RPS Planning, Transport and Environment

INDEX DATA	RPS INFORMATION
Scheme Title Bingley Relief Road.	Details Geophysical survey Report 99195.
Road Number	Date
Contractor Babbie.	
County West Yorkshire	
OS Reference SE 13.	
Single sided ✓ Double sided A3 6 Colour 1(A3).	

4172 559-70005

12.9.00

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GEOPHYSICAL SURVEY REPORT 99/95

PROJECT NO. 4172 P Box File

BINGLEY RELIEF ROAD
West Yorkshire

Client:

Babtie

SITE SUMMARY SHEET

99 / 95 Bingley Relief Road, West Yorkshire

NGR: SE 1208 3764 (approximate centre of survey area)

Location, topography and geology #

The proposed route of the A650 Bingley Relief Road crosses the River Aire to the northwest of the Bankfield Hotel, Bingley. The areas of geophysical survey are located immediately to the north and south of the River Aire and east of the Cottingley Beck. The topography changes considerably across the area. Area A comprises mostly level flood-plain, whereas in Area B the flood-plain gives way to a very steep slope that terminates in a terrace in the south of the survey area. No soil survey information is available within the urban area, although the geology of the locality is sandstone and shale with loamy soils (SSEW 1983).

Archaeology #

A 'Stage 2 Archaeological Assessment' was carried out by **Babtie Group** and was supplemented by **West Yorkshire Archaeology Service**. During these assessments several sites were located within the vicinity of the survey area.

- **Site 6** [SE 1202 3770] is predominately to the north of the River Aire and comprises lithic scatters dating from the Neolithic, although Roman coins have been recovered from both sides of the river.
- **Site 49** [SE 121 376] is a lynchet along the southern field boundary of the survey area. The remains of a terraced trackway may run along the northern edge of the lynchet.
- **Site 50** [SE 121 376] consists of terraces and possible stone footings on a steep slope to the north of Site 49.
- **Site 51** [SE 119 376] comprises a water-filled channel on the south side of the River Aire that may suggest former water control or power generation in the vicinity.

Aims of Survey

The geophysical survey was carried out to locate any buried archaeological remains that might be present within two survey areas. The work forms part of a wider archaeological assessment of the route of the proposed road being undertaken by the **Babtie Group**.

Summary of Results *

The gradiometer survey detected possible archaeological features in both survey areas. However, the ill-defined nature of these responses and extensive ferrous disturbance from modern debris makes this a cautious interpretation. The resistance survey in Area B identified several amorphous areas of high and low resistance that are thought to reflect mainly natural changes in topography and soil depth. A low resistance anomaly recorded in the northern part of Area B may have been produced by features associated with water control.

Information provided by client in 'Specification of Works'

*** It is essential that this summary is read in conjunction with the detailed results of the survey.**

SURVEY RESULTS

99 / 95 Bingley Relief Road, West Yorkshire

1. Survey Area

1.1 Two areas of the proposed A650 Bingley Relief Road were surveyed. Area A comprises approximately 0.5 hectares to the north of the River Aire and Area B is approximately 0.5 hectares immediately to the south. Area B was subjected to both gradiometer and resistance survey, whereas gradiometry alone was conducted in Area A. Figure 1 shows the location of both survey areas.

1.2 The survey areas were set out by **GSB Prospection** in accordance with baseline markers established by the **Babtie Group**.

2. Display

2.1 The results are displayed as X-Y traces, dot density plots and greyscale images. These display formats are discussed in the *Technical Information* section at the end of the text.

2.2 Figures 2 is a summary interpretation of both gradiometer and resistance survey results produced at a scale of 1:1000. Figures 4 to 11 are data plots and interpretation diagrams of the results from the individual areas at a scale of 1:500. For Area B, processed data plots are included in addition to the those produced for the raw resistance data.

2.3 Letters in parentheses in the text of the report refer to individual anomalies highlighted on the relevant interpretation diagram.

3. General Considerations - Complicating factors

3.1 In general, the ground conditions were not favourable for either survey technique. Thick weed cover in Area A was cut down and revealed ferrous debris, remains of bonfires and ground disturbance. In Area B the mixed vegetation and steep gradient across most of the survey area made walking difficult. In addition, some areas were inaccessible due to dense brambles and trees.

3.2 The soils are of a type that would be expected to be readily enhanced, thus providing a sufficient contrast for the detection of archaeological remains. Therefore, despite the disturbance and difficult ground conditions, it was hoped that substantial features such as hearths, kilns or ditches would produce detectable magnetic anomalies.

3.3 The interpretation of the resistance data is complicated by the presence of anomalies produced by topographic changes and varied vegetation cover. However, it was thought that anomalies associated with former lynchets, artificial terraces and possible water control or power generation sites might be recognisable in the data.

4. Results of Gradiometer Survey

Area A

4.1 The results are dominated by extensive areas of ferrous disturbance produced by modern debris; a considerable amount was visible on the surface at the time of the survey. If archaeological features are present in these areas, any magnetic response produced by them will be hidden by this interference. Trenches and deep ruts in the ground surface indicate further recent disturbance to the site.

4.2 A group of archaeological type responses has been recorded in the centre of the survey area and might represent remains of occupation activity. However, the interpretation is cautious because of the disturbed nature of the site. Ferrous objects buried at greater depth and remains of bonfires can produce anomalies that appear to be archaeological in character.

4.3 Two areas of ferrous disturbance in the southern part of the site may be of interest. They appear to have a discrete edge and may represent debris backfilling natural or man made hollows or pools. Although there is no corroborating evidence, they could be associated with riverside industrial activity.

Area B

4.4 In general, the data recorded a high level of background noise, though the magnetic interference from ferrous debris is not as substantial as that recorded in Area A. Some of the elevated background response may have been produced as a result of the difficult walking conditions.

4.5 Magnetically strong anomalies (A) and (B) may reflect burnt or fired structures such as kilns or furnaces, but are most likely to result from modern ferrous objects.

4.6 The areas of magnetic disturbance indicated on the interpretation diagram could represent concentrations of fired material or burnt stones. Anomaly (C) corresponds with some dense tree cover and (D) with the spread of building debris from the southern field boundary. It is considered more likely that these are modern in origin.

4.7 Several faint linear trends can be seen in the gradiometer results that might be of archaeological interest. Two parallel trends aligned NNW run down the slope and other examples are aligned with the contour of the slope. These may represent remains of trackways or terrace features, though the magnetically weak nature of the responses makes this a cautious interpretation. They could equally result from natural variations in soils and bedrock and/or landscaping.

