14.2 Results of the Geophysical and Metal Detecting Survey

A96 Dualling: Inverness to Nairn (including Nairn Bypass) Geophysical Survey

AOC 23327

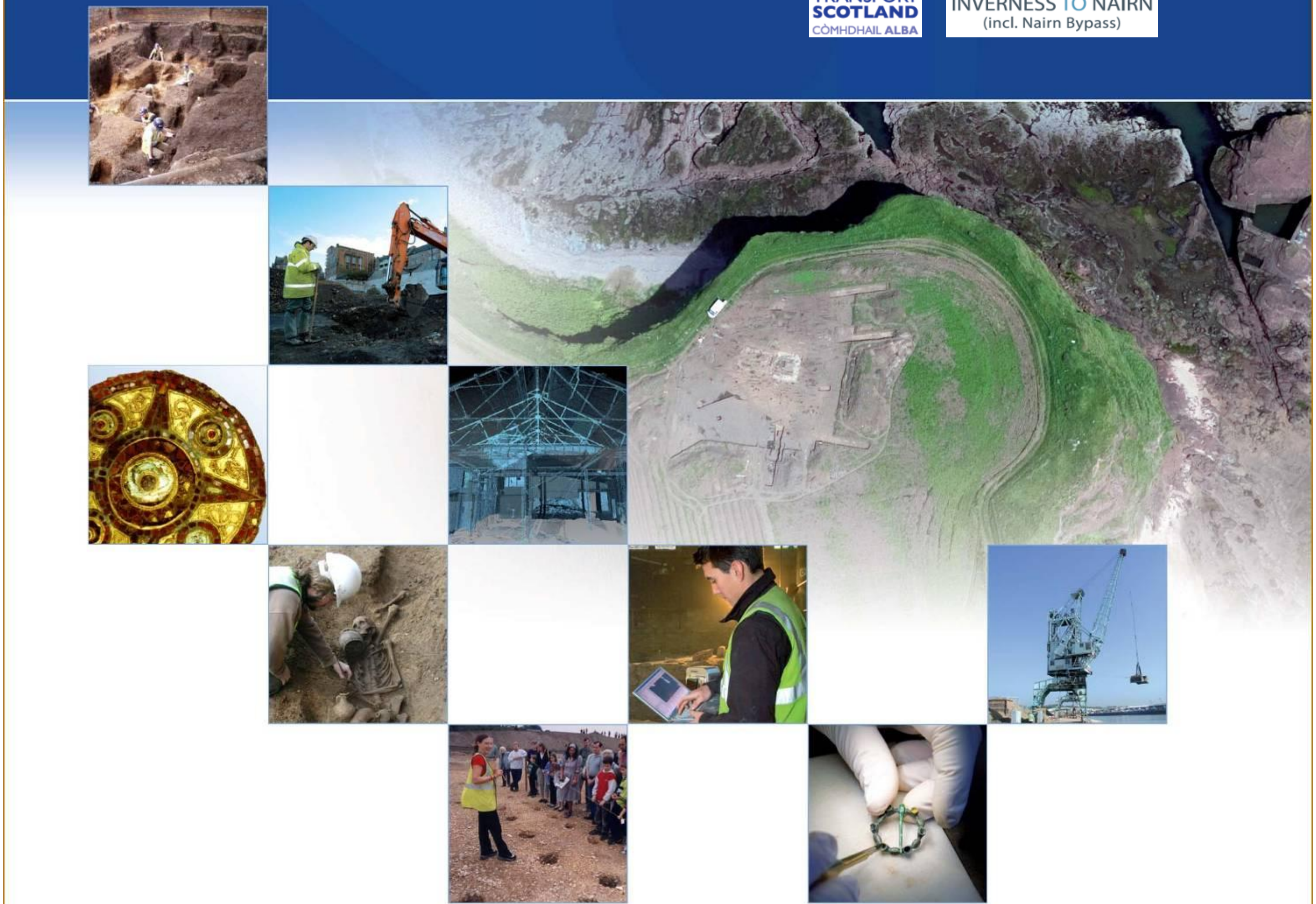
Client Project Ref No.: B2103500/EN/01/RP/001

4th April 2016

Oasis Number: 247102

TRANSPORT SCOTLAND
CÒMHDHAIL ALBA

A96 DUALLING
INVERNESS TO NAIRN
(incl. Nairn Bypass)



AOC Archaeology Group

ARCHAEOLOGY | HERITAGE | CONSERVATION

A96 Dualling Inverness to Nairn (including Nairn Bypass) Archaeological Geophysical Survey

Commissioned by:	**Jacobs U.K. Limited** **160 Dundee Street** **Edinburgh** **EH11 1DQ**
AOC Project No:	**23327**
Prepared by:	**Alice James**
Illustration by:	**Alice James**
Date:	**31st March 2016**

This document has been prepared in accordance with AOC standard operating procedures.

Author: Alice James	**Date: 4th April 2016**
Approved by (Manager): Graeme Cavers	**Date: 4th April 2016**
Approved by (QA): Andy Heald	**Date: 4th April 2016**
Report Stage: Final	**Date: 4th April 2016**

Enquiries to: AOC Archaeology Group
The Raylor Centre
James Street
York
YO10 3DW

Tel. 01904 413404
e-mail. york@aocarchaeology.com

Contents

List of Figures

List of Plates

Non-Technical Summary

AOC Archaeology Group was commissioned by Jacobs U.K. Limited to undertake an archaeological geophysical (gradiometer) survey to investigate the potential for buried archaeological remains between Inverness and Nairn, Highland as part of the cultural heritage assessment works for the A96 Dualling Inverness to Nairn project.

The site includes eighteen parcels of land running between Inverness and Nairn, following the route of the A96 (NH 8020 5260).

A gradiometer survey was undertaken over approximately 85ha which detected anomalies representing features previously recorded on historic mapping, such as field boundaries. The results have also identified linear, curvilinear and rectilinear anomalies that possibly relate to former human activity. Across the survey area there are large areas of modern and geological disturbance and subsequently detailed interpretation is tentative. Modern features are also visible within the survey results, such as plough lines, land drains and buried utilities.

1 Introduction

1.1 AOC Archaeology Group was commissioned by Jacobs U.K. Limited to undertake an archaeological geophysical (gradiometer) survey to investigate the potential for buried archaeological remains between Inverness and Nairn, Highland as part of the cultural heritage assessment works for the A96 Dualling: Inverness to Nairn project.

1.2 The current survey was carried out to provide information on the extent and significance of potential buried archaeological remains within the preferred route of the A96. Fieldwork took place between 15th February and 9th March 2016.

2 Site location and description

2.1 The site includes eighteen parcels of land running between Inverness and Nairn, largely following the route of the current A96 (NH 8020 5260; Figure 1). The areas targeted with geophysical survey had a variety of different land uses with Parcels 1, 2, 3, 11 and 15d containing scrubland and high vegetation; Parcels 4, 7, 8c, 9a, 15d and 16b had been recently ploughed; 5, 6, 8a, 8b, 9b, 13a, 15a, 15b, 15c, 16a, 16c, 16d, 17b and 17c contained low lying crop; and 8a, 10, 12, 13b, 14, 17a and 18 were being used for pasture.

2.2 The natural topography undulates ranging between Inverness and Nairn from 20m above Ordnance Datum (aOD) to 50m (aOD), with the present course of the A96 being positioned in a depression between the higher coastal areas to the north and hills to the south.

2.3 The bedrock geology between Inverness and Nairn largely comprises Middle Old Red Sandstone (undifferentiated) - Conglomerate, Sandstone, Siltstone and Mudstone, with an area to the south-east of Nairn being composed of Unnamed Igneous Intrusion, Late Silurian To Early Devonian - Felsic-rock (BGS 2015).

2.4 Gradiometer survey is recommended over any sedimentary geology, but thermoremanent effects on some igneous rock types can be detrimental to magnetic based surveys. Gradiometer survey is suggested to provide an average to poor response over conglomerates and a poor response over sandstone and mudstone, however results can vary depending on the formation of these types of geology (David *et al.* 2008, 15).

3 Archaeological Background

3.1 The following section summarises the archaeological background outlined in the *Specification for Archaeological Geophysical Survey and Metal Detecting* prepared by Jacobs U.K. Limited in 2015 (Curtis 2015). Table 1 summarises each parcel and the known archaeology within the red line boundary.

3.2 The earliest recorded human activity within the vicinity of the survey area dates to the Mesolithic Period, evidence of which has been revealed during excavations at 13-24 Castle Street in Inverness with the discovery of several flint chips and charcoal. Two shell middens dated to the Mesolithic period have also been identified at Muirtown near Caledonian Canal and Milton of Culloden.

3.3 The Neolithic and Bronze Age periods are largely characterised by ritual/ceremonial monuments such as the stone circles at Upper Cullerine and upstanding stones at Milton. There are a several Bronze Age funerary monuments within the vicinity of the survey area including the chambered cairn at Culloden and the Clava Cairns, which comprise a complex of passage cairns, rings cairns, a kerb cairn and standing stones. Individual burial cists have also been excavated in the general area, such as the two cist burials located at Holm Mains Farm. Material evidence dating to these periods includes a variety of stone artefacts discovered at Allanfearn, Balloch and Clava. Evidence of hut circles, field systems and clearance cairns have been found at Loch Duntelchaig, Eastertown. Settlements relating to the prehistoric period largely exists as cropmarks, including ring ditches, such as those of the Scheduled Monument of a ring ditch and enclosure at Allanfearn.

