

**Geophysical Survey of land at  
Hangingstone Hill,  
Dartmoor**



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Dartmoor**

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## Executive Summary

Project Name	Geophysical Survey of Land at Hangingstone Hill, Dartmoor
Location	Hangingstone Hill, Dartmoor
NGR	(NGR SX 61658 86059)/(NGR SX 61929 866139) (centre)
Type	Geophysical Survey
Date	May 2016
Job Code	0168

## Summary

BUARC, Bournemouth University's archaeological consultancy, was commissioned by Dartmoor National Park Authority to undertake a geophysical survey as part of a programme of archaeological work ahead of proposed investigation and excavation of two possible cairns on Hangingstone Hill, Dartmoor.

A Written Scheme of Investigation for Geophysical Survey was prepared and approved prior to the fieldwork that proposed a complementary survey of gradiometry and earth resistance over two areas (Area 1 and Area 2) measuring 40m x 40m centred on (NGR SX 61658 86059) and (NGR SX 61929 866139) respectively. Each survey area was established due to the presence of concentrations of stones visible on the surface.

The gradiometer survey was undertaken using Bartington Grad 601-2 fluxgate gradiometers, with data collected at 0.125m intervals along traverses spaced 1m apart. Earth resistance data were collected using a Geoscan Research RM15 in parallel twin configuration at 1m x 1m intervals. Twenty metre grids were established along a common baseline and georeferenced using Leica survey-grade GNSS to Ordnance Survey British National Grid coordinates. The total survey area comprised c.3200 m<sup>2</sup> across the two survey areas.

The gradiometer data demonstrated the presence of few areas of magnetic enhancement in each survey area, while the earth resistance survey identified a number of high resistance anomalies potentially representing features of archaeological origin. In Area 1 a central area of high resistance has been identified in the location of a group of slightly raised area of stones evident on the surface of the survey area. These stones had been identified as potentially representing the location of a burial cairn prior to the survey, and the survey results show an area of high resistance, orientated NE/SW, measuring c. 16m x 8m in this location.

In Area 2 a central area of high resistance has been identified measuring c. 4.5m x 8m. Similar areas of high resistance have also been identified towards the south west and east, along with a linear trend orientated SW/NE.

The effectiveness of the two complementary techniques can be seen clearly. While the gradiometer survey has detected weak magnetic anomalies in each survey area, it is probable that these would be overlooked if not backed up by the earth resistance results.

## 1 INTRODUCTION

### 1.1 Project Background

- 1.1.1 BUARC, Bournemouth University's Archaeology Consultancy, has been appointed by Dartmoor National Park Authority (DNPA) to carry out a geophysical survey as part of a programme of archaeological work on the possible locations of two cairns on the summit of Hangingstone Hill, Dartmoor, hereafter the 'survey areas'.
- 1.1.2 Archaeological excavation is planned on Hangingstone Hill for summer 2016, as part of the Moor Than Meets the Eye Landscape Partnership Scheme, a conservation initiative focused on eastern Dartmoor and funded by the Heritage Lottery Fund. The Scheme will focus on features of possible Bronze Age date identified in earlier field survey.
- 1.1.3 The aim of the geophysical survey is to maximise the available information with the survey results being used to characterise the geophysical signature of the target features.
- 1.1.4 This geophysical survey was carried out in accordance with current guidance (English Heritage, 2008) and was carried out by BUARC staff between 19<sup>th</sup> and 21<sup>st</sup> April 2016.

### 1.2 Objectives

- 1.2.1 The primary objectives of the geophysical surveys were to carry out gradiometer and resistivity surveys to locate geophysical anomalies that may be archaeological in origin.
- 1.2.2 The interpretation of any identified anomalies will improve the understanding of the nature and extent of archaeological remains and inform and guide the excavation.

### 1.3 Site Description

- 1.3.1 The survey areas were located on the summit of Hangingstone Hill on the north eastern edge of Dartmoor, accessed via c. 9km of military track from Okehampton Camp (SX 5882 9303). The Sites were centred on the location of possible cairns;
- Area 1 (NGR SX 61658 86059) measured c.970m<sup>2</sup>
- Area 2 (NGR SX 61929 866139) measured c. 1040m<sup>2</sup>.
- 1.3.2 Each survey area has been centred on an area of stones identified on the surface as potentially representing the location of cairns. Each of these areas was slightly raised with heavier vegetation growth than the surrounding vicinity.
- 1.3.3 For ease of data collection each survey area was increased in area to 1600m<sup>2</sup> each to allow a 40m x 40m grid to be used for each area.

### 1.4 Survey Conditions

- 1.4.1 The conditions for survey were generally good. The vegetation cover was predominantly mixed coarse grasses. The weather was dry but with strong winds throughout the survey.

## 2 METHODOLOGY

### 2.1 Field Survey

- 2.1.1 The survey area was divided into square grids measuring 20m x 20m, centred on a central point identified by Dartmoor National Park's Archaeologist on the first day of the data collection.
- 2.1.2 The gradiometer survey was undertaken using the dual-sensor Bartington Grad 601-2 vertical fluxgate gradiometer to complete a full gradiometer survey of the area. Data were collected at 0.125m intervals along traversed spaced 1m apart. This equates to 3200 sampling points in each full 20m x 20m grid.

