BATH & COUNTIES ARCHAEOLOGICAL SOCIETY

Lawn below the Royal Crescent Ha-ha, Bath

Further geophysical study

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DRAFT

Lawn below the Royal Crescent Ha-ha, Bath

Report on a further geophysical survey

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Janet Pryke and John Oswin

Summary

The lawn below the Royal Crescent Ha-ha in Bath was part of an archaeological investigation in 2002 for a Time Team television programme on Channel 4. In this they confirmed the route of and excavated a known Roman road across this lawn, and also revealed and excavated a ditch containing Bronze Age remains. Our previous work extended the geophysical part of this work, and we obtained some results indicating other possible developments in the area. This is a continuation of this work. This shows a linear high resistivity feature extending from the north west towards the south east under the lawn, appearing to at depth beyond the proposed Roman road line. This is adjacent to and parallel to a very deep and wide low resistivity volume crossing the area. Our results also indicate differential resistivity results at depth below the soil. These may indicate that these areas may have been filled or levelled over time, a process either man-made or following down-slip from the hillside, with subsequent development on the new ground level.

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We are also very grateful for the permission to use results in our continued work from the report by Dr John Gater (of then Geoscan, GSB Prospection Ltd, now SUMO Group).

We acknowledge and appreciate the help, comments and advice that has also been given by Ian Brooks of Engineering Archaeological Services (EAS), Clare Baxter, Collections Manager of the Alnwick Castle collection, Dirk Booms and Paul Roberts then of the British Museum, during the previous work, and from Susan Fox and Zofia Matyjaszkiewicz of the Roman Baths Museum, Maurice Tucker of Bath Geological Society, and all the help given from the Bath Record Office. Through the project there is especially appreciation of the guidance and advice from Marek Lewcun and the discussion with Peter Davenport.

Acknowledgement is due for the publicly available information from the Environment Agency for LiDAR data and to Google Maps.

1. INTRODUCTION

1.1 Location

This is the report of a geophysical investigation of the lawn below the Royal Crescent Ha-ha, Bath. It was designed to analyse part of this area in more detail and to relate these results to previous geophysics in this area including to our work from 2012 and 2013.[1,2,3]

The lawn is within the Bath Conservation Area and the World Heritage Site. The Royal Victoria Park is in the English Heritage Register of Historic Parks and Gardens. The lawn is owned by Bath & North East Somerset Council (B&NES).

The area is on the north slope of the Avon river valley. Its geology is in a layer of Charmouth Mudstone. The area includes limestone as seen in the quarry in the Park to the west. To its north are the Fullers Earth and Inferior Oolite layers of the higher slopes of Lansdown.

No development is known on the site before the building of the Royal Crescent. It had been agricultural land, being part of Barton Middle Field (Barton Farm). When the Royal Crescent was built the fields in front of it became known as the Crescent Fields.

This project involved resistivity profiling of a section of the area shown in Figure 1.1.

Figure 1.1 The lawn below the Royal Crescent Ha-ha, separated from the curved-edged Royal Crescent lawn by the linear Ha-ha.
The area surveyed is marked in red.

———— 40m ↑N

1.2 Background information

Information from the records shows that the area is surrounded by places that show a Roman historic presence. These include to the north, behind the Crescent and in Julian Road, in Royal Victoria Park to the west, and to the east along Gravel Walk and also a site close to the Brock Street entrance to the area where Roman cremation urns and associated finds were found.[1,4,5,6] Haverfield drew a "Miscellaneous?" symbol in the area to the south of this in his map of Roman Bath,[6] and Skinner reported the find of a green glass vase from "the part of Crescent Fields where gardens were created" as well as "stone coffins in the vicinity".[7] A Roman bracelet was found in a trench to the south, dug when the Charlotte Street car park (which replaced the gardens) was extended.[8] A quantity of Roman pottery was discovered around the creation of the Royal Victoria Park

in 1830. The Park included parts of the Crescent Fields and the Bath Commons to the west. The small remaining collection of this is now at Alnwick Castle.[9] Most of it is described with the general provenance of the Park. Only one of these items was given the provenance as Crescent Fields, a Roman flask described as "not really found after the middle of the mid-1st century BC, to 30-20BC at the latest".[10]

Indications of this area's past history are indicated by the parch marks visible in the grass in dry summers (see Figure 1.2).

Figure 1.2 Parch marks in the lawn observed in dry summers

a

2013 Photograph looking down from the top floor of No. 1 Royal Crescent across the eastern part of the lawn, showing the darker green (ditch) line excavated by Time Team (arrowed)

b

2018 A view looking to the SE across the lawn from the trees in the NW corner

,

The work of Time Team in 2002 showed the presence of previous developments under this lawn. They described a gravel Roman road its proposed route followings the Foss Way alignment route across the area heading for the River Avon. They excavated a burial by the side of this road in both their trenches. To the east of this road, and following the parch mark information as shown in Figure 1.2a, they excavated a V-shaped ditch which contained finds including some dating back to the Late Bronze Age, and also indicating earlier Mesolithic presence from flint remains. This ditch was described as having been maybe a field boundary ditch or part of a settlement enclosure. The Bronze Age occupation was considered to be quite close by due to the "quite large sherds" of pottery and the butchered animal bone.

In addition to the information shown in the television programme, the clear linear band of high resistance readings corresponding to the dried out line seen in Figure 1.2b was noted by them as appearing to be of archaeological interest as well as other indications. It was stated that the variation they observed in the area could be natural or associated with landscaping/gardening as well as possibly being of archaeological in origin.

As a member's project with BACAS in 2012 Janet Pryke with John Oswin, and BACAS volunteers carried out a geophysics project which extended the Time Team resistance survey work to cover the whole lawn.[3] This investigation was set up to contribute to the suggestion that was being put together, based on a wide range of indications from a range

of sources, that this area might possibly be the site of an early Roman presence, possibly military in nature, in Bath (Pryke unpublished observations). However even with these added geophysics results, the accumulated indications made a list of tentative possibilities and did not make a convincing case. These considerations have been added to over the years and make up the background to this project.

A composite of ground resistance[1,3] results from our and Time Team's work is shown in Figure 1.3, with acknowledgement to John Gater for his permission for the use of the (then) Geoscan results in this work. We have compared these with the results from EAS done for B&NES in 2006 and all three sets of results showed a good similarity of pattern, with slightly less definition in the latter set, which was done at 1m reading electrode spacing (we used 0.5m).

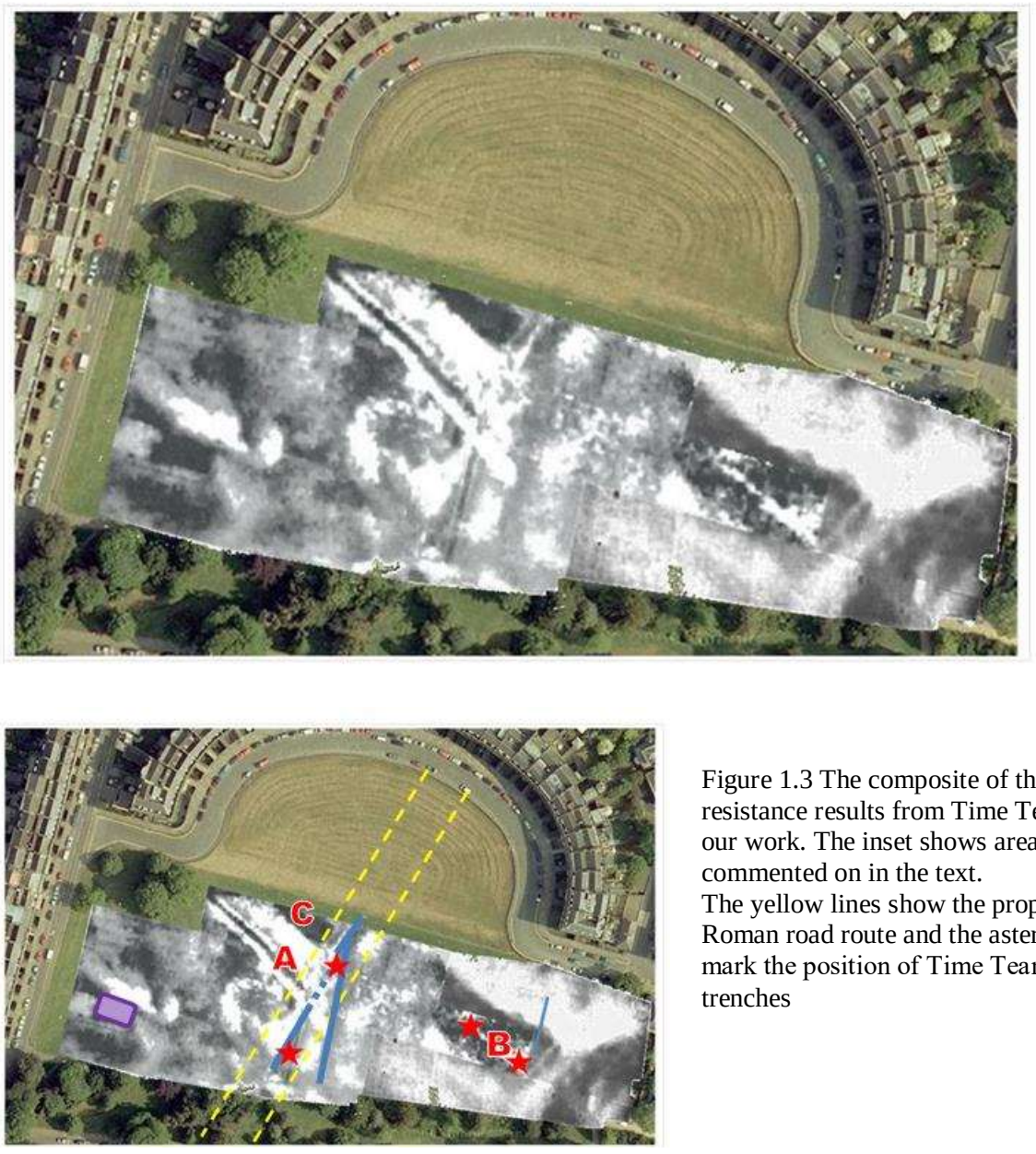


Figure 1.3 The composite of the resistance results from Time Team and our work. The inset shows areas commented on in the text.
The yellow lines show the proposed Roman road route and the asterisks mark the position of Time Team's 4 trenches

