GeoArch
Report 2001/04

Geophysical Survey of the Roman Villa, Ely, Cardiff

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Abstract

An area of approximately 4 hectares including the site of Ely Roman Villa was surveyed using magnetic gradiometry and ground resistivity.

The ground resistivity survey was undertaken under non-ideal conditions, with standing surface water on parts of the site, but none the less gave good resolution of the early ditched enclosure surrounding the villa. Although uncertainties remain, this enclosure appears to have had a trapezoidal shape of approximately 100 x 120m, with three lines of ditches on the sides away from the former stream. Evidence exists for the inner ditch continuing for at least part of the side adjacent to the stream, but the outer ditches on this side, if they existed, have been destroyed during the modern canalisation of the stream. The later, smaller, enclosure described by Wheeler, is also clearly seen in the resistivity survey, together with evidence for its internal bank. The villa itself was not well resolved by the resistivity survey, but some of the walls are clear. The resistivity survey provides some suggestion for additional masonry structures in the unexcavated SE part of the enclosure.

The resistivity survey produced rather few ancient features outside the enclosure. Only one substantial compound feature to the north was well imaged; other visible surface suggestions of ditches attached to the enclosure were without expression in the resistivity results.

The resistivity survey is complicated by the detailed resolution of the field markings for the sports pitches. Not only are the current pitch markings clearly resolved, but also previous generations, often on slightly different alignments. The sports pitch alignment is also close to the alignment of closely-spaced negative ENE-WSW resistivity anomalies over much of the site. These are interpreted as being associated with the levelling of the site for use as a sports ground. The survey also helps delineate the former position of the braided channel of the Caerau Brook, together with modern works to drain the fields and culvert the brook.

The magnetic gradiometry gave clear indications of the positions of modern services, drainage and associated features, but resolved little of the buried archaeology. There was no evidence for the survival of significant iron slag dumps or metal working furnaces near building 2 as recorded by early excavators, but a large magnetic anomaly was recorded at the point marked by the Ordnance Survey as “Roman Steel Furnace”, to the SE of the late enclosure.

The villa site, with it buildings ranged around a quadrilateral enclosure with multiple ditches begs comparison with sites such as Whitton, but the internal area of Ely (0.65 ha) is over twice that of Whitton (0.30 ha), the enclosure is more regular, and it apparently lacks the substantial internal bank of the Whitton enclosure. At Whitton, the earthwork features probably date from the Middle or Late Iron Age, with the roundhouses replaced by rectangular stone buildings in the 2nd century AD. Comparison could also be made with more distant sites, such as Frocester Court, Gloucestershire, where an irregular double-ditched enclosure of 0.29 ha survives from the Middle Iron Age, but gains Romanised buildings in the 2nd century AD, and is then replaced by a 2.8 ha double ditched enclosure containing a villa in the late 3rd century. Wheeler’s excavations did produce tantalising evidence for a pre-masonry phase, but of 2nd century date, immediately preceding the construction of the modest villa; he found no evidence for Iron age occupation.

Ely therefore seems to fit into a regional tradition of quadrilateral ditched enclosures, but is likely to represent a Roman, rather than pre-Roman, foundation.

Background and previous studies

The site lies on a rather flat, poorly drained, valley floor across which the Caerau Brook formerly meandered. The area was part of Cardiff Racecourse, which is shown in 1878 as passing over the eastern part of the site, before being expanded further to the east by 1922. The Caerau Brook had been canalised by 1878, presumably as part of the creation of the racecourse. The racecourse was abandoned by WWII, when an anti-aircraft gun battery lay just to the west of the site. The post-war period saw the large-scale development of the Ely suburb of Cardiff. The development included the culverting of the brook and the conversion of the former racecourse into the Trelai playing fields.

The villa and its enclosure survive as a raised earthwork complex. It was this mound which attracted archaeological attention at the end of the 19th century. The mound was trenched by J. Storrie of the Cardiff Naturalists' Society in 1894 (Storrie 1894a, 1894b). He hoped to find a prehistoric “lake village”, but instead revealed that site to be Roman. His report is supplemented by a later report by J. Ward of the National Museum of Wales (Ward 1917). The site was more fully excavated by Wheeler (Wheeler 1921, 1922). A summary is given in the RCAHMW (1976) volume, which repeats Wheeler's interpretations in an uncritical overview. In none of the later reports is much indication given of the proportion of the site actually dug.

The dating evidence for the site is extremely poor, with a total of only six coins. Wheeler's interpretation was of construction of the villa in the first half of the second century, with two buildings (I and II), lying within a ditched enclosure created by canalising the stream. A bath house was added to the south of building II, apparently soon after the original construction. Wheeler records that some of the earliest pottery from the site came from a burnt area associated with "hut floors” SE of building I, suggestive of either a pre-masonry building occupation phase, or ephemeral structures from the construction period.

The bath house was converted to other uses, and the hypocausts of building I abandoned, probably before the end of the second century. Wheeler, hints that a phase of abandonment may have intervened before reconstruction.

A further reorganization of the site took place possibly late in the third century. According to Wheeler, the original northern section of building II was demolished and levelled, a ditch was dug outside the line of the earlier boundary ditch to the west and north of the site, and a new ditch dug around the west and south of building 1, forming a smaller compound. The ditch spoil was placed on the inside of the ditch forming a low bank surrounding the compound, and which appears to have had a wall on its crest. This compound has a markedly defensive air to it.

The site has many strange features, not least of which is its situation on low ground adjoining the stream. Wheeler argued that it was this low-lying situation which made the hypocausts untenable. The RCAHMW report restates the earlier view that the situation was associated with defence and privacy. It seems equally likely that the site demonstrates the pressure on land, and the need to reclaim marginal ground, as evidenced, for instance, by the reclamation of the Wentloog levels east of Cardiff.

One component of activity on the site appears to have been iron making, though the significance of this is hard to determine from the published accounts. Most of the significant activity seems to have been concentrated around the northern end of building II, with a "furnace" discovered in 1894 probably lying within (or within the area of) room 12 of building II (although Wheeler states room 14). Wheeler summarizes by suggesting that “the main industry was apparently iron-working”.

Methods

Survey area: the area of the geophysical survey was 4.4 hectares (200m N-S, 220m E-W) which was divided into 110 20m grid squares. Of that overall area, 98 squares were surveyed using magnetic gradiometry and 77 using ground resistivity. A wider area encompassing the entire area of the recreation fields was surveyed topographically.

Coordinate system: the site grid was laid out along the national grid orientation, with site grid (0,0) at NGR [314620 176020]. Site coordinates will be used for brevity in this report. Conversion can be obtained by the formulae E = x + 314620, N = y + 176020 (where E, N are NGR eastings and northings; x,y are site coordinates).

