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Survey Event No. **78**

Survey Name **Land Adjacent to Archaeological Sites at Busherstown 1, Drumbaun 2, Drumroe 1, Killeisk 1 & Park 1, N7 Castletown To Nenagh (Derrinsallagh To Ballintotty) Road**

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There are no known archive issues with this report

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Land Adjacent to Archaeological Sites at Busherstown 1, Drumbaun 2, Drumroe 1, Killeisk 1 & Park 1, N7 Castletown To Nenagh (Derrinsallagh To Ballintotty) Road Scheme, County Offaly & County Tipperary

Archaeological Geophysical Survey

Survey undertaken on behalf of

Eachtra Archaeological Projects

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EAG 153

13 March 2009

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Summary of Results

A series of geophysical surveys commissioned by Eachtra Archaeological Projects was conducted at 5 sites outside the C.P.O. boundary of the new N7 Castletown to Nenagh road scheme. The survey areas were located adjacent to significant archaeological remains that were excavated within the C.P.O. boundary of the road scheme.

A combination of fluxgate gradiometer and magnetic susceptibility surveys were undertaken on the selected sites. The fluxgate gradiometer surveys were undertaken at a sampling resolution of 1 x 0.25 m and magnetic susceptibility survey at a 5 x 5 m sampling resolution.

The bedrock geology along the scheme consists of a mixture of greywacke, siltstone, sandstone and mudstone all of which are suitable for magnetic surveys although very weak magnetic responses were noted across most sites. The majority of the survey areas was covered in short grass or cut crops at the time of survey.

A number of ditches were detected at Busherstown 1 which appear to represent a continuation of the archaeological activity revealed during the excavation. An arcing enclosure ditch has been identified to the south of the excavation.

Three possible ditches were detected across the Drumbaun 2 survey area. These appear to represent a continuation of the possible medieval boundary identified on the northern edge of the excavation. A continuation of a possible prehistoric boundary was also identified. Two possible pits were also identified within the confines of the medieval boundary.

A number of possible ditches were detected at Drumroe 1 which have a direct relationship to the archaeological excavation results. The edge of the probable zone of archaeological activity was also established with the detection of an arcing enclosure ditch.

A continuation to the medieval oval-shaped enclosure ditch was identified at Killeisk 1. The mapped components of the ditched enclosure, from both excavation and geophysics, measures 95 m NW-SE and 41 m NE-SW, enclosing a total area of 0.335 hectares. A continuation of parts of the droveway was also identified along with a number of other possible ditches and a relict field boundary.

A possible boundary ditch was identified at Park 1. The remains of a "finger-shaped" ditch, which could be interpreted as a cursus monument, were also identified on the western edge of the survey area.

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.*

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1 Introduction to the Sites

Earthsound Archaeological Geophysics were commissioned by Eachtra Archaeological Projects to execute a series of geophysical surveys over pre-selected sites located outside the C.P.O. boundary of the new N7 Road Scheme. The survey areas were located adjacent to sites containing archaeological remains that were excavated within the C.P.O. boundary and extend beyond it.

The new N7 road development extends from the eastern edge of the present N7 Nenagh Bypass and ties into the M7 / M8 Portlaoise-Castletown Scheme. The new development terminates south of Borris-in-Ossory. The scheme in total covers a length of 35 km and the work undertaken for this report comprised of land adjacent to Contract 1 (Clashnevin to Castleroan), a 17.1 km section of the road located on the western half of the overall development.

The bedrock geology along the scheme consists of a mixture of greywacke, siltstone, sandstone and mudstone all of which are suitable for magnetic susceptibility and magnetic gradiometer geophysical surveys. However, the majority of archaeological features were magnetically very weak, which reflects a poor contrast between the fill of cut materials and the parent geology. Magnetic susceptibility data were also generally very weak.

Permissions to undertake the geophysical surveys were obtained under ministerial direction from the *Department of the Environment, Heritage and Local Government* (R179).

The geophysical survey was requested to assess the extent of the archaeological remains located outside the C.P.O. boundary. All sites were assessed using magnetic gradiometer and magnetic susceptibility surveys with the exception of Drumbaun 2 where high vegetation prevented the use of the magnetic susceptibility meter.

1.1 Busherstown 1

Located within the townland of Busherstown, the northwest corner of the site (Figure 1) lies at *Ordnance Survey of Ireland* Irish National Grid (ING) Reference E204746 N181956, adjacent to Chainage 13500-13700.

Fieldwork was conducted on the 20th November 2008. The survey area is situated on the top of a small hill and is surrounded on three sides by higher ground, to the north are extensive views of the surrounding bogland. The site drops sharply from the north CPO boundary down to a small but fast flowing stream now forming part of a field boundary.

In the week preceding the geophysical survey, the climatic conditions were cold and wet and this continued during the fieldwork.

The site is located in a landscape which contains ringforts and possible enclosures as well as medieval and post-medieval landscape features.

Archaeological testing of the land within the C.P.O. boundary revealed an area of archaeological potential with a series of pits, kilns, ditches and postholes being exposed. This suggested a complex multiperiod site combining agricultural and industrial processing, a moated site and further habitation remains contained within an enclosing ditch. An extension of this moated site can be seen to the north of the C.P.O. boundary as a topographical depression (Eachtra 2008a).

1.2 Drumbaun 2

Located within the townland of Drumbaun, the northwest corner of the site (Figure 1) lies at *Ordnance Survey of Ireland* Irish National Grid (ING) Reference E204056 N181849, adjacent to Chainage 12900-13050.

The survey area is located on the northern edge of the N7 C.P.O. boundary and is bounded to the north by a field boundary and woodland. The site is located on the top of a hill with good views over looking the surrounding landscape and at the time of survey the land was covered in high pasture.

Fieldwork was conducted on the 5th June 2008. In the week preceding the geophysical survey, the climatic conditions were dry and hot and this continued during fieldwork. The weather is unlikely to have affected the surveys.

The archaeological excavation at Drumbaun 2 revealed a number of phases of activity. Evidence of perhaps the earliest activity is provided by a number of cremation pits at the northern end of the site. Two circular houses (probably Bronze Age in date) and associated pits were excavated at the southern end of the site. A number of additional features were located north-west of these houses. A group of three pits containing iron slag were also excavated north-west of the houses. Several ditches were located at the northeast end of the site (Eachtra 2008b).

1.3 Drumroe 1

Located within the townland of Drumroe, the northwest corner of the site (Figure 1) lies at *Ordnance Survey of Ireland* Irish National Grid (ING) Reference E205155 N181674, adjacent to Chainage 13970-14170. The survey area is located on the southern edge of the N7 C.P.O. boundary within land that is topographically high and rising to the east.

Fieldwork was conducted on the 4th June 2008 in hot and dry weather conditions that were suitable for the geophysical survey.

The archaeological excavation at Drumroe 1 comprised a Bronze Age house, a group of pits and a number of medieval and modern field boundaries. The house measured 7 m in diameter and was truncated by the C.P.O. boundary (Eachtra 2008c).

1.4 Killeisk 1

Located within the townland of Killeisk, the northwest corner of the site (Figure 1) lies at *Ordnance Survey of Ireland* Irish National Grid (ING) Reference E194488 N179462, adjacent to Chainage 2800-2900.

Fieldwork was conducted on the 19th November 2008. The survey area encompassed flat land, which is relatively low lying and was under stubble at the time of survey.

In the week preceding the geophysical survey, the climatic conditions were cold and wet and this continued during the fieldwork.

The excavated archaeology at Killeisk consisted primarily of a large number of cut features and their fills, including a number of interrelated linear and curvilinear ditches, pits of various shapes and sizes, a small number of post-holes and a kiln, the basal courses of which had been inserted into a specifically shaped cut. Truncation was evidenced throughout the site and was locally severe, with the result that few or none of the cut features excavated could be considered whole or even substantially intact.

A portion of a ringfort or medieval enclosure was located within the Lands Made Available (LMA) at Killeisk. It measured 35 m north-south by 33 m within the area of the LMA. The area of the entrance was not located within the LMA. The ditch was 1.6 m to 2.2 m wide by 0.4 m to 0.5 m in depth. A well was cut into the base of the ditch. There were a number of fills in the ditch, some of which contained animal bone. Two quern stones were recovered from the ditch. The ditch was re-cut in places and there was evidence of an internal bank. There were a small number of pits, post-holes and stake-holes in the interior of the site but there is no evidence of a structure. There were three sets of features outside the ringfort, a field system and droveway, a group of pits and a kiln (Eachtra 2008d).

1.5 Park 1

Located within the townland of Park, the northwest corner of the site (Figure 1) lies at *Ordnance Survey of Ireland* Irish National Grid (ING) Reference E199594 N181017. The site is located on either side of the N7 C.P.O. boundary, adjacent to Chainage 8100-8500.

Fieldwork was conducted on the 14th November 2008 in cold and wet weather.

Park is situated on level well drained ground which overlooks the River Ollatrim. At the time of survey the site was under short pasture which was ideal for geophysical survey.

Approximately 100 m to the east a fulacht fiadh was located during archaeological excavation. The excavation at Park 1 revealed a multiperiod site. The earliest phase of activity appeared to be represented by a concentration of pits, post-holes and stake-holes in the western area of the site. The site extended over a distance of c.450m. Also revealed on the site were kilns, metalworking activity, several ditches and a number of hearths and pits (Eachtra 2008e).

1.6 Aims & Objectives

The geophysical survey was requested to assess the extent of the archaeological remains located outside the C.P.O. boundary. Specific objectives were to:

- Assess the extent and location of the archaeological remains associated with those uncovered in the excavation
- Determine the presence or absence other associated archaeological features

A methodology was developed to allow multiple techniques to systematically investigate the site. Detailed magnetic gradiometer and magnetic susceptibility surveys were carried out within the survey area. 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 (Clarke 1996, Scollar *et al.* 1990).

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 Methodology

The fieldwork was carried out by J. Bonsall, D. Jones and H. Gimson of *Earthsound Archaeological Geophysics*.

A magnetic gradiometer survey was carried out using two *Geoscan Research* FM256 fluxgate gradiometers. Two pairs of sensors were mounted on a CF6 carry frame.

A magnetic susceptibility survey was carried out using a *Bartington* MS2 Magnetic Susceptibility meter and MS2D search loop interfaced with a *Trimble* Pro-XRS Differential GPS.

A rectangular grid was laid out using a *Trimble* Pro-XRS Differential Global Positioning System (see Technical Appendix 2), and divided in to 40 × 40 m sub-grids for the gradiometer survey.

2.1 Magnetic Gradiometer Survey

The survey was undertaken along lines parallel to the sub-grid edges, walking approximately south to north, starting in the southwest corner of each grid. Subsequent lines were surveyed in alternate directions ('zigzag').

Data were recorded using an FM256 at a spatial resolution of 1 m intervals between traverses and 0.25 m intervals along those lines. The instrument was positioned facing north, parallel to the Earth's magnetic field, to allow increased geo-magnetic resolution.

The instrument was set to a recording sensitivity of 0.1 nT. Prior to the beginning of the survey and after the completion of every two sub-grids, the electronic and mechanical set-up of the instrument were examined and calibrated as necessary over a common reference point. The magnetic drift from zero was not logged.

Data were collected automatically using an internal sample trigger while the operator walked at a constant pace along the traverse. The data were stored in an internal data logger and downloaded to a field computer using *Geoscan Research* Geoplot v.3.00a software.

2.1.1 Data Processing

2.1.1.1 Preliminary Data Treatment

The data were pre-processed in Geoplot 3.00.

Spurious high intensity anomalies, commonly statistical outliers, are referred to as geophysical 'spikes'. In magnetic data, an 'iron spike' is a response to a buried ferrous object, often in the topsoil. Iron spikes are generally not removed in geophysical data; although often modern in origin, they can be indicative of archaeological material.

The raw data contained some poorly matched sub-grids, caused by the internal drift of the fluxgate gradiometer and the gradual misalignment of the fluxgate sensors between calibration episodes. To compensate for this, a zero mean traverse (ZMT) function was employed. The use of ZMT alters data to adjust the mean of each traverse to zero by increasing or decreasing data as necessary. This alters the statistical properties of the data to give a uniformly bipolar background, centred around zero. Post-ZMT plots were compared with raw data to analyse the potential removal of geophysical anomalies along the line of a traverse.

2.1.1.2 Further Processing

No further processing functions were applied due to the high quality of the data collection.

A low pass Gaussian filter was applied, reducing the variability of the data whilst improving the visibility of weak archaeological features. This also had a smoothing effect on the data.

A sine wave interpolation function was applied to provide a smooth, aesthetically pleasing image for presentation. For a given point x, the contribution of adjacent readings to the interpolated point is given by the function sinc $(x) = \sin \pi x / \pi x$ (Scollar 1990). This function is used as a sliding window along each transect, resulting in an interpolated image, expanding the resolution of the data from 1 m x 0.25 m to 0.5 m x 0.125 m. This function was chosen as giving a clearer interpolated image than linear interpolation (which assumes a direct linear change between each point) or bicubic interpolation (taking the surrounding sixteen values into account).

2.1.2 Graphical Display

Pre-processed data are displayed in XY traceplot format in Figures 2, 7, 10, 15, and 20. An XY traceplot presents the data logged on each traverse as a single line with each successive traverse incremented on the Y-axis to produce a stacked plot. The data have not been clipped at –3 and +3 nT. The main advantage of this display option is that the full range of data can be viewed, dependent on the clip, so that the 'shape' of individual anomalies can be discerned and potential archaeological anomalies differentiated from iron 'spikes'.

Processed data are shown in Greyscale format in Figures 3, 8, 11, 16 and 21. The greyscale plot presents data as pixels on a linear grey shaded scale, increasing or decreasing dependent on the values of the maximum and minimum clip. The magnetic gradiometer data have been clipped at –2 (white) and +2 nT (black). Data values beyond the clip limits are shown as 'pure' black or white. The main advantage of this display option is that the data can be viewed as a base map.

An interpretation plot is presented in Figures 4, 9, 12, 17 and 22.

2.2 Magnetic Susceptibility Survey

A geophysical grid baseline was not established for the Magnetic Susceptibility survey; a Differential Global Positioning System (DGPS) data logger, a *Trimble* TSC1, displayed a graphical representation of the survey area, with traverses spaced every 5 m. The graphical representation was utilised by the geophysicists to navigate and collect data points at pre-determined intervals.

The topsoil volume magnetic susceptibility survey was undertaken along lines parallel to the survey grids, walking approximately south to north. Subsequent lines were surveyed in alternate directions ('zigzag'). Data were recorded at a spatial resolution of 5m intervals between traverses and 5m intervals along those lines.

The MS2 was set to a recording sensitivity of 1 SI unit to obtain (infinite) volume specific magnetic susceptibility (Volume MS or κ). When measured in SI units, the data is expressed as 1 x 10^{-5} κ. The MS-DGPS recorded northing and easting within the Irish National Grid to a minimum accuracy of ±1 m, and altitude to an accuracy of ±2 m.

Prior to surveying each survey station, the MS2 was calibrated according to the manufacturers guidelines, by 'zeroing' whilst holding the sensor approximately 3 m in the air. The positive and negative data presented in this report are the κ value of the survey area compared to the κ value of the air, being, theoretically, zero.

Data were collected and stored automatically in the TSC1 data logger by using a push button trigger on the MS2. The geophysicists walked at a constant pace along each traverse, pausing only briefly at each survey station to obtain a measurement of magnetic susceptibility. The data were downloaded to a field computer using *Trimble* Pathfinder Office 2.9 software.

2.2.1 Data Processing

2.2.1.1 Preliminary Data Treatment

The data were exported from Pathfinder Office 2.9 to *Microsoft* Excel. The Excel data were gridded in xyz format as northing, easting and κ, using *Golden Software* Surfer 8.00.

2.2.1.2 Further Processing

A natural neighbour interpolation function was applied to the data to provide a smooth, aesthetically pleasing image for presentation. No further processing functions were applied due to the high quality of the data collection.

2.2.2 Graphical Display

Contour plots can be shaded to emphasise particular regions between lines. Processed data are shown in interpolated colourscale contour plot format in Figures 5, 13, 18 and 23. The colourscale plot presents data as pixels on a linear colour shaded scale, increasing or decreasing dependent on the values of the maximum and minimum clip. The geophysical data have not been clipped. The main advantage of this display option is that the data can be viewed as a base map. A disadvantage is that the interpolation process can exaggerate isolated high or low data (this is noticeable over areas where no data has been collected, e.g. in the space occupied by a field boundary); to compensate for this, each survey station has been marked by a small black dot, creating a point cloud, to an accuracy of ±1 m, so that exaggeration between points can be visualised. An interpretation plot of the magnetic susceptibility data is presented in Figures 6, 14, 19 and 24.

2.3 Reporting, Mapping & Archiving

The geophysical survey and report follow the recommendations outlined in the *English Heritage Guidelines* (David *et al.* 2008) and *IFA Paper No. 6* (Gaffney *et al.* 2002) as a minimum standard. The conditions of the Detection Licence issued by the Licensing Section of the Department of the Environment, Heritage and Local Government require a copy of this report.

Geophysical data, figures and text are archived following the recommendations of the *Archaeology Data Service* (Schmidt 2001).

Field boundaries were mapped and drawn based upon data gathered by the DGPS.

