8.4.4 Transect T1E

This transect was undertaken to provide complimentary data for terrestrial NIR (near infra red 950nm) scanning over a palaeochannel, which itself was comparative data for airborne LiDAR intensity (1047nm) survey. The location of this ER transect was an area of terrace 1 (Fig. 8.10). It has been proposed that LiDAR intensity can act as a proxy for subsurface sediment architectures and hence geoarchaeological potential (*Carey et. al 2007*). Therefore, it is important to be able to quantify surface and subsurface sediment relationships. The ER transect was 91m long and used a 1m electrode spacing, giving a depth coverage of c. 6m. As NIR scanning was being undertaken, time taken for the ER sections was limited, and only a limited gouge core transect was completed in the time available (10m core spacing).

From the LiDAR LP DTM a palaeochannel is evident as a topographic feature (Fig. 8.10), which is also evident through LiDAR intensity survey (Fig. 8.11) and ground based earth resistance survey (Fig. 8.12). The ER section clearly defines a palaeochannel (units D and E) between two areas of terrace (units A and B; Fig. 8.13). The ER data shows a close correlation with the limited gouge core transect. There is a good agreement in the depth to the gravels within the palaeochannel between the ER and gouge core data. The palaeochannel/terrace interface is also evident from the ER section and closely matches that depicted by the gouge core transect.

The relationship of the gouge core data to the ER section is revealing. The palaeochannel is at its deepest where the area of lowest resistivity defined by unit E is located. At this point the palaeochannel is dominated by unit 2 (stiff red brown silty clay, with Fe and Mn mottling), unit 4 (dark grey clay with a trace of sand) and unit 5 (dark grey clayey sand). A dark grey peaty clay (unit 7) is seen in the palaeochannel, but this does not coincide with unit E, the area of lowest resistivity. However, based on its field description unit 7 is likely to have the highest organic content of the palaeochannel sediment units. Again the ER section does not define the sediment units to match the gouge core transect, although broad changes in resistivity can be attributed to changes in the sediment stratigraphy recorded through the gouge core transect.

The interpretation of the ER section allows the identification of the alluvium on top of the terrace gravels (unit A). The general palaeochannel morphology is evident (units D and E) , with the base of the palaeochannel/gravel interface (c. 2.5m deep) and the edge of the palaeochannel/terrace interface well defined. The area of lowest resistance within the palaeochannel is identified (unit E). The depth to gravels is evident both on the terrace and below the palaeochannel (units B and F). A higher resistivity unit on top of the palaeochannel is seen in the ER section (unit C), although no equivalent sediment unit was identified on the gouge core transect.

The profile of the gravel body is evident from the ER section. Again two units can be seen within the gravels. Unit B has a high resistivity value and represents either a clast supported gravel, a gravel with lower water content or a combination of the two factors. Unit F has a lower resistivity value and represents either a matrix supported gravel, a gravel with higher water content or a combination of the two factors. It is unlikely that the location of the palaeochannel above the gravel unit F is a coincidence and they are probably related factors, i.e. the palaeochannel above the gravel is restricting water loss, increasing the water content of the gravel below it. The lower resistivity value of the gravel unit F indicates an area of higher biotaphonomic potential within the gravel body. This again has importance for the preservation of organic material within the gravel. A suggested boundary between the gravels (units B and F) and the Mercian Mudstone is given (unit G). This is a good example of the integration of the airborne prospection with ground based prospection, whereby a palaeochannel identified though airborne prospection can have its general morphology defined through ground based geoprospection.

Transect T1E summary:

- There is close agreement between the gouge core transect and the ER section.
- The main geomorphological units of palaeochannel and terrace are defined by the ER transect.
- The alluvial covering on top of the terrace gravels is definable.
- The area of lowest resistance within the palaeochannel is identifiable, identifying the area of the palaeochannel with the highest biotaphonomic potential.
- The gravel bedrock interface is interpreted from the ER section.

