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A25.3

Archaeological Geophysical Survey Report – St Stephen's Green to Lissenhall

St. Stephen's Green to Lissenhall, MetroLink, Dublin

Archaeological Geophysical Survey

Detection Licence No. 18R0196

Survey undertaken for
Jacobs Engineering
on behalf of
Transport Infrastructure Ireland

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Summary of Results

Between the 17th September and the 23rd November 2018, a series of geophysical survey were undertaken in advance of the proposed MetroLink. The work was commissioned by Jacobs Engineering on behalf of Transport Infrastructure Ireland. Five pre-selected survey areas were chosen for investigation as they represented Sites of Archaeological Interest along the proposed MetroLink route. Magnetometer surveys were undertaken at a sample resolution of 0.5m x 0.25m. At two sites additional electromagnetic surveys were undertaken over anomalies detected within the magnetometer data at a sample resolution of 0.5m x 0.25m.

Further surveys were carried out between the 15th and 18th April 2019. A ground penetrating radar survey was undertaken at a sample resolution of 0.25m x 0.2s at Homefarm, while an additional electromagnetic survey was carried out at a sample resolution of 0.5m x 0.25m at the Mater plot.

The surveys were conducted upon a bedrock geology consisting of Limestone and Shale, beneath a variety of soils including made ground, grey-brown podzolics, brown earths and surface water gleys and ground water gleys. The survey area at Lissenhall Little comprised a number of grazed pasture fields with some areas of nettles and a number of tree stumps and fallen tree branches along the boundaries. Turnapin Great comprised of a cultivated field with a young crop present. The survey at Homefarm was undertaken on the grounds of a sports pitch, while both Mater Hospital and St. Stephen's Green Park (East) were parklands with extensive areas of metal railings and gravel and tarmac paths.

The geophysical surveys undertaken for this report have investigated five different areas in advance of MetroLink. At Lissenhall a previously unknown D-shaped enclosure was detected, which has been cut by a larger service pipe and a series of internal pits, divisions and a possible stone or bank feature were also detected. The surveys indicate that this enclosure may link to further features to the north with the detection of a zone of raised magnetism and possible pits. Further potential archaeological remains were detected at Lissenhall, including arcing ditches, pits and arcing compacted earth or stone features.

The Turnapin surveys revealed a landscape which has been heavily impacted by relatively modern agricultural processes. A series of relict field boundaries and land drains were detected as well as evidence of green manure. Between these features a number of arcing ditches, trends and stone or compacted earth features were detected which could be archaeological or agricultural. Three potential enclosure ditches were also identified throughout the survey area, these appear to contain possible pits and an area of enhancement.

The survey undertaken at Homefarm revealed a landscape which contains numerous potential archaeological deposits. The northern end of the pitch is dominated by enclosing ditches, zones of compacted earth or stone which may be structural in origin and a number of possible pits or graves. To the south a series of arcing and interconnecting ditches were detected. A large outer enclosure ditch traverses the area and within this a number of archaeological ditches, possible pits or graves and zones of potential archaeological deposits can be seen. The most significant being two arcing interconnecting ditches with radial features which was detected in both surveys. This feature is likely to represent an archaeological enclosure and is likely to be associated with a number of pits, graves or post holes.

Surveys undertaken at the Mater Hospital revealed a landscape dominated by modern disturbance. In addition a number of ditches and compacted earth features were detected which could be archaeological in origin, but are more likely to be associated with the construction of the park or relict flowerbeds. Within St. Stephen's Green (East) four possible ditches were detected as well a large amount of modern metallic disturbance.

Statement of Indemnity

A geophysical survey is a scientific procedure that produces observations of results which are influenced by specific variables. The results and subsequent interpretation of the geophysical survey presented here should not be treated as an absolute representation of the underlying archaeological features, but as a hypothesis that must be proved or disproved. ***Direct investigations are recommended to confirm the findings of this report.*** *Verification can only be provided via intrusive means, such as Test Trench excavations.*

1 Introduction

1.1 Brief Description of the Proposed Development

Earthsound Geophysics Ltd. were commissioned by Jacobs Engineering on behalf of Transport Infrastructure Ireland to carry out geophysical surveys at five pre-selected areas along the proposed MetroLink scheme, Dublin. The techniques to be used on each site were pre-determined by Transport Infrastructure Ireland.

1.2 Aims of the Survey

Transport Infrastructure Ireland required a series of archaeological geophysical surveys at a series of pre-selected areas along the route of MetroLink, Dublin. The survey was carried out in accordance with the brief prepared by Jacobs Engineering, using a combination of Magnetic Gradiometer and EM Apparent Electrical Resistivity. An additional Ground Penetrating Radar survey was also deployed at one site.

The purpose of these surveys were to ascertain to identify and map the presence of any previously unrecorded and buried archaeological structures and/or features at several key locations along the proposed MetroLink alignment. The results of the geophysical survey may be followed by a programme of invasive archaeological test trenching and will inform the archaeological strategy for the proposed scheme. From these results, it will be possible to identify the effects of the MetroLink project on archaeology in the surrounding environment.

1.3 Description of the Survey Area

The survey areas are located across a wide area with varying bedrock geology – the majority of these were comprised of different forms of limestone and shale: Lucan Formation, Tober Colleen Formation and Malahide Formation. These were overlain by a number of soils including made grounds, grey brown podzolics, brown earths and surface water gleys and ground water gleys. All these soils and geologies are weakly magnetic and may create limited magnetic contrast within the magnetometer data. The use of apparent electrical resistivity surveys will help to mitigate against these influences on the magnetometer surveys. While an additional ground penetrating radar survey was deployed at Homefarm due to the potential presence of burials.

The individual survey areas are listed in Table 1 which is based on the tender document.

Site name	Townland	Description
Lissenhall	Lissenhall Little	Greenfields
Turnapin	Turnapin Great, Ballystruan, Ballymun	Greenfield
Homefarm	Bankfarm	Greenfield, Sports ground
Mater Hospital	Inns Quay B	Landscaped park including paths and areas of dense vegetation and trees
St. Stephen's Green Park (East)	St. Stephen's Ward	Landscaped park including paths and areas of dense vegetation and trees

Table 1 Geophysical Survey Areas

The climatic conditions for the surveys undertaken between September and November 2018 were mixed with periods of sunshine, strong winds, rain and overcast weather. The weather is unlikely to have had an impact on the results obtained as the EMI apparent electrical resistivity surveys map contrasts at depth rather than at the surface.

The weather experienced during the surveys in April 2019 was dry and cold. This has had no impact on the Ground Penetrating Radar and EMI apparent electrical resistivity survey.

1.4 Archaeological Background and Statutory Protections

There are no known monuments within any of the survey areas, with the exception of St. Stephen's Green Park (East) with the park itself comprising a National Monument and Recorded Monument DU018-020334- Park. The park is of historical significance due to its establishment in 1635 by the City Assembly and its subsequent use as a defensive position by Irish rebel forces during the 1916 Easter rising, which saw barricades erected and trenches dug (Brück 2014). These defensive positions were the subject of geophysical investigations in 2014 (Brück 2014) which targeted areas beside the railings at various points in the park. Several lines of Ground Penetrating Radar and Electrical Resistivity Tomography were carried out by the Leeson St. Gate, within the boundary of the current survey. The results proved inconclusive, with only a small number of anomalies in the Electrical Resistivity Tomography interpreted as possibly being archaeology.

Within Homefarm playing fields at Bankfarm, human remains have been recovered (NMI topographic file: IA/182/2008). These are reported to have been uncovered at the southern end of the football pitch during the digging of a posthole; and from the northern end when laying foundations for a changing room. There was no mention of formal gravecuts and the exact location of the remains is unclear.

The National Monuments Acts (1930-2014) prohibit the unauthorised use of detecting devices on archaeological sites as well as unauthorised searches for archaeological objects using such devices. All elements of the survey were carried out in accordance with a written method statement and an application for a detection licence from the Department of Culture, Heritage, and the Gaeltacht to carry out the work. The Detection Licence was issued to Heather Gimson, Licence number 18R0196.

1.5 Health and Safety requirements

A health and safety statement was submitted to Jacobs Engineering/TII prior to the commencement of work.

2 Methodology

Fieldwork was carried out between the 17th September and the 23rd November 2018 and the 15th and 18th April 2019 by C. Hogan and U. Garner of Earthsound Geophysics.

Site name	Townland	Technique
Lissenhall	Lissenhall Little	Magnetometer, EMI apparent electrical resistivity
Turnapin	Turnapin Great, Ballystruan, Ballymun	Magnetometer, EMI apparent electrical resistivity
Homefarm	Bankfarm	Magnetometer, Ground Penetrating Radar
Mater Hospital	Inns Quay B	Magnetometer, EMI apparent electrical resistivity
St. Stephen's Green Park (East)	St. Stephen's Ward	Magnetometer

Table 2 Geophysical Techniques

Magnetometer surveys were carried out using a LEA MAX Förster gradiometer system. At St. Stephen's Green Park (East) due to the limited survey area and park furniture a Geoscan FM256 fluxgate gradiometer survey was deployed. A total of 20.5 hectares of magnetometer surveys were conducted for this project.

Apparent EMI Electrical Resistivity data were collected using a GF Instruments CMD Mini-Explorer. The survey areas covered a total of 5.6 hectares.

The Ground Penetrating Radar survey was carried out using a SIR-3000 GPR with a 400MHz antenna. The survey area covered a total of 0.75 hectares.

The Magnetometer surveys and EMI Electrical Resistivity surveys were undertaken gridlessly with each data point logged using a Trimble RTK GPS VRS Now system. The exception to this was within St. Stephen's Green Park (East) where the survey was undertaken using 50m grids located using a Trimble RTK GPS VRS Now system.

The Ground Penetrating Radar survey was undertaken in gridded mode along parallel lines in alternate directions ('zigzag') and the data stored in an automatic data logger. The grid points were also logged using a Trimble RTK GPS VRS Now system.

All these techniques have been used in commercial and research archaeological projects for many years and are considered the most appropriate techniques for a detailed investigation of the underlying archaeology (Aspinall *et al*. 2008, Clark 1996, Scollar *et al.* 1990, Gaffney & Gater 2003).

Where possible, the use of multiple geophysical techniques allows a greater confidence to be placed in the interpretation of detected anomalies, which is especially useful on small sites such as this. Their combined application can be used to determine the geometry, compositional material and the extent of an archaeological target.

2.1 Magnetometer Survey

Instrument	Eastern Atlas LEA MAX^{1505} System	Geoscan Research FM256
Components	LEA D2, 10-channel digitiser	-
Data Acquisition Resolution	0.5m x 0.1m	0.5m x 0.25m
Sensors	8 x Förster FEREX® 4.032 CON650 fluxgate gradiometers	FM256 fluxgate gradiometer
Platform	LEA MAX^{1505} System cart	
Data Acquisition Method	Gridless, using a Trimble RTK GPS VRS Now system to an accuracy of 5cm	Gridded
Sensitivity	<0.1 nT	0.1 nT
Data Logger	Panasonic Toughbook CF-H2 Field computer	Internal Data logger
Calibration	According to manufacturers guidelines (Pilz & Goossens 2015)	According to manufacturers guidelines (Geoscan Research 2004)
Data Processing	Ealdec: Profile decoding Ealmat.m: Normalisation, drift correction Process-it: Surfer 8: Data Gridding (0.5m x 0.25m), using the Kriging Gridding Method	Geoplot v.3.00mx: Zero Mean Traverse Low Pass Gaussian Filter (1, 1) Interpolation (sine wave) to 0.5m x 0.25m
Graphical Display / Dynamic Range	Greyscale -2nT (white) to 2nT (black) at Lissenhall and Turnapin Greyscale -2.5nT (white) to 2.5nT (black) at Homefarm. Greyscale -10nT (white) to 10nT (black) at Mater Hospital.	Greyscale -10nT (white) to 10nT (black) at Stephen's Green Park (East).

2.2 Electromagnetic Induction Survey

EMI Measurement	Apparent Electrical Resistivity (ER_a)
Instrument	GF Instruments CMD-MiniExplorer (Bonsall *et al*. 2013)
Data Acquisition Resolution	0.5m x 0.2s
Coil Configuration	Vertical Coplanar Coil configuration (VPC) or 'half-depth', effective depth range: 0.25m, 0.5m, 0.9m
Platform	SparrowHawk-1000 cart system, sensor positioned 10cm above the ground
Data Acquisition Method	Continuous mode, Gridless, using a Trimble RTK GPS VRS Now system to an accuracy of 5cm
Measuring Range	ER_a: 1000mS/m, resolution 0.1mS/m
Data Logger	CMD Control Unit
Calibration	According to manufacturers guidelines (GF Instruments 2010)
Data Processing	CMD Data Transfer: conversion to Apparent Electrical Resistivity (ER_a) from Apparent Electrical Conductivity (Quadrature) Process-it: Drift correction using a moving filter, Despike, Low Pass Gaussian Filter, Interpolation
Graphical Display / Dynamic Range	Greyscale (white to black) Lissenhall: ± 2 Standard Deviation Turnapin: ± 2 Standard Deviation Mater: -27/27 mS/m

2.3 Ground Penetrating Radar Survey

Instrument	GSSI TerraSIRch SIR System-3000
Antenna	400MHz
Profile Separation	0.25m
Sample Resolution	0.2s
Platform	GSSI Model 623 Survey Cart
Data Acquisition Method	Survey Wheel with Calibrated Odometer (zig-zag)
Measuring Range	0-8000nS
Data Logger	SIR-3000
Calibration	According to manufacturers guidelines (GSSI 2003)
Relative Diel. Permittivity	16
Time Window	50nS
No. of Profiles Collected	536
Profile Line Length	Grid A & B: 240 Profiles @ 102m; Grid C: 17 Profiles @ 4m; Grid D: 25 Profiles @ 8m; Grid E: 41 Profiles @ 13m; Grid F: 89 Profiles @ 11m; Grid G: 25 Profiles @ 9m; Grid H: 37 Profiles @ 5m; Grid I: 21 Profiles @ 100m; Grid J: 20 Profiles @ 80m; Grid K: 21 Profiles @ 60m.
Profile Direction	Zig-zag
Radargram Data Processing	GPR Viewer: Gain, Resampled to 0.05m sample resolution Background Averaging Subtraction of background signal that was formed by averaging all traces of a transect Migration of each transect with a velocity of 0.084m/ns Autogain separately for each transect
Timeslice Data Processing	GPR Process: Creation of 25 timeslices of 0.2 m thickness Zero Median Transect for each line of each timeslice Low-pass filtering along each line of each transect using a filter radius of 0.25m Surfer: Gridded to 0.25m x 0.15m using the Kriging Gridding Method
Graphical Display	Amplitude slice-maps. Range 0 (white) to 500 (red)

2.4 Reporting, Mapping & Archiving

The geophysical survey and report follow the recommendations outlined by relevant best practice guidance documents as a minimum standard (Bonsall *et al*. 2014; David *et al*. 2008; Gaffney *et al*. 2002, Schmidt *et al*. 2015).

Ordnance Survey of Ireland mapping was supplied by IAC Archaeology.

Geophysical data, the figures presented here and the text have been archived following the recommendations of the Archaeology Data Service (Schmidt & Ernenwein 2011).

3 Results & Discussion

The interpretation figures should not be looked at in isolation but in conjunction with the relevant discussion section and with the information contained in the Appendices. Features are highlighted in the interpretation diagrams and are described and interpreted within the text.

3.1 Lissenhall

Method of Assessment:		**Magnetometer**							**Site:**	**Lissenhall**	
Site Description:		Pasture field containing short grass, tree stumps, fallen trees and nettles.									
Figure No.:		7 & 8									
No.	Form of Anomaly	ITM (E,N)	Possible Source(s) of Anomaly						Comment	Recommendation	
			Ditch	**Archaeology**	**? Archaeology**	Ferrous	Geology / Soils	Interference / Modern		Test Excavation	Geophysical Survey
M1	Four sub-oval areas of magnetic enhancement	718861.445,748907.138 Multiple locations					✓		Four roughly oval areas of magnetic enhancement, measuring up to 29m in diameter and located near the northeastern field boundary. May be associated with magnetically enhanced soils caused by agricultural, archaeological or geological activities.	✓	
M2	Highly magnetic linear	718896.770,748833.706	✓		✓			✓	Possible ditch or cut feature, measuring c. 44m SW-NE. This feature roughly coincides with a topographical depression (visible in LiDAR data) and may be archaeological or agricultural in origin.	✓	
M3	Positively magnetic curvilinear	718820.233,748843.429	✓		✓			✓	Possible ditched feature (max. diameter 21.8m E-W) which is oval in shape and runs into an area of probable modern disturbance or dumping. May be associated with an archaeological ring-ditch.	✓	
M4	Multiple isolated positively magnetic responses	718833.800,748840.614 Multiple locations			✓		✓	✓	Four possible pits or postholes which are located within M3. These features may be archaeological and are likely associated with M3.	✓	
M5	Positively magnetic linear	718816.905,748803.514	✓		✓				Possible ditch, cut feature or field division. This feature is running along a topographical ridge seen in the LiDAR data as a low wide bank.	✓	
M6	Positively magnetic curvilinear	718853.766,748805.050	✓		✓				Possible dug feature (17m in length) which may be archaeology, geological or agricultural in origin.	✓	

Method of Assessment:	**Magnetometer**								**Site:**	**Lissenhall**
Site Description:	Pasture field containing short grass, tree stumps, fallen trees and nettles.									
Figure No.:	7 & 8									
No.	Form of Anomaly	ITM (E,N)	Possible Source(s) of Anomaly						Comment	Recommendation	
			Ditch	**Archaeology**	**? Archaeology**	Ferrous	Geology / Soils	Interference / Modern		Test Excavation	Geophysical Survey
M7	L-shaped highly magnetic anomaly	718891.650,748811.702	✓		✓				Possible ditch or cut feature, measuring c. 21.5m E-W and 24m NW-SE. May be related to M5.	✓	
M8	Positively magnetic linear and parallel negatively magnetic linear	718883.459,748794.559	✓		✓				Possible ditch (c. 25.7m NW-SE) and bank (c. 18.6m NW-SE) which appear to be connecting M5 and M9. This anomaly also coincides with the topographical expression mentioned above (and is visible in LiDAR data). Possible archaeology or agricultural in origin.	✓	
M9	Two parallel negatively magnetic linears	718920.320,748774.858			✓				Two possible banks, walls or stone features, measuring c. 27.7m NW-SE and spaced roughly 6m apart. The northern linear appears to continue as M8 in the field to the east. M9 may be associated with a topographic expression and may be a trackway or possible archaeological feature.	✓	
M10	Two areas of magnetic enhancement	718920.320,748774.858					✓		Two areas of enhanced soil measuring up to c. 22m in diameter and located in the northeastern field. May be soil changes caused by agricultural, archaeological or geological activities.	✓	
M11	Positively magnetic curvilinear	718748.518,748704.232	✓		✓				Possible archaeological ditch or cut feature, c.18m NW-SE.	✓	
M12	Positively magnetic linear	718747.238,748666.364	✓		✓				Possible ditch or field drain, c. 107.5m E-W (cut by modern farm track). May be archaeology or agricultural in origin.	✓	
M13	Sub-circular weakly magnetic anomaly	718733.671,748650.245	✓		✓				Possible enclosing ditch with wide opening on the northern side. Measuring c. 16m E-W, 17.5m N-S, this feature is possible archaeological.	✓	
M14	Multiple isolated magnetic responses	718741.094,748652.292			✓		✓		A number of possibly archaeology pits or postholes which may be associated with M13.	✓	
M15	Weakly magnetic linear	718816.351,748640.778	✓		✓				Possible ditch or field drain, c. 40.5m N-S which links with M12 and M16. May be archaeology or agricultural in origin.	✓	
M16	Weakly magnetic linear	718791.778,748643.337	✓		✓				Possible ditch or field drain, c. 42.5m E-W which links with M15. May be archaeological or agricultural in origin.	✓	

