AERIAL PHOTOGRAMMETRY SURVEY REPORT

Grim's Ditch

Client

Red River Archaeology (Infra) / Fusion / HS2

Survey Report

AC-22-AER-06

Date

09/02/2022

Survey Report AC-22-AER-06: Grim's Ditch

Survey dates	02/12/2020
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1 SUMMARY OF RESULTS

An aerial photogrammetry survey of an ~260m stretch of Grim's Ditch near Kingsash in Buckinghamshire was conducted to record the ancient earthwork and associated features. LiDAR obtained from DEFRA has also been used to show the wider landscape and to compare the results with the photogrammetry.

2 INTRODUCTION

2.1 Background Synopsis

SUMO / Aerial-Cam Ltd was commissioned by Red River Archaeology (Infra) on behalf of Fusion/HS2 to conduct a photogrammetry survey of Grim's Ditch.

2.2 Site Details

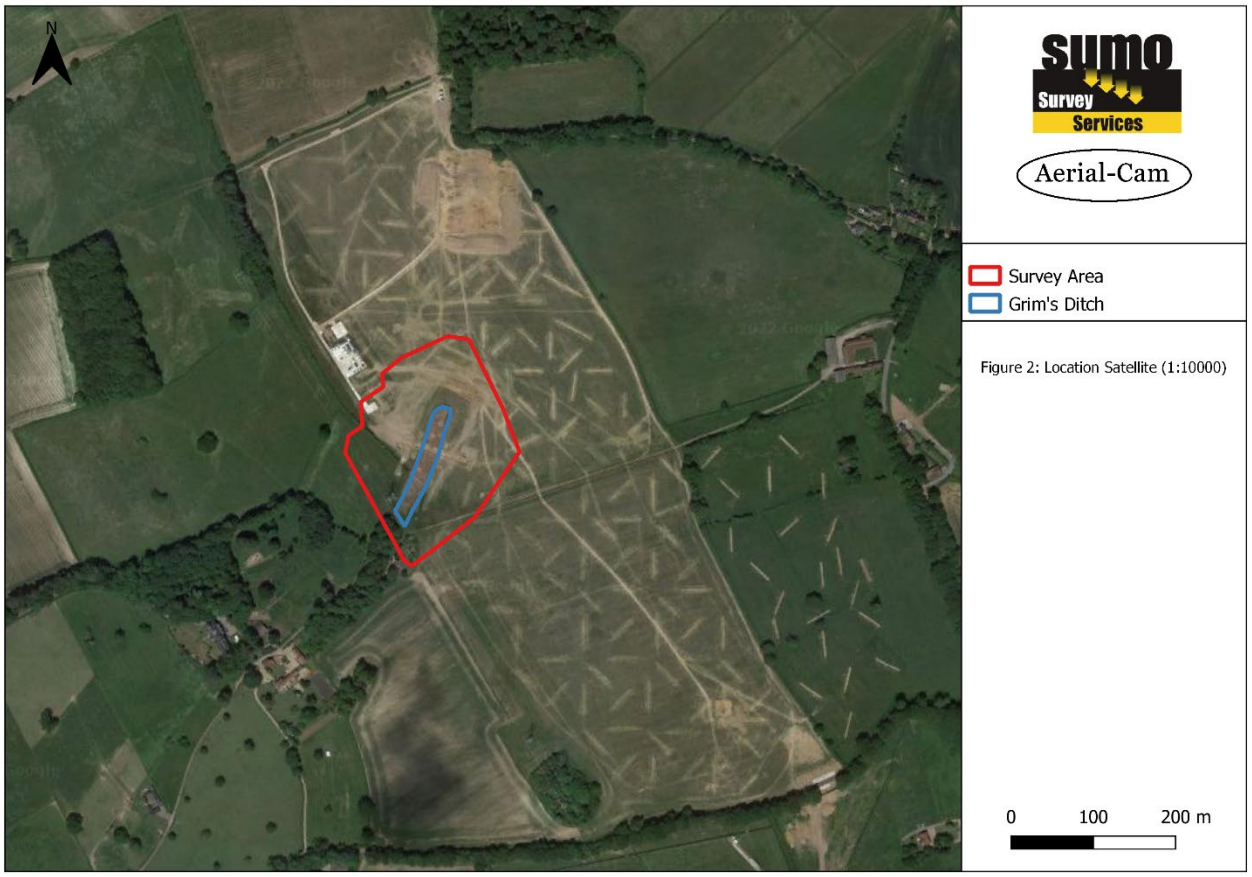
NGR	SP891036
Location	King's Lane, The Lee, Kingsash, Buckinghamshire.
HER	Buckinghamshire HER
District	Chiltern
Parish	The Lee
Topography	The site slopes down moderately from a height of 198.4m (656ft) in the east to 190m (620ft) in the west.
Current Land Use	Agriculture. Acquired by HS2
Geology	Bedrock: Lewes Nodular Chalk Formation and Seaford Chalk Formation Superficial: Clay-with-flint Formation - Clay, Silt, Sand And Gravel (BGS 2022)
Archaeology	Grim's Ditch, or Grim's Dyke, is a Bronze Age boundary ditch stretching across 18km of the Chilterns. It is the focal part of archaeological investigations taking place in this location due to the HS2 preconstruction phase. An evaluation and excavation in the field has also occurred subsequent to the excavation of Grim's Ditch.
Survey Methods	Aerial photogrammetry
Study Area	3.89

2.3 Aims and Objectives

To identify and characterise earthworks and other features of archaeological significance relating to Grim's Ditch.

2.4 Site Location

Figure 1: Site Location (1:25000), produced from Open Street Map (2022)



3 METHODS

3.1 Survey Methodology - Topographic

3.1.1 PHOTOGRAPHY

A UAS with a gimbal mounted camera was flown at 66m above ground level to obtain a spatial resolution of 1.64cm per image pixel.

3.1.2 PHOTOGRAMMETRY

Images were processed in photogrammetry software to produce a 3D pointcloud with a horizontal density of 232 points per square metre. Data were exported as a raster digital elevation model with a 6.56cm/pix spatial resolution and an orthophoto with a 0.82cm spatial resolution.

3.1.3 REFERENCING

The photogrammetric model was referenced by 8 ground control points that were distributed around the survey area. The seven points are visible in the aerial photographs and were also surveyed using high accuracy GPS to facilitate georeferencing to OS coordinates. The ground control points provide an error of 1.6cm.

3.2 Data Processing and Visualization

3.2.1 DIRECTIONAL LIGHT SHADING

Simulated illumination of the terrain surface from a chosen light source direction. This gives the viewer an intuitive sense of the 3D topography but can fail to reveal some features that are aligned with the light source.

3.2.2 AMBIENT LIGHT SHADING

Simulated illumination of the terrain surface from a continuous encompassing light source. Illumination of a given point is determined by surrounding terrain and other objects which occlude incoming light. It gives the viewer an intuitive sense of the 3D topography but can fail to reveal subtle features near much larger objects.

3.2.3 TERRAIN FLATTENING

Terrain flattening entails constructing a mathematical model that approximates broad-scale variation in the topography. This model surface is then subtracted from the original DEM to produce a new dataset that reflects only smaller scale features.

3.2.4 RELIEF VISUALIZATION TOOLBOX (RVT) PROCESSING

Automated manipulation of DEM including further flattening, smoothing and light simulation to highlight subtle features in the landscape.