4.8 A linear arrangement of ferrous responses across the north of the survey area almost certainly represents the collection of modern debris along a footpath.

5. Results of Resistance Survey

Area B

5.1 A short band of high resistance, accompanied by a linear low resistance anomaly, recorded in the northernmost part of the survey area coincide with surface variations visible on the ground. They are thought to be natural, possibly relating to a former water course or scouring of the river band. Alternatively, they could represent remains of water control features.

5.2 A well-defined area of low resistance was recorded to the south of the footpath that runs across the top of the survey area; it corresponds with a region of waterlogged ground. It is probably natural in origin, possibly representing a former stream channel. However, the possibility that it may form part of former water control measures cannot be dismissed.

5.3 A region of 'noisy' readings and high resistance responses have been detected in the central section of the survey area. These could represent the remains of former terraces or stone footings, though they are most likely to result from a natural accumulation of stone debris at the base of the slope. Indeed, numerous stones could be seen across the survey area.

5.4 The resistance data in the southern part of the survey area display broad regions of high resistance (E) and (F) that are typical of anomalies produced by topographic changes and/or near surface bedrock. They also coincide with trees; variations in vegetation cover can often produce localised effects on soil moisture content.

5.5 Anomaly (E) appears to be partially enclosed within a low resistance response. While an archaeological origin cannot be ruled out, it might relate to a feature cut into bedrock, it is likely that the anomaly is natural in origin. Concentrations of stone or rubble were apparent at the time of the survey but there are no indications in the data to suggest the presence of walls or lynchet structures.

5.6 The space between anomalies (E) and (F) coincides with the area of the gradiometer survey where linear anomalies were tentatively interpreted as relating to a trackway. Generally low resistance has been recorded in this area, but no anomalies are visible in the data that suggest the presence of a trackway.

6. Conclusions

6.1 Interpretation of the gradiometer survey results was complicated by individual ferrous anomalies and areas of magnetic disturbance. Several archaeological type responses were recorded in the centre of Area A that may relate to activity suggested by the find scatters of Site 6. The results also suggest that remains or debris associated with industrial activity may be present along the north bank of the river.

6.2 Survey in Area B recorded weak linear trends that could have been produced by terrace features associated with Site 50. There was no evidence for the trackway identified as Site 49 along the southern edge of the survey, though there are suggestions of a possible track running down the slope to the river. In addition, areas of magnetic disturbance were detected that may relate to concentrations of fired material or burnt stones. However, modern building debris was visible along the southern field boundary and is likely to account for these disturbed regions.

6.3 Several areas of high readings were identified by the resistance survey in Area B that relate to topographic or geological changes. It is possible that some high resistance anomalies in the central section of the survey area may represent previously identified terrace features and stone footings, Site 50.

Project Co-ordinator: D Shiel
Project Assistants: C Martinez, A Shields & C Stephens

Date of Survey: 12th and 26th August 1999
Date of Report: 10th September 1999

Reference:

SSEW 1983. *Soils of England and Wales. Sheet 3, Midland and Western England.* Soil Survey of England and Wales. 1983.

TECHNICAL INFORMATION

The following is a description of the equipment and display formats used in **GSB Prospection (GSB)** reports. It should be emphasised that whilst all of the display options are regularly used, the diagrams produced in the final reports are the most suitable to illustrate the data from each site. The choice of diagrams results from the experience and knowledge of the staff of **GSB.**

All survey reports are prepared and submitted on the basis that whilst they are based on a thorough survey of the site, no responsibility is accepted for any errors or omissions.

Instrumentation

(a) Fluxgate Gradiometer - Geoscan FM36

This instrument comprises of two fluxgates mounted vertically apart, at a distance of 500mm. The gradiometer is carried by hand, with the bottom sensor approximately 100-300mm from the ground surface. At each survey station, the difference in the magnetic field between the two fluxgates is conventionally measured in nanoTesla (nT), or gamma. The fluxgate gradiometer suppresses any diurnal or regional effects. Generally features up to one metre deep may be detected by this method. Readings are normally logged at 0.5m intervals along traverses 1.0m apart.

(b) Resistance Meter - Geoscan RM15

This measures the electrical resistance of the earth, using a system of four electrodes (two current and two potential.) Depending on the arrangement of these electrodes an exact measurement of a specific volume of earth may be acquired. This resistance value may then be used to calculate the earth resistivity. The "Twin Probe" arrangement involves the paring of electrodes (one current and one potential) with one pair remaining in a fixed position, whilst the other measures the resistance variations across a fixed grid. The resistance is measured in Ohms and the calculated resistivity is in Ohm-metres. The resistance method as used for area survey has a depth resolution of approximately 0.75m, although the nature of the overburden and underlying geology will cause variations in this generality. The technique can be adapted to sample greater depths of earth and can therefore be used to produce vertical "pseudo sections". In area survey readings are typically logged at 1.0m x 1.0m intervals.

(c) Magnetic Susceptibility

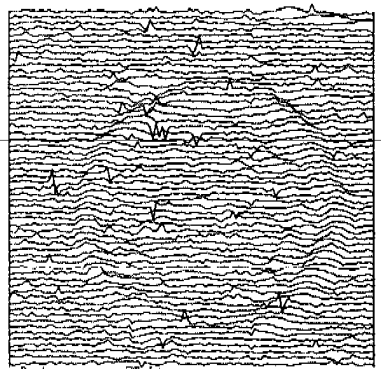
Variations in the magnetic susceptibility of subsoils and topsoils occur naturally, but greater enhanced susceptibility can also be a product of increased human/anthropogenic activity. This phenomenon of susceptibility enhancement can therefore be used to provide information about the "level of archaeological activity" associated with a site. It can also be used in a predictive manner to ascertain the suitability of a site for a magnetic survey. The instrument employed for measuring this phenomenon is either a field coil or a laboratory based susceptibility bridge. For the latter 50g soil samples are collected in the field. Sampling intervals vary widely but are often at the 10m or 20m level.

Display Options

The following is a description of the display options used. Unless specifically mentioned in the text, it may be assumed that no filtering or smoothing has been used to enhance the data. For any particular report a limited number of display modes may be used.