3.4 To the south of Inverness at Culduthel Mains Farm lies a former multi phased settlement, comprising a substantial Iron Age settlement and industrial centre with material relating to the Neolithic, Iron Age and Romano-British Periods.

3.5 The Roman occupation in northern Scotland is largely characterised by marching camps relating to the military campaigns of AD 84 and the 3rd century AD. In the wider area around the proposed development site several temporary marching camps have been recorded at Thomshill near Elgin and Burghead (Ptoroton), as well as a Roman Fort at Easter Galcantray.

3.6 Evidence of the Picts in Northern Scotland during the Post-Roman period is largely defined by symbol stones, such as that of Sueno's Stone, Forres, and forts including that at Burghead, which was a centre of significant power during the Pictish period and is located to the north-east of the survey area.

3.7 From the 8th century Norse occupation had begun in the northern isles of Scotland and by the mid 9th century the Norse were frequently invading and settling along the coasts of Scotland. In 884 AD Sigurd the Powerful captured Burghead and the site became the centre of Norse power within Moray.

3.8 During the medieval period the Highlands saw a period of considerable social and economic change with the development of the clan system and the erection of numerous castles. Examples of which include the 14th century Cawdor Castle, which is located to the south of the proposed development area, and the Old Miller's Cottage to the south-east and Auldearn to the east of the proposed development which comprises a motte and bailey castle.

3.9 The post-medieval period involved much political and religious turmoil between Scotland and England with several Jacobite Risings which resulted in the battle of Culloden in 1746, which was located at Drumossie Moor to the south of the proposed development site. Following this battle several military sites were constructed such as that of Fort George, as well as a system of military roads leading between the forts and military garrisons.

3.10 During the 18th and 19th centuries agricultural and economic improvements resulted large changes to the landscape with increases in land enclosures, quarrying, reforestation and the burning of lime for fertilizer. Also during this period was the construction of the Inverness to Nairn Railway line, which was opened in 1855 and by 1861, had been absorbed into the Aberdeen and Inverness Junction Railway.

Parcel	Location Description	Known Archaeology	Area (Ha)
1	Low-lying coastal area below the 15m contour, near Seafield. Unoccupied farmland.	None.	2.27
2	Low-lying coastal area below the 15m contour, near Seafield. Unoccupied farmland.	Location of possible barrows (NMRS: NH74NW 111), visible as cropmarks.	3.80

3	Low-lying coastal area below the 15m contour at Milton of Culloden smallholdings.	None	1.11
4	Stretch of flat pasture lying below the 30m contour, between A96 and Balloch.	Evidence for prehistoric activity including pits (NH74NW74), enclosures (NH74NW 34; NH74NW 45) and ring-ditches (NH74NW 116).	20.35
5	Cultivated fields S of Newton of Petty farm.	Close to a cropmark enclosure (NH74NW 28).	7.02
6	Cultivated land SW of Tornagrain Wood.	None, though parcels are located just N of Kerrowaird settlements and funerary remains (SM 6017).	3.49
7	Cultivated land SW of Tornagrain Wood.	None, though parcels are located just N of Kerrowaird settlements and funerary remains (SM 6017).	1.60
8	Cultivated ground NW of Tornagrain wood.	None.	12.28
9	Cultivated fields NE of Brackley farm.	Ring ditch at Brackley (NH85SW 73). Just N of Brackley settlement (SM 11834).	7.59
10	Low rise, around the 35m contour, cultivated land S of Blackcastle farm.	Blackcastle farmstead, marked on OS 1st edn (NH85SW 30).	3.19
11	Level pasture around the 30m contour.	None	2.79
12	Level, cultivated land around the 25m contour, S of Balnaspirach farm.	None, though lose to enclosure and cultivation remains (NH85SE 30).	8.63
13	Level, cultivated land around the 25m contour.	None, though close to cropmarks around Lochdhu farm (NH85SE 52).	8.52
14	Level, cultivated land around Blackpark farm.	None.	2.96
15	Undulating, cultivated land around A96.	Partially including designated Battle of Auldearn (BTL3).	12.31
16	Rising, cultivated land S of Bogside of Boath, rising from the 20m to 45m contour.	None	5.93
17	Level, cultivated ground S of Penick farm.	None.	6.70
18	Levle, cultivated ground NW of Innesfree, S of A96.	None.	3.17

Table 1: Summary of survey parcels and known archaeology.

4 Aims

4.1 The aim of the geophysical survey was to identify any potential archaeological anomalies that would enhance the current understanding of the archaeological resource within the proposed development site.

4.2 The results of the geophysical survey have been assessed and interpreted to gain a clear understanding of potential buried remains within the survey area.

4.3 Specifically, the aims of the gradiometer survey were to:

- Locate, record and characterise any surviving sub-surface archaeological remains within the defined survey area
- Provide an assessment of the potential significance of any identified archaeological remains in a local, regional and (if relevant) national context
- Produce a comprehensive site archive and report

5 Methodology

5.1 Parameters were selected that were suitable for the prospective aims of the survey and in accordance with recommended professional good practice (David et al. 2008, 8).

5.2 The gradiometer survey was carried out using Bartington Grad601-2 fluxgate gradiometer (see Appendix 1 and 2). Data was collected on a north-south alignment using zig-zag traverses, with a sample interval of 0.25m and a traverse interval of 1m.

5.3 Field work covered a total of 902 complete and partial 30m by 30m grids were surveyed within the proposed site, totalling a surveyed area of approximately 85 ha.

5.4 Care was taken to attempt to avoid metal obstacles present within the survey area, such as the electrical fencing used to divide the fields into smaller enclosures as gradiometer survey is affected by 'above-ground noise'. Several areas were considered unsuitable for survey due to factors including: high vegetation in parcel 1, 2 and 3; waterlogging in areas 9a and 11; deep ploughing in 4 and 7a; quarrying in Parcel 8a; livestock in Parcel 12e and 14c; and crop in 13.

5.5 All geophysical survey work was carried out in accordance with recommended good practice specified in guideline documents published by English Heritage (David *et al.* 2008), and the Chartered Institute for Archaeologists *Standard and Guidance for archaeological geophysical survey* (2014). Data processing, storage and documentation were carried out in accordance with the good practice specifications detailed in the guidelines issued by the Archaeology Data Service (Schmidt and Ernenwein 2011).

5.6 The gradiometer data were downloaded using Bartington Grad601 PC Software v313 and processed using Geoscan Geoplot v3.0. Raw data is visualised as greyscale plots (Figures 28 to 85) and minimally processed XY trace plots are visualised in Figures 86 to 143). The details of these processes can be found in Appendices 3 and 4.

5.7 Interpreted point, polyline and polygon layers were created as layers in AutoCAD and technical terminology used to describe identified features can be found in Appendix 5.

6 Results and Interpretations

6.1 Gradiometer survey results have been visualised as greyscale plots (Figures 144 to 201) and an interpretation of the gradiometer survey results can be found in Figures 202 to 259. A characterisation of individual identified anomalies can be found in Appendix 6.

Isolated linear trends

6.2 Four field boundaries depicted on the 1906 and 1907 OS Map have been identified **(e1)**, **(g1)** and **(m1)**.

6.3 Although not recorded on historic mapping, it is possible that the change in background 'noise' between the east and west of Parcel 7b indicates the presence of a former field boundary **(f1)** (Figure 211), similarly there is a general change in background readings between the north and south of Parcel 8c which may indicate a former field boundary **(g2)** (Figure 213).

Discrete archaeology

6.4 In Parcel 1 there are two contiguous rectilinear anomalies that possibly indicate the presence of buried remains of an archaeological origin, such as an enclosure **(a1)** and **(a2)** (Figure 202). However, interpretation is fairly tentative as these anomalies have been in part masked by the strong responses of the buried utility **(a7)**.

6.5 **(d1 – d3)** (Figure 207) are likely to relate to the same feature, which runs on and east west alignment across Parcel 5. Although unclear due to weak patterning, it is possible these anomalies indicate the presence of buried enclosure ditches with an opening forming between **(d2)** and **(d3)**. The similarity in response values of **(d4 – d7)** (Figure 207) suggests these anomalies relate to a similar activity to **(d3)** and **(d4)**. In particular, it is possible that **(d4)** forms a second ditch to the north of **(d1 – d3)**, in which case suggesting the presence of a large concentric ditched enclosure. However, this interpretation is very tentative as **(d4)** is composed of a very fragmented patterning. **(d8 – d11)** are composed of both a weak patterning and poor increase in magnetic response values. Consequently, although their positioning in relation to the possible enclosure ditch **(d1 – d3)** may suggest that also belong to a similar phase of activity; further investigation is required to fully understand these anomalies. Therefore, it may be of use to extend the survey area in this parcel further to the south to see if there are further anomalies relating to these features.