3.2.5 LiDAR

LiDAR was obtained from DEFRA to illustrate the wider landscape and contextualise the study area.

4 RESULTS

Survey Area

Figure 3: Orthophoto (1:1500)

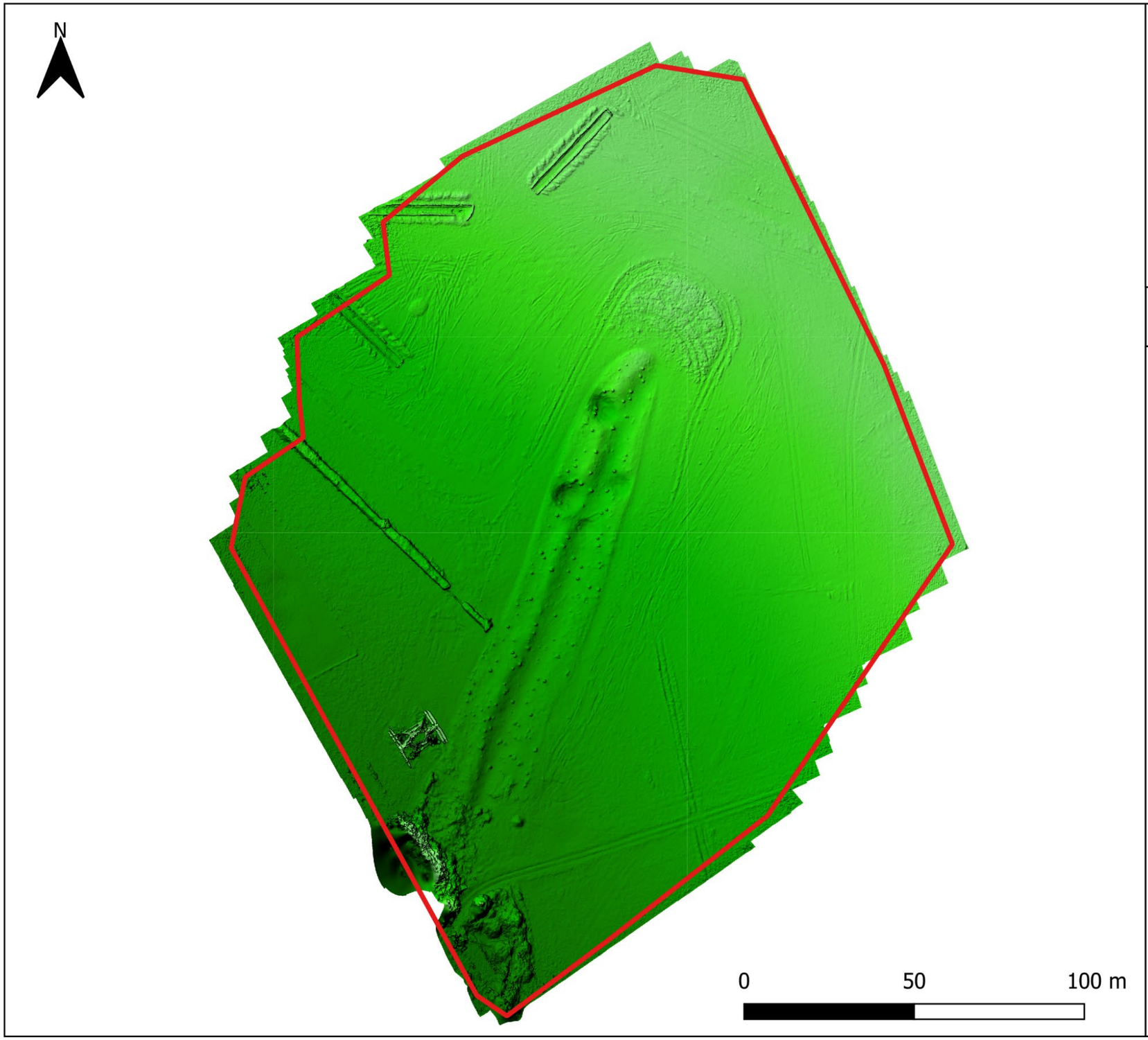


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Figure 4: DEM (1:1500)

Simulated illumination from north-west

Elevation (metres)

