White Hill Wind Farm Electricity Substation & Electricity Line

Environmental Impact Assessment Report

Annex 10.1: Geophysical Survey Report

White Hill Wind Limited

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Geophysical Survey Report

Proposed electricity substation in Shankill townland, Co. Kilkenny

Client
Galetech Energy Services Ltd

On behalf of
White Hill Wind Ltd.

Detection License
24R0294

TAG Project
2024IE15

Date
July 2024

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TARGET GEOPHYSICAL SURVEY REPORT 2024IE15
PROPOSED ELECTRICITY SUBSTATION IN SHANKILL TOWNLAND, CO. KILKENNY

PROJECT BACKGROUND

Target Archaeological Geophysics Ltd. was appointed by Galetech Energy Services Ltd. on behalf of White Hill Wind Ltd. to undertake a geophysical survey at the site of a proposed electricity substation situated in Shankill townland, County Kilkenny, c.4.8km W-SW of Bagenalstown (County Carlow). Encompassing an area c.9.5 ha in size, the site of the proposed electricity substation lies 1.2km NE of Junction 7 of the M9 Motorway, and extends over 6 adjacent fields, bound to the NE by a minor road and to the E by the M9. A total 7.63ha of high-resolution recorded magnetometry was completed in 6 areas within the boundary of the proposed development, examining all lands suitable to geophysical investigation at the time of fieldwork.

This geophysical survey forms part of a pre-planning archaeological assessment being undertaken prior to proposed development. The survey was carried out under license from the National Monuments Service, Department of Housing, Local Government & Heritage with the following aims (detection license 24R0294):

- to identify geophysical anomalies of possible archaeological origin within the investigation areas
- accurately locate these anomalies and present the findings in graphical format
- describe the anomalies and discuss their likely provenance in a written report

ITM central coordinates: 665574 660551
Townland: Shankill
County: Kilkenny
Landuse: Grazed pasture

Landscape, soils, geology

The proposed development occupies good quality low-lying grassland situated 68-73m above mean sea level. Soils of the locality comprise of Elton (1000x) and Clonroche (1100a) fine loamy drift, typically luvisols and brown earths (Irish National Soils Map, 1:250,000k, V1b, 2014). Superficial geology is characterised by limestone till, with bedrock deriving from Ballyadams formation crinoidal wackestone/packstone limestone (Geological Survey of Ireland Spatial Resources, Public Data Viewer Series).

Archaeology

No recorded monuments and places (RMPs) are located within the boundary of the proposed development. However, the zone of notification associated with linear earthwork KK016-006 borders the proposed development to the S. Further RMPs also are present in the surrounding landscape, though none in the immediate vicinity of the site. The following extract from the National Monuments Service SMR database provides summary details of all RMPs within 1km of the proposed development:

SMR No.	Townland	Class	East	North
KK016-002----	Shankill	Burnt spread	665742	661519
KK016-003----	Shankill	Burnt spread	665636	661252
KK016-004----	Shankill	Ringfort - rath	666300	660999
KK016-005----	Shankill	Redundant record	666685	660721
KK016-006----	Shankill	Linear earthwork	665171	660521
KK016-006001-	Shankill	Linear earthwork	665962	660244
KK016-007----	Shankill	Enclosure	666654	660336
KK016-008001-	Shankill	Church	666228	659953
KK016-008002-	Shankill	Graveyard	666227	659949
KK016-012----	Shankill	Castle - tower house	666137	659936
KK016-018----	Kellymount	Excavation - miscellaneous	665189	659447
KK016-019----	Kellymount	Fulacht fia	665102	659513
KK016-020---	Kellymount	Fulacht fia	665289	659644

KK016-021----	Kellymount	Kiln - corn-drying	665355	659847
KK016-022----	Kellymount	Fulacht fia	665461	660030
KK016-023----	Kellymount	Ring-ditch	665469	660000
KK016-024----	Kellymount	Metalworking site	665456	659982
KK016-026----	Shankill	Enclosure	666047	660857
KK016-027----	Shankill	Enclosure	666746	661019

Fieldwork	4th June 2024
Geophysical technique	High-resolution recorded magnetometry (fluxgate gradiometry)
Report issue	10th July 2024
Author	John Nicholls MSc.
Detection license no.	24R0294
Client	Galetech Energy Services Ltd. on behalf of White Hill Wind Ltd.

