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SPECIALISTS IN ARCHAEOLOGICAL SURVEY

GEOPHYSICAL SURVEY REPORT

DOUNE CASTLE DEPOT

RGC19350/DCD

Commissioned by: CFA Archaeology

On behalf of: Historic Environment Scotland

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NON-TECHNICAL SUMMARY

Rose Geophysical Consultants LLP was commissioned by CFA Archaeology LTD., on behalf of Historic Environment Scotland, to undertake a geophysical survey within a field to the northwest of the HES Maintenance and Conservation Unit Depot at Doune Castle. The geophysical survey forms part of wider archaeological evaluations of the area as part of considerations for a new visitor's car park for Doune Castle.

Gradiometer and resistance surveys were undertaken over an area of approximately 0.9ha.

The gradiometer data is dominated by the strong response from a presumed water pipe running across the southern half of the survey area. Although numerous ferrous / fired and pit type anomalies, together with several linear trends, have been recorded within the gradiometer data, it is thought that these have modern and natural origins.

The resistance data is dominated by amorphous bands of high resistance and apparently associated high and low resistance curvilinear trends which most likely indicate natural bands of sands and gravels associated with the migrating burn that defines the northern, western and southern limits of the field. Discrete low resistance anomalies have also been noted within the field and are thought to indicate the location of former trees. Numerous trends have been recorded the south and east of the survey area and are most likely associated with current and former services.

No anomalies indicative of archaeological remains have been identified.

Survey:	Doune Castle Depot, Doune, Stirling
Client:	CFA Archaeology on behalf of Historic Environment Scotland
Date of Fieldwork:	10th – 13th September 2019
Survey Personnel:	Dr S M Ovenden and A S Wilson
Report Author:	Dr S M Ovenden
Report Illustrations:	Dr S M Ovenden
Checked by:	A S Wilson
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1 INTRODUCTION

1.1 Rose Geophysical Consultants LLP (RGC) was commissioned by CFA Archaeology LTD., on behalf of Historic Environment Scotland (HES), to undertake a geophysical survey within a field to the northwest of the HES Maintenance and Conservation Unit (MCU) Depot at Doune Castle.

1.2 Gradiometer and resistance surveys were undertaken over an area of approximately 0.9ha.

1.3 The geophysical survey forms part of wider archaeological evaluations of the area as part of considerations for a new visitor's car park for Doune Castle.

2 SITE LOCATION, GEOLOGY & DESCRIPTION

2.1 Doune Castle is sited at the neck of a promontory between the River Teith to the west and Ardoch Burn to the east, approximately 13km north-west of Stirling. The MCU depot lies 200m to the northeast of the Castle. The survey area is centred on NN 72955 01200

2.2 The geology of the area comprises sandstones, and sands and gravels which respond well to all geophysical techniques.

2.3 The survey area occupies a meander of the Ardoch Burn and areas immediately to the north and west of MCU depot complex, approximately 0.9ha in total. The main field was under short rough pasture at the time of survey that had been recently cut, while the areas around the depot buildings were under short maintained lawn.

3 ARCHAEOLOGICAL BACKGROUND

3.1 The area is not scheduled and no known sites exist within the area. However, it is thought that features associated with the castle may survive in the area.

4 SURVEY AIMS AND OBJECTIVES

4.1 The aim of the geophysical survey was to determine the location, nature and extent of any potential archaeological anomalies within the area by undertaking gradiometer and resistance survey of the whole area.

4.2 Specifically the objectives of the survey were:

- to determine the location, nature and extent of any potential archaeological anomalies.
- to assess the presence /absence of potential archaeological features that might be present.
- to produce a comprehensive report and data archive.

5 METHODOLOGY

5.1 SURVEY TECHNIQUES USED

5.1.1 Gradiometer and Resistance surveys were undertaken at the site.

5.1.2 All geophysical survey work was carried out in accordance with recommended good practice specified in guideline documents published by Historic England (David et al. 2008), European Archaeological Council (Schmidt et al. 2016) and the Chartered Institute for Archaeologists (CIfA, 2014).

5.1.3 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, 2009).

5.2 ESTABLISHMENT OF SURVEY GRID

5.2.1 Prior to data collection a series of 20m grids were set out and georeferenced using a Trimble R8 RTK GPS system using the VRS network with correction via mobile data connection. The grid was established to an accuracy of +/ - 5cm.

5.2.2 All data was collected on a local grid and geo-referenced retrospectively.

5.2.3 Geo-referencing information is provided within Appendix I of this report and the accompanying CAD files.

5.3 DATA COLLECTION

5.3.1 Gradiometer Survey

5.3.1.1 The gradiometer survey was carried out using a Bartington Grad601-2 fluxgate gradiometer. The system is a dual system which enables two transects of data to be collected simultaneously.