+198.4

+197.4

+195.7

+191.4

+181.0

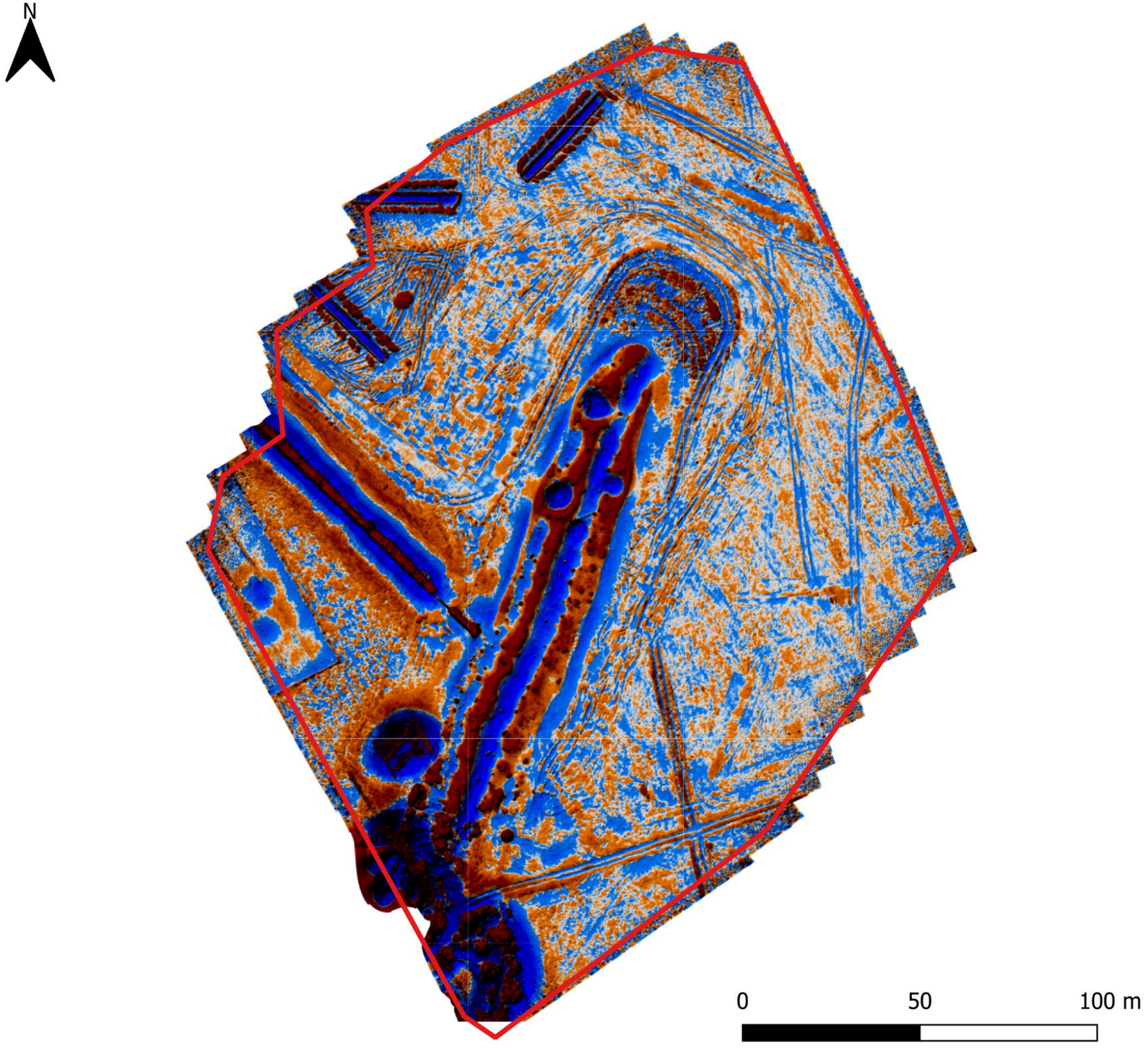

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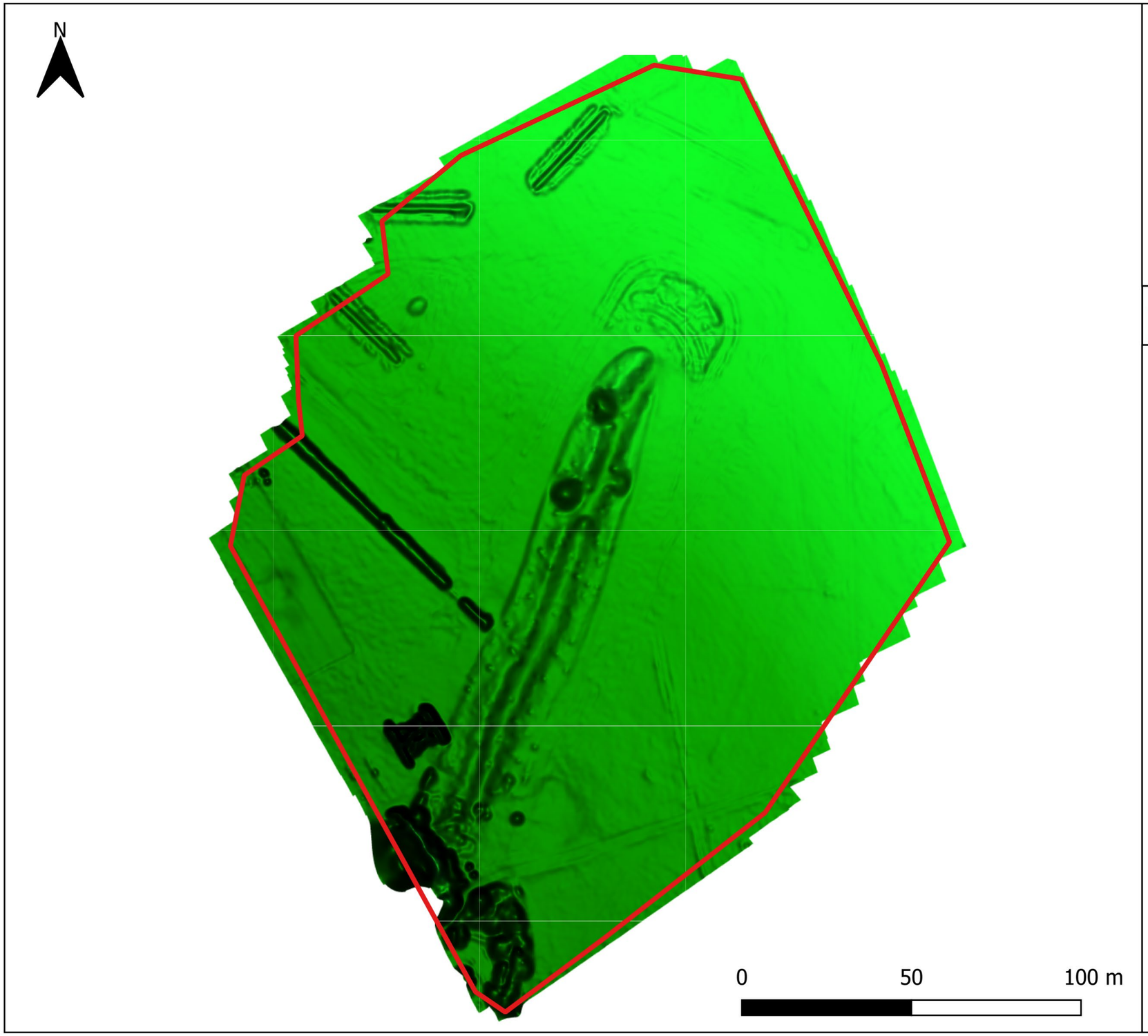
Figure 5: Flattened topography
(1:1500)

Simulated illumination from north-west

Elevation (Metres)

+0.18
+0.019
+0.0
-0.02
-0.29



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Survey Area

Figure 6: Smoothed topography (1:1500)