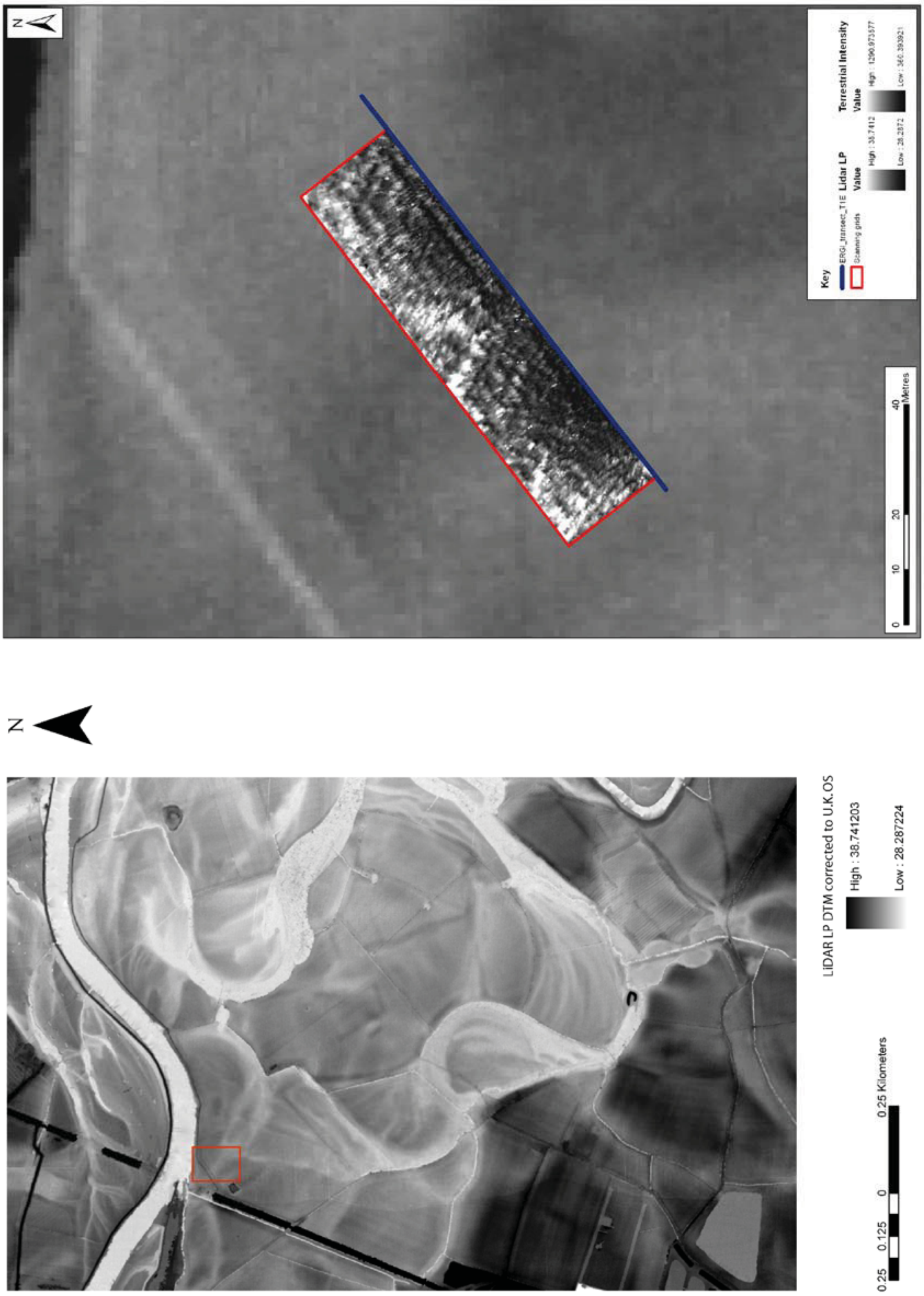


Fig 8.10: The location of ER transect T1E, placed on the LiDAR LP DTM. The palaeochannel is evident as a topographic feature.