1 SURVEY METHODOLOGY

1.1 Methodology

1.1.1 Geophysical survey by high-resolution recorded magnetometry was conducted in 6 areas (M1-M6) within the boundary of the proposed development, investigating 7.63ha of land suitable to survey, within a site boundary encompassing c.9.5ha.

1.1.2 The geophysical survey employed an advanced multichannel fluxgate gradiometer system combined with cm precision GPS, recording magnetometer (fluxgate gradiometer) and GPS data simultaneously at rates of 50Hz and 1Hz respectively. The geophysical data were acquired along parallel instrument traverses 3.64m in width, with the instrumentation installed in 'tow configuration' for use with an ATV.

1.2 Instrumentation

1.2.1 The following table provides a summary of the survey methodology and geophysical instrumentation employed during the course of this work:

Technique	Sensor spacing	Sample rate	Instrumentation	Sensitivity/precision	No. of data recorded
Magnetometry (fluxgate gradiometry)	0.28m	50Hz	Multi-channel fluxgate gradiometer	<75pT/√Hz @ 1Hz (650mm baseline)	385,915
GPS	3.92m	1Hz	Trimble R10 (VRS)	<0.1m	9,641

1.2.2 The instrumentation and software employed for this geophysical survey were configured to apply a spatial resolution of c.80 magnetometer measurements per m^2. This spatial resolution meets with ease the 'Level 3 – Characterisation' EAC Guidelines for geophysical survey in archaeology (Schmidt et al, 2016).

1.3 Data processing

1.3.1 Post-fieldwork geophysical survey data processing was undertaken as follows:

Process	Description
i	Positioning of geophysical data based on real-time GPS measurements (WGS84 Geodetic CRS)
ii	Zero median transect processing for multi-sensor magnetometer data collected along parallel transects
iii	Transformation from WGS84 geodetic coordinate system to ITM (IRENET95) projected CRS
iv	Gridding (ordinary kriging)
v	Export of greyscale images georeferenced in ITM (IRENET95) projected CRS

1.3.2 To maintain the integrity of the processed geophysical data, and its correlation with the original raw on-site measurements, no further processing, filtering or 'smoothing' of the data was undertaken following steps i-v.

1.4 Data display

1.4.1 Figure 1 presents a site location diagram highlighting the site of proposed development to the NE of Junction 7 of the M9 Motorway (scale 1:25,000).

1.4.2 Figure 2 displays the soil associations and bedrock geology specific to the site of proposed development and the surrounding area (scale of 1:25,000).

1.4.3 Figure 3 presents the locations of RMPs within a 1km radius of the proposed development (scale 1:12,500).

1.4.4 The results from geophysical survey in M1-M6 are presented in greyscale format in figure 4 at a scale of 1:1500.

1.4.5 An interpretation diagram based on the results from geophysical survey in M1-M6 is presented in figure 5 at a scale of 1:1500. Letters included on the interpretation diagram refer to notable anomalies recorded by the geophysical survey, and these are discussed in the results section of this report.

2 GENERAL CONSIDERATIONS

2.1 Ground conditions & access

2.1.1 The proposed development encompasses c.7.63ha of good quality low-lying grassland sub-divided in to 6 adjacent fields all of which were suitable to geophysical survey.