The yellow lines in Figure 1.3 inset show the route of the Roman road proposed by Time Team.[1] In their work they had not been able to extend their excavation to the bottom of the gravel layer beyond 0.5m and so did not define the road depth or any foundation

layer. In this investigation this will be surveyed further in our profiling. In Figure 1.3 a dark (higher resistance) area running in this approximate direction (blue in the inset) can be seen possibly crossed by the light (low resistance) area extending from the NW direction. There is at least one similar looking higher resistance line to the east at a more vertical angle (also blue) not crossed by this lighter area. This lighter area appears to widen and continue to the southeast.

Passing NW to SE, there is a very strong high resistance (dark coloured) line shown in area A, with a light coloured low resistance area to the north and south of it, the northerly one being considerably wider. Our results from 2012 had indicated there may be evidence of a possible past deep ditch or watercourse in this position,[3] but those results used only a single 31m profile length and did not reach to the depths of the current project. These results will be extended in this project.

In Figure 1.3 to the east of these linear features is the area B. In this area a comparison with our survey results, which extended further to the east than those by Time Team shows in Figure 1.4 that the ditch excavated by them continues to a right-angled corner (arrowed). It extends up towards the top of the lawn (as shown in Figure 1.2a).

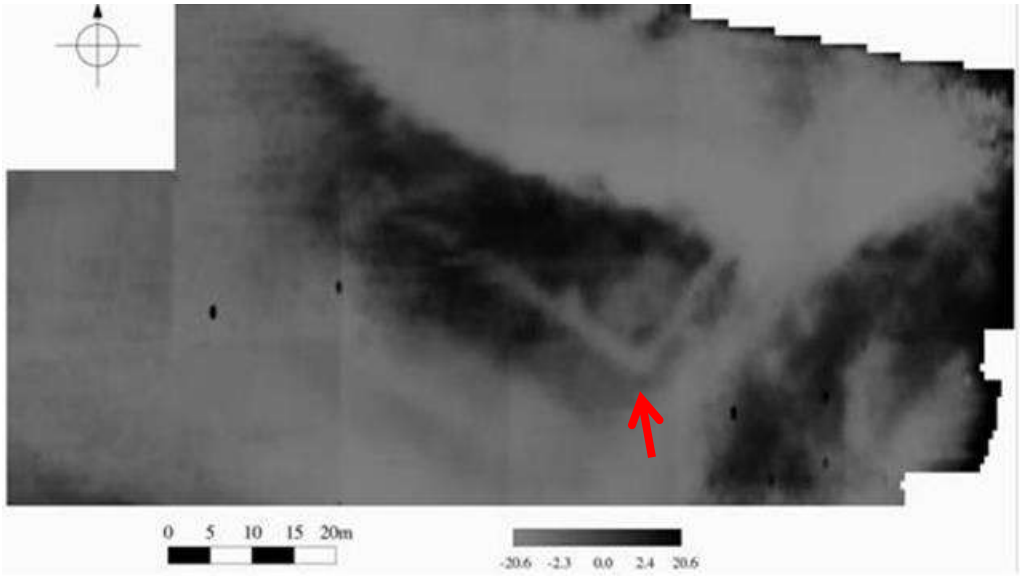


Figure 1.4 Results from our previous work showing the enclosure continuing the ditch excavated by Time Team

In Figure 1.3 to the NE of A is a regular-looking high resistance area (C) which was noted in the Time Team report[1] as being of possible archaeological significance, but not investigated further by them. This is surveyed further here.

Other features were noted by them outside the television programme, and one of those, the possibly rectangular feature marked purple in Figure 3 inset was profiled by us in our earlier work. Here the regular shaped area appeared in cross section as a high resistivity volume, extending about 18x10m to about 2.5m depth from the surface. We also observed immediately beneath part of it an irregular 3m wide high resistivity volume

extending down to beyond 3.3m. Other possible areas of possible significance can be observed in the variations in resistance intensity across the lawn in Figure 1., but only those considered further in this work are described here.

The resistance measurement results were added to by us in our project in 2012 with a magnetometry survey over the whole area, the results of which are shown in Figure 1.5. This is very noisy plot which indicates much use of the area in the past. Two areas are marked in the inset. The first in purple marks the line of the ditch excavated by Time Team (B in Figure 1.3). This survey indicates a circular, possibly ditched, area in the corner of this image, not seen in the resistance survey shown in Figure 1.4. In 2012 we profiled over this area and possible ditch remains to just over 0.5m depth were observed. This area is just to the east of the most easterly Time Team excavation area.

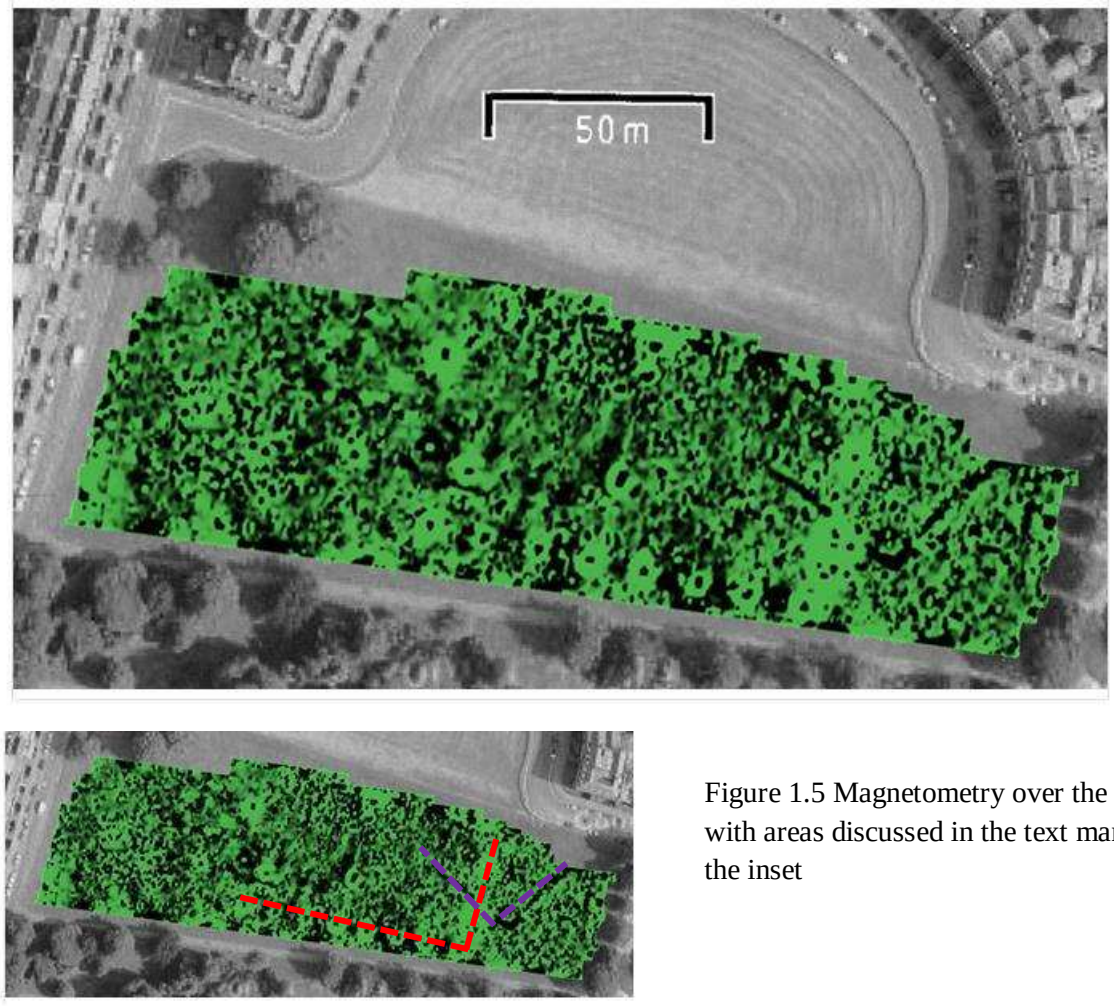


Figure 1.5 Magnetometry over the lawn,[3] with areas discussed in the text marked in the inset

In Figure 1.5 across the bottom middle section is what appears to be a regular arrangement of more highly magnetic remains (marked in red in the inset), a pattern that might be indicative of regular metal fixings. At approximately right angles to this is an elongated mass of higher magnetic anomalies that may be linear, the effect of which appears to obliterate any possible anomaly line due to the ditch described above.

