series of magnetically weak linear trends (23), which intersect with a zone of increased response (24) W of survey centre. Combined anomalies 23-24 are expected to be of probable significance, although they are generally weakly magnetic.

3.4.2 Numerous small-scale and weakly magnetic positives are indicated elsewhere in M4, notably anomalies 25-27 to the SW, W and SE of survey centre, and weak linears 28-29 to the E-NE. Interpretation of these responses is cautious given their weakly magnetic signature and small-scale, and a natural soil/geological, modern ferrous or recent landuse origin for some of these should not be excluded.

3.4.3 No further responses of note are indicated by the results from survey within M4.

3.5 M5 (1:1500 scale diagrams, figures 4 & 8)

3.5.1 No responses of archaeological significance have been recorded from survey in M5.

3.6 M6 (1:1500 scale diagrams, figures 4 & 8)

3.6.1 No responses of archaeological character have been recorded from survey in M6. A small-scale positive (30), to the NE of survey centre, is expected to reflect modern ferrous debris or natural soil/geological variation.

3.7 M7 (1:1500 scale diagrams, figures 5 & 9)

3.7.1 No recognisable archaeological patterns are indicated by the results from survey in M7. Small-scale positives are apparent in the results, notably response 31 to the E. These anomalies are expected to represent modern ferrous debris or natural soil/geological variation.

3.8 M8 (1:1500 scale diagrams, figures 5 & 9)

3.8.1 Weakly positive curvilinear anomalies and trends (32) to the W in M8 suggest the location of a possible enclosure defined by 2 circular ditches. Interpretation of these anomalies has been significantly complicated by magnetic disturbance from the Dart Railway immediately to the W. Where subtle magnetic responses associated with buried archaeological features may be present in this location they will most likely remain beyond detection due to the range of interference encountered.

3.8.2 Further weak trends and poorly defined positives (33-34) S-SE may represent linear remains and potential pit/posthole locations associated with responses 32. Interpretation of responses 33-34 remains cautious given the extent of magnetic disturbance present.

3.8.3 No further responses of note are indicated by the results from survey in M8.

4 CONCLUSION

4.1 The results from survey within the proposed development W and E of the Dart Railway highlight the location of 1 definite enclosure site and 3 probable enclosures. These include remains of a circular enclosure, measuring c.32m in diameter, which traverses the proposed development boundary in M3; 2 smaller probable circular enclosures c.5-8m in diameter to the SW in M4; and the suspected eastern portion of a larger enclosure site to the W in M8. Interpretation of the probable enclosure recorded in M8 has been significantly complicated by magnetic disturbance caused by the proximity of the Dart Railway, which is located immediately to the W.

4.2 The geophysical survey has also recorded further anomalies within the site boundary, which may be of potential interest. These are mainly located in the western portion of the proposed development, and include zones of increased response and discrete anomalies in M1, which extend N-NW from survey centre; a probable early field system in M3; and a multitude of weakly magnetic trends, zone of increased response and small-scale positives in M4. The potential significance of a number of these responses should not be ignored. However, the weakly magnetic nature of many of these anomalies and natural soil/geological variations across the site has caused some difficulty with interpretation. A natural soil/geological, recent landuse or modern ferrous origin for a number of the anomalies recorded should not be entirely dismissed.

4.3 Remnants of former boundaries are indicated in M1-M3, with magnetic disturbance from high voltage overhead power cables (M1 and M3) and the Dart Railway (M7-M8) also present. Low-level variations in response associated with natural soil/geological variation are also evident in M1, M3-M4 and M7.

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LIST OF FIGURES

APPENDIX 1: TECHNICAL INFORMATION

INSTRUMENTATION

GPR/Ground Penetrating Radar: GPR systems comprise a configuration/data acquisition unit, a transmitting/receiving antenna (250-500mhz), and a cart with an odometer or integrated GPS. The technique is used for identifying remains of buried foundations, structures and cavities. GPR systems transmit a continuous electromagnetic wave of energy into the ground and record reflections of that energy as it interacts with the stratigraphy and structures below the surface. Data is acquired along parallel transects, 0.5m or 1m apart, and recorded as a function of the elapsed time for the energy wave to travel from transmitter to reflector and back to the surface. The strength of reflections recorded from GPR survey is proportional to the conductive and dielectric properties of the buried objects with which the transmitted energy is incident.