Each grid was surveyed in a zigzag fashion. This sampling interval is effective at locating a wide range of archaeological features and is the recommended methodology for archaeological prospection (English Heritage, 2008).

- 2.1.3 Gradiometer survey measures extremely small changes in the Earth's background magnetic field and is sensitive to anomalies produced by alterations in the magnetic enhancement of the soil. Archaeological features resulting from human activity, such as episodes of burning, soil disturbance or depositions, can produce measurable changes in the magnetic properties of the soil, and the magnitude and distribution of these changes allow the diagnostic interpretation of these anomalies. The Grad-601 is sufficiently sensitive to detect archaeological anomalies at depths of up to 1m, although strongly magnetised anomalies may be detected at greater depths in certain conditions.
- 2.1.4 The electrical resistance survey was undertaken using the RM15-D Resistance Meter in parallel twin probe configuration. The grids were surveyed in a zigzag pattern taking readings at 1.0m intervals along traverses set 1.0m apart, with readings stored on an internal data logger.
- 2.1.5 Resistivity survey operates by passing an electrical current through the ground at regular points on a site-specific survey grid. Electrical resistance in the soil varies, and is affected by the presence of archaeological, and other, features. Soil resistance survey relies on the ability of the soil to conduct an electrical current passed through it. This is affected by a number of factors, such as the underlying geology, soil moisture and porosity and the presence of sub-surface features, with the current following the path of least resistance.
- 2.1.6 A low resistivity response will be recorded if the current passes through a low conducting feature, such as moisture retaining feature, like a back-filled ditch. Conversely a higher resistivity response will be recorded above a more insulating feature, such as a stone wall, where the current will find an easier path by flowing around it. The patterns of resistance in the soil are recorded, plotted and interpreted.
- 2.1.7 All fieldwork was carried out in accordance with the existing national guidelines (EH 2008).

## 2.2 Data processing

- 2.2.1 The data gathered during the survey were downloaded, processed and analysed using specialist processing software. The software allows greyscale and XY trace plots to be produced for presentation and display and allowed the data to be processed and presented in an appropriate format for this report. Survey grids are assembled to form an overall composite of data creating a dataset of each complete survey area.
- 2.2.2 In line with current guidelines (EH 2008), only minimal data processing was carried out, in order to enhance the results of the survey for display; further filtering is noted below and presented separately in the figures. Raw and minimally processed data are always analysed as processing can modify anomalies. The following schedule sets out the basic data and image processing used in this survey;
  - Zero mean traverse (gradiometer only) to normalise differences between sensors
  - Destagger (gradiometer only) to correct for the effects of topography and ground cover
  - Deslope (gradiometer only) to correct for the effect of strong magnetic disturbance
  - Edge-matching (resistance only) to maintain continuous background between grids
  - Despiking (resistance only) to remove effects of ground cover and contact resistance
  - High-pass filtering (resistance only) to enhance local variability & suppress background
- 2.2.3 **Figures 2 to 5** display the minimally processed data as greyscale and XY trace, and interpretation of the survey data respectively.

## 3 RESULTS

### 3.1 Overview

- 3.1.1 Geophysical anomalies can be categorised as linear, curvilinear and discrete responses of archaeological potential, anomalies and regions of uncertain origin, and responses consistent with natural or geological origins. Anomalies clearly anthropogenic in origin but considered to be modern in provenance, such as dipoles associated with ferrous debris and pipelines, have been identified but are not referred to further unless relevant to the archaeological interpretation.
- 3.1.2 The archaeological interpretation refers to anomalies identified with alphanumeric characters where relevant. Anomalies identified as being 'Archaeology', 'Probable Archaeology' and 'Possible Archaeology' are considered to be areas of archaeological potential. Given the target features within this investigation were cairns the earth resistance data interpretation refers only to high resistance and linear trend anomalies, while the gradiometer data interpretation refers to ferrous anomalies and linear trends.
- 3.1.3 The dimensions of magnetic anomalies may not reflect the physical dimensions of the underlying features, and are presented here to inform the archaeological interpretation only.

### **3.2 Gradiometer Survey Results**

- 3.2.1 Within the gradiometer data for each area (**Figures 2 & 3**) few anomalies were recorded. Isolated ferrous anomalies can be seen in each survey area. Central to Area 1 an area of magnetic enhancement was recorded, possibly relating to a feature of archaeological origin, while further magnetically enhanced areas to the south and east may also be archaeological in origin. A concentration of weak magnetic anomalies was recorded towards the north western quadrant of Area 2 and may also be archaeological in origin.
- 3.2.2 Weak linear trends were recorded in both areas and are considered to be a result of topography as opposed to being of archaeological origin. Other weak trends and isolated ferrous anomalies were also recorded, although their character is not considered consistent with archaeological features and as such these have been interpreted as relating to ferrous debris and near-surface changes.

### **3.3 Earth Resistance Survey Results: Standard Density**

- 3.3.1 Within the resistance data for each area (**Figures 4 & 5**) areas and bands of high resistance anomalies were recorded.
- 3.3.2 In Area 1 a centrally located area of high resistance was recorded. This is relatively well defined and is considered to be of possible archaeological origin; the background resistance response further northwest is more textured and the high resistance anomalies across the rest of the survey area are less distinct. Other high resistance anomalies were recorded to the north and east extending beyond the limit of the survey area.
- 3.3.3 In Area 2 a series of high resistance areas were recorded. The most central of these is relatively well defined and is considered to be of possible archaeological origin. A relatively well-defined strong linear trend from south west to north east in close proximity to another well-defined area of high resistance may also be of archaeological origin.