Technical information on the equipment used, data processing and methodology are given in Appendix 1. Appendix 2 details the survey geo-referencing information and Appendix 3 describes the composition and location of the archive.

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 numbered in the relevant figures listed below **[G1**=gradiometer anomalies, **M1**=magnetic susceptibility anomalies**]** *and are described and interpreted within the text.*

In magnetic gradiometer data, a dipolar anomaly or 'iron spike' 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, they can be indicative of archaeological material.

3.1 Busherstown 1 – Ch. 13500 - 13700

Magnetic Gradiometer Survey

Figure 2 – Pre-processed Magnetic Gradiometer Data

Figure 3 – Magnetic Gradiometer Data

Figure 4 – Magnetic Gradiometer Interpretation

Anomaly **[G1]** is located in the northern survey area and is a small linear possible ditch measuring 19 m in length. It is on the same general alignment (NNE-SSW) as the excavated moated site, located 30m to the south, within the CPO. This suggests a continuation of features associated with the layout of the moated site. Anomaly G1 may also be related to G2, which could suggest further small divisions to the north of the moated site.

Anomaly **[G2]** is a right-angled possible ditch which has a total length of 24 m. This anomaly may be associated with G1.

Anomaly **[G3]** is a curvilinear possible ditch which runs across the survey area. Measuring 75 m in length, this anomaly was not identified in the excavation area – it may terminate on or near the CPO boundary. The possible ditch may drain into the stream at the northern end of the site.

There are a small number of possible pits associated with G1 and G2. To the north of G1 and G2, and 4 m west of G3, is an area of strongly magnetic responses which could suggest metalwork or firing, possible indicative of industrial deposits. There are no strong increase in the magnetic susceptibility data for this area, which could imply that any metal/fired remains are buried deep under the surface, or that thick layers of sediment could be masking their magnetic susceptibility response. G3 may be acting as a boundary feature to these deposits, or could be associated with them, as it drains down to the stream at the northern end of the field.

Anomaly **[G4]** is a linear possible ditch which extends from the field boundary across the survey area and may be associated with the moated site ditch revealed in the excavation area. This anomaly measures 40 m in length.

Anomaly **[G5]** is located to the south of the excavation area (in the southern geophysical survey area). The anomaly is a linear ditch which begins in the survey area and extends beyond it. Measuring 50 m in length this anomaly is cut by the double ditch feature of G6.

Anomaly **[G6]** comprises a possible double ditched feature which cuts anomaly G5. G6 appears to have a parallel double ditch at its western edge which turns into a single ditched feature to the east. The double ditch has a length of 38 m with the single ditch extending for a further 22 m, where it terminates against G7. Anomaly G6 appears to run parallel to sections of anomaly G8 indicating that the two may be associated.

Anomaly **[G7]** is a linear ditch which is located on the eastern edge of anomaly G6. Anomaly G7 appears to run from north-south for a length of 29 m and terminates close to anomaly G8. It may continue beyond the CPO boundary to the north, although it does not appear in the excavation plan.

Anomaly **[G8]** represents a curvilinear ditch which appears to enclose anomalies G6 and G7. The anomaly comprises of a single ditch which is likely to be associated with the south facing annex ditch revealed in the excavation. It could represent an outer enclosing element.

Anomaly **[G9]** is a linear ditch which crosses anomaly G8 and runs for a length of 33 m to the field boundary. This anomaly could be archaeological in nature or associated with a former field division.

Anomaly **[G10]** is a curvilinear possible ditch which is located on the northern edge of G11. Anomaly G10 measures 50 m in length.

Anomaly **[G11]** is a linear ditch which runs south from the middle of anomaly G10. The location and orientation of this anomaly indicates that it might be agricultural in origin as it runs parallel to the present field boundaries. It could represent a drainage ditch, a field division or a strongly enhanced plough furrow.

Anomalies **[G12]** and **[G13]** are linear ditches which form a right-angled pattern which appear to match the present field boundaries. It is likely that these anomalies represent relict field boundaries or drainage ditches which may once have continued westwards towards a kink in the present field boundary.

Anomaly **[G14]** is a linear ditch which runs parallel to anomaly G13 and the present field boundary and is likely to be a drainage ditch, or field boundary.

Between the rectilinear formation of anomalies G11-14, there is an area of dipolar responses. These represent metal/concrete deposits within the soil. They appear to curl to the north and this suggests that an object or structure has been ploughed out – the resulting pattern of dipolar anomalies have aligned within the plough furrows. This could be indicative of a potential destroyed structure.

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Magnetic Susceptibility Survey

Figure 5 – Magnetic Susceptibility Data

Figure 6 – Magnetic Susceptibility Interpretation

The magnetic susceptibility data are generally very quiet for Busherstown 1. The data set has a mean of 2 SI units which is quite low. In general terms, the western half of the survey area is much quieter (-2 to 2 SI units) than the eastern half (mostly 2 to 10 SI units), which could reflect agricultural practices on either side of a field, however the presence of the moated site is likely to have caused an increase in magnetic susceptibility in the eastern half.

Anomaly **[M1]** is located in the northern survey area. It represents an area of slightly raised magnetic susceptibility readings, compared to the background responses. The zone has a north-south alignment indicating that it could represent archaeological activity associated with the moated site revealed during the excavation, or more likely, a former agricultural division within the field. It broadly follows the alignment of anomaly G3, a possible ditch or drainage ditch.

Anomaly **[M2]** represents a probable continuation of the enhanced zone of M1, which suggests that the enhanced zone continued through the CPO, located over the eastern half of the moated site.

Anomaly **[M3]** is located on the western edge of M2 and represents a small anomaly of high magnetic susceptibility. This anomaly was only detected at a single survey station and therefore could represent a near surface iron object either archaeological or modern or possibly a small archaeological feature.

Anomaly **[M4]** is an isolated anomaly created from one survey station only, located close to the southern field boundary. It falls upon ditched anomaly G8 – it could represent a deposit within the fill of the ditch or an spurious piece of metal.

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3.2 Drumbaun 2 – Ch. 12900 - 13050

Magnetic Gradiometer Survey

Figure 7 – Pre-processed Magnetic Gradiometer Data

Figure 8 – Magnetic Gradiometer Data

Figure 9 – Magnetic Gradiometer Interpretation

The Offaly-Tipperary County Boundary passes through the geophysical survey area, which is parallel to a ditch revealed in the excavation area. Whilst no discrete ditch type anomalies can be seen in the vicinity of the County Boundary, there is a linear trend of noisy data aligned along the boundary zone. This noisy data could suggest an old boundary feature – a post fence, a weakly magnetic ditch fill, a hedgerow or wall, which may have been destroyed subsequently.

Anomaly **[G15]** is a curving ditch which runs from the excavation, across the survey area and continues beyond the field boundary. Measuring 64 m in length, this anomaly represents an enclosing ditch which may be associated with a possible medieval arcing boundary revealed during the excavation and also appears to enclose anomalies G16 and G17.

Anomaly **[G16]** represents two possible pits which are spaced 22m apart, enclosed by anomaly G15.

Anomaly **[G17]** is a small section of ditch which was detected running parallel to G15 and extending into the survey area.

Anomaly **[G18]** is a set of parallel double ditches which run in a southeast-northwest direction from the northern edge of the survey area. Measuring 33 m in length and with a separation of 3.6 m, these anomalies are aligned parallel to a ditch revealed in the excavation and could represent a continuation of it.

A magnetic Susceptibility survey could not be undertaken on this site due to the height of the vegetation on the land at the time of survey.

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3.3 Drumroe 1 Ch. 13970 - 14170

Magnetic Gradiometer Survey

Figure 10 – Pre-processed Magnetic Gradiometer Data

Figure 11 – Magnetic Gradiometer Data

Figure 12 – Magnetic Gradiometer Interpretation

Anomaly **[G19]** represents an arcing boundary ditch which appears to be made up of two parallel ditches on the western side, whereas only a single ditch was detected to the east. Measuring 116 m in length this anomaly is forms an enclosure ditch associated with the medieval boundary and possible structure revealed during the excavation. Some weakly magnetic parallel linear features can be seen, enclosed by the G19 ditch – these are likely to represent plough furrows.

Anomaly **[G20]** is a linear ditch which runs from the edge of the survey area for a length of 56 m and terminates against anomaly G19. This relict field boundary can be seen in the 1st Edition Ordnance Survey Map of the area.

Anomaly **[G21]** comprises several linear parallel ditches which run from the excavation area in the north to the south and extend beyond the survey area. Measuring approximately 50 m in length, these anomalies represent a continuation of the parallel ditches revealed during the excavation.

Anomaly **[G22]** is a linear ditch which runs from the excavation area for a length of 30 m and terminates against G19.

Anomaly **[G23]** is a curvilinear ditch which extends from G19, aligned SE-NW, extending beyond the survey area. Measuring 40 m in length, this anomaly could be archaeological or agricultural in origin.

Magnetic Susceptibility Survey

Figure 13 – Magnetic Susceptibility Data

Figure 14 – Magnetic Susceptibility Interpretation

The magnetic susceptibility data is reasonably enhanced at this site, with general trends between 2 to 14 SI Units, with lower magnetic susceptibility in the SW corner and higher background responses.

Anomaly **[M5]** marks the location of a boundary between low magnetic susceptibility values to the southwest and slightly higher values to the north. This anomaly probably marks the boundary to the archaeological activity.

Anomaly **[M6]** is located inside the higher values of M5 and marks a further increase in the values, probably associated with archaeological remains. The location of this anomaly places it inside G19 the enclosure ditch detected in the magnetic gradiometer data, suggesting that this enclosure ditch did represent the extent of the majority of archaeological activity.

3.4 Killeisk 1 Ch. 2800 - 2920

Magnetic Gradiometer Survey

Figure 15 – Pre-processed Magnetic Gradiometer Data

Figure 16 – Magnetic Gradiometer Data

Figure 17 – Magnetic Gradiometer Interpretation

The magnetic gradiometer data is very weakly enhanced at this site, making the ringfort or medieval enclosure ditch features difficult to visualise. Nonetheless, dipolar anomalies and trends of magnetic noise mark out the extent of a number of ditches and enclosing elements. There are also a number of possible pits and possible isolated areas of burning, which could suggest the presence of hearths and a possible kiln, both within and beyond the enclosure.

Anomaly **[G24]** is an arcing ditch which represents the southern extent of the ringfort or medieval enclosure ditch revealed in the excavation area. The anomaly is comprised of weakly magnetic ditch fill and a number of possible pits, or isolated magnetic components (including some ferrous responses) within the ditch fill. The anomaly measures 123 m in length. Taking the ditched enclosure as a whole, the feature measures 95 m NW-SE and 41 m NE-SW, enclosing a total area of 0.335 hectares.

Anomaly **[G25]** comprises two parallel ditch features. The eastern example matches a linear boundary ditch revealed in the excavation. The western example matches a small annex enclosure ditch, revealed in the excavation.

Anomaly **[G26]** is a linear trend which traverses the survey area. Measuring 83 m in length this anomaly crosses anomaly G24 and is a probable continuation of the droveways's southern ditch, as revealed in the excavation. The remains of the northern ditch of the droveway could not be seen in the magnetic gradiometer data.

Anomaly **[G27]** is a linear trend which runs in a northerly direction across the survey area. Measuring 100 m in length this anomaly extends beyond the survey area to the south and its orientation suggests that it continues into the excavation area although no feature was detected during the excavation. This anomaly runs parallel to the existing field boundaries and is likely to represent a former field division, drainage ditch or magnetically strong plough furrow.

Anomaly **[G28]** comprises of two trends which are located on the southern edge of the survey area. The trends measure 20 m and 47 m respectively. The larger of the two may represent a relict field boundary visible on the 1st Edition OS map of the area.

Anomaly **[G29]** is a small cluster of possible pits which were detected between G27 and G28. A possible area of industrial deposits or modern dumping can be seen in the southern corner of the survey area, which include possible pits and ferrous responses.

Anomaly **[G30]** represents two possible pit clusters located in the centre of the survey area. One cluster of three possible pits is located within the enclosure. The other comprises of two possible pits and is located 20 m to the east, on the outer edge of the enclosure ditches.

Anomaly **[G31]** is an area of plough furrows which were detected across the eastern edge of the survey area.

Magnetic Susceptibility Survey

Figure 18 – Magnetic Susceptibility Data

Figure 19 – Magnetic Susceptibility Interpretation

The magnetic gradiometer anomaly G24, which represents the southern extent of the enclosure ditch, has been superimposed on to Figure 18. The magnetic susceptibility data are reasonably quiet which was also apparent in the weakly enhanced magnetic gradiometer data. The data generally falls between 1 and 4 SI units. The mean of the data (3 SI units) reflects the slightly stronger data on the western side of the site, no doubt influenced by the stronger magnetic susceptibility of the enclosure and the droveway.

Anomaly **[M7]** marks the location of a boundary between low magnetic susceptibility values to the southwest and slightly higher values to the north. This anomaly probably marks the boundary of the archaeological activity zone.

Anomaly **[M8]** is located in the northwest corner of the survey area and represents a coherent area of slightly raised magnetic susceptibility values. Located close to the new M7 C.P.O boundary this anomaly could be associated with the droveway and kiln activity revealed during the excavation.

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3.5 Park 1 Ch. 8100 - 8500

Magnetic Gradiometer Survey

Figure 20 – Pre-processed Magnetic Gradiometer Data

Figure 21 – Magnetic Gradiometer Data

Figure 22 – Magnetic Gradiometer Interpretation

The survey area contains some old field boundaries marked on the modern OS map, which do not appear within the field.

Anomaly **[G32]** is a curvilinear possible ditch which is located on the eastern edge of the survey area. Measuring 36 m in length this anomaly extends beyond the survey area and is difficult to characterise, however its curvilinear nature suggests that it might be archaeological or could be associated with the adjacent field boundary. There is a general level of disturbance against the eastern edge of the survey area, generated by a field boundary, a cattle feeding station and a possible access route (see anomaly G34, below).

Anomaly **[G33]** is a weakly magnetic arcing ditch which extends northwards beyond the survey area. This anomaly may be bounding another area of archaeological interest associated with the archaeological remains revealed during the excavation.

Anomaly **[G34]** is a linear area of highly magnetic material which extends 198 m, along the length of the survey area. This anomaly represents a relict field boundary once present on the site. This boundary although no longer extant is shown on the OS maps of the area implying that its destruction is relatively modern. The anomaly is characterised by large amounts of ferrous material, which probably represents debris or infill from the destruction of the boundary.

Anomaly **[G35]** represents a relict field boundary. It would have joined G34 at a right angle forming a field system. Like G34, this anomaly is also characterised by frequent ferrous responses, representing metal debris or infill associated with the destruction of the field boundary. An extension of the field boundary was revealed in the excavation to the south.

Anomaly **[G36]** extends from G35 and runs parallel to G34. This anomaly does not contain the highly magnetic material present in G34 and G35 but it is likely that this anomaly represents the southern edge to a field system comprised of G34/G35/G36 and possibly G32.

Anomaly **[G37]** consists of two parallel linear ditches which extend from the western edge of the survey area for a length of 65 m, and are spaced 24 m apart. These ditches appear to join up in an arcing semi-circular feature, creating an anomaly with a total length of 180 m. This anomaly has a moderate magnetic signature. The typology of the ditched feature in plan resembles a “finger-shaped” response, suggestive of a prehistoric cursus-type feature, although this is only a tentative interpretation. Such a monument would certainly complement the multiperiod nature of the site as seen in the archaeological excavation results. The “finger-shaped” response is located to the north of the main zone of archaeological activity identified in the excavation and is likely to continue west beyond the survey area.

Anomaly **[G38]** is an area of plough furrows. The presence of this agricultural activity may have impacted the underlying archaeology, especially effecting anomaly G37.

Surveys could not be undertaken in the southern survey area at this time due to the presence of a tulip crop.

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Magnetic Susceptibility Survey

Figure 23 – Magnetic Susceptibility Data

Figure 24 – Magnetic Susceptibility Interpretation

The ditched anomalies identified in the magnetic gradiometer data have been superimposed upon the magnetic susceptibility data in order to gauge the responses within their wider setting.

The magnetic susceptibility data at Park 1 are the strongest encountered within this report, with a mean response of 10 SI units, the data can be split in to two populations which fall on either side of an old field boundary, as revealed in both the excavation and as magnetic gradiometer anomaly G35. Magnetic susceptibility data to the east of the old field boundary generally fall between 0 to 14 SI units, whilst on the western side the data range between 10 to 25 SI units, with a particularly strong zone reaching as high as 341 SI units.

Anomaly **[M9]** is an area of raised magnetic susceptibility values which run from the edge of the excavation across the survey area. This area measures up to 55m in width and is likely to represent archaeological activity associated with the kilns and enclosure ditches revealed in the excavation results.

[M10] represents consistently high magnetic susceptibility values over a 5 x 5 m area, on the western side of the site within anomaly M9. The processing software used has contoured the responses to approximate a circle and surrounding values, though weaker, are still very strong. These responses are not spurious and reflect the presence of metal or fired material over a reasonably sized area. The responses occur to the south of the "finger-shaped" anomaly in the magnetic gradiometer data (G37), and are not associated with any particular deposits or anomalies. This could imply that the origin of the responses are in the topsoil, possibly indicating the presence of a ploughed out feature or deposit, perhaps associated with the kilns identified in the excavation.