2.1.2 The following table provides a description of the terrain and landuse on site, and the hectares completed in M1-M6 during the course of this geophysical survey:

Area	Description of terrain	Ha
M1	Narrow level pasture field bordering a minor road to the N. Grass height across M1 was > 0.5m. A water trough lies at the approximate centre of this field.	2.48
M2	Small level pasture field bordering a minor road to the N with agricultural buildings to NE. Generally good ground conditions throughout.	0.73
M3	Level grazed pasture field with scrub/high vegetation along western field boundary.	1.99
M4	Level grazed pasture field. Generally good ground conditions throughout.	1.32
M5	Level pasture field W of M9 Motorway with private dwelling located N-NE	0.68
M6	Narrow level pasture field sub-divided by temporary electric fencing and located immediately W of the M9 Motorway. Generally good ground conditions throughout.	0.43

2.2 Modern interference

2.2.1 The results from geophysical survey in M1-M6 display an abundance of small-scale ferrous throughout. Ferrous responses are a common occurrence in magnetometer data and relate mostly to modern metallic debris contained in the topsoil. Broad ferrous responses are also evident in the results, the majority at the perimeter of survey in proximity to existing field boundaries, metal fencing, gates and other modern surfaces.

2.3 Recent landuse & cultivation

2.3.1 Remnants of 3 former field boundaries depicted on historic mapping have been recorded S of survey centre in M1 and to the SW in M3.

2.3.2 An extensive network of land drains is also indicated throughout the results from M1-M6, generally visible as weakly positive/negative parallel linear responses on various alignments.

3 GEOPHYSICAL SURVEY RESULTS

3.1 General overview

3.1.1 The results from geophysical survey in M1-M6 at the site of proposed development demonstrate a mostly quiet magnetic background throughout, and this lies within a range of +/-1nT. 'Noise' in the geophysical survey data from M1-M6 can be attributed mostly to responses from former boundaries, land drains and modern ferrous.

3.1.2 Remnants of a possible fulacht fiadh are indicated by a broad area of suspected burnt/fired material detected at the western survey limit in M4. No further responses of definite archaeological character or significant archaeological potential are indicated by the results from geophysical survey in M1-M6.

3.1.3 The geophysical survey results from M1-M6 do, however, highlight a number of anomalies which may require further invasive examination to confirm their exact origin. These include 2 clusters of small-scale positives to the N in M1, and 2 zones of increased response in M1 to the E and M5 N of survey centre. Further details relating to the location, description and likely provenance of these anomalies are provided below in Section 3.2. In the majority of cases, where no immediate archaeological context is present in the data, poorly defined anomalies and trends such as those mentioned above derive mostly from effects from past landuse, natural soil/geological variation and/or modern ferrous.

3.2 Survey results (figures 4-5)

3.2.1 The following table highlights responses of note recorded during the geophysical survey conducted in M1-M6 within the boundary of the proposed development:

Northern land parcel			
Area	**Anomaly(s)**	**Location from survey centre**	**Description & likely provenance**
M1	A, B	N	*Anomaly of uncertain origin* 2 clusters of small-scale positives of uncertain origin a distance of c.12m apart from one another. A-B are not expected to be of archaeological significance. A recent landuse, modern ferrous and/or natural soil/geological origin is expected.
M1	C	E of centre	*Increased response* Zone of increased response c.10m in diameter. C is not expected to be of significance, particularly given its proximity to an existing field boundary and its location along the axis of a former boundary depicted on historic mapping. A recent landuse and/or natural soil/geological is expected.
M2	NA	NA	*No significant responses recorded* No responses indicative of archaeological settlement/activity or significant potential are evident in the results. The data display a network of land drains, very quiet magnetic background and occasional modern ferrous.
M3	NA	NA	*No significant responses recorded* No responses indicative of archaeological settlement/activity or significant potential are evident in the results. The data display a network of land drains, very quiet magnetic background, occasional modern ferrous and small-scale positives of limited interest.
M4	D	W	*Burnt/fired* Broad zone of poorly defined positive/negative magnetic response with strongly magnetic positives at the interior. Anomaly D is indicative of a concentration of burnt/fired material, likely associated with a fulacht fiadh/burnt mound. Interpretation is cautious as concentrations of modern ferrous debris can exhibit similar patterns of response.