## **4 DISCUSSION**

### **4.1 Summary**

- 4.1.1 The geophysical surveys have demonstrated the presence of previously unknown anomalies of archaeological potential, possibly representing cairns.
- 4.1.2 In Area 1 a central area of high resistance has been identified in the location of a group of slightly raised area of stones evident on the surface of the survey area. These stones had been identified as potentially representing the location of a burial cairn prior to the survey, and the survey results show an area of high resistance, orientated NE/SW, measuring c. 16m x 8m in this location.

- 4.1.3 In Area 2 a central area of high resistance has been identified measuring c. 4.5m x 8m. Similar areas of high resistance have also been identified towards the south west and east, along with a linear trend orientated SW/NE.
- 4.1.4 The effectiveness of the two complementary techniques can be seen clearly; whilst gradiometer survey is typically considered to detect a wider range of archaeological features, earth resistance survey is considerably more suited to the identification of buried solid features. While the gradiometer survey has detected weak magnetic anomalies in each survey area, it is probable that these would be overlooked if not backed up by the earth resistance results.

## **5 STATEMENT OF INDEMNITY**

- 5.1.1 Geophysical survey is the collection of data that relate to subtle variations in the form and nature of soil. Surveys may not always detect sub-surface archaeological features due to a range of factors, although attempts will be made to identify areas where this may be the case. Agricultural activity, such as ploughing and drainage, deeper areas of topsoil from artificial build-up and varying soil conditions may affect the detection of features. This may also be true when dealing with earlier periods of human activity, for example those periods that are not characterised by sedentary social activity.
- 5.1.2 This report contains at least one image of minimally processed data to represent the results of the survey. Any additional processing necessary to enhance the interpretation of the data is noted in this report, for instance where a large number of strong, dipolar responses are recorded that can mask more subtle responses.

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## **7 ACKNOWLEDGEMENTS**

- 7.1.1 BUARC would like to thank DNPA for commissioning the project and DNPA Archaeologist Lee Bray for liaison prior to the data collection and meeting the survey team on site on the first day of the survey.
- 7.1.2 The geophysical survey was undertaken by Jon Milward and Alan Whitaker. The geophysical data were processed, interpreted and reported upon by Jonathan Monteith, which was then edited and issued by Jonathan Monteith. The project was managed for Bournemouth University by Jonathan Monteith.

## **8 REFERENCES**

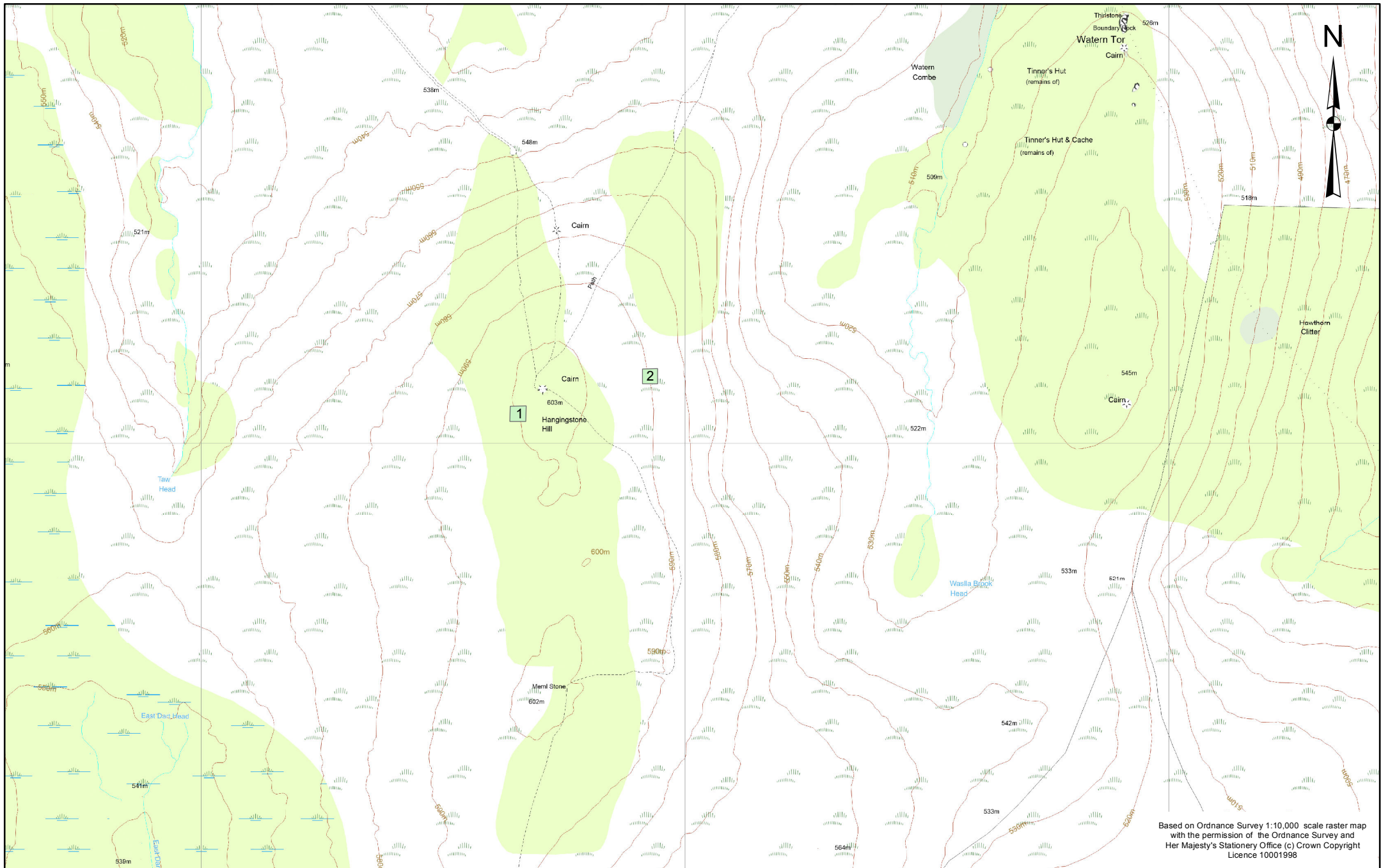
British Geological Survey, Geology of Britain viewer: <http://www.bgs.ac.uk/discoveringGeology/geologyOfBritain/viewer.html>; accessed 19/05/2015