6.6 To the east of Parcel 10 there are several linear anomalies that are composed of response values that may indicate the presence of buried ditches, relating to former phases of human activity **(i1)** and **(i2)**. **(i3)** and **(i4)** (Figure 223) are composed of weaker patterning and response values, but possibly may be of an archaeological nature and indicate the presence of small enclosures. Interpretation however is unclear for all these features especially as ploughing appears to have disturbed these features.

6.7 At the time of survey parcel 11 comprised water logged scrubland with overgrown vegetation. **(j1)** (Figure 227) appears as a curvilinear anomaly with two central magnetic disturbances. It is possible given the present nature of the site that this feature relates to former human activity, but the positioning of **(j1)** corresponds with a feature recorded on Google Earth imagery (Figure 8) and so may instead belong to modern agricultural activity. Likewise, several weak rectilinear anomalies are visible within the survey area **(j2)** and **(j3)**, but it is unclear as to whether they are of an archaeological, geological or modern nature.

6.8 Running across Parcel 12b and 12c are a series of fragmented linear anomalies **(l1a – l1c)** (Figure 230). Given the similarity in response values and alignment they anomalies are likely to relate to the same feature and possibly indicate the presence of a former enclosure predating the present field system. **(l2)** denotes two parallel linear anomalies that although are positioned in an area of high geological disturbance, have a patterning that suggests they indicate the presence of buried ditches. However further investigation is required to fully characterise these anomalies and expanding the survey area to the north of Parcel 12c may be useful in understanding these anomalies.

6.9 To the south of Parcel 13b there is a linear anomaly running on an east-west alignment that appears to continue beyond the southern extent of the survey area **(m2)** (Figure 238). Consequently, although this anomaly has a response that is likely to indicate an archaeological origin, further investigation is required to understand the full form of this anomaly and it could be of use to extend the survey area in this parcel to the south.

6.10 To the east of Parcel 14b there is a strong magnetic rectilinear anomaly **(n1**) (Figure 240) that is surrounded by a rectangular area of high magnetic disturbance **(n2)**. Although unclear it is possible that **(n1)** represents the foundations of a former structure composed of a material with a high magnetic susceptibility. However, this interpretation is very tentative as the response values of this disturbance could equally suggest **(n1)** and **(n2)** are either of a modern or geological nature and further investigation is required to fully characterise this anomaly. Running along the northern extent of Parcel 14a and 14b are a series of linear anomalies **(n3)** and **(n4)**. It is possible these anomalies relate to the same feature and indicate a former enclosure, but as they extend beyond the limits of the survey area further investigation is required to fully characterise these anomalies. Therefore, extending the survey area to the north of Parcel 14a and 14b may enhance our understanding of the archaeology in this area.

6.11 Several very faint anomalies have been identified as relating to possible archaeology, but given their weak patterning or poor response values a very tentative interpretation is required. **(a3)** (Figure 202) has a rectilinear patterning and contains an isolated circular disturbance that is possibly indicative of a pit, however given the high level of 'noise' in this area and weak response values of this anomaly a very tentative interpretation applies. **(a4)** and **(a5)** (Figure 202) both appear as weakly enhanced linear anomalies composed of poor patterning. Parcel 2 appears to contain a high level of magnetic 'noise' and consequently it is difficult to decipher whether identified anomalies relate to former human activity **(b1 – b5)** (Figure 203). **(c1 – c3)** (Figure 204) are composed of good response values, but weak patterning and therefore it is unclear as to whether they relate to buried archaeology or modern disturbance. **(e2)** and **(e3)** (Figure 209 and 210) are composed of a weak patterning and may indicate drainage ditches, geological changes in the substrata or are of an archaeological origin. There are two linear anomalies **(f2)** and **(f3)** (Figure 211) running parallel with the possible field boundary **(f1)** that are composed of very weakly enhanced magnetic readings. Although unclear, they may indicate a former headland or ditch running alongside the possible field boundary. **(g3)** and **(g4)** (Figure 213) represent rectilinear and linear anomalies in area 8c that are composed of very weak response values. There are several linear anomalies running on a north-west to south-east alignment towards the north of Parcel 8a **(g6)** and **(g7)** (Figures 216 and 217). Given the high levels of magnetic disturbance in this parcel caused by geological activity, it is unclear as to whether these anomalies relate to natural changes in the soils magnetic properties or indicate the presence of ditches relating to former human habitation. There are a series of weakly enhanced intercutting linear features in Parcel 9a, which may be of an archaeological origin, but given their poor response values require further investigation to be fully characterised **(h1 – h3)** (Figures 219-221). **(h4 – h6)** appear as a series of linear anomalies running on a similar alignment, but it is unclear as to whether they relate to modern agricultural practice such as land drainage or an earlier activity. There are several anomalies in Parcel 12a that are composed of poor patterning and consequently it is difficult to determine whether they relate to modern agricultural, archaeological or geological activity **(l3 – l5)** (Figures 230 to 234). **(l7)** and **(l8)** appear as two weak rectilinear anomalies in an area of high geological disturbance and subsequently it is difficult to decipher whether they relate to small enclosures or the underlying geology. Parcel 13a appears very archaeologically quiet with the detection of two very faint rectilinear anomalies **(m3)** (Figure 236). Parcel 14 appears to contain large disturbances of modern and geological natures, but it is possible that identified rectilinear **(n7 – n5)** (Figure 240) and linear **(n8 – n 10)** (Figures 241 to 242) anomalies are of an archaeological nature. Across Parcel 15 there are several rectilinear and linear anomalies that could indicate buried archaeology, but are composed of a weak patterning and increases in response values and subsequently it is unclear as to whether they are of an archaeological nature and if so their character **(o1 – o7)** (Figures 244 to 249). Anomalies of a linear **(p1)**, rectilinear **(p2)** and amorphous **(p3)** (Figure 249) form have been identified in Parcel 16, but lack the necessary patterning for detailed interpretation. There are several rectilinear and linear anomalies in Parcel 17 that although have faint magnetic responses, have a patterning that may be indicative of archaeology **(q2 – q4)** (Figures 255 to 257). In particular, **(q2b)** and **(q2c)** appear on the same alignment and form a rectilinear anomaly to the south-east of Parcel 17c. **(q2h)** and **(q2i)** appear to belong to the same curvilinear feature possibly indicating the presence of a buried ditch. There are three parallel linear anomalies running on a south-west to north-east alignment to the west of Parcel 17a **(q4)**. It is possible these are of an archaeological nature, but this interpretation is tentative as they follow the alignment of ploughing in this area and so could instead belong to land drains. Very faint linear and rectilinear anomalies in Parcel 18 have highlighted **(r1)** (Figures 258 and 259), but detailed interpretation is unclear due to the poor signatures of these anomalies.

6.12 **(a6)** and **(o8)** are composed of a very weak increase in magnetic values and poor patterning and consequently has been schematically highlighted as possible archaeology and a very tentative interpretation applies.

6.13 Several isolated positive magnetic anomalies with a more consistent patterning possibly relate to pits caused by earlier phases of activity.

Non-archaeology

6.14 Across the dataset there are a series of regularly spaced linear anomalies that are likely to represent agricultural activity, such as ploughing. Largely these correspond with the modern layout of the field systems and so are considered to relate to modern activity, but it is possible some of which have earlier origins and indicate the presence of rig and furrow.

6.15 Within the data set there are several isolated dipolar anomalies. These are commonly caused by ferrous or high magnetically susceptible material on the surface or within the topsoil of the site, and it is likely that modern agricultural activity has changed the magnetic properties of the top soil and created a high level of background ‘noise’ within the data set.

6.16 It is unclear as to whether **(b6)** (Figure 206) relates to modern or an early phase of activity. The rectilinear pattern possibly indicates an earlier origin, but given the strong response values it is plausibly more likely that **(b6)** belongs to modern phase of activity, possibly relating to **(b7)**.

6.17 **(a7a)**, **(a7b)**, **(b7)**, **(b8)**, **(c4)**, **(d12)**, **(e4)**, **(f4)**, **(h7)**, **(l9)**, **(o9)**, **(p4)** and **(r2)** denotes linear trends likely to be of modern origins and are likely to indicate the presence of buried utilities.

6.18 **(g8)** (Figure 214) represents an area of general weakly enhanced magnetic readings to the north of quarry activity in Area 8a and consequently it is unclear as to whether this disturbance relates to the quarrying or an alternative activity.

6.19 **(j4)** (Figure 226) indicates an area to the south-west of Parcel 11a that contains strongly enhanced magnetic readings. Given the nature of this Parcel it is unclear as to whether these responses are of an archaeological or geological nature.

6.20 Parcel 15a and the south of Parcel 15b appear to contain a high level of background ‘noise’ likely to have been caused by modern agricultural activity. Within these parcels there are several concentrations of high magnetic disturbance and it unclear as to whether they relate to modern agricultural practices or an earlier phase of activity **(o10)** (Figure 244).

6.21 **(b9)**, **(c5)**, **(e5)**, **(f5)**, **(g9)**, **(h8 - h10) (j5)**, **(j6)**, **(l10)**, **(l11)**, **(n11)**, **(o11)**, **(p5)** and **(q5)** represents the various disturbances across the survey area that are likely to be caused by modern above ground 'noise' within the targeted fields. In particular, several of these areas of magnetic disturbance occur along the edges of fields and so are likely to be caused by modern features such as metal field boundaries and agricultural activity.