M5	E	N of centre	*Increased response* Zone of increased response c.9m in diameter. E is not expected to be of interest. A recent landuse and/or natural soil/geological origin is expected.
M6	NA	NA	*No significant responses recorded* No responses indicative of archaeological settlement/activity or significant potential are evident in the results. The data display a network of land drains, generally quiet magnetic background, modern ferrous at the eastern survey edge and small-scale positives of limited interest.

4 CONCLUSION

4.1 The geophysical survey at the site of the proposed electricity substation in Shankill townland has recorded the remains of a probable fulacht fiadh/burnt mound at the western survey in M4. Further zones of increased response and small-scale positives have been detected during the geophysical survey, although these, are not expected to be of archaeological significance, and likely relate to effects from past landuse, natural soil/geological variation and/or modern ferrous. Numerous land drains are indicated throughout M1-M6 by the results, with remnants of former field boundaries and modern ferrous also apparent in the results.

BIBLIOGRAPHY

Schmidt A, Linford P, Linford N, David A, Gaffney C, Sarris A, and Fassbinder J, (2016), EAC Guidelines for the Use of Geophysics in Archaeology.

ONLINE RESOURCES

Archaeological Survey of Ireland SMR Database: http://webgis.archaeology.ie/historicenvironment/

Bing Maps: https://www.bing.com/maps

Geological Survey of Ireland Spatial Resources, Public Data Viewer Series: https://dcenr.maps.arcgis.com/apps/MapSeries/index.html?appid=a30af518e87a4c0ab2fbde2aaac3c228

Google Maps: https://www.google.com/maps

Geohive Mapviewer: http://www.geohive.ie

Irish National Soils Map, 1:250,000k, V1b (2014). Teagasc, Cranfield University (jointly funded by the EPA STRIVE Research Programme 2007-2013 & Teagasc): http://gis.teagasc.ie/soils/map.php

LIST OF FIGURES

APPENDIX

MAGNETOMETRY

Introduction

Magnetometry represents one of a suite of geophysical techniques employed in archaeological prospection to inform invasive work such as trial trenching and excavation.

Frequently used to determine the often non-visible boundaries of archaeological remains, magnetometer surveys enable archaeologists to identify the location, form and extent of a diverse array of archaeological features no longer visible at the surface.

Buried archaeological remains successfully identified using magnetometry include sites such as enclosure systems and deserted villages, hillforts and military encampments, henges and tumuli, villa/castle foundations, ecclesiastical settlements and formal gardens.

Background to application

The basis for use of magnetometry in archaeological prospection derives from the abundance of natural iron oxides in most soils, and our ability to measure subtle variations in the magnetic properties of these iron oxides caused by human activity. Discrete variations in soil magnetism associated with buried archaeological remains derive typically from in situ burning and organic enrichment of the soil, through activities such as cooking and heating; pottery manufacture and metal working; as well as use of fired building materials such as ceramic tiles and brick. These burnt, fired and organic rich deposits create subtle magnetic contrasts visible as discrete magnetic anomalies superimposed on the earth's geomagnetic field.

1. Magnetometer survey data in greyscale format highlighting pit remains SE of an enclosure and Roman villa.

2. Burnt-fired debris uncovered during excavation of the highlighted area SE of the same enclosure and Roman villa.

Magnetometer surveys conducted in both commercial and research archaeological investigations enable determination of the location, form and extent of buried archaeological remains. Data acquired from these surveys can be quickly generated into georeferenced images and interpretation layers to inform subsequent trial trenching and excavation.

Technology

TARGET provides precise mapping and characterization of buried archaeological remains by employing an array of highly stable and sensitive fluxgate gradiometers, combined with an advanced data logging system and cm precision GPS. This state-of-the-art geophysical instrumentation, which is capable of collecting extremely dense data sets, permits detailed high-resolution survey of archaeological sites from as small as 1ha in size, to larger scale investigation of sites up to 150ha or more.