Method of Assessment:	**Magnetometer**								**Site:**	**Lissenhall**
Site Description:	Pasture field containing short grass, tree stumps, fallen trees and nettles.									
Figure No.:	7 & 8									
No.	Form of Anomaly	ITM (E,N)	Possible Source(s) of Anomaly						Comment	Recommendation	
			Ditch	**Archaeology**	**? Archaeology**	Ferrous	Geology / Soils	Interference / Modern		Test Excavation	Geophysical Survey
M17	Positively magnetic curvilinear	718770.020,748625.938			✓		✓		Possible ditch or cut feature, c. 6.6m NW-SE, may be archaeology or agricultural in origin.	✓	
M18	Positively magnetic linear	718766.180,748617.751	✓		✓				Possible ditch or cut feature, c. 15.6m NW-SE which runs from the field boundary into M21. Possible archaeology or of agricultural origin.	✓	
M19	Interconnecting sub-oval and curvilinear highly magnetic anomalies	718788.194,748602.399	✓	✓	✓				A sub-oval enclosure ditch, 38m NE-SW and 35m NW-SE, which may be connected to or is dissected by a curving ditch at the northern extent. The sub-oval enclosure sits on top of a topographical rise in the field with a gentle slope down all sides. It appears to be enclosed by M21 around the northwestern half and contains M20. A modern services pipe cuts through the enclosure in SW-NE direction. The highly magnetic nature of the anomaly M19 suggests it might contain burnt or fired remains.	✓	
M20	Multiple isolated magnetic responses and a linear anomaly	718801.249,748588.838		✓					Possible pits or postholes located within the interior of enclosure M19. Adjacent to these is a possible ditch which may form part of the enclosure or be associated with internal division.	✓	
M21	Curvilinear band of high magnetism	718798.433,748616.983	✓		✓		✓		Possible wide ditch or enclosing feature (c.4.5 to 11.5m wide) curving around the northwestern side of enclosure M19. The wide ditch or enclosing feature contains a large number of possible pits or postholes and is likely to be archaeological in origin.	✓	
M22	Weakly magnetic linear	718674.797,748653.827	✓		✓		✓		Linear possible archaeological or agricultural ditch or drain, c. 67m NW-SE.	✓	
M23	Highly magnetic curvilinear	718695.531,748631.567	✓		✓				Possible dug feature, c. 8m NW-SE which may be of archaeological or agricultural origin. The highly magnetic signature indicates the presence of burnt or fired deposits.	✓	
M24	Highly magnetic curvilinear	718698.602,748620.309	✓		✓				Possible ditch, c. 39m N-S. May be of archaeological or agricultural origin. The highly magnetic signature indicates the presence of burnt or fired deposits.	✓	

Method of Assessment:	**Magnetometer**								**Site:**	**Lissenhall**
Site Description:	Pasture field containing short grass, tree stumps, fallen trees and nettles.									
Figure No.:	7 & 8									
No.	Form of Anomaly	ITM (E,N)	Possible Source(s) of Anomaly						Comment	Recommendation	
			Ditch	**Archaeology**	**? Archaeology**	Ferrous	Geology / Soils	Interference / Modern		Test Excavation	Geophysical Survey
M25	Highly magnetic curvilinear	718686.828,748598.049	✓		✓				Possible dug features, c. 7.8m E-W and 10.6m N-S. May be of archaeological or agricultural origin and is likely to contain burnt or fired remains.	✓	
M26	Weakly magnetic curvilinear	718711.145,748602.911	✓		✓		✓		Possible ditch or cut feature, c. 14.8m SW-NE. May be of archaeological or agricultural origin and M26 may extend from M24.	✓	
M27	Weakly magnetic curvilinear	718707.050,748582.698	✓		✓		✓		Possible dug feature, c. 10m E-W. May be of archaeological or agricultural origin.	✓	
M28	Highly magnetic linear	718717.710,748422.262	✓		✓				Possible ditch, c. 23.4m NW-SE which contains burnt or fired remains. May be of archaeological or agricultural origin.	✓	
	L-shaped highly magnetic anomaly	718865.959,748939.735						✓	A modern services pipe running across the northern corner of the northernmost field.		
	Linear highly magnetic anomaly	718816.906,748601.377						✓	A modern services pipe running in NE-SW direction through the two southeastern fields. Cuts through archaeological site M19/20/21.		
	Multiple linear and curvilinear magnetic trends	Multiple locations			✓		✓		Possible archaeological, agricultural or geological features.	✓	
	Multiple parallel positively magnetic linears	Multiple locations					✓		Cultivation furrows running mostly in NW-SE direction throughout the central and southern fields.		
	Areas of strongly magnetic responses	Multiple locations				✓		✓	Modern disturbance such as fencing materials, dumping against field boundaries, buried metal objects, electricity pole foundations.		

Method of Assessment:	**Resistivity**								**Site:**	**Lissenhall**
Site Description:	Pasture field containing short grass, tree stumps, fallen trees and nettles.									
Figure No.:	9 & 10									
No.	Form of Anomaly	ITM (E,N)	Possible Source(s) of Anomaly						Comment	Recommendation	
			Ditch	**Archaeology**	**? Archaeology**	Ferrous	Geology / Soils	Interference / Modern		Test Excavation	Geophysical Survey
R29	Low resistivity linear	718821.271,748855.979	✓		✓		✓		Possible ditch or cut feature (c. 40.8m E-W).	✓	
R30	Two angular areas of raised resistivity	718836.335,748844.687			✓		✓		Possible compacted earth or stone areas, the larger measures c. 14.5m N-S and 17.5m E-W. The smaller area measuring c. 8m N-S and 7m E-W. Both features could be archaeological or geological in origin.	✓	
R31	Amorphous area of low resistivity	718811.746,748832.510			✓		✓		An area of disturbed ground or containing higher moisture content than the surrounding soil. This area measures c. 55m E-W and up to 12m N-S. The eastern section, which contains an irregular pit of very low resistivity, corresponds to an area of modern disturbance in the magnetometer data which cuts ditched anomaly M3.	✓	
R32	Low resistivity linear	718792.474,748812.362	✓		✓		✓		Possible ditch or cut feature (c. 46m N-S).	✓	
R33	C-shaped high resistivity anomaly with central amorphous high resistivity anomaly	718817.727,748814.576 718824.373,748816.126			✓		✓		Possible sub-circular compacted earth or stone feature (c. 18.5m N-S and 13m E-W) with a wide gap at the southeast. This feature contains a possible compacted earth or stone feature, measuring c. 8.8m NW-SE by 3m SW-NE and is possibly archaeological and maybe connected to R34.	✓	
R34	Amorphous area of raised resistivity	718841.429,748821.439			✓		✓		Possible area of compacted earth or stony soil (c. 27m E-W and 8m N-S) which may be related to R33. This anomaly could be archaeological, agricultural or geological.	✓	
R35	Two interconnecting curvilinear anomalies	718845.638,748807.491 718854.721,748809.262	✓		✓				Two possible ditches or cut features (c. 54m N-S and 60.5m SW-NE). May be related to R36 which is located between the two possible ditches.	✓	
R36	Three isolated low resistivity responses	718852.062,748801.956 Multiple locations			✓		✓		Three possible pits (c. 4m and 3.5m in length) which may be related to R35.	✓	
R37	Amorphous areas of low resistivity	718852.062,748801.956			✓		✓		An area of disturbed or wetter soil (c. 7m by 14m in diameter) containing two large possible pits and a third large possible pit to the west. This anomaly may be related to magnetometer anomaly M2 and could be archaeological or agricultural.	✓	

Method of Assessment:		**Resistivity**							**Site:**	**Lissenhall**	
Site Description:		Pasture field containing short grass, tree stumps, fallen trees and nettles.									
Figure No.:		9 & 10									
No.	Form of Anomaly	ITM (E,N)	Possible Source(s) of Anomaly						Comment	Recommendation	
			Ditch	**Archaeology**	**? Archaeology**	Ferrous	Geology / Soils	Interference / Modern		Test Excavation	Geophysical Survey
R38	Crescent shaped raised resistivity anomaly	718866.018,748810.369			✓		✓		Possible compacted earth or stone feature (c. 10.8m SE-NW and 4m NE-SW) which could be archaeological, agricultural or geological.	✓	
R39	Multiple high resistivity anomalies	718894.816,748810.148			✓				A crescent shaped compacted earth or stone feature (c. 9.8m diameter) and three irregular possible stone features (measuring between 2.5m and 6m in diameter). These features appear to coincide with magnetometer anomaly M7 and may relate to archaeology or geology.	✓	
R40	Two areas of low resistivity	718892.822,748799.299	✓		✓		✓		Two roughly linear areas of disturbed or wetter soil containing large possible pits. R40 may represent two segments of a wide ditch (c. 14m and 18m E-W and c. 4.5m wide).	✓	
R41	High resistivity anomaly	718891.714,748788.007			✓				Compacted earth or stone feature (c. 7.7m NW-SE and 2.5m SW-NE) which coincides with magnetometer anomaly M9 and is possibly associated with a bank, wall or trackway.	✓	
R42	Raised resistivity curvilinear	718867.569,748781.808			✓		✓		Possible bank, path or stone drain, measuring c. 31.8m N-S.	✓	
R43	Raised resistivity curvilinear	718872.221,748782.472			✓		✓		Possible compacted earth or stone feature, measuring c. 62m E-W and 28.5m N-S. This feature may represent two linear sections of wall, bank or stone surface of archaeological or agricultural origin.	✓	
R44	Sub-oval area of high resistivity	718848.961,748769.630			✓		✓		Possible compacted earth or stone feature (c. 15.5m NW-SE and 9.5m SW-NE), which may be archaeological, agricultural or geological in origin.	✓	
R45	Sub-oval area of low resistivity	718837.221,748782.693			✓		✓		Area of disturbed or wetter soil (c. 22m E-W and 10m N-S) which contains a large possible pit or cut feature (c. 4.2m by 8m in diameter). This anomaly appears to cross R35.	✓	
R46	Raised resistivity linear	718806.208,748789.778			✓		✓		Possible compacted earth or stone feature (c. 18.2m E-W), which may run parallel to R43.	✓	

Method of Assessment:	**Resistivity**								**Site:**	**Lissenhall**
Site Description:	Pasture field containing short grass, tree stumps, fallen trees and nettles.									
Figure No.:	9 & 10									
No.	Form of Anomaly	ITM (E,N)	Possible Source(s) of Anomaly						Comment	Recommendation	
			Ditch	**Archaeology**	**? Archaeology**	Ferrous	Geology / Soils	Interference / Modern		Test Excavation	Geophysical Survey
R47	High resistivity linear	718782.190,748808.868			✓			✓	Possible compacted earth or stone feature (c. 31.5m SW-NE) which runs through an area of possible modern disturbance and may be related to modern agricultural activities.	✓	
R48	Irregular high resistivity anomalies	718804.657,748775.608			✓		✓		Possible curvilinear compacted earth or stone feature (c. 11m diameter) connecting two irregular possible stone features (up to 6m and 9.5m in diameter). This feature could be geological or archaeological.	✓	
R49	Low resistivity curvilinear	718836.999,748768.745	✓		✓				Possible ditch or cut feature (c. 21m NW-SE). May be related to R45 or modern disturbance near the field entrance.	✓	
R50	Right-angled low resistivity linear	718744.662,748709.399	✓		✓				Possible ditch or cut feature (c. 22.3m SW-NE and 32.3m NW-SE).	✓	
R51	L-shaped low resistivity anomaly	718730.223,748671.672	✓		✓				Possible ditch or cut feature (c. 30.5m SW-NE and 24.5m NW-SE).	✓	
R52	Low resistivity curvilinear	718753.531,748684.041	✓		✓		✓		Near oval possible ditch or cut feature with possible entranceway towards the southwest. Measuring c. 17m N-S and 10m E-W, this feature may be partially enclosed by R53 on the southeastern side.	✓	
R53	Raised resistivity curvilinear	718756.007,748675.795			✓		✓		Possible compacted earth or stone feature (c. 22.5m diameter) curving around the southeastern half of R52.	✓	
R54	Low resistivity linear	718746.725,748649.200	✓		✓				Possible ditch or field drain (c. 54m SW-NE).	✓	
R55	Low resistivity curvilinear	718754.769,748645.489	✓		✓				Possible ditch or cut feature (c. 17.2m N-S) of archaeological or agricultural origin.	✓	
R56	Low resistivity linear	718809.223,748644.046	✓		✓				Possible ditch or field drain (c. 78.8m E-W) which coincides with magnetometer anomaly M16.	✓	
R57	Low resistivity linear	718831.500,748616.833	✓					✓	Linear feature running in NE-SW direction across the southeastern field (c. 128m in length). This anomaly matches the strong magnetometer anomaly and is associated with a modern services pipe.		

Method of Assessment:	**Resistivity**								**Site:**	**Lissenhall**
Site Description:	Pasture field containing short grass, tree stumps, fallen trees and nettles.									
Figure No.:	9 & 10									
No.	Form of Anomaly	ITM (E,N)	Possible Source(s) of Anomaly						Comment	Recommendation	
			Ditch	**Archaeology**	**? Archaeology**	Ferrous	Geology / Soils	Interference / Modern		Test Excavation	Geophysical Survey
R58	Raised resistivity curvilinear	718824.286,748625.664			✓				Possible compacted earth or stone feature (c. 25m SW-NE) of archaeological, agricultural or geological origin.	✓	
R59	Low resistivity linear	718806.472,748618.579	✓		✓				Possible ditch or cut feature (c. 36.5m E-W). May be related to R56 and magnetometer anomaly M21.	✓	
R60	Low resistivity linear	718784.296,748613.128	✓	✓	✓				Possible ditch or cut feature (c. 22.5m NW-SE). Coincides with section of magnetometer anomaly M19 and is likely to be part of an archaeological enclosure ditch.	✓	
R61	Area of raised resistivity	718770.300,748588.420			✓		✓		Possible zone of compacted earth spanning 39.5m N-S and 17.5m E-W. Contains a possible stone deposit (c. 3m by 5m in diameter) and could be archaeological or agricultural in origin.	✓	
R62	Low resistivity curvilinear	718784.478,748597.867	✓	✓	✓				Possible ditch or cut feature (c. 41m SW-NE). Coincides with section of magnetometer anomaly M19 and is likely to be part of an archaeological enclosure ditch.	✓	
R63	Area of low resistivity	718785.387,748575.884			✓		✓		Area of disturbed or wetter soils (c. 30.5m SW-NE and 14.5m NW-SE). Possibly caused by archaeological activities relating to enclosure M19/20.	✓	
R64	Curvilinear low resistivity anomaly	718791.203,748591.509	✓		✓				Possible ditch or cut feature (c. 32m E-W) curving around the northern side of R63. Possibly related to enclosure M19/20.	✓	
R65	Two curvilinear raised resistivity anomalies	718789.749,748566.982			✓				Compacted earth or stone feature (c. 13m NW-SE) which is cut by modern services pipe. This feature is located within the centre of enclosure M19/20 and could be archaeological in origin.	✓	
R66	Curvilinear L-shaped anomaly	718705.067,748623.546	✓		✓		✓		Possible ditch or cut feature (c. 19.5m NW-SE and 26m NE-SW).	✓	
R67	Raised resistivity curvilinear	718682.115,748604.402			✓		✓		Possible compacted earth or stone feature (c. 32m N-S). May be related to R68/69/70.	✓	

Method of Assessment:	**Resistivity**								**Site:**	**Lissenhall**
Site Description:	Pasture field containing short grass, tree stumps, fallen trees and nettles.									
Figure No.:	9 & 10									
No.	Form of Anomaly	ITM (E,N)	Possible Source(s) of Anomaly						Comment	Recommendation	
			Ditch	**Archaeology**	**? Archaeology**	Ferrous	Geology / Soils	Interference / Modern		Test Excavation	Geophysical Survey
R68	Raised resistivity curvilinear	718691.929,748589.530			✓		✓		Possible compacted earth or stone feature (c. 29m E-W). May be related to R67/69/72.	✓	
R69	Two raised resistivity curvilinears	718693.828,748608.991			✓		✓		Two segments of a possible sub-circular compacted earth or stone feature (c. 11m E-W and 10m N-S). May be related to R67/69/72 and could be archaeological in origin.	✓	
R70	Low resistivity curvilinear	718720.422,748621.015	✓		✓		✓		Possible ditch or cut feature (c. 45m N-S).	✓	
R71	Low resistivity curvilinear	718712.507,748608.832	✓		✓		✓		Possible sub-circular ditched feature with opening at north (c. 7m diameter) which may be archaeological or agricultural in origin.	✓	
R72	Raised resistivity linear	718704.909,748580.829			✓		✓		Possible compacted earth or stone feature (c. 26m NE-SW).	✓	
	Multiple parallel linear trends	Multiple locations							Possible cultivation furrows, running in SW-NE direction, parallel to modern field boundary in south-eastern field.		
	Irregular areas of high or low resistivity	Multiple locations						✓	Areas of modern disturbance located mostly near field entrances, electricity poles or cattle feeding areas and associated with these.		