Anomaly **[M11]** is an area of lower magnetic susceptibility values which is located to the east of M9.

Surveys could not be undertaken in the southern survey area at this time due to the presence of a tulip crop.

4 Conclusion

4.1 Achievement of Objectives

The geophysical surveys have assessed land adjacent to archaeologically significant sites which were identified within the C.P.O boundary of the new road. The magnetic gradiometer surveys have identified and mapped possible archaeological remains within these areas which will help to enhance the interpretation of the sites' extent and composition. The magnetic susceptibility survey across the sites was useful in that it reinforced certain trends identified in the magnetic gradiometer data.

4.2 Summary of Results

Busherstown 1

A number of ditches were detected which appear to represent a continuation of the archaeological activity revealed during the excavation. An arcing enclosure ditch has been identified to the south of the excavation. Further linear and curvilinear possible ditches were also detected which may be archaeological or agricultural in origin.

Drumbaun 2

Three possible ditches were detected across the survey area. These appear to represent a continuation of the possible medieval boundary identified on the northern edge of the excavation. A continuation of a possible prehistoric boundary was also identified. Two possible pits were also identified within the confines of the medieval boundary suggesting that further archaeological activity continues beyond the N7 road boundary.

Drumroe 1

A number of possible ditches were detected which have a direct relationship to the archaeological excavation results. The edge of the probable zone of archaeological activity was also established with the detection of an arcing enclosure ditch. A number of single and interconnecting ditches were also detected which may be archaeological or agricultural in origin.

Killeisk 1

A continuation to the medieval oval-shaped enclosure ditch was detected in the geophysical results. The northern half of the enclosure ditch and a south-western possible annex were revealed during the excavation - the geophysical results have mapped the southern extent of the enclosure. The mapped components of the ditched enclosure, from both excavation and geophysics, measures 95 m NW-SE and 41 m NE-SW, enclosing a total area of 0.335 hectares. 37% of the enclosure lies within the CPO of the N7. A continuation of parts of the droveway were also identified along with a number of other possible ditches and a relict field boundary.

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Park 1

A possible boundary ditch was identified as well as series of linear isolated and interconnecting possible ditches. The remains of a "finger-shaped" ditch, which could be interpreted as a cursus monument, were also identified on the western edge of the survey area.

Surveys could not be undertaken in the southern survey area of Park 1 due to the presence of a tulip crop.

4.3 Recommendations

Busherstown 1

The magnetic gradiometer survey indicates that the magnetic contrast within the ditch fills is not particularly high. The magnetic susceptibility indicates a generally low magnetic contrast across the entire site. This suggests that Busherstown 1 may respond better to earth resistance surveys to delineate the archaeological features uncovered in the excavation areas.

Killeisk 1

The magnetic gradiometer survey indicates that the magnetic contrast within the ditch fills is not particularly high, although the remains of the oval enclosure can be seen as weakly magnetic anomalies – the fill also contains some ferrous items which indicates the extent of the ditch well. The magnetic susceptibility indicates a generally low magnetic contrast across the entire site, with slight enhancement in the vicinity of the enclosure. The overall lack of a strong magnetic contrast suggests that Killeisk 1 may respond better to earth resistance surveys to delineate the archaeological features uncovered in the excavation areas.

Park 1

The "finger-shaped" ditch is worthy of further investigation. Earth resistance could be used in the first instance to confirm that it represents a ditch to determine if the feature could represent a cursus monument as suggested. The feature appears to continue further westwards adjacent to the CPO boundary and this should be confirmed also. Tests indicate that the site would respond better to 0.5m traverse intervals, rather than 1m intervals for any future magnetic gradiometer survey.

4.4 Dissemination

The results of this survey were submitted to *Eachtra Archaeological Projects*. *Earthsound* will ensure that copies will be forwarded to the *Department of the Environment, Heritage and Local Government* and the National Museum of Ireland in compliance with the Licence agreement.

5 Acknowledgements

Fieldwork: James Bonsall BA (Hons) MSc PIFA
Daniel Jones MA
Heather Gimson BA (Hons) MSc MIAI

Report: Heather Gimson
James Bonsall

Graphics: Heather Gimson

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EACHTRA 2008b Drumbaun 2 Preliminary Archaeological Report, N7 Castletown to Nenagh (Derrinsallagh to Ballintotty) Road Scheme, Unpublished Archaeological Report by Eachtra Archaeological Projects

EACHTRA 2008c Drumroe 1 Preliminary Archaeological Report, N7 Castletown to Nenagh (Derrinsallagh to Ballintotty) Road Scheme, Unpublished Archaeological Report by Eachtra Archaeological Projects

EACHTRA 2008d Killeisk 1 Preliminary Archaeological Report, N7 Castletown to Nenagh (Derrinsallagh to Ballintotty) Road Scheme, Unpublished Archaeological Report by Eachtra Archaeological Projects

EACHTRA 2008e Park 1 Preliminary Archaeological Report, N7 Castletown to Nenagh (Derrinsallagh to Ballintotty) Road Scheme, Unpublished Archaeological Report by Eachtra Archaeological Projects

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7 Figures

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Technical Appendix

Appendix 1

Magnetic survey: Technical Information

Magnetic Susceptibility and Soil Magnetism

The Earth is comprised of approximately 6% iron. Via geological and pedological processes iron is present in soils and rocks as three main minerals; haematite, magnetite and maghaemite. Haematite is a very common mineral in archaeological soils and is largely responsible for most of the red colouration in the environment. Magnetite is a common mineral found in all igneous rocks, most sedimentary rocks and nearly all soils. These minerals have a weak, measurable magnetic property.

The magnetism observed in a rock is made up of remanent and induced components. In the weak magnetic field due to the earth, the induced component is proportional to the earth's field. The constant of proportionality is called the magnetic susceptibility. The susceptibility of a rock is controlled by the amount of ferrimagnetic material contained in them, their grain size, and mode of distribution.

An enhancement of ferrimagnetic minerals is responsible for the formation of magnetic anomalies in soils at archaeological sites. Magnetic Susceptibility (MS) measures how susceptible a material is to becoming magnetized. A MS survey can identify and classify different types of iron bearing materials in a safe, fast and non-destructive manner either in a laboratory or as a fieldwork component, complementing other archaeological analyses.

Anthropogenic activities can redistribute these minerals and alter others into more magnetic forms by a process of enhancement, such as burning, industrial activity, fermentation and manuring. MS enhancement of antiferromagnetic haematite in the topsoil is caused by the Le Borgne effect of domestic fires on soils and vegetational matter:

> *The burning of organic matter and the heating of non-organic matter above 200°C, allows electrons to be gained through a process of reduction, creating ferrimagnetic magnetite. As the matter cools, or in the case of organic matter, is combusted, electrons are lost through a process of re-oxidation, creating ferrimagnetic maghaemite.*

The decay of organic material associated with areas of human occupation or settlement can be identified by measuring the MS of the topsoil and noting the degree of enhancement. If the enhanced material subsequently comes to fill features, such as ditches or pits, localised isolated and linear magnetic anomalies can result whose presence can be detected by a magnetometer (fluxgate gradiometer).

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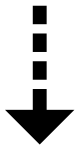
There are five different types of magnetic behaviour found in Magnetic Susceptibility surveys, dependent upon the sub-atomic properties of the samples:

- *Ferromagnetism*
- *Ferrimagnetism*
- *Antiferromagnetism*
- *Antiferromagnetism*
- *Paramagnetism*
- *Diamagnetism*

Strongest



Weakest

Magnetic susceptibility is a value defined by a combination of all of the above types of magnetic behaviour, so that weaker paramagnetism and diamagnetism will be masked if other, *stronger*, magnetic properties are present. For example, a topsoil magnetic susceptibility survey will introduce additional contributions from colluvial/alluvial covering or a disturbed Ap horizon (cultivation/pasturing disturbance *etc*.) that may mask an archaeologically derived response.

Types of Magnetic Anomaly

Magnetic anomalies are either are termed **'negative'** or **'positive'** referring to their magnetic properties relative to the bipolar background (theoretically, 'zero').

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

Areas of positive/negative enhancement

These responses can be quite widespread, and often caused by rubble or foundations, burning, agricultural disturbance and general occupational induced enhancement.

Linear and curvilinear anomalies

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

Isolated positive/negative anomalies

These generally represent small areas of enhancement. They may be caused by exotic geology or by in-filled archaeological pits.

Isolated Ferrous anomalies

Theses are very strong magnetic responses caused by ferrous (iron) debris, often found scattered in fields. These are usually modern in origin, although may represent archaeological material such as coffin nails.

Areas of Disturbance

These are mostly modern in origin, causing widespread magnetic interference, often masking all other magnetic features within the vicinity. These can be caused by nearby structures, metallic fences, road traffic and metallic pipelines.

Methodology

Magnetic Susceptibility Survey

The magnetic susceptibility meter displays the MS value of material when they are brought within the influence of the sensor, such as the field search loop. An oscillator circuit within the *Bartington* MS2 meter generates a low alternating magnetic field. Any material brought within the influence of the field (in the case of the search loop, the field of influence is between 0-18cm beneath the loop, i.e. generally the topsoil), will bring about a change in the oscillator frequency. The frequency information is returned in pulse form to the MS2, where it is converted in to a value of magnetic susceptibility, κ, in SI units.

A topsoil MS survey assumes that the sample size is infinite, as the precise mass of each sample point cannot be calculated in the field. Calibration therefore, is best expressed in units of Volume Specific susceptibility. Repeatability of the survey is dependent upon the uniformity of the surface under investigation. Volume susceptibility is expressed as $\kappa \times 10^{-5}$ SI units.

Fluxgate Gradiometer Survey

A detailed survey requires a sample trigger to automatically take readings at predetermined points. These readings are stored in the memory of the instrument and are later dumped to computer for processing and interpretation. Detailed survey allows the visualisation of weaker anomalies that may not have been detected by magnetic scanning or magnetic susceptibility.

Data Processing and Presentation

Interpolation

Interpolation can be defined as the estimation of a value between known values. The data magnetometer data displayed in this project have been interpolated using the sin *x*/*x* function in *Geoplot* 3.0 (Walker 2000).

Gridding methods produce a regularly spaced, rectangular array of Z values from irregularly spaced XYZ data. The term "irregularly spaced" means that the points follow no particular pattern over the extent of the map, so there are many "holes" where data are missing. Gridding fills in these holes by extrapolating or interpolating Z values at those locations where no data exists.

A grid is a rectangular region comprised of evenly spaced rows and columns. The intersection of a row and column is called a grid node. Rows contain grid nodes with the same Y co-ordinate, and columns contain grid nodes with the same X co-ordinate. Gridding generates a Z value at each grid node by interpolating or extrapolating the data values. The *Kriging* gridding method produces visually appealing maps from irregularly spaced data. *Kriging* is a geostatistical gridding method that has proven useful and popular in many fields. *Kriging* attempts to express trends suggested in the data so that, for example, high points might be connected along a ridge rather than isolated by bull's-eye type contours.

Appendix 2

Survey Grid Re-location

1. Each survey grid was laid out using a *Trimble* Pro-XRS Differential Global Positioning System (DGPS), to an accuracy of ±50cm.
2. There was a good correlation between the geophysical survey data and the digital map base and it is estimated that the average 'best fit' error is lower than ±0.25m. It is important to note that local grid north varies slightly from *Ordnance Survey* north, with an annual decrease of 0.9°3'.

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Appendix 3

Geophysical Archive

Earthsound Archaeological Geophysics takes its archiving responsibilities very seriously. Archiving is a necessary measure to maintain a complete record of past research, prevent unnecessary duplication and allow the re-use and re-interpretation of geophysical data as analytical techniques evolve.

The geophysical archive comprises:-

- an archive CD-ROM containing files of the raw data (Geoplot 3.00a, MS-Excel), report text (Word 2000 9.0), and graphics files (AutoCAD 2000).
- a hard (paper) copy of the report

At present, two copies of the archive are held by *Earthsound Archaeological Geophysics*, at separate locations to ensure preservation against accidental damage or theft. The Client, *Eachtra Archaeological Projects*, holds one further copy of the archive. Additional paper copies intended for ultimate deposition with the *Department of the Environment, Heritage and Local Government* are in the guardianship, and are the responsibility of, *Earthsound Archaeological Geophysics*.

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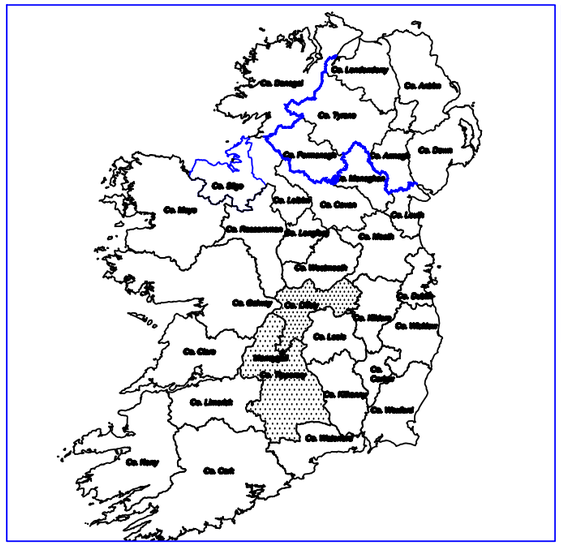