English Heritage, 2008. *Geophysical survey in archaeological field evaluation*. Research and




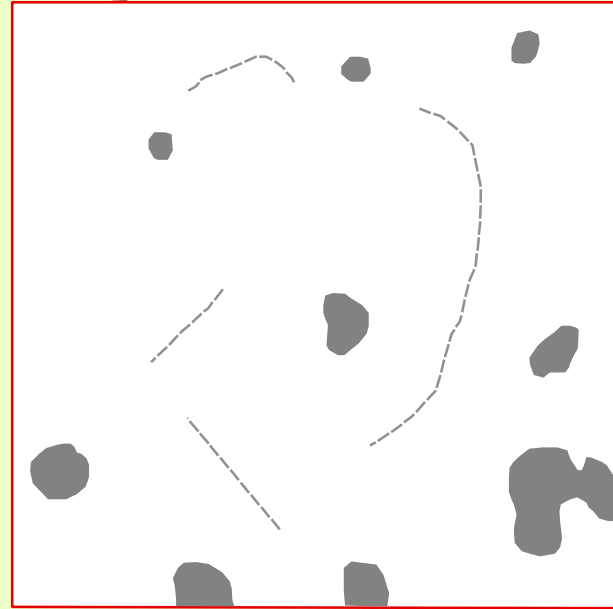
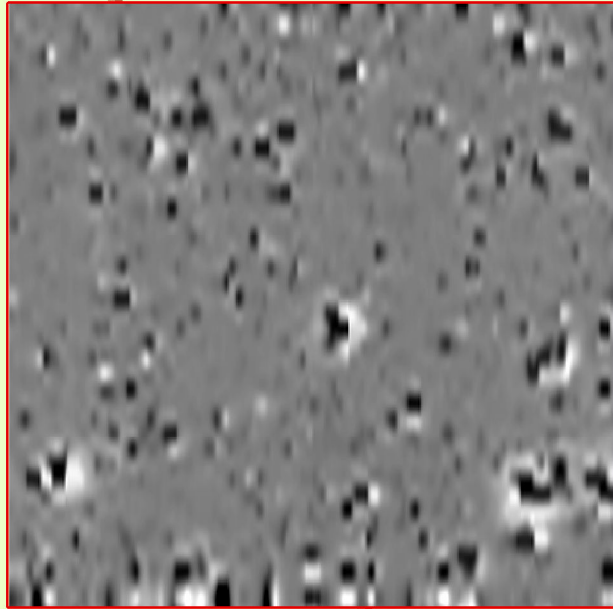
Professional Service Guideline No.1. 2nd ed. Swindon: English Heritage.




Schmidt, A., 2013. *Guide to Good Practice: Geophysical Data in Archaeology*. 2nd ed. York: Archaeology Data Service.