3.2 Turnapin

Method of Assessment:	**Magnetometer**								**Site:**	**Turnapin**
Site Description:	Cultivated field containing a young crop.									
Figure No.:	11 & 12									
No.	Form of Anomaly	ITM (E,N)	Possible Source(s) of Anomaly						Comment	Recommendation	
			Ditch	**Archaeology**	**? Archaeology**	Ferrous	Geology / Soils	Interference / Modern		Test Excavation	Geophysical Survey
M1	Two arcing anomalies and a number of isolated responses	716179.475,741786.317 Numerous locations	✓		✓				Two arcing possible ditches which may form an archaeological enclosure ditch (22m in diameter) with a possible entrance to the SW. Contained within this feature are a number of possible pits.	✓	
M2	Weakly magnetic curvilinear	716167.511,741778.416	✓		✓				Possible ditch or cut feature, c.26m in length, this may be associated with M1.	✓	
M3	Weakly magnetic linear	716303.24,741771.54	✓		✓				Possible agricultural ditch 183m in length.	✓	
M4	Linear magnetic anomaly	716277.702,741761.053	✓		✓				Possible ditch or cut feature 73m in length.	✓	
M5	Two linear magnetic anomalies	716331.165,741723.161	✓		✓				Two possible ditch or cut features which may represent a former agricultural boundary.	✓	
M6	Linear magnetic anomaly	716306.165,741688.957	✓		✓				Probable agricultural ditch 152m in length.	✓	
M7	Linear magnetic anomaly	716331.165,741723.161	✓		✓				Possible ditch or cut feature 79m in length.	✓	
M8	Linear magnetic anomaly	716339.478,741626.292	✓		✓				Possible ditch or cut feature 52m in length.	✓	
M9	Linear magnetic anomaly	716269.348,741651.159	✓		✓				Possible ditch or cut feature 96m in length.	✓	
M10	Series of highly magnetic interconnecting anomalies	716331.165,741723.161	✓		✓				Series of interconnecting highly magnetic ditches which are likely to contained metallic or burnt remains. These anomalies correspond to relict field boundaries.	✓	
M11	Linear magnetic anomaly	716146.102,741701.137	✓		✓				Possible ditch or cut feature 30m in length.	✓	
M12	Linear magnetic anomaly	716171.65,741653.803	✓		✓				Possible ditch or cut feature 96m in length.	✓	
M13	Linear magnetic anomaly	716171.65,741653.803	✓		✓				Possible ditch or cut feature 144m in length.	✓	
M14	Linear magnetic anomaly	716159.375,741605.26	✓		✓				Possible ditch or cut feature 98m in length.	✓	
M15	Linear magnetic anomaly	716230.157,741580.875	✓		✓				Possible ditch or cut feature 45m in length.	✓	
M16	Series of interconnecting linear magnetic anomalies	716185.274,741518.252	✓		✓				Series of interconnecting ditch or cut features which are likely to be associated with agricultural processes.	✓	

Method of Assessment:	**Magnetometer**								**Site:**	**Turnapin**
Site Description:	Cultivated field containing a young crop.									
Figure No.:	11 & 12									
No.	Form of Anomaly	ITM (E,N)	Possible Source(s) of Anomaly						Comment	Recommendation	
			Ditch	**Archaeology**	**? Archaeology**	Ferrous	Geology / Soils	Interference / Modern		Test Excavation	Geophysical Survey
M17	Two arcing anomalies and a number of isolated responses	716141.715,741525.441	✓		✓				Two arcing possible enclosure ditches (40m in diameter), which may be archaeological in origin. Contained within this feature are a number of possible pits.	✓	
M18	Linear magnetic anomaly	716141.715,741525.441	✓		✓				Possible ditch or cut feature 73m in length.	✓	
M19	Arcing magnetic anomaly and area of magnetic enhancement	716244.981,741517.96	✓		✓		✓		An arcing possible ditch or cut feature (46m in length) which may surround an area of magnetic enhancement. This enhancement (7m in width) may be archaeological or agricultural in origin.	✓	
M20	Linear magnetic anomaly	716244.981,741517.96	✓		✓				Possible ditch or cut feature 64m in length.	✓	
M21	Two curvilinear magnetic anomalies	716240.062,741447.525	✓		✓				Two curvilinear possible ditches or cut features which may interlink.	✓	
M22	Linear magnetic anomaly	716114.274,741429.221	✓		✓				Possible ditch or cut feature 30m in length.	✓	
M23	Two interconnecting linear magnetic anomalies	716086.682,741434.428	✓		✓				Two interconnecting possible ditches or cut features.	✓	
	Multiple linear and curvilinear magnetic trends	Multiple locations			✓		✓		Possibly associated with archaeology, agricultural or geology.	✓	
	Areas of strongly magnetic responses	Multiple locations				✓		✓	Modern disturbance such as fencing materials, dumping against field boundaries, buried metal objects, electricity pole foundations.		
	Background dipolar responses across the survey area	Multiple locations						✓	It is likely that these dipolar anomalies are associated with green manure. The presence of these signatures has produced an enhanced magnetic background and it therefore can be difficult to distinguish archaeology from geology.		

Method of Assessment:	**Resistivity**								**Site:**	**Turnapin**
Site Description:	Cultivated field containing a young crop.									
Figure No.:	13 & 14									
No.	Form of Anomaly	ITM (E,N)	Possible Source(s) of Anomaly						Comment	Recommendation	
			Ditch	**Archaeology**	**? Archaeology**	Ferrous	Geology / Soils	Interference / Modern		Test Excavation	Geophysical Survey
R24	Arcing low resistivity anomaly	716184.19,741786.843	✓		✓				Possible ditch or cut feature (24m in length) which partially matches the location of M1 detected in the magnetometer data. This ditch is likely to be archaeological in origin.	✓	
R25	High resistivity anomaly	716279.247,741745.867			✓		✓		Possible stone or compacted earth feature (11m in length) which may be archaeological, agricultural or geological in origin.	✓	
R26	Arcing high resistivity anomaly	716279.36,741729.944			✓		✓		Possible stone or compacted earth feature (25m in length). This anomaly is likely to have similar origins to R2.	✓	
R27	Area of low resistivity	716262.946,741724.711	✓		✓		✓		Area of disturbed ground or waterlogging. This anomaly could be agricultural or archaeological in origin.	✓	
R28	Arcing low resistivity anomaly	716263.659,741681.428	✓		✓				Possible ditch or cut feature (28m in length) which may match a magnetic trend detected in the magnetometer data.	✓	
R29	Arcing low resistivity anomaly	716151.5,741549.18	✓		✓				Arcing ditch which has been truncated by a land drain. This feature measures 94m in length and appears to enclose an area 38m in diameter. It is likely to be archaeological in origin and contains a subdivision.	✓	
R30	High resistivity linear	716143.846,741526.234			✓				Linear stone or compacted earth feature (32m in length) which may be agricultural in origin.	✓	
R31	High resistivity anomaly	716223.189,741554.926			✓		✓		Compacted earth or stone feature (13m in length) which may be agricultural, agricultural or geological in nature.	✓	
R32	Low resistivity linear	716247.784,741560.057	✓		✓				Linear ditch or cut feature, 28m in length, which may be archaeological.	✓	
R33	Low resistivity anomaly	716250.907,741536.671	✓		✓				Oval enclosure ditch, which was also partially detected in the magnetometer data (M19). Measuring 32m in diameter this anomaly appears to have internal divisions and has been crossed by a land drain.	✓	
R34	Two isolated high resistivity anomalies	716298.752,741536.995			✓		✓		Two stone or compacted earth deposits. These anomalies may be archaeological but are more likely to be associated with near surface geology or agricultural processes.	✓	

Method of Assessment:	**Resistivity**								**Site:**	**Turnapin**
Site Description:	Cultivated field containing a young crop.									
Figure No.:	13 & 14									
No.	Form of Anomaly	ITM (E,N)	Possible Source(s) of Anomaly						Comment	Recommendation	
			Ditch	**Archaeology**	**? Archaeology**	Ferrous	Geology / Soils	Interference / Modern		Test Excavation	Geophysical Survey
R35	High resistivity linear	716218.113,741462.688			✓				Linear compacted earth or stone feature (28m in length) which may be associated with the adjacent land drain.	✓	
R36	Two high resistivity anomalies	716218.113,741462.688 Multiple locations			✓		✓		Two compacted earth or stone features which may interconnect outside the survey area. Measuring 13m and 27m in length these anomalies could be archaeological or agricultural.	✓	
	Linear low resistance trends	Located throughout site						✓	Series of parallel land drains which traverse the survey areas. There is some evidence that these land drains are interconnected in 'Z-shaped' formation.		

3.3 Homefarm

Method of Assessment:	**Magnetometer**								**Site:**	**Homefarm**
Site Description:	Greenfield sports ground enclosed by thick metal railing and containing metal goal posts at northern and southern ends.									
Figure No.:	15 & 16									
No.	Form of Anomaly	ITM (E,N)	Possible Source(s) of Anomaly						Comment	Recommendation	
			Ditch	**Archaeology**	**? Archaeology**	Ferrous	Geology / Soils	Interference / Modern		Test Excavation	Geophysical Survey
M1	Multiple isolated positively magnetic responses	Multiple locations throughout survey area			✓			✓	A number of possible pits throughout the survey area. These are possibly archaeological in nature. However, some may also be related to modern disturbances.	✓	
M2	Amorphous area of very strong magnetism	715444.910,737342.652						✓	Comprising highly magnetic parallel linears extending from the northern edge of the pitch towards the centre of the survey area. These are most likely caused by modern disturbances such as land drains which could have been put in at the time the sports pitch was created.		
M3	Interconnecting linear and curvilinear anomalies	715463.292,737333.385	✓		✓			✓	Possible ditches or cut features, measuring between 3.5m and 16m in length. May be archaeology or associated with the construction of the sports pitch.	✓	
M4	Two positively magnetic linears	715447.147, 737318.367 715438.835,737315.970	✓		✓			✓	Two possible ditches or cut features (c. 13.5m N-S and 33.5m SW-NE). May be archaeology or related to modern drainage.	✓	
M5	Multiple interconnecting curvilinear anomalies	715432.442,737307.981 Multiple locations	✓		✓		✓		A number of interconnecting curvilinear possible ditches or cut features, measuring between c. 3m and 10m in length. May be archaeology in origin.	✓	
M6	Sub-circular positively magnetic anomaly	715442.991,737307.502	✓		✓				Possible sub-circular ditched feature near the centre of the field, measuring c. 5.4m E-W and 7m N-S. Four possible pits are located along the edge of the feature and one pit is located near its centre. May be an archaeology enclosure containing a possible entranceway to the south.	✓	

Method of Assessment:	**Magnetometer**								**Site:**	**Homefarm**
Site Description:	Greenfield sports ground enclosed by thick metal railing and containing metal goal posts at northern and southern ends.									
Figure No.:	15 & 16									
No.	Form of Anomaly	ITM (E,N)	Possible Source(s) of Anomaly						Comment	Recommendation	
			Ditch	**Archaeology**	**? Archaeology**	Ferrous	Geology / Soils	Interference / Modern		Test Excavation	Geophysical Survey
M7	Area of magnetic enhancement which contains positively magnetic linear anomalies	715457.537,737301.750			✓			✓	An area of enhanced soil, possible associated with burnt material, measuring c. 20m N-S and 17m E-W. There are two possible ditches within the area (c. 16.5m N-S and 8.5m SW-NE) and a number of magnetic trends running in E-W direction. The enhancement is bounded by two interconnecting possible ditches and areas of modern disturbance. This feature could be associated with the construction of the sports pitch or archaeological activity.	✓	
M8	Multiple interconnecting linear and curvilinear positively magnetic anomalies	715434.839,737292.483	✓		✓				A number of interconnecting possible archaeological ditches or cut features (ranging between c. 14.5m to 22m in length) which may suggest the presence of archaeological enclosures. Several possible pits are located within the vicinity of some of these ditches.	✓	
M9	Area of strong magnetic enhancement	715430.204,737270.115			✓			✓	An area of enhanced soil, possible associated with burning, near the southern edge of the pitch, measuring c. 9m E-W. This could be archaeological or relatively modern in origin. A number of possible pits surround the feature and are likely to be associated with it.	✓	
M10	Series of interconnecting arcing positively magnetic anomalies	715447.947,737275.867	✓		✓				Series of arcing ditches or cut features which are likely to be archaeological in origin. Spanning an area of at least 27m these features may relate to enclosure ditches. A number of possible pits are contained at their intersections as well as internally while a number of magnetic trends were detected within the area and may be related.	✓	
	Multiple linear and curvilinear magnetic trends	Multiple locations			✓		✓		Possibly associated with archaeology, agricultural or geology.		

Method of Assessment:	**Ground Penetrating Radar**								**Site:**	**Homefarm**
Site Description:	Greenfield sports ground enclosed by thick metal railing and containing metal goal posts at northern and southern ends. The data has been divided for interpretation purposes into three depth ranges. If full depth penetration was achieved then it is anticipated that the shallow depth features are located between c.0m – 1.12m, medium depth = c.1.12m – 2.88m and deep depth = c.2.88m – 4.00m.									
Figure No.:	17, 18, 19 & 20									
No.	Form of Anomaly	ITM (E,N)	Possible Source(s) of Anomaly						Comment	Recommendation	
			Ditch	**Archaeology**	**? Archaeology**	Ferrous	Geology / Soils	Interference / Modern		Test Excavation	Geophysical Survey
GPR11	Shallow depth – linear amplitude band	715423.753,737349.812			✓				Possible surface or compacted earth or stone feature near the northwestern corner of the pitch, measuring c. 23m N-S and 4.6m E-W. This anomaly may be archaeological but is more likely to be associated with the sports ground.	✓	
GPR12	Medium depth – isolated oval anomaly	715429.953.737354.721			✓			✓	Possible area of disturbed soil, pit or burial, measuring c. 1.m x 2.5m.	✓	
GPR13	Medium depth – linear amplitude band	715430.782,737347.351	✓		✓			✓	Possible ditch or cut feature, measuring c. 46m in length which runs in NE-SW direction. This feature contains a turn at the southwestern end and may represent a boundary or drainage ditch, modern service trench or archaeological feature.	✓	
GPR14	Medium depth – linear amplitude bands	715429.952,737330.609			✓			✓	Four parallel bands of hard or compacted material running c. N-S, measuring between 15 and 42m in length and up to 4m in width. These may be the result of levelling, dumping or infilling, possibly related to the movement of imported deposits or building material.	✓	
GPR15	Medium depth – amorphous area of raised amplitude	715439.833,737337.470			✓		✓	✓	Possible zone of hard and compacted material, possibly archaeological in origin. Max. dimensions c. 60.6m N-S and 15m E-W. GPR15 is likely to be associated with GPR14 and is crossed by GPR17, 18, 19 & 22. It is possible that GPR16, 19 & 32 act as boundary features for GPR15. The anomaly partially corresponds to an area of magnetic disturbance in the magnetometer data, therefore this material has a high magnetic content.	✓	

Method of Assessment:	**Ground Penetrating Radar**								**Site:**	**Homefarm**
Site Description:	Greenfield sports ground enclosed by thick metal railing and containing metal goal posts at northern and southern ends. The data has been divided for interpretation purposes into three depth ranges. If full depth penetration was achieved then it is anticipated that the shallow depth features are located between c.0m – 1.12m, medium depth = c.1.12m – 2.88m and deep depth = c.2.88m – 4.00m.									
Figure No.:	17, 18, 19 & 20									
No.	Form of Anomaly	ITM (E,N)	Possible Source(s) of Anomaly						Comment	Recommendation	
			Ditch	**Archaeology**	**? Archaeology**	Ferrous	Geology / Soils	Interference / Modern		Test Excavation	Geophysical Survey
GPR16	Medium depth – sub-rectangular area of low amplitude	715419.403,737325.921			✓		✓	✓	A wide zone of low ('quiet') radar responses which roughly surrounds GPR14&15. Measuring c. 49.5m NE-SW by 42.5m NW-SE this anomaly may be caused by areas of clay, sand, waterlogged or undisturbed soil and may be archaeological in origin.	✓	
GPR17	Medium depth – three sub-oval anomalies	715430.462,737311.482			✓				Three possible pits, graves or areas of disturbed soil located within the southern extent of anomaly GPR15. The features measure between 1.3 and 2.5m in diameter.	✓	
GPR18	Shallow depth – two sub-oval anomalies	715438.862,737319.271			✓				Two possible pits, graves or areas of disturbed soil within the southern extent of anomaly GPR15. The features measure between 2.4 and 3.4m in diameter and may relate to archaeological remains or due to their shallow nature may be associated with the sports pitch.	✓	
GPR19	Medium depth – multiple parallel amplitude linears	715425.322,737313.330	✓		✓			✓	A number of parallel possible ditches or cut features running N-S and NE-SW, measuring up to 29m in length and spaced c. 1.3 to 2m apart. About half of these possible ditches appear to partially coincide with the gaps between the hard material making up GPR14 and therefore the two may be connected. GPR19 may be relatively modern in origin or associated with agricultural or historic drainage ditches.	✓	
GPR20	Shallow depth – oval area of raised amplitude	715455.532,737353.453			✓				A possible hard or compacted feature in the northern section of the pitch, measuring c.8.4m x 3.6m.	✓	
GPR21	Deep depth – curvilinear anomaly of raised amplitude	715480.090,737356.132			✓			✓	A hard or compacted feature cutting across the northeastern corner of the survey area, measuring c. 9.4m NW-SE. Due to the proximity to a manhole this anomaly is likely to be related to modern services.	✓	

Method of Assessment:		**Ground Penetrating Radar**								**Site:**	**Homefarm**
Site Description:		Greenfield sports ground enclosed by thick metal railing and containing metal goal posts at northern and southern ends. The data has been divided for interpretation purposes into three depth ranges. If full depth penetration was achieved then it is anticipated that the shallow depth features are located between c.0m – 1.12m, medium depth = c.1.12m – 2.88m and deep depth = c.2.88m – 4.00m.									
Figure No.:		17, 18, 19 & 20									
No.	Form of Anomaly	ITM (E,N)	Possible Source(s) of Anomaly						Comment	Recommendation	
			Ditch	**Archaeology**	**? Archaeology**	Ferrous	Geology / Soils	Interference / Modern		Test Excavation	Geophysical Survey
GPR22	Shallow depth – linear amplitude anomaly	715462.078,737337.701	✓		✓				A shallow possible ditch, measuring c. 88.7m NE-SW which runs across the width of the sports ground and crosses a number of deeper features.	✓	
GPR23	Medium depth – multiple rectangular or linear anomalies	715467.148,737354.634	✓		✓			✓	Located in the northern half of the survey area GPR23 comprises a series of near parallel rectangular ditch anomalies. These cross anomalies GPR13, 14, 15, 16, 20, 22, 25 & 27. Measuring between 18m and 24m in length, it is possible that these ditches represent a series of divisions which existed before the construction of the sports pitch. Contained within GPR23 are a number of closely spaced (c. 0.5m apart and up to 15m in length) parallel ditches, oriented roughly E-W. These resemble plough furrows, but may also be related to mechanical modification of the ground surface. Further similar but wider spaced ditch features are located several meters to the south. A large linear ditch on the same orientation traverses the survey area to the south. Contained within the centre of GPR23 is a deep compacted earth or stone feature which may also be related.	✓	
GPR24	Deep depth – oval high amplitude anomaly	715474.475,737349.390			✓				Possible pit, grave or disturbed ground, measuring c. 1.4m x 1.5m.	✓	
GPR25	Medium depth – linear amplitude anomaly	715474.155,737335.290	✓		✓			✓	Possible ditch or cut feature, c. 39m in length and running NE-SW. This anomaly crosses GPR16, 23 & 26 and may be archaeological in origin.	✓	
GPR26	Medium depth – linear amplitude anomaly	715446.858,737334.700	✓		✓			✓	Possible ditch or drain running across the width of the survey area in E-W direction. Given its orientation this anomaly is likely to be associated with GPR23.	✓	

Method of Assessment:		**Ground Penetrating Radar**							**Site:**	**Homefarm**	
Site Description:		Greenfield sports ground enclosed by thick metal railing and containing metal goal posts at northern and southern ends. The data has been divided for interpretation purposes into three depth ranges. If full depth penetration was achieved then it is anticipated that the shallow depth features are located between c.0m – 1.12m, medium depth = c.1.12m – 2.88m and deep depth = c.2.88m – 4.00m.									
Figure No.:		17, 18, 19 & 20									
No.	Form of Anomaly	ITM (E,N)	Possible Source(s) of Anomaly						Comment	Recommendation	
			Ditch	**Archaeology**	**? Archaeology**	Ferrous	Geology / Soils	Interference / Modern		Test Excavation	Geophysical Survey
GPR27	Medium depth – curving band of raised amplitude	715456.727,737311.366			✓		✓		A zone of possible archaeological deposits or disturbed ground, curving from the eastern edge of the pitch towards the centre and extending towards south and back towards east from the centre. Maximum dimensions c. 56m NE-SW. A number of possible ditches (GPR 29) and disturbed soil or cut feature (GPR31) are located within this zone.	✓	
GPR28	Medium depth – curvilinear anomaly of low amplitude	715427.090,737298.808	✓		✓				Possible ditch, curving across the pitch, measuring 99m in length. Two segments of this feature are also visible as ditches in the magnetometer data (see M4 & M8). This anomaly is likely to represent an archaeological enclosing element.	✓	
GPR29	Medium depth – multiple linear and curvilinear anomalies	715471.630,737318.73	✓		✓				A series of curving and linear possible ditches which are located within GPR27 and west of it. Ranging from 2.4m to 18.7m in length these features may be archaeological in origin possibly associated with GPR27.	✓	
GPR30	Medium depth – two sub-circular anomalies	715446.839,737313.840	✓		✓				Two sub-circular possible ditch or cut features near the centre of the survey area. These features are located at depth and are therefore not associated with the centre of the sports ground. Possibly archaeological in origin the southern measures c. 3.9m to 5m in diameter with a small gap at the southeastern side, and the other joins it to the north, measuring c. 4.6m x 3.5m in diameter.	✓	
GPR31	Medium depth – cluster of amplitude anomalies	715455.248,737293.301			✓		✓	✓	One isolated possible pit or grave is located on the northern edge of the cluster, c. 1.7m in length. To the south a collection of possible pits, cut features or areas of disturbed ground are located within the zone of possible archaeology (GPR27). A group of four pits interlinked by a trench has been identified, while the largest area may be structural in origin.	✓	