6.22 Across the data sets there are various areas of enhanced magnetic readings that are composed of a patterning likely to relate to geological changes in strata **(g10)**, **(j7)**, **(l12)**, **(m4)**, **(n12)**, **(o12)**, **(p6)** and **(r3)**

7 Conclusion

7.1 Gradiometer survey results have successfully identified various field boundaries recorded on early 20th century Ordnance Survey maps as well as potential previously unrecorded field boundaries. Although there are vast modern and geological disturbances across the parcels targeted with geophysical survey, several linear and rectilinear anomalies have been detected that potentially indicate the presence of former human activity and relate to ditches, enclosures and structures that no longer exist within the modern landscape.

7.2 Further investigation work would aid in fully characterising identified anomalies. In particular, by extending the survey areas in Parcels 5, 12c, 13 and 14 it may be possible to understand identified anomalies, especially those that extend beyond the limits of the survey areas.

7.3 Several anomalies of a weaker patterning or faint increase in magnetic values have been detected, but further investigation is required to fully understand their archaeological significance

7.4 The survey has also identified modern features that relate to the contemporary composition of the fields, including land drains, ploughing and modern utilities as well as geological features.

8 Statement of Indemnity

8.1 Although the results and interpretation detailed in this report have been produced as accurately as possible, it should be noted that the conclusions offered are a subjective assessment of collected data sets.

8.2 The success of a geophysical survey in identifying archaeological remains can be heavily influenced by several factors, including geology, seasonality, field conditions, the technique used and the properties of archaeological features being detected. Therefore geophysical survey may only reveal certain archaeological features and not create a complete plan of all the archaeological remains within a survey area.

9 Bibliography

Bartington Instruments, 2007 User Manual

BGS, 2015 British Geological Survey website, http://www.bgs.ac.uk/data/mapViewers/home.html (last accessed 20th March 2016)

CIfA 2014 *Standards and Guidance for archaeological geophysical survey*

Clark, A., 1996 *Seeing Beneath the Soil: Prospecting Methods in Archaeology*, Second Edition. London

Curtis, A., 2015 'A96 Dualling Inverness to Nairn (including Nairn Bypass) Specification for Archaeological Geophysical Survey and Metal Detecting' Jacobs U.K. Limited Unpublished report B2103500/EN/CH/RP/001

David, A. Linford, N. Linford, P., 2008 *Geophysical Survey in Archaeological Field Evaluation*, Swindon

Gaffney, C. and Gater, J., 2003 *Revealing the Buried Past Geophysics for Archaeologists*. Stroud: Tempus Publishing Ltd.

Kearey, P. and Brooks, M. 1991 *An Introduction to Geophysical Exploration (2nd ed.)*

Heron, C. and Gaffney, C., 1987 'Archaeogeophysics and the site: ohm sweet ohm? in C. Gaffney and V. Gaffney (eds.) *Pragmatic Archaeology: Theory in crisis?* British Archaeological Report, British Series 167:71-81.

Lowe, K.M. and Fogel, A.S., 2010 'Understanding Northeastern Plains Village sites through archaeological geophysics', *Archaeological Prospection*, Volume 17, Issue 4, pages 247–257

Schmidt, A. and Ernenwein, E., 2009 *Guide to Good Practice: geophysical data in archaeology*

Scollar, I., Tabbagh, A., Hesse, A. and Herzog, I., 2011 *Archaeological prospecting and remote sensing*

Sharma, P.V., 1997 *Environmental and Engineering Geophysics*

Plate 1. Parcel 1 before survey, looking south-west

Plate 2. Parcel 1 after data collection, looking south-west

Plate 3. Parcel 2 before data collection, looking north

Plate 4. Parcel 2 after data collection, looking north

Plate 5. Parcel 3 before survey, looking south

Plate 6. Parcel 3 after data collection, looking south

Plate 7. Parcel 5 before data collection, looking north-east

Plate 8. Parcel 5 after data collection, looking north-east

Plate 9. Parcel 6 after data collection, looking north-west

Plate 10. Parcel 7 after data collection, looking south-west

Plate 11. Parcel 8a before data collection, looking north-east

Plate 12. Parcel 8a after data collection, looking north-east

Plate 13. Parcel 8b before data collection, looking north-west

Plate 14. Parcel 8b after data collection, looking north-west

Plate 15. Parcel 8c before data collection, looking south-west

Plate 16. Parcel 8c after data collection, looking south-west

Plate 17. Parcel 9a before data collection, looking north-east

Plate 18. Parcel 9a after data collection, looking north-east

Plate 19. Parcel 9b before data collection, looking south-east

Plate 20. Parcel 9b after data collection, looking south-east

Plate 21. Parcel 10 before data collection, looking north-east

Plate 22. Parcel 10 after data collection, looking south-west

Plate 23. Parcel 11a before data collection, looking west

Plate 24. Parcel 11a after data collection, looking west

Plate 25. Parcel 11b before data collection, looking north-east

Plate 26. Parcel 11b after data collection, looking north-east

Plate 27. Parcel 12a before data collection, looking east

Plate 28. Parcel 12a after data collection, looking east

Plate 29. Parcel 12b before data collection, looking north

Plate 30. Parcel 12b after data collection, looking north

Plate 31. Parcel 12c before after data collection, looking east

Plate 32. Parcel 12c after before data collection, looking west

Plate 33. Parcel 12d after data collection, looking north-east

Plate 34. Parcel 12e after data collection, looking east

Plate 35. Parcel 13a before data collection, looking east

Plate 36. Parcel 13a after data collection, looking east

Plate 37. Parcel 13b after data collection, looking north

Plate 38. Parcel 14a before data collection, looking north

Plate 40. Parcel 14b before data collection, looking east

Plate 39. Parcel 14b after data collection, looking east

Plate 41. Parcel 14a and 14b after data collection, looking east

Plate 42. Parcel 14c before data collection, looking north-west

Plate 43. Parcel 14c after data collection, looking south-west

Plate 44. Parcel 15a before data collection, looking north-east

Plate 45. Parcel 15a after data collection, looking north-east

Plate 46. Parcel 15b before data collection, looking north-east

Plate 47. Parcel 15b after data collection, looking south-west

Plate 48. Parcel 15c before data collection, looking east

Plate 49. Parcel 15c after data collection, looking west

Plate 50. Parcel 15d after data collection, looking south-east

Plate 51. Parcel 16a before data collection, looking south-east

Plate 52. Parcel 16a after data collection, looking south-east

Plate 53. Parcel 16b before data collection, looking west

Plate 54. Parcel 16b after data collection, looking west

Plate 55. Parcel 16c before data collection, looking south-west

Plate 56. Parcel 16c after data collection, looking east

Plate 57. Parcel 16d after data collection, looking north-west

Plate 58. Parcel 17a before data collection, looking south-west

Plate 59. Parcel 17a after data collection, looking south-west

Plate 60. Parcel 17b before data collection, looking south

Plate 61. Parcel 17b after data collection, looking west

Plate 62. Parcel 17c before data collection, looking south

Plate 63. Parcel 17c after data collection, looking west

Plate 64. Parcel 18a before data collection, looking east

Plate 65. Parcel 18a after data collection, looking east

Plate 66. Parcel 18b before data collection, looking north-east

Plate 67. Parcel 18b after data collection, looking north-east

Appendix 1: Survey Information

Field	Description
Surveyor	AOC Archaeology
Client	Jacobs U.K. Limited
Site	A96 Dualling Inverness to Nairn
County	Highland
NGR	NH 8020 5260
Solid geology	Between Inverness and Nairn : Middle Old Red Sandstone (undifferentiated) (BGS 2015). Area to the south-east of Nairn: Unnamed Igneous Intrusion, Late Silurian To Early Devonian - Felsic-rock (BGS 2015).
Soil composition	Conglomerate, Sandstone, Siltstone and Mudstone (BGS 2015)
Historical documentation/ mapping on site	
Known archaeology on site	
Scheduled Ancient Monument	No
Land use/ field condition	Mixed - pasture and arable
Duration	Phase One: 15/02/16 – 8/03/16
Weather	Periods of sun, rain, snow and hail.
Survey type	Gradiometer Survey
Instrumentation	Trimble GXOR system Bartington Grad 601-2
Area covered	95ha (902 grids)
Data collection staffing	Tom Bradley-Lovekin, Gemma Hudson, Jamie Humble, Alice James, Clare Leevers, Jessica Lumb, Cathy MacIver, Diana Sproat and Matt Walker
Download software	Grad601 PC Software v313
Processing software	Geoplot v3.0
Visualisation software	AutoCAD LT 2009
Report title	A96 Dualling Inverness to Nairn, Highlands
Project number	51511
Report Author	Alice James
Report approved by	Graeme Cavers

Appendix 2: Archaeological Prospection Techniques, Instrumentation and Software Utilised

Gradiometer survey

Gradiometer surveys measure small changes in the earth's magnetic field. Archaeological materials and activity can be detected by identifying changes to the magnetic values caused by the presence of weakly magnetised iron oxides in the soil (Aspinall *et al.*, 2008, 23; Sharma, 1997, 105). Human inhabitation often causes alterations to the magnetic properties of the ground (Aspinall et al, 2008, 21). There are two physical transformations that produce a significant contrast between the magnetic properties of archaeological features and the surrounding soil: the enhancement of magnetic susceptibility and thermoremnant magnetization (Aspinall *et al.*, 2008, 21; Heron and Gaffney 1987, 72).