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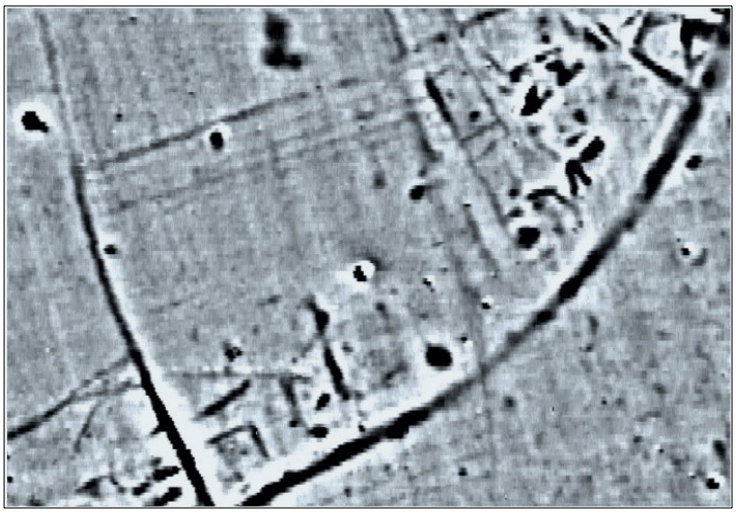
High resolution magnetometer surveys are undertaken as standard, recording data at c.5cm intervals with probe separations of 0.3m for precise measurement and characterization of buried archaeological remains. This spatial resolution meets with ease the 'Level 3 – Characterisation' EAC Guidelines recommendation for geophysical survey in archaeology (Schmidt et al, 2016).

Instrumentation is used in combination with cm precision GPS and data collected along parallel traverses with the system installed in 'tow configuration' for use with an ATV or in push mode.

Data Display

Greyscale plots are the most common format for displaying magnetometer data. This display 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 visible above natural 'background' magnetic variation on site.



6. Greyscale from survey at the site of a deserted medieval village.

XY trace plots provide a near-perspective representation of measurements along individual lines of data recorded from each magnetometer sensor. The XY trace format is used as a conventional method for identifying responses of modern ferrous debris, and also as an aid in identifying locations of potential industrial features, such kilns and metal working.