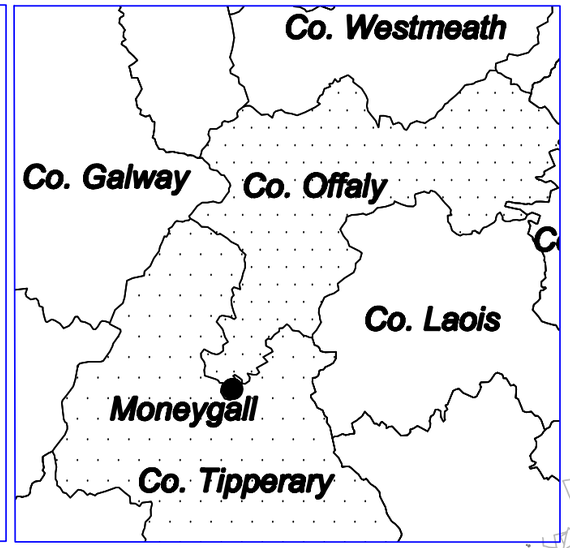

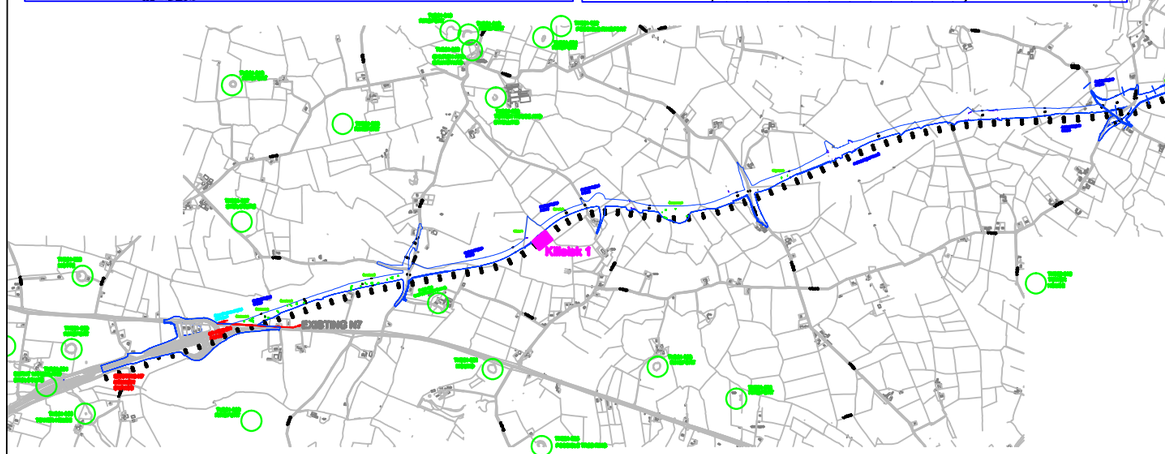

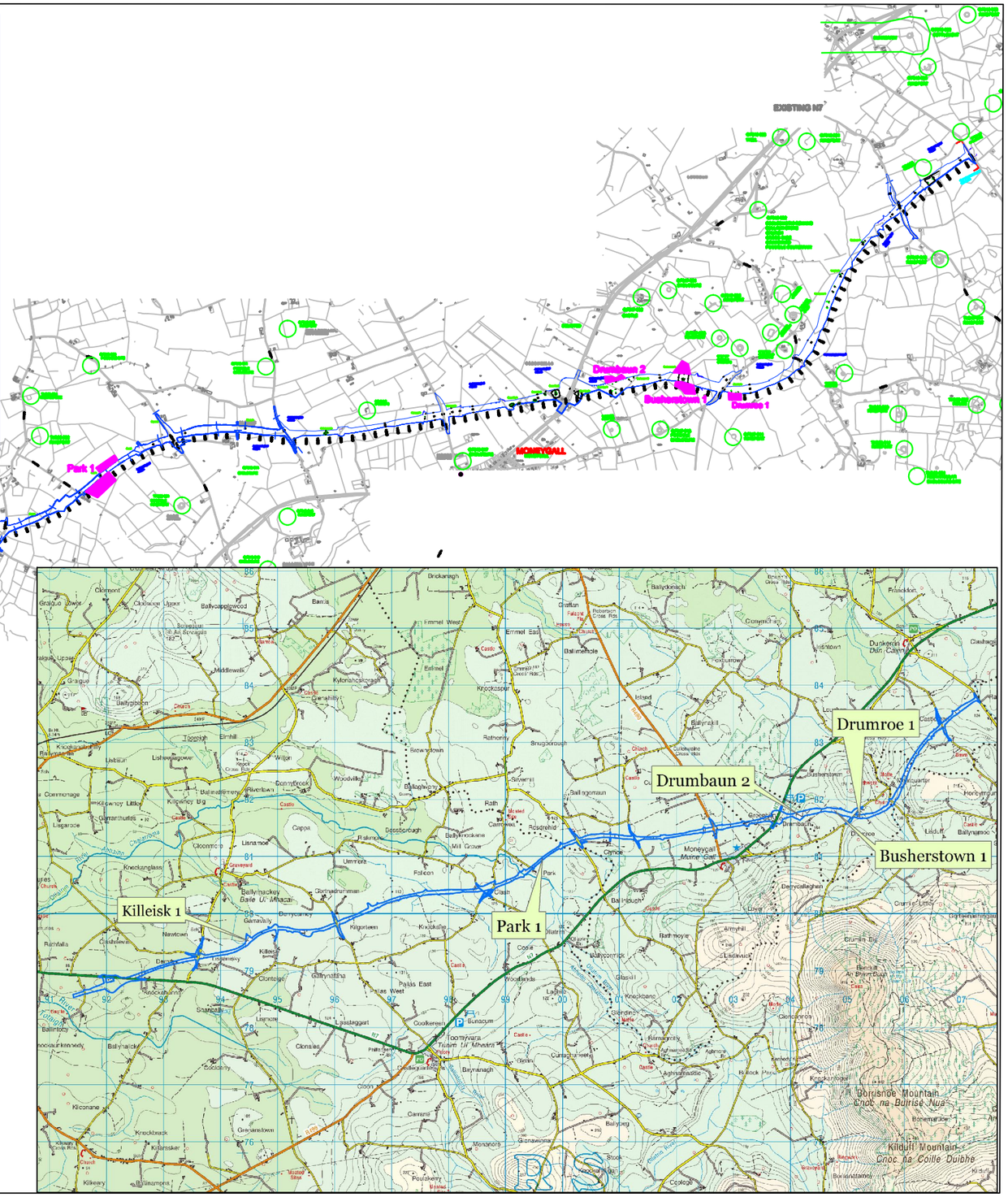

Legend

- Basemap
- RMP Archaeological Sites
- New N7 C.P.O. Boundary
- Geophysical Survey Area

Site Location: Land Adjacent to Archaeological sites, N7 Castletown to Nenagh Road Scheme

Client: Eachtra Archaeological Projects

Drawing Courtesy of: Eachtra / OSI	Date 8/1/09	Drawing No.: 08-25/01

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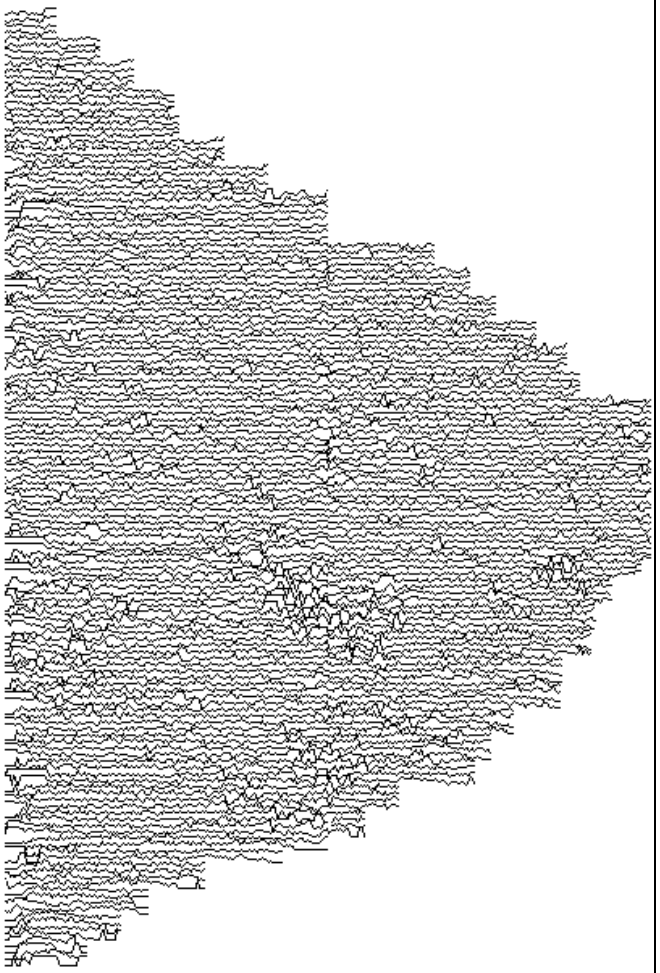
0m 2km 4km

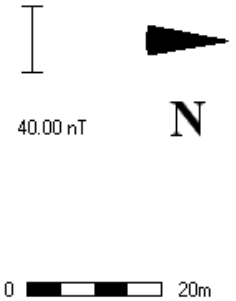
Figure No. 1 Location map

EARTHSOUND archaeological geophysics

Land Adjacent to Archaeological Sites, N7 Castletown to Nenagh Road Scheme

Figure 2: Pre-processed Magnetic Gradiometer XY Traceplot – Busherstown 1





Resolution 0.5nT,

Data Clipped to ± 3nT,

1m x 0.25m Sample Interval

EARTHSOUND archaeological geophysics

Drawing No.: 08_25/02

13200

13300

13400

00

13700

13800

13900

Spring

UND

Legend

- Basemap
- RMP Archaeological Sites
- New N7 C.P.O. Boundary
- Archaeological Excavation Results

nT

-2 0 2

Site Location: Land Adjacent to Archaeological sites, N7 Castletown to Nenagh Road Scheme

Client: Eachtra Archaeological Projects

Drawing Courtesy of: Eachtra / OSI	Date 8/1/09	Drawing No.: 08-25/03

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0m 85m 170m

Figure No. 3 Magnetic Gradiometer data - Busherstown 1

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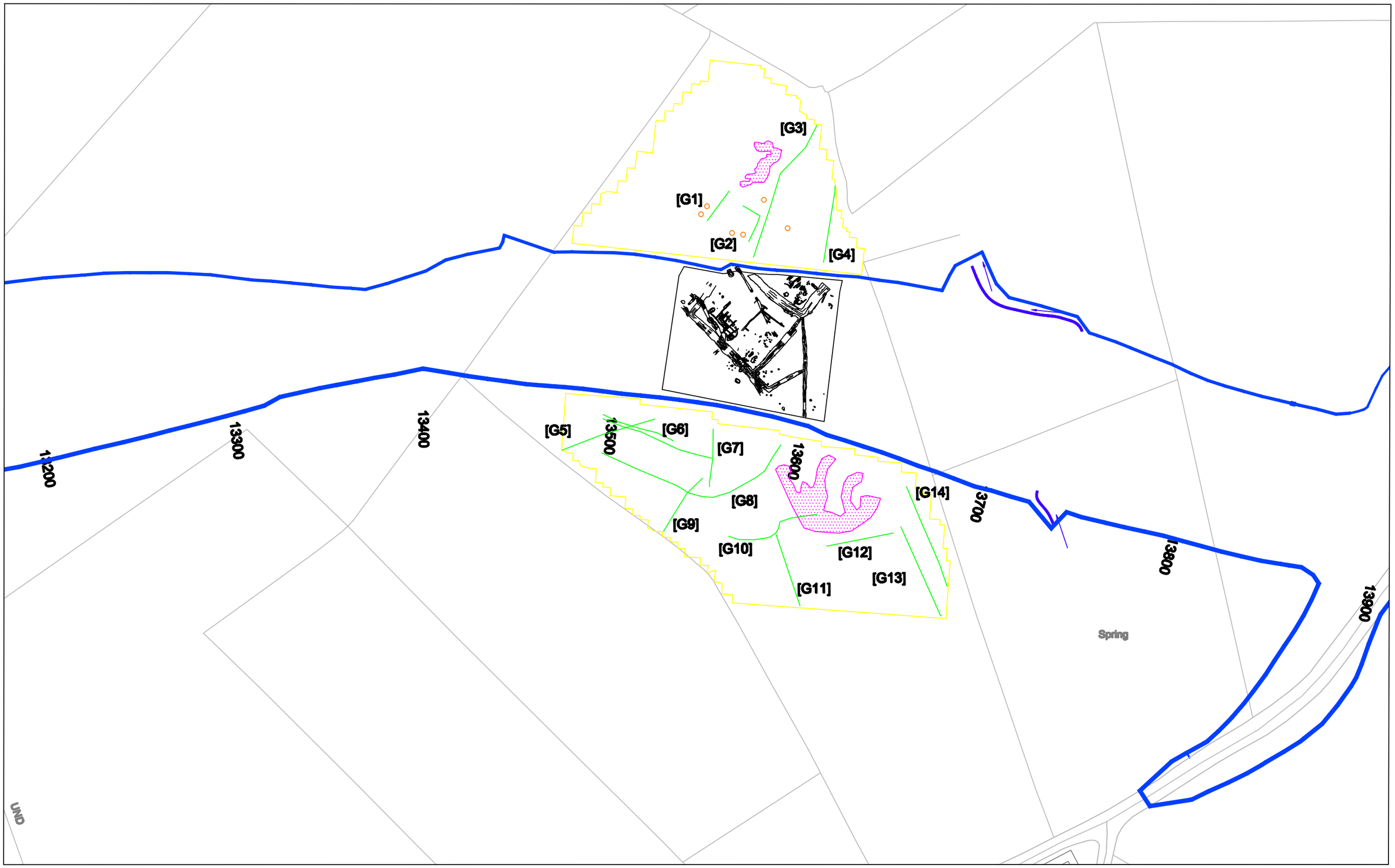

Legend

- Basemap
- New N7 C.P.O. Boundary
- Geophysical Survey Area
- Archaeological Excavation Results
- Possible Ditch
- Possible Pit
- Possible Plough Furrow
- Possible industrial / modern deposits

Site Location: Land Adjacent to Archaeological sites, N7 Castletown to Nenagh Road Scheme

Client: Eachtra Archaeological Projects

Drawing Courtesy of: Eachtra / OSI	Date 8/1/09	Drawing No.: 08-25/04

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0m 85m 170m

Figure No. 4 Magnetic Gradiometer Interpretation - Busherstown 1

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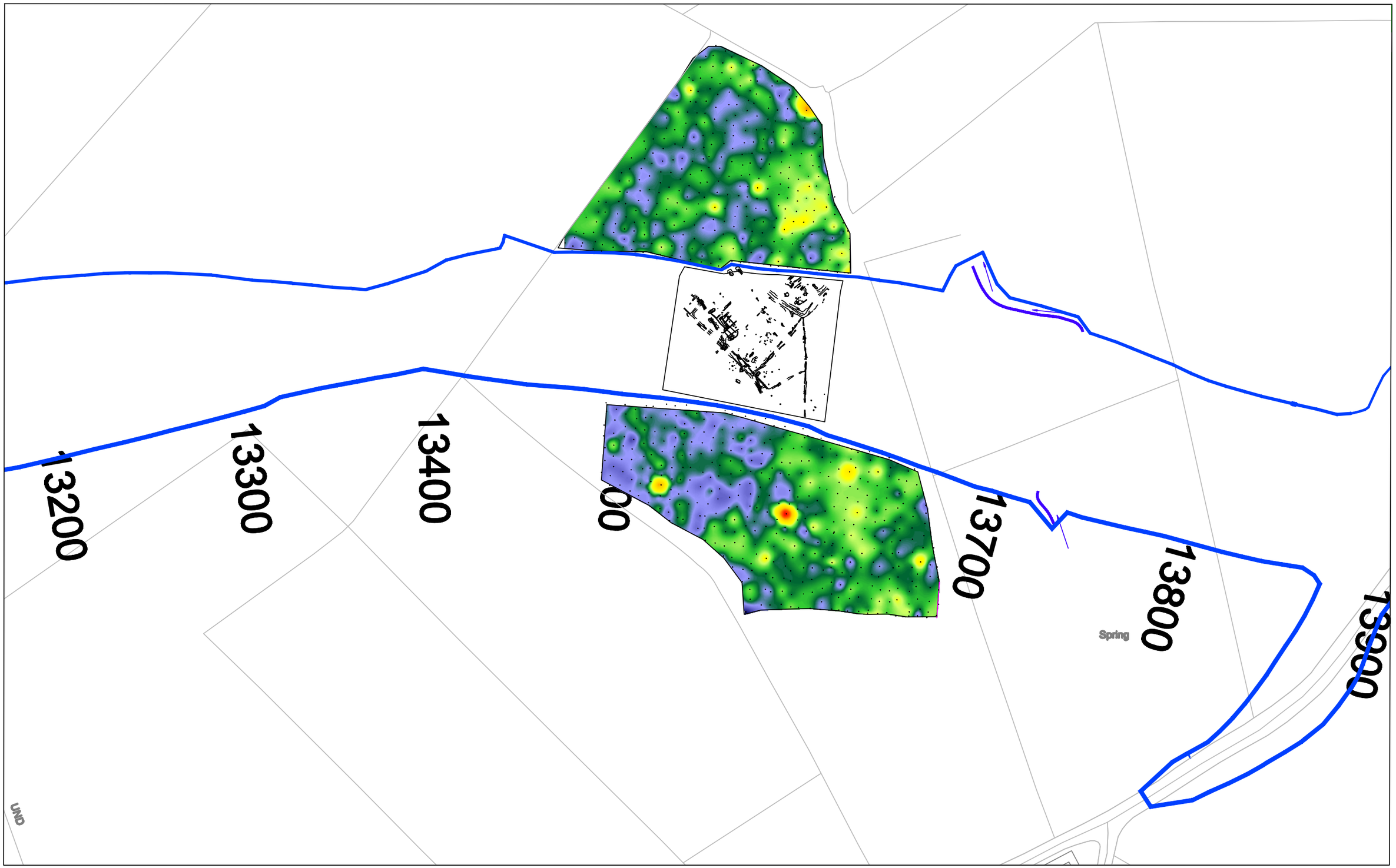

Legend

- Basemap
- New N7 C.P.O. Boundary
- Archaeological Excavation Results
- Magnetic Susceptibility Point Cloud

K

-3 2 10 16 25

Site Location: Land Adjacent to Archaeological sites, N7 Castletown to Nenagh Road Scheme

Client: Eachtra Archaeological Projects

Drawing Courtesy of: Eachtra / OSI	Date 9/1/09	Drawing No.: 08-25/05

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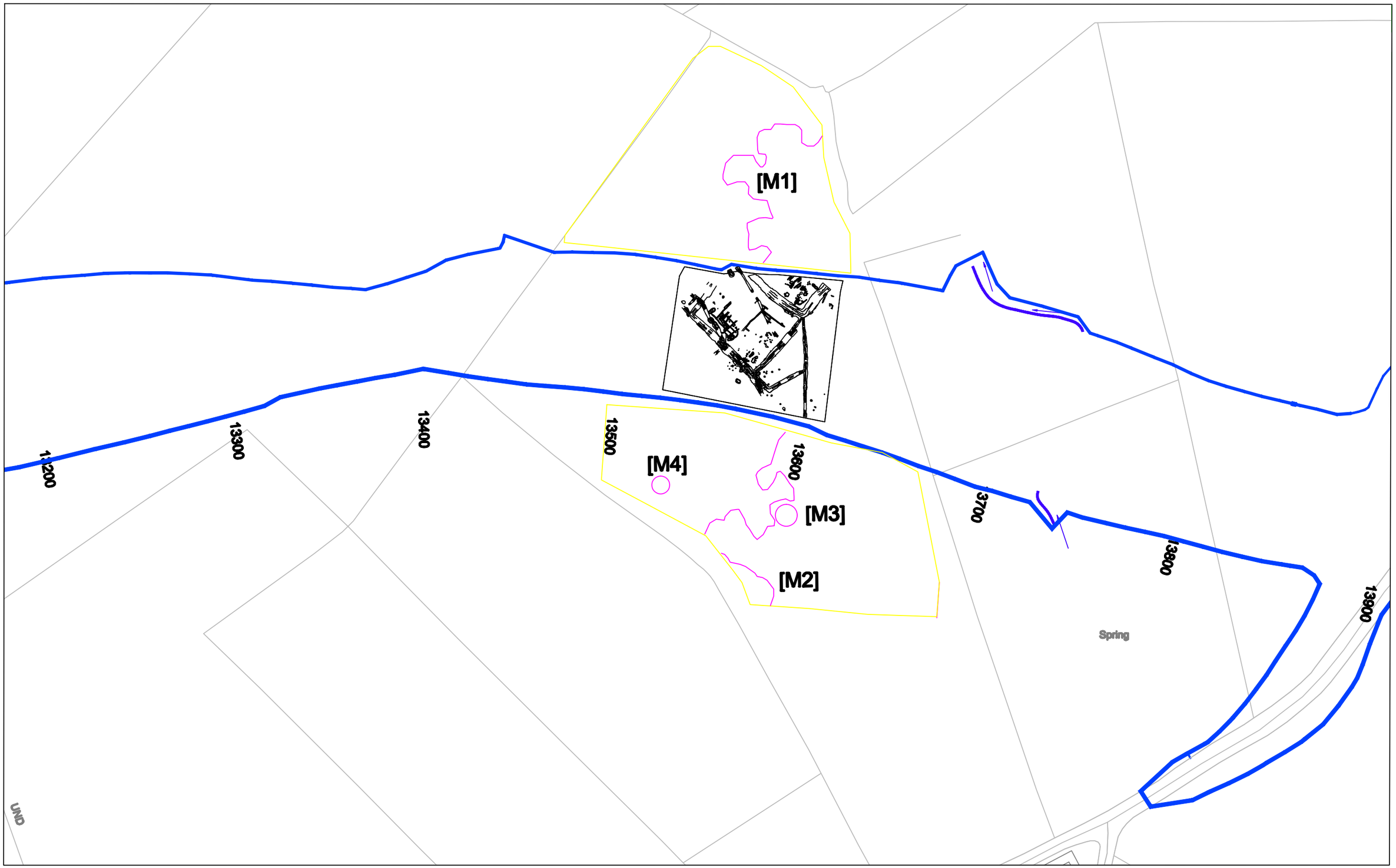
0m 85m 170m