Method of Assessment:		**Ground Penetrating Radar**							**Site:**	**Homefarm**	
Site Description:		Greenfield sports ground enclosed by thick metal railing and containing metal goal posts at northern and southern ends. The data has been divided for interpretation purposes into three depth ranges. If full depth penetration was achieved then it is anticipated that the shallow depth features are located between c.0m – 1.12m, medium depth = c.1.12m – 2.88m and deep depth = c.2.88m – 4.00m.									
Figure No.:		17, 18, 19 & 20									
No.	Form of Anomaly	ITM (E,N)	Possible Source(s) of Anomaly						Comment	Recommendation	
			Ditch	**Archaeology**	**? Archaeology**	Ferrous	Geology / Soils	Interference / Modern		Test Excavation	Geophysical Survey
GPR32	Medium depth – linear amplitude anomaly	715418.411,737305.375			✓				Possible compacted earth or stone feature, bank or surface, measuring c. 23m in length and up to 2.6m wide. This anomaly may form the southern boundary of GPR16, 17 & 19.	✓	
GPR33	Medium depth – Three isolated amplitude anomalies	715427.006,737288.408			✓				Three possible pits, graves or areas of disturbed soil, measuring between 0.8m and 3m in width.	✓	
GPR34	Deep depth – isolated amplitude anomaly	715429.444,737292.129			✓				Possible pit, grave or soil disturbance, c. 1.2m in diameter.	✓	
GPR35	Medium depth – interconnecting linear and curvilinear low amplitude anomalies	715449.289,737285.856 Multiple locations	✓		✓				A number of interconnecting possible archaeological ditches throughout the southern half of the survey area. These anomalies appear to comprise of two arcing interconnecting ditches with a number of radial divisions, the longest segment measuring 52m in length. A number of the larger anomalies coincide with magnetometer anomaly M10, which is a series of interconnecting ditches. The low amplitude nature of all these anomalies suggests that they may contain clay rich soils.	✓	
GPR36	Medium depth – multiple isolated amplitude anomalies	715446.610,737271.791 Multiple locations			✓		✓		A number of isolated possible pits or areas of disturbed soil in the southern section of the pitch, some of which coincide with a zone of potential archaeology (GPR37). A number of anomalies contained within GPR37 and located to the south of GPR35 are slightly larger in formation and could be associated with graves.	✓	
GPR37	Medium depth – amorphous area	715438.070,737272.126			✓		✓		A zone of potential archaeology in the southern section of the survey area, measuring c. 21.5m E-W and 17.6m N-S. This anomaly may be associated with GPR35.	✓	

Method of Assessment:	**Ground Penetrating Radar**								**Site:**	**Homefarm**
Site Description:	Greenfield sports ground enclosed by thick metal railing and containing metal goal posts at northern and southern ends. The data has been divided for interpretation purposes into three depth ranges. If full depth penetration was achieved then it is anticipated that the shallow depth features are located between c.0m – 1.12m, medium depth = c.1.12m – 2.88m and deep depth = c.2.88m – 4.00m.									
Figure No.:	17, 18, 19 & 20									
No.	Form of Anomaly	ITM (E,N)	Possible Source(s) of Anomaly						Comment	Recommendation	
			Ditch	**Archaeology**	**? Archaeology**	Ferrous	Geology / Soils	Interference / Modern		Test Excavation	Geophysical Survey
GPR38	Deep depth – isolated amplitude anomaly	715438.070,737272.126			✓				A small possible pit or disturbed soil within the zone of possible archaeology GPR37.	✓	
GPR39	Medium depth – multiple parallel linear anomalies	715471.220,737289.540 Multiple locations			✓			✓	A number of parallel hard or compacted linear features oriented in E-W direction detected throughout an area measuring roughly 51m N-S by 19.7m E-W. One linear feature bounds this area at the western side and a second linear runs through the eastern portion of this area. These may represent part of a drainage system. Most of these are visible throughout medium depth layers and a few are also visible in deeper depth layers.	✓	
GPR40	Medium depth – linear amplitude anomaly	715463.689,737263.754	✓		✓				A possible ditch, measuring c. 24m NE-SW, which may be archaeological in origin.	✓	
GPR41	Shallow depth – multiple isolated amplitude anomalies	715463.689,737263.754 715441.381,737249.540 715459.739,737244.127 715430.907,737258.013			✓				Six possible pits, graves or areas of disturbed ground located throughout the southern section of the survey area. Measuring between 0.5m and 3.2m in diameter and situated at a shallow depth within the soil these anomalies could be associated with archaeology.	✓	
GPR42	Medium depth – multiple parallel linear amplitude anomalies	715425.494,737264.368 Multiple locations	✓		✓				A number of parallel possible ditches or drains running in NW-SE direction, measuring up to 30m in length.	✓	
GPR43	Deep depth – multiple isolated amplitude anomalies	715427.789,737256.013 715441.204,737260.132 715434.497,737257.660 715438.498,737256.836			✓				Four possible pits, graves or areas of disturbed ground located at a deeper depth within the southern section of the survey area. They measure between 0.6m and 4m in width.	✓	

Method of Assessment:		**Ground Penetrating Radar**								**Site:**	**Homefarm**
Site Description:		Greenfield sports ground enclosed by thick metal railing and containing metal goal posts at northern and southern ends. The data has been divided for interpretation purposes into three depth ranges. If full depth penetration was achieved then it is anticipated that the shallow depth features are located between c.0m – 1.12m, medium depth = c.1.12m – 2.88m and deep depth = c.2.88m – 4.00m.									
Figure No.:		17, 18, 19 & 20									
No.	Form of Anomaly	ITM (E,N)	Possible Source(s) of Anomaly						Comment	Recommendation	
			Ditch	**Archaeology**	**? Archaeology**	Ferrous	Geology / Soils	Interference / Modern		Test Excavation	Geophysical Survey
GPR44	Shallow depth – two isolated amplitude anomalies	715412.251,737265.545 715427.667,737264.368			✓				An area of compacted or hard ground in the southwestern corner of the survey area (c. 8.6m N-S and 4.2m E-W) may be associated with the sports pitch. An oval compacted or hard feature (c. 2m x 3.1m) several metres to the east may be archaeological or relatively modern in origin.	✓	
GPR45	Medium depth – multiple isolated amplitude anomalies	715418.370,737268.840 Multiple locations			✓				Five possible pits, graves or disturbed soil located at medium depth levels within the southern section of the survey area. They measure between 0.6m and 3.5m in diameter.	✓	
GPR46	Shallow depth – multiple curvilinear and linear anomalies	715431.138,737256.568 Multiple locations	✓		✓				A number of possible ditches situated at a shallow depth within the southern section of the survey area and measuring up to 27m in length. these may be archaeological or associated with the construction of the sports pitch.	✓	
GPR47	Medium depth – two isolated irregular amplitude anomalies	715432.668,737249.50 715448.791,77256.333			✓				Two compacted earth or stone features, measuring c. 5m x 1.3m and 3.4m x 1.6m. They may be associated with archaeological deposits	✓	
GPR48	Medium depth – two linear amplitude anomalies	715446.205,737247.026 715453.187,737243.967			✓			✓	Two possible hard or compacted features, c. 2.7m and 3.3m in length, which may be associated with GPR49.	✓	
GPR49	Medium depth – sub-rectangular / linear anomalies	715456.142,737246.582			✓				A number of linear features comprising of disturbed ground or cut features. The anomalies form a sub-rectangular alignment with sub-divisions and measure in total c. 9.6m NW-SE by 3.2m NE-SW. These features may be structural in origin.		
Note									Several features visible in the top layers of the radar data were not marked in this report as they relate to the sports pitch layout, including the centre point, goal keeper's position and pitch layout marked in white paint on the ground.		

3.4 Mater

Method of Assessment:		**Magnetometer**							**Site:**	**Mater**	
Site Description:		Flat landscaped park containing short grass, trees, vegetation, metallic sculptures and gravel paths									
Figure No.:		21 & 22									
No.	Form of Anomaly	ITM (E,N)	Possible Source(s) of Anomaly						Comment	Recommendation	
			Ditch	**Archaeology**	**? Archaeology**	Ferrous	Geology / Soils	Interference / Modern		Test Excavation	Geophysical Survey
	Areas of very strong magnetic responses	Throughout the survey area						✓	The highly magnetic responses along the edges of the survey area were caused mainly by the iron fence surrounding the park; however, there are also electricity cables and lights beside the trees along the fence. There is a metal sculpture connected to an underground gas pipe which shows up as highly magnetic disturbance in the northwest portion of the survey area. Further metallic remains and possible electric cables have been detected in the form of highly magnetic disturbance. Other isolated dipoles anomalies located in the centre of the survey area are likely caused by buried metal objects of modern origin. Overall the high level of magnetic disturbance may have masked any potential archaeology present.		

Method of Assessment:	**Resistivity**								**Site:**	**Mater**
Site Description:	Flat landscaped park containing short grass, trees, vegetation, metallic sculptures and gravel paths									
Figure No.:	23 & 24									
No.	Form of Anomaly	ITM (E,N)	Possible Source(s) of Anomaly						Comment	Recommendation	
			Ditch	**Archaeology**	**? Archaeology**	Ferrous	Geology / Soils	Interference / Modern		Test Excavation	Geophysical Survey
R1	Three isolated high resistivity anomalies	715182.131,735711.312 715182.040,735706.722 715186.393,735700.849			✓			✓	Three areas of compacted earth or stone located around the upstanding cross monument in the northern corner of the survey area. Two large area measuring c. 10.2m x 4.3m and 8.7m x 4.2m and one small area c. 1.6m in diameter. It is likely that these anomalies are associated with the monument or park construction.	✓	
R2	Two isolated low resistivity anomalies	715193.200,735706.490 715198.450,735705.685			✓			✓	Two possible dug features in the northern section of the survey area. One measuring c. 6.6m x 2.5m and the other is c. 2m in diameter. These are located adjacent or under the present pathway within the park. They could be archaeological in origin or associated with the construction of the park.	✓	
R3	Three isolated raised resistivity anomalies	715202.043,735694.216 715198.865,735702.922 715192.163,735692.627			✓			✓	Two large (11.7m x 3.9m and 9.7m x 3m) and one small (c. 1.2m diameter) area of compacted earth or stone which may be archaeological in origin or associated with the construction of the park.	✓	
R4	Raised resistivity linear	715198.761,735675.033						✓	Linear compacted earth or stone feature measuring c. 62m in length which coincides with the location of the path along the southwestern edge of the park. It is likely that this anomaly has been caused by the path or its foundations.		
R5	Raised resistivity linear	715224.738,735692.210						✓	Linear compacted earth or stone feature measuring c. 32.5m in length and coinciding with the location of the path along the northern edge of the park. It is likely that this anomaly has been caused by the path or its foundations.		
R6	Two interconnecting low resistivity linears	715198.932,735680.084	✓					✓	Possible shallow ditches measuring c. 62m NW-SE and 15m NE-SW. They run along the side of the present day paths and although they could be archaeological in origin it is more likely to be associated with the park construction or park services.	✓	

Method of Assessment:	**Resistivity**								**Site:**	**Mater**
Site Description:	Flat landscaped park containing short grass, trees, vegetation, metallic sculptures and gravel paths									
Figure No.:	23 & 24									
No.	Form of Anomaly	ITM (E,N)	Possible Source(s) of Anomaly						Comment	Recommendation	
			Ditch	**Archaeology**	**? Archaeology**	Ferrous	Geology / Soils	Interference / Modern		Test Excavation	Geophysical Survey
R7	Low resistivity linear	715221.318,735690.655							Possible shallow ditch measuring c. 26m in length and running along the path along the northern edge of the park. This feature is similar in origin to R6.	✓	
R8	Three linear and curvilinear raised resistivity anomalies	715229.558,735680.239 715221.007,735687.701 715198.932,735686.613			✓		✓	✓	Three compacted earth or stone features up to 29m in length. These may be associated with a former park layout or archaeological features.	✓	
R9	Multiple isolated low resistivity anomalies	715216.654,735670.290 Multiple locations			✓		✓	✓	A number of isolated possible ditches cut features or pits which are located within the central area of the park. They range from 0.9m to 10.3m in width and may be associated with archaeological remains or a former park layout. It is possible that some of the anomalies represent former flowerbed alignments.	✓	
R10	Multiple isolated high resistivity anomalies	715213.571,735664.149 Multiple locations			✓		✓	✓	Four areas of compacted earth or soil near the central area of the park, ranging from 1m to 12m in width. These anomalies may be archaeological in origin but are more likely to represent a former park layout. It is possible that some of the anomalies represent former flowerbed or path alignments.	✓	
R11	Multiple low resistivity curvilinear anomalies	715228.210,735677.830	✓		✓		✓	✓	A number of possible ditches, cut features or areas of disturbed soil, measuring up to 13.7m in length. These anomalies may be associated with archaeological remains or a former park layout. It is possible that some of the anomalies represent former flowerbed alignments.	✓	
	Areas of very high resistivity disturbance	Along the edges of the survey area and around sculpture						✓	Modern interference around the edges of the survey area is caused by a combination of fencing materials and foundations, underground cables or services along the edges of the. Interference within the centre of the pathways is caused by a central gas-sculpture.		

3.5 St. Stephen's Green Park (East)

Method of Assessment:		**Magnetometer**							**Site:**	**St. Stephen's Green**
Site Description:		Landscaped public park containing areas of trees and shrubs as well as tarmac paths bounded by iron railings and benches.								
Figure No.:		25 & 26								
No.	Form of Anomaly	ITM (E,N)	Possible Source(s) of Anomaly						Comment	Recommendation	
			Ditch	**Archaeology**	**? Archaeology**	Ferrous	Geology / Soils	Interference / Modern		Test Excavation	Geophysical Survey
M1	Weakly magnetic linear	716055.637,733304.293	✓		✓			✓	Possible ditch or cut feature, c. 23m E-W. May be archaeology or associated with landscape or park works.	✓	
M2	Weakly magnetic linear	716061.303,733295.740	✓		✓			✓	Possible ditch or cut feature, c. 9m E-W. May be archaeology or associated with landscape or park works.	✓	
M3	Two parallel weakly magnetic linears	716062.566,733262.598 716061.934,733258.495	✓		✓			✓	Two possible ditches or cut features, c. 3m and 4m E-W. May be archaeology or associated with landscape or park maintenance.	✓	
	Areas of very strong magnetic responses	Throughout survey area						✓	The magnetometer data collected over the majority of the surveyed area produced very strong magnetic responses. This is due to above ground park furniture such as iron railings along the paths, iron fences, benches, bins and lamp posts. All of these are highly magnetic and have resulted in large areas producing maximum data ranges. Further to this, there are a large number of isolated highly magnetic responses within the lawn areas. These are likely caused by buried ferrous objects, manhole covers and modern disturbance/debris. Overall the level of high magnetic disturbance has likely masked any potential archaeology present.		

4 Conclusion

4.1 Summary of Results

The geophysical surveys undertaken for this report have investigated five different areas in advance of MetroLink. At Lissenhall a previously unknown D-shaped enclosure was detected, which has been cut by a larger service pipe and a series of internal pits, divisions and a possible stone or bank feature were also detected. The surveys indicate that this enclosure may link to further features to the north with the detection of a zone of raised magnetism and possible pits. Further potential archaeological remains were detected at Lissenhall, including arcing ditches, pits and arcing compacted earth or stone features.

The Turnapin surveys revealed a landscape which has been heavily impacted by relatively modern agricultural processes. A series of relict field boundaries and land drains were detected as well as evidence of green manure. Between these features a number of arcing ditches, trends and stone or compacted earth features were detected which could be archaeological or agricultural. Three potential enclosure ditches were also identified throughout the survey area, these appear to contain possible pits and an area of enhancement.

The survey undertaken at Homefarm revealed a landscape which contains numerous potential archaeological deposits. The northern end of the pitch is dominated by enclosing ditches, zones of compacted earth or stone which may be structural in origin and a number of possible pits or graves. To the south a series of arcing and interconnecting ditches were detected. A large outer enclosure ditch traverses the area and within this a number of archaeological ditches, possible pits or graves and zones of potential archaeological deposits can be seen. The most significant being two arcing interconnecting ditches with radial features which was detected in both surveys. This feature is likely to represent an archaeological enclosure and is likely to be associated with a number of pits, graves or post holes.

Surveys undertaken at the Mater Hospital revealed a landscape dominated by modern disturbance. In addition a number of ditches and compacted earth features were detected which could be archaeological in origin, but are more likely to be associated with the construction of the park or relict flowerbeds. Within St. Stephen's Green (East) four possible ditches were detected as well a large amount of modern metallic disturbance.

4.2 Dissemination

The results of this survey were submitted to Jacobs Engineering/TII. Additional copies will be distributed in accordance with the Consent to use a Detection Device (see Appendix 2).

5 Acknowledgements

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7 Tables

8 Figures

Technical Appendix

Appendix 1: Anomaly Classifications

Magnetometer

Magnetometer surveys are undertaken using magnetic gradiometers which measure the magnetic content of the underlying soils. Measurements are gained using sensors which calculate the difference between the geological / pedological background and anthropogenic remains associated with archaeological activity.

Positive Magnetic Anomalies
Burnt features, particularly kilns, but also hearths, furnaces and burnt (specifically 'burnt', not 'heated') mounds of stone will create a strongly magnetic anomaly due to thermoremanence. Cut features, such as pits, ditches or wooden postholes will create anomalies that will vary in shape and magnetic intensity depending on which material they were backfilled by (Fassbinder 2015). For cut features backfilled (or 'refilled') by

- magnetically enhanced topsoil – the refill will generate a positive magnetic anomaly
- homogeneous topsoil – the refill will generate an anomaly proportional to the size and volume of the archaeological feature.

The magnetic anomaly shape and intensity will also be determined by concentrations of pottery, ash or burned material, solid rocks or other material.

Negative Magnetic Anomalies
Negative magnetic anomalies have a number of causes (Fassbinder 2015):

- The material remains of the archaeological feature may have a lower magnetic susceptibility (MS) than the adjacent topsoil. In some cases the MS of a ditch may appear as both a positive and negative anomaly, reflecting the variable MS of the refill material. Some stone foundations can also appear as weakly magnetic or negative magnetic anomalies.
- If a cut feature is immediately refilled by the same material e.g. a grave cut excavated before a funeral is (almost) immediately refilled by the human body and the same (unaltered) sediment that was excavated before.
- Geochemical processes (see Fassbinder 2015) can alter the magnetic response, e.g. an archaeological feature identified by a positive anomaly can convert to a negative anomaly due to the combination of stagnant moisture and a changing groundwater table.

Dipolar Anomalies
A dipolar anomaly is a response to buried ferrous objects, often in the topsoil. Iron spikes generally are not removed in geophysical data; although often modern in origin (iron agricultural implements, rubbish), they can be indicative of archaeological material.

Absence of Anomalies
It is also possible that archaeological features exist that exhibit no magnetic contrast and hence cannot be identified by magnetometer survey.