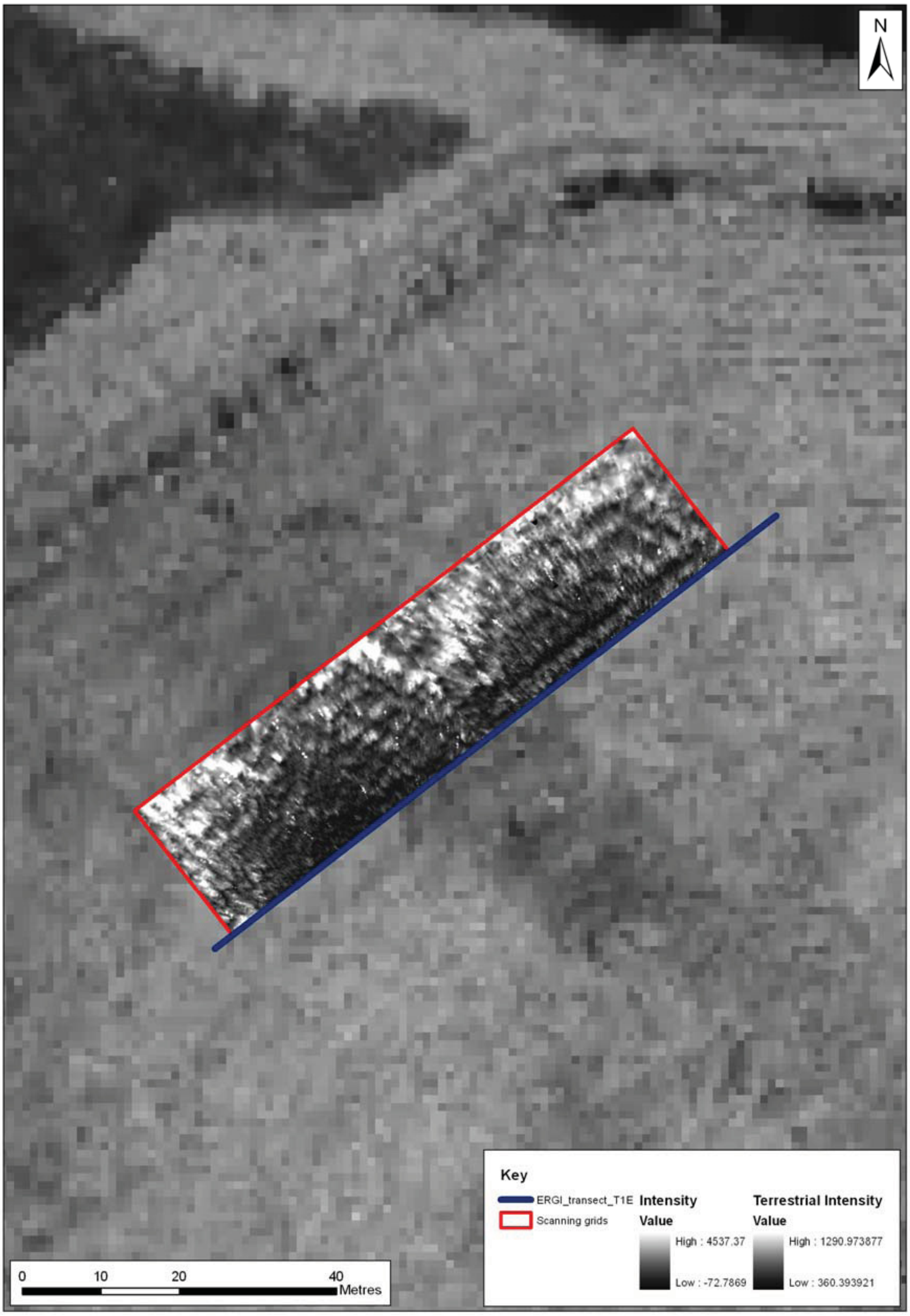


Fig 8.11: ER transect T1E placed on the LiDAR intensity survey.