Figure No. 5 Magnetic Susceptibility data - Busherstown 1

EARTHSOUND archaeological geophysics



Legend

- Basemap
- New N7 C.P.O. Boundary
- Geophysical Survey Area
- Archaeological Excavation Results
- Magnetic Susceptibility Anomaly

Site Location: Land Adjacent to Archaeological sites, N7 Castletown to Nenagh Road Scheme

Client: Eachtra Archaeological Projects

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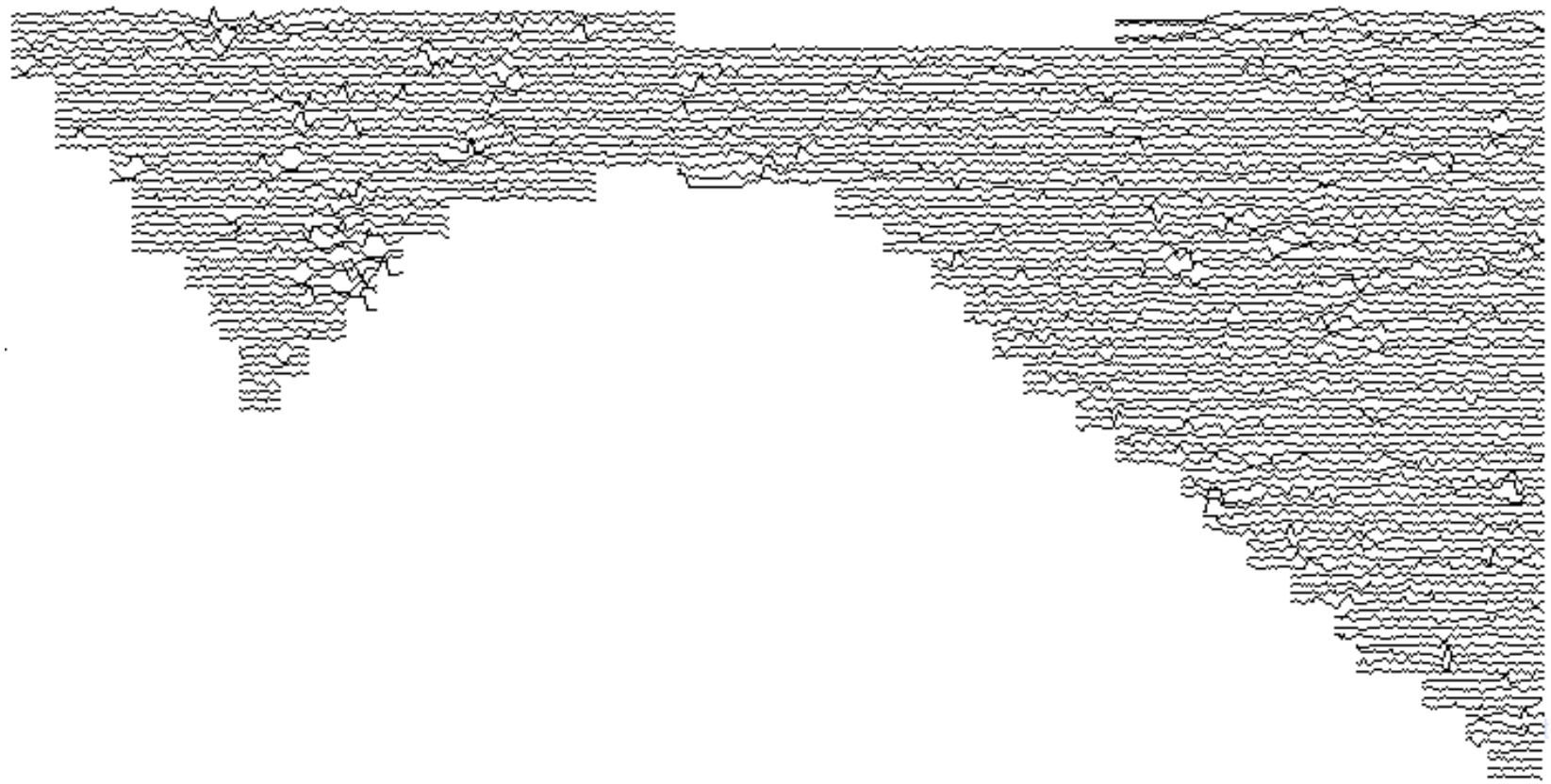
0m 85m 170m

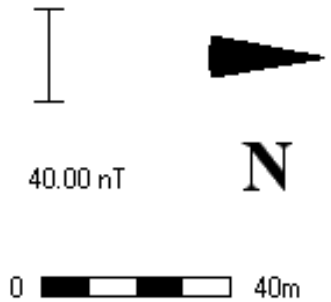
Figure No. 6 Magnetic Susceptibility Interpretation - Busherstown 1

EARTHSOUND archaeological geophysics

Land Adjacent to Archaeological Sites, N7 Castletown to Nenagh Road Scheme

Figure 7: Pre-processed Magnetic Gradiometer XY Traceplot – Drumbaun 2





Resolution 0.5nT,

Data Clipped to ± 3nT,

1m x 0.25m Sample Interval

EARTHSOUND archaeological geophysics

Drawing No.: 08_25/07

Legend

- Basemap
- RMP Archaeological Sites
- New N7 C.P.O. Boundary
- Archaeological Excavation Results

nT

-2 0 2

Site Location: Land Adjacent to Archaeological sites, N7 Castletown to Nenagh Road Scheme

Client: Eachtra Archaeological Projects

Drawing Courtesy of: Eachtra / OSI	Date 8/1/09	Drawing No.: 08-25/08

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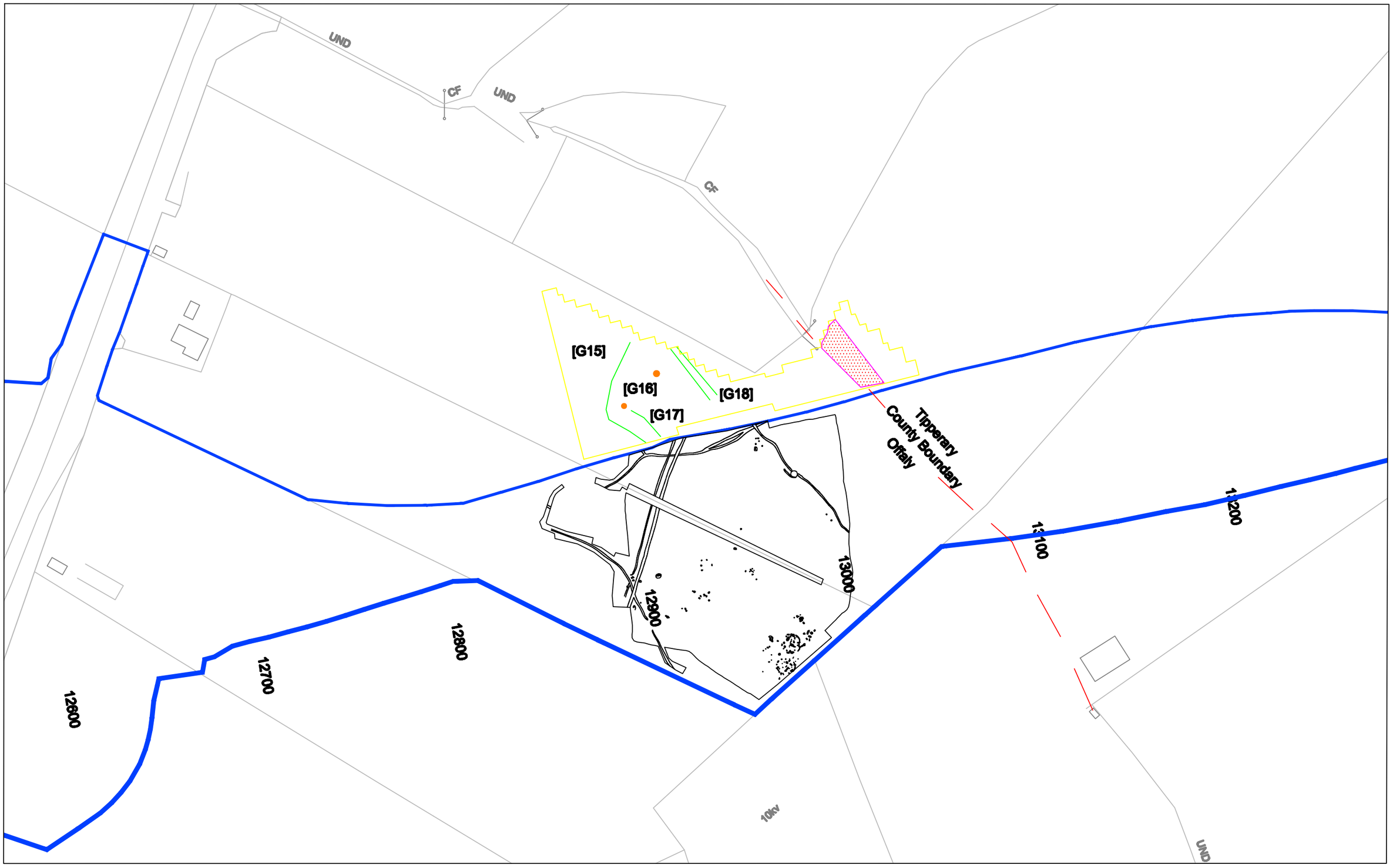
0m 85m 170m

Figure No. 8 Magnetic Gradiometer data - Drumbaun 2

EARTHSOUND archaeological geophysics



Legend

- Basemap
- New N7 C.P.O. Boundary
- Geophysical Survey Area
- Archaeological Excavation Results
- Possible Ditch
- Possible Pit
- Possible Plough Furrow
- Possible County Boundary Feature

Site Location: Land Adjacent to Archaeological sites, N7 Castletown to Nenagh Road Scheme

Client: Eachtra Archaeological Projects

Drawing Courtesy of: Eachtra / OSI	Date 8/1/09	Drawing No.: 08-25/09

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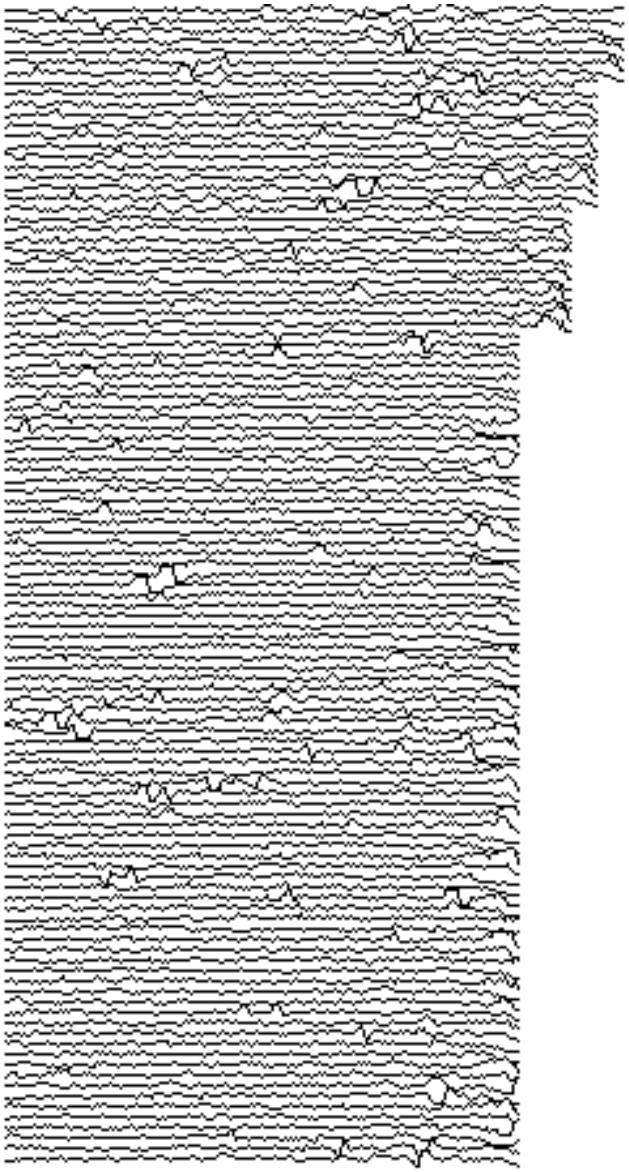
0m 85m 170m

Figure No. 9 Magnetic Gradiometer Interpretation - Drumbaun 2

EARTHSOUND archaeological geophysics

Land Adjacent to Archaeological Sites, N7 Castletown to Nenagh Road Scheme

Figure 10: Pre-processed Magnetic Gradiometer XY Traceplot – Drumroe 1



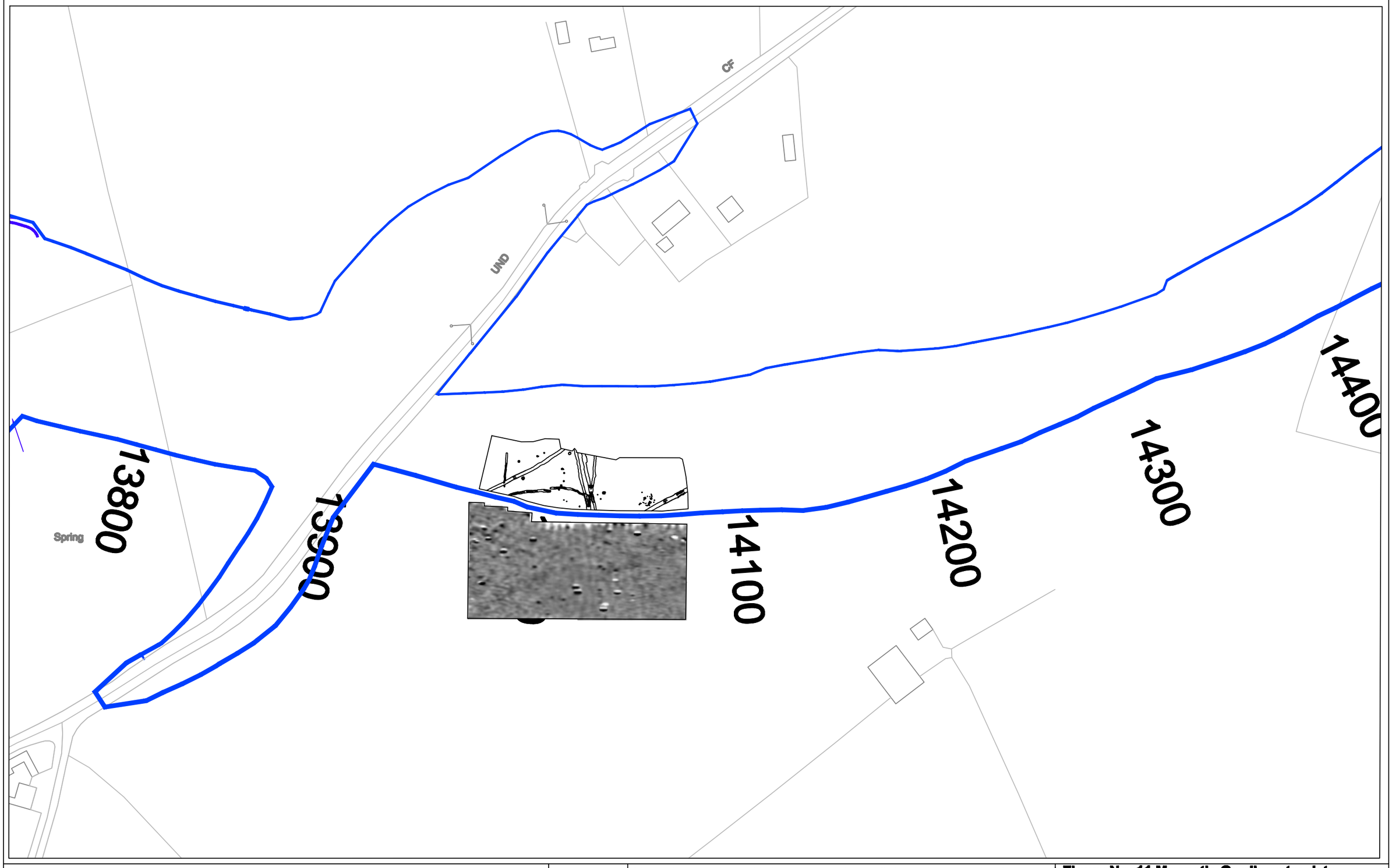
Resolution 0.5nT,

Data Clipped to ± 3nT,

1m x 0.25m Sample Interval

EARTHSOUND archaeological geophysics

Drawing No.: 08_25/10



Legend

- Basemap
- RMP Archaeological Sites
- New N7 C.P.O. Boundary
- Archaeological Excavation Results

nT

-2 0 2

Site Location: Land Adjacent to Archaeological sites, N7 Castletown to Nenagh Road Scheme