This area was used for allotments during WWII, which could have added additional material contributing to the complexity seen here as well as that of any previous occupation and use. In photograph during WWII, the orientation of the elongated allotment plots can be seen to be at right angles to the pathway at the southern edge of the lawn.[11]

The resistivity profiles to be carried out in this survey were designed to carry out investigation to extend this information, to survey across the areas around A and C in Figure 1.3 and also to include the Roman road route, using extended and deeper resistivity profiling than we used before.

1.3 Scope

This report is intended as a report designed to disseminate the results after the end of the survey for information and comment towards possible development of the project.

2 Survey Method

2.1 Gridding

The 0 point was on the Ha-ha at the east edge of the angular buttress before the start of the western Crescent curve. A base line was run W-E from there along the base of the Ha-ha. From a point 25m along this line a 15m grid layout was assembled by laying out using a 15/17/8 right-angled triangle system.

2.2 Resistivity profiling

These measurements were done using a Frobisher TAR3 (kindly donated to BACAS by the Bathscape organisation). Measurement data were downloaded to a Lenovo laptop Windows 10 computer (also generously supplied to BACAS by Bathscape) and converted using RES2DINV. In each case a 31 m line of probes, 1m apart, was set out along the length and profiles taken using probe separation measurements of 1 to 9m or 1 to 6m.
Concatenated profile lines are shown in several surveyed areas in the Results section. The individual profiles are all in the Appendix.

2.3 Topographical readings

Topographical information was read from LiDAR information obtained from the Environment Agency. The data were processed using QGIS 3.14.

2.4 Programme

The survey was planned over one week in September, 20-24th. The weather was fine, bright and good for this work.

The geophysics work was completed by the team of volunteers from BACAS.

3 Results

3.1 Topography

The lawn is set across a slope extending from 40m at the SW corner to 49m at the NE corner as shown in Figure 3.1). As the slope is relatively smooth and only the very ends of the lines were affected by any approach to the Ha-ha and its ditch no topographical adjustments have been made to our profiling results across their lengths.

In the underlying LiDAR image in Figure 3.1 a slight differential in shading and in the contouring can be seen running approximately NS across the centre of the lawn.

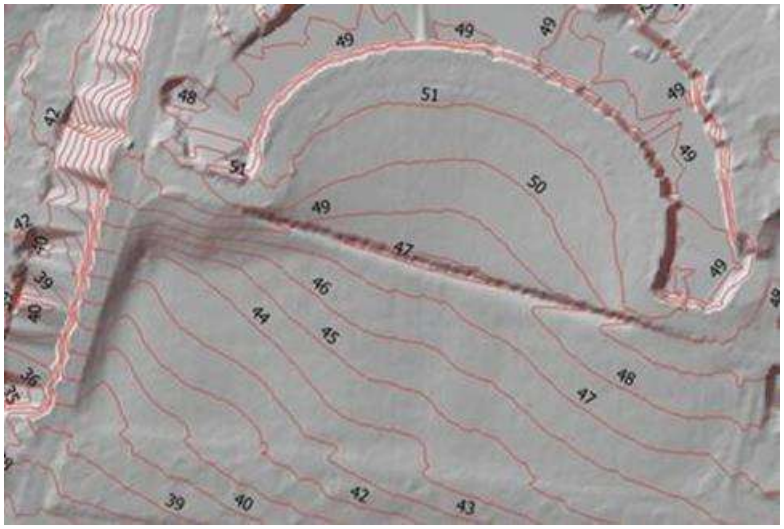
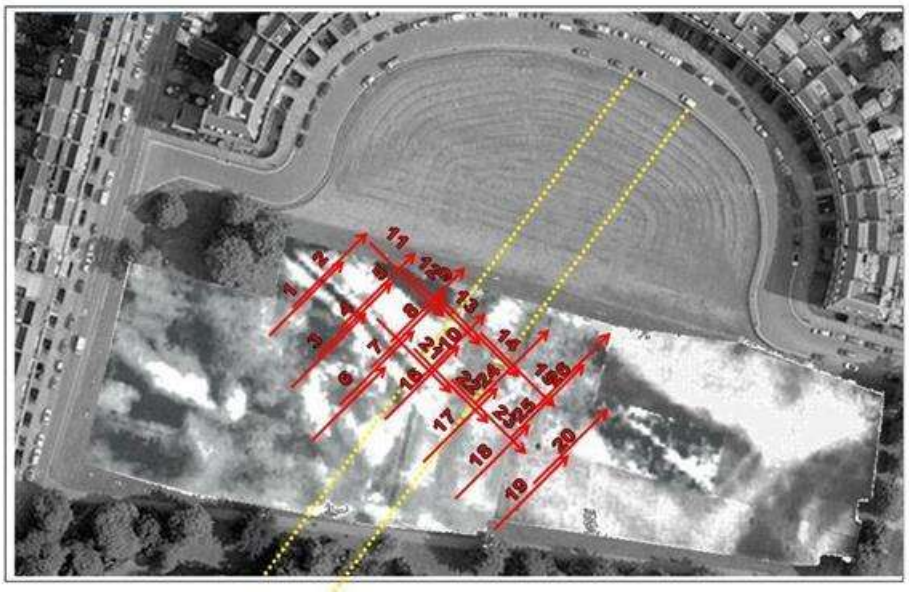


Figure 3.1 The Royal Crescent lawn and the lawn below the Ha-ha showing the heights in m. LiDAR DTM_ST7065...

3.2 Profile layout

The resistivity profile layout in this project is summarised in Figure 3.2 showing the layout of the profiles arranged in a 15m grid pattern.

Figure 3.2 The arrangement of the profiles

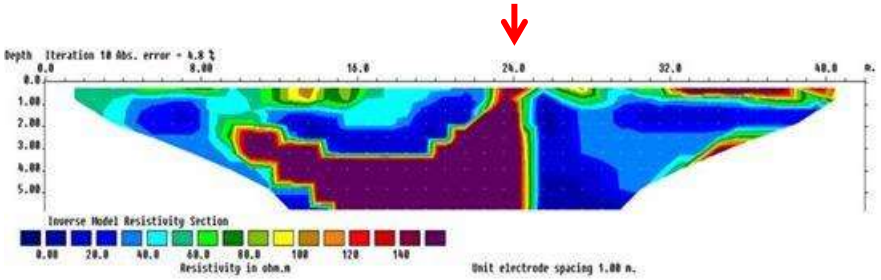


3.3 Results from resistivity profiles crossing the linear features (A) in Figure 1.3

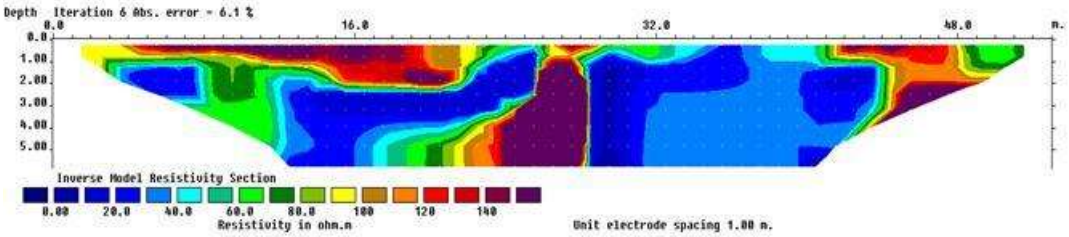
The high and low resistance linear features marked A in Figure 1.3 were crossed with a series of resistivity profile lines set up to run about SW to NE, 15m apart. The concatenated image of the successive profiles 1&2, 3,4&5, 6,7,8&9 and 16,10 are shown in Figure 3.3a-d arranged in alignment with the position of the observed high resistance feature (red/purple coloured) towards the middle line indicated by the red arrow.

Figure 3.3 Profiles crossing the linear features (A) shown in Figure 1.3

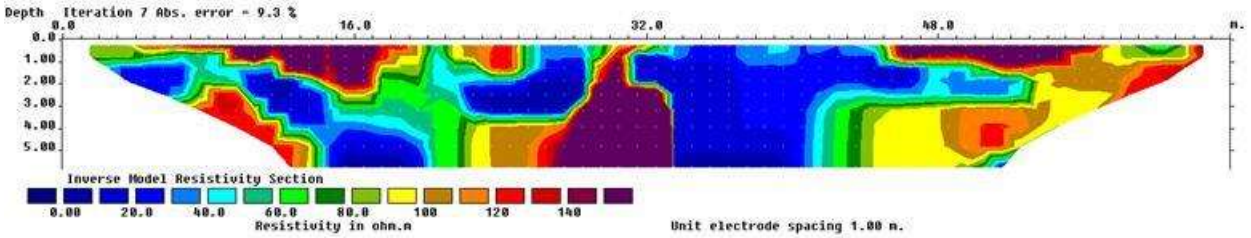
a Profiles 1&2 SW-NE overlapping at 11m



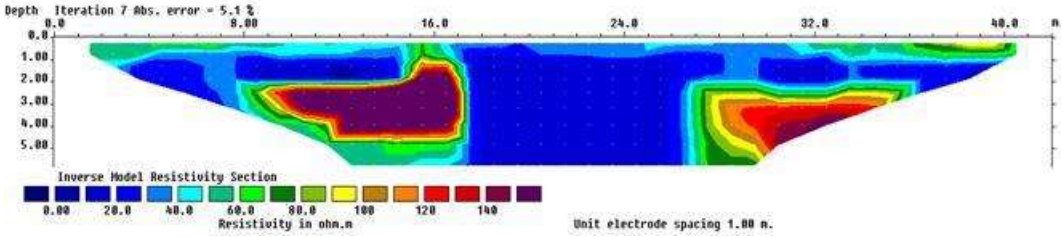
b Profiles 3,4&5 SW-NE overlapping at 11m



c Profiles 6,7,8&9 SW-NE overlapping at 11m



d Profiles 16&10 SW-NE overlapping at 11m



These four show a band of higher resistivity results about 2m wide close to the surface, which if continuous, shows decreasing resistance along the length towards the SE. These volumes are all situated above a wider higher resistivity volume deeper under the ground.