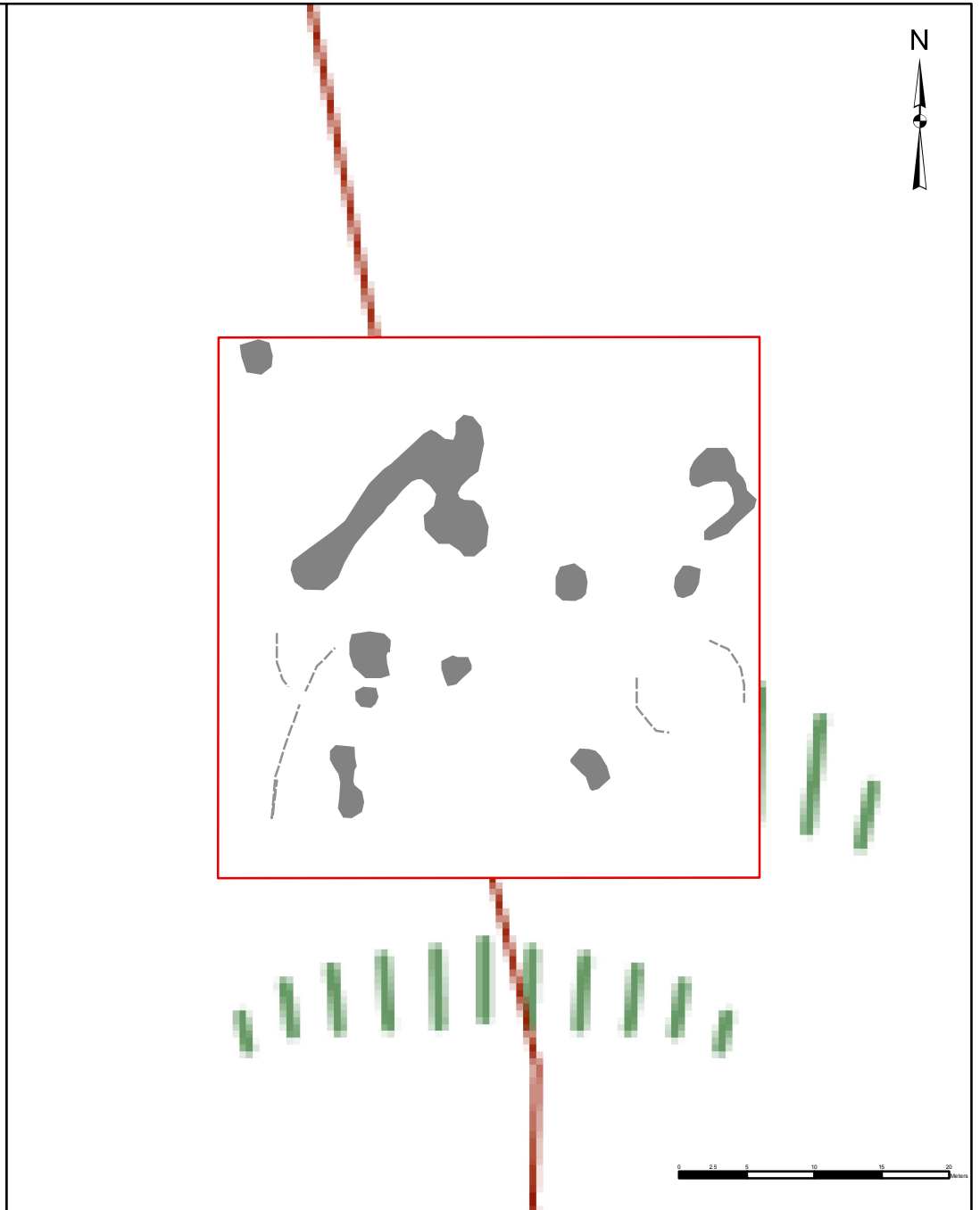
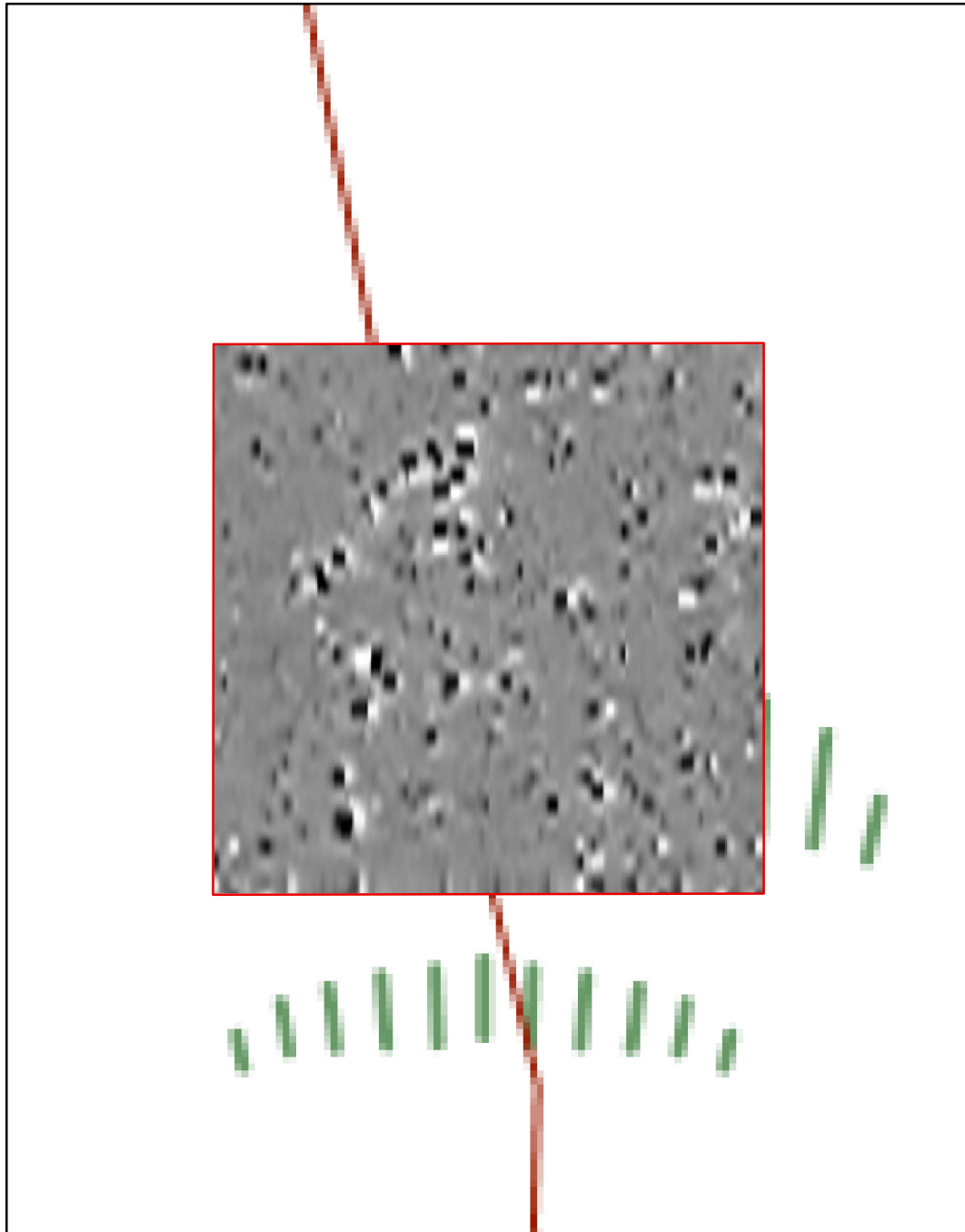