Survey techniques: the geophysical survey employed three techniques.
Ground resistivity was measured over most of the site using a Geoscan RM15 instrument with a twin electrode configuration of 0.5m spacing. A small area of the site was surveyed with a Geoscan RM4 with DL10 logger, with a similar electrode configuration. The survey was undertaken in 20m grid squares with 0.5m sample spacing and 1m traverse interval.
Magnetic gradiometry was undertaken with a Geoscan FM36. The survey was undertaken in 20m grid squares with 0.5m sample spacing and 1m traverse interval.
Magnetic susceptibility was surveyed using two Bartington MS2 instruments with MS2D search loop. Unfortunately both instruments failed and this survey had to be abandoned.
In addition, *Topographic survey* of the area including the site was undertaken using Topcon EDMs.

Results

The resistivity survey data are mainly of high quality, with just a few minor problems associated with surface water on the southern part of the site. Features including the drainage systems, sports pitches and Roman enclosure are well imaged; the structures internal to the enclosure less well so. The magnetic gradiometer survey is also of reasonable quality, and again the drainage features are well imaged. The archaeological features associated with the villa and its enclosure were not well imaged by this technique, apparently through a lack of susceptibility contrast coupled with an accumulation of modern ferrous rubbish within the rough grass of the topographically featured part of the site (the scheduled ancient monument). In particular the lines of the ditches appear to have been imaged through enhanced rubbish accumulation compared with the adjacent banks. One modern addition to the magnetic noise is debris from burnt out stolen cars, which is abundant across much of the site. The fine debris from one recently burnt car remained partially in-situ, and was well imaged by the magnetic survey.

Drainage

The area surveyed straddles the line of Caerau Brook. Sinuous resistivity highs correspond to features visible on the December 1946 aerial photographs as abandoned relicts of the course of the brook prior to its canalisation. The precise nature of the geophysical anomalies is unclear: to the south of the later conduits, the stream is imaged as a low resistivity braided channel, with high resistivity banks and “islands”, whereas to the north of the conduits a single high resistivity feature is seen, which may either be the north bank, or an infilling of the channel itself.

The brook had been canalised by the time OS map 1878 (1st edition). The subsequent (post-WWII) placement of the brook into underground pipes adds to the complex nature of the features in this area. The position of the two conduits in the western part of the area is marked by a pair of narrow linear features with a resistivity of about 30 Ωm within a broad swathe with a negative anomaly at about 18 Ωm. The two

conduits both have a very strong magnetic signature. The northern of these two conduits appears to be on the line of the earlier canalised brook. Between x=108 and 130 the northern conduit appears to swing to join the southern. To the east of this point the northern feature continues as an anomaly of reversed resistivity, being a negative anomaly, with a positive anomaly along its northern margin. This section of the feature may represent a change in the type of conduit, an older conduit, or even simply the filled course of the canalised brook.

Modern sports pitches

The sports pitches, both those currently active and those previously on the site, are imaged through narrow negative resistivity anomalies. Such features have been observed on other sites and attributed to the former use of (amongst others) lime and caustic soda in the preparation of the line markings. These strongly ionic chemicals remain present in the ground below the position of the line and significantly enhance conductivity. It is not clear whether the modern paint-based line markings have a similar effect. The markings indicate that the pitches were formerly much closer to the enclosure to both the east and west than at present.

Other ENE-WSW linear features

Almost the entire northern part of the site outside the current rough grass area (and locally within the eastern part of that area) bears marked negative resistivity anomalies trending ENE-WSW. These features are strongly suggestive of a process of land improvement, probably involving a deep plough. The encroachment onto the enclosure in the east suggests this process may have been associated with the construction of the racecourse (which originally passed between the villa and the former hedgeline to the east) rather than of the playing fields.

Early excavations

Ward comments that in the first part of the investigation of 1894 Storrie dug 81 holes in the site! Of this early activity only the long trench, with its lateral expansions over the villa buildings, is clearly located in the subsequent report. This trench is visible in the ground resistivity results, despite the subsequent excavations of Wheeler over much of the same ground. Other rather similar features are also seen in the resistivity data (for instance parallel to Storrie's trench, but across the northern part of building 1), but there is no independent evidence whether these additional features are other examples of Storrie's trenches.

Villa and other features internal to the enclosure

Some of the internal walls of building 1 were imaged by ground resistivity, but with fairly poor contrast of about +7-9 Ωm. The northern section of building 2 was poorly imaged. The southern part of building 2 (the bath house) was partly imaged by ground resistivity, and the stoke hole area was imaged by the gradiometry. Areas outside the east of the bath-house showed slight magnetic features.

Both magnetometry and resistivity gave suggestions of structures in the SE quadrant of the enclosure, but the anomalies lack clarity and cannot readily be interpreted in terms of individual buildings. The resistivity anomalies include both positive and negative linear features. The magnetometry suggests an approximately rectangular feature.

Linear features, particularly visible in the resistivity survey, extend southwards from the road identified by Wheeler, and provide evidence for the likely extension of this road towards the south.

A very strong positive magnetic anomaly (off-scale with magnetometer set to a range of +/-204nT), 5m in diameter, on the outer face of the later enclosure bank near its SE angle lies close to the position of the

"Roman Steel Furnace" marked on early 20th century Ordnance Survey maps. The source of the information regarding this supposed furnace is not clear; Ward (1917) indicates that it does not figure in the notes of Storrie's 1894 excavations. Subsequent authors have ignored the OS feature, apparently believing it to have been in error. The new geophysical data suggest that there might really be a furnace at this location. The position of the feature apparently on the outer face of the bank might suggest that, if it is a furnace, it is possible that it is post-Roman in age. The position of the magnetic anomaly coincides with a strong positive resistivity anomaly with a right-angled corner to the north.

Enclosure

To the north, the inner enclosure ditch shows as a feature about 5m wide (with resistivity down to 37 Ωm), the middle ditch about 4m wide (to 45 Ωm), and the outer 1-2m wide but with discontinuous response (down to 48 Ωm). The inner and middle ditches are separated by bank 4.5m wide, typically with a resistivity of 140 ohm/m, but locally up to 210 Ωm; the middle and outer ditches are separated by a less clearly marked feature, up to 205 Ωm in the NW corner, but centrally not above the external background of 70-90 Ωm.

On the west side of the enclosure the 3 ditches are very clear. This is a very important observation, and the ditches are visible as ground resistivity anomalies even outside the featured area, demonstrating that the features are indeed buried ditches and not merely the effect of wet hollows between the upstanding banks. The inner ditch has a resistivity down to 30 Ωm and is 4m wide, the inner interval ranges into the low 70s Ωm on its inner edge and is 4m wide, the middle ditch ranges down to 30 Ωm and is 5m wide, the outer interval is 4.5m wide and of resistivity up to 70 Ωm, and the outer ditch is 2.5m wide with resistivity down to 31 Ωm.