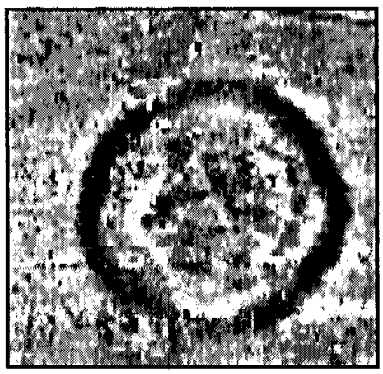
(a) Dot Density

In this display minimum and maximum cut-off levels are chosen. Any value that is below the minimum will appear white, whilst any value above the maximum will be black. Values that lie between these two cut-off levels are depicted with a specified number of dots depending on their relative position between the two levels. Assessing a lower than normal reading involves the use of an inverse plot that reverses the minimum and maximum values, resulting in the lower values being presented by more dots. In either representation, each reading is allocated a unique area dependent on its position on the survey grid, within which numbers of dots are randomly placed. The main limitation of this display method is that multiple plots have to be produced in order to view the whole range of the data. It is also difficult to gauge the true strength of any anomaly without looking at the raw data values. However, this display is favoured for producing plans of sites, where positioning of the anomalies and features is important.



(b) XY Plot

This involves a line representation of the data. Each successive row of data is equally incremented in the Y axis, to produce a stacked profile effect. This display may incorporate a hidden-line removal algorithm, which blocks out lines behind the major peaks and can aid interpretation. The advantages of this type of display are that it allows the full range of the data to be viewed and shows the shape of the individual anomalies. The display may also be changed by altering the horizontal viewing angle and the angle above the plane. The output may be either colour or black and white.



(c) Greyscale

This format divides a given range of readings into a set number of classes. These classes have a predefined arrangement of dots or shade of grey, the intensity increasing with value. This gives an appearance of a toned or grey-scale. Similar plots can be produced in colour, either using a wide range of colours or by selecting two or three colours to represent positive and negative values. While colour plots can look impressive and can be used to highlight certain anomalies, greyscales tend to be more informative.

Terms commonly used in the graphical interpretation of gradiometer data

Ditch / Pit

This category is used only when other evidence is available that supports a clear archaeological interpretation e.g. cropmarks or excavation.

Archaeology

This term is used when the form, nature and pattern of the response is clearly archaeological but where no supporting evidence exists. These anomalies, whilst considered anthropogenic, could be of any age. If a more precise archaeological interpretation is possible then it will be indicated in the accompanying text.

? Archaeology

The interpretation of such anomalies is often tentative, with the anomalies exhibiting either weak signal strength or forming incomplete archaeological patterns. They may be the result of variable soil depth, plough damage or even aliasing as a result of data collection orientation.

Areas of Increased Magnetic Response

These responses show no visual indications on the ground surface and are considered to have some archaeological potential.

Natural

These responses form clear patterns in geographical zones where natural variations are known to produce significant magnetic distortions e.g. palaeochannels or magnetic gravels.

? Natural

These are anomalies that are likely to be natural in origin i.e geological or pedological.

Ridge and Furrow

These are regular and broad linear anomalies that are presumed to be the result of ancient cultivation. In some cases the response may be the result of modern activity.

Ploughing Trend

These are isolated or grouped linear responses. They are normally narrow and are presumed modern when aligned to current field boundaries or following present ploughing.

Trend

This is usually an ill-defined, weak or isolated linear or curvilinear anomaly of unknown cause or date.

Areas of Magnetic Disturbance

These responses are commonly found in places where modern ferrous or fired materials are present e.g. fencelines, pylons or brick rubble. They are presumed to be modern.

Ferrous Response

This type of response is associated with ferrous material and may result from small items in the topsoil or larger buried objects such as pipes. Ferrous responses are usually regarded as modern. Individual burnt stones, fired bricks or igneous rocks can produce responses similar to ferrous material.

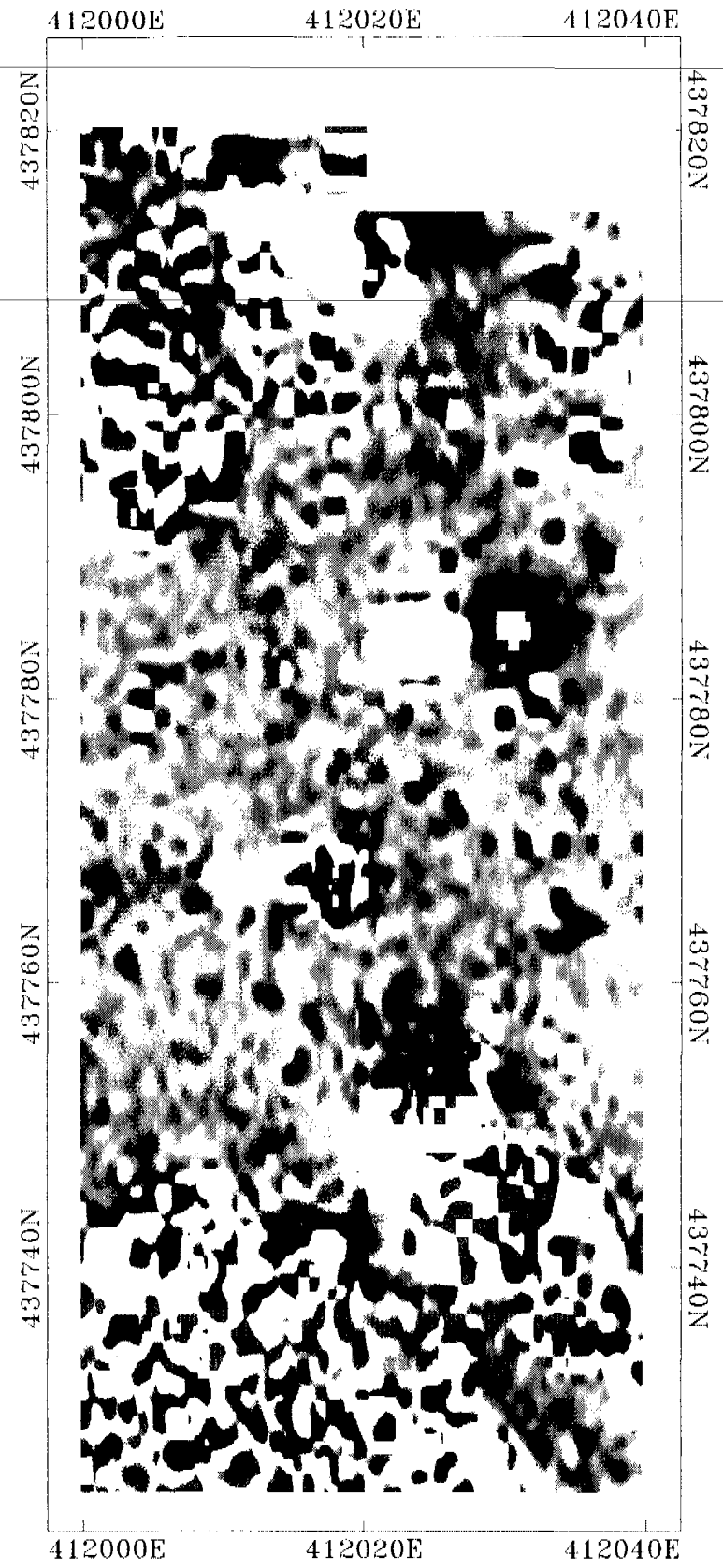
List of Figures


GSB PROSPECTION
PROJECT: 99/95 BINGLEY RELIEF ROAD
TITLE: Location of Survey Areas
Based on a plan provided by the Babtie Group
0
metres
40
437800
437700
437600
AREA A
AREA B
Path (um)
Stepping Stones
Path (um)
Path (um)
Cottingley Beck
The Walks
The Walks
Riversdene
412000
412100
Gradiometer Survey
Resistance Survey