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<b>Title</b> Figure 1 Survey area locations	<b>Legend</b>  Geophysics Survey Areas	<b>Project Code</b> 0168	<b>Compiled By</b> JM	<b>Issued By</b> JM	<b>Site</b> Hangingstone Hill, Dartmoor	BUARC C216 Christchurch House Fern Barrow Poole Dorset BH12 5BB Tel: +44 (0) 1202 965295 Mob: +44 (0) 7984 599449 Email: heritage@bournemouth.ac.uk <b>BUARC</b> <i>Protecting the past, supporting the future</i>
		<b>Date</b> 12/05/2016	<b>Scale</b> 1:10,000	<b>Drawing No.</b> Figure 1	<b>Project</b> Geophysical Survey	



<b>Title</b> Gradiometer Survey: Greyscales and Interpretation - Area 1	<b>Legend</b>  Survey Area 1 boundary  Area 1 Ferrous Anomaly  Area 1 Trend	<b>Project Code</b> 0168	<b>Compiled By</b> JM	<b>Issued By</b> JM	<b>Site</b> Hangingstone Hill, Dartmoor	<b>BUARC</b> C216 Christchurch House Fern Barrow Poole Dorset BH12 5BB Tel: +44 (0) 1202 965295 Mob: +44 (0) 7984 599449 Email: heritage@bournemouth.ac.uk <b>BUARC</b> <i>Protecting the past, supporting the future</i>
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**Title**  
 Gradiometer Survey: Greyscales and Interpretation - Area 2

**Legend**  
 Survey Area 2 boundary    - - - Area 2 Trend  
 Ferrous Anomaly

**Project Code**  
 0168  
**Date**  
 12/05/2016

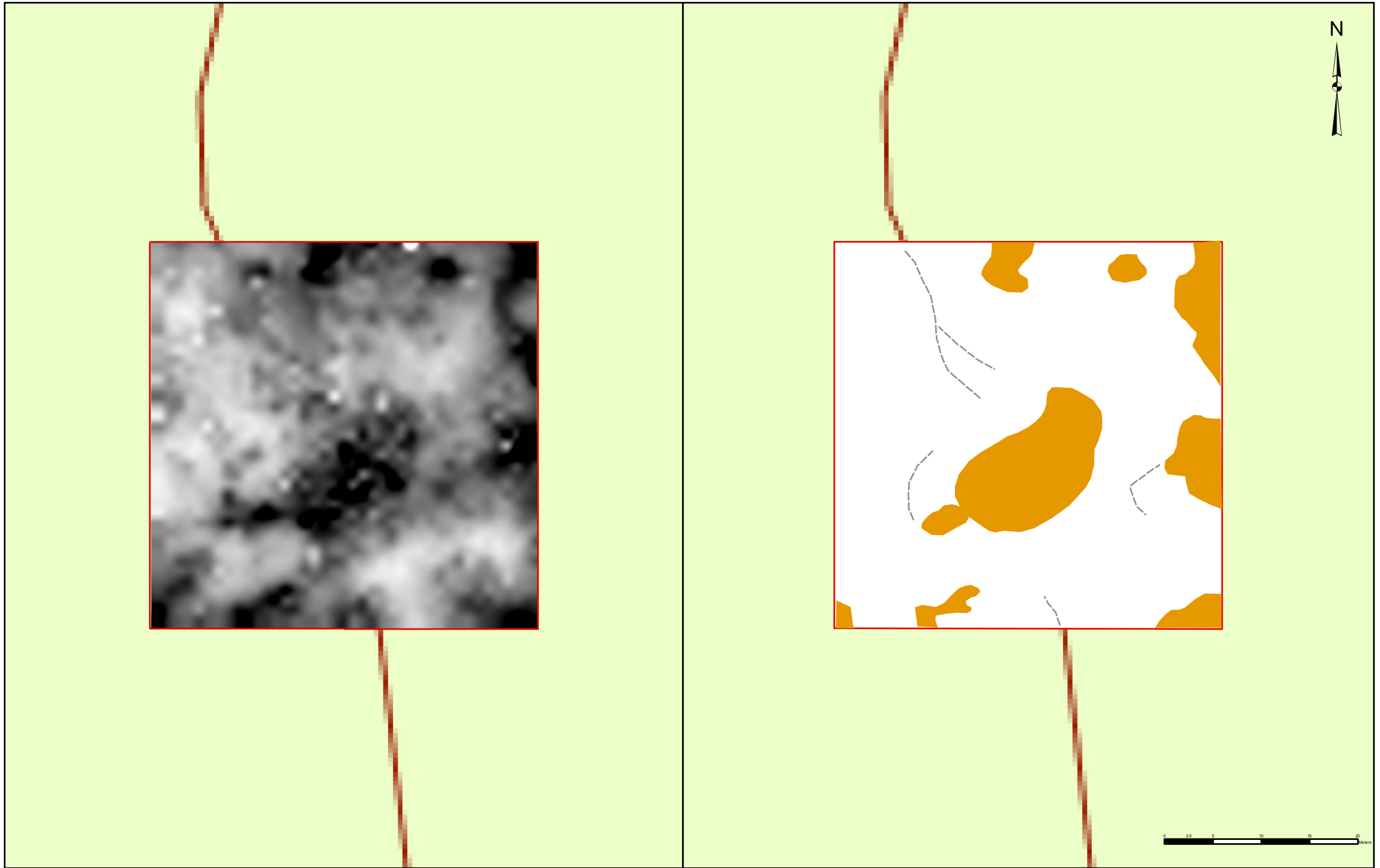
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**Title**  
 Earth Resistance Survey: Greyscale  
 (minimally processed & filtered data)  
 & Interpretation: Area 1