Gradiometry/Magnetometry (6 sensor gradiometer system combined with GPS): Gradiometry is the most widely applied technique in archaeological prospection, and is regularly used on sites 1-100ha in size to locate and characterize buried remains of enclosure ditches, pits, hearths, furnaces and kilns. These remains often produce magnetic contrasts above localized soil/geological variation due to enhancement from burning activity and organic enrichment of the soil during archaeological settlement. Mapping of these contrasts is undertaken using an array of either caesium or fluxgate magnetometer sensors for measurement of the earth's total field or variations in its vertical component. Target uses a 6 sensor gradiometer system combined with cm precision GPS to measure magnetic anomalies from buried archaeological remains in detail, collecting data along parallel lines 0.5m or 0.75m apart, at 10-12cm intervals along each line.

Electrical Resistivity: Electrical resistivity is generally used to map locations of buried structures, including foundation remains, walls, burial cairns, and existing earthworks. Using an array of electrodes mounted on a portable frame a small electrical current is passed through the ground at regular intervals via *current* emitting probes. Variations in resistance to the flow of this electrical current as it passes through the ground are measured by *potential* probes. Single or parallel twin arrays use 1 or 2 pairs of current and potential probes fixed to a mobile frame, with 1 remote *current* and 1 *potential* probe maintained stationary 20m from the survey limit. Resistivity surveys are normally conducted at 0.5m x 1m or 1m x 1m intervals.

EMI/Electromagnetic Induction (EMI sled system combined with GPS): EMI is suitable for detection of buried remains including foundations, enclosures, ditches, pits, and kilns. The technique measures variations in both the electrical conductivity and magnetic susceptibility of the soil. EMI systems comprises of 1 transmitting and 2-4 receiving coils, providing 2-8 data sets from below surface. The transmitting coil generates a time varying primary magnetic field which propagates above and below ground, generating alternating (eddy) currents within the soil and the objects it contains. These create a secondary magnetic field proportional to the rate of change of the magnetic field, which is measured by receiving coils 0.5m and 1m from the transmitting coil. Target's EMI sled system is used to survey in vertical or horizontal modes along 0.5m, 0.75m or 1m spaced lines at 10-12cm intervals along each line.

DISPLAY

Greyscale: The greyscale format assigns a cell to each datum according to its location on the grid. The display of each data point is conducted at very fine increments, allowing the full range of values to be displayed within a given data set. This display method also enables the identification of discrete responses barely above localized soil/geological variations.