To the east of the enclosure the ditches are much less clearly imaged by ground resistivity. The outer ditches are not seen for a distance of 30m in from the NE angle. The inner ditch is 5m wide, narrowing to 3m south of the late enclosure, and has a resistivity of 20-30 Ωm, the inner interval is 5.5m wide, the middle ditch 2m wide, the outer interval 4m and the outer ditch 2m wide. The inner ditch can be seen to turn westwards along the south side of the enclosure, before being destroyed by the modern canalised stream about 25m west of the SE angle of the enclosure. The southeast section of the enclosure is also marked by a slight negative feature parallel to, and about 2m inside, the inner ditch. This feature could indicate there was a palisade internal to the ditch system.

The area of the villa has a background resistivity of 50-60 Ωm, with the late bank up to 140 Ωm, and the late ditch down to 37 Ωm.

Discussion

The interpretation of the villa and its enclosure differ in some significant respects from that of Wheeler. The most significant difference is the recognition of another ditch between the two recognised and sectioned by Wheeler. The key area enabling this interpretation is on the west of the enclosure where the three parallel negative resistivity features continue southwards away from the featured area; they cannot therefore be the product of damper ground between the upstanding mounds. The triple-ditched enclosure is so regular as to suggest a deliberate, single phase, construction, rather than the inner and outer ditches being of different periods as suggested by Wheeler. The inner ditch on the north may have been abandoned first (and encroached upon by Building 1), with the outer ones continuing in use and the spoil from redigging spread over the site of building 2, but it seems likely that all three ditches formed part of the original plan. The east side of the enclosure is problematic. The northeast corner appears to have been obscured by later works, and the outer two ditches are only visible for part of the length of the side. The later enclosure follows the outer ditch to the north, but the inner ditch to the east. Cartographic evidence

shows that the line of the racecourse initially cut the enclosure on its east side, and it is likely that the lack of imaging of the ditches on this side is related to levelling at that time.

Wheeler attributed the siting of the villa to a position within a bend of Caerau Brook. There are several problems with this interpretation. Firstly the geomorphological features interpreted by Wheeler as the early stream channel, which were still visible in the 1946 aerial photograph and which have been partially imaged by ground resistivity, surely represent the last channel position before canalisation in the 19th century, and are therefore extremely unlikely to bear directly on any channel position in Roman times. Secondly, the connection between the ditches and stream to the east of the enclosure marked by Wheeler is not borne out by the geophysical data, and it seems Wheeler may have confused the hollow of the large drain with the stream course. The ground resistivity survey shows the westwards turn of the inner ditch at the SE angle of the enclosure, providing evidence that the enclosure was complete on all sides, with the stream either flowing through the outer ditches on the south side, or lying farther to the south.

The villa site, with buildings ranged around a multiply ditched quadrilateral enclosure begs comparison with sites such as Whitton, but the internal area of Ely (0.65 ha) is over twice that of Whitton (0.30 ha), the enclosure is more regular, and it apparently lacks the substantial internal bank of the Whitton enclosure. At Whitton, the earthwork features probably date from the Middle or Late Iron Age, with the roundhouses replaced by rectangular stone buildings in the 2nd century AD. Comparison could also be made with more distant sites, such as Frocester Court, Gloucestershire, where an irregular, elongate, double-ditched enclosure of 0.29 ha survived from the Middle Iron Age, but gained Romanised buildings in the 2nd century AD, and was then replaced by a 2.8 ha double ditched enclosure containing a villa in the late 3rd century. Wheeler's excavations did produce tantalising evidence for a pre-masonry phase, but apparently of 2nd century date, immediately preceding the construction of the modest villa; he found no evidence for Iron age occupation. The large size and regularity of the enclosure strongly suggests it is not an enclosure of Whitton-type, but rather part of the later, Roman, tradition of slightly larger ditched enclosures.

No evidence was forthcoming from the magnetometry for substantial surviving evidence for the iron making described by Wheeler as the site's major industry. The survey does, however, add to the confusion over the early 20th century Ordnance Survey mapping of "Roman Steel Furnace (Site of)" near the SE corner of the later small enclosure. Ward (1917) commented that despite the appearance of this feature on the survey's maps he could not "find any reference to this by Mr Storrie". Later descriptions (Wheeler 1921, 1922; RCAHMW 1976) omit any mention of this apparent furnace, and the assumption seems to have been that this was an error. The gradiometer survey does, however, show a strong positive anomaly, of 5m diameter, at exactly this point, apparently lying on the outer face of the late enclosure bank. Three smaller anomalies also lie along the outer face of the bank in the western part of its circuit, but these are of lower magnitude and more complex and so may represent ferrous rubbish. If this substantial anomaly is indeed a furnace, it may predate the late bank, but since such iron smelting furnaces are commonly built into banks, it could equally represent a later (post-Roman?) feature.

Future Work

This new survey adds considerably to the understanding of this site but several major question remain:

1. *when was the initial occupation of the site?*
Wheeler's excavations hinted at an early 2nd century pre-masonry occupation, but there appears to have been very little excavation outside the masonry buildings.

2. *what date is the "late enclosure"?*
The geophysical survey appears to confirm the plan of the late ditched enclosure as envisaged by Wheeler. The dating of the enclosure rests on a coin of c. 270 below the "rampart" of the late enclosure, and less directly on Wheeler's assumption that the late enclosure was accompanied by the infilling of the inner ditch N of building 1 (with debris from the demolition of building 2?) over which room 10 of building

1 was built, and that the latest floor in room 2 yielded a coin of 320-4. However, given the paucity of the coin evidence, the ceramic evidence might be reviewed in the light of modern understanding. The stratigraphic evidence does not seem to preclude the late enclosure being significantly later.

3. *what is the age and status of the iron working on the site?*

Although the early excavators recorded substantial amounts of slag in and around building 2, the significance of this is uncertain. The presence of manganiferous iron ore and slag hints at the exploitation of bog ore, but there is no evidence (from excavation or geophysical survey) for the large quantities f slag that would be expected if this was on the industrial scale proposed by Wheeler. The possible existence of a furnace under the SE corner of the late enclosure could be tested by trial excavation.

4. *what was the economic basis of the site?*

The suggestion that iron making was a significant component of the economic basis of the site does not appear to be upheld by the geophysical survey. The key to understanding the site may lie in the structures which appear to lie in the SE quadrant of the enclosure. Detailed resurvey of ground resistivity of this quadrant with multiple electrode spacings under more favourable ground conditions might help shed light on these structures.

Acknowledgments

The survey was carried out by kind permission of the owner, the Council of the City and County of Cardiff, and through authorisation by CADW on behalf of the National Assembly for Wales (under section 42 of the Ancient Monuments and Archaeological Areas Act, 1979). The survey was undertaken as an exercise for module HS2314 “Surveying and Prospecting” of the Archaeology Section, Cardiff University. The project was directed by Dr Tim Young, with the assistance of demonstrators (assistant geophysicists) Mr N Blackamore and Ms R Hart.

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Figures

Figure 1.
Ground Resistivity: Direct output of data from Geoplot. Data clipped at 0Ω measured resistance (black) and 140Ω measured resistance (white).