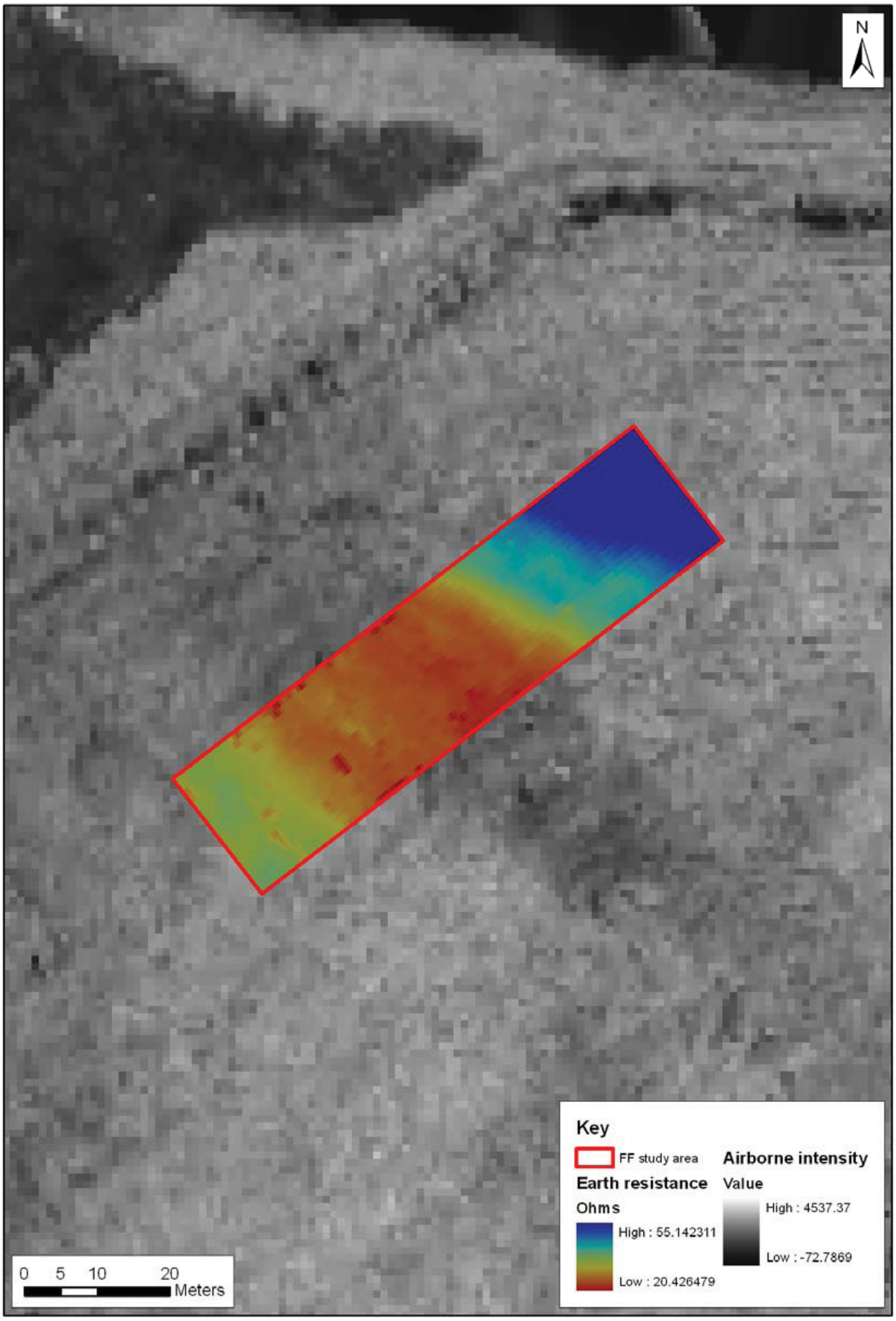
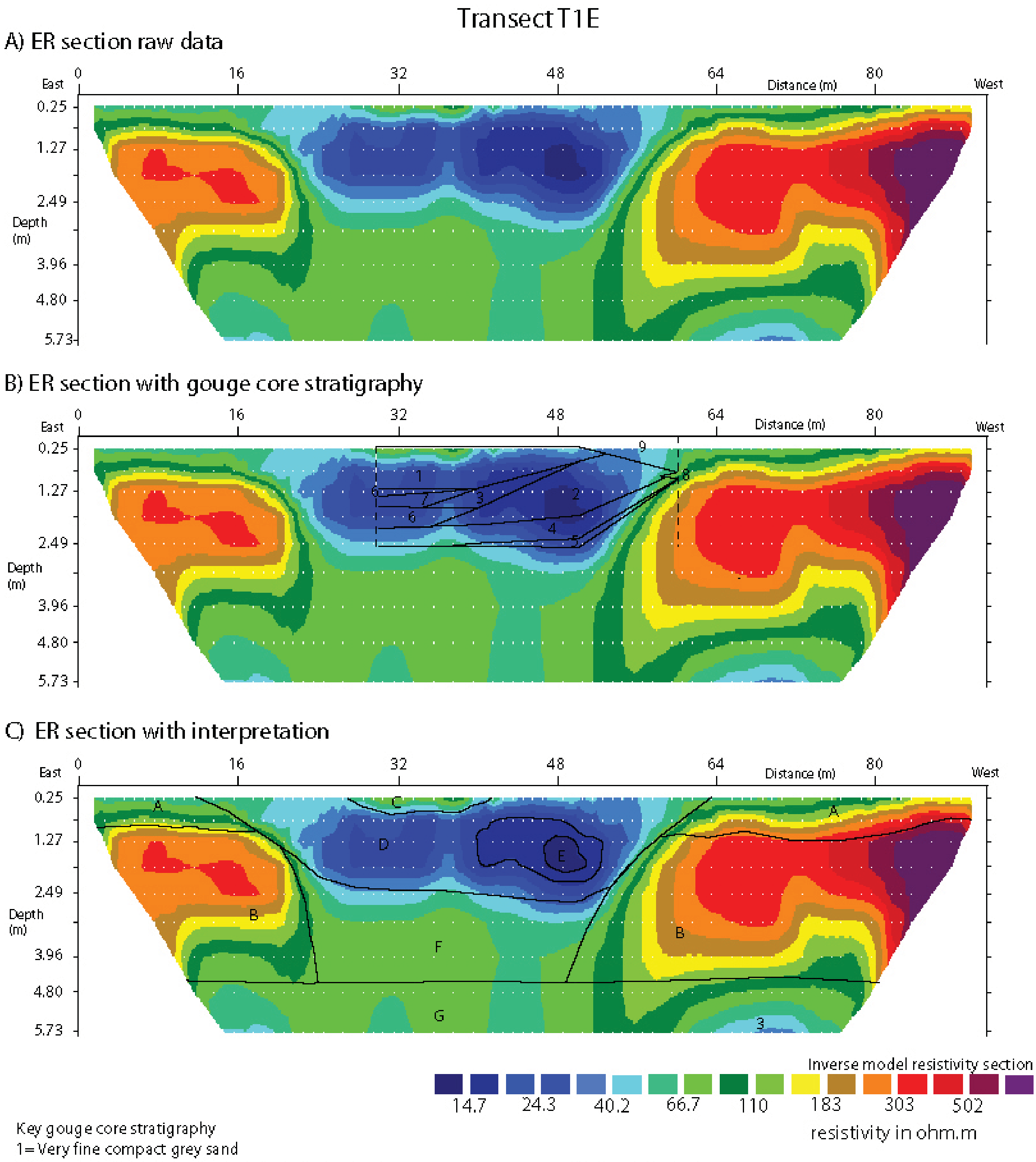