**Legend**

Survey Area 1 boundary
  High Resistance  
 Resistance Trend

**Project Code**  
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**Date**  
12/05/2016

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**Scale**  
1:500

**Issued By**  
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**Drawing No.**  
Figure 4

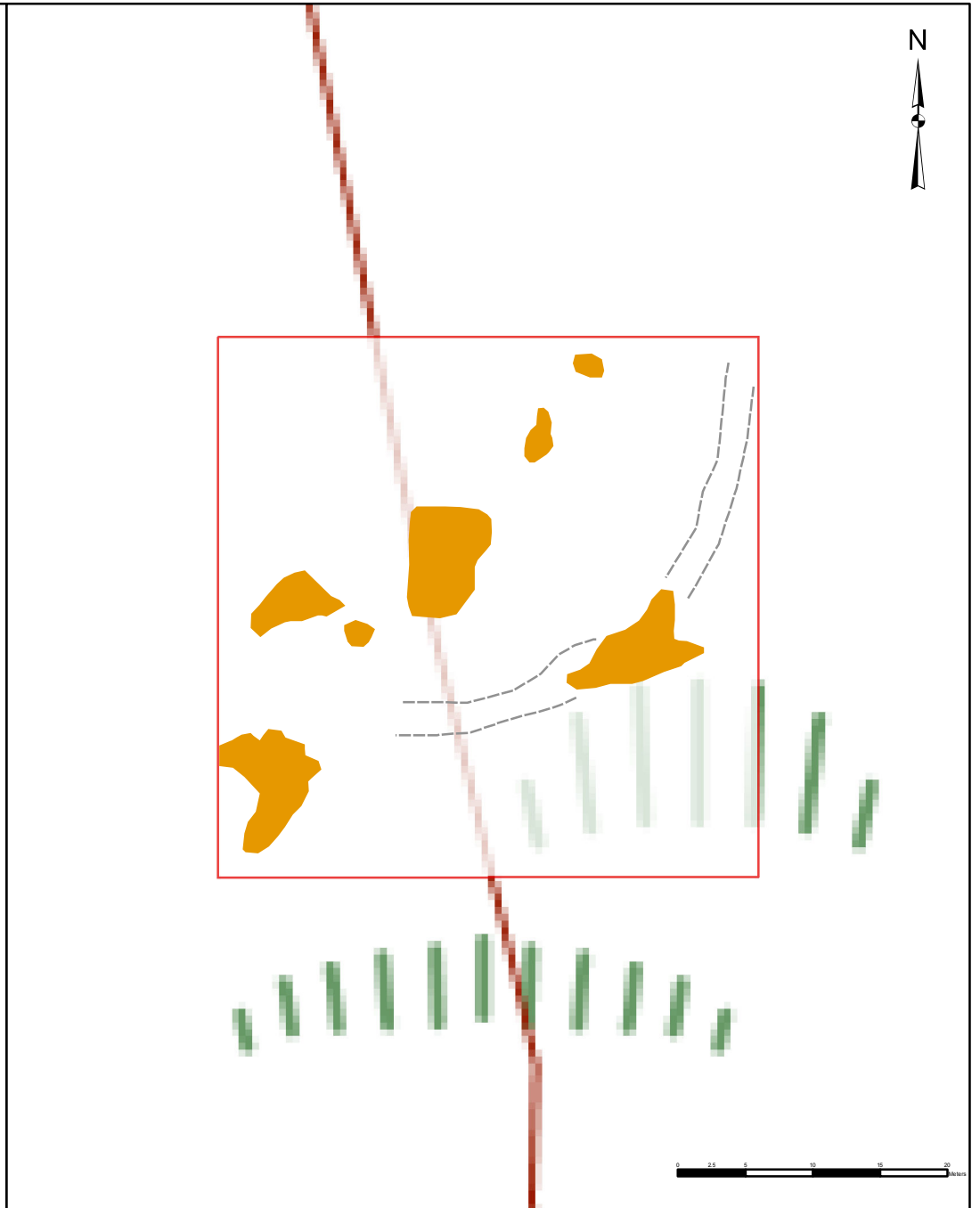
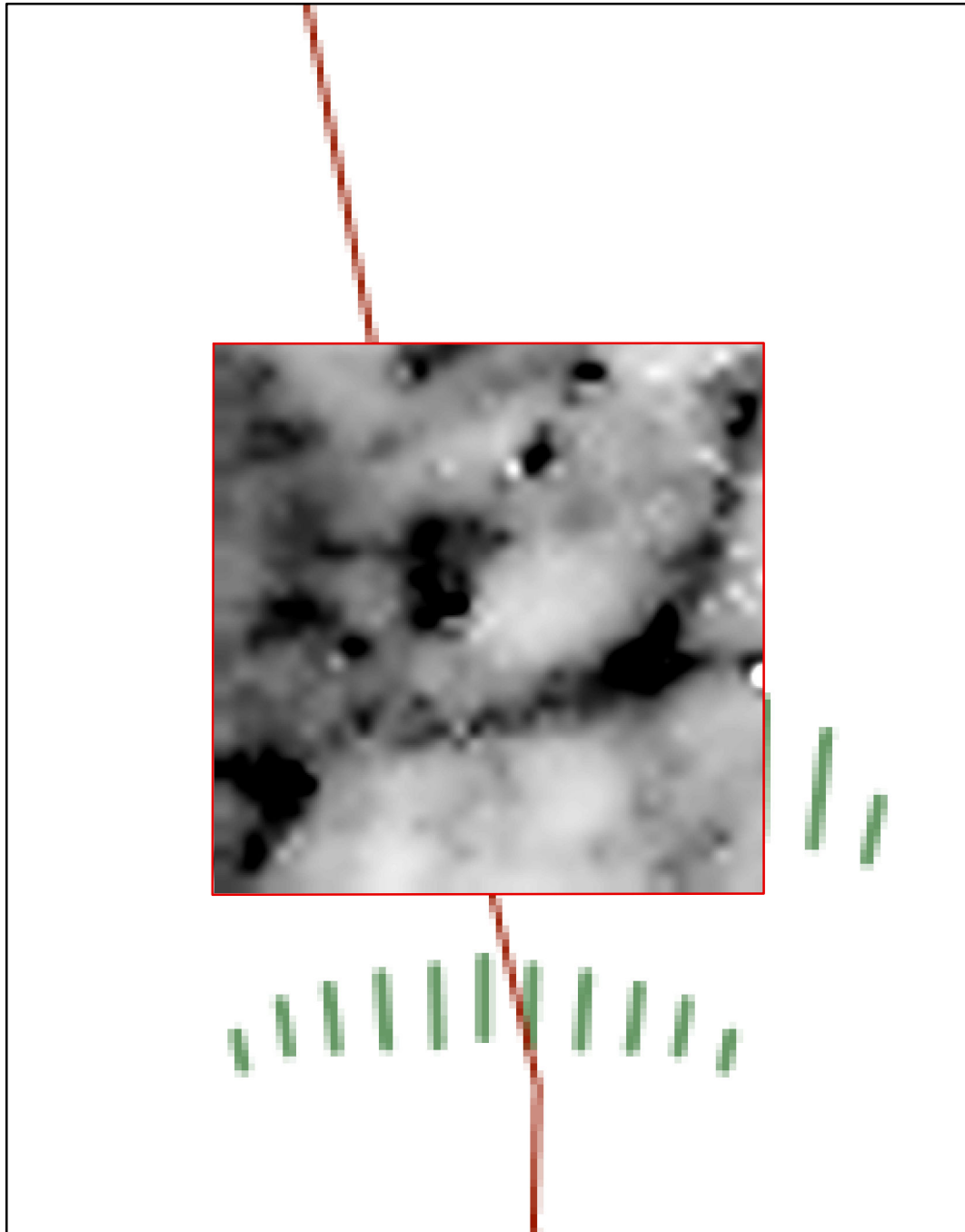
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<b>Title</b> Earth Resistance Survey: Greyscale (minimally processed & filtered data) & Interpretation: Area 2	<b>Legend</b>  Survey Area 2 boundary  High Resistance  Resistance Trend	<b>Project Code</b> 0168	<b>Compiled By</b> JM	<b>Issued By</b> JM	<b>Site</b> Hangingstone Hill, Dartmoor	BUARC C216 Christchurch House Fern Barrow Poole Dorset BH12 5BB Tel: +44 (0) 1202 965295 Mob: +44 (0) 7984 599449 Email: heritage@bournemouth.ac.uk <b>BUARC</b> <i>Protecting the past, supporting the future</i>
		<b>Date</b> 12/05/2016	<b>Scale</b> 1:500	<b>Drawing No.</b> Figure 5	<b>Project</b> Geophysical Survey	