7. XY trace from survey at the site of a deserted medieval village.

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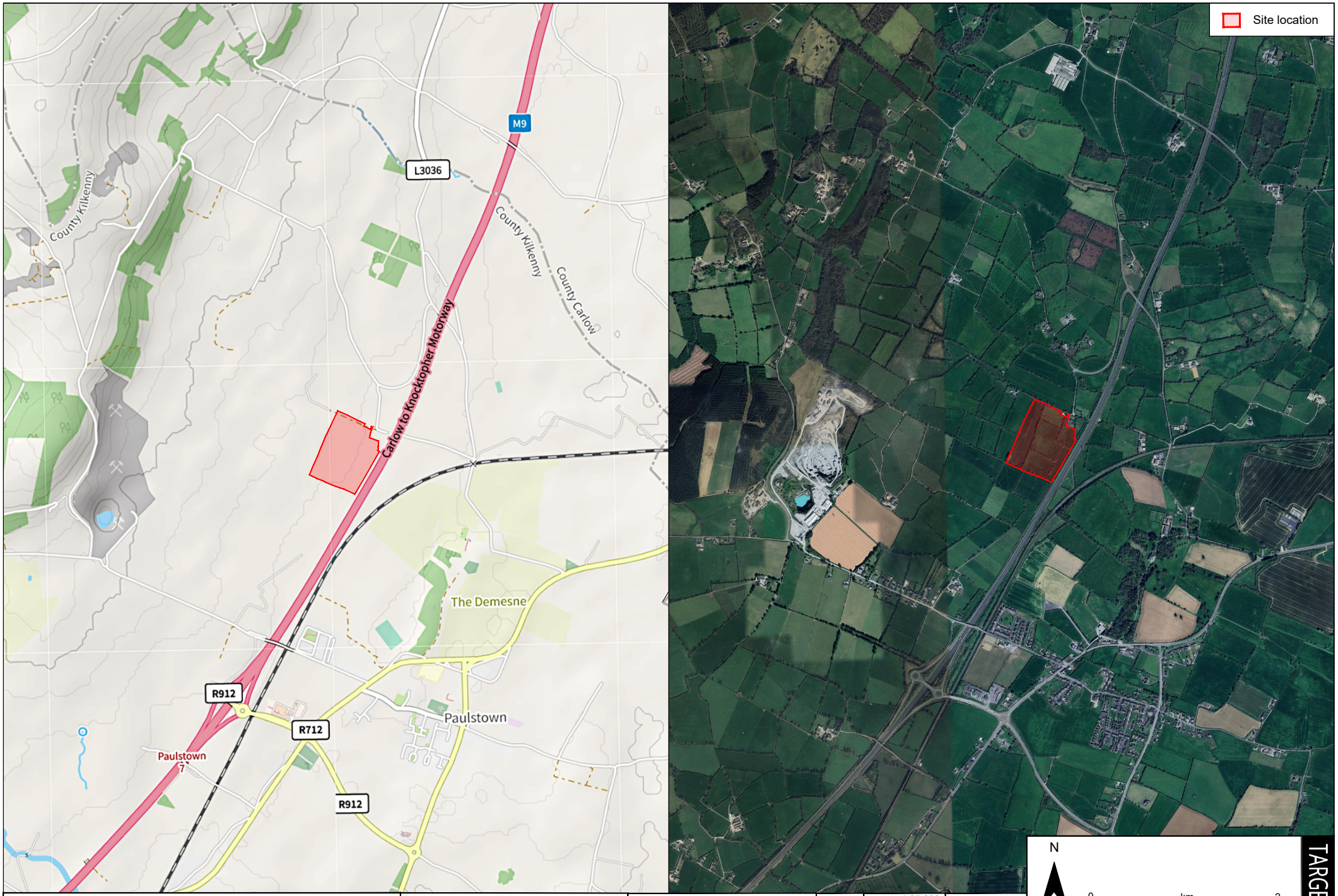
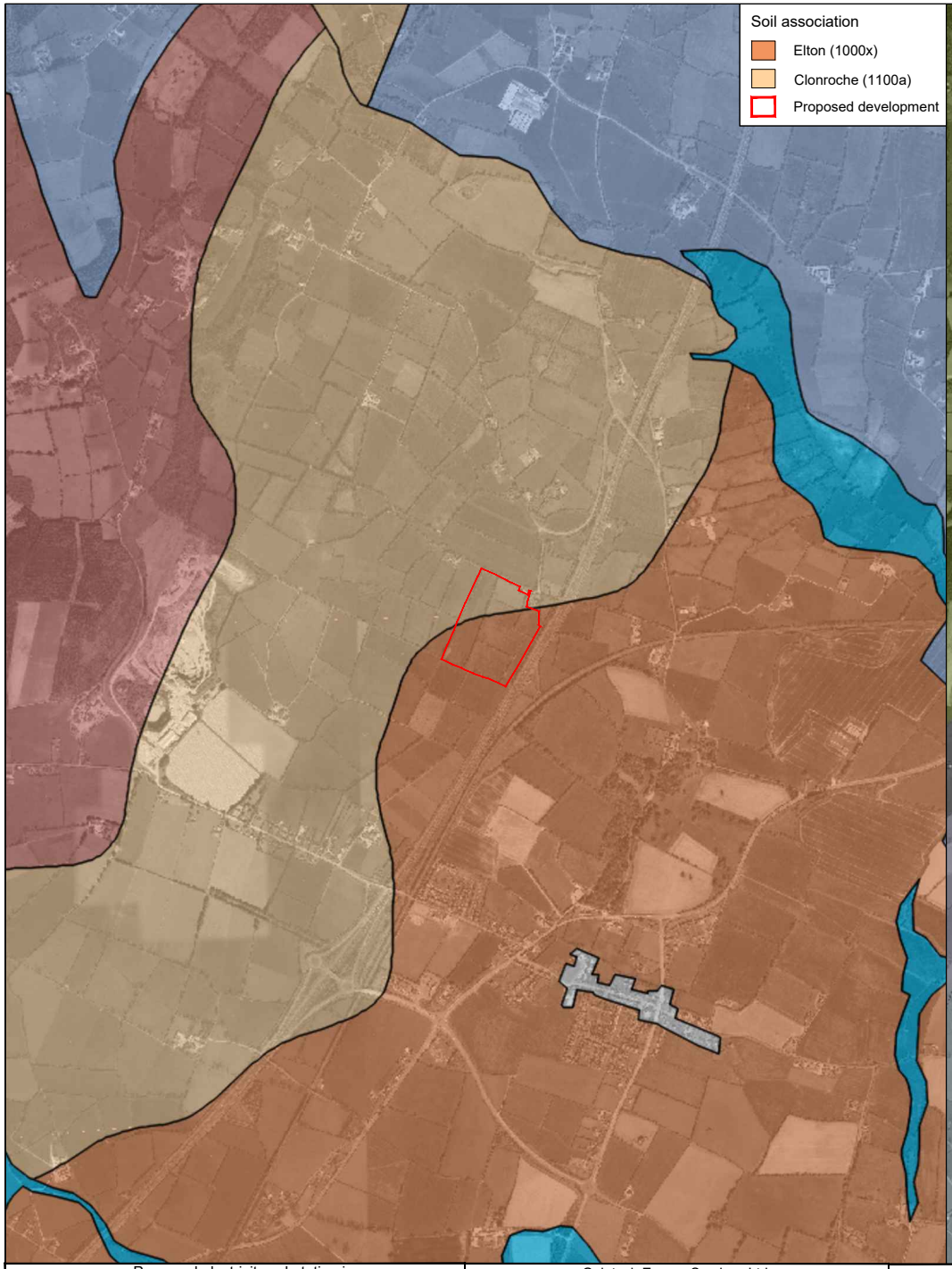