Figure 2.
Ground Resistivity: Kriged dataset output from Surfer. Data clipped at 0Ω measured resistance (black) and 90Ω measured resistance (white).

Figure 3.
Ground Resistivity: Kriged dataset output from Surfer. Shaded relief image, illuminated from NW.

Figure 4.
Ground Resistivity: Kriged dataset output from Surfer. Shaded relief image, illuminated from NE.

Figure 5.
Magnetic gradient: Direct output of data from Geoplot. Data clipped at +15nT (white) and –15nT (black).

Figure 6.
Aerial photograph. RAF 4/12/1946.

Figure 7.
Interpretation. Features of 19th and 20th century age.
Grey, old stream channel; mid blue, culverts and canalised stream with disturbed area in pale blue and inspection covers in red;
Black, old fence lines;
Green, ditches and drains (non-magnetic);
Red, ditches and drains (magnetic);
Purple, sports pitches with goal posts in red;
Brown, limit of rough grass with benches in black;
Pink area, roadway;
Pink narrow lines, deep ploughing?;
Orange, Storrie's 1894 trenches (after Ward 1917);
Thin brown, race course in 1878 (after OS 1st Edition).

Figure 8.
Interpretation. Features of Roman age.
Pale grey, enclosure ditches and other negative resistivity features;
Black, buildings (after Wheeler);
Pink, buildings (from geophysics);
Dark grey, roads (after Wheeler);
Brown, road? (from geophysics);
Yellow, slight magnetic features;
Red, strongly magnetic features;
Green, negative resistivity features;
Orange, positive resistivity features.

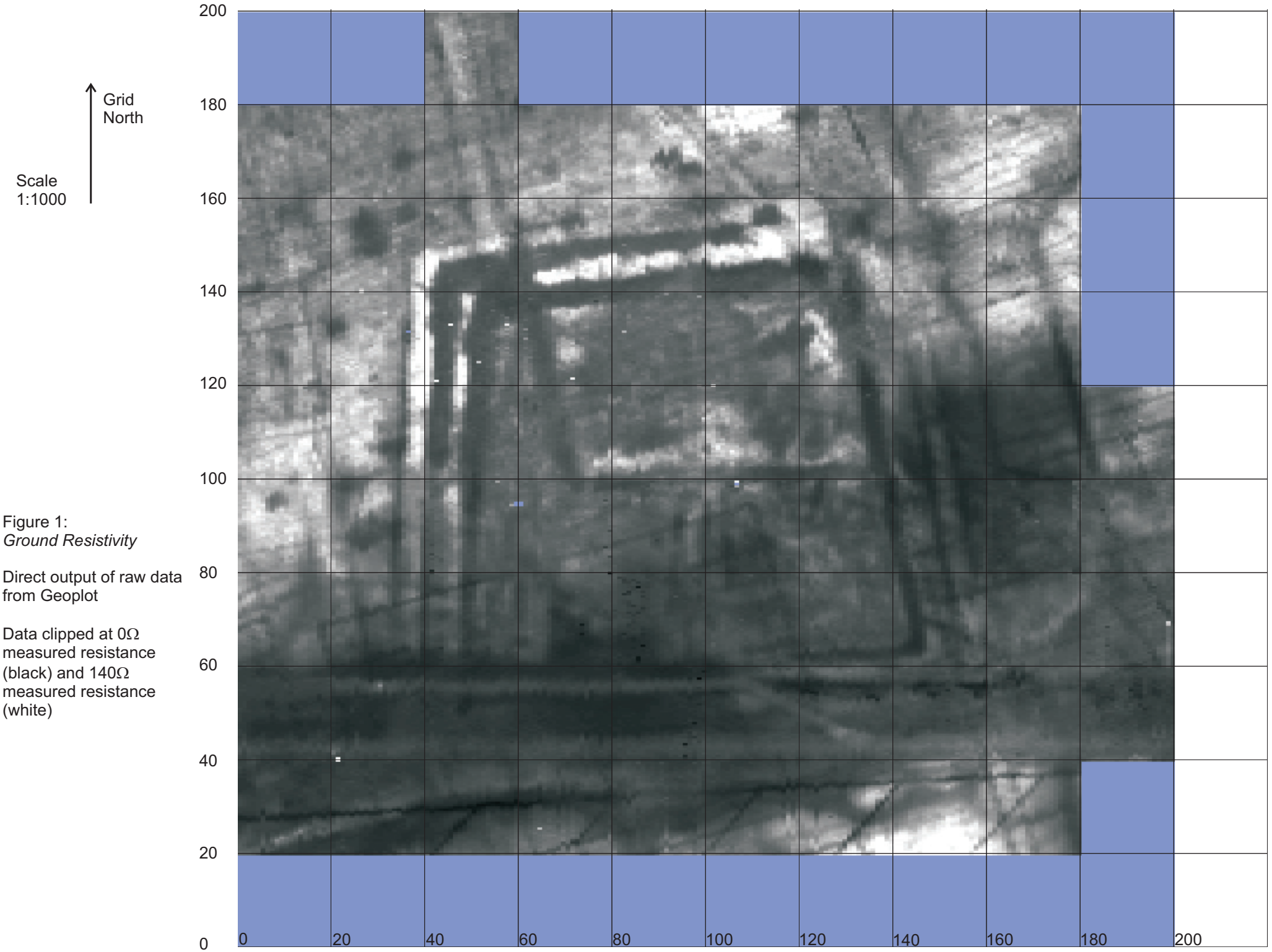

Figure 1:
Ground Resistivity

Direct output of raw data from Geoplot

Data clipped at 0Ω measured resistance (black) and 140Ω measured resistance (white)