5.3.1.2 Data was collected on an east-west alignment using zig-zag traverses with a sample interval of 0.25m along traverses 1m apart.

5.3.1.3 The data were downloaded using Bartington Grad601 PC Software at lunchtime and at the end of the day to check data quality and to back-up the data.

5.3.2 Resistance Survey

5.3.2.1 The resistance survey was carried out using a Geoscan Research RM85 Resistance System.

5.3.2.2 The system was configured as a 0.5m Twin probe array. The system is a dual system which enables two transects of data to be collected simultaneously.

5.3.2.3 Data was collected on an east-west alignment using zig-zag traverses with a sample interval of 0.5m along traverses 0.5m apart.

5.3.2.4 The data were downloaded using Geoscan Research Geoplot 4.0 at lunchtime and at the end of each day to check data quality and to back-up the data.

5.4 Data Processing

5.4.1 Gradiometer Survey

5.4.1.1 Following data download, the survey grids were imported and assembled into composites using Geoscan Research Geoplot 4.0. The data was processed using a range of standard processing algorithms appropriate for gradiometer data. The data had the following processing steps applied:

Edited Data: Zero mean traverse & de-stagger

- *Zero mean traverse*. This sets the mean value of each traverse to zero, to remove striping in the data caused by slight misalignment of sensors. Applied with a -5nT to 5nT threshold.
- *Destagger.* This corrects slight misalignment of data when the survey is conducted in a zig-zag traverse pattern. Applied when required.

Interpolated Data: As for edited data plus low pass filter and interpolate

- *Low Pass Filter*. Gaussian filter to remove high-frequency instrument noise.
- *Interpolation.* Increases the resolution of a survey by interpolating new values between surveyed data points, creating a smoother overall effect. Data was interpolated twice in the Y direction to create the effect of a square, 0.25m by 0.25m, data set

5.4.2 Resistance Survey

5.4.2.1 Following data download, the survey grids were imported and assembled into composites using Geoscan Research Geoplot 4.0. The data was processed using a range of standard processing algorithms appropriate for resistance data. The data had the following processing steps applied:

Edited Data: Despike & Edge Match/Deslope

- *Despike:* Extremely high and / or low readings caused by poor contact, which are false readings, are replaced with the mean value of the immediate area.
- *Edge Match/Deslope:* Occasionally there can be a variation in the mean value between grids which results in visible grid edges. This is corrected by simple addition/subtraction as required.

Interpolated Data: As for edited data plus interpolation

- *Interpolation.* Increases the resolution of a survey by interpolating new values between surveyed data points, creating a smoother overall effect. Data was interpolated once in the Y and X directions to create the effect of a square, 0.25m by 0.25m, data set.

Filtered Data: As for Interpolated data plus High Pass Filter

- *High Pass Filter.* Running a high pass filter on the data effectively removes background trends within the data thereby enhancing more discrete anomalies.

5.5 DATA PRESENTATION

5.5.1 A location plan showing the areas investigated by the different techniques is provided in Figure 1 at a scale of 1:1000.

5.5.2 Gradiometer Survey

5.5.2.1 The data plots have been exported from Geoscan Research Geoplot 4.0 and have been attached to CAD base mapping provided by the client.

5.5.2.2 The data are displayed at 1:625 in the following formats in Figures 2 & 3:

- **Edited Data** - XY Trace plotted at 30nT/cm
- **Interpolated Data** - Greyscale Image plotted at -4nT to 5nT

5.5.2.3 An interpretation diagram is provided in Figure 4, also at a scale of 1:625.

5.5.3 Resistance Survey

5.5.3.1 The data plots have been exported from Geoscan Research Geoplot 4.0 and have been attached to CAD base mapping provided by the client.

5.5.3.2 The data are displayed at 1:625 in the following formats in Figures 5 - 8:

- **Edited Data** - Greyscale image plotted at 123Ω to 536Ω
- **Interpolated Data** - Greyscale image plotted at 100Ω to 525Ω
- **Interpolated Data** - Colour scale image plotted at 100Ω to 550Ω
- **High Pass Filtered Data** - Greyscale image plotted at -2SD to +2SD

5.5.3.3 An interpretation diagram is provided in Figure 9, also at a scale of 1:625.

6 SITE CONDITIONS / GENERAL CONSIDERATIONS

6.1 The weather at the time of the survey was generally dry and warm with occasional showers.

6.2 Conditions on site were good with the survey area under short grass and generally free of obstructions.

7 GRADIOMETER SURVEY: RESULTS AND INTERPRETATION (FIGURES 2 – 4)

The anomaly letters referred to below are shown on the interpretation diagram.