Anomaly classification used to interpret Magnetometer data

After Gaffney & Gater (2003) and Gaffney *et al*. (2000).

A known archaeological feature type e.g. Ditch / Wall / Structure etc: An anomaly with a magnetic gradient that contrasts strongly with the surrounding sub-soil, where the presence of a type of archaeological feature is known from supporting evidence.

Archaeology: A linear, curvilinear or isolated anomaly with a magnetic gradient that contrasts strongly with the surrounding sub-soil, without any supporting evidence from another source.

- **Ditch / Wall:** A linear, curvilinear, annular or penannular anomaly with a magnetic gradient that contrasts strongly with the surrounding sub-soil. A positive polarity suggests a ditch; a negative polarity suggests a stone-filled ditch or wall.
- **Burnt Mound / Spread:** A horseshoe or ovoid shaped anomaly with a positive magnetic gradient that contrasts strongly with the surrounding sub-soil. An associated trough may be observed as a positive/negative anomaly, a hearth may also be expected nearby. Isolated responses in the vicinity could represent spreads of (or ploughed out) heat shattered stones.
- **Hearth:** A small isolated area (<2m diameter) of higher magnetic gradient than the surrounding sub-soil (typically >6nT).
- **Pit:** A small isolated area (>1-2m diameter) of moderate to high magnetic gradient, judged to be caused by a pit-type feature with a fill more magnetic than the surrounding soil.

Industrial: An isolated anomaly with a strong positive gradient (>30nT), judged not to be surface iron. This type of anomaly is typically caused by the remains of kilns or furnaces.

Magnetic Enhancement: A broad area of moderate positive magnetic gradient that contrasts with the surrounding sub-soil. May represent cultural noise associated with occupation or soil disturbance, judged to be of archaeological origin.

Ferrous: Dipolar anomalies indicating ferrous responses, judged to be in the near-surface.

Cultivation: Parallel linear responses of positive or negative polarity. Strong responses may indicate added magnetic material (e.g. burnt deposits) as fertiliser. Lower magnetic gradient anomalies 'beneath' the furrow overprint may be obscured. Higher magnetic gradient anomalies may be visualised *in situ* or ploughed out 'beneath' the furrow overprint.

?Archaeology: A linear, curvilinear or isolated anomaly with a magnetic gradient that contrasts weakly with the surrounding sub-soil, without any supporting evidence from another source. Such categories may represent possible archaeological or geological sources.

Modern Disturbance: Area where the ground has been disturbed in the recent past. Characterised by very large magnetic gradients and a high level of noise often accompanied by concentrations of dipolar, near-surface ferrous responses. This category also represents anomalies whose source may lie beyond the survey area, such as fencelines, vehicles or modern buildings.

Modern Pipe: Straight, linear anomaly with very large magnetic gradients alternating regularly between positive and negative polarity.

Previous Excavation?: Area of uniform magnetic signal contained within a well-defined boundary in regions otherwise densely covered with archaeological anomalies.

Geology: Anomalies of possible geomorphological origin.

Electromagnetic Apparent Electrical Resistivity

Electromagnetic instruments transmit an alternating current which induces a primary and subsequently a secondary electromagnetic field which interacts with the underlying soils. One of the subsequent responses is the Apparent Electrical Conductivity of the soil, which are subsequently calculated via automated software to Apparent Electrical Resistivity (ER_a).

Anomaly classification used to interpret ER_a data

After Gaffney & Gater (2003) and Gaffney *et al*. (2000).

A known archaeological feature type e.g. Ditch / Wall / Structure etc: An anomaly with a ER_a that contrasts strongly with the surrounding sub-soil, where the presence of a type of archaeological feature is known from supporting evidence.

Archaeology: A linear, curvilinear or isolated anomaly with an ER_a that contrasts strongly with the surrounding sub-soil, without any supporting evidence from another source.

- **Ditch / Wall:** A discrete linear, curvilinear, annular or penannular anomaly with an ER_a that contrasts strongly with the surrounding sub-soil. A low ER_a suggests a ditch; a high ER_a suggests a stone-filled ditch or wall.
- **Mound of Stones:** A discrete horseshoe or ovoid shaped anomaly with a higher ER_a than the surrounding sub-soil.
- **Pit:** A small isolated area (>1-2m diameter) of ER_a that contrasts with the surrounding sub-soil, judged to be caused by a pit-type feature.
- **Cultivation:** Parallel linear responses of high or low ER_a.
- **Disturbed Soil:** A broad area of moderate ER_a change that contrasts with the surrounding sub-soil. May represent cultural noise associated with soil disturbance, judged to be of archaeological origin.

High ER_a Anomalies
Soils comprised of materials of a higher ER_a than the surrounding soil will exhibit anomalies of 'higher resistivity'. These are likely to include stone walls, masonry, rubble, cobbled or gravel surfaces, as well as near surface geology.

Low ER_a Anomalies
Soils that are comprised of materials of a lower ER_a than the surrounding soil will exhibit anomalies of 'lower resistivity'. These are likely to include ditches, drainage ditches and pits, as well as palaeochannels, drained soils, a high water table, deep topsoil, springs, boggy areas, areas adjacent to rivers and clay soils.

Modern Disturbance: Area where the ground has been disturbed in the recent past. Characterised by very large ER_a gradients and a high level of noise.

Modern Pipe: Straight, linear anomaly with an ER_a contrast.

Geology: Anomalies of possible geomorphological origin.

Absence of Anomalies
It is also possible that archaeological features exist that exhibit no resistivity contrast and hence cannot be identified by Apparent Electrical Resistivity survey.

Ground Penetrating Radar

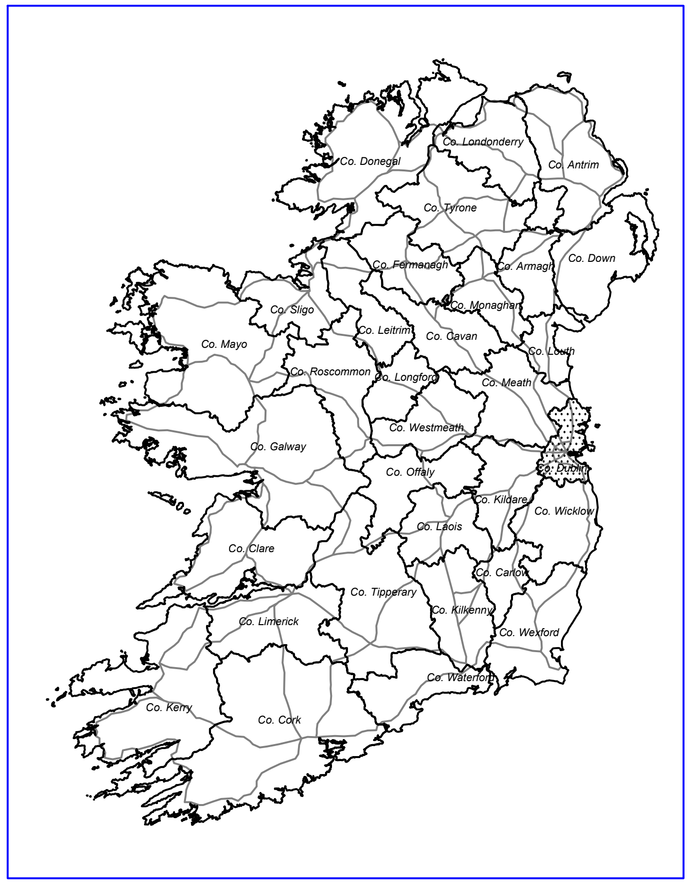
Ground Penetrating Radar (GPR) surveys transmit electromagnetic pulses from a surface antenna into the ground. These radar waves reflect of each interface within the subsoil allowing the detection of buried archaeological features.

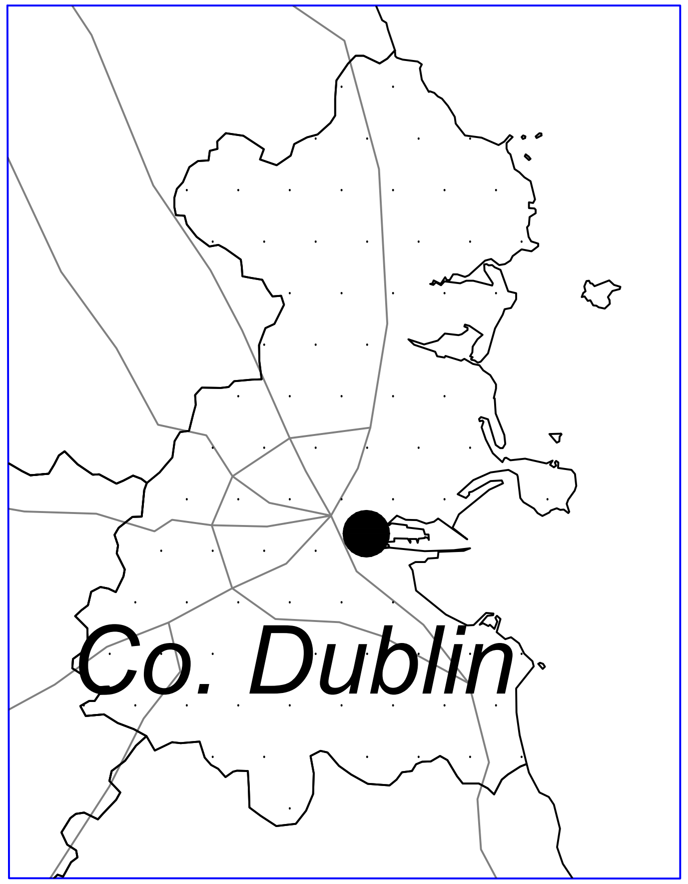
Stone Feature: Soils comprised of materials of a higher amplitude than the surrounding soil. These are likely to include stone walls, masonry, rubble, cobbled or gravel surfaces, as well as near surface geology.

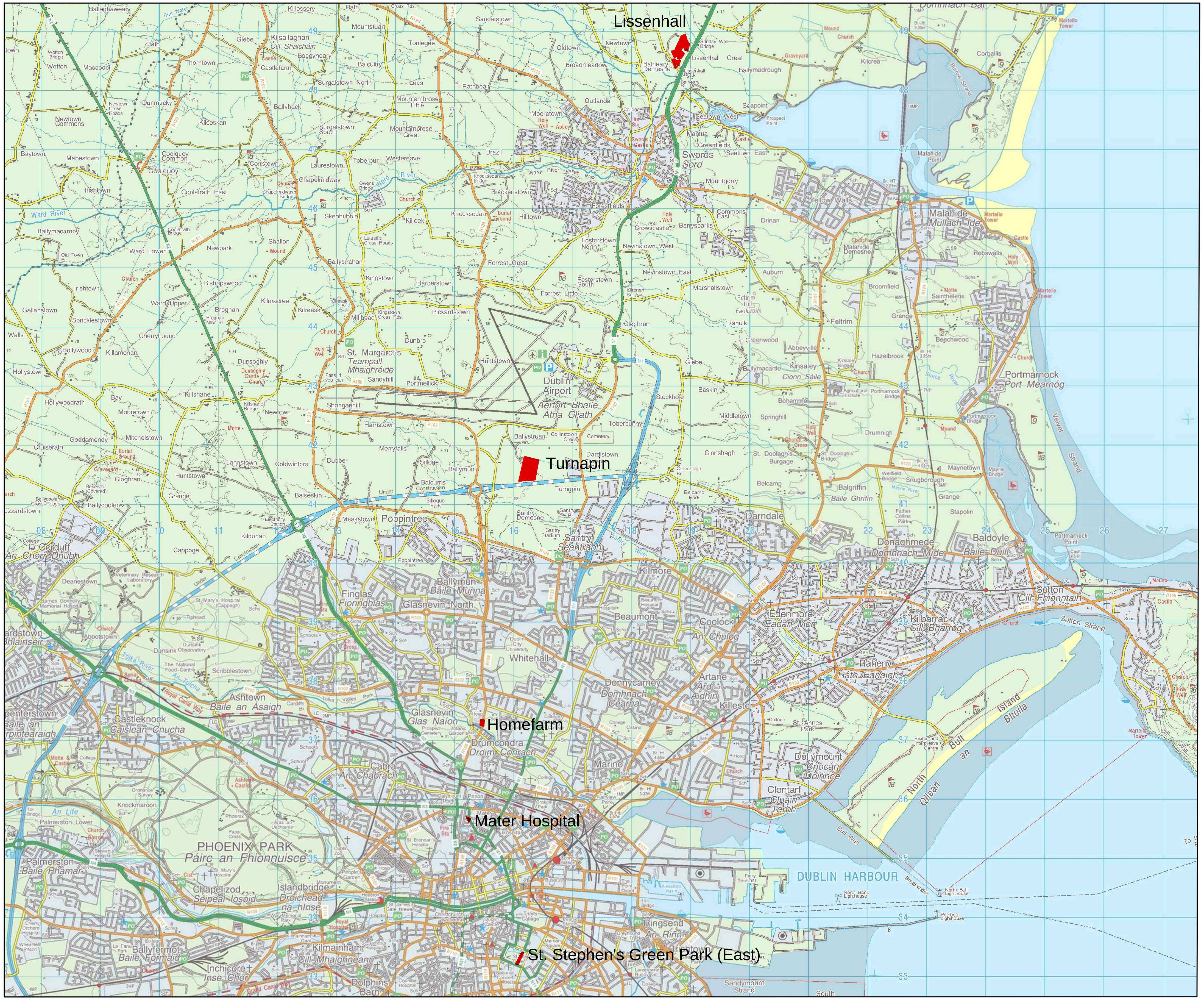
Possible Archaeology: A linear, curvilinear or isolated anomaly that contrasts with the surrounding sub-soil, without any supporting evidence from another source. Such categories may represent possible archaeological or geological sources.

Appendix 2: Geophysical Archive

- Copies of the archive are held by Earthsound Archaeological Geophysics, at separate locations to ensure preservation against accidental damage or theft.
- The Client, Jacobs Engineering/TII, holds further copies of the report.
- A hard copy and a soft copy will be deposited with the Archaeological Licensing Section, National Monuments Service, Department of Culture, Heritage and the Gaeltacht, Room G50, Custom House, Dublin 1.
- A hard copy will be deposited with the National Museum of Ireland, Kildare Street, Dublin 2.