Fig 8.12: Earth resistance survey over the same area as T1E. The palaeochannel is evident as a low resistance feature.



Key gouge core stratigraphy
1= Very fine compact grey sand
2 = Stiff red brown silty clay, with Fe and Mn mottling
3 = Fine compact grey sand
4 = Dark grey clay, trace of sand
5 = Dark grey clayey sand
6 = Grey sandy clay with Mn and fe mottling
7 = Dark grey peaty clay
8 = Brown silty clay
9 = Brown clayey silt

Key for interpretation:
A = terrace alluvium (red brown silty clay)
B = gravel higher resistance (clast supported/higher water content)
C = area of drier alluvium above palaeochannel fill
D = palaeochannel
E = area of palaeochannel with highest water content
F = gravel lower resistance (matrix supported/lower water content)
G = bedrock (Mercian mudstone)

Fig 8.13: ER transect T1E.

8.4.5 ER transect T1F

Transect T1F was undertaken on a palaeochannel thought to be a relatively recent palaeochannel of the river Soar (Fig. 8.14). Much of this palaeochannel holds water throughout the year and has an extensive reed bed, making survey into the palaeochannel difficult (Fig. 8.15). An ER transect ran from the terrace edge part way into the palaeochannel, in an attempt to ascertain some of the palaeochannel morphology. The transect ran for 58m, using a 1m electrode spacing.

The ER section defined the major geomorphological units within the transect (Fig. 8.16). The palaeochannel (unit 2) is clear, sloping away from the terrace alluvium (unit A) and incising into the gravels (unit B). The junction between the above gravel alluvium (unit A) and the gravel (units B and C) is interpreted. The junction between the gravel (units B and C) and bedrock (unit E) is also interpreted. Again variation is seen in the resistivity values of the gravels, with areas of lower resistivity values having higher potential to preserve organic remains.

From the interpretation of the ER section it is clear that the transect has only covered the edge of the palaeochannel. The palaeochannel is relatively shallow throughout the section and based on these ER results it would not be cored for palaeoenvironmental samples, due to its shallow morphology.

Transect T1F summary:

- The main geomorphological units are identified by ER.
- The edge of the palaeochannel is relatively shallow and has a low biotaphonomic potential.
- Variation in the resistivity values of the gravels are evident.
- The boundary between the Mercian Mudstone and the gravels is evident.

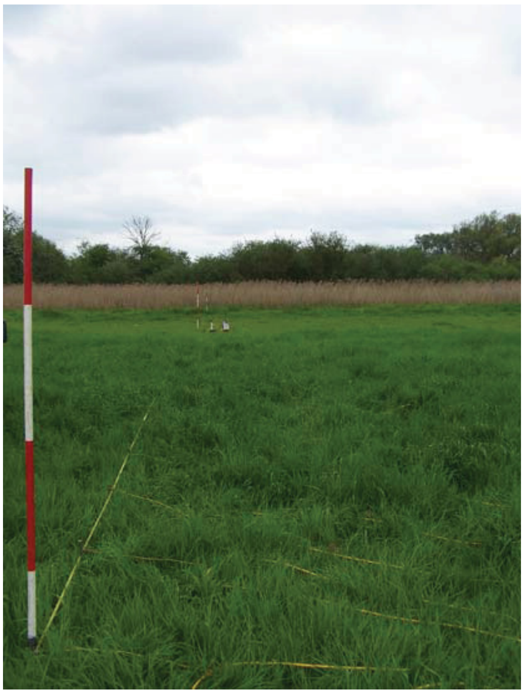


Fig 8.15: Photograph of ER transect T1F. The palaeochannel still holds water, as evidenced by the abundant reeds.