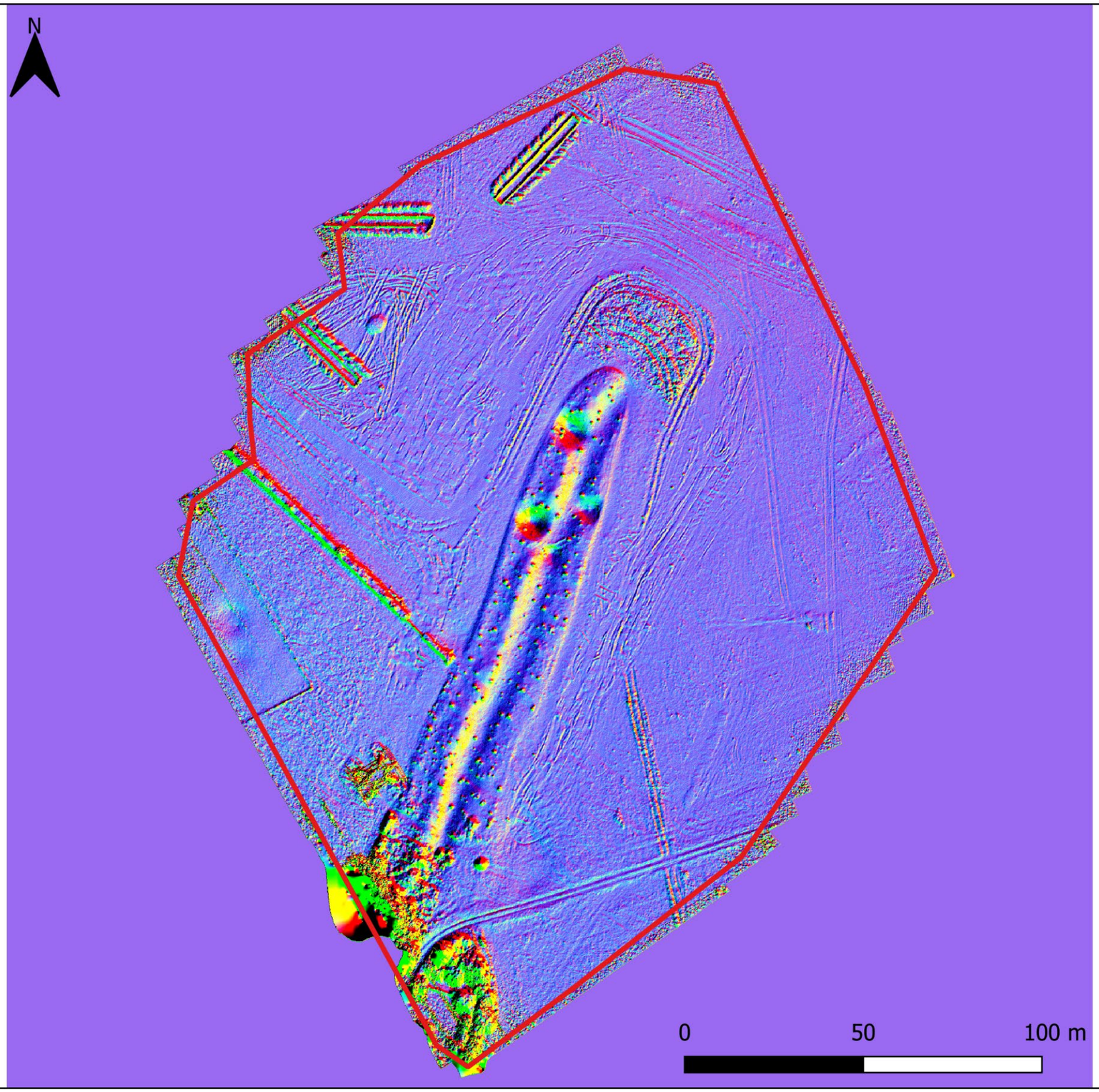
Simulated illumination from above

Elevation (metres)

+198.4

+195.7

+190.0



Survey Area

Figure 7: RVT enhanced luminance (1:1500)

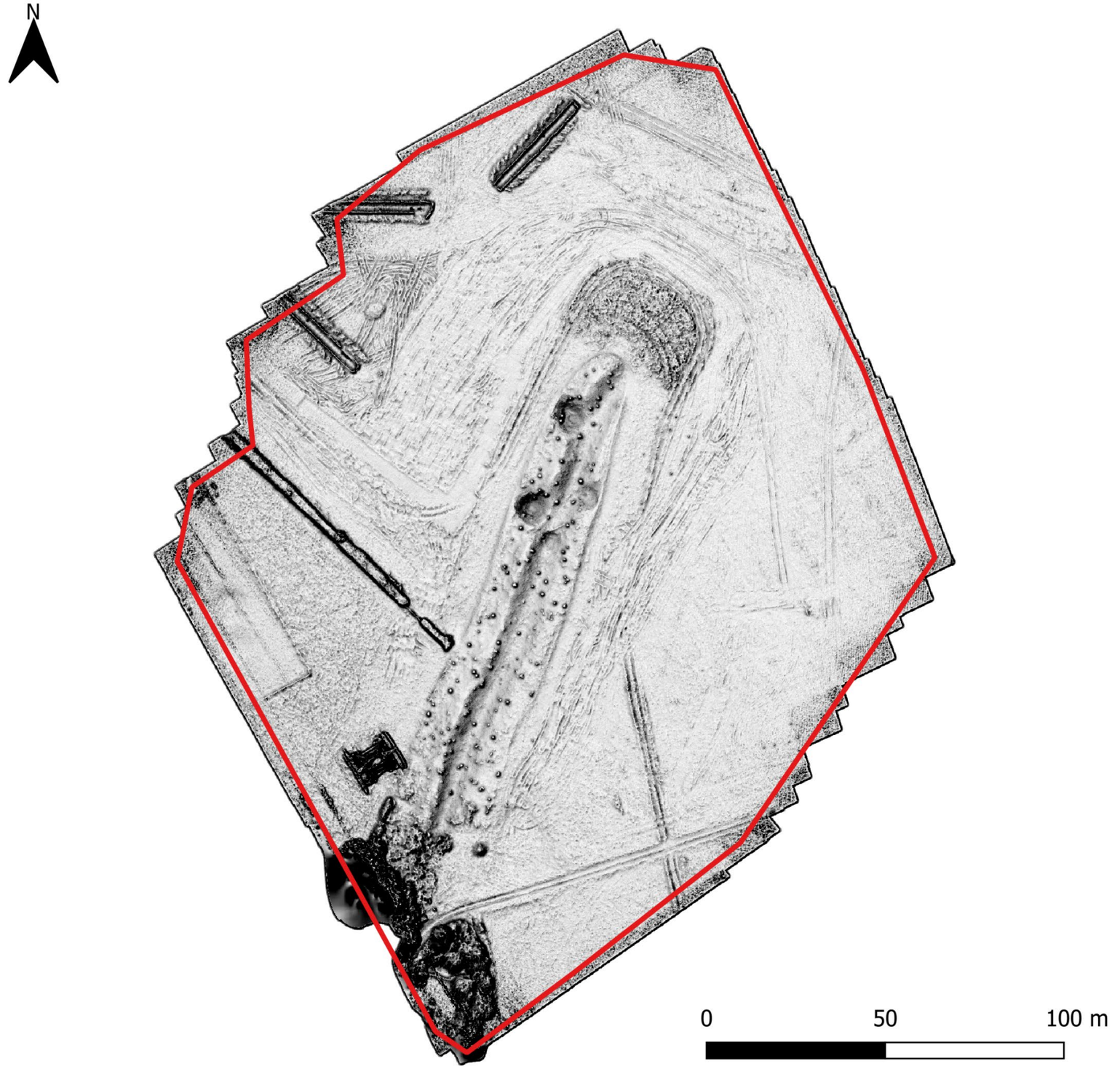


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Figure 8: RVT smoothed and flattened topography, greyscale (1:1500)

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Aerial-Cam

- Survey Area
- Bank
- Buffer
- Field Boundary
- Pit
- Tree Stump
- Evaluation Trench
- Ditch
- Farm Track
- Pylon
- Vegetation

Figure 9: Interpretations (1:1500)