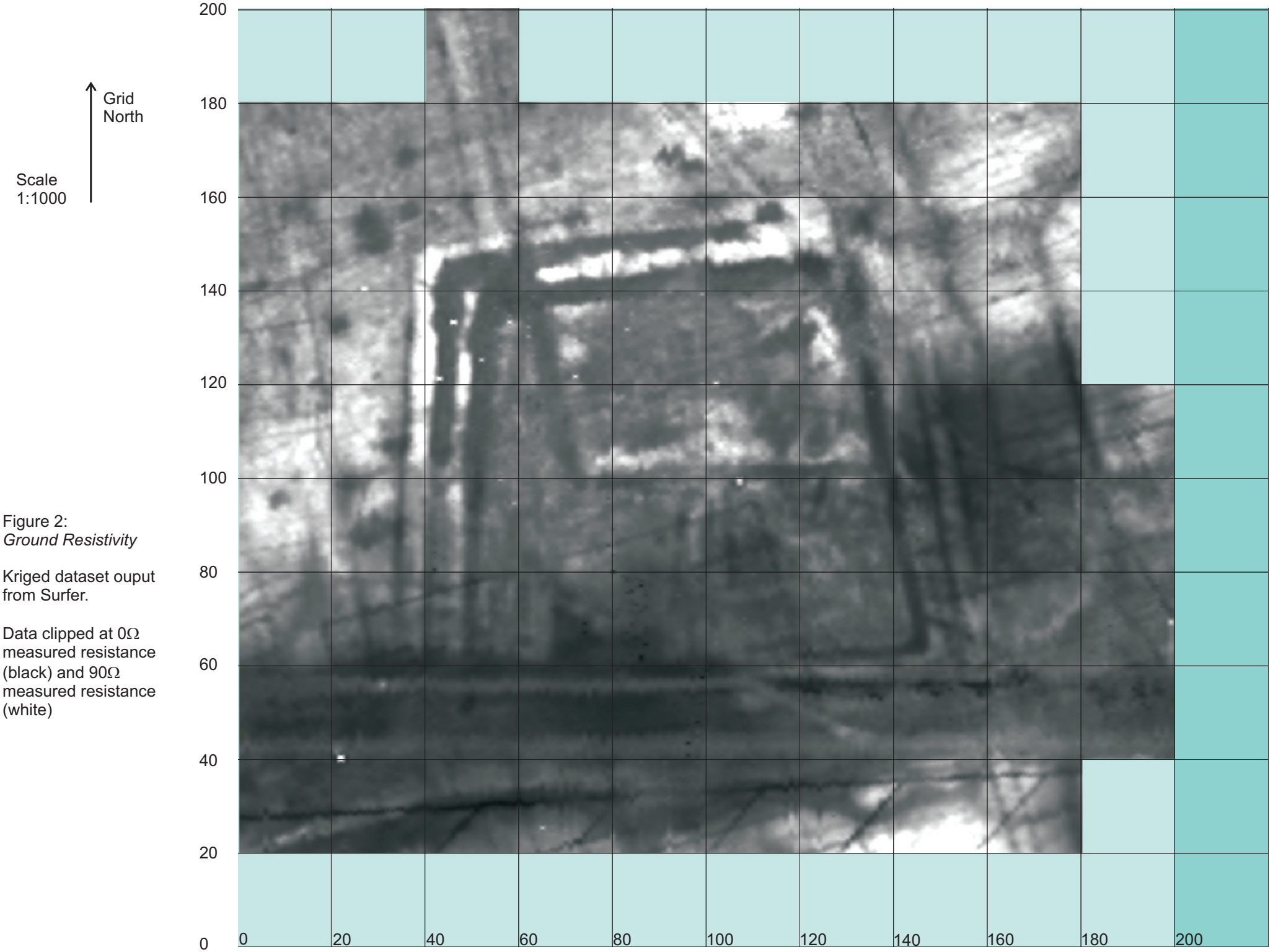

Figure 2:
Ground Resistivity

Kriged dataset ouput from Surfer.

Data clipped at 0Ω measured resistance (black) and 90Ω measured resistance (white)

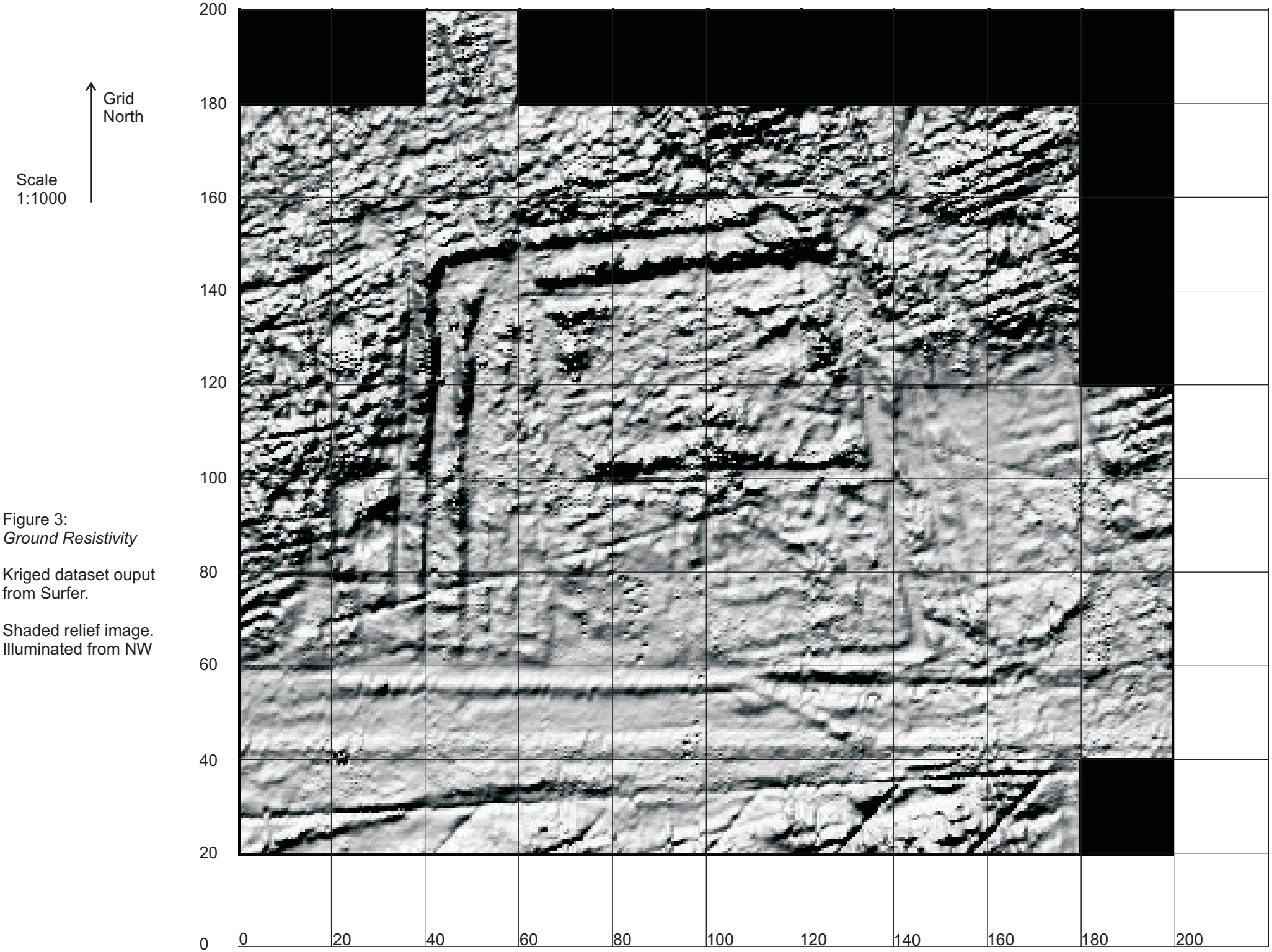

Figure 3:
Ground Resistivity

Kriged dataset ouput from Surfer.