Figure 1


GSB PROSPECTION
PROJECT: 99/95 BINGLEY RELIEF ROAD
TITLE: Summary Interpretation
Based on a plan provided by the Babtie Group
0
metres
40
437800
437700
437600
AREA A
AREA B
Path (um)
Stepping Stones
Path (um)
Path (um)
Cottingley Beck
The Walks
The Walks
Riversdene
412000
412100
MAGNETIC ANOMALIES
?Archaeology
Linear Trend
Area of Magnetic Disturbance
Ferrous
RESISTANCE ANOMALIES
High Resistance - Bedrock
High Resistance - ?Natural
Low Resistance - ?Natural

Figure 2



BINGLEY RELIEF ROAD
Area A: Gradiometer Data

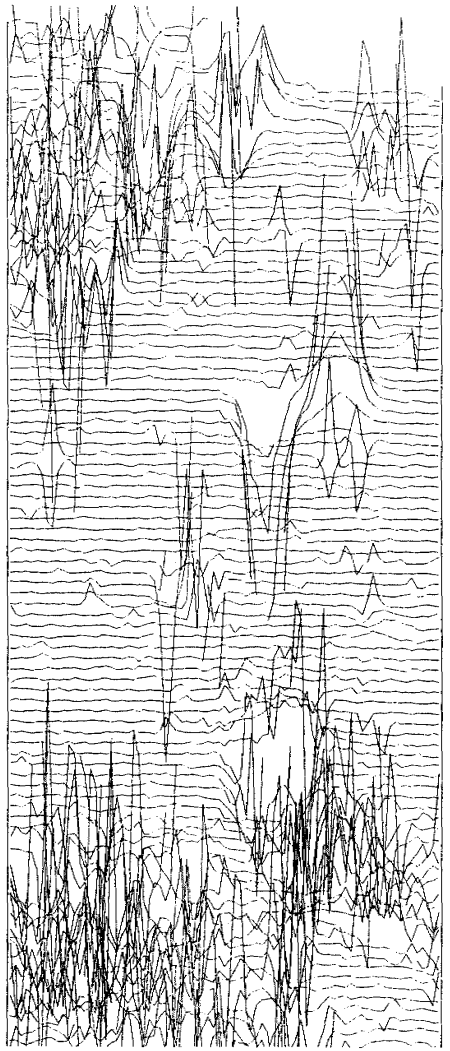
5 0 5 10 15
(metres)

GSB Prospection 99/95

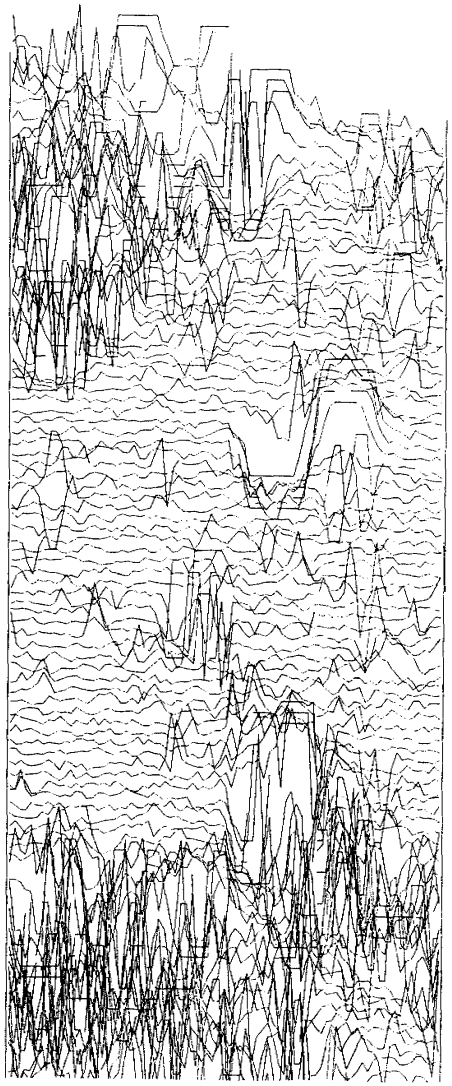
1.8
1.6
1.4
1.3
1.1
0.9
0.7
0.5
0.3
0.1
-0.1
-0.3
-0.4
-0.6
-0.8
-1.0
nT