Alongside these high resistivity possibly linear features is a large deep low resistance (blue) volume to its right with another shallower resistance volume to its left. The large

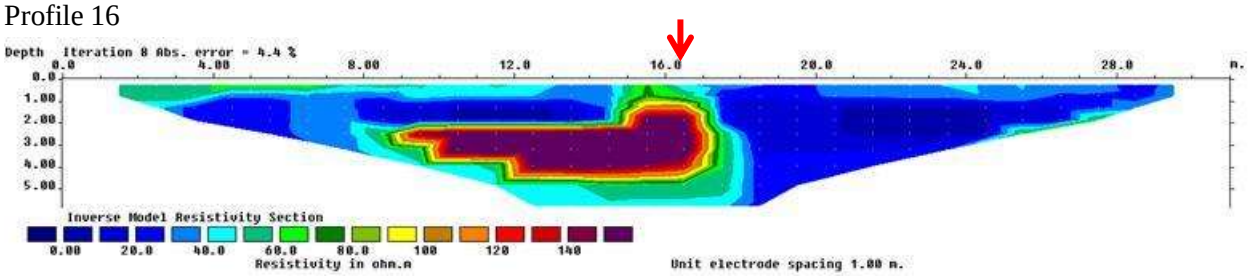
deep one extends deeper than 5m. We had observed this deep low resistivity volume in our 2012 geophysics work, extending beyond the depth those results reached, and had hoped that the deeper measurement in this project might reach the bottom of the low resistance feature. As seen in Figure 3.3 this was not achieved even at >5m.

The profiles in Figures 3.3b and c cross towards their NE ends the area of interest marked as C in Figure 1.2. This correlates with a high resistivity volume extending to about 1m depth between 40-48m in 3.3b and 45-58m in 3.3c. [Profiles set up at right angles to these to cross this area and will be shown in Figure 3.5.]

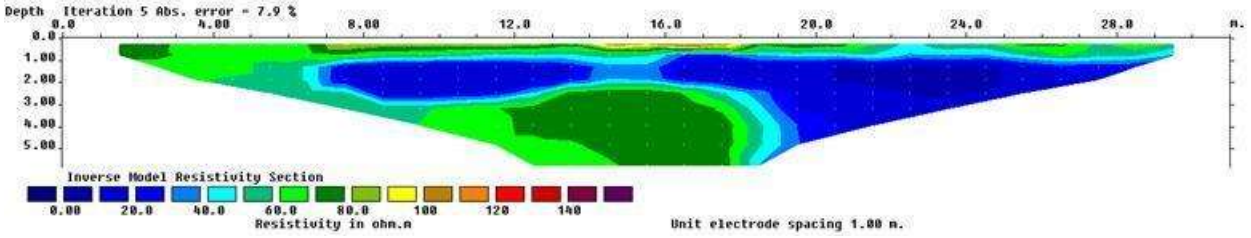
The apparent line of the high resistance apparently linear feature shown and arrowed in Figure 3.3 was continued with profiles 17, 18 and 19 to the SE set up at 15m intervals, shown together with profile 16 in Figure 3.4.

Figure 3.4 Profiles 16-19 continuing the line of the high resistance feature to the SW (indicated by red arrow)

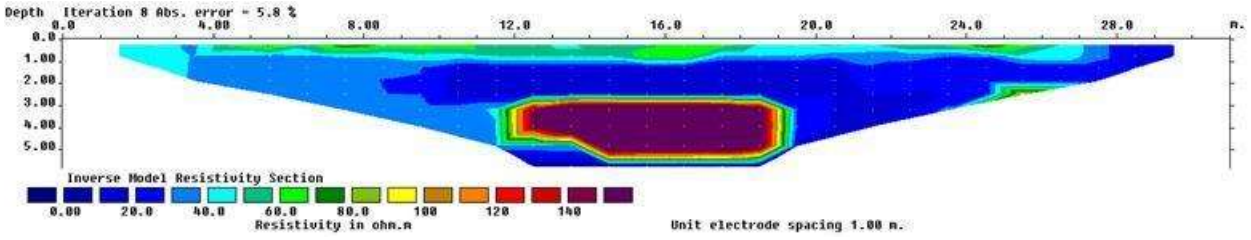
Profile 16



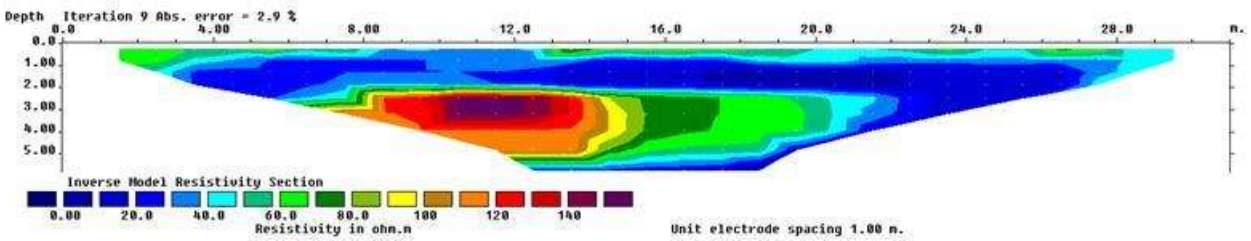
Profile 17



Profile 18



Profile 19



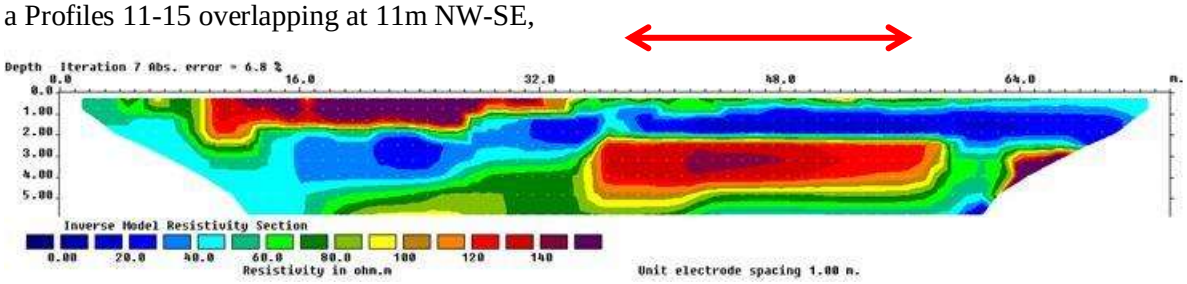
The last profile extends from next to the path across the bottom of the lawn. It was observed by us that in this part of the grass there is an accumulation of water as it was very easy to get the probes into the ground here, unlike higher up the slope. Our 2012 results had indicated that the large low resistivity feature did appear to continue to this part of the lawn, and appears to be shown in the right hand side of these profiles. There is no continuation into this area of the (arrowed) higher resistivity linear volume near the surface shown in Figure 3.3. A comparison of the higher resistivity features at 2-4m depth does show there may appear to be linear continuation of this at depth. If so the one in profile 19 may indicate displacement, and profile 17 shows its relatively lower resistivity results. Both profiles 16 and 17 are in the proposed Roman road route shown in Figure 1.3.

3.4 Results from NW-SE profiles crossing the area

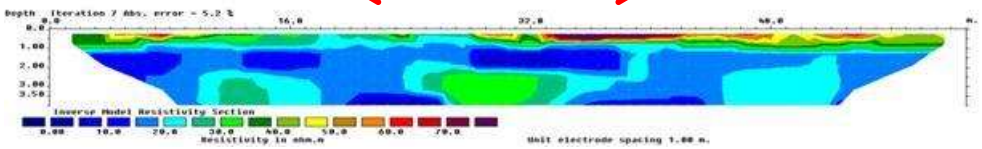
A line of resistivity profiles was set up to run NW to SE starting from the Ha-ha at 27m from 0 (profiles 11-15). This was designed so the concatenated profiles shown in Figure 3.5a were sure to cross the highly resistant area C in Figure 1.3 and to continue across the proposed road route (between about 38–58 m).

A second line of profiles (Figure 3.5b) was set up 15m to the SW of these (profiles 21-23). The proposed Roman road route crosses it at about 20-40m as shown in Figure 3.5b. This figure has a lower scale as it shows much lower values, presumably due to it running along the deep low resistivity volume described above. Figure 3.5c shows it with the same scale as 3.5a where this latter profile indicates that the deep lower resistance volume from the NW extends beyond the proposed Roman road route.