Shaded relief image. Illuminated from NW

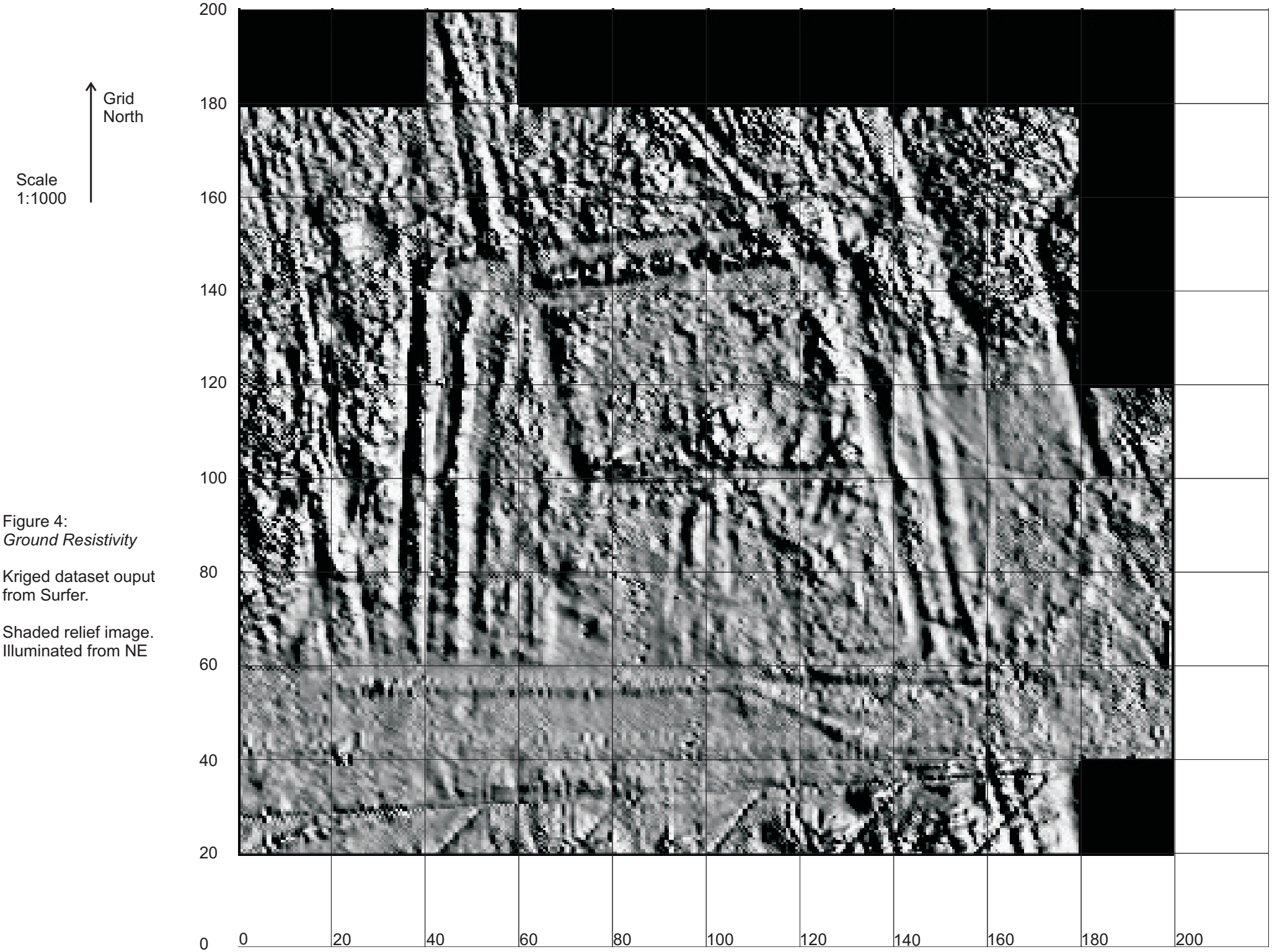

Figure 4:
Ground Resistivity

Kriged dataset ouput from Surfer.