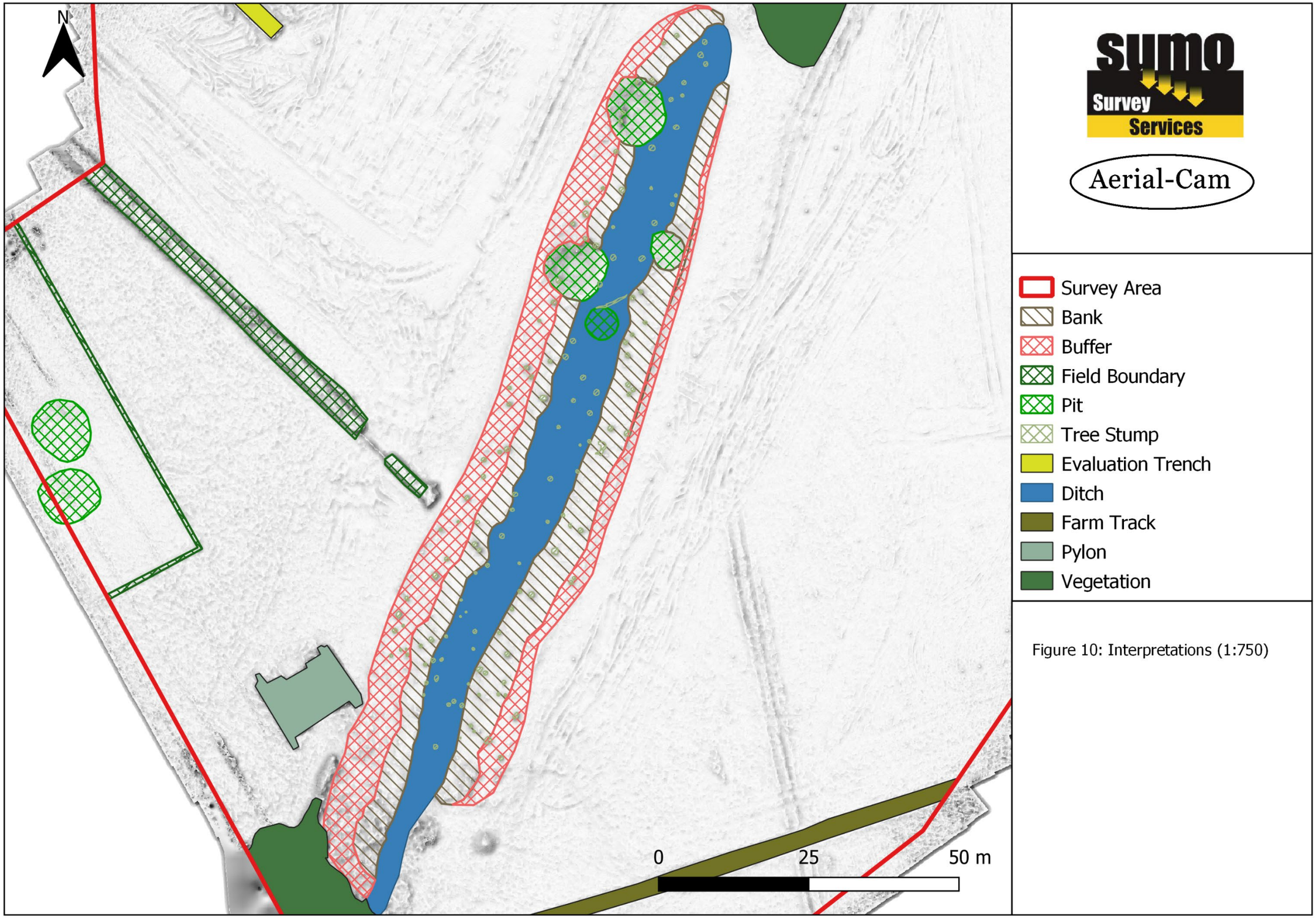

Figure 10: Interpretations (1:750)