7.1 The gradiometer data has a relatively high level of background response which is to be expected given the sands and gravels and past use of the field as a paddock.

7.2 The data are dominated by a strong response (A) from a buried service and its associated zone of magnetic disturbance (B). This is thought to be due to an iron water pipe that can be seen crossing the burn immediately to the west of the survey area and leads to a fire hydrant just to the east of the survey area.

7.3 The data collected in the south of the area, immediately to the west of the building complex, is also dominated by magnetic disturbance (C) due to buried services and ferrous material in adjacent structures. Limited areas of magnetic disturbance (D) have also been recorded along the perimeter of the survey area due to fencing, gates, etc.

7.4 Numerous large ferrous / fired responses (E) have been recorded throughout the survey area. These are most likely due to modern ferrous material in the topsoil associated with past use of the field as a paddock. Areas of concrete were also noted along the north-western limits of the survey area suggesting an earlier area of hardstanding / structure.

7.5 Smaller fired and ferrous responses (F) have also been recorded which are likely to be due to modern fired and ferrous material in the topsoil. These are concentrated in the north of the survey area near the ruined brick structure and the entrance into the field.

7.6 Several positive pit type responses have also been noted. Interpretation of these is cautious as they are not coherent. In addition, more deeply buried ferrous and / or fired material can give a pit type response as well as naturally magnetic gravels.

7.7 The larger responses (G) are likely to have a modern origin given their location relative to structures and former fences.

7.8 Two well defined pit type responses (H) and associated parallel trends may be associated with former track, although an archaeological origin cannot be entirely dismissed.

7.9 It is thought that the smaller pit type responses and linear trends are modern and / or natural in origin.

8 RESISTANCE SURVEY: RESULTS AND INTERPRETATION (FIGURES 5 – 9)

The anomaly numbers referred to below are shown on the interpretation diagram.

8.1 Resistance survey has recorded a wide range of values with higher values being recorded across the pasture field and lower values being recorded within the lawned areas adjacent to the MCU building.

8.2 The data within the main field are dominated by amorphous bands of high resistance (1) and apparently associated high and low resistance curvilinear trends (2). These are most likely natural in origin and due to natural bands of sands and gravels associated with the migrating burn that defines the northern, western and southern limits of the field.

8.3 Numerous well-defined low resistance pit type responses (3), of varying sizes, have been recorded across the field. Given there is no correlation with the gradiometer data, it is likely that these are due to former trees.

8.4 A very weak negative and positive trend (4) in the south of the survey area coincides with the location of the water pipe detected in the gradiometer survey.

8.5 A better defined low resistance trend (5) has been recorded just to the south of (4) and follows the field boundary. This is most likely a cable trench for an electric cable leading from the telegraph pole which defines the western limit of the trend.

8.6 A relatively well-defined area of high resistance (6) has been recorded in the south of the survey area. The origin of this is unclear but it is thought to have a modern origin.

8.7 Several trends (7) have been recorded in the south and east of the area near the depot buildings and are most likely associated with current and former services.

9 CONCLUSION

9.1 The gradiometer data is dominated by the strong response from a presumed water pipe running across the southern half of the survey area.

9.2 Although numerous ferrous / fired and pit type anomalies, together with several linear trends, have been recorded within the gradiometer data, it is thought that these have modern and natural origins.

9.3 The resistance data is dominated by amorphous bands of high resistance and apparently associated high and low resistance curvilinear trends which most likely indicate natural bands of sands and gravels associated with the migrating burn that defines the northern, western and southern limits of the field.

9.4 Discrete low resistance anomalies have also been noted within the field and are thought to indicate the location of former trees.

9.5 Numerous trends have been recorded the south and east of the survey area and are most likely associated with current and former services.

9.6 No anomalies indicative of archaeological remains have been identified.

10 STATEMENT OF INDEMNITY

10.1 Geophysical data can be ambiguous and while every effort has been made to ensure that the interpretations contained within this report represent an accurate record of potential surviving archaeological deposits, it is a subjective analysis of the data.

10.2 The success of a geophysical survey in identifying archaeological remains is dependent on several factors including geology and soils, time of year for some techniques, field conditions and the nature of the buried archaeological features / deposits. As a result a geophysical survey may only reveal certain archaeological features and not produce a complete plan of all of the archaeological remains within a survey area and can only confidently predict a presence of archaeology, not an absence.