Shaded relief image. Illuminated from NE

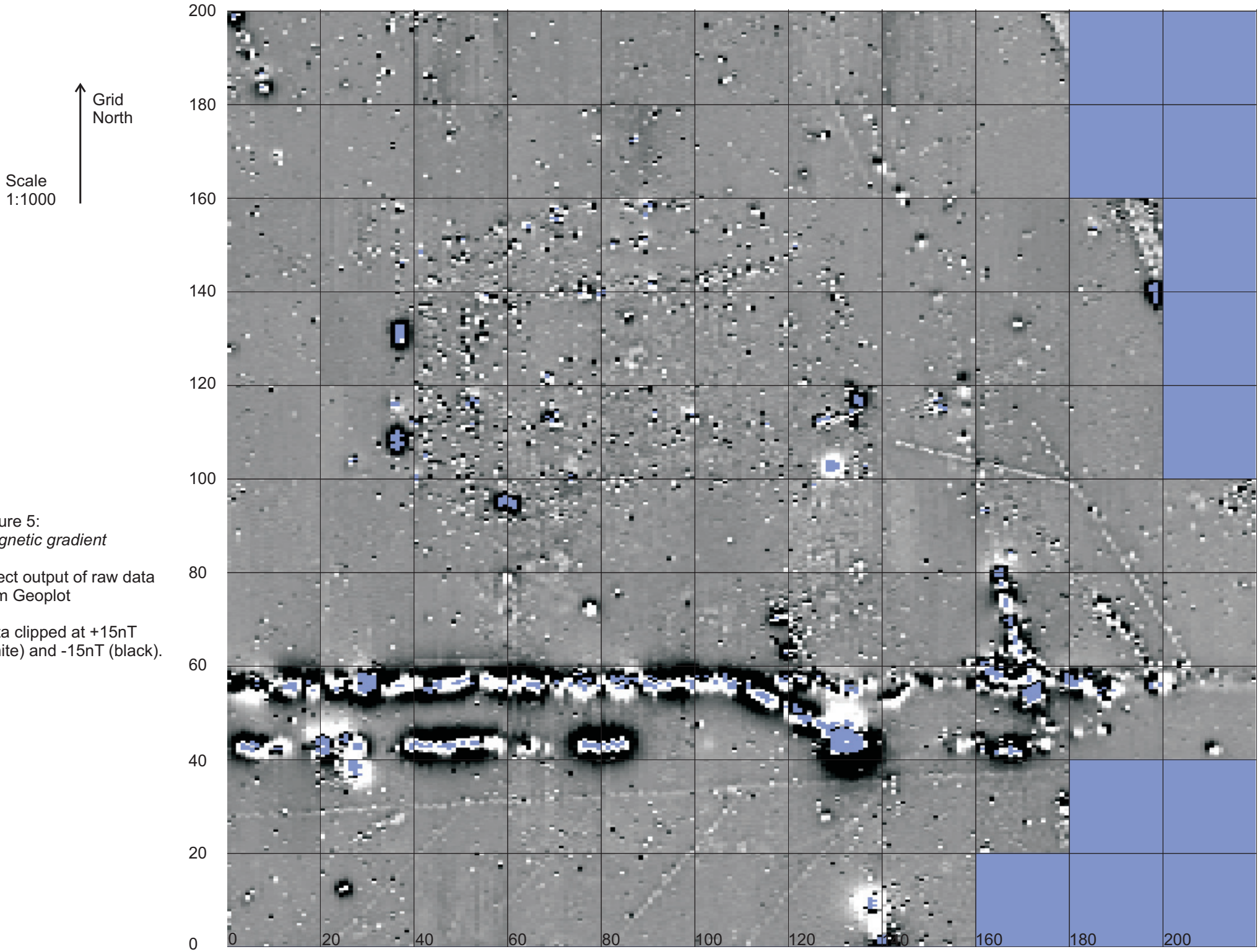

Figure 5:
Magnetic gradient

Direct output of raw data from Geoplot

Data clipped at +15nT (white) and -15nT (black).