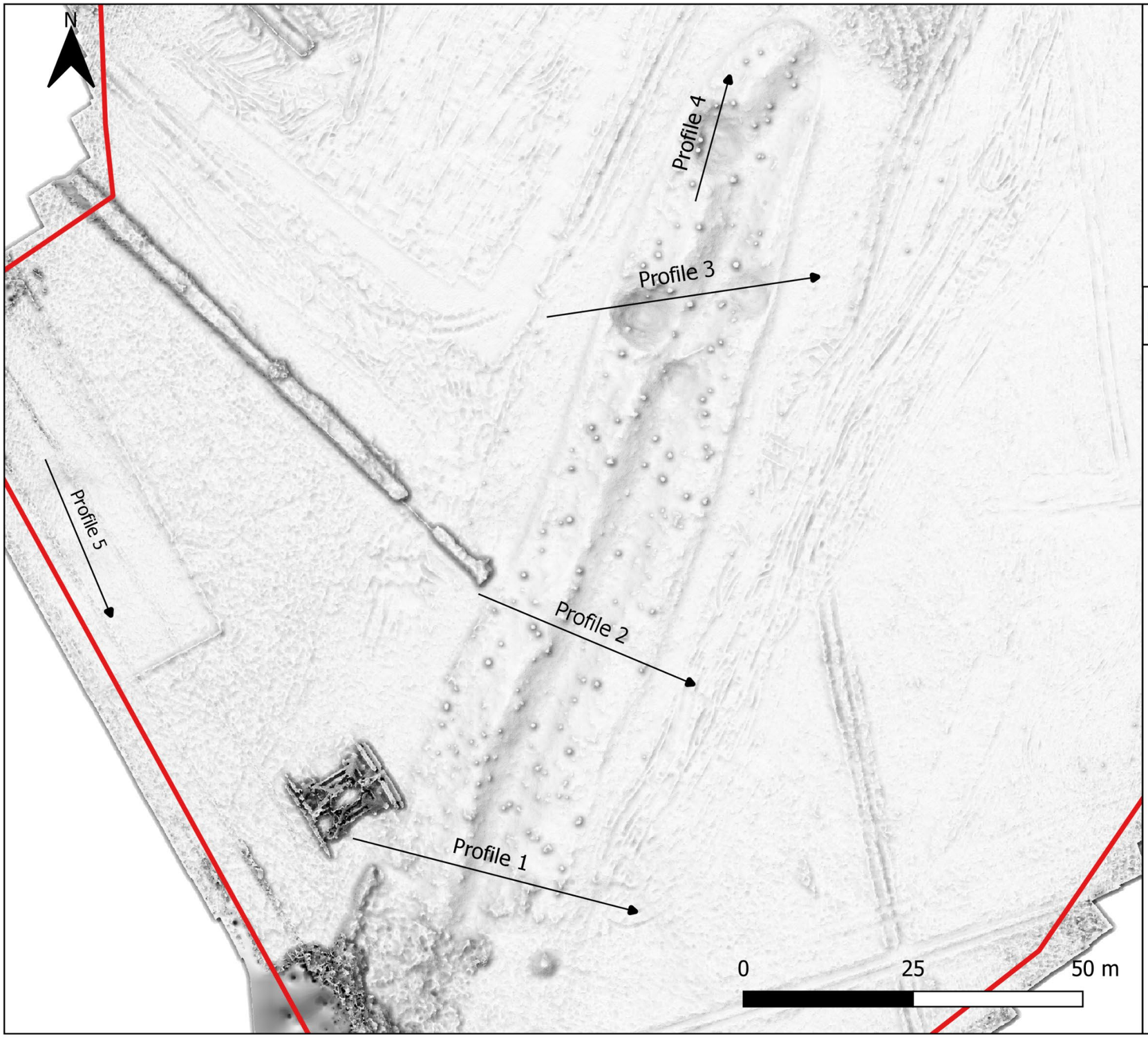

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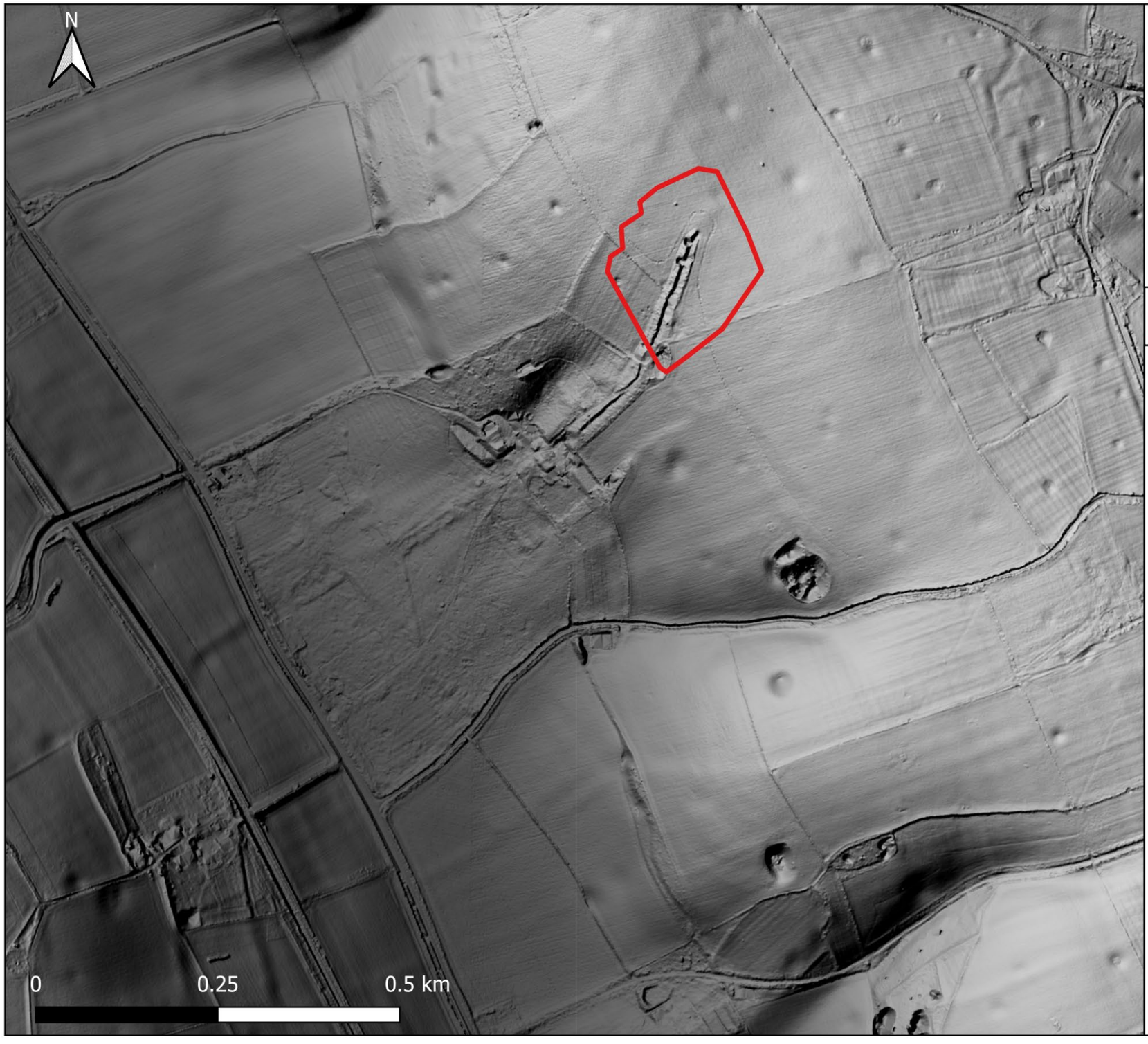
Figure 11: Profile Line Locations
(1:750)

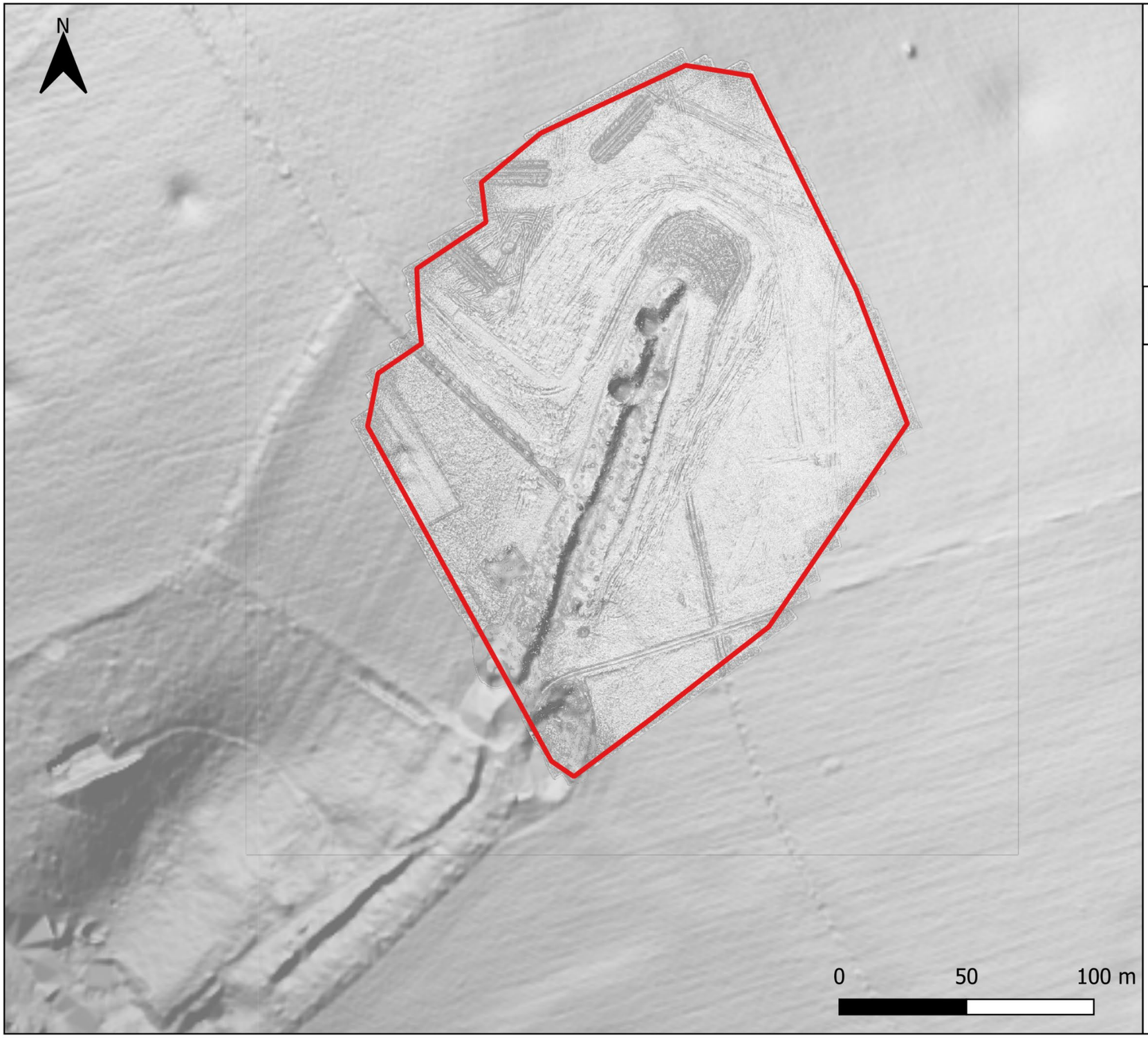


Survey Area

Figure 17: LiDAR wider landscape
DTM 1m (1:7000)

Elevation (metres)

+218.0
+198.0
+186.0
+162.0
+133.0



Survey Area

Figure 18: LiDAR (DTM 1m) overlain by DEM (6.56cm/pix) with smoothed and flattened topography (1:2000)

4.1 Monument

The monument consists of a ditch contained between a bank on either side, following an ENE-WSW alignment. In addition to the banks, there is a vegetation buffer between the monument and the ploughed field. In Profile 1 (Figure 12), **Bank 1** is ~5m wide and ~0.75m tall with steep edges on both sides. **Bank 2** is ~2.5m wide and also ~0.75m tall. Similarly it has steep edges on both sides. The ditch here is ~6m wide and 0.9m deep, with a U-shaped base and steep sides.
The buffer to the west is ~9m wide and 1m tall with a relatively flat peak. The east buffer is ~8m wide and 0.5m tall.