Ditches and pits can be easily detected through gradiometer survey as the top soil is generally suggested to have a greater magnetisation than the subsoil caused by human habitation. Also areas of burning or materials which have been subjected to heat commonly have high magnetic signatures, examples include: hearths, kilns, fired clay and mudbricks (Clark 1996, 65; Lowe and Fogel 2010, 24). It should be noted that negative anomalies can also be useful for characterising archaeological features. If the buried remains are composed of a material with a lower magnetisation compared with the surrounding soil, the surrounding soil will consequently have a greater magnetisation resulting in the feature displaying a negative signature. For example stone materials of a structural nature that are composed of sedimentary rocks are considered non-magnetic and so will appear a negative features within the data set.

Ferrous objects- i.e. iron and its alloys- are strongly magnetic and are typically detected as high-value peaks in gradiometer survey data, though it is not usually possible to determine whether these relate to archaeological or modern objects.

Although gradiometer surveys have been successfully carried out in all areas of the United Kingdom, the effectiveness of the technique is lessened in areas with complex geology, particularly where igneous and metamorphic bedrock is present. All magnetic geophysical surveys must therefore take the effects of background geological and geomorphological conditions into account.

Gradiometer survey instrumentation

AOC Archaeology's gradiometer surveys are carried out using Bartington Grad601-2 magnetic gradiometers. The Grad601-2 is a high-stability fluxgate magnetic gradient sensor, which uses a 1m sensor separation. The detection resolution is from 0.03 nT/m to 0.1nT/m, depending on the sensor parameters selected, making the Grad601-2 an ideal instrument for prospective survey of large areas as well as detailed surveys of known archaeology. The instrument stores the data collected on an on-board data-logger, which is then downloaded as a series of survey grids for processing.

Gradiometer survey software

Following the survey, gradiometer data was downloaded from the instrument using Grad601 PC Software v313. Survey grids were then assembled into composites and enhanced using a range of processing techniques are applied to the data using Geoscan's Geoplot v3.0 (see Appendix 2 for a summary of the processes used in Geoplot and Appendix 3 for a list of processes used to create final data plots).

Appendix 3: Summary of Processes used in Geoplot

Process	Effect
Clip	Replaces data values outside a specified range, in order to display important data with relative values stretched across the display range.
De-spike	Removes exceptionally high values represented in the data that can obscure the visibility of archaeological features. In resistivity survey, these can be caused by poor contact of the mobile probes with the ground; in gradiometer survey, these can be caused by highly magnetic items such as buried ferrous objects.
De-stagger	Counteracts the striping effect caused by misalignment of data when collected on a zig-zag traverse pattern.
Edge Match	Counteracts edge effects in grid composites by subtracting the difference between mean values in the two lines either side of the grid edge.
High pass filter	Removes low-frequency, large scale detail in order to remove background trends in the data, such as variations in geology.
Interpolate	Increases the resolution of a survey by interpolating new values between surveyed data points
Low Pass filter	Uses a Gaussian filter to remove high-frequency, small scale detail, typically for smoothing or generalising data.
Periodic Filter	Used to either remove or reduce amplitudes of constant and reoccurring features that distort other potential patterns. An example of which is plough lines.
Wallis filter	Applies a locally adaptive contrast enhancement filter.
Zero Mean Grid	Resets the mean value of each grid to zero, in order to counteract edge discontinuities in composite assemblies.
Zero Mean Traverse	Resets the mean value of each traverse to zero, in order to address the effect of striping in the data and counteract edge effects.

Appendix 4: Survey Processing Steps

Process	Extent
Parcel 1	
Zero Mean Traverse	All LMS =on Pos. Thresh. = 5 Neg. Thresh. = -5
Despike	X=1 Y=1 Thr = 3 Repl = Mean
Clip	Min =-5 Max = 5
Destagger	All grids dir Shift = 2 Line Pattern 34-78 Dual-DS
Low Pass filter	X=1 Y=1 Wt=G
Interpolate	Y, Expand – Linear x2
Raw Palette Scale	Grey55 Min= -10 Max= 10
Palette Scale	Grey55 Min= -3 Max= 3
XYZ Scale	Scale: 35.
Parcel 2	
Zero Mean Traverse	All LMS =on Pos. Thresh. = 5 Neg. Thresh. = -5
Despike	X=1 Y=1 Thr = 3 Repl = Mean
Clip	Min =-5 Max = 5
Destagger	All grids dir Shift = 2 Line Pattern 34-78 Dual-DS
Low Pass filter	X=1 Y=1 Wt=G
Interpolate	Y, Expand – Linear x2
Raw Palette Scale	Grey55 Min= -10 Max= 10
Palette Scale	Grey55 Min= -3 Max= 3
Parcel 3	
Zero Mean Traverse	All LMS =on Pos. Thresh. = 5 Neg. Thresh. = -5
Despike	X=1 Y=1 Thr = 3 Repl = Mean
Clip	Min =-5 Max = 5
Low Pass filter	X=1 Y=1 Wt=G
Interpolate	Y, Expand – Linear x2
Raw Palette Scale	Grey55 Min= -10 Max= 10
Palette Scale	Grey55 Min= -3 Max= 3
Parcel 5	
Zero Mean Traverse	All LMS =on
Despike	X=1 Y=1 Thr = 3 Repl = Mean

Clip	Min =-5 Max = 5
Destagger	All grids dir Shift = 2 30 = 2 34 = 2 Line Pattern 34-78 Dual-DS
Low Pass filter	X=1 Y=1 Wt=G
Interpolate	Y, Expand – Linear
Raw Palette Scale	Grey55 Min= -10 Max= 10
Palette Scale	Grey55 Min= -3 Max= 3
Parcel 6	
Zero Mean Traverse	All LMS =on Pos. Thresh. = 5 Neg. Thresh. = -5
Despike	X=1 Y=1 Thr = 3 Repl = Mean
Clip	Min =-5 Max = 5
Low Pass filter	X=1 Y=1 Wt=G
Interpolate	Y, Expand – Linear
Raw Palette Scale	Grey55 Min= -10 Max= 10
Palette Scale	Grey55 Min= -3 Max= 3
Parcel 7a	
Zero Mean Traverse	All LMS =on Pos. Thresh. = 5 Neg. Thresh. = -5
Despike	X=1 Y=1 Thr = 3 Repl = Mean
Clip	Min =-5 Max = 5
Destagger	All grids dir Shift = 4 Line Pattern 34-78 Dual-DS
Low Pass filter	X=1 Y=1 Wt=G
Interpolate	Y, Expand – Linear x2
Raw Palette Scale	Grey55 Min= -10 Max= 10
Palette Scale	Grey55 Min= -3 Max= 3
Parcel 7b	
Zero Mean Traverse	All LMS =on Pos. Thresh. = 5 Neg. Thresh. = -5
Despike	X=1 Y=1 Thr = 3 Repl = Mean
Clip	Min =-5 Max = 5
Low Pass filter	X=1 Y=1 Wt=G
Interpolate	Y, Expand – Linear x2
Raw Palette Scale	Grey55 Min= -10 Max= 10
Palette Scale	Grey55

	Min= -3 Max= 3
Parcel 8a	
Zero Mean Traverse	All LMS =on Pos. Thresh. = 5 Neg. Thresh. = -5
Despike	X=1 Y=1 Thr = 3 Repl = Mean
Clip	Min =-5 Max =5
Destagger	All grids dir Shift = 4 Line Pattern 34-78 Dual-DS
Low Pass filter	X=1 Y=1 Wt=G
Interpolate	Y, Expand – Linear
Raw Palette Scale	Grey55 Min= -10 Max= 10
Palette Scale	Grey55 Min= -3 Max= 3
Parcel 8b	
Zero Mean Traverse	All LMS =on Pos. Thresh. = 5 Neg. Thresh. = -5
Despike	X=1 Y=1 Thr = 3 Repl = Mean
Clip	Min =-5 Max = 5
Low Pass filter	X=1 Y=1 Wt=G
Interpolate	Y, Expand – Linear x2
Raw Palette Scale	Grey55 Min= -10 Max= 10
Palette Scale	Grey55 Min= -3 Max= 3
Parcel 8c	
Zero Mean Traverse	All LMS =on Pos. Thresh. = 5 Neg. Thresh. = -5
Despike	X=1 Y=1 Thr = 3 Repl = Mean
Clip	Min =-5 Max = 5
Low Pass filter	X=1 Y=1 Wt=G
Interpolate	Y, Expand – Linear
Raw Palette Scale	Grey55 Min= -10 Max= 10
Palette Scale	Grey55 Min= -3 Max= 3
Parcel 9a	
Zero Mean Traverse	All LMS =on Pos. Thresh. = 5 Neg. Thresh. = -5
Despike	X=1 Y=1 Thr = 3 Repl = Mean
Clip	Min =-5 Max = 5
Low Pass filter	X=1 Y=1 Wt=G
Interpolate	Y, Expand – Linear
Raw Palette Scale	Grey55