Client: Eachtra Archaeological Projects

Drawing Courtesy of: Eachtra / OSI	Date 8/1/09	Drawing No.: 08-25/11

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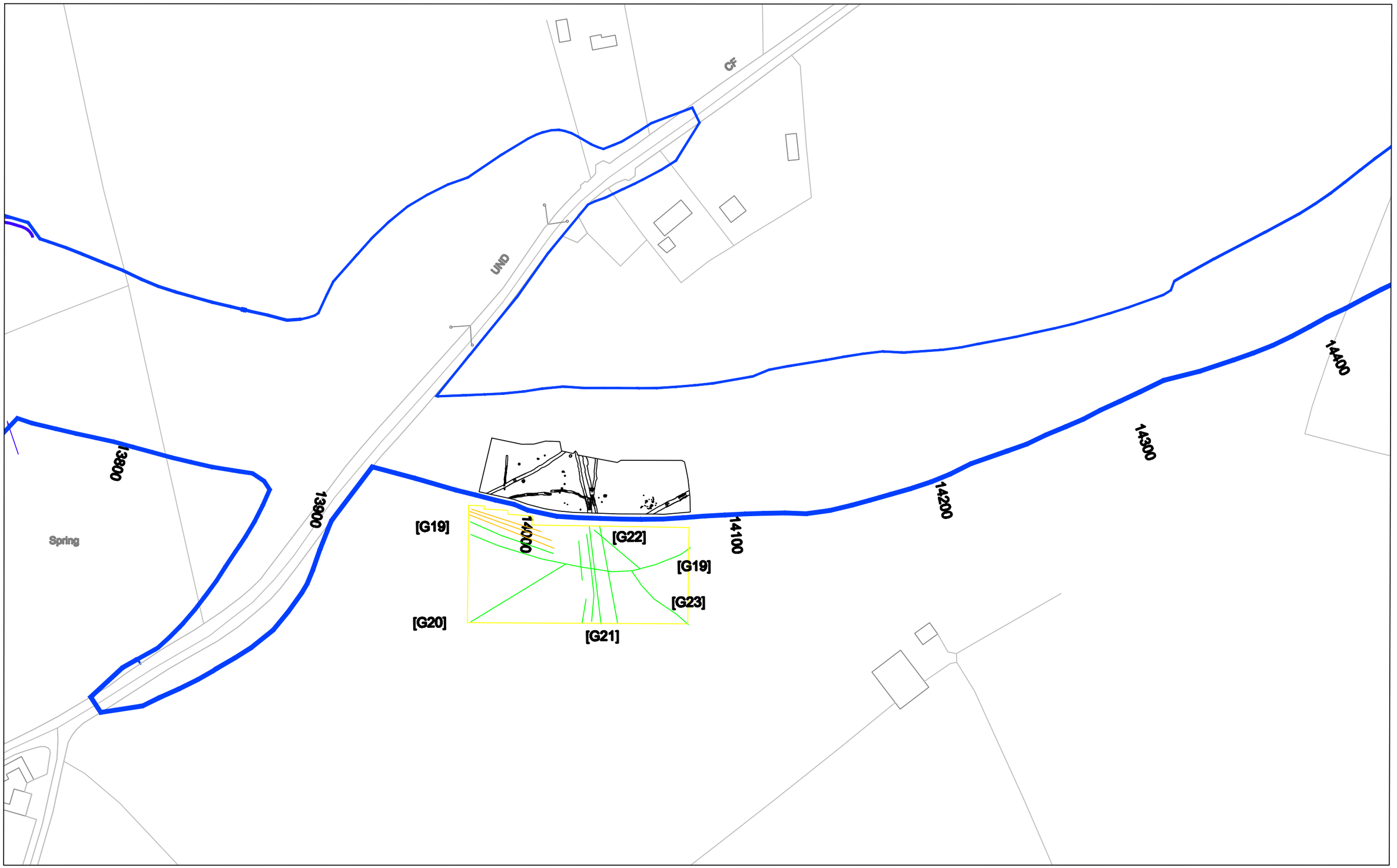
0m 85m 170m

Figure No. 11 Magnetic Gradiometer data - Drumroe 1

EARTHSOUND archaeological geophysics



Legend

- Basemap
- New N7 C.P.O. Boundary
- Geophysical Survey Area
- Archaeological Excavation Results
- Possible Ditch
- Possible Pit
- Possible Plough Furrow

Site Location: Land Adjacent to Archaeological sites, N7 Castletown to Nenagh Road Scheme

Client: Eachtra Archaeological Projects

Drawing Courtesy of: Eachtra / OSI	Date 8/1/09	Drawing No.: 08-25/12

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0m 85m 170m

Figure No. 12 Magnetic Gradiometer Interpretation - Drumroe 1

EARTHSOUND archaeological geophysics

Legend

- Basemap
- New N7 C.P.O. Boundary
- Archaeological Excavation Results

K

-3 2 10 16 25

Site Location: Land Adjacent to Archaeological sites, N7 Castletown to Nenagh Road Scheme

Client: Eachtra Archaeological Projects

Drawing Courtesy of: Eachtra / OSI	Date 9/1/09	Drawing No.: 08-25/13

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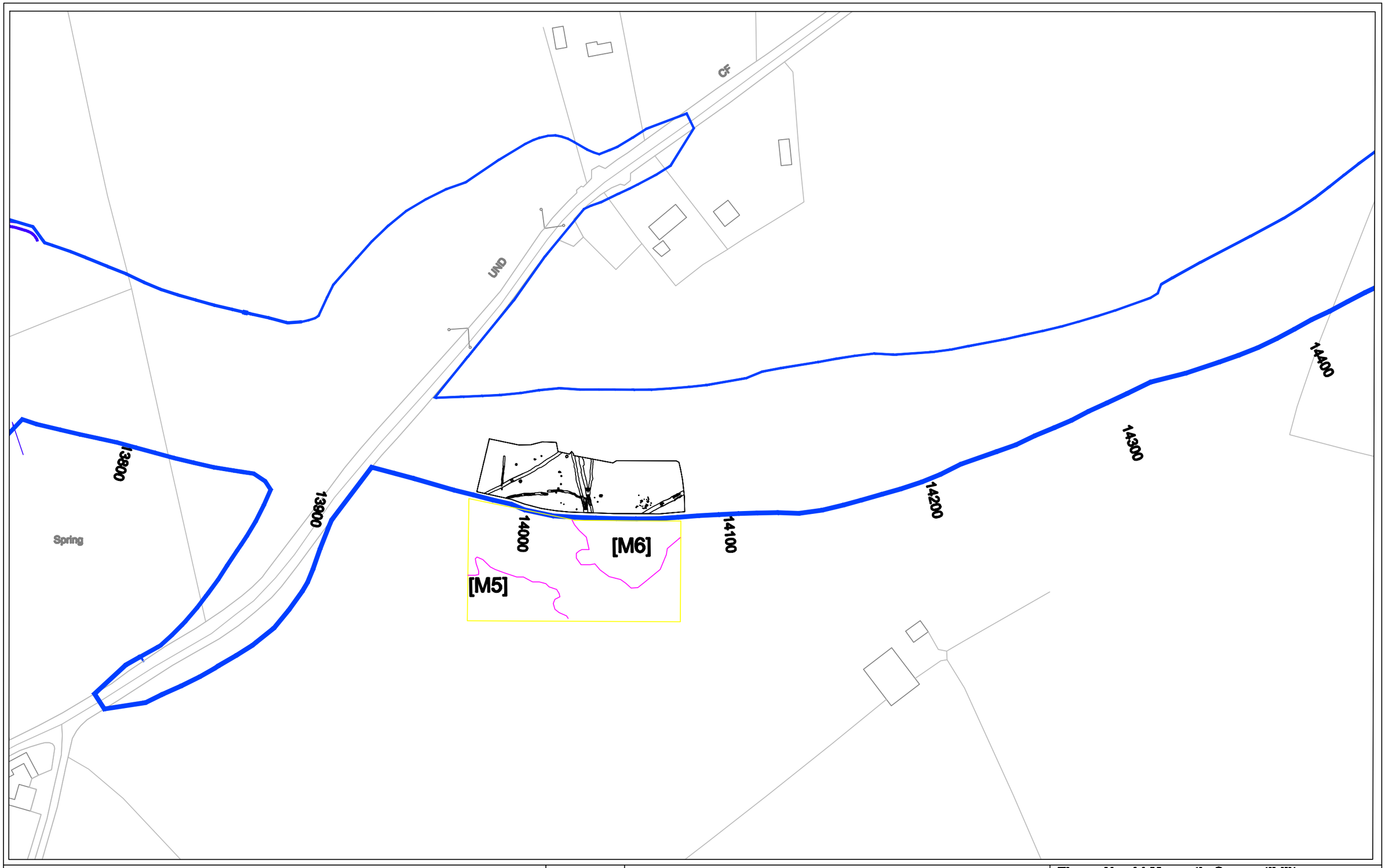
0m 85m 170m

Figure No. 13 Magnetic Susceptibility data - Drumroe 1

EARTHSOUND archaeological geophysics



Legend

- Basemap
- New N7 C.P.O. Boundary
- Geophysical Survey Area
- Archaeological Excavation Results
- Magnetic Susceptibility Anomaly

Site Location: Land Adjacent to Archaeological sites, N7 Castletown to Nenagh Road Scheme

Client: Eachtra Archaeological Projects

Drawing Courtesy of: Eachtra / OSI	Date 9/1/09	Drawing No.: 08-25/14

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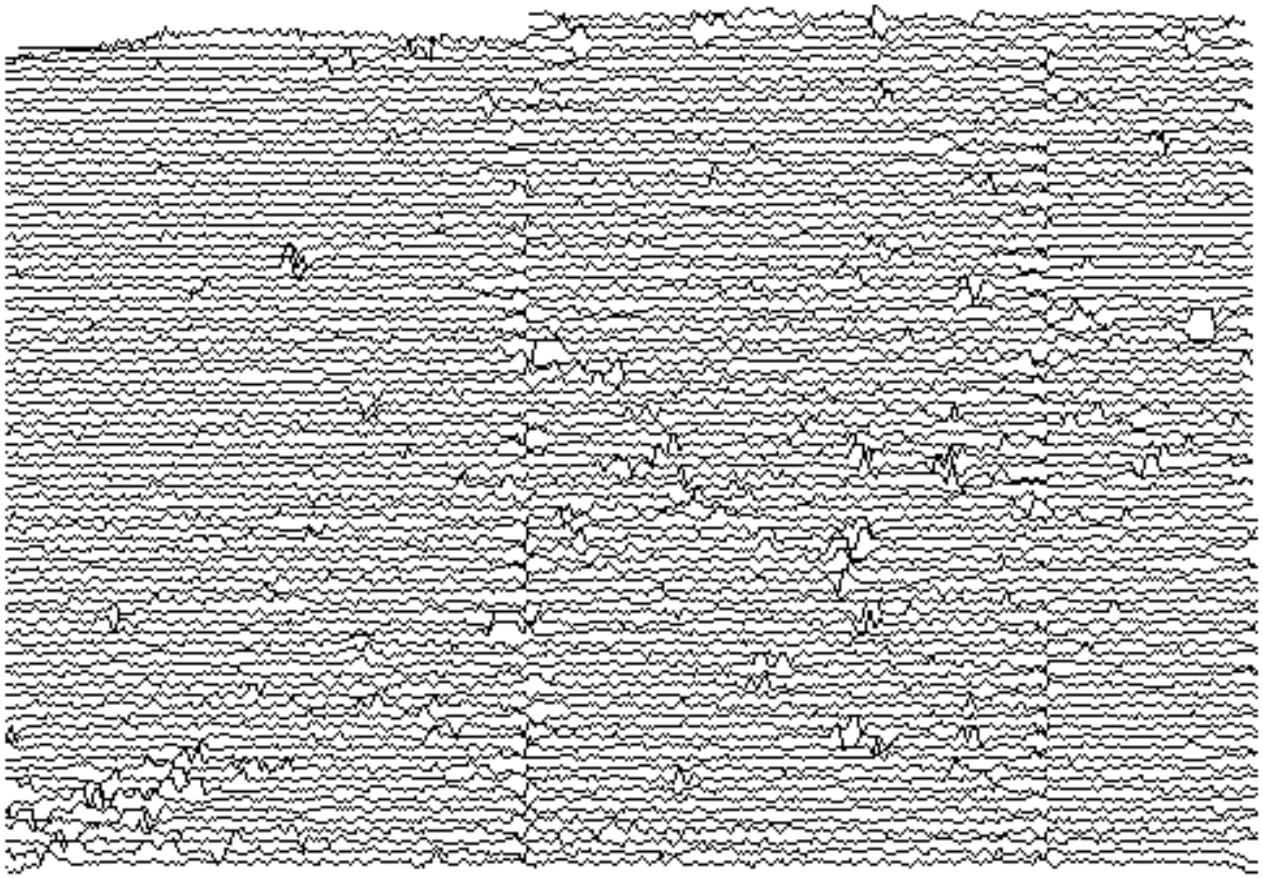
0m 85m 170m

Figure No. 14 Magnetic Susceptibility Interpretation - Drumroe 1

EARTHSOUND archaeological geophysics

Land Adjacent to Archaeological Sites, N7 Castletown to Nenagh Road Scheme

Figure 15: Pre-processed Magnetic Gradiometer XY Traceplot – Killeisk 1



28.00 nT

N

0 20m

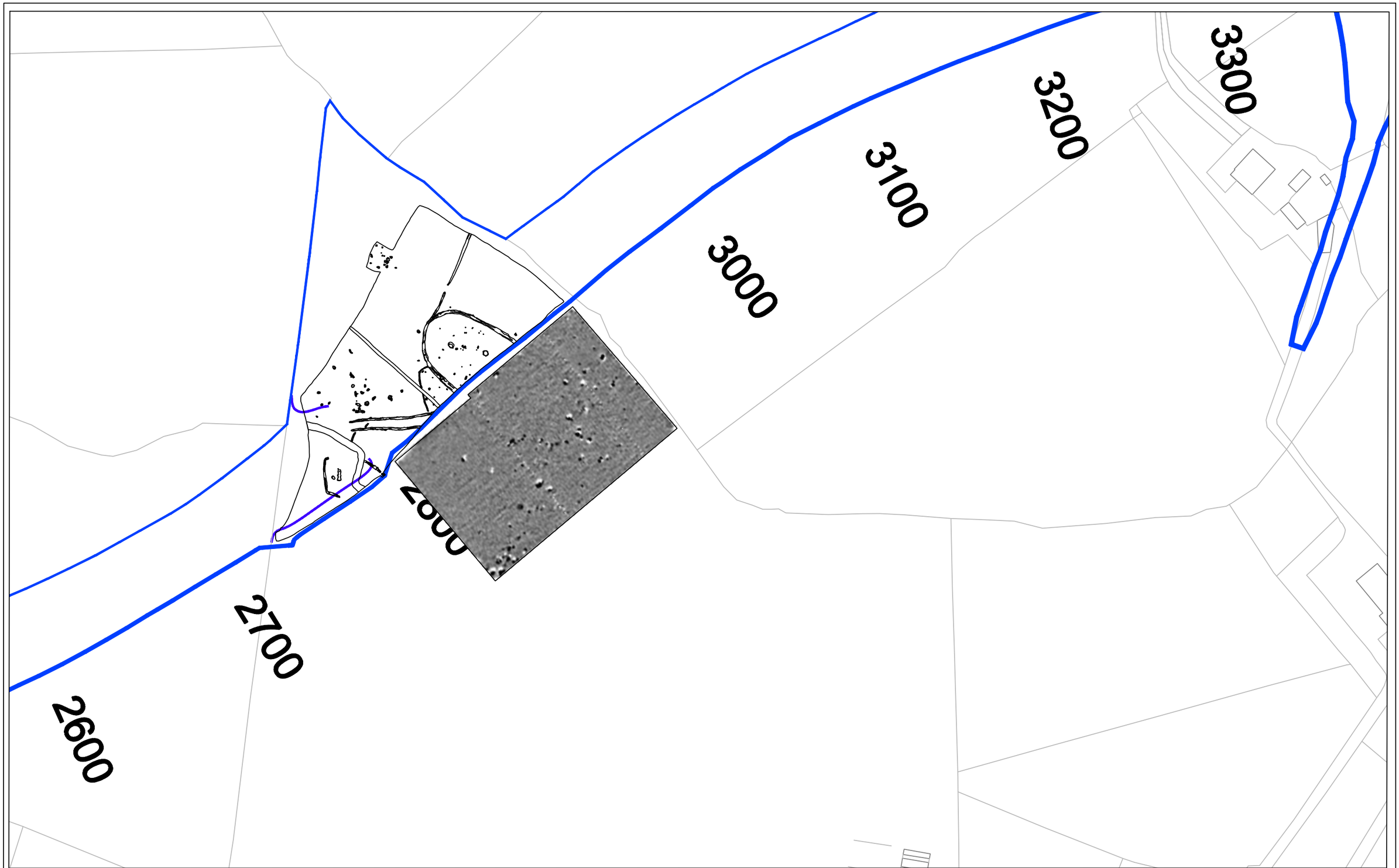
Resolution 0.5nT,

Data Clipped to ± 3nT,

1m x 0.25m Sample Interval

EARTHSOUND archaeological geophysics

Drawing No.: 08_25/15



Legend

- Basemap
- RMP Archaeological Sites
- New N7 C.P.O. Boundary
- Archaeological Excavation Results

nT

-2 0 2

Site Location: Land Adjacent to Archaeological sites, N7 Castletown to Nenagh Road Scheme