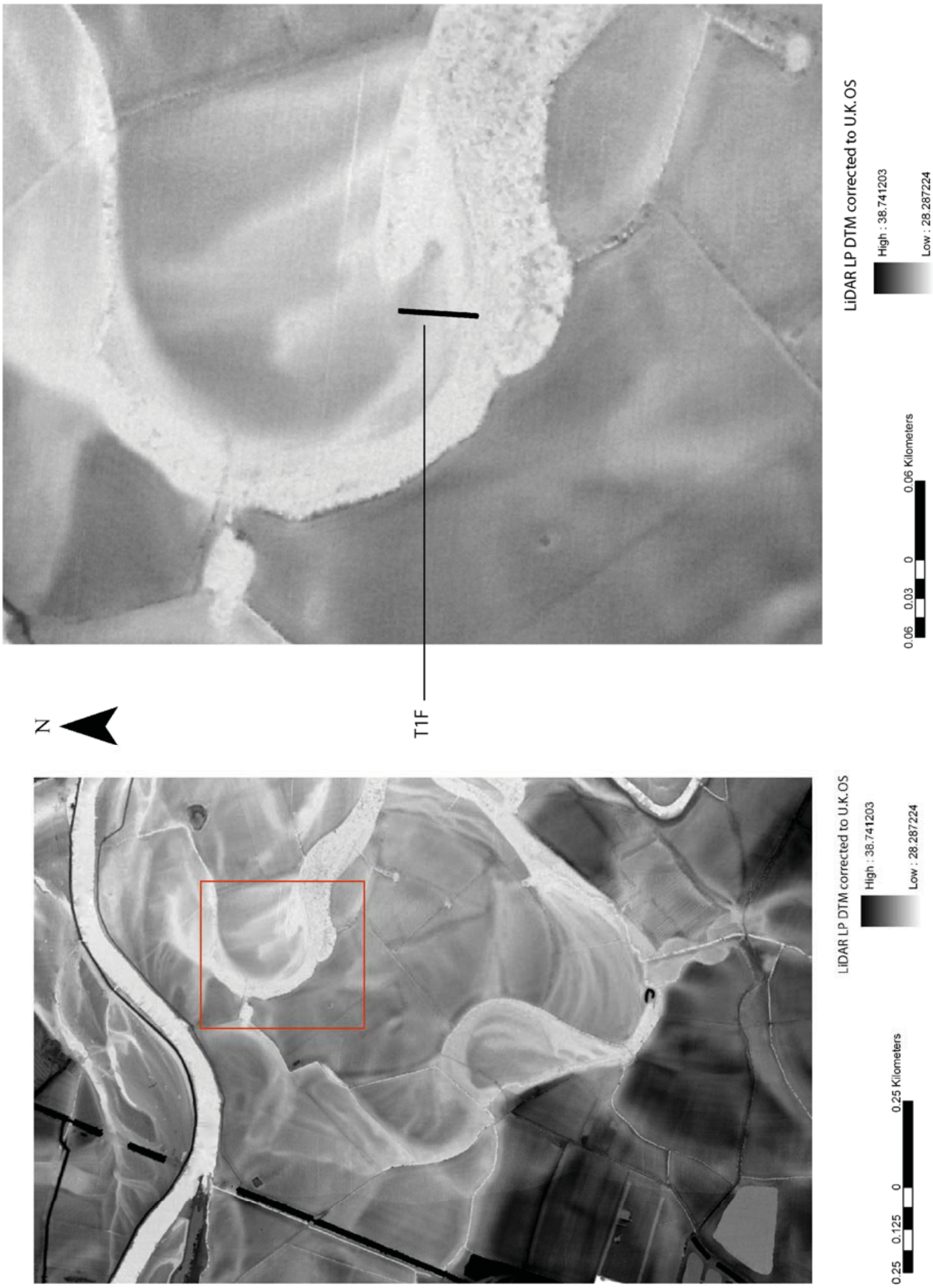


Fig 8.14: Location of the ER transect T1F.