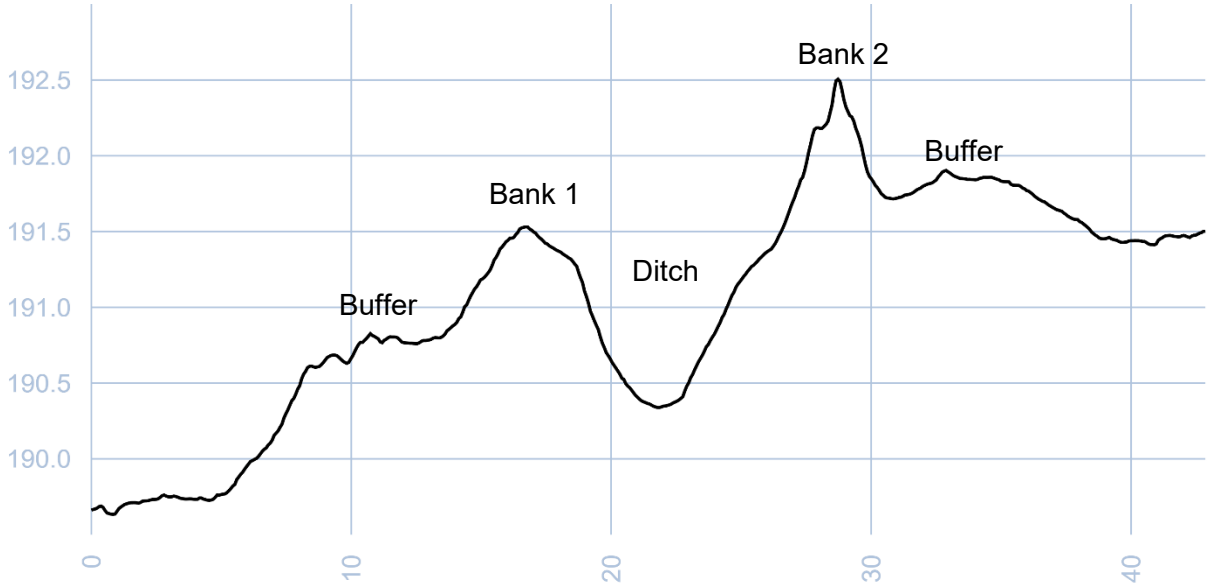


Figure 12: Profile 1 - WNW-ESE across Grim's Ditch

In Profile 2 (Figure 13), **Bank 1** is ~5m wide and ~0.3m tall though its boundary with the buffer is more diffuse here. **Bank 2** is ~6m wide and 0.6m tall, with a shallower dip on the inside before sharply dropping into the ditch. The ditch is ~10.5m wide and ~1.1m deep, with steep edges.

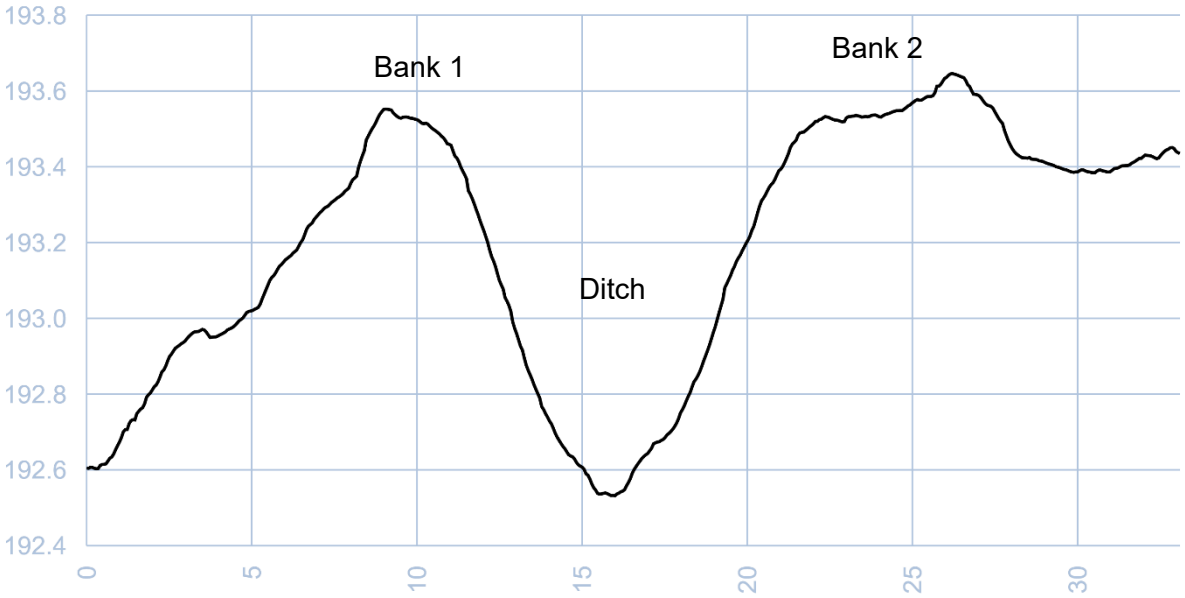


Figure 13: Profile 2 - WNW-ESE across Grim's Ditch

In Profile 3 (Figure 14), **Bank 1** has been completely truncated by **Pit 1. Pit 1** measures to ~2.1m deep, ~10m in diameter at the top and ~1.5m in diameter at the base. It has very steep sides and a U-shaped base. **Pit 2** is smaller with dimensions of ~1.4m in depth and a diameter of 6.5m. The outer slope is moderately steep whereas the inside slope is lost to the ditch. Here, the ditch is shallower reaching a depth of ~0.42m and width of ~7.8m. **Bank 2** is also shallower here, measuring a height of ~0.1m and diameter of ~1.5m.