Legend

Geophysical Survey Area

Site Location: MetroLink, Dublin

Client: Jacobs / TII

Drawing Courtesy of: OSI	Date: 04/10/18	Drawing No.: 18-039/01

0m 3km 6km

Figure No. 1: Location Map

EARTHSOUND geophysics

Legend

Basemap

Geophysical Survey Area

N

Site Location: MetroLink, Dublin

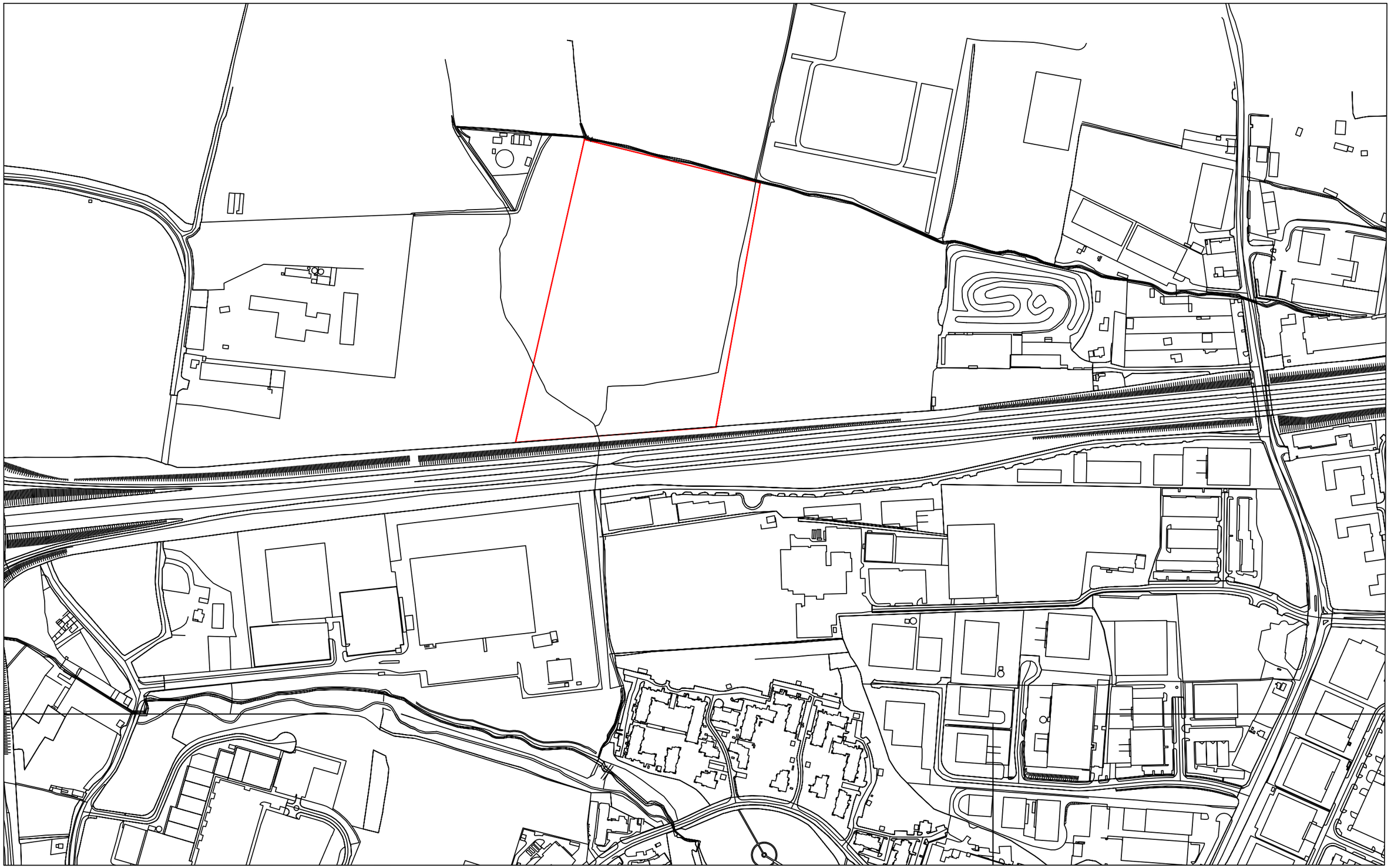
Client: Jacobs / TII

Drawing Courtesy of: IAC Archaeology	Date: 04/10/18	Drawing No.: 18-039/02

0m 200m 400m

Figure No. 2: Detailed Location Map - Lissenhall

EARTHSOUND geophysics



Legend

- Basemap
- Geophysical Survey Area

Site Location: MetroLink, Dublin

Client: Jacobs / TII

Drawing Courtesy of: IAC Archaeology	Date: 04/10/18	Drawing No.: 18-039/03

0m 200m 400m

Figure No. 3: Detailed Location Map - Turnapin

EARTHSOUND geophysics

Legend

- Basemap
- Geophysical Survey Area

Site Location: MetroLink, Dublin

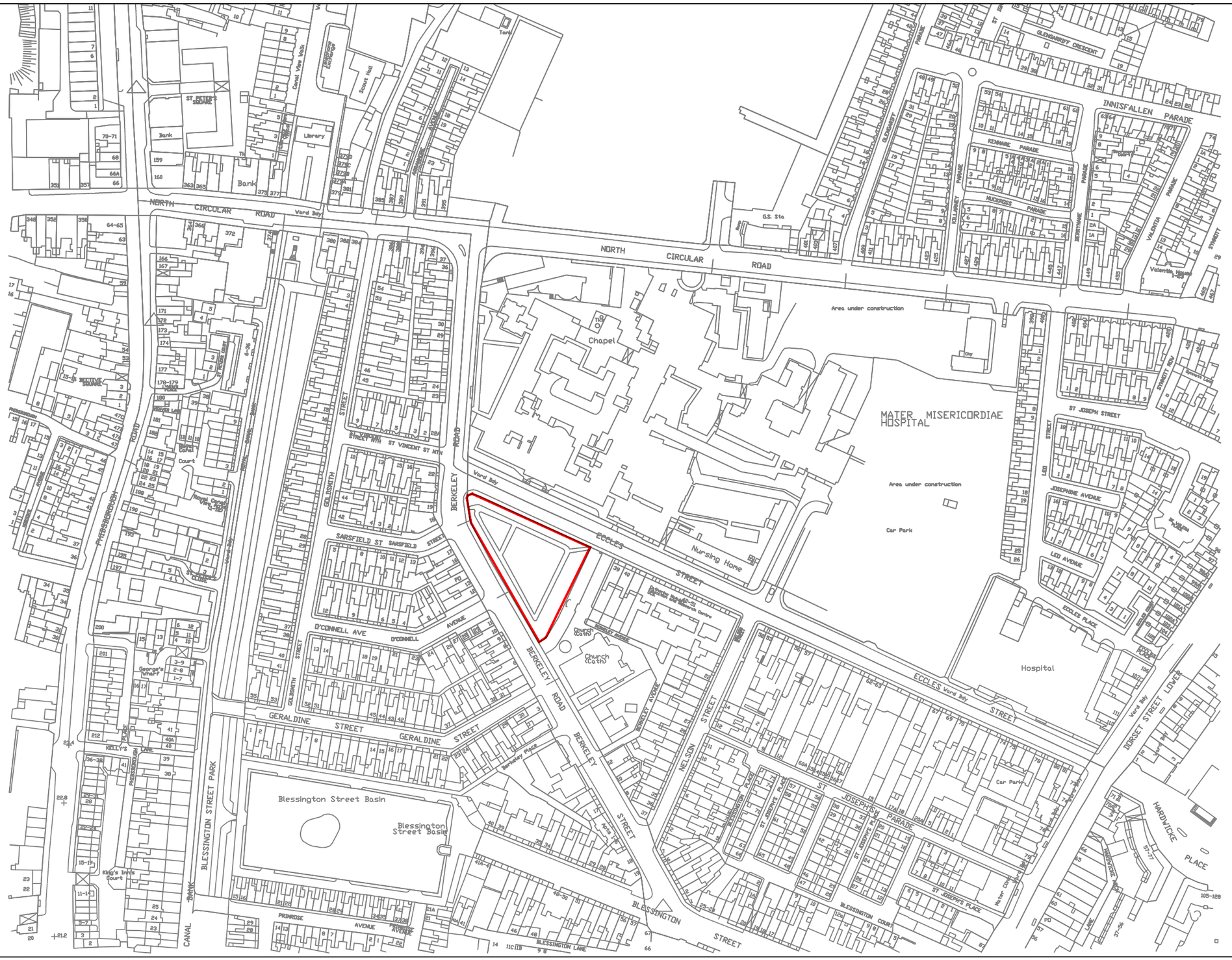
Client: Jacobs / TII

Drawing Courtesy of: IAC Archaeology	Date: 04/10/18	Drawing No.: 18-039/04

0m 100m 200m

Figure No. 4: Detailed Location Map - Homefarm

EARTHSOUND geophysics



Legend

- Basemap
- Geophysical Survey Area

Site Location: MetroLink, Dublin

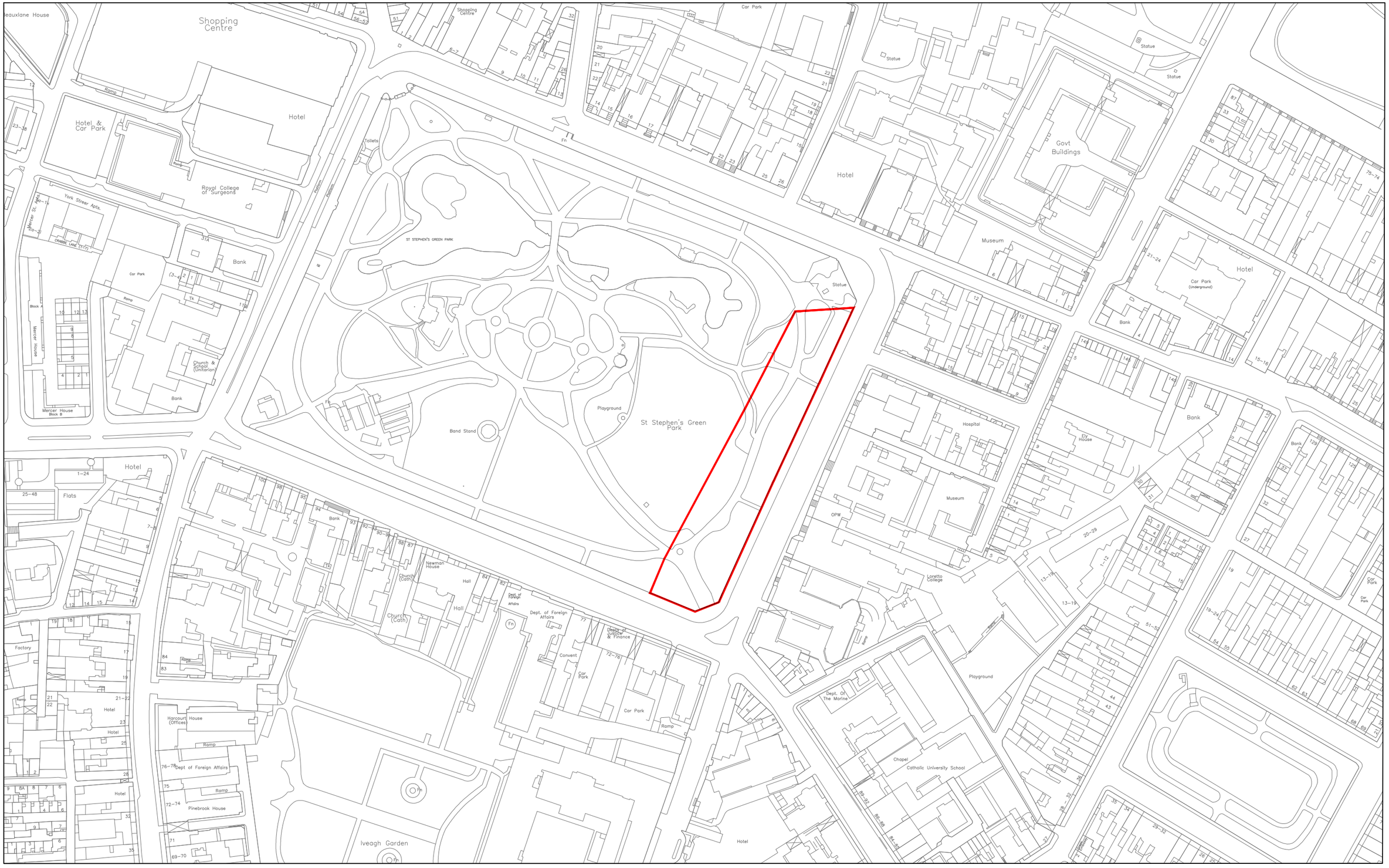
Client: Jacobs / TII

Drawing Courtesy of: IAC Archaeology	Date: 04/10/18	Drawing No.: 18-039/05

0m 100m 200m

Figure No. 5: Detailed Location Map - Mater Hospital

EARTHSOUND geophysics



Legend

- Basemap
- Geophysical Survey Area

Site Location: MetroLink, Dublin

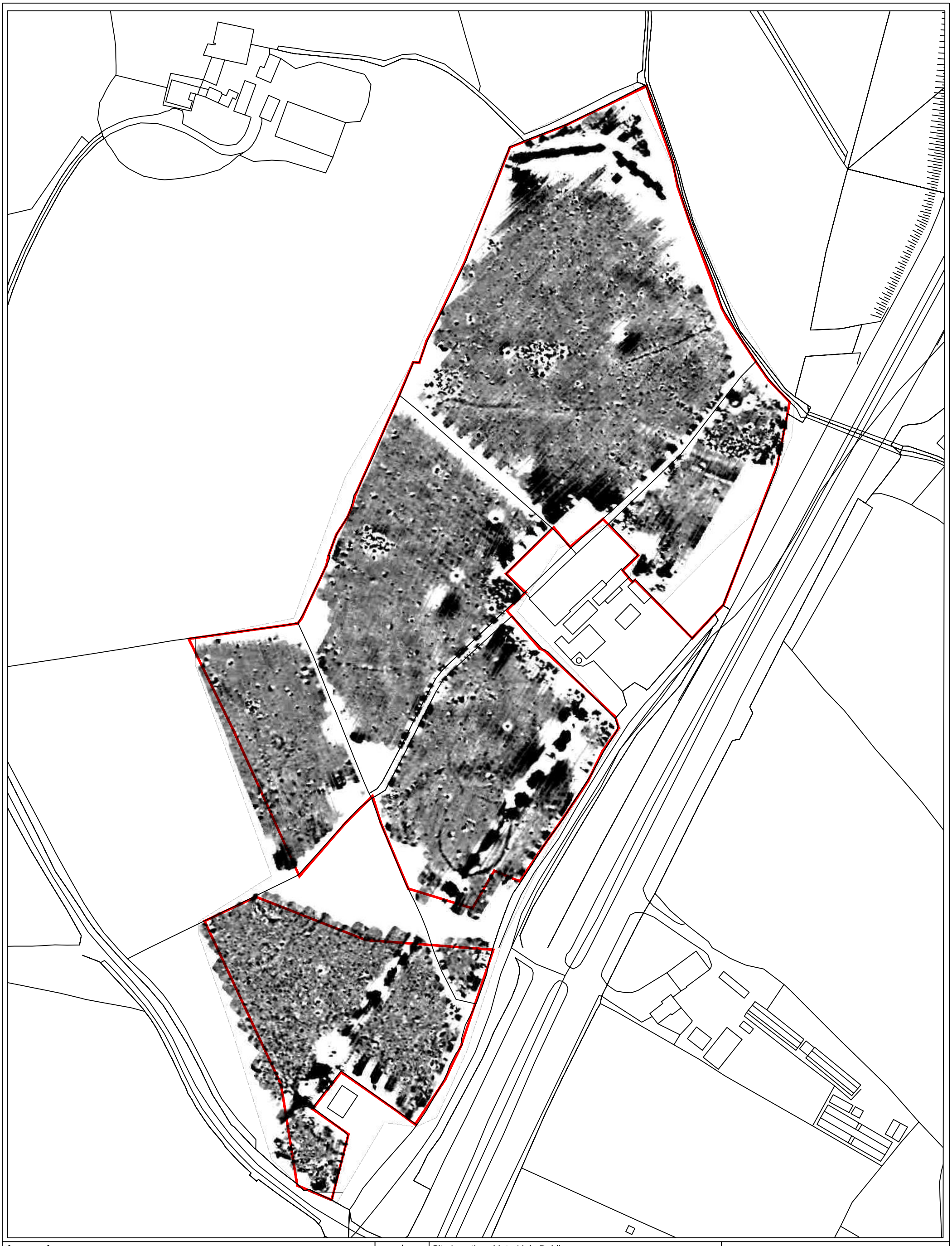
Client: Jacobs / TII

Drawing Courtesy of: IAC Archaeology	Date: 04/10/18	Drawing No.: 18-039/06

0m 100m 200m

Figure No. 6: Detailed Location Map - St. Stephen's Green Park (East)

EARTHSOUND geophysics



Legend

Basemap

Geophysical Survey Area

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-2 0 2

Site Location: MetroLink, Dublin

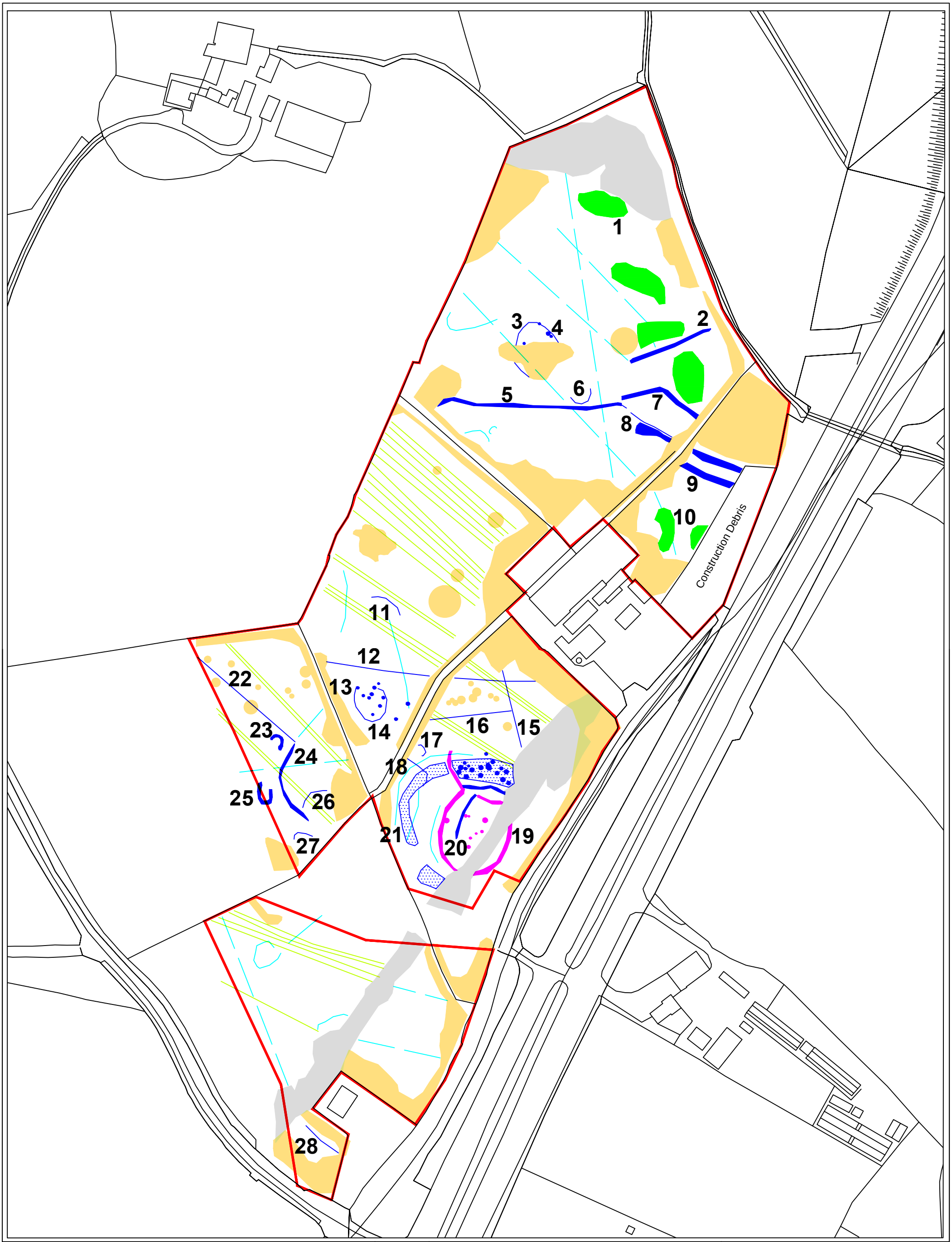
Client: Jacobs / TII

Drawing Courtesy of: IAC Archaeology | Date: 4/10/18 | Drawing No.: 18-039/07

0m 50m 100m

Figure No. 7: Magnetometer Data - Lissenhall

EARTHSOUND geophysics



Legend

- Basemap
- Geophysical Survey Area
- Archaeology
- ? Archaeology
- Industrial
- Magnetic Enhancement
- Trend
- Cultivation
- Modern Disturbance
- Modern Pipe
- Geology
- Feature on Historic OS

N

Site Location: MetroLink, Dublin

Client: Jacobs / TII

Drawing Courtesy of: IAC Archaeology | Date: 4/10/18 | Drawing No.: 18-039/08

0m 50m 100m

Figure No. 8: Magnetometer Intepretation - Lissenhall

EARTHSOUND geophysics

Legend

Basemap

Geophysical Survey Area

mS/m

-2 Standard Deviation 2

Site Location: MetroLink, Dublin

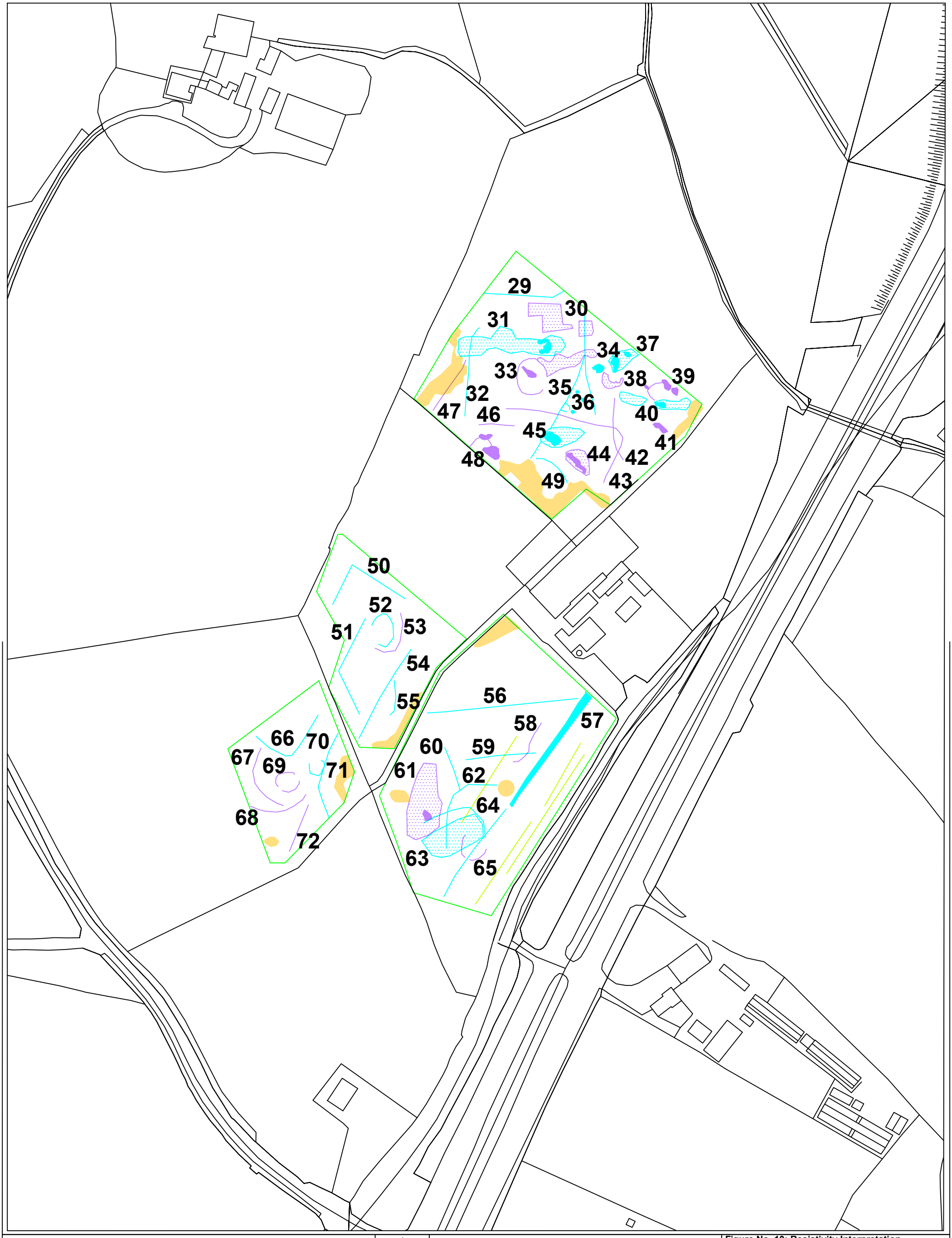
Client: Jacobs / TII

Drawing Courtesy of: IAC Archaeology | Date: 4/10/18 | Drawing No.: 18-039/09

0m 50m 100m

Figure No. 9: Resistivity Data - Lissenhall

EARTHSOUND geophysics



Legend

- Basemap
- Geophysical Survey Area
- Archaeology
- ? Archaeology
- Low ER_a Anomaly
- High ER_a Anomaly
- Cultivation
- Modern Disturbance
- Modern Pipe or Land Drain
- Geology
- Feature on Historic OS