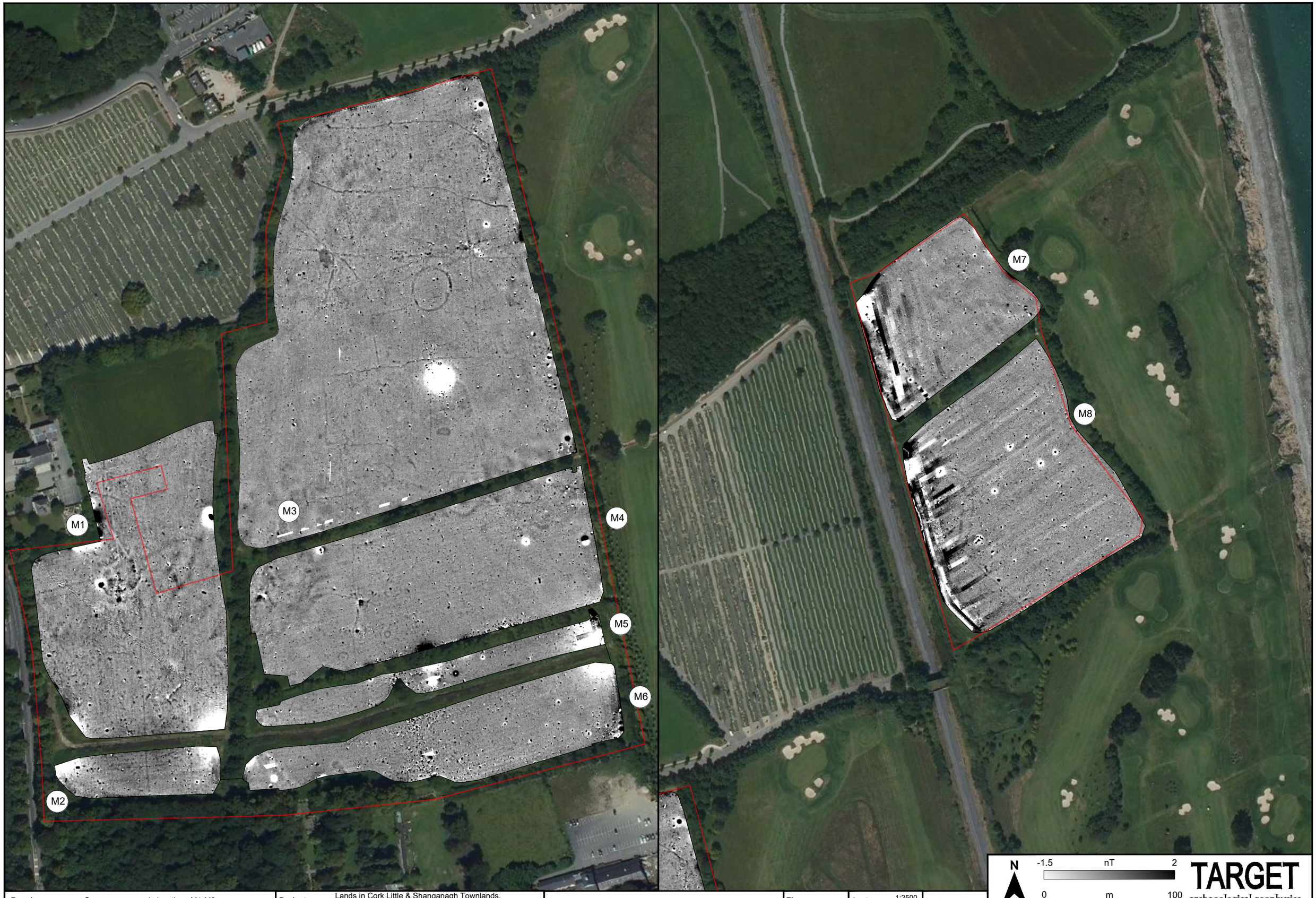
Colour Plot: Colour plots comprising RGB values linearly interpolated between a user-specified range of values can provide further insight into the varying anomalies within a given data set. Colour plots are particularly useful for EMI data where presentation of results within a confined range of values is not always feasible with other formats.

XY Trace: XY Trace displays provide a near-perspective representation of responses recorded along each instrument traverse. The format is used mainly for locating responses from modern ferrous, but can assist in identifying magnetically strong anomalies relating to hearth, kiln and furnace remains. Ferrous anomalies can also be identified via a search of the attribute table in a GIS extracting readings beyond a specified range (e.g. where z<= -15 and where z>=15), and then combining this layer with other display formats for interpretation.

Time-slice: Radargrams collected from grid based survey or parallel transects can be compiled as a 3D volume, then re-sampled to produce a series of 2D plans at incremental depth/time offsets. A series of Time-slice displays at 25-50cm offsets permits analysis of the pattern and depth of reflections within a given GPR survey area.

Drawing	Site location	**Project**	Lands in Cork Little & Shanganagh Townlands, South County Dublin	**Client**	IAC Ltd. on behalf of Castlethorn Ltd.	**Fig.**	1	**Scale**	1:7500 @ A3	**TAG.**	1800IE41

TARGET archaeological geophysics



Drawing	Summary greyscale locations M1-M8	**Project**	Lands in Cork Little & Shanganagh Townlands, South County Dublin	**Client**	IAC Ltd. on behalf of Castlethorn Ltd.	**Fig.**	2	**Scale**	1:2500 @ A3	**TAG.**	1800IE41