Client: Eachtra Archaeological Projects

Drawing Courtesy of: Eachtra / OSI	Date 8/1/09	Drawing No.: 08-25/16

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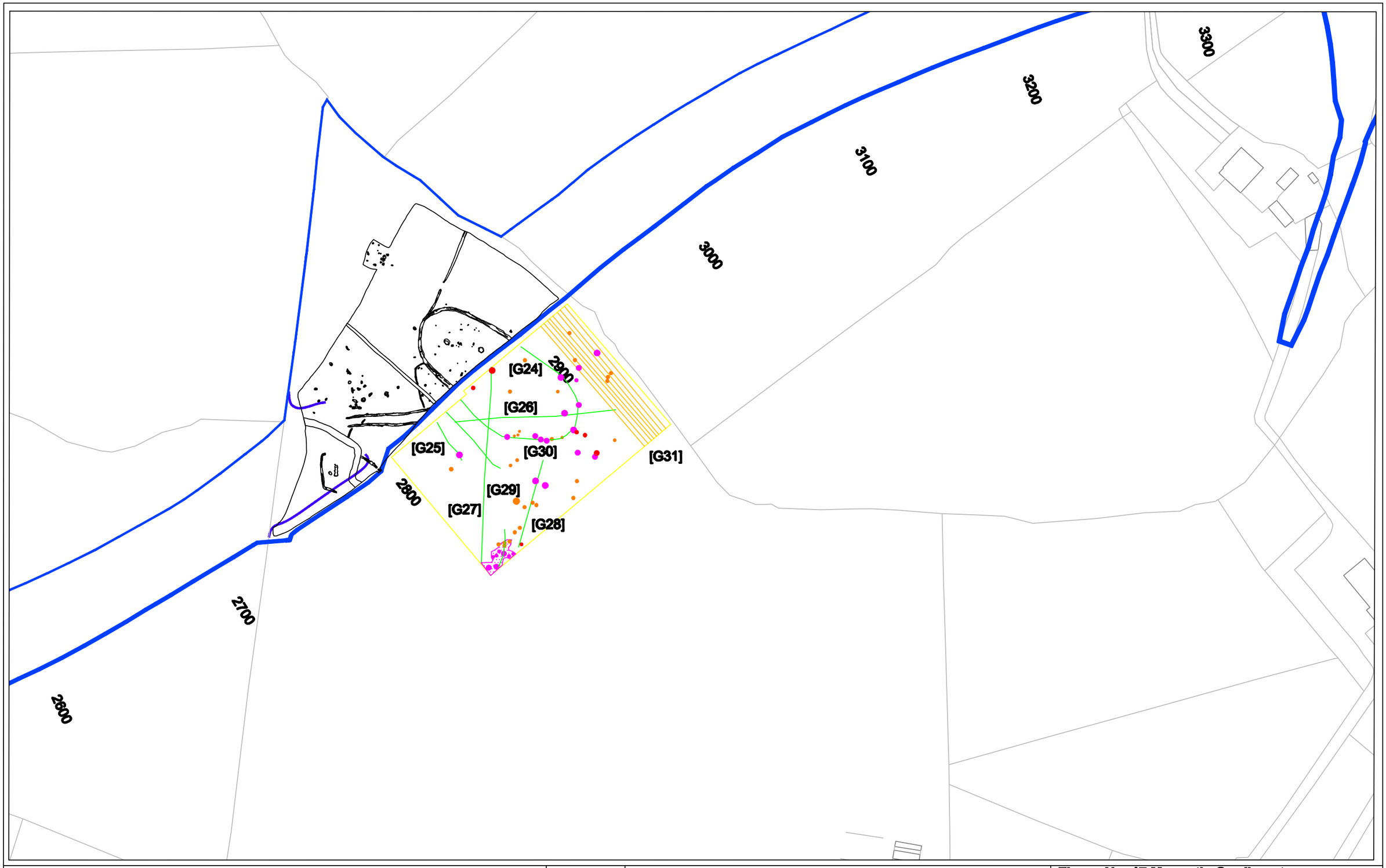
0m 85m 170m

Figure No. 16 Magnetic Gradiometer data - Killeisk 1

EARTHSOUND archaeological geophysics



Legend

- Basemap
- New N7 C.P.O. Boundary
- Geophysical Survey Area
- Archaeological Excavation Results
- Possible Ditch
- Possible Pit
- Possible Plough Furrow
- Possible Industrial / ferrous iron
- Possible Hearth / Burning

Site Location: Land Adjacent to Archaeological sites, N7 Castletown to Nenagh Road Scheme

Client: Eachtra Archaeological Projects

Drawing Courtesy of: Eachtra / OSI	Date 8/1/09	Drawing No.: 08-25/17

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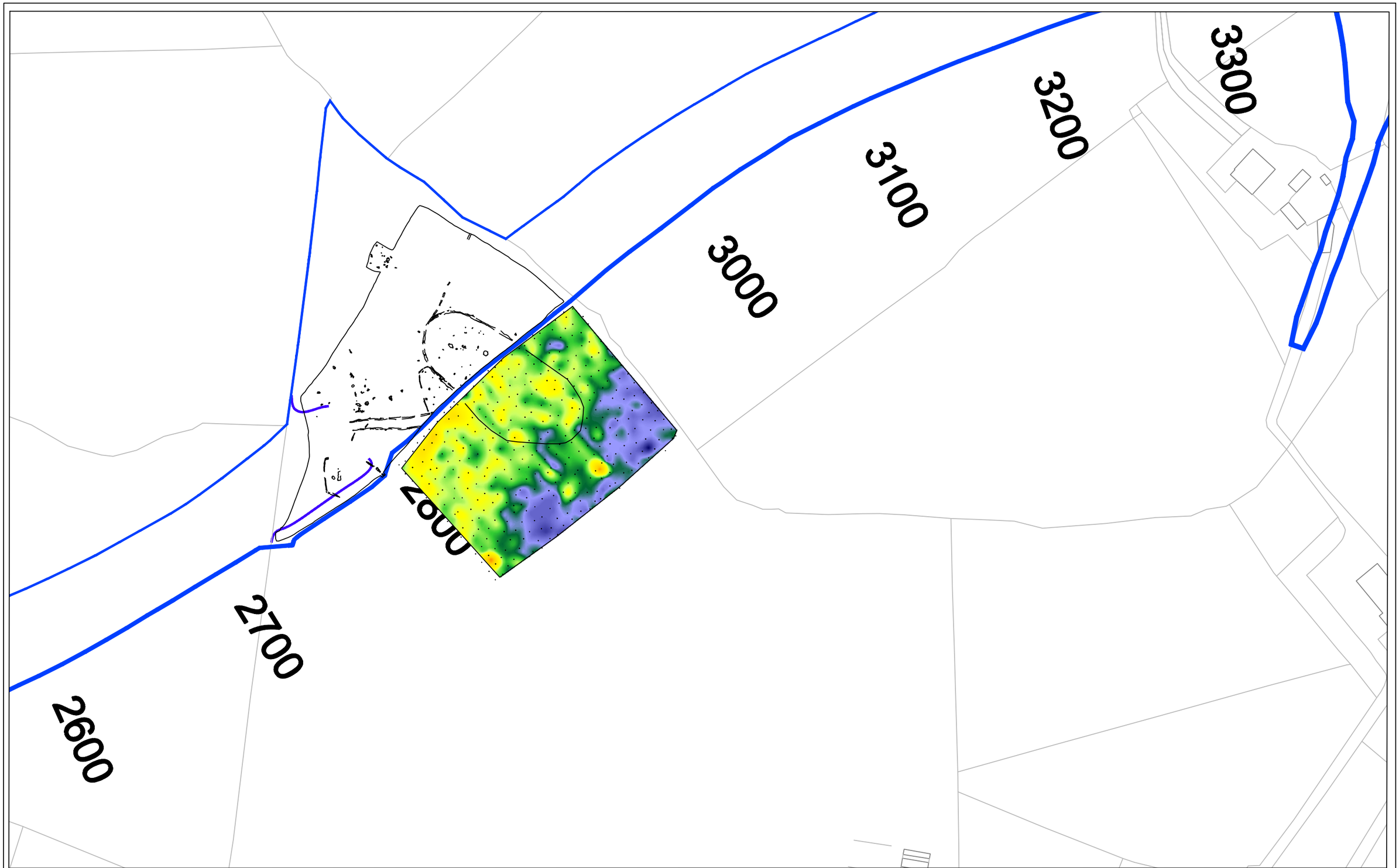
0m 85m 170m

Figure No. 17 Magnetic Gradiometer interpretation - Killeisk 1

EARTHSOUND archaeological geophysics



Legend

- Basemap
- New N7 C.P.O. Boundary
- Archaeological Excavation Results
- Magnetic Susceptibility Point Cloud

K

-3 2 10 16 25

Site Location: Land Adjacent to Archaeological sites, N7 Castletown to Nenagh Road Scheme

Client: Eachtra Archaeological Projects

Drawing Courtesy of: Eachtra / OSI	Date 9/1/09	Drawing No.: 08-25/18

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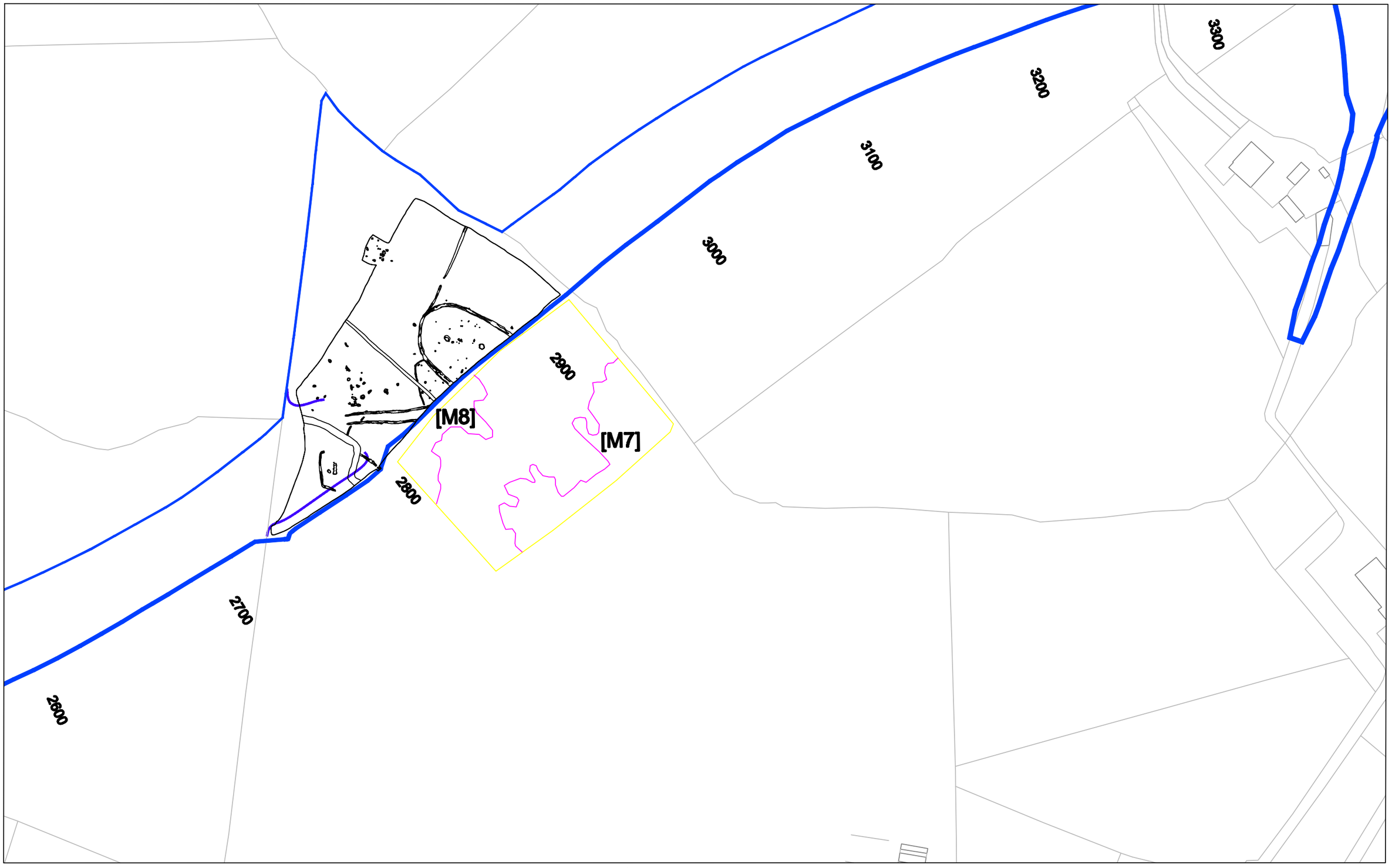
0m 85m 170m

Figure No. 18 Magnetic Susceptibility data - Killeisk 1

EARTHSOUND archaeological geophysics



Legend

- Basemap
- New N7 C.P.O. Boundary
- Geophysical Survey Area
- Archaeological Excavation Results
- Magnetic Susceptibility Anomaly

Site Location: Land Adjacent to Archaeological sites, N7 Castletown to Nenagh Road Scheme

Client: Eachtra Archaeological Projects

Drawing Courtesy of: Eachtra / OSI	Date 9/1/09	Drawing No.: 08-25/19

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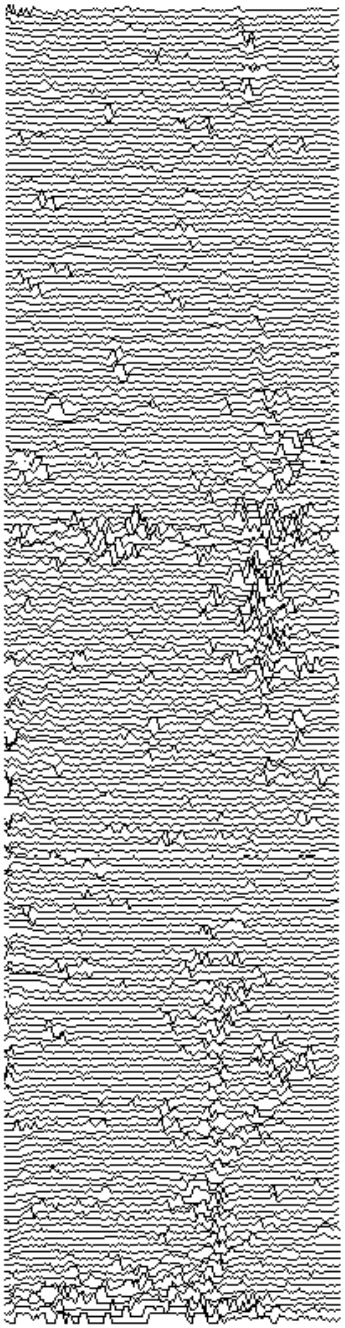
0m 85m 170m

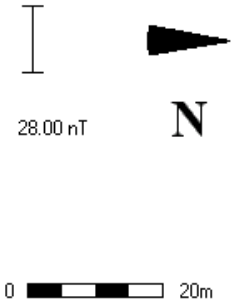
Figure No. 19 Magnetic Susceptibility interpretation - Killeisk 1