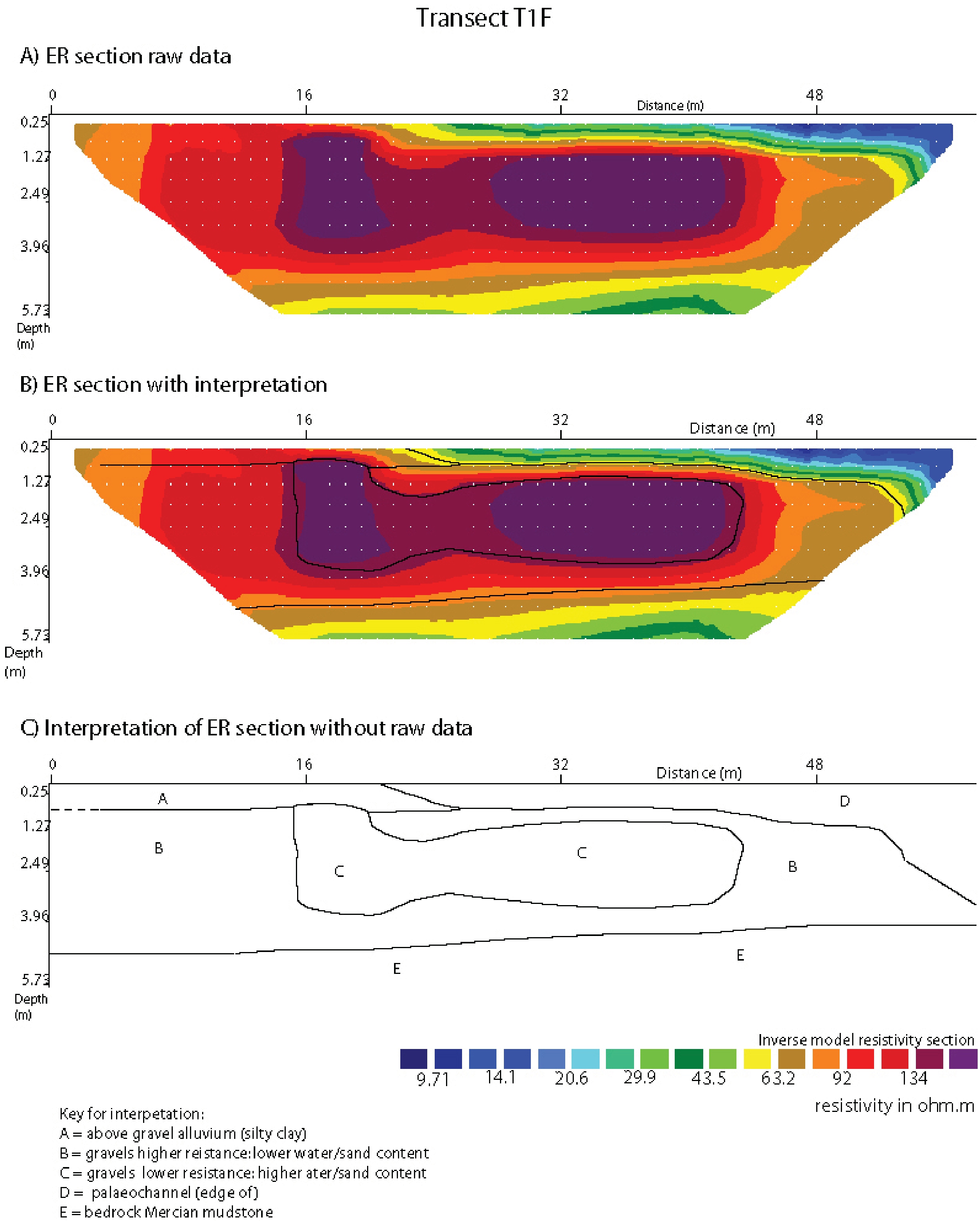


Fig 8.16: ER transect T1F.

8.4.6 ER transect T1G

This palaeochannel was located in the field adjacent to the transects T1A and T1B (Fig. 8.17). The ER transect ran across the widest section of this field in order to provide baseline information on the general morphology of this palaeochannel. This palaeochannel demarcates the boundary between the Holme Pierrepont terrace 2 and the later Holocene Hemington terrace 1, and has importance for understanding the general chronostratigraphy of the study area. However, due to the high ground water table of this area (the surface sediments were saturated), attempts to understand the stratigraphy of the palaeochannel using GPR were abandoned. The transect ran for 83m, using a 0.5m electrode interval. A gouge core transect recorded sediment stratigraphy at 10m intervals along the ER transect.

The ER transect revealed the upper section of the profile to have two palaeochannels (units A and C) separated by a feature (unit B). The gouge core stratigraphy shows sediment unit 6 (stiff red black silty clay with organics) and partly sediment unit 4 (red brown humic clay) to correlate with palaeochannel defined by unit A. The palaeochannel unit C, again correlates with unit 6 and also partly unit 5 (brown silty A horizon).

The feature that occurs between these two palaeochannels is unit B. This correlates closely with the two sediment units 6a (stiff red grey silty clay) and 6b (stiff brown silty clay). The two units 6a and 6b, represent a marginal difference in sediment composition from unit 6. However, unit 6 was recorded as having a much higher organic content and the ER section makes a clear distinction between units A, B and C. Unit B on first impressions may be thought to be a gravel bar in a shallow braided channel. However, the sediment composition of feature B shows it is not a gravel bar and was formed within a low energy depositional regime. Unit B has a relatively low resistivity value compared to the gravels lower in the section. It possibly represents a hiatus in occupation of a larger channel system.

Below the units A, B and C, unit D is interpreted as sands lying at the top of the gravel. This unit corresponds to units 3 (grey black coarse sand), 7 (grey brown organic peaty clay), 8 (grey medium clayey sand), 9 (dark grey black silty clay) and 10 (red clayey sand) on the north side of the section. Therefore, there is some correlation with sand dominated units above the gravels, although some of these units are clays, which should have lower resistivity values. On the south side of the section there is unit 12 (grey coarse sand) lying at the top of the gravel unit.