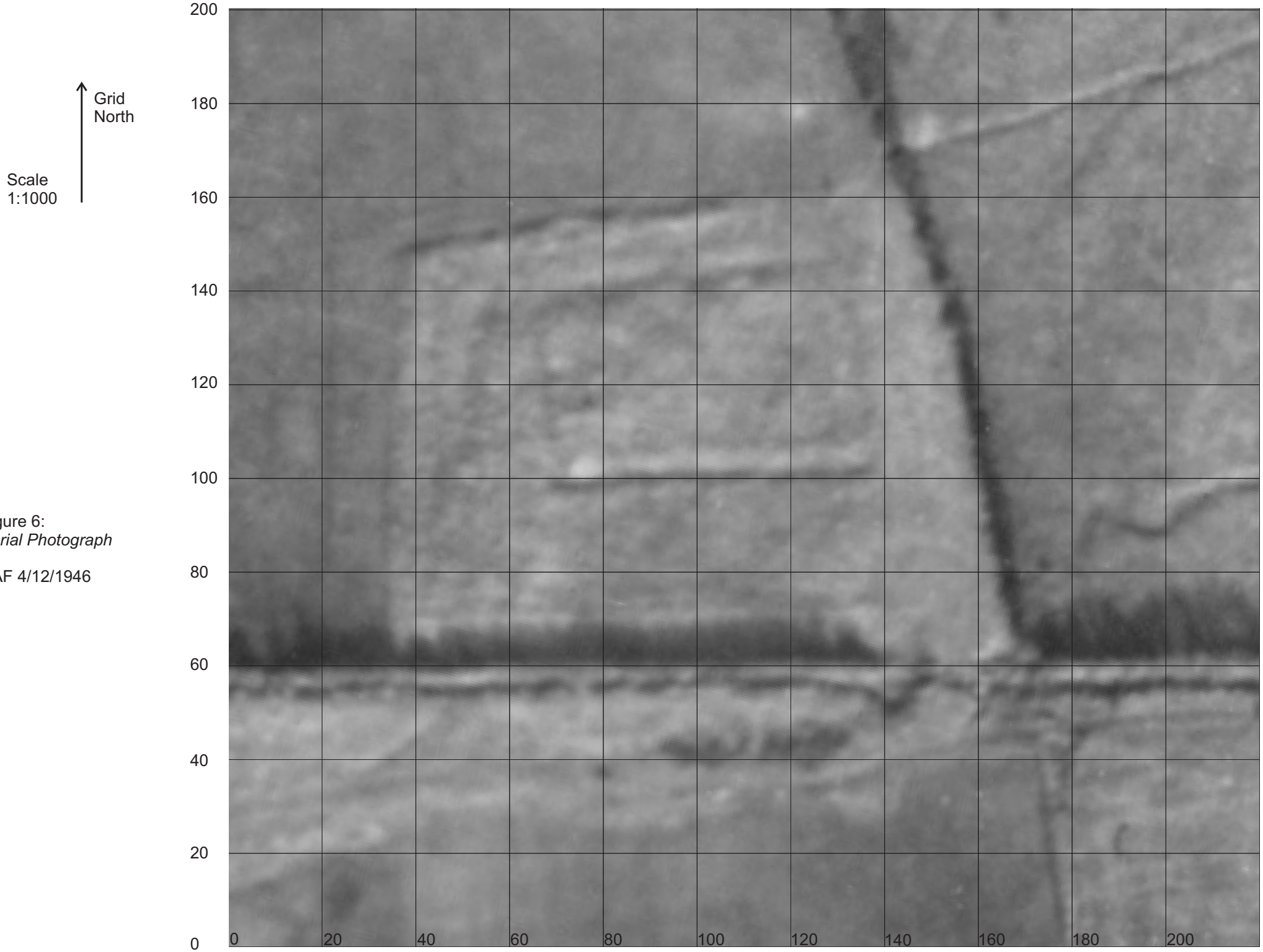

Figure 6:
Aerial Photograph

RAF 4/12/1946

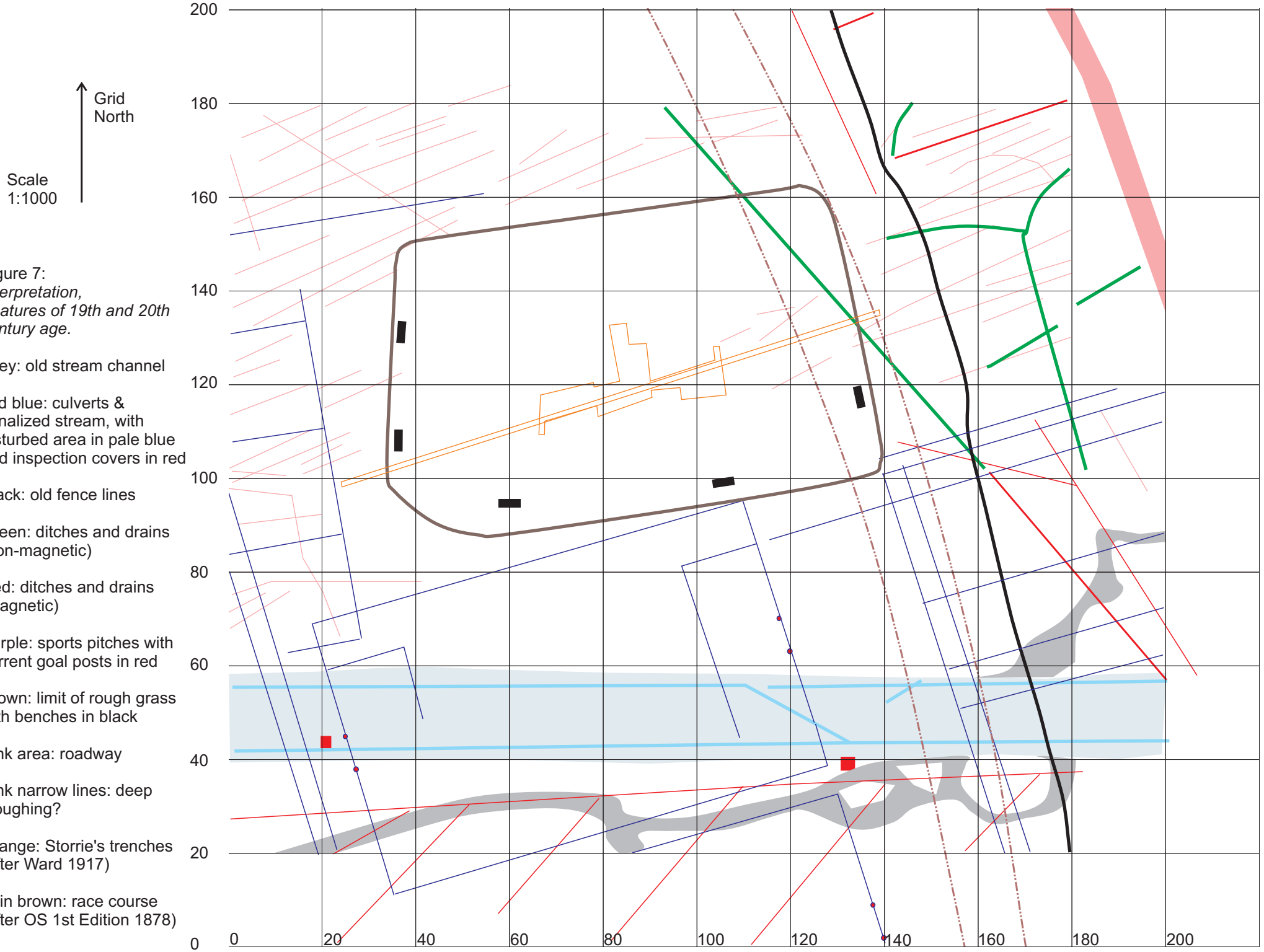

Figure 7:
Interpretation,
Features of 19th and 20th century age.

Grey: old stream channel

Mid blue: culverts & canalized stream, with disturbed area in pale blue and inspection covers in red

Black: old fence lines

Green: ditches and drains (non-magnetic)

Red: ditches and drains (magnetic)

Purple: sports pitches with current goal posts in red

Brown: limit of rough grass with benches in black

Pink area: roadway

Pink narrow lines: deep ploughing?

Orange: Storrie's trenches (after Ward 1917)

Thin brown: race course (after OS 1st Edition 1878)

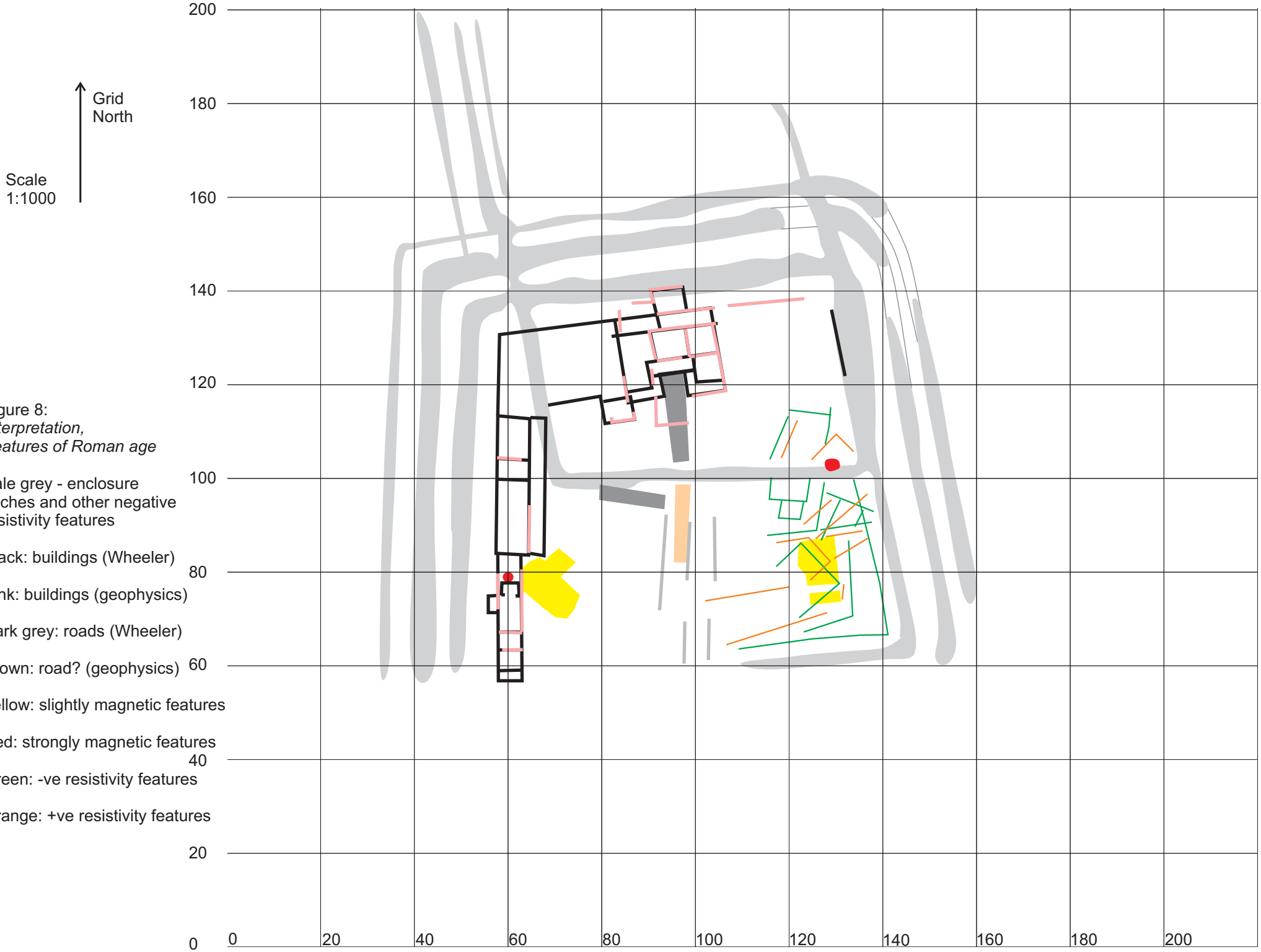

Figure 8:
Interpretation,
Features of Roman age

Pale grey - enclosure ditches and other negative resistivity features

Black: buildings (Wheeler)

Pink: buildings (geophysics)

Dark grey: roads (Wheeler)

Brown: road? (geophysics)

Yellow: slightly magnetic features

Red: strongly magnetic features

Green: -ve resistivity features

Orange: +ve resistivity features