EARTHSOUND archaeological geophysics

Land Adjacent to Archaeological Sites, N7 Castletown to Nenagh Road Scheme

Figure 20: Pre-processed Magnetic Gradiometer XY Traceplot – Park 1





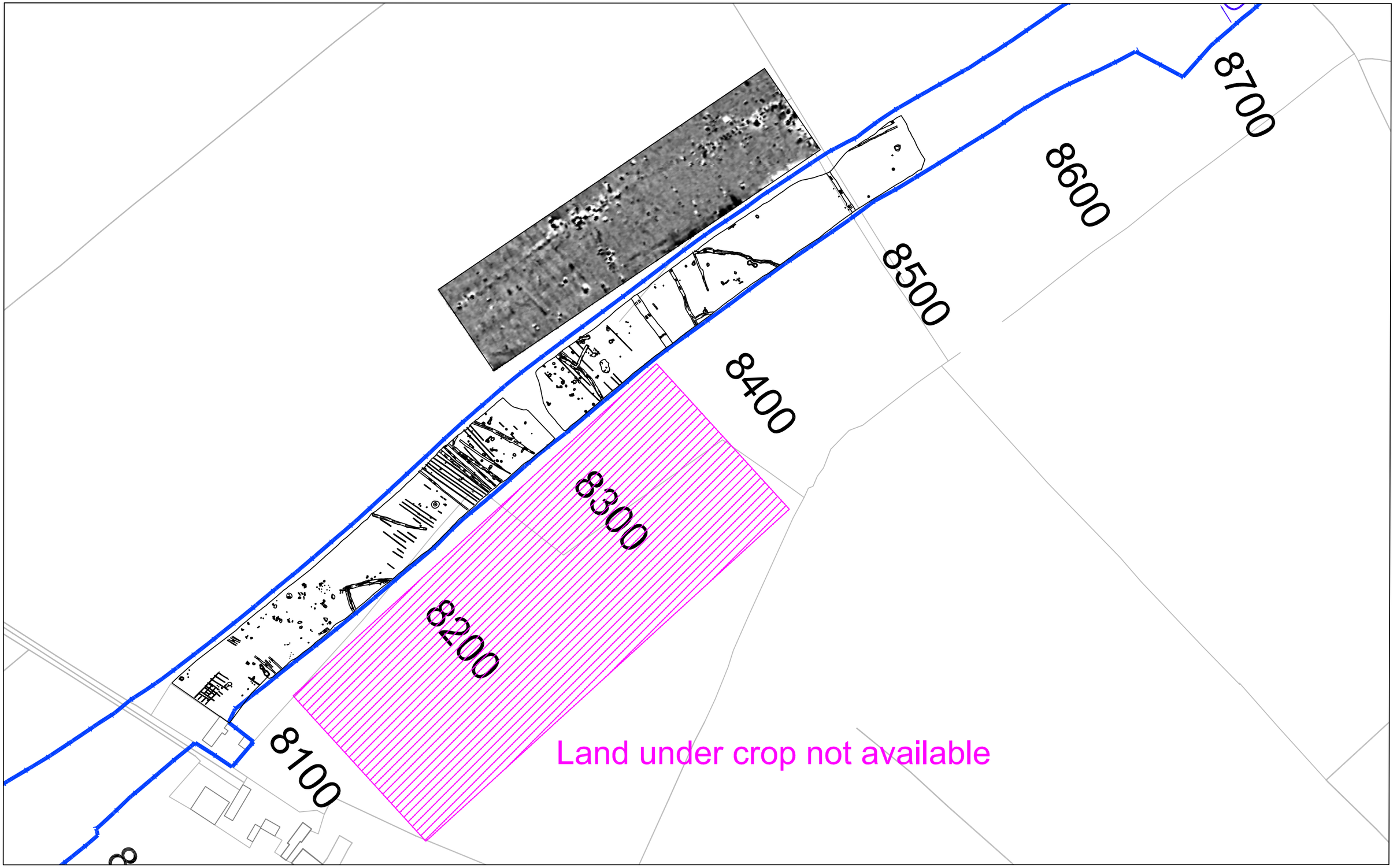
Resolution 0.5nT,

Data Clipped to ± 3nT,

1m x 0.25m Sample Interval

EARTHSOUND archaeological geophysics

Drawing No.: 08_25/20



Legend

- Basemap
- RMP Archaeological Sites
- New N7 C.P.O. Boundary
- Archaeological Excavation Results

nT

-2 0 2

Site Location: Land Adjacent to Archaeological sites, N7 Castletown to Nenagh Road Scheme

Client: Eachtra Archaeological Projects

Drawing Courtesy of: Eachtra / OSI	Date 8/1/09	Drawing No.: 08-25/21

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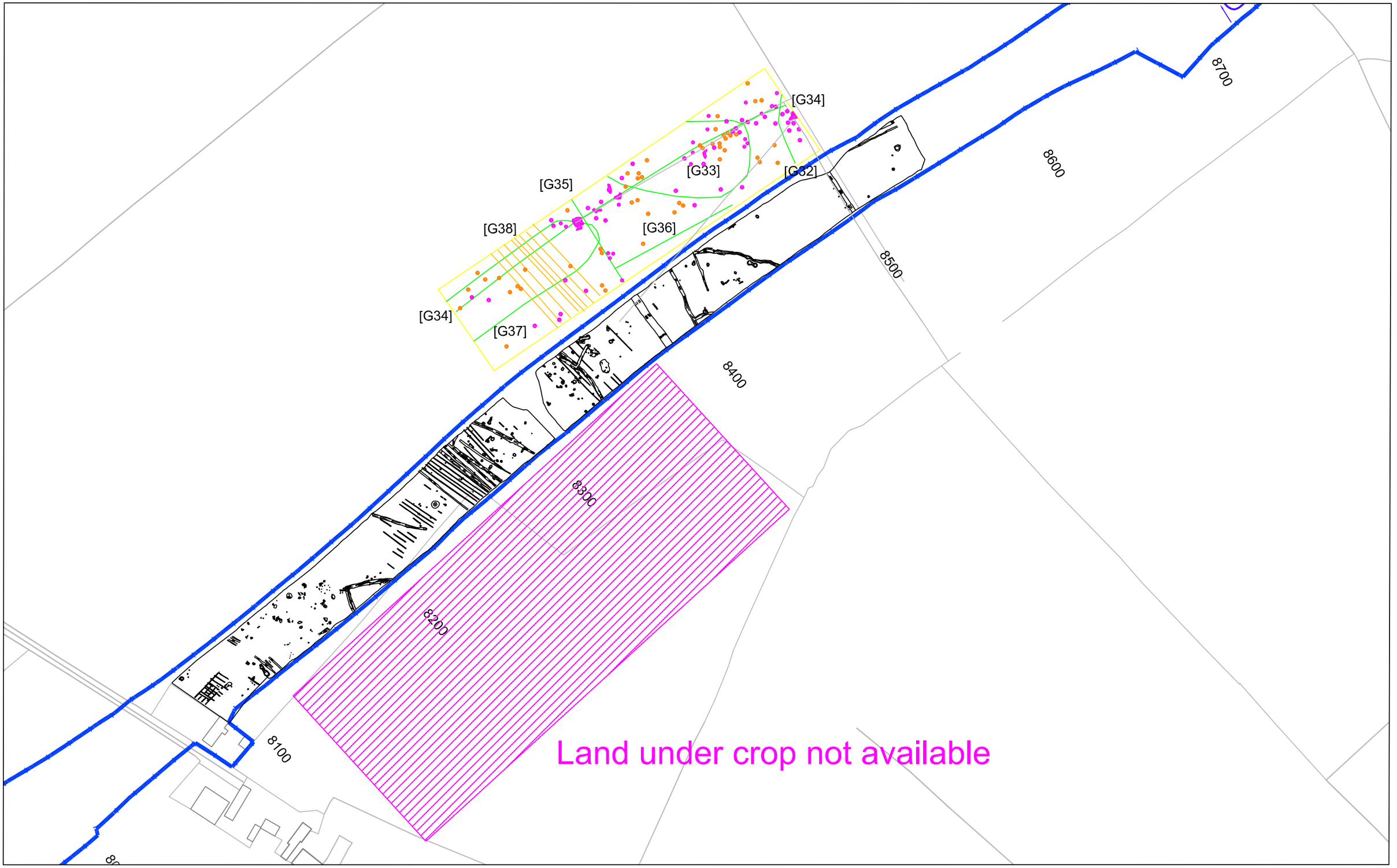
0m 85m 170m

Figure No. 21 Magnetic Gradiometer data - Park 1

EARTHSOUND archaeological geophysics



Legend

- Basemap
- New N7 C.P.O. Boundary
- Geophysical Survey Area
- Archaeological Excavation Results
- Possible Ditch
- Possible Pit
- Possible Plough Furrow
- Possible Industrial / ferrous iron
- Possible Hearth / Burning

Site Location: Land Adjacent to Archaeological sites, N7 Castletown to Nenagh Road Scheme

Client: Eachtra Archaeological Projects

Drawing Courtesy of: Eachtra / OSI	Date 8/1/09	Drawing No.: 08-25/22

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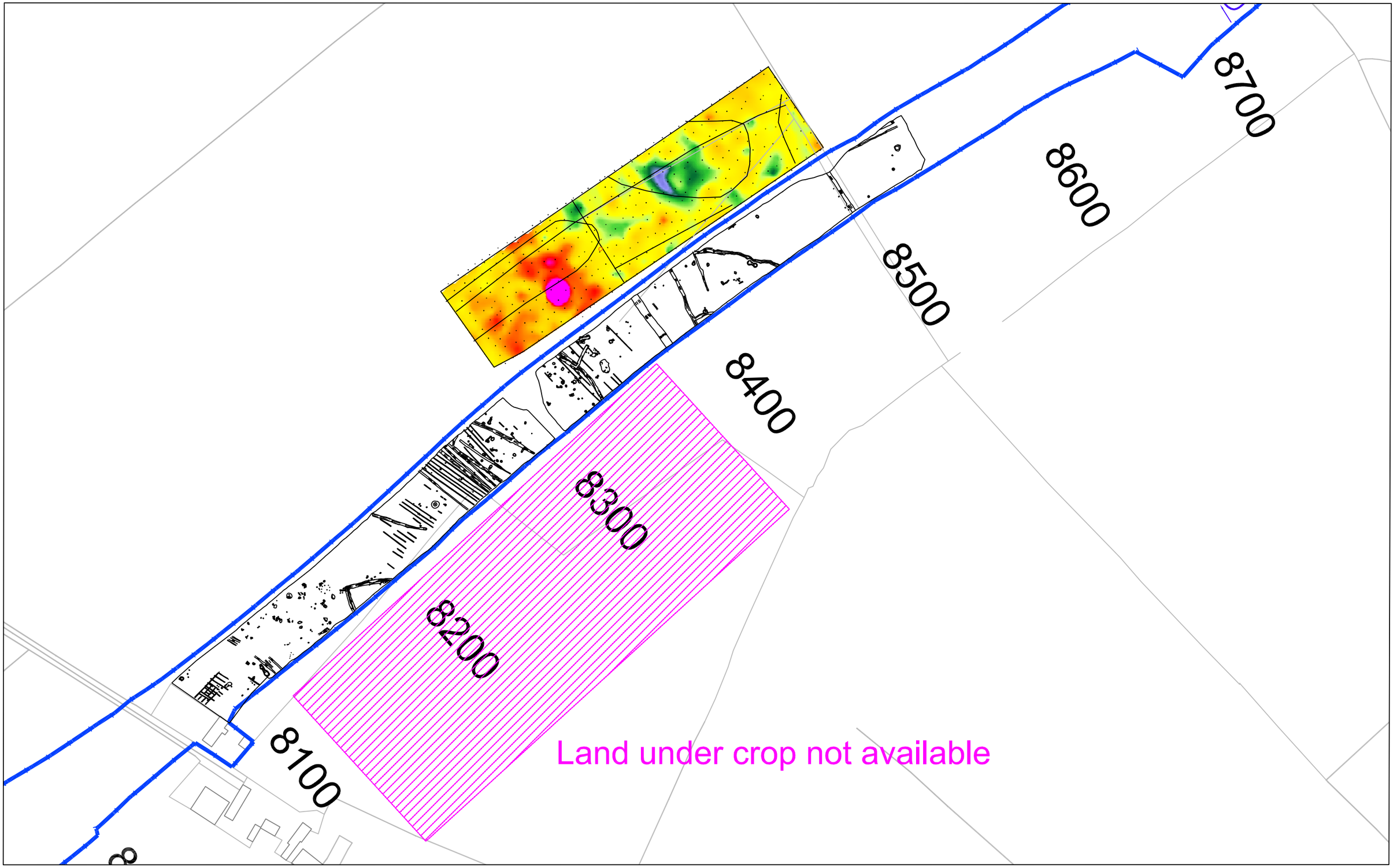
0m 85m 170m

Figure No. 22 Magnetic Gradiometer interpretation - Park 1

EARTHSOUND archaeological geophysics



Legend

- Basemap
- New N7 C.P.O. Boundary
- Archaeological Excavation Results
- Magnetic Susceptibility Point Cloud

K

-3 2 10 16 25

Site Location: Land Adjacent to Archaeological sites, N7 Castletown to Nenagh Road Scheme

Client: Eachtra Archaeological Projects

Drawing Courtesy of: Eachtra / OSI	Date 9/1/09	Drawing No.: 08-25/23

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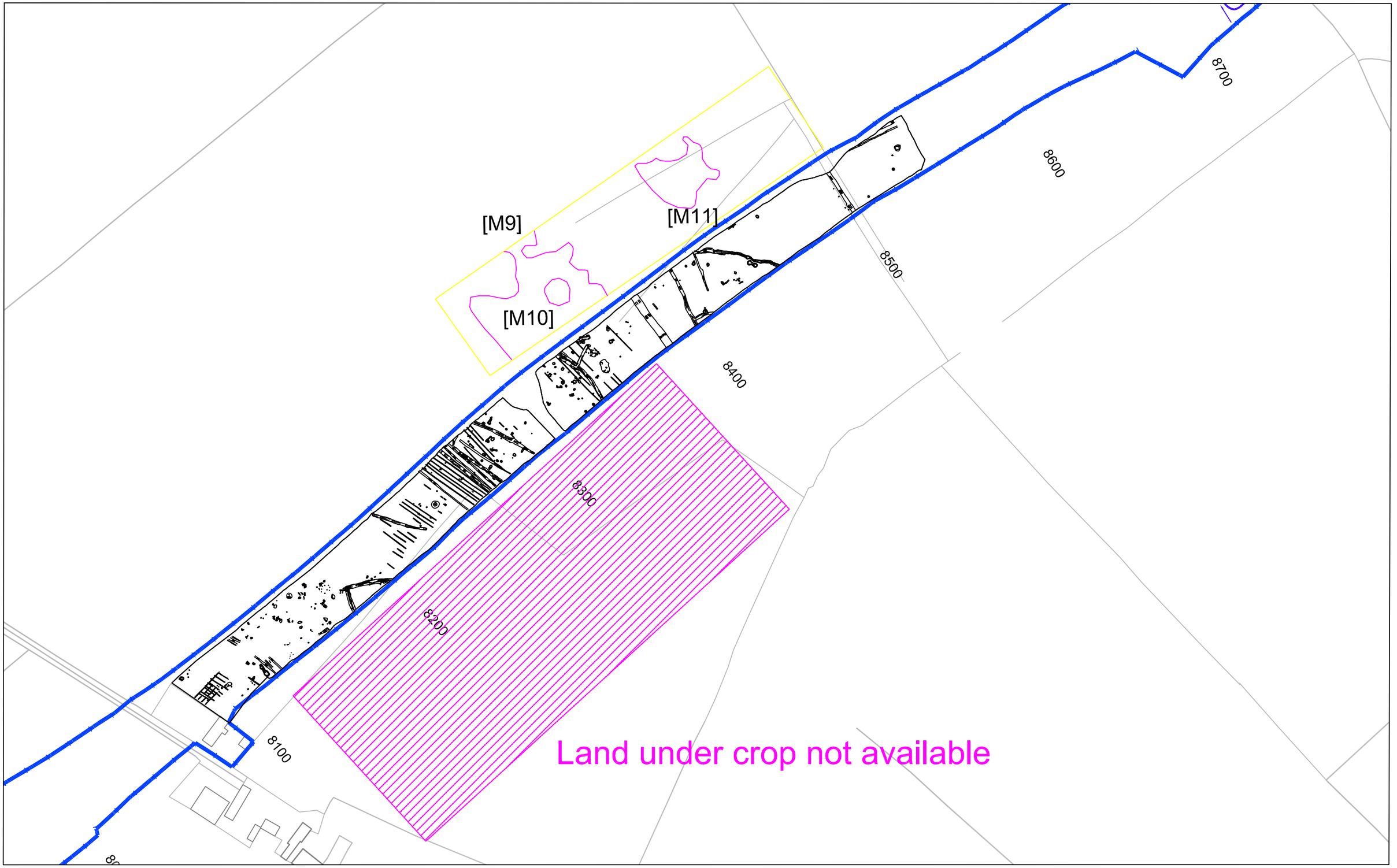
0m 85m 170m

Figure No. 23 Magnetic Susceptibility data - Park 1

EARTHSOUND archaeological geophysics



Legend

- Basemap
- New N7 C.P.O. Boundary
- Geophysical Survey Area
- Archaeological Excavation Results
- Magnetic Susceptibility Anomaly

Site Location: Land Adjacent to Archaeological sites, N7 Castletown to Nenagh Road Scheme

Client: Eachtra Archaeological Projects

Drawing Courtesy of: Eachtra / OSI	Date 9/1/09	Drawing No.: 08-25/24

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0m 85m 170m

Figure No. 24 Magnetic Susceptibility interpretation - Park 1

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