REFERENCES

CIfA, 2014, Standards and Guidance for Archaeological Geophysical Survey

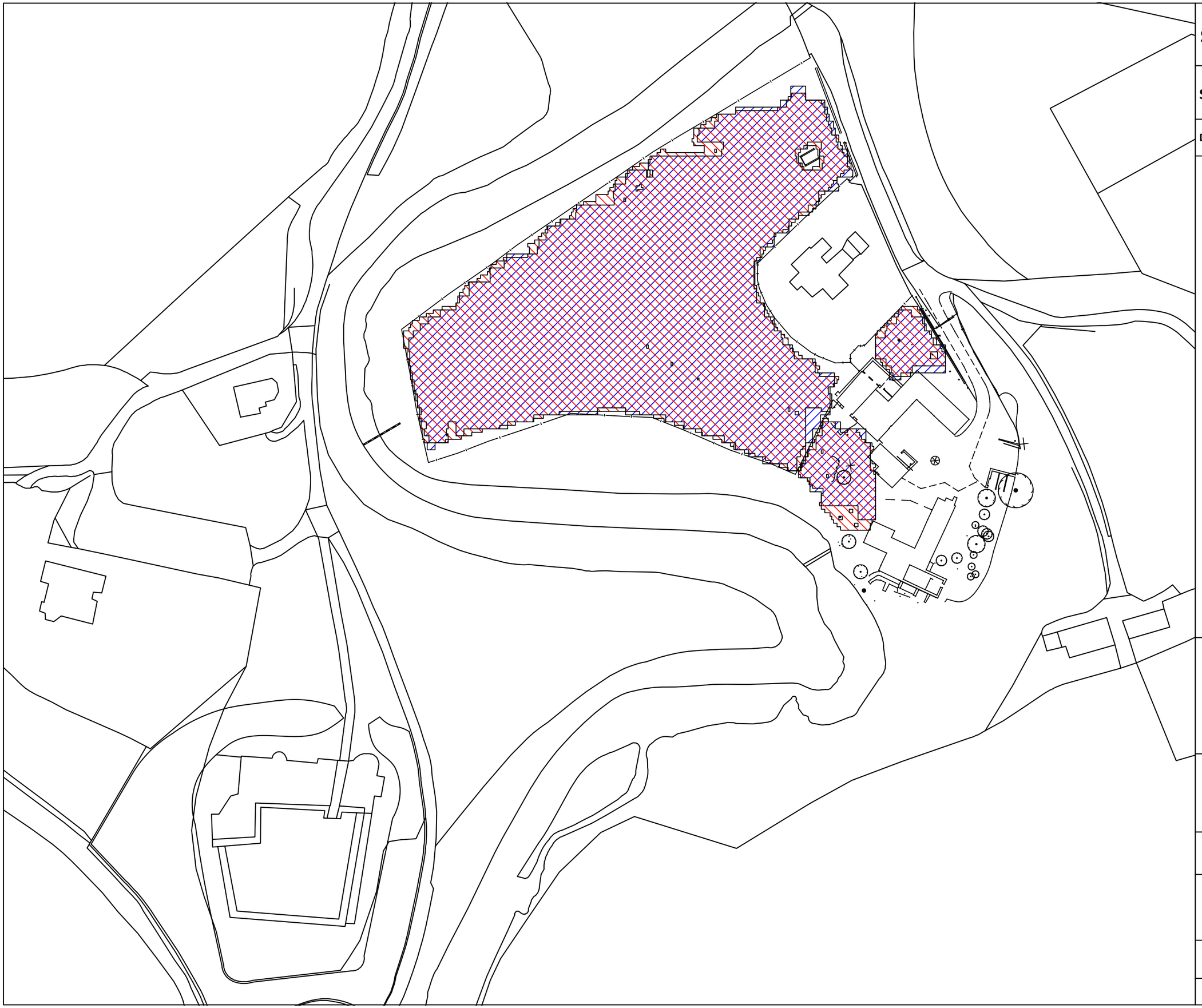
David, A. Linford, N. Linford, P., 2008, English Heritage (Historic England): *Geophysical Survey in Archaeological Field Evaluation*, Swindon.

Schmidt, A. and Ernenwein, E., 2009, Archaeology Data Service: Geophysical Data in Archaeology: A Guide to Good Practice

Schmidt, A. Linford, P., Linford, N. David, A. Gaffeny, C. Sarris, A. Fassbinder, J., 2016, *EAC Guidelines for the use of Geophysics in Archaeology*. European Archaeological Council.