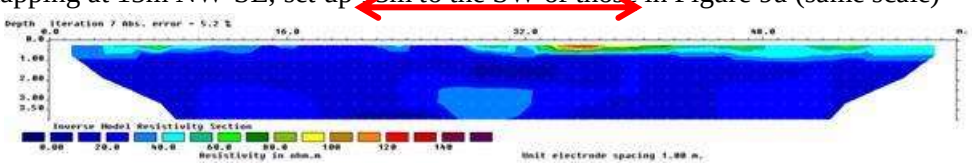
Figure 3.5 Profiling lines crossing the Roman road line indicated by arrows
a Profiles 11-15 overlapping at 11m NW-SE,



b Profiles 21-23 overlapping at 15m NW-SE, set up 15m to the SW of those in Figure 9a (lower scale)



c Profiles 21-23 overlapping at 15m NW-SE, set up 15m to the SW of those in Figure 9a (same scale)



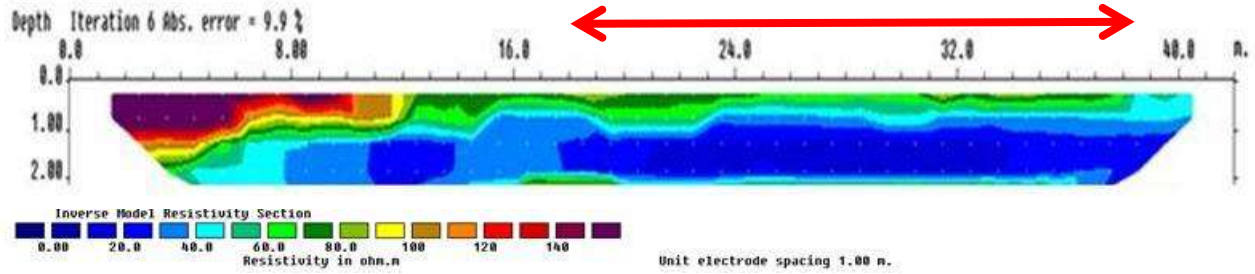
With the rescaling comparable differentiation is observable between 3.5a and b. In profile 3.5a the area noted as one that may appear "structural in origin"[1] and shown in area C in Figure 1.3 correlates with a high resistivity volume between 10 and 33m (marked blue). This extends at three levels between 0.5 and 2.5m depth and may indicate some structural remains.

The remains of the Roman road were excavated on two sites by Time Team (Figure 1.3, areas avoided in this profiling). Their excavation process involved removing topsoil of 0.3m, over 0.1m of clay subsoil, revealing a layer of gravel at least 0.5m thick.[1] The results underneath the road arrows indicate that the higher resistivity indications near the surface in these profiles do not go much deeper than this, the observations extending down to just >1m.

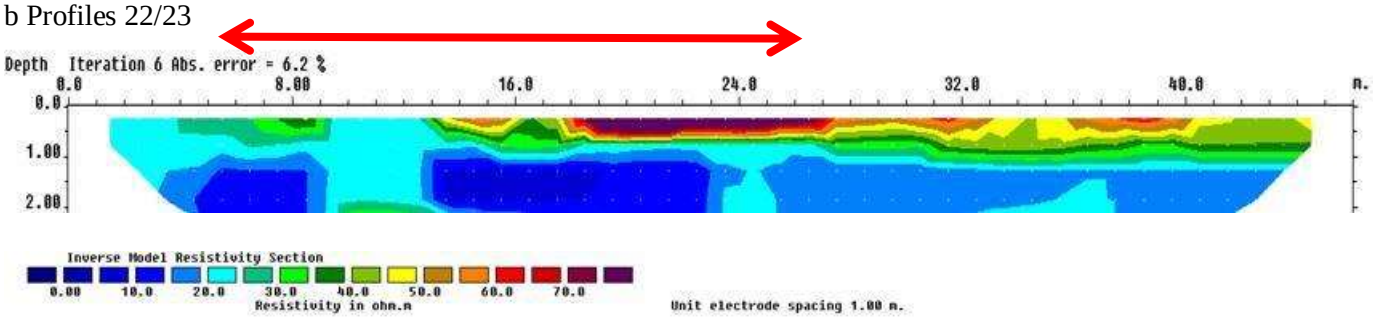
The profiles coinciding with the proposed Roman road route were further compared in Figure 3.6 extending the upper area of the graph for better comparison of the information close to the surface.

Figure 3.6 Profiles crossing the proposed Roman road route showing surface detail

a Profiles 13/14



b Profiles 22/23



In this direct comparison of the pattern some similarities can be picked out but no comparison is easy to make and the presence of a defined road line or foundation structure across the proposed width is not clearly apparent from these results.

Profiles 16 and 17 are in the approximate area of the proposed Roman road (Figure 3.3). Profile 16, shown in Figure 3.4, shows little indication, but profile 17, 15m to the SE, could run along the area, and it appears to show similar surface resistivity patterning near the surface along some of its length as that observed in Figure 3.6.

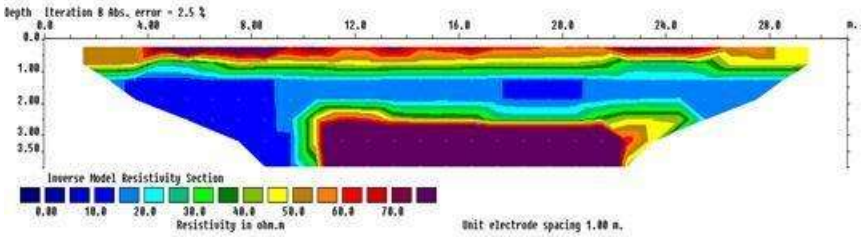
3.5 Results from profiles crossing the NW edge of the linear deep low resistance volume extending NW to SE across the area

The large deep low resistivity volume is indicated from these results to cross the lawn area from the NW area with the trees and corresponds to a lighter area in the composite resistance image in Figure 1.3. To the north of this is the area excavated by Time Team showing evidence of settlement remains (B in Figure 1.2 inset) which is in a much darker higher resistance image area. Profiles were run across the line of this edge to attempt to investigate its nature and these are shown in Figure 3.7.

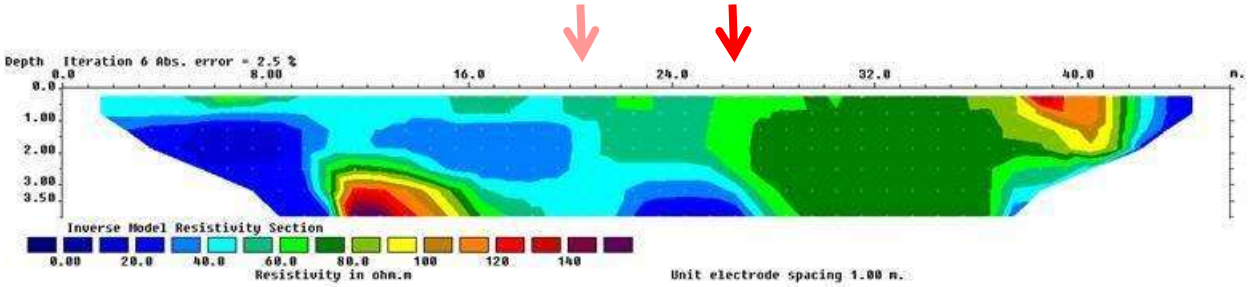
This edge is not seen in Figure 3.7a (profile 24) set up to the west of area B. It might be indicated in Figure 3.7c (arrowed), at its right hand end, but it is clearly shown as a differentiated volume in Figure 3.7b (arrowed), and with a possible layer giving less high resistivity results to the left (lighter arrow).

Figure 3.7 Profiles running SE-NW towards Ha-ha aligned as above

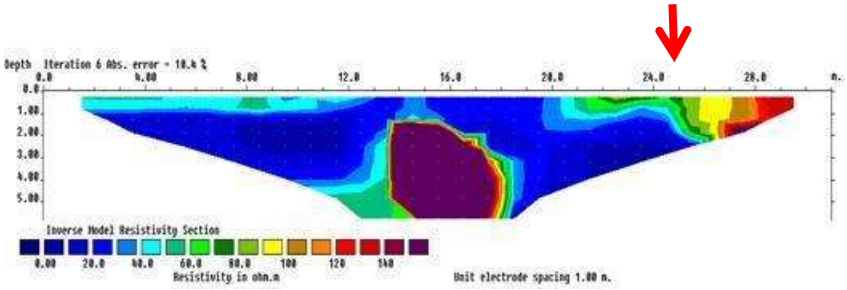
a Profile 24 running from line shown in Figure 7b towards the Ha-ha



b Profile 25-26 at 15m to the SE of the profile above



c Profile 20, 15m to the SE of the profile in Figure 9b the edge of the high resistivity area marked with an arrow



The results seen in profile 24 in Figure 3.7a may include upper levels including some of the Roman road remains as it continues profile 17 (Figure 3.4) and there is some similarity between that and results ion the profiles in Figure 3.6a&b can in the resistivity results close to the surface.