N

Site Location: MetroLink, Dublin

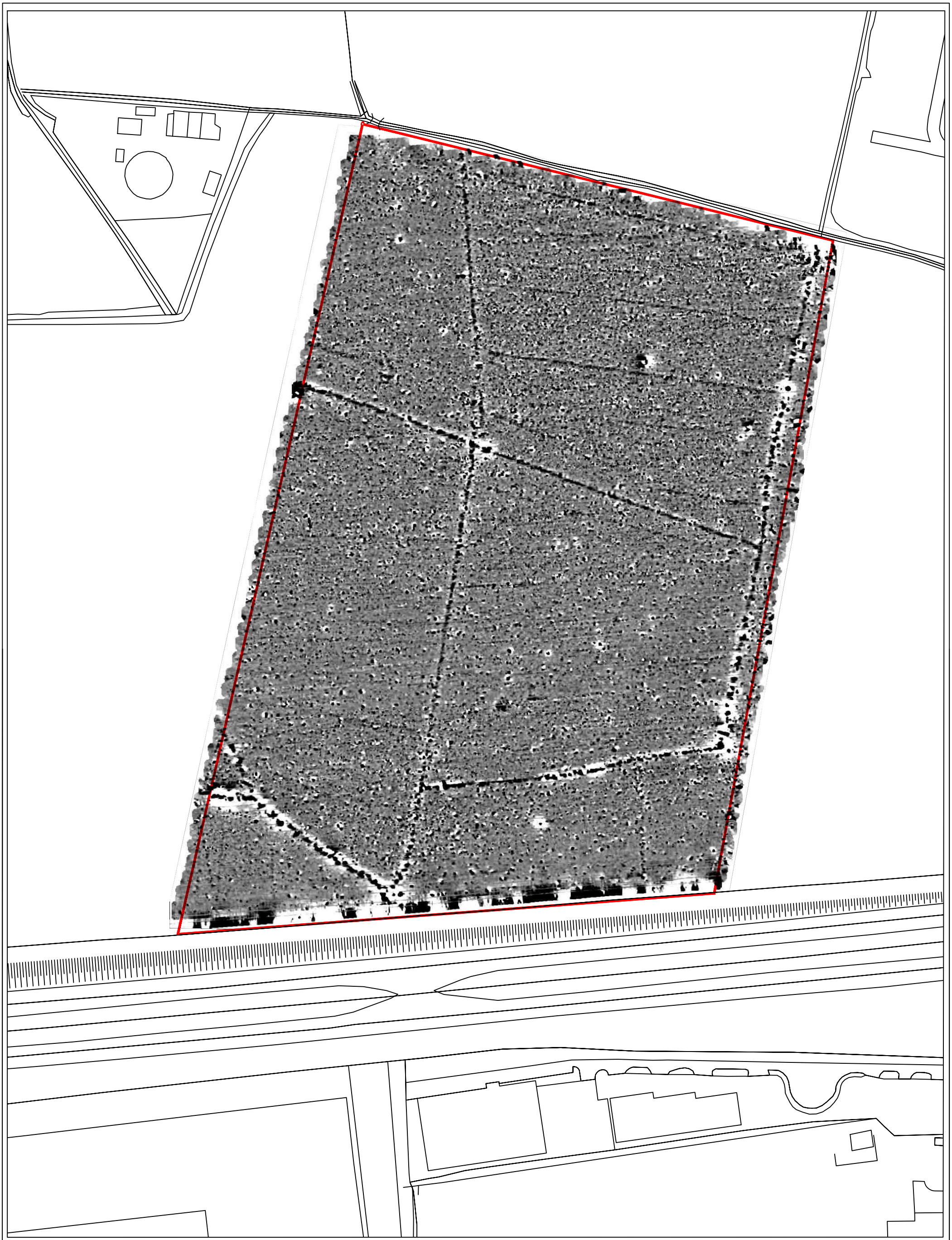
Client: Jacobs / TII

Drawing Courtesy of: IAC Archaeology | Date: 4/10/18 | Drawing No.: 18-039/10

0m 50m 100m

Figure No. 10: Resistivity Interpretation - Lissenhall

EARTHSOUND geophysics



Legend

Basemap

Geophysical Survey Area

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-2 0 2

Site Location: MetroLink, Dublin

Client: Jacobs / TII

Drawing Courtesy of: IAC Archaeology | Date: 22/11/18 | Drawing No.: 18-039/11

0m 50m 100m

Figure No. 11: Magnetometer Data - Turnapin

EARTHSOUND geophysics

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Legend

- Basemap
- Geophysical Survey Area
- Archaeology
- ? Archaeology
- Industrial
- Magnetic Enhancement
- Trend
- Cultivation
- Modern Disturbance
- Modern Pipe
- Geology
- Feature on Historic OS

N

Site Location: MetroLink, Dublin

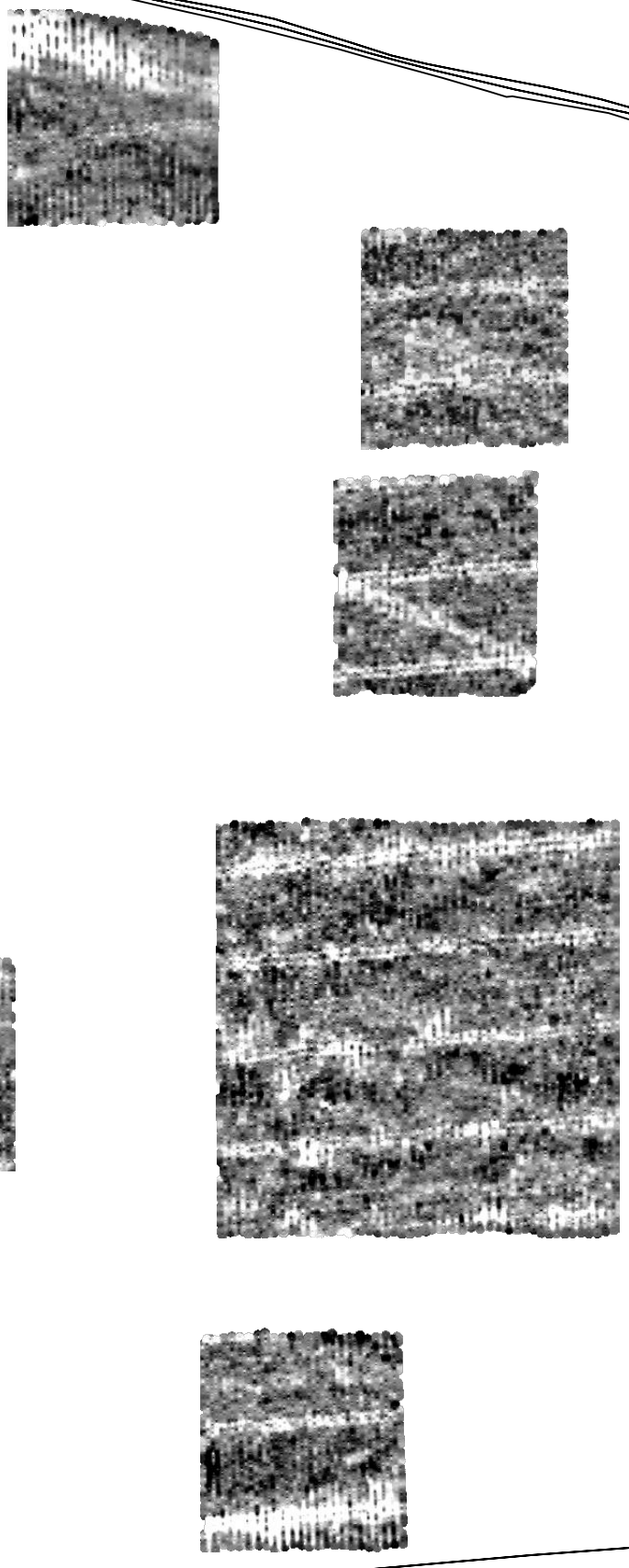
Client: Jacobs / TII

Drawing Courtesy of: IAC Archaeology | Date: 4/10/18 | Drawing No.: 18-039/12

0m 50m 100m

Figure No. 12: Magnetometer Interpretation - Turnapin

EARTHSOUND geophysics



Legend

Basemap

Geophysical Survey Area

mS/m

-2 Standard Deviation 2

Site Location: MetroLink, Dublin

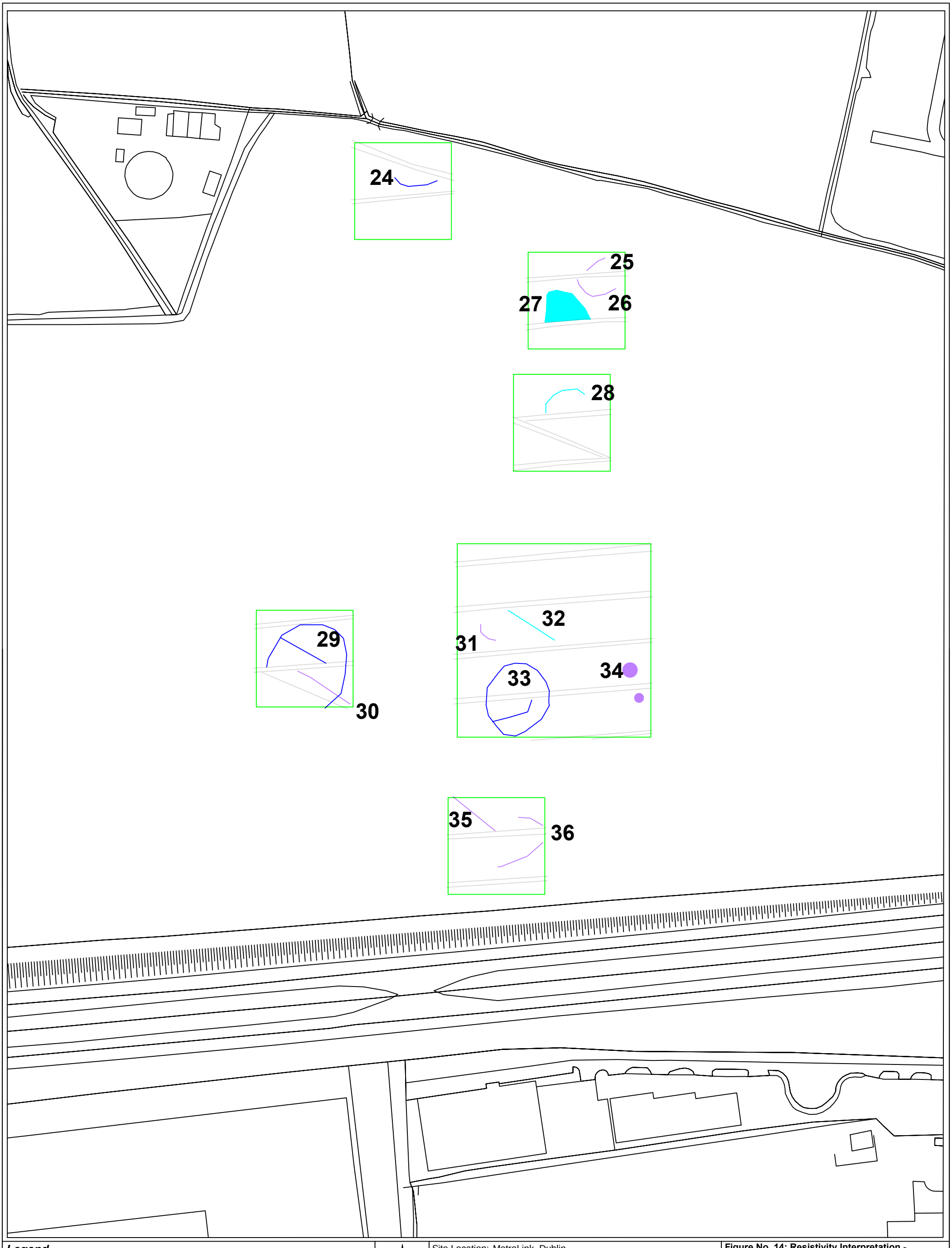
Client: Jacobs / TII

Drawing Courtesy of: IAC Archaeology | Date: 3/12/18 | Drawing No.: 18-039/13

0m 50m 100m

Figure No. 13: Resistivity Data - Turnapin

EARTHSOUND geophysics



Legend

- Basemap
- Geophysical Survey Area
- Archaeology
- ? Archaeology
- Low ER_a Anomaly
- High ER_a Anomaly
- Cultivation
- Modern Disturbance
- Modern Pipe or Land Drain
- Geology
- Feature on Historic OS

N

Site Location: MetroLink, Dublin

Client: Jacobs / TII

Drawing Courtesy of: IAC Archaeology | Date: 4/12/18 | Drawing No.: 18-039/14

0m 50m 100m

Figure No. 14: Resistivity Interpretation - Turnapin

EARTHSOUND geophysics

115

117

23

Ward Bdy

Sports Ground

Legend

Basemap

Geophysical Survey Area

nT

-2 0 2

Site Location: MetroLink, Dublin

Client: Jacobs / TII

Drawing Courtesy of: IAC Archaeology | Date: 4/10/18 | Drawing No.: 18-039/15

0m 10m 20m

Figure No. 15: Magnetometer Data - Homefarm

EARTHSOUND geophysics

115

117

23

Ward Bdy

1

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9

10

Sports Ground

Legend

- Basemap
- Geophysical Survey Area
- Archaeology
- ? Archaeology
- Industrial
- Magnetic Enhancement
- Trend
- Cultivation
- Modern Disturbance
- Modern Pipe
- Geology
- Feature on Historic OS

N

Site Location: MetroLink, Dublin

Client: Jacobs / TII

Drawing Courtesy of: IAC Archaeology | Date: 4/10/18 | Drawing No.: 18-039/16

0m 10m 20m

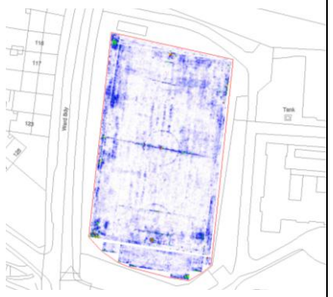
Figure No. 16: Magnetometer Interpretation - Homefarm