Figure 3

BINGLEY RELIEF ROAD
Area A: Gradiometer Data

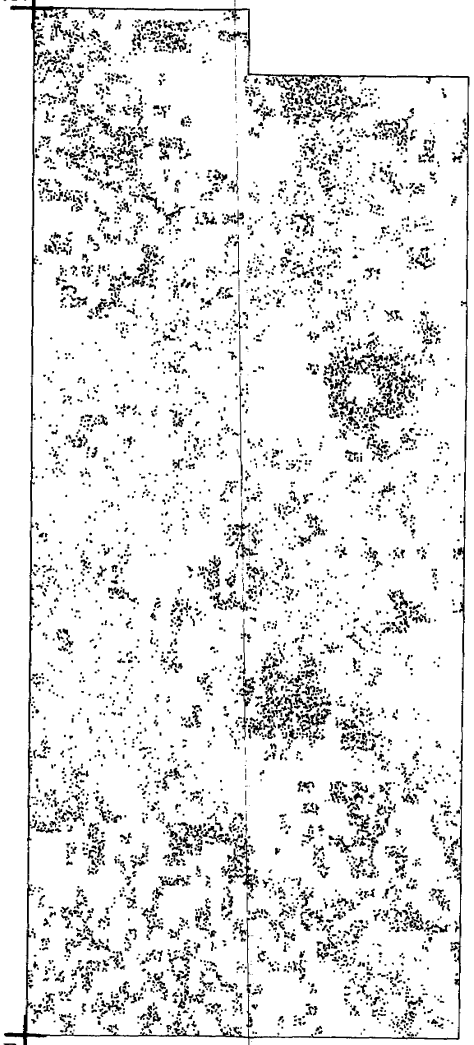


50 nT



15 nT

411960.303E
437811.727N



412000.002E
437724.320N

2.0
nT
0.1

0 m 20

GSB Prospection 99/95

Figure 4

BINGLEY RELIEF ROAD

Area A: Gradiometer Data Interpretation

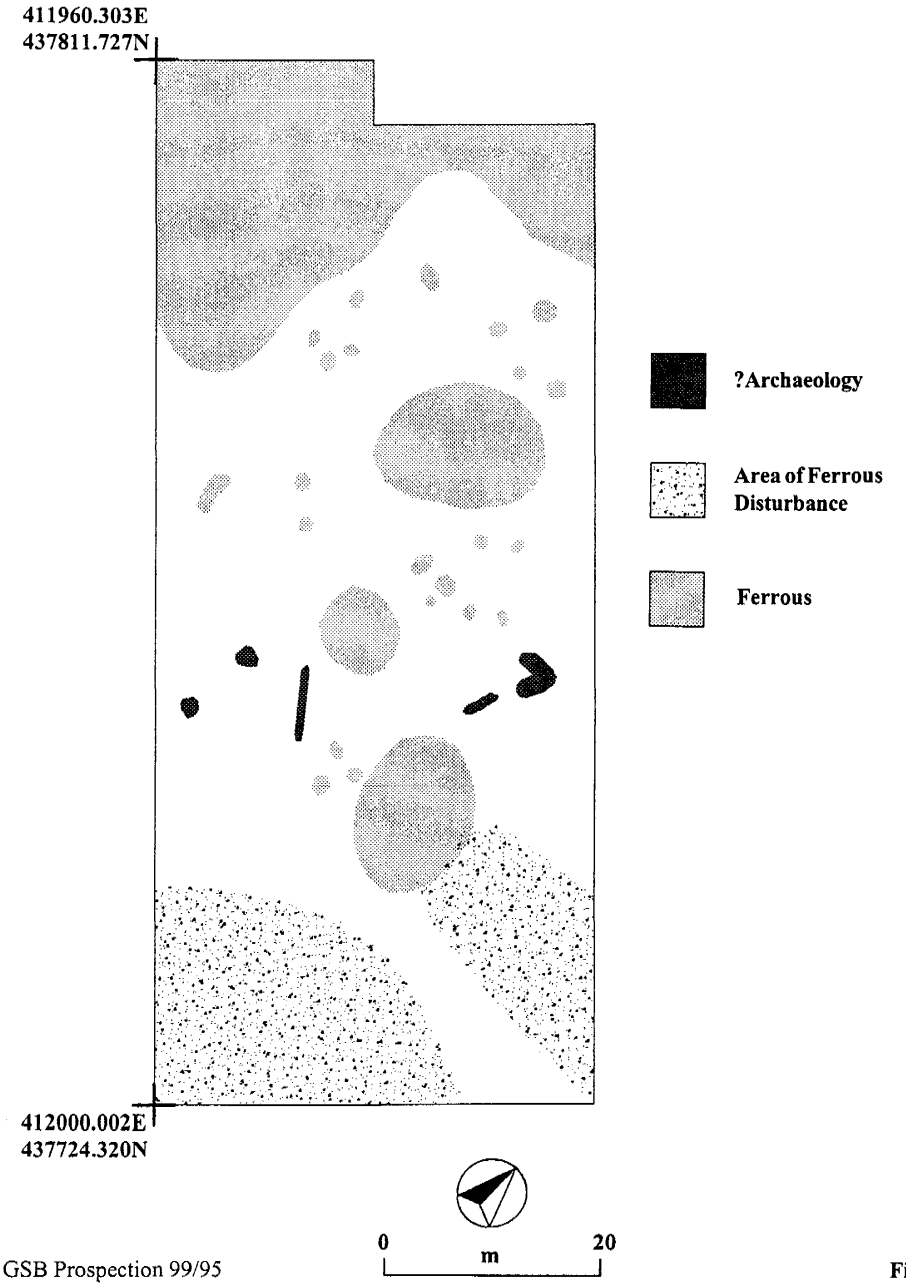


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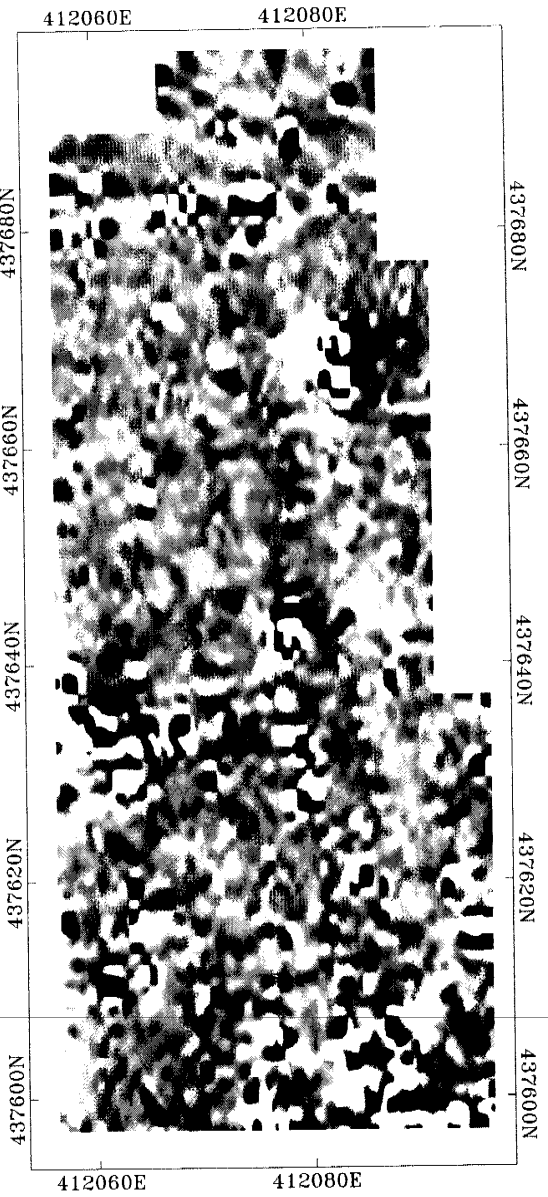
Figure 5



BINGLEY RELIEF ROAD
Area B: Gradiometer Data

5 0 5 10 15
(metres)