Project	Proposed electricity substation in Shankill townland, Co. Kilkenny	**Client**	Galetech Energy Services Ltd. on behalf of White Hill Wind Ltd.	**Figure**	Site location	**Fig.** 1	**Scale** 1:25,000 @ A3	**TAG** 2024IE15	TARGET



Project	Proposed electricity substation in Shankill townland, Co. Kilkenny	**Client**	Galetech Energy Services Ltd. on behalf of White Hill Wind Ltd.	**Figure**	Soil associations & bedrock geology	**Fig.** 2	**Scale** 1:25,000 @ A3	**TAG** 2024IE15

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Site location
1km radius from site boundary
SMR Zone & National Monument
Townland boundary
Aerial imagery © Google & Maxar Technologies 2023

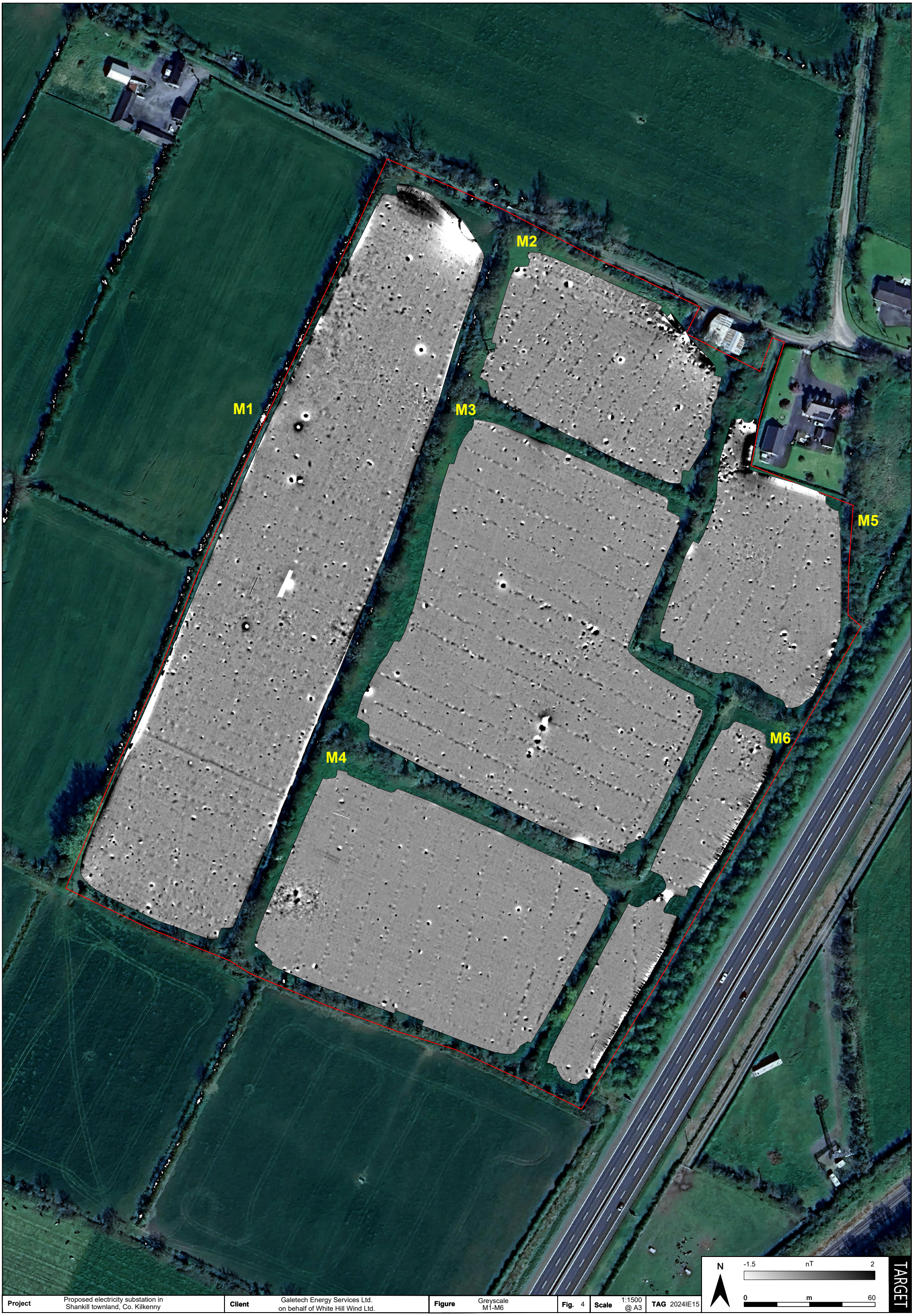
Moanmore
Tinnagarney
Coorleagh
Shankill
Kellymount
ttia
CW
W
C
CW0

KK016-002----
KK016-003----
KK016-004----
KK016-026----
KK016-005----
KK016-006----
KK016-007----
KK016-006001-
CW015-023002-
CW015-023001-
KK016-023-
KK016-024----
KK016-008002-
KK016-021----
KK016-006002-
KK016-020----
KK016-019----
KK016-018----

N
0 m 500

Project	Proposed electricity substation in Shankill townland, Co. Kilkenny	**Client**	Galetech Energy Services Ltd. on behalf of White Hill Wind Ltd.	**Figure**	Recorded monuments & places (RMPs)	**Fig.** 3	**Scale** 1:12,500 @ A3	**TAG** 2024IE15

TARGET



Project	Proposed electricity substation in Shankill townland, Co. Kilkenny	**Client**	Galetech Energy Services Ltd. on behalf of White Hill Wind Ltd.	**Figure**	Greyscale M1-M6	**Fig.** 4	**Scale**	1:1500 @ A3	**TAG** 2024IE15

? Burnt/fired material
Anomaly of uncertain origin
Increased response
Former boundary (historic mapping)
Trend
Land drain
Ferrous

M1
M2
M3
M4
M5
M6

A
B
C
D
E

N

0 m 60

Project	Proposed electricity substation in Shankill townland, Co. Kilkenny	Client	Galetech Energy Services Ltd. on behalf of White Hill Wind Ltd.	Figure	Interpretation M1-M6	Fig. 5	Scale 1:1500 @ A3	TAG 2024IE15

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