APPENDIX I: METADATA

RGC Project Name	Doune Castle MCU Depot		
RGC Project Number	RGC19350/DCD		
Client	CFA Archaeology on behalf of Historic Environment Scotland.		
Date of Survey	10th – 13th September 2019		
Personnel	Susan Ovenden & Alistair Wilson		
Date of Report	1st October 2019		
Report Author	Susan Ovenden		
Local Authority	Stirling		
Parish	Kilmadock		
Site / Monument Type	Castle - 14th Century		
Site Number	NN70SW 1 - Castle to the south west		
Canmore ID	24738 - Castle to the south west		
NGR	NN 72955 01200		
DES Entry	Yes		
Ground Cover	Short grass		
Weather Conditions	Dry		
Survey Techniques Area Data Interval	Gradiometer Survey 0.9ha; Data collected @ 0.25m by 1m Resistance Survey 0.9ha; Data collected @ 0.5m by 0.5m		
Geo-reference details	Data collected on Local Grid	BL 0m,0m	TR 160m, 140m
	Survey grid georeferenced (OSTN15)	BL 272880, 701140	TR 273040, 701280
Archive Details	Working Files (Geoplot 4)	Preservation Files (XYZ)	JPEG Images
Grids	No	No	No
Composites	Yes	Yes - CSV files	Yes



SITE: Doune Castle Depot

SURVEY TYPE: Geophysical Survey

DATA TYPE: Location

Gradiometer Survey

Resistance Survey

0m 40m

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CLIENT: CFA Archaeology on behalf of HES

Scale: 1:1000 @ A3 | Revision No: 0

Date: 30/09/2019 | Illustrator: SMO

Figure 1

SITE: Doune Castle Depot

SURVEY TYPE: Gradiometer Survey

DATA TYPE: Edited Data

30nT/cm

0m 30m

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CLIENT: CFA Archaeology on behalf of HES

Scale: 1:625 @ A3
Date: 30/09/2019

Revision No: 0
Illustrator: SMO

Figure 2

SITE: Doune Castle Depot

SURVEY TYPE: Gradiometer Survey

DATA TYPE: Interpolated Data

5nT

-4nT

0m 30m

rose geophysics

CLIENT: CFA Archaeology on behalf of HES

Scale: 1:625 @ A3 | Revision No: 0

Date: 30/09/2019 | Illustrator: SMO

Figure 3

SITE: Doune Castle Depot

SURVEY TYPE: Gradiometer Survey

DATA TYPE: Interpretation

- Positive Response
- Trend
- Service
- Ferrous / Fired
- Magnetic Disturbance

0m — 30m

rose geophysics

CLIENT: CFA Archaeology on behalf of HES

Scale: 1:625 @ A3 | Revision No: 0
Date: 30/09/2019 | Illustrator: SMO

Figure 4

SITE: Doune Castle Depot

SURVEY TYPE: Resistance Survey

DATA TYPE: Edited Data

536Ω

123Ω

0m 30m

rose geophysics

CLIENT: CFA Archaeology on behalf of HES

Scale: 1:625 @ A3 | Revision No: 0

Date: 30/09/2019 | Illustrator: SMO

Figure 5

SITE: Doune Castle Depot

SURVEY TYPE: Resistance Survey

DATA TYPE: Interpolated Data

525Ω

100Ω

0m 30m

rose geophysics

CLIENT: CFA Archaeology on behalf of HES

Scale: 1:625 @ A3
Date: 30/09/2019

Revision No: 0
Illustrator: SMO

Figure 6

SITE: Doune Castle Depot

SURVEY TYPE: Resistance Survey

DATA TYPE: Interpolated Data

550Ω

100Ω

0m 30m

rose geophysics

CLIENT: CFA Archaeology on behalf of HES

Scale: 1:625 @ A3 | Revision No: 0

Date: 30/09/2019 | Illustrator: SMO

Figure 7

SITE: Doune Castle Depot

SURVEY TYPE: Resistance Survey

DATA TYPE: Filtered Data

2SD

-2SD

0m 30m

rose geophysics

CLIENT: CFA Archaeology on behalf of HES

Scale: 1:625 @ A3 | Revision No: 0

Date: 30/09/2019 | Illustrator: SMO

Figure 8

SITE: Doune Castle Depot

SURVEY TYPE: Resistance Survey

DATA TYPE: Interpretation

- High Resistance
- High Resistance: Trend
- Low Resistance
- Low Resistance: Trend
- High Resistance: Probable Natural

0m 30m

rose geophysics

CLIENT: CFA Archaeology on behalf of HES

Scale: 1:625 @ A3
Date: 30/09/2019

Revision No: 0
Illustrator: SMO

Figure 9