GSB Prospection 99/95

nT

Figure 6

BINGLEY RELIEF ROAD
Area B: Gradiometer Data

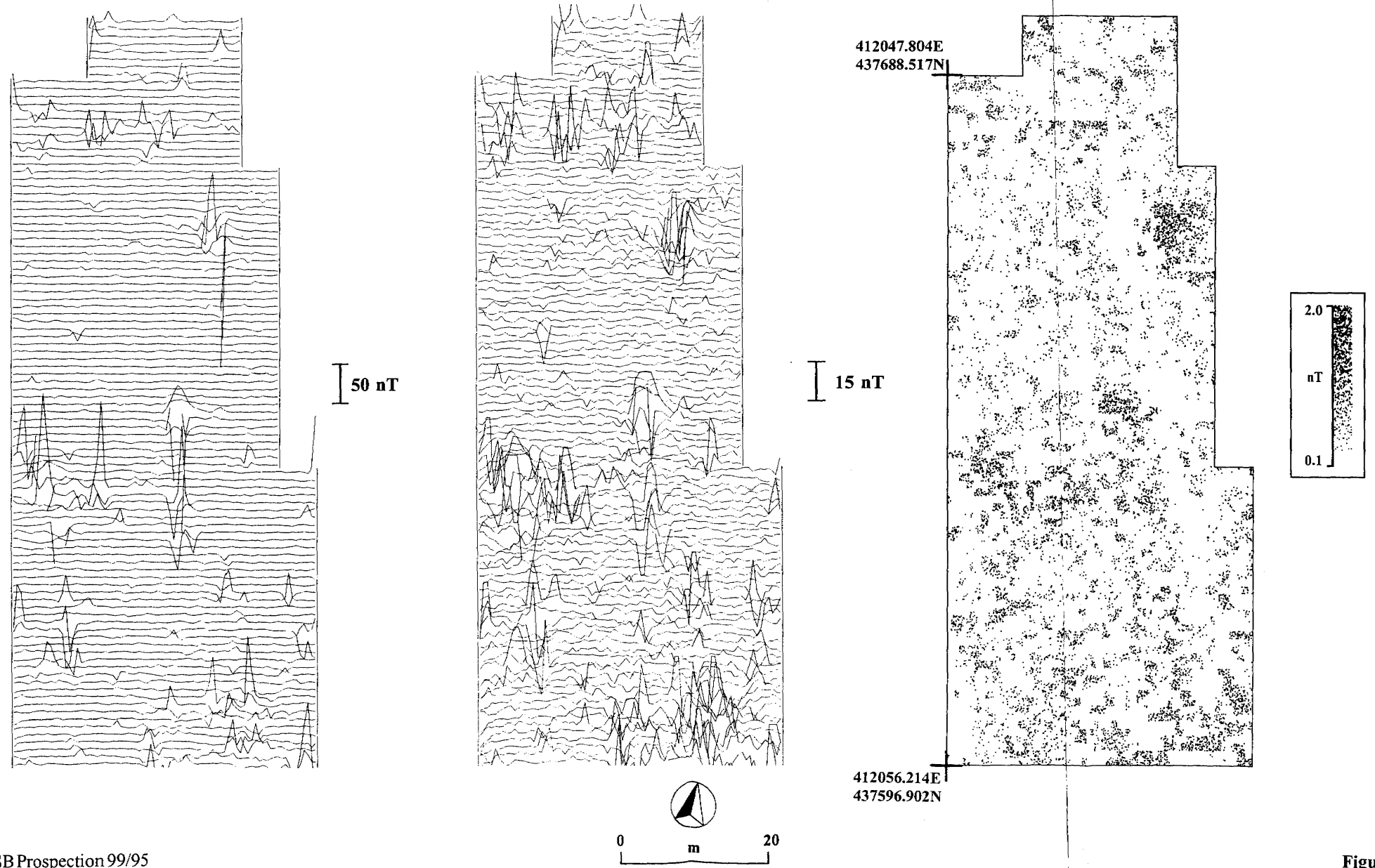


Figure 7

BINGLEY RELIEF ROAD

Area B: Gradiometer Data Interpretation

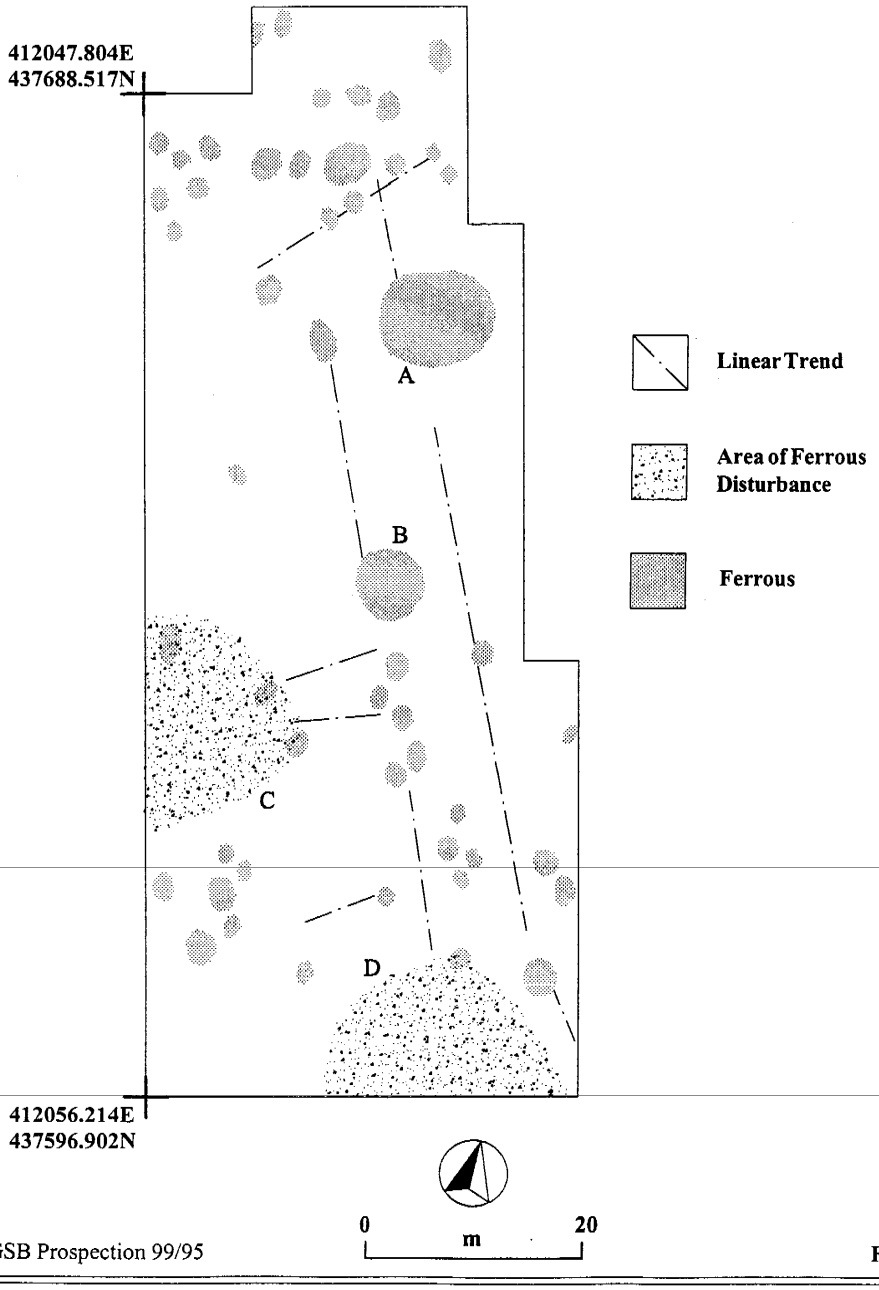