In the profiles in Figure 3.7 other higher resistivity results can be observed. Profile 24 (Figure 3.7a) shows an elongated high resistivity volume at 3m depth, also possibly seen at the end of the right angled profile seen in Figure 3.3d. Both the profiles in Figures 3.7b and c show an irregular high resistance volume at >2m depth. It can be noted that at in an analysis at high scale the image in profile 20 shows differentiation so it does not appear to be due to one of the underground void cavities known to be present at the bottom of the lawn further to the west[2,3]

4 Discussion

The results can be compared across the area by assembling these resistivity profile results into a single image as shown in Figure 4.1.

Figure 4.1 The profiles taken during this project assembled over the resistivity map shown in Figure 1.3

The resistance survey and the resistivity profile image indicate that very large resistivity volume runs from the NW corner of the lawn, and this from these results appears to extend to the bottom SE part of the lawn. Our results do not go deep enough, at just over 5m, to define its volume. There are a range of possibilities for the origin of such a linear low resistance area, from its being a palaeochannel, to its being the remains of a water course or a very large ditch.

It is aligned to the NW pointing towards the spring areas in Middle and High Common, but our geophysics results from Royal Victoria Park do not indicate similar low resistance results to continuing across to there.[12] The line passes at about 200m to the NW of this rea to the south of the possible group of standing stones, four large blocks of rough limestone set deep into the clay, detected in excavations in 1985, under the level ground towards the top of the allotments behind Marlborough Buildings (shown in Figure 4.1 to the west of the Royal Crescent).[13] This line does not seem to show any continuation from the main watercourse, Mud/Mad/Muddle Brook, in its course from the springs up the hill towards now culverted behind Marlborough Buildings in its descent towards the river. Any course it had to the NW would have crossed the route of the known large ditch that was open when pictured in the 18th century,[14] at right angles to the

Royal Crescent, a ditch later to be built over with Marlborough Buildings. Continued down the slope the line of this possible feature points towards the old walled city area. However it can also be noted that this is the orientation of geological trends in the bedrock.[15]

Parallel to this is the linear highly resistant feature observed in our results. If man-made, the northerly part of this appears to be a built up volume on top of a deeper high resistivity volume. This latter volume, at least 5m across about and 1.5m deep, continues to progress at below 2m depth (so not detectable to the resistance meter) towards the SE edge of the lawn. If these results indicate structural material the upper high resistance volume could have been a wall or boundary. We note it shows a kink. It is known that in Roman developments slight kinks in reorientation have been created [e.g.16] The built-up part is at least 60m long (from the parch mark) and the possible continuation is at least another 45m long. The disappearance of the surface feature occurs at the road position described by Time Team.

The indications from the previous resistance survey as well as the profiles in this project indicate that there may have been infilling of this area over time resulting in the burial of earlier remains. Although area C in Figure 3, the area containing the Bronze Age remains, was not observed in detail in this survey, where our results crossed into this area there appeared to be a continuous higher resistivity volume to the surface. There was no low resistivity observed over it which would be expected if there was slumping of such ground down the hillside slope across the whole area in extremely wet weather conditions. This area could have been left exposed if it was already at a higher level position.

The wide road line described by Time Team was crossed by our profiles, but our results do not add to extend the description by Time Team.[1] No clear foundation can be seen for this roadway and the cross section of a wide road area is not clearly distinguishable in Figure 3.6. The arrangements may be the results of additional complexity. It has been noted that there appear to be a higher resistivity volume at 2m depth beneath part of it as shown in Figure 3.6b. If this were to be a road cross section there remains the possibility this could be an earlier version of the Foss Way direction road route across the area.

Other areas show high resistivity volumes in Figure 3, including the regular building-type shape noted by Time Team (B) that might be possibly structural in origin. The results in Figures 8b&c and 9a show the extent of high resistivity material apparently relating to this, extending in depth to less than 2m, results which could be consistent with a structural development.

A further possibly regular area indicating structural remains is seen in Figures 3.5a, at about 2.5- 4.5m depth. It is at least 22m wide so could possibly indicate large structural remains in this position. This overlaps with the wide road line proposed by Time Team,

so if it was a building the supposition would have to be that it would have been there at a different time or be a part of the road route structure.

Consideration of our observed resistivity differential showing possible developments at depth could add to information including the wall of unknown origin consisting of large stones which was photographed in 1860[17] next to the railing on the south side of the pathway running along the bottom of this lawn. In the photograph it is not shown to depth but does extend downwards into the soil.

We have described indications of possible areas of structural development that have been observed in these results. If these results are not the result of geological differentiation, they do appear to indicate areas of layered structural development under the lawn. These if so appear to have been infilled or covered before further developments were created on top of them. These areas also appear to be created in a relatively ordered manner either on an orientation NW/SE (approximate to the Foss Way direction) or N/S, more in line with the more recent developments.

We look forward to further discussion and consultation towards the possible development of suggestions to help explain the nature and pattern of these results, and to hopefully lead towards continuation of the investigation.

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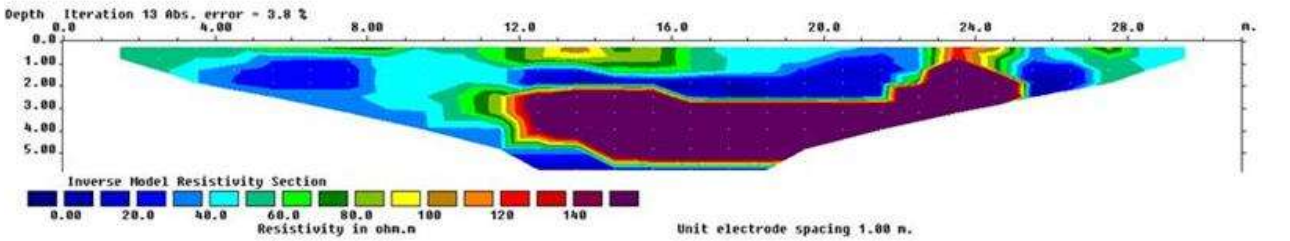
17. Royal Crescent 1860?, photograph, Bath Central Library Collection (Bath in Time ref. 12228)

APPENDIX

Individual profiles not shown in text, numbered as in Figure 3.2

1



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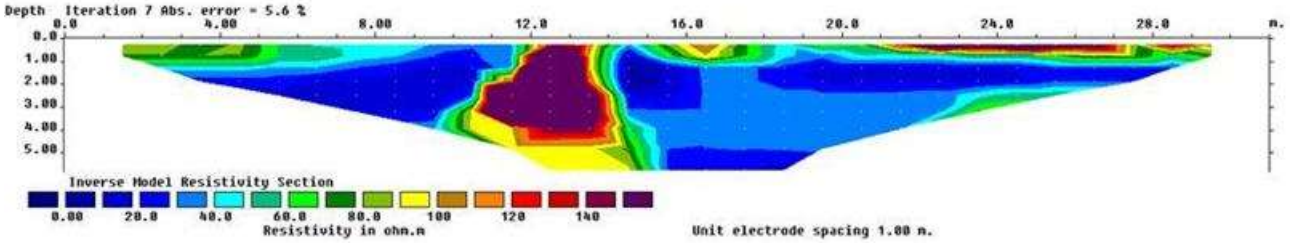

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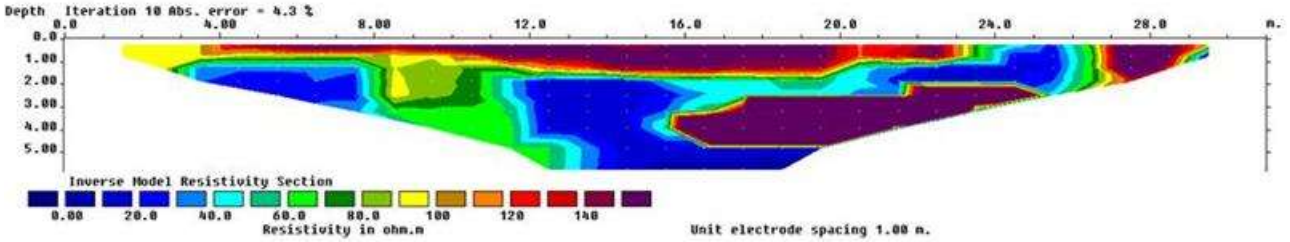

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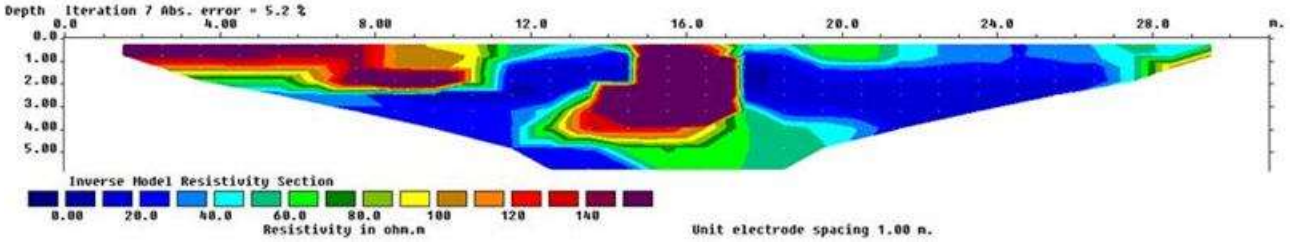