M1

M3

M4

N

-1.5 nT 2

0 m 60

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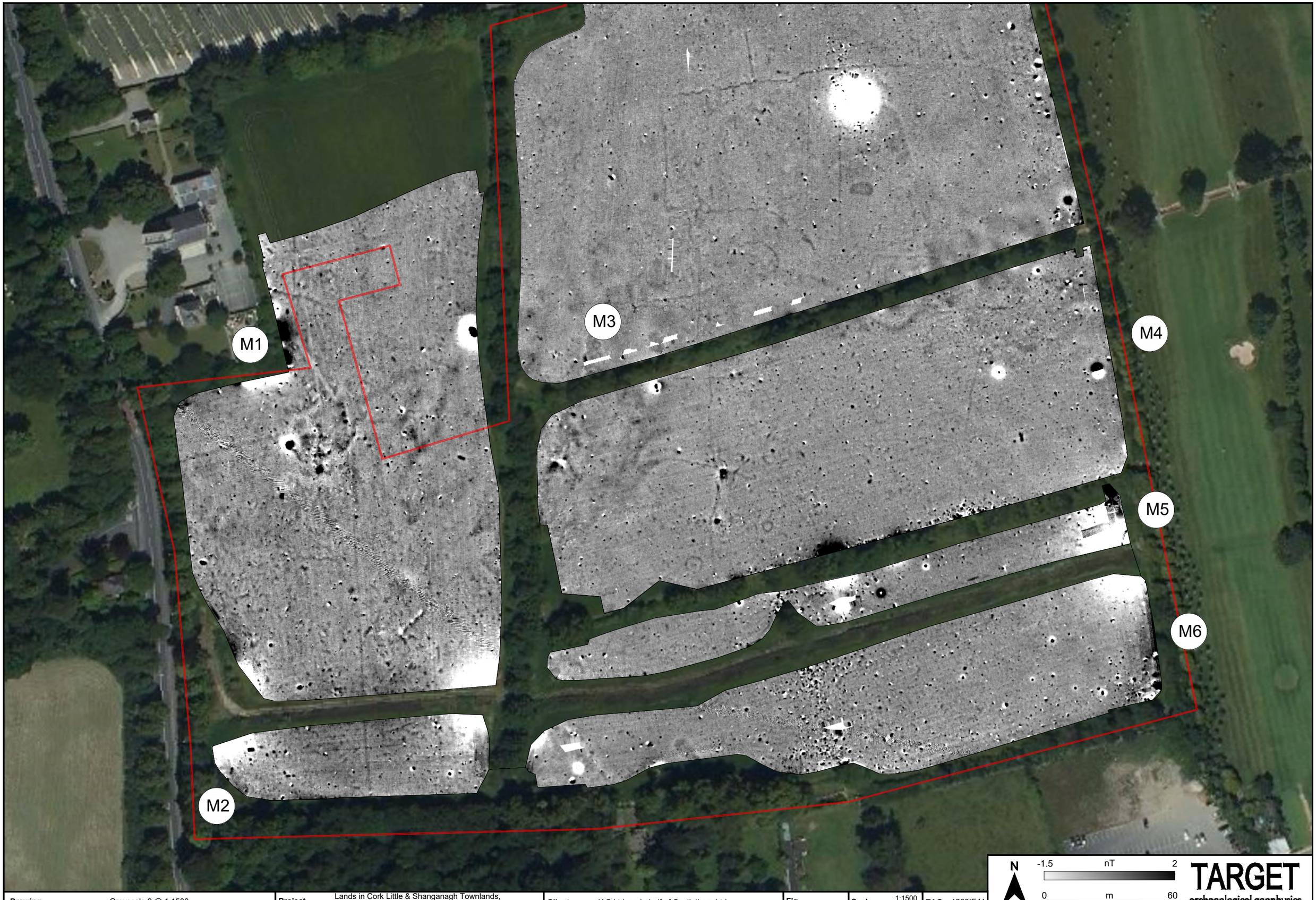
Drawing	Greyscale 1 @ 1:1500	**Project**	Lands in Cork Little & Shanganagh Townlands, South County Dublin	**Client**	IAC Ltd. on behalf of Castlethorn Ltd.	**Fig.**	3	**Scale**	1:1500 @ A3	**TAG.**	1800IE41



Drawing	Greyscale 2 @ 1:1500	**Project**	Lands in Cork Little & Shanganagh Townlands, South County Dublin	**Client**	IAC Ltd. on behalf of Castlethorn Ltd.	**Fig.**	4	**Scale**	1:1500 @ A3	**TAG.**	1800IE41

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Drawing	Greyscale 3 @ 1:1500	**Project**	Lands in Cork Little & Shanganagh Townlands, South County Dublin	**Client**	IAC Ltd. on behalf of Castlethorn Ltd.	**Fig.**	5	**Scale**	1:1500 @ A3	**TAG.**	1800IE41