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Figure 8

BINGLEY RELIEF ROAD
Area B: Resistance Data

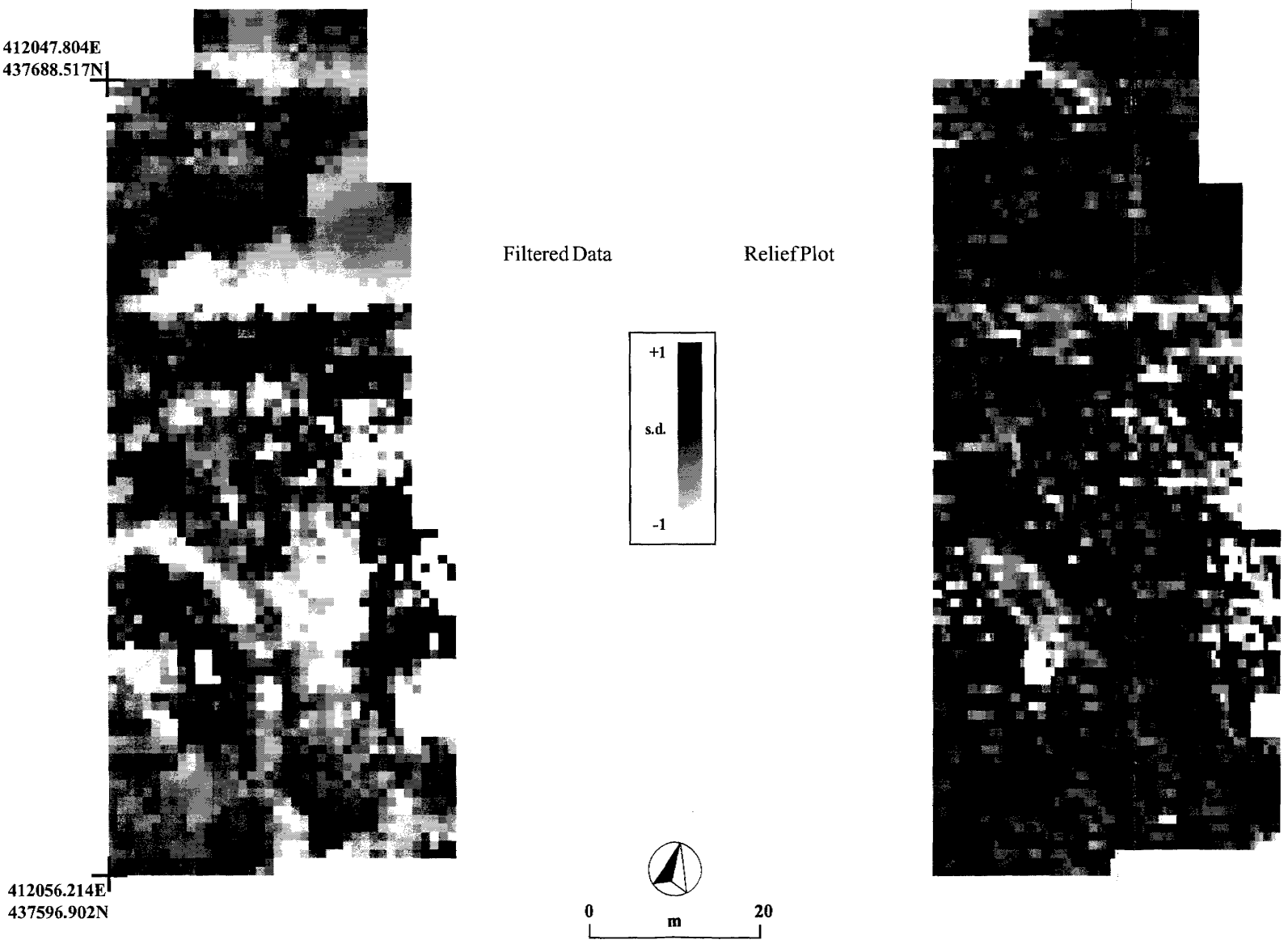

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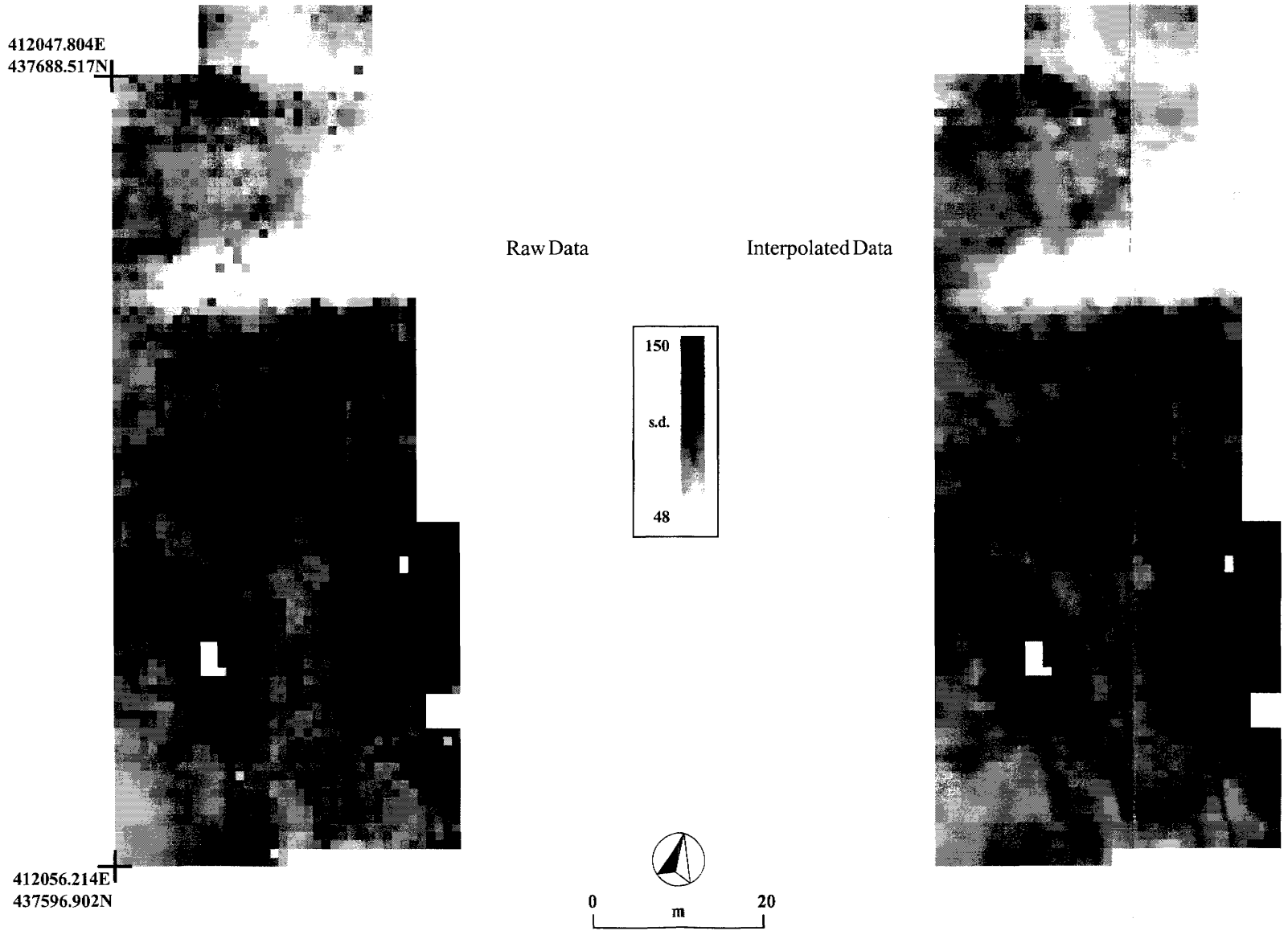
Figure 10