EARTHSOUND geophysics

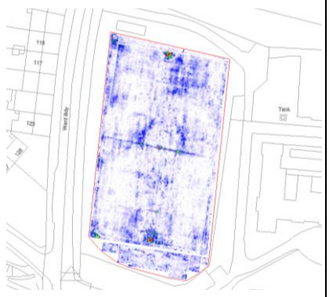
MetroLink, Dublin

Figure 17: Homefarm - Ground Penetrating Radar Amplitude Slice-maps

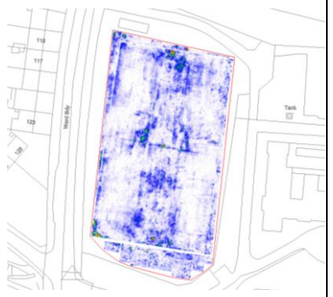
4 – 6ns Amplitude Slice



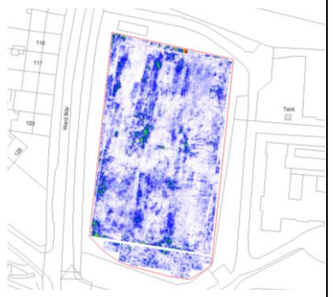
6 – 8ns Amplitude Slice



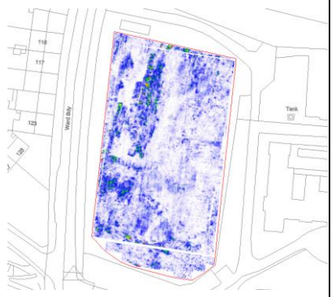
8 – 10ns Amplitude Slice



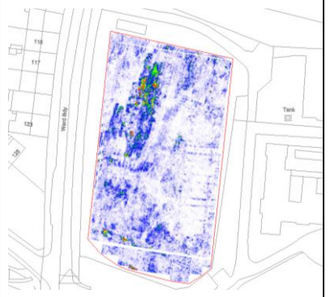
10 – 12ns Amplitude Slice



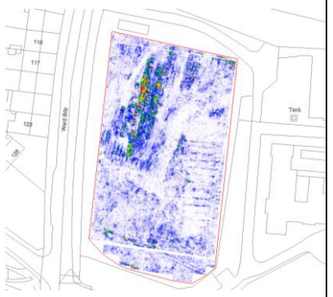
12 – 14ns Amplitude Slice



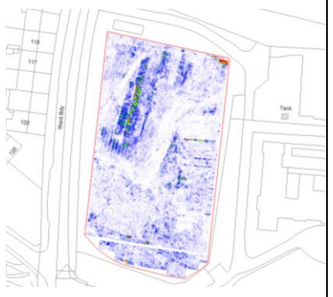
14 – 16ns Amplitude Slice



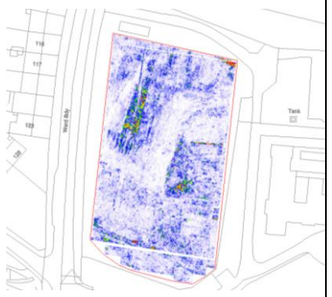
16 – 18ns Amplitude Slice



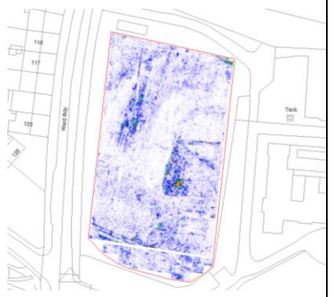
18 – 20ns Amplitude Slice



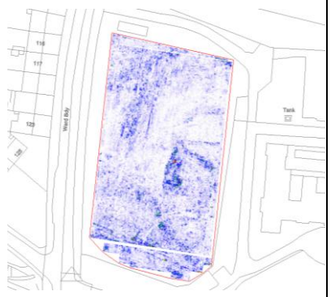
20 – 22ns Amplitude Slice



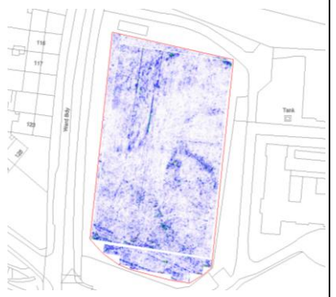
22 – 24ns Amplitude Slice



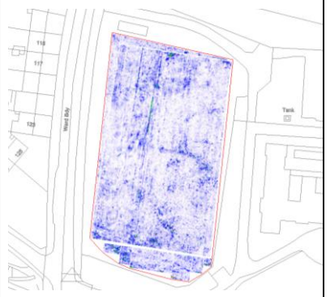
24 – 26ns Amplitude Slice



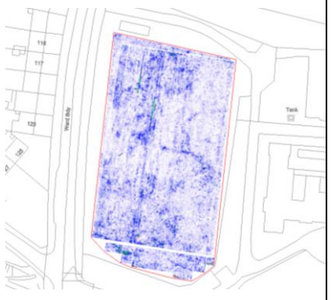
26 – 28ns Amplitude Slice



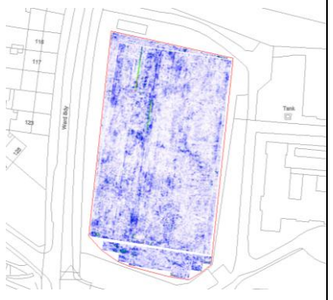
28 – 30ns Amplitude Slice



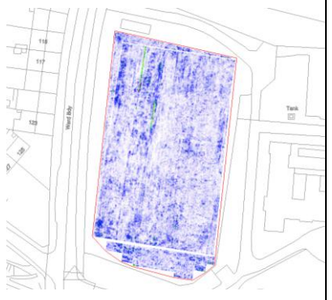
30 – 32ns Amplitude Slice



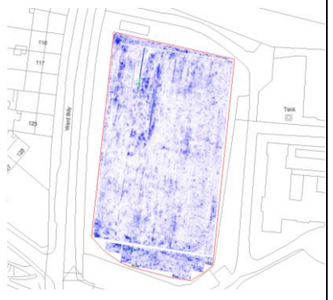
32 – 34ns Amplitude Slice



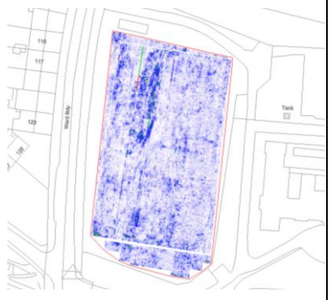
34 – 36ns Amplitude Slice



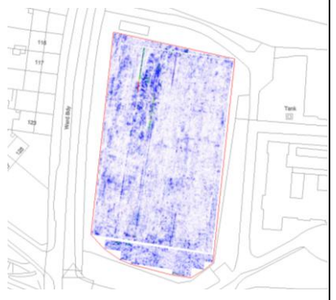
36 – 38ns Amplitude Slice



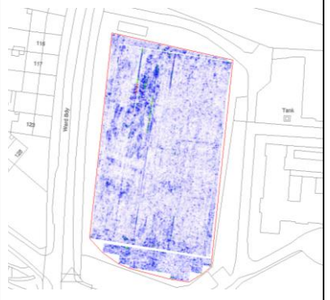
38 – 40ns Amplitude Slice



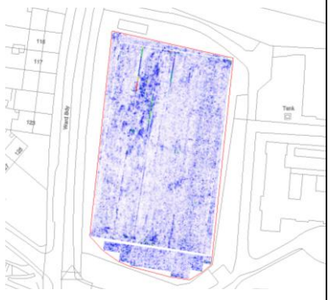
40 – 42ns Amplitude Slice



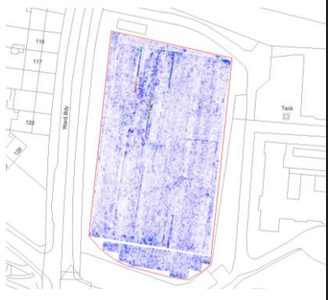
42 – 44ns Amplitude Slice



44 – 46ns Amplitude Slice



46 – 48ns Amplitude Slice



48 – 50ns Amplitude Slice

EARTHSOUND geophysics

115

117

23

Ward Bdy

Sports Ground

Legend

Basemap

Geophysical Survey Area

Min. Amplitude of reflections Max.

0 500

Site Location: MetroLink, Dublin

Client: Jacobs / TII

Drawing Courtesy of: OSI | Date: 13/05/19 | Drawing No.: 19-036/18

0m 10m 20m

Figure No. 18: Ground Penetrating Radar Amlplitude Slice map 18-20ns - Homefarm

EARTHSOUND geophysics

115

117

23

Ward Bdy

Sports Ground

Legend

Basemap

Geophysical Survey Area

Min. Amplitude of reflections Max.

0 500

Site Location: MetroLink, Dublin

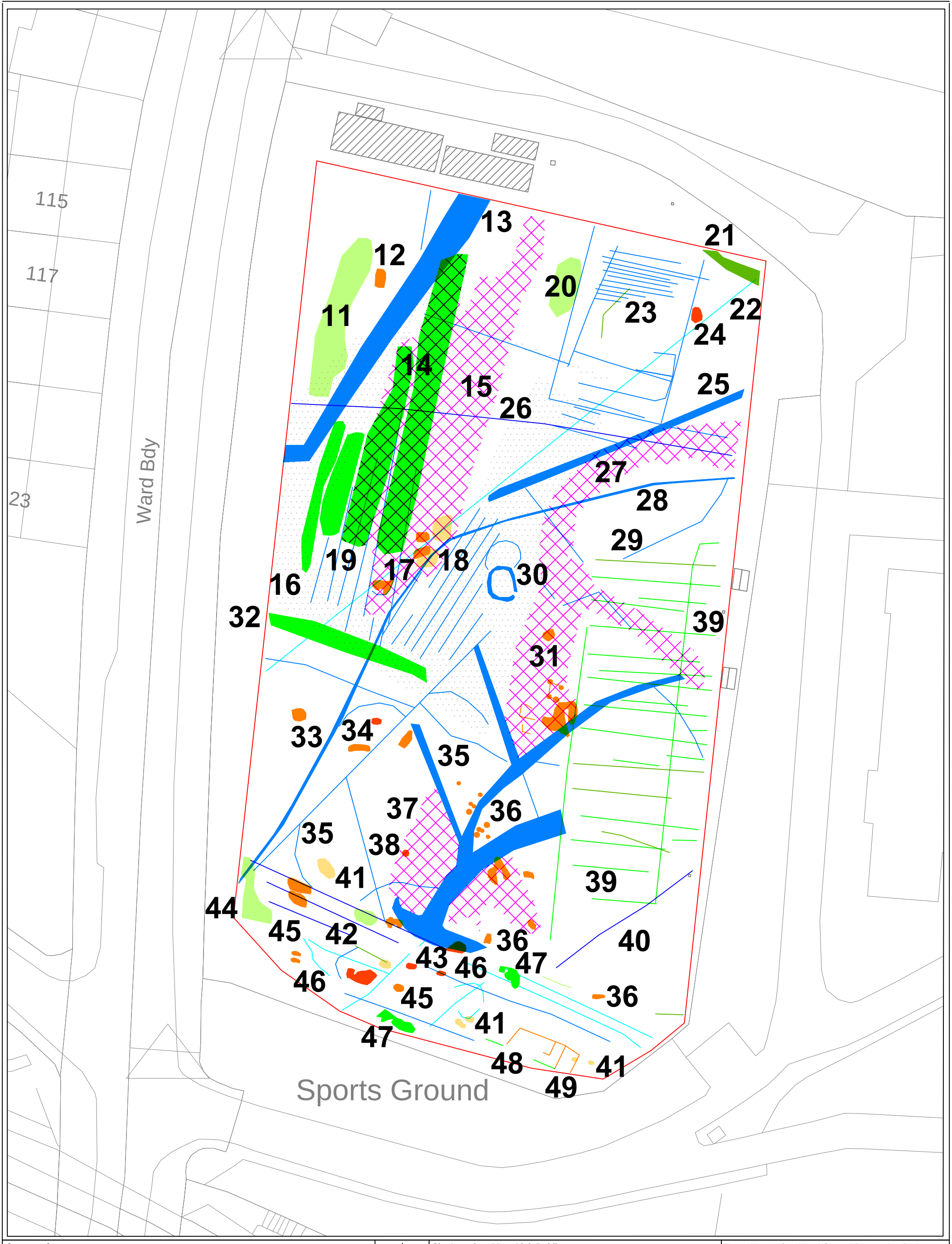
Client: Jacobs / TII

Drawing Courtesy of: OSI | Date: 13/05/19 | Drawing No.: 19-036/19

0m 10m 20m

Figure No. 19: Ground Penetrating Radar Amlplitude Slice map 24-26ns - Homefarm

EARTHSOUND geophysics



Legend

- Basemap
- Geophysical Survey Area
- Shallow Depth - Ditch or Cut Feature
- Medium Depth - Ditch or Cut Feature
- Medium Depth - Ditch or Cut Feature
- Shallow Depth - Pit, Grave or Area of Disturbed Ground
- Medium Depth - Pit, Grave or Area of Disturbed Ground
- Medium Depth - Pit, Grave or Area of Disturbed Ground
- Shallow Depth - Compacted Earth or Stone
- Medium Depth - Compacted Earth or Stone
- Medium Depth - Compacted Earth or Stone
- Medium Depth - Possible Archaeological Zone
- Medium Depth - Quiet Amplitude Area - Possible Clay deposits

Site Location: MetroLink Dublin

Client: Jacobs / TII

Drawing Courtesy of: OSI	Date: 13/05/19	Drawing No.: 18-039/20

0m 10m 20m

Figure No. 20: Combined Ground Penetrating Radar Interpretation - Homefarm

EARTHSOUND geophysics

Legend

Basemap

Geophysical Survey Area

nT

-10 0 10

N

Site Location: MetroLink, Dublin

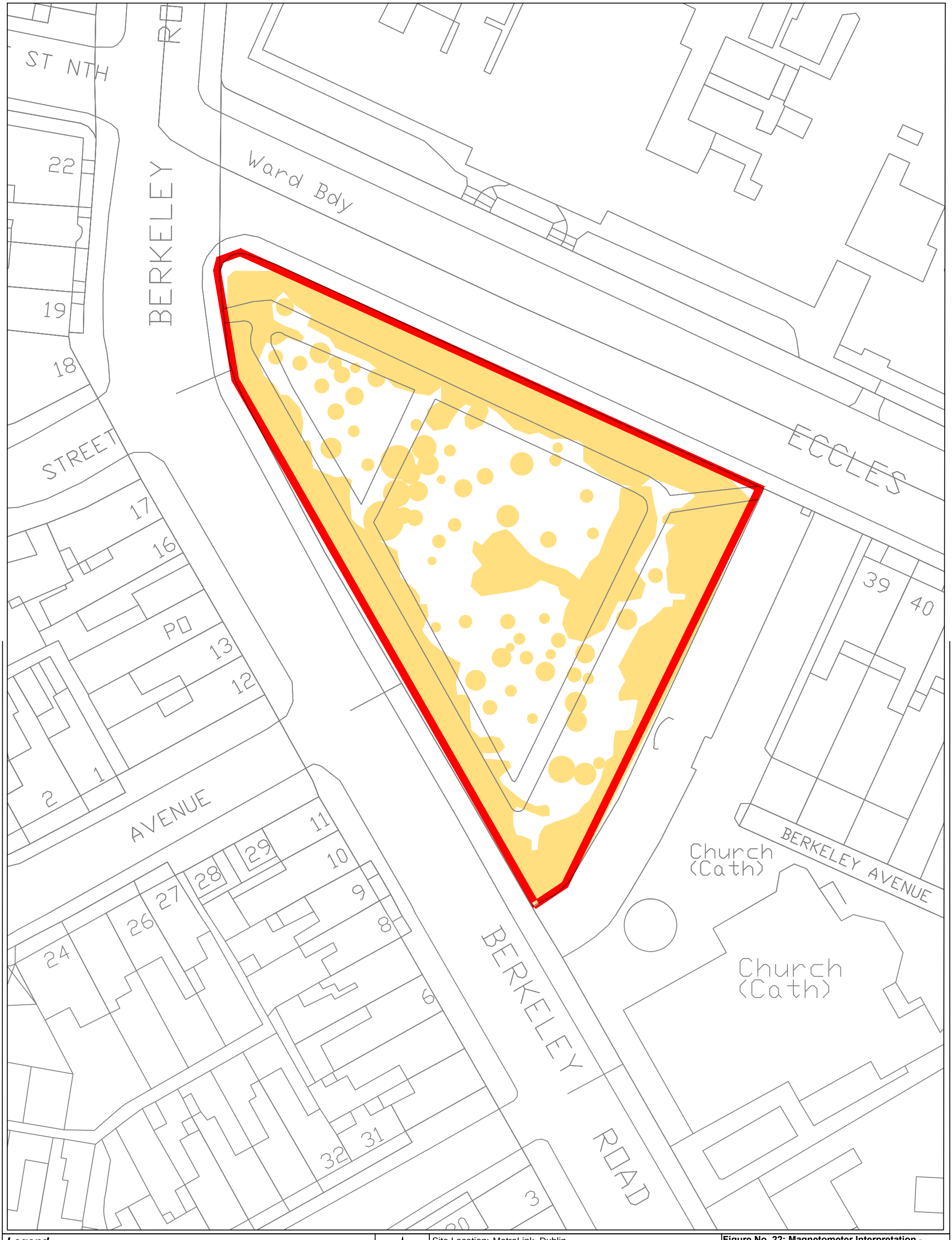
Client: Jacobs / TII

Drawing Courtesy of: IAC Archaeology | Date: 4/10/18 | Drawing No.: 18-039/21

0m 10m 20m

Figure No. 21: Magnetometer Data - Mater Hospital

EARTHSOUND geophysics



Legend

- Basemap
- Geophysical Survey Area
- Archaeology
- ? Archaeology
- Industrial
- Magnetic Enhancement
- Trend
- Cultivation
- Modern Disturbance
- Modern Pipe
- Geology
- Feature on Historic OS

N

Site Location: MetroLink, Dublin

Client: Jaconbs / TII

Drawing Courtesy of: IAC Archaeology | Date: 4/10/18 | Drawing No.: 18-039/22

0m 10m 20m

Figure No. 22: Magnetometer Interpretation - Mater Hospital

EARTHSOUND geophysics

Legend

- Basemap
- Geophysical Survey Area
- Vegetation

mS/m

-2 Standard Deviation 2

Site Location: MetroLink, Dublin

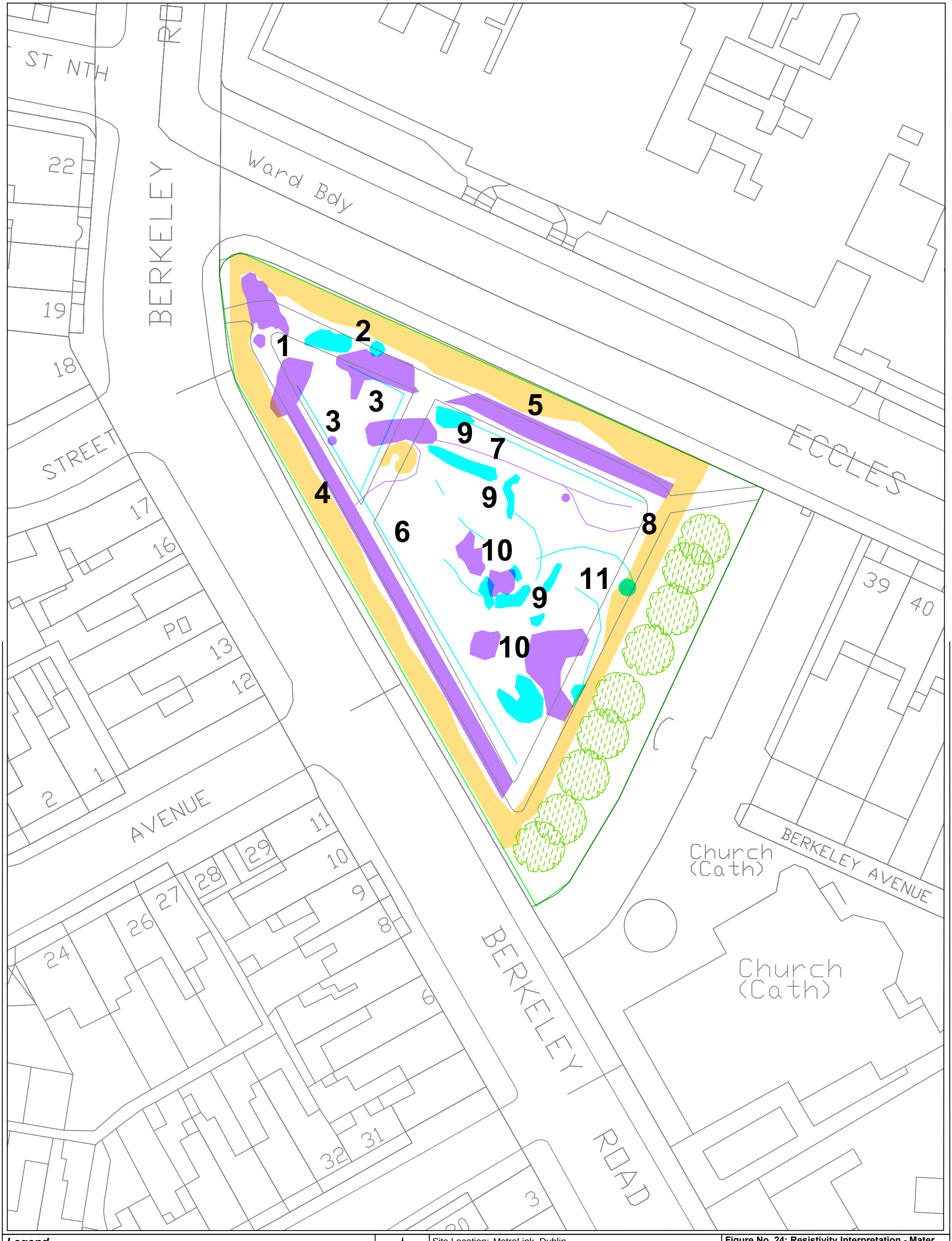
Client: Jacobs / Tii

Drawing Courtesy of: IAC Archaeology | Date: 13/05/19 | Drawing No.: 18-039/23

0m 10m 20m

Figure No. 23: Resistivity Data - Mater Hospital

EARTHSOUND geophysics



Legend

- Basemap
- Geophysical Survey Area
- Vegetation
- Archaeology
- ? Archaeology
- Low ER_a Anomaly
- High ER_a Anomaly
- Cultivation
- Modern Disturbance
- Modern Pipe or Land Drain
- Geology
- Feature on Historic OS

Site Location: MetroLink, Dublin

Client: Jacobs / TII

Drawing Courtesy of: IAC Archaeology | Date: 13/05/19 | Drawing No.: 18-039/24

0m 10m 20m

Figure No. 24: Resistivity Interpretation - Mater Hospital

EARTHSOUND geophysics

Legend

- Basemap
- Geophysical Survey Area
- Vegetation

nT
-10 0 10

Site Location: MetroLink, Dublin

Client: Jacobs / TII

Drawing Courtesy of: IAC Archaeology | Date: 4/10/18 | Drawing No.: 18-039/25

0m 20m 40m

Figure No. 25: Magnetometer Data - St. Stephen's Green Park (East)

EARTHSOUND geophysics

Statue

Playground

St Stephen's Green Park

OPW

1

2

3

Legend

- Basemap
- Geophysical Survey Area
- Vegetation
- Archaeology
- ? Archaeology
- Industrial
- Magnetic Enhancement
- Trend
- Cultivation
- Modern Disturbance
- Modern Pipe
- Geology
- Feature on Historic OS

N

Site Location: MetroLink, Dublin

Client: Jacobs / TII

Drawing Courtesy of: IAC Archaeology | Date: 4/10/18 | Drawing No.: 18-039/26

0m 20m 40m

Figure No. 26: Magnetometer Interpretation - St. Stephen's Green Park (East)

EARTHSOUND geophysics