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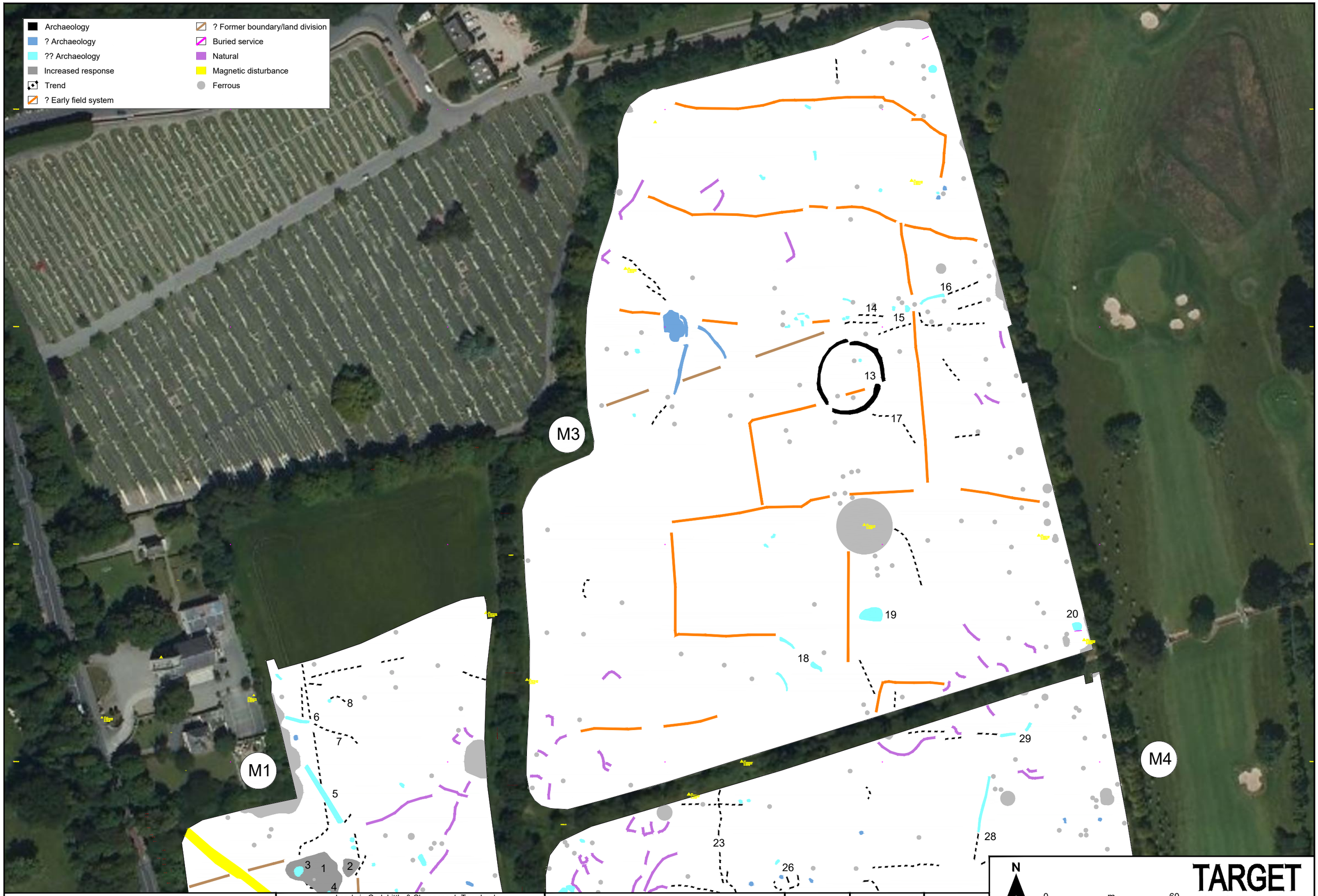
Drawing	Interpretations M1-M8	**Project**	Lands in Cork Little & Shanganagh Townlands, South County Dublin	**Client**	IAC Ltd. on behalf of Castlethorn Ltd.	**Fig.**	6	**Scale**	1:2500 @ A3	**TAG.**	1800IE41



Drawing	Interpretation 1 @ 1:1500	**Project**	Lands in Cork Little & Shanganagh Townlands, South County Dublin	**Client**	IAC Ltd. on behalf of Castlethorn Ltd.	**Fig.** 7	**Scale** 1:1500 @ A3	**TAG.** 1800IE41