	Min= -10 Max= 10
Palette Scale	Grey55 Min= -3 Max= 3
Parcel 9b	
Zero Mean Traverse	All LMS =on Pos. Thresh. = 5 Neg. Thresh. = -5
Despike	X=1 Y=1 Thr = 3 Repl = Mean
Clip	Min =-5 Max = 5
Low Pass filter	X=1 Y=1 Wt=G
Interpolate	Y, Expand – Linear x2
Raw Palette Scale	Grey55 Min= -10 Max= 10
Palette Scale	Grey55 Min= -3 Max= 3
Parcel 10	
Zero Mean Traverse	All LMS =on Pos. Thresh. = 5 Neg. Thresh. = -5
Despike	X=1 Y=1 Thr = 3 Repl = Mean
Clip	Min =-5 Max = 5
Destagger	All grids dir Shift = 2 Line Pattern 34-78 Dual-DS
Low Pass filter	X=1 Y=1 Wt=G
Interpolate	Y, Expand – Linear x2
Raw Palette Scale	Grey55 Min= -10 Max= 10
Palette Scale	Grey55 Min= -3 Max= 3
Parcel 11a	
Zero Mean Traverse	All LMS =on Pos. Thresh. = 5 Neg. Thresh. = -5
Despike	X=1 Y=1 Thr = 3 Repl = Mean
Clip	Min =-5 Max = 5
Destagger	All grids dir Shift = 2 Line Pattern 34-78 Dual-DS
Low Pass filter	X=1 Y=1 Wt=G
Interpolate	Y, Expand – Linear x2
Raw Palette Scale	Grey55 Min= -10 Max= 10
Palette Scale	Grey55 Min= -3 Max= 3
Parcel 11b	
Zero Mean Traverse	All LMS =on Pos. Thresh. = 5 Neg. Thresh. = -5
Despike	X=1 Y=1 Thr = 3 Repl = Mean
Clip	Min =-5 Max = 5

Low Pass filter	X=1 Y=1 Wt=G
Interpolate	Y, Expand – Linear x2
Raw Palette Scale	Grey55 Min= -10 Max= 10
Palette Scale	Grey55 Min= -3 Max= 3
Parcel 12a	
Zero Mean Traverse	All LMS =on Pos. Thresh. = 5 Neg. Thresh. = -5
Despike	X=1 Y=1 Thr = 3 Repl = Mean
Clip	Min =-5 Max = 5
Destagger	All grids dir Shift = 1 Line Pattern 34-78 Dual-DS
Low Pass filter	X=1 Y=1 Wt=G
Interpolate	Y, Expand – Linear x2
Raw Palette Scale	Grey55 Min= -10 Max= 10
Palette Scale	Grey55 Min= -3 Max= 3
Parcel 12b	
Zero Mean Traverse	All LMS =on
Despike	X=1 Y=1 Thr = 3 Repl = Mean
Clip	Min =-5 Max = 5
Destagger	All grids dir Shift = 3 Line Pattern 34-78 Dual-DS
Low Pass filter	X=1 Y=1 Wt=G
Interpolate	Y, Expand – Linear x2
Raw Palette Scale	Grey55 Min= -10 Max= 10
Palette Scale	Grey55 Min= -3 Max= 3
Parcel 12c	
Zero Mean Traverse	All LMS =on
Despike	X=1 Y=1 Thr = 3 Repl = Mean
Clip	Min =-5 Max = 5
Destagger	All grids dir Shift = 3 Line Pattern 34-78 Dual-DS
Low Pass filter	X=1 Y=1 Wt=G
Interpolate	Y, Expand – Linear x2
Raw Palette Scale	Grey55 Min= -10 Max= 10
Palette Scale	Grey55 Min= -3 Max= 3
Parcel 12d	

Zero Mean Traverse	All LMS =on Pos. Thresh. = 5 Neg. Thresh. = -5
Despike	X=1 Y=1 Thr = 3 Repl = Mean
Clip	Min =-5 Max = 5
Low Pass filter	X=1 Y=1 Wt=G
Interpolate	Y, Expand – Linear x2
Raw Palette Scale	Grey55 Min= -10 Max= 10
Palette Scale	Grey55 Min= -3 Max= 3
Parcel 12e	
Zero Mean Traverse	All LMS =on Pos. Thresh. = 5 Neg. Thresh. = -5
Despike	X=1 Y=1 Thr = 3 Repl = Mean
Clip	Min =-5 Max = 5
Low Pass filter	X=1 Y=1 Wt=G
Interpolate	Y, Expand – Linear x2
Raw Palette Scale	Grey55 Min= -10 Max= 10
Palette Scale	Grey55 Min= -3 Max= 3
Parcel 13a	
Zero Mean Traverse	All LMS =on Pos. Thresh. = 5 Neg. Thresh. = -5
Despike	X=1 Y=1 Thr = 3 Repl = Mean
Clip	Min =-5 Max = 5
Destagger	All grids dir Shift = 2 Line Pattern 34-78 Dual-DS
Low Pass filter	X=1 Y=1 Wt=G
Interpolate	Y, Expand – Linear
Raw Palette Scale	Grey55 Min= -10 Max= 10
Palette Scale	Grey55 Min= -3 Max= 3
Parcel 13b	
Zero Mean Traverse	All LMS =on Pos. Thresh. = 5 Neg. Thresh. = -5
Despike	X=1 Y=1 Thr = 3 Repl = Mean
Clip	Min =-5 Max = 5
Low Pass filter	X=1 Y=1 Wt=G
Interpolate	Y, Expand – Linear x2
Raw Palette Scale	Grey55 Min= -10 Max= 10
Palette Scale	Grey55 Min= -3 Max= 3

Parcel 14a	
Zero Mean Traverse	All LMS =on Pos. Thresh. = 5 Neg. Thresh. = -5
Despike	X=1 Y=1 Thr = 3 Repl = Mean
Clip	Min =-5 Max = 5
Low Pass filter	X=1 Y=1 Wt=G
Interpolate	Y, Expand – Linear x2
Raw Palette Scale	Grey55 Min= -10 Max= 10
Palette Scale	Grey55 Min= -3 Max= 3
Parcel 14b	
Zero Mean Traverse	All LMS =on
Despike	X=1 Y=1 Thr = 3 Repl = Mean
Clip	Min =-5 Max = 5
Destagger	All grids dir Shift = 2 Line Pattern 34-78 Dual-DS
Low Pass filter	X=1 Y=1 Wt=G
Interpolate	Y, Expand – Linear x2
Raw Palette Scale	Grey55 Min= -10 Max= 10
Palette Scale	Grey55 Min= -3 Max= 3
Parcel 14c	
Zero Mean Traverse	All LMS =on
Despike	X=1 Y=1 Thr = 3 Repl = Mean
Clip	Min =-5 Max = 5
Low Pass filter	X=1 Y=1 Wt=G
Interpolate	Y, Expand – Linear x2
Raw Palette Scale	Grey55 Min= -10 Max= 10
Palette Scale	Grey55 Min= -3 Max= 3
Parcel 15a	
Zero Mean Traverse	All LMS =on
Despike	X=1 Y=1 Thr = 3 Repl = Mean
Clip	Min =-5 Max = 5
Destagger	All grids dir Shift = 3 Line Pattern 34-78 Dual-DS
Low Pass filter	X=1 Y=1 Wt=G
Interpolate	Y, Expand – Linear
Raw Palette Scale	Grey55 Min= -10 Max= 10
Palette Scale	Grey55

	Min= -3 Max= 3
Parcel 15b	
Zero Mean Traverse	All LMS =on Pos. Thresh. = 5 Neg. Thresh. = -5
Despike	X=1 Y=1 Thr = 3 Repl = Mean
Clip	Min =-5 Max = 5
Destagger	All grids dir Shift = 2 115 = 5 Line Pattern 34-78 Dual-DS
Low Pass filter	X=1 Y=1 Wt=G
Interpolate	Y, Expand – Linear
Raw Palette Scale	Grey55 Min= -10 Max= 10
Palette Scale	Grey55 Min= -3 Max= 3
Parcel 15c	
Zero Mean Traverse	All LMS =on Pos. Thresh. = 5 Neg. Thresh. = -5
Despike	X=1 Y=1 Thr = 3 Repl = Mean
Clip	Min =-5 Max = 5
Destagger	All grids dir Shift = 5 Line Pattern 34-78 Dual-DS
Low Pass filter	X=1 Y=1 Wt=G
Interpolate	Y, Expand – Linear x2
Raw Palette Scale	Grey55 Min= -10 Max= 10
Palette Scale	Grey55 Min= -3 Max= 3
Parcel 15d	
Zero Mean Traverse	All LMS =on Pos. Thresh. = 5 Neg. Thresh. = -5
Despike	X=1 Y=1 Thr = 3 Repl = Mean
Clip	Min =-5 Max = 5
Destagger	9 = 4 Line Pattern 34-78 Dual-DS 6= Line number: 1 = 8 2 = 8 3 = 8 4 = 8 5 = 4 6 = 4 7 = 8 8 = 8
Low Pass filter	X=1 Y=1 Wt=G