BINGLEY RELIEF ROAD
Area B: Resistance Data



GSB Prospection 99/95

Figure 9

BINGLEY RELIEF ROAD

Area B: Resistance Data Interpretation

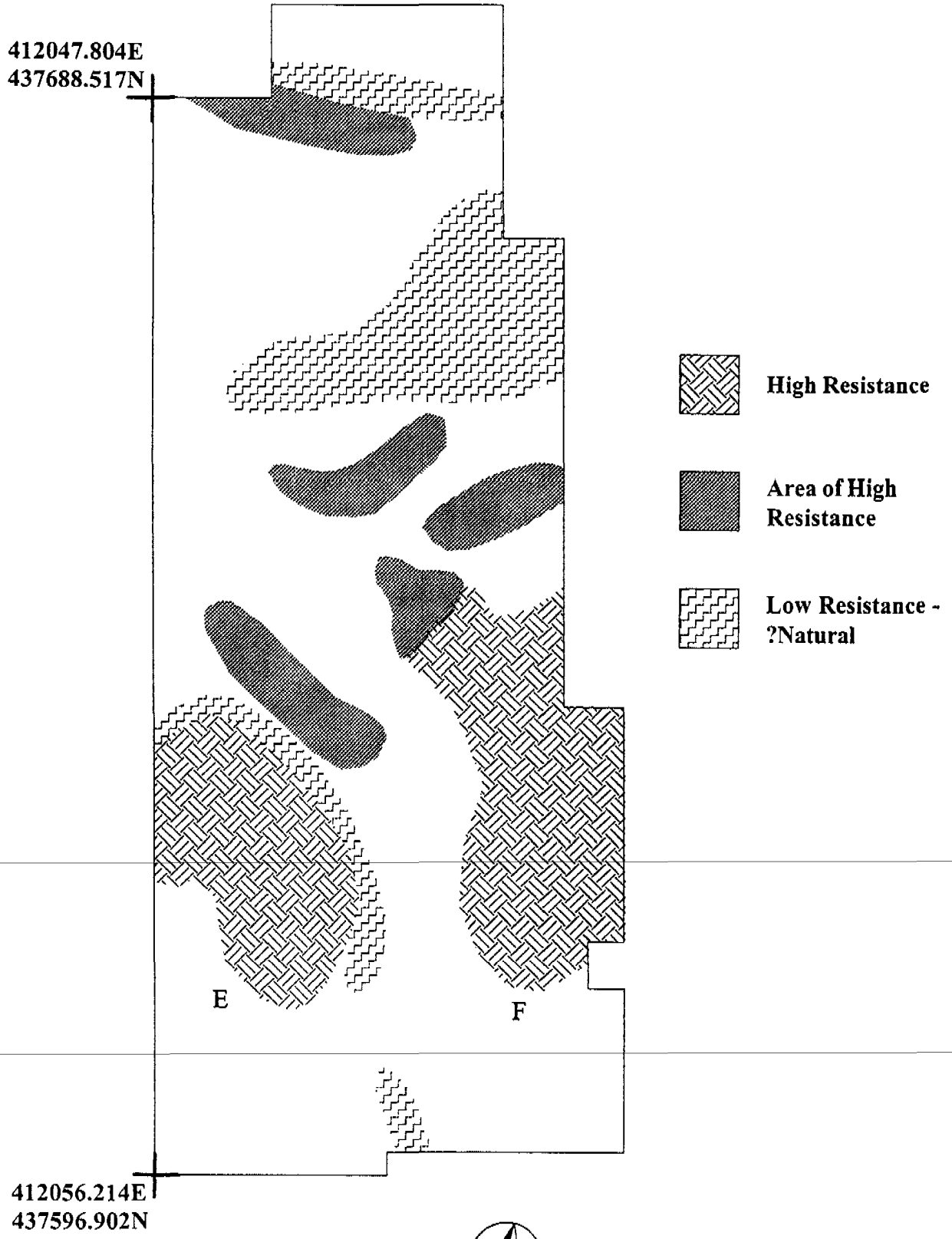


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Figure 11