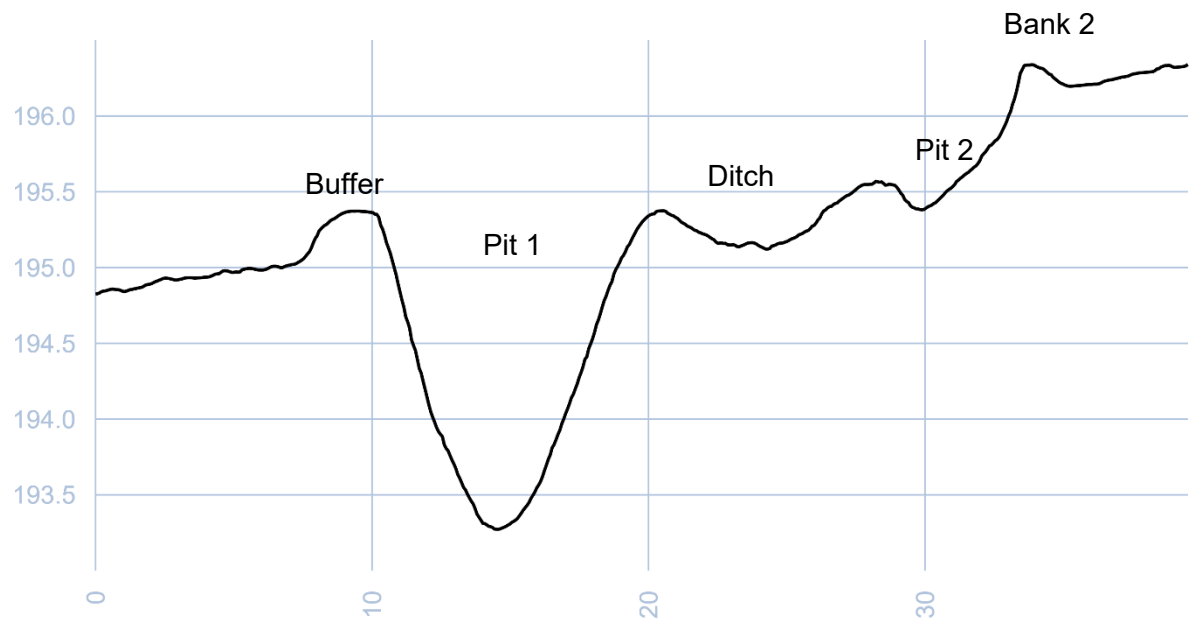


Figure 14: Profile 3 - WSW-ENE across Grim's Ditch and pits

Pit 3 has a diameter of ~11.5m and a depth of ~2.75m (Figure 15: Profile 4).

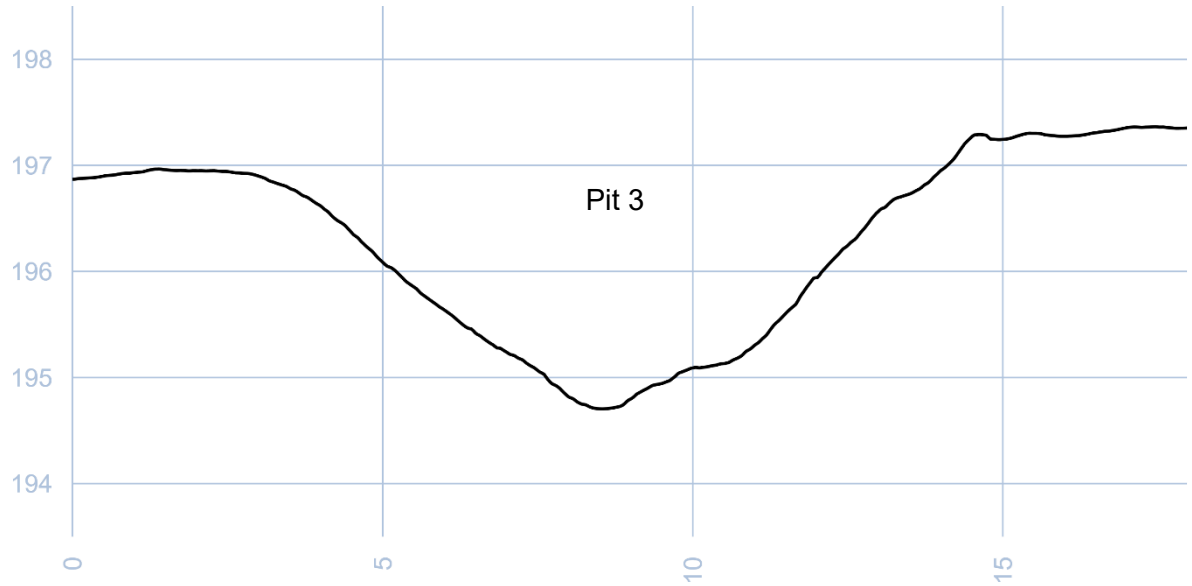


Figure 15: Profile 4 - NNE-SSW through pit

To the west of Grim's Ditch are two shallower, more diffuse pits. **Pit 4** has a depth of ~0.26m and a diameter of ~14m. **Pit 5** has a depth of 0.4m and diameter of 7.4m.

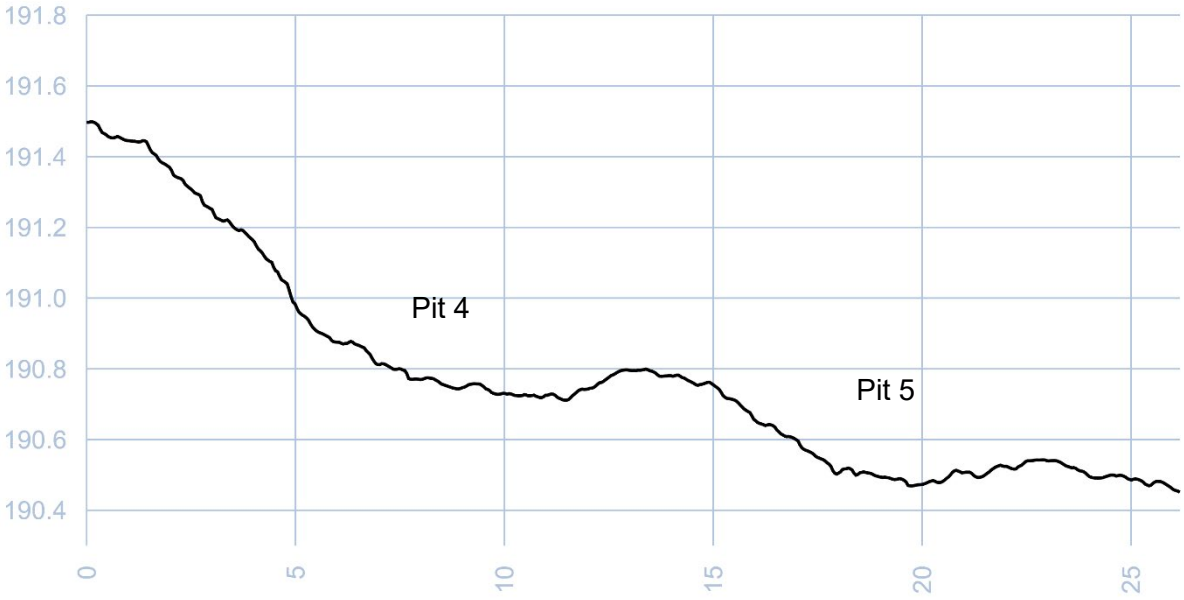


Figure 16: Profile 5 - NNW-SSE through shallow pits

Pits 1 to **3** likely relate to the machine excavation of Grim's Ditch and the removal of trees. It is unclear what **Pits 4** and **5** may relate to.

5 LIMITATIONS

Due to extensive ploughing and machine tracking over the area surrounding the monument, additional earthworks may have been lost or otherwise not detected by the survey. It is possible that other features of archaeological significance exist in this area, including the continuation of the ditch heading northwards.

6 CONCLUSION

The aerial survey has successfully mapped this portion of Grim's Ditch and identified the features that comprise the monument including the ditch and banks, as well as excavation pits/tree throws, ploughing buffer, and shallow pits in adjoining field.

7. REFERENCES

British Geological Survey – Geology of Britain Viewer
http://mapapps.bgs.ac.uk/geologyofbritain/home.html

DEFRA Survey Data Download
https://environment.data.gov.uk/DefraDataDownload/?Mode=survey

Historic England Photogrammetric Applications for Cultural Heritage
https://historicengland.org.uk/images-books/publications/photogrammetric-applications-for-cultural-heritage/heag066-photogrammetric-applications-cultural-heritage/