Interpolate	Y, Expand – Linear x2
Raw Palette Scale	Grey55 Min= -10 Max= 10
Palette Scale	Grey55 Min= -3 Max= 3
Parcel 16a	
Zero Mean Traverse	All LMS =on Pos. Thresh. = 5 Neg. Thresh. = -5
Despike	X=1 Y=1 Thr = 3 Repl = Mean
Clip	Min =-5 Max = 5
Destagger	All grids dir Shift = 2 Line Pattern 34-78 Dual-DS
Low Pass filter	X=1 Y=1 Wt=G
Interpolate	Y, Expand – Linear x2
Raw Palette Scale	Grey55 Min= -10 Max= 10
Palette Scale	Grey55 Min= -3 Max= 3
Parcel 16b	
Zero Mean Traverse	All LMS =on Pos. Thresh. = 5 Neg. Thresh. = -5
Despike	X=1 Y=1 Thr = 3 Repl = Mean
Clip	Min =-5 Max = 5
Destagger	15 = 4 Line Pattern 34-78 Dual-DS
Low Pass filter	X=1 Y=1 Wt=G
Interpolate	Y, Expand – Linear x2
Raw Palette Scale	Grey55 Min= -10 Max= 10
Palette Scale	Grey55 Min= -3 Max= 3
Parcel 16c	
Zero Mean Traverse	All LMS =on Pos. Thresh. = 5 Neg. Thresh. = -5
Despike	X=1 Y=1 Thr = 3 Repl = Mean
Clip	Min =-5 Max = 5
Destagger	15 = 4 14 = 1 Line Pattern 34-78 Dual-DS
Low Pass filter	X=1 Y=1 Wt=G
Interpolate	Y, Expand – Linear x2
Raw Palette Scale	Grey55 Min= -10 Max= 10
Palette Scale	Grey55 Min= -3 Max= 3

Parcel 16d	
Zero Mean Traverse	All LMS =on Pos. Thresh. = 5 Neg. Thresh. = -5
Despike	X=1 Y=1 Thr = 3 Repl = Mean
Clip	Min =-5 Max = 5
Destagger	All grids dir Shift = 1 Line Pattern 34-78 Dual-DS
Low Pass filter	X=1 Y=1 Wt=G
Interpolate	Y, Expand – Linear x2
Raw Palette Scale	Grey55 Min= -10 Max= 10
Palette Scale	Grey55 Min= -3 Max= 3
Parcel 17a	
Zero Mean Traverse	All LMS =on Pos. Thresh. = 5 Neg. Thresh. = -5
Despike	X=1 Y=1 Thr = 3 Repl = Mean
Clip	Min =-5 Max = 5
Destagger	18 = 5 29 = 4 34 = 4 Line Pattern 34-78 Dual-DS
Low Pass filter	X=1 Y=1 Wt=G
Interpolate	Y, Expand – Linear x2
Raw Palette Scale	Grey55 Min= -10 Max= 10
Palette Scale	Grey55 Min= -3 Max= 3
Parcel 17b	
Zero Mean Traverse	All LMS =on Pos. Thresh. = 5 Neg. Thresh. = -5
Despike	X=1 Y=1 Thr = 3 Repl = Mean
Clip	Min =-5 Max = 5
Destagger	All grids dir Shift = 2 Line Pattern 34-78 Dual-DS
Low Pass filter	X=1 Y=1 Wt=G
Interpolate	Y, Expand – Linear x2
Raw Palette Scale	Grey55 Min= -10 Max= 10
Palette Scale	Grey55 Min= -3 Max= 3
Parcel 17c	
Zero Mean Traverse	All LMS =on Pos. Thresh. = 5 Neg. Thresh. = -5
Despike	X=1 Y=1 Thr = 3 Repl = Mean

Clip	Min =-5 Max = 5
Destagger	All grids dir Shift = 2 111 = 2 117 = 2 105 = 1 110 = 2 Line Pattern 34-78 Dual-DS
Low Pass filter	X=1 Y=1 Wt=G
Interpolate	Y, Expand – Linear
Raw Palette Scale	Grey55 Min= -10 Max= 10
Palette Scale	Grey55 Min= -3 Max= 3
Parcel 18a	
Zero Mean Traverse	All LMS =on Pos. Thresh. = 5 Neg. Thresh. = -5
Despike	X=1 Y=1 Thr = 3 Repl = Mean
Clip	Min =-5 Max = 5
Destagger	All grids dir Shift = 4 Line Pattern 34-78 Dual-DS
Low Pass filter	X=1 Y=1 Wt=G
Interpolate	Y, Expand – Linear x2
Raw Palette Scale	Grey55 Min= -10 Max= 10
Palette Scale	Grey55 Min= -3 Max= 3
Parcel 18b	
Zero Mean Traverse	All LMS =on Pos. Thresh. = 5 Neg. Thresh. = -5
Despike	X=1 Y=1 Thr = 3 Repl = Mean
Clip	Min =-5 Max = 5
Destagger	All grids dir Shift = 1 29 = 4 Line Pattern 34-78 Dual-DS
Low Pass filter	X=1 Y=1 Wt=G
Interpolate	Y, Expand – Linear x2
Raw Palette Scale	Grey55 Min= -10 Max= 10
Palette Scale	Grey55 Min= -3 Max= 3

Appendix 5: Technical Terminology

Type of Anomaly	Description
Archaeology (Isolated Linear trends)	
Linear trend (field boundary)	Isolated long linear anomalies that are likely to relate to field boundaries. Signal may appear inconsistent but patterning and positioning, especially when compared with historic mapping suggests such anomalies belong to former field division systems
Linear trend (field boundary?)	Anomalies of a long linear form, but lack the necessary patterning, signal strength or positioning to be positively identified as field boundaries.
Discrete	
Linear trend (archaeology?)	Anomalies of a linear form either composed of an increased or decreased signal compared to background values. It is possible these anomalies belong to structural remains, but poor patterning or response values makes interpretation difficult.
Disturbed area (archaeological?)	Anomalies with an increase or decrease in values compared with background reading over a localised area. Poor patterning or weak signal changes creates difficulty in defining the nature of the archaeology and so interpretation is fairly tentative. On certain geologies these anomalies could be caused by in-filled natural features, and it would be necessary to undertake intrusive archaeological investigation to establish their form and character.
Possible archaeology (Unclear to origins of the remains)	Anomalies composed of a weak change in signal values compared to background reading or are composed of incomplete patterning. Consequently, interpretation is tentative and it is unclear to whether anomalies belong to an archaeological nature.
Pit?	Isolated circular anomalies composed of an increase in magnetic values with a patterning that may be suggestive of buried remains such as the infill of a pit.
Non- Archaeology	
Linear trend (plough lines)	A series of regular anomalies of a linear form either composed of an increased or decreased signal compared to background values. Likely to denote the presence of ploughing and relating to modern agricultural activity.
Linear trend (agricultural)	Series of linear anomalies, of an indeterminate date, likely to have been caused by agricultural activity such as ploughing and land drainage
Linear trend (modern?)	Anomalies of a linear form that are likely to belong to modern features, but are composed of values, patterning or positioning which makes definite interpretation difficult
Disturbed area (modern?)	Area of disturbance that is composed of significant increases or decreases in values compared with background readings. It is highly likely that these readings are caused by modern disturbances, but interpretation is tentative.
Linear trend (modern)	Anomalies of a linear form often composed of contrasting positive and negative values. Such anomalies usually signify a feature with a high level of magnetisation and are likely to belong to modern activity such as pipe lines

Disturbed area (modern)	Area of disturbance that is likely to be caused by modern disturbances and is characterised by significant increases or decreases in values compared with background readings.
Isolated dipolar anomalies (iron spikes)	Response normally caused by ferrous materials on the surface or within the top soil of the site, which cause a ‘spike’ representing a rapid variation in the magnetic response. These are generally not assessed to be archaeological when surveying on rural sites, and generally represent modern material often re-deposited during manuring.
Geology	Area of disturbance that is composed of irregular significant increase or decreases in values compared with background readings and are likely to indicate natural variations in soil composition or geology