N

0 m 60

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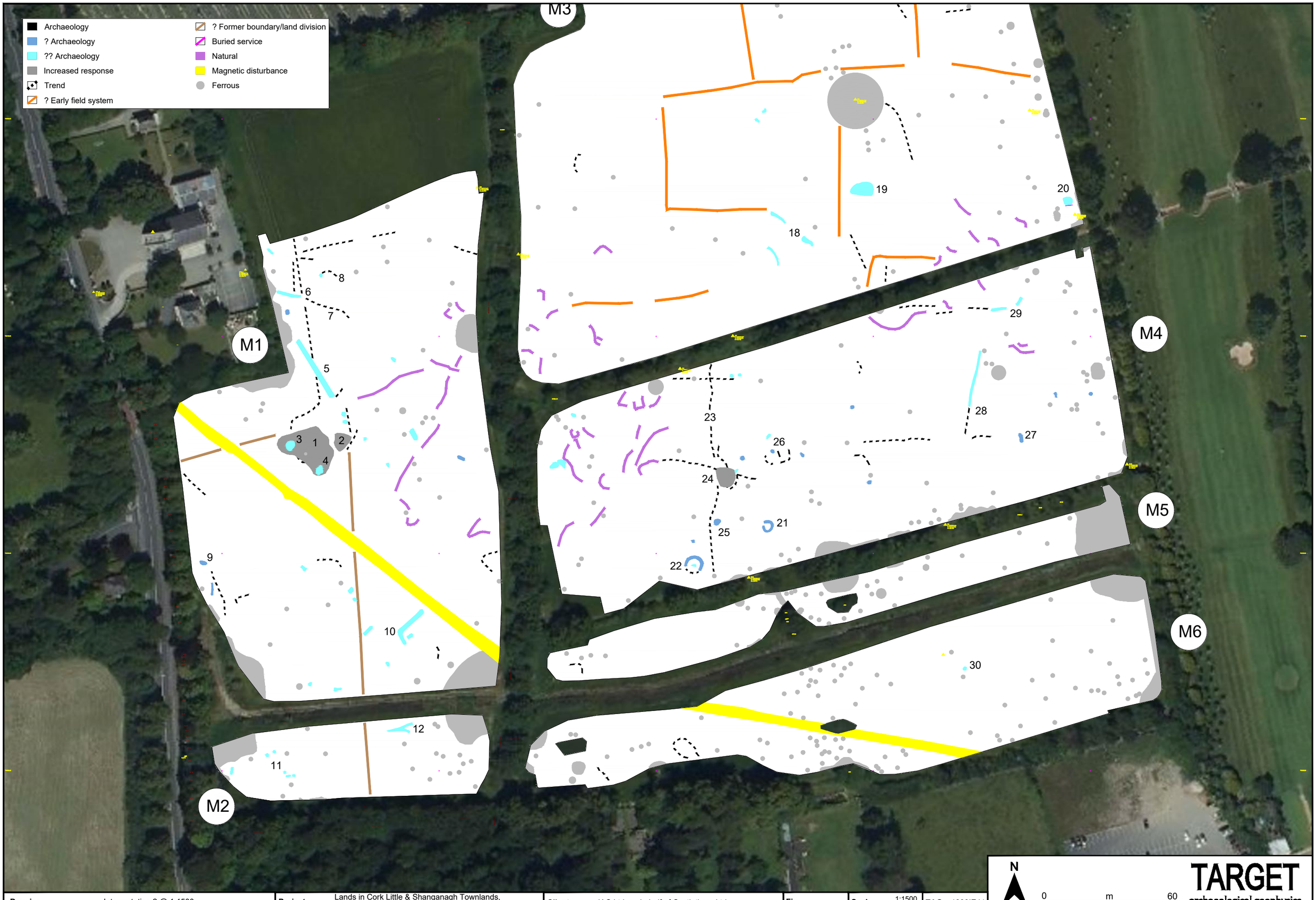

Drawing	Interpretation 2 @ 1:1500	**Project**	Lands in Cork Little & Shanganagh Townlands, South County Dublin	**Client**	IAC Ltd. on behalf of Castlethorn Ltd.	**Fig.**	8	**Scale**	1:1500 @ A3	**TAG.**	1800IE41

Drawing	Interpretation 3 @ 1:1500	**Project**	Lands in Cork Little & Shanganagh Townlands, South County Dublin	**Client**	IAC Ltd. on behalf of Castlethorn Ltd.	**Fig.**	9	**Scale**	1:1500 @ A3	**TAG.**	1800IE41

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