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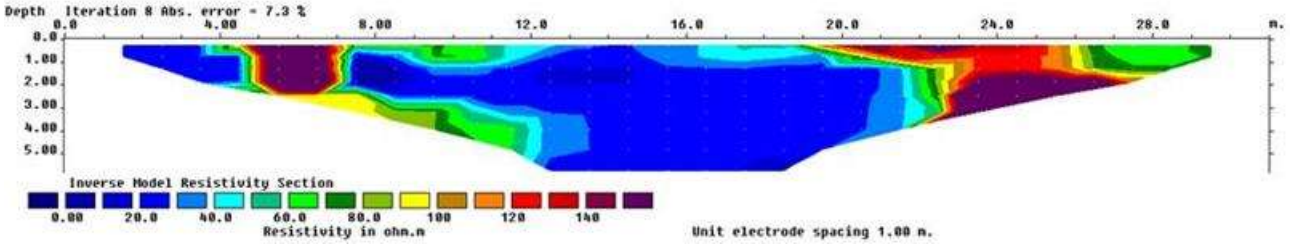

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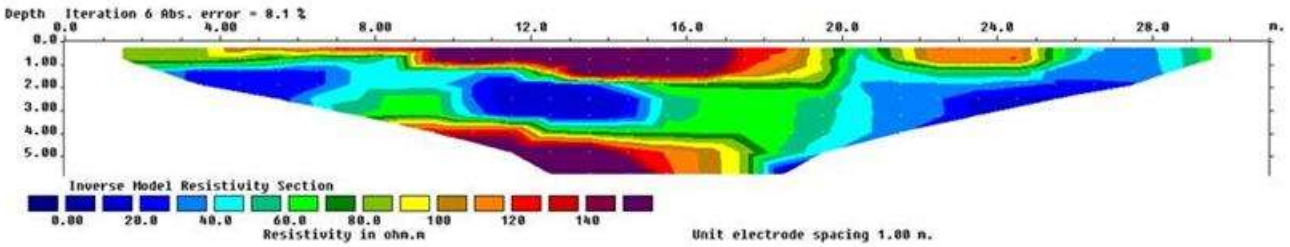

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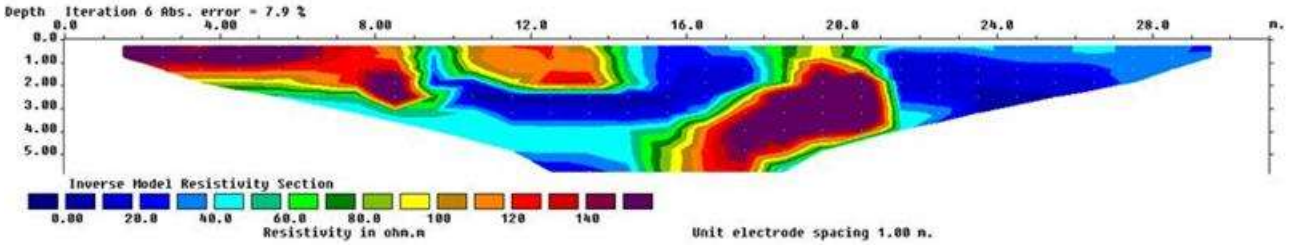
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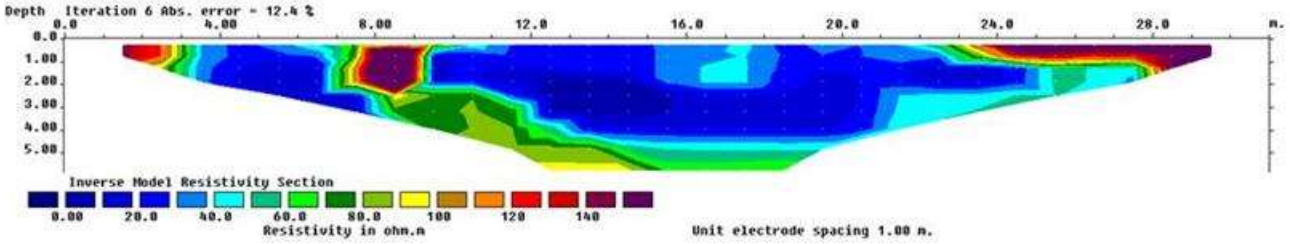
Resistivity in ohm.m
Unit electrode spacing 1.00 m.

8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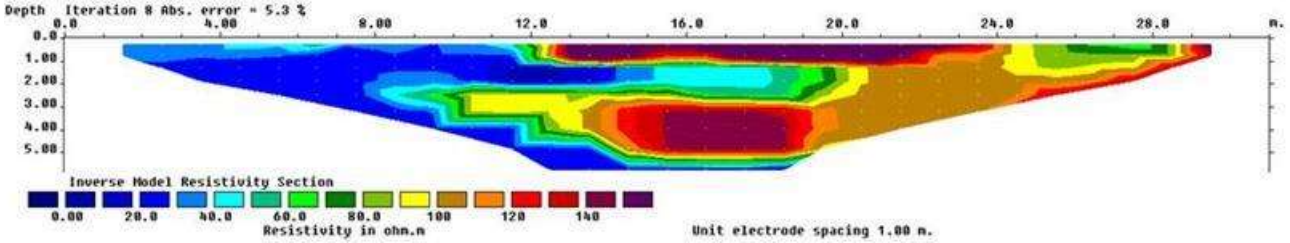
Resistivity in ohm.m
Unit electrode spacing 1.00 m.

9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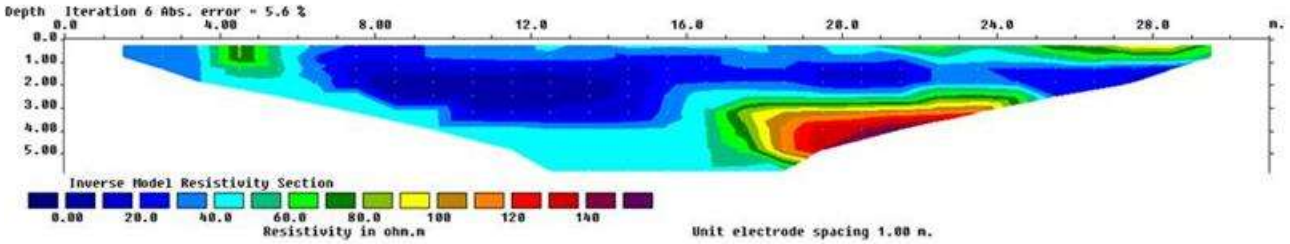
Resistivity in ohm.m
Unit electrode spacing 1.00 m.

10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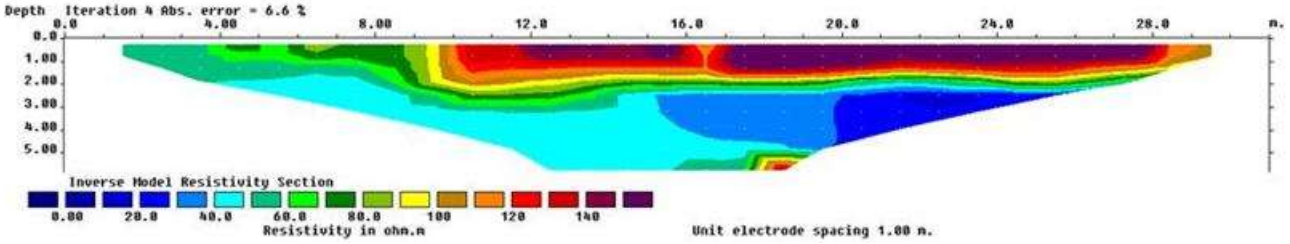
Resistivity in ohm.m
Unit electrode spacing 1.00 m.

11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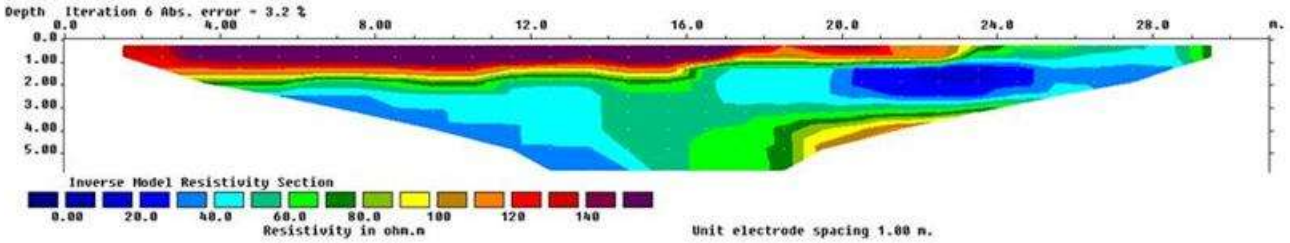
Resistivity in ohm.m
Unit electrode spacing 1.00 m.

12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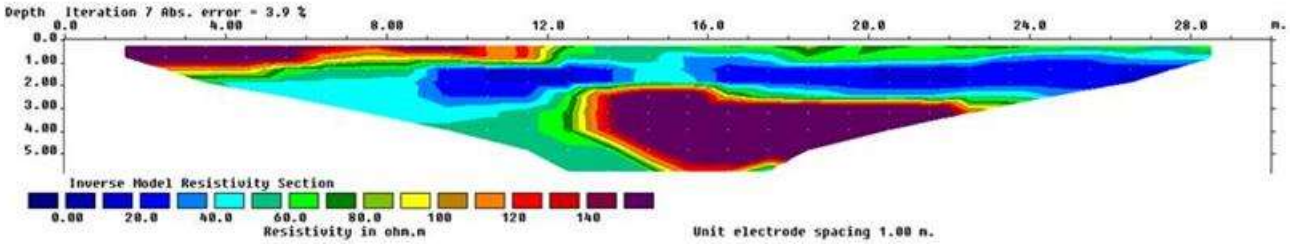
Resistivity in ohm.m
Unit electrode spacing 1.00 m.