From the ER section the geomorphological features of the palaeochannels (units A and C), the between palaeochannel feature (unit B) and the gravels (and E and F) are interpretable. Again variation in the resistivity values of the gravels is seen, with unit F having a lower value, lying underneath the palaeochannel unit C.

Transect T1G summary:

- The ER section showed a good level of correlation with the gouge core stratigraphy.
- Two palaeochannels (units A and C) were evident either side of a feature (unit B).
- The junctions between the palaeochannel fill (units A and C) and the between channel feature (unit B), and the gravels is interpretable.
- Variation in the resistivity values of the gravels were seen, again correlating with the gravels below the palaeochannel having a lower resistance.

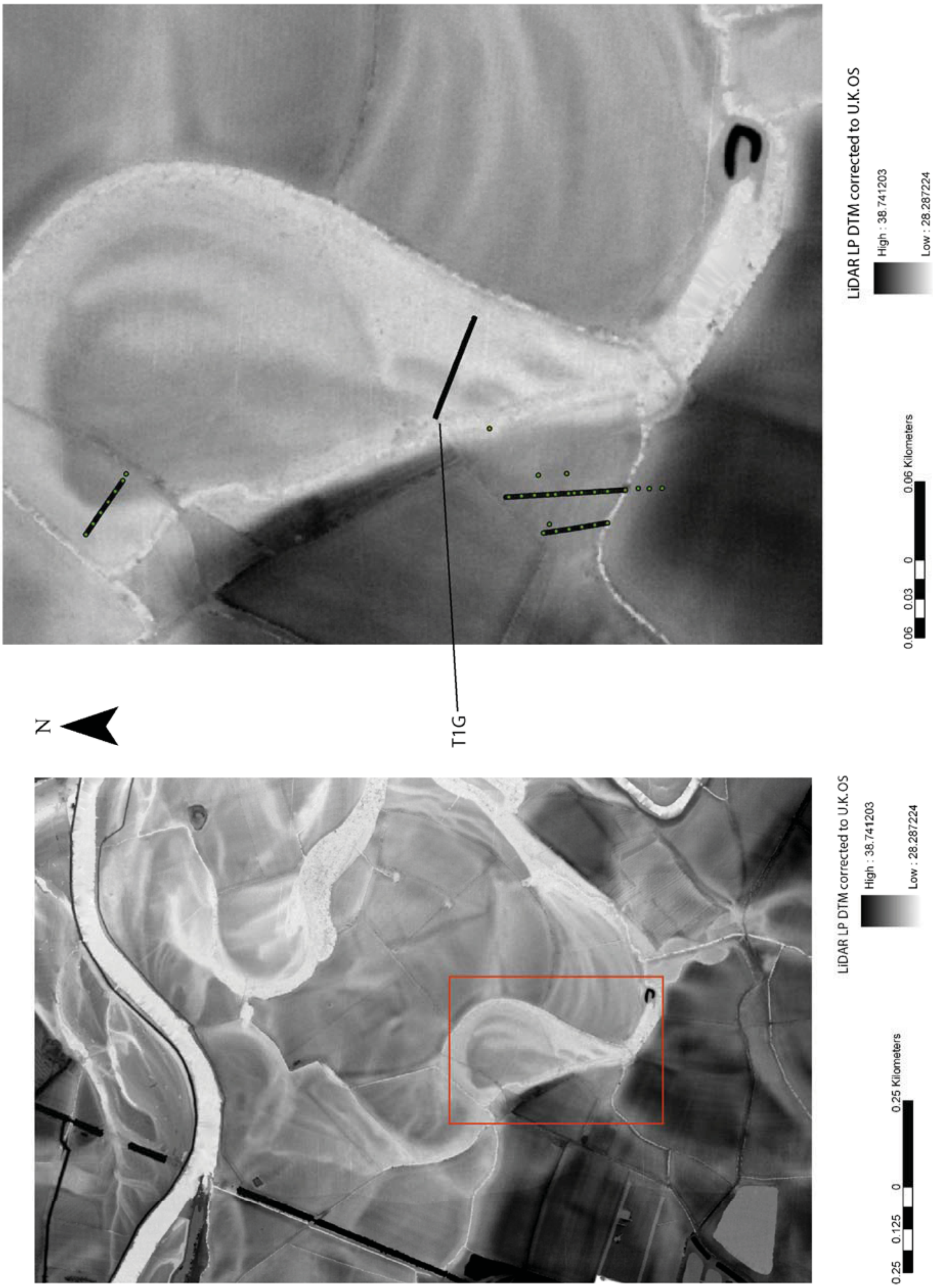


Fig 8.17: Location of ER transect T1G.