Appendix 6: Individual Characterisation of Identified Anomalies

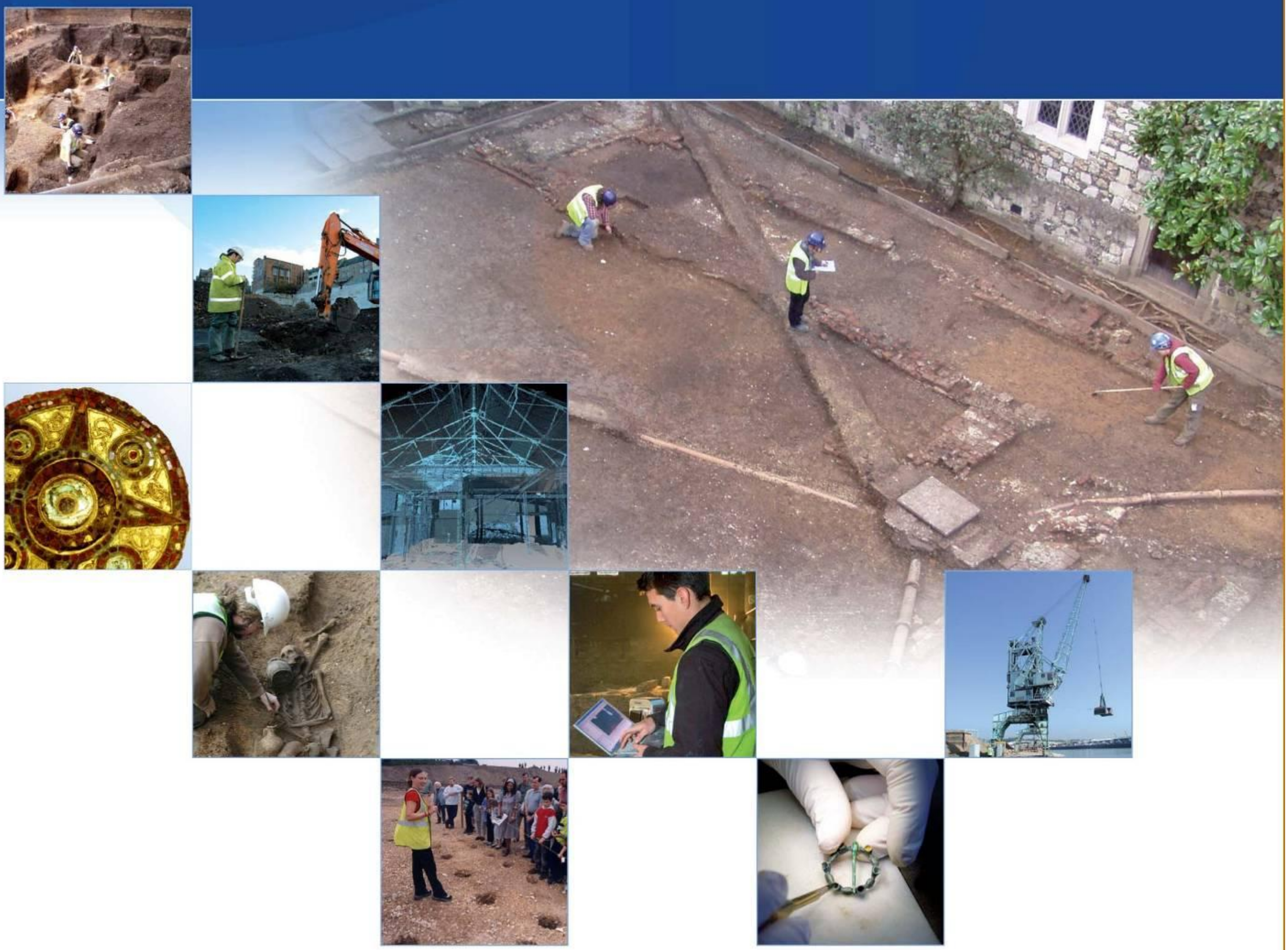
Anomaly Identifier (Site Name XX)	**Type of Archaeology**
Gradiometer survey	
a1	Linear trend (archaeology?)
a2	Linear trend (archaeology?)
a3	Possible archaeology
a4	Possible archaeology
a5	Possible archaeology
a6	Possible archaeology
a7	Linear trend (modern)
b1	Possible archaeology
b2	Possible archaeology
b3	Possible archaeology
b4	Possible archaeology
b5	Possible archaeology
b6	Linear trend (modern?)
b7	Linear trend (modern)
b8	Linear trend (modern)
b9	Disturbed area (modern)
c1	Possible archaeology
c2	Possible archaeology
c3	Possible archaeology
c4	Linear trend (modern)
c5	Disturbed area (modern)
d1	Linear trend (archaeology?)
d2	Linear trend (archaeology?)
d3	Linear trend (archaeology?)
d4	Linear trend (archaeology?)
d5	Linear trend (archaeology?)
d6	Linear trend (archaeology?)
d7	Linear trend (archaeology?)
d8	Possible archaeology
d9	Possible archaeology
d10	Possible archaeology
d11	Possible archaeology
d12	Linear trend (modern)
d13	Disturbed area (modern?)
e1	Linear trend (field boundary)
e2	Possible archaeology
e3	Possible archaeology
e4	Linear trend (modern)
e5	Disturbed area (modern)
f1	Linear trend (field boundary?)
f2	Possible archaeology
f3	Possible archaeology
f4	Linear trend (modern)
f5	Disturbed area (modern)
g1	Linear trend (field boundary)
g2	Linear trend (field boundary?)

g3	Possible archaeology
g4	Possible archaeology
g5	Possible archaeology
g6	Possible archaeology
g7	Possible archaeology
g8	Disturbed area (modern?)
g9	Disturbed area (modern)
g10	Disturbed area (geology)
h1	Possible archaeology
h2	Possible archaeology
h3	Possible archaeology
h4	Possible archaeology
h5	Possible archaeology
h6	Possible archaeology
h7	Linear trend (modern)
h8	Disturbed area (modern)
h9	Disturbed area (modern)
h10	Disturbed area (modern)
i1	Linear trend (archaeology?)
i2	Linear trend (archaeology?)
i3	Possible archaeology
i4	Possible archaeology
i5	Disturbed area (modern)
j1	Possible archaeology
j2	Possible archaeology
j3	Possible archaeology
j4	Disturbed area (modern)
j5	Disturbed area (modern)
j6	Disturbed area (modern)
j7	Disturbed area (geology)
l1	Linear trend (archaeology?)
l2	Linear trend (archaeology?)
l3	Possible archaeology
l4	Possible archaeology
l5	Possible archaeology
l6	Possible archaeology
l7	Possible archaeology
l8	Possible archaeology
l9	Linear trend (modern)
l10	Disturbed area (modern)
l11	Disturbed area (modern)
l12	Disturbed area (geology)
m1	Linear trend (field boundary)
m2	Linear trend (archaeology?)
m3	Possible archaeology
m4	Disturbed area (geology)
n1	Linear trend (archaeology?)
n2	Disturbed area (archaeology?)
n3	Possible archaeology
n4	Possible archaeology
n5	Possible archaeology

n6	Possible archaeology
n7	Possible archaeology
n8	Possible archaeology
n9	Possible archaeology
n10	Possible archaeology
n11	Linear trend (modern)
n12	Disturbed area (geology)
o1	Possible archaeology
o2	Possible archaeology
o3	Possible archaeology
o4	Possible archaeology
o5	Possible archaeology
o6	Possible archaeology
o7	Possible archaeology
o8	Possible archaeology
o9	Linear trend (modern)
o10	Disturbed area (modern?)
o11	Disturbed area (modern)
o12	Disturbed area (geology)
p1	Possible archaeology
p2	Possible archaeology
p3	Possible archaeology
p4	Linear trend (modern)
p5	Disturbed area (modern)
p6	Disturbed area (geology)
q1	Linear trend (field boundary?)
q2	Possible archaeology
q3	Possible archaeology
q4	Possible archaeology
q5	Disturbed area (modern)
r1	Possible archaeology
r2	Linear trend (modern)
r3	Disturbed area (geology)

APPENDIX 7: Discovery and Excavation in Scotland Entry

LOCAL AUTHORITY:	Highland Council
PROJECT TITLE/SITE NAME:	A96 Dualling Inverness to Nairn (including Nairn Bypass); Geophysical Survey
PROJECT CODE:	AOC 23327
PARISH:	Auldearn
NAME OF CONTRIBUTOR:	Alice James
NAME OF ORGANISATION:	AOC Archaeology Group
TYPE(S) OF PROJECT:	Geophysical Survey (gradiometry)
NMRS NO(S):	None
SITE/MONUMENT TYPE(S):	Field boundaries, ditches, structures (possible)
SIGNIFICANT FINDS:	None
NGR (2 letters, 6 figures)	NH 8020 5260
START DATE (this season)	15th February 2016
END DATE (this season)	9th March 2016
PREVIOUS WORK (incl. DES ref.)	None
MAIN (NARRATIVE) DESCRIPTION: (May include information from other fields)	AOC Archaeology Group was commissioned by Jacobs U.K. Limited to undertake an archaeological geophysical (gradiometer) survey to investigate the potential for buried archaeological remains between Inverness and Nairn, Highland as part of the cultural heritage assessment works for the A96 Dualling Inverness to Nairn project. A gradiometer survey was undertaken over approximately 85ha which detected anomalies representing features previously recorded on historic mapping, such as field boundaries. The results have also identified linear, curvilinear and rectilinear anomalies that possibly relate to former human activity. Across the survey area there were large areas of modern and geological disturbance and subsequently detailed interpretation is tentative. Modern features are also visible within the survey results, such as plough lines, land drains and buried utilities.
PROPOSED FUTURE WORK:	None
CAPTION(S) FOR ILLUSTRS:	N/A
SPONSOR OR FUNDING BODY:	Transport Scotland
ADDRESS OF MAIN CONTRIBUTOR:	AOC Archaeology Group; Edgefield Road Industrial Estate; Loanhead, Midlothian, EH20 9SY
EMAIL ADDRESS:	admin@aocarchaeology.com
ARCHIVE LOCATION	Archive to be deposited in NMRS



AOC Archaeology Group, The Raylor Centre, James Street, York, YO10 3DW
tel: 01904 413 404 | e-mail: york@aocarchaeology.com