13



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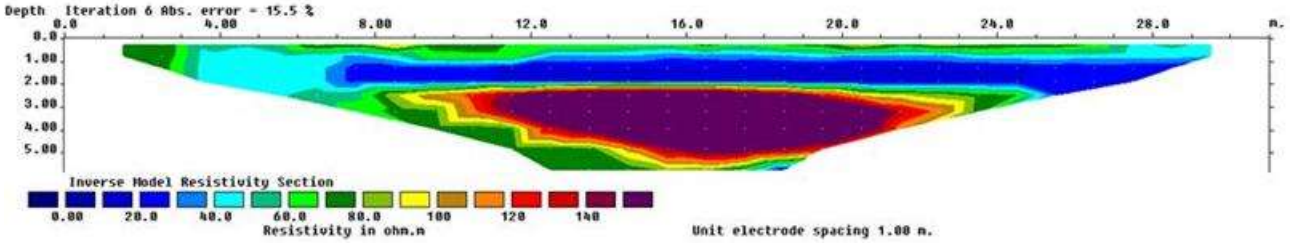

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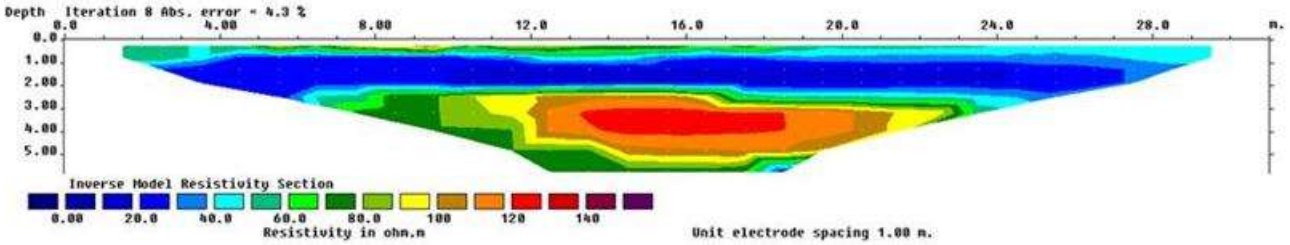

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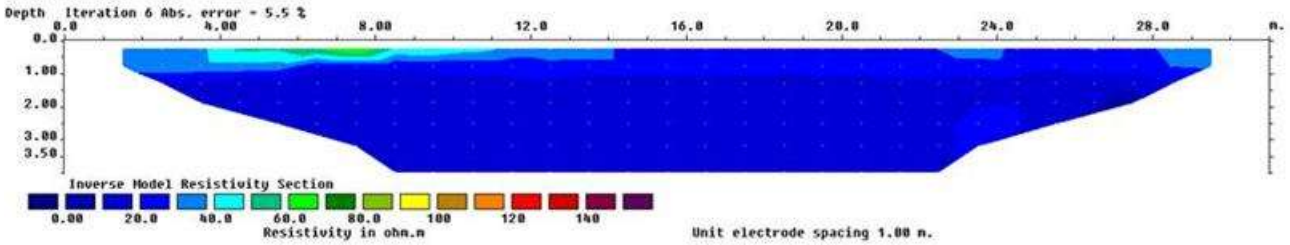

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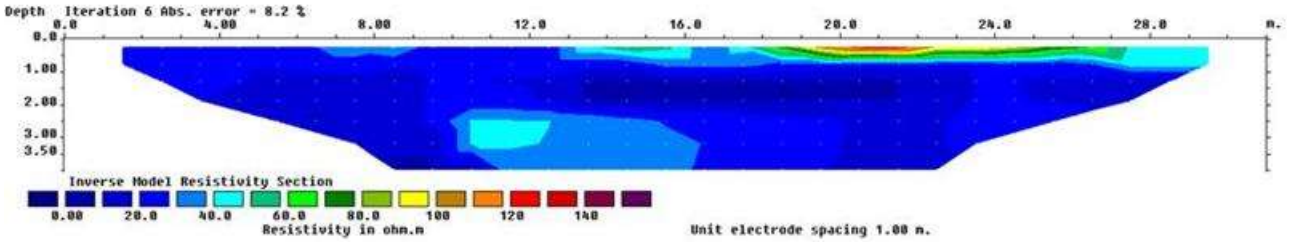

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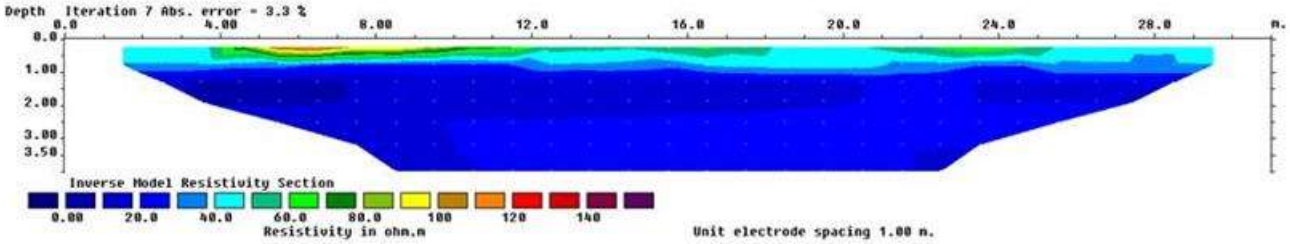

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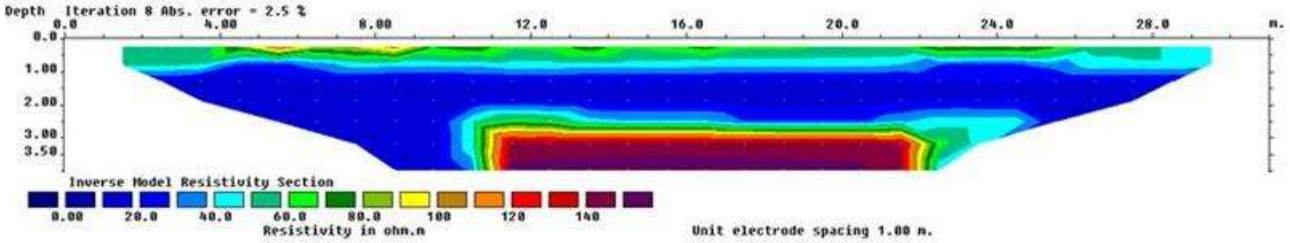
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2.00
3.00
3.50
Inverse Model Resistivity Section
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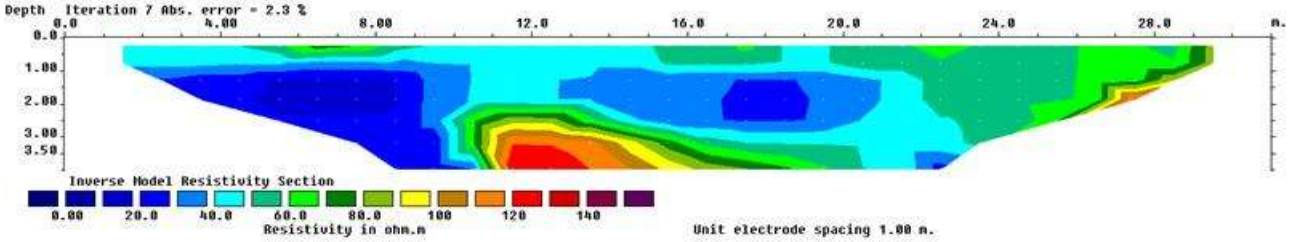
120
140
Resistivity in ohm.m
Unit electrode spacing 1.00 m.

25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3.00
3.50
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120
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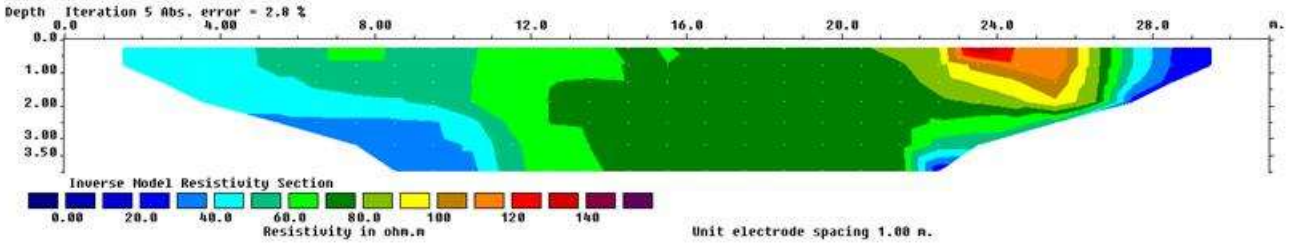
Resistivity in ohm.m
Unit electrode spacing 1.00 m.

26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2.00
3.00
3.50
Inverse Model Resistivity Section
0.00
20.0
40.0
60.0
80.0
100
120
140
Resistivity in ohm.m
Unit electrode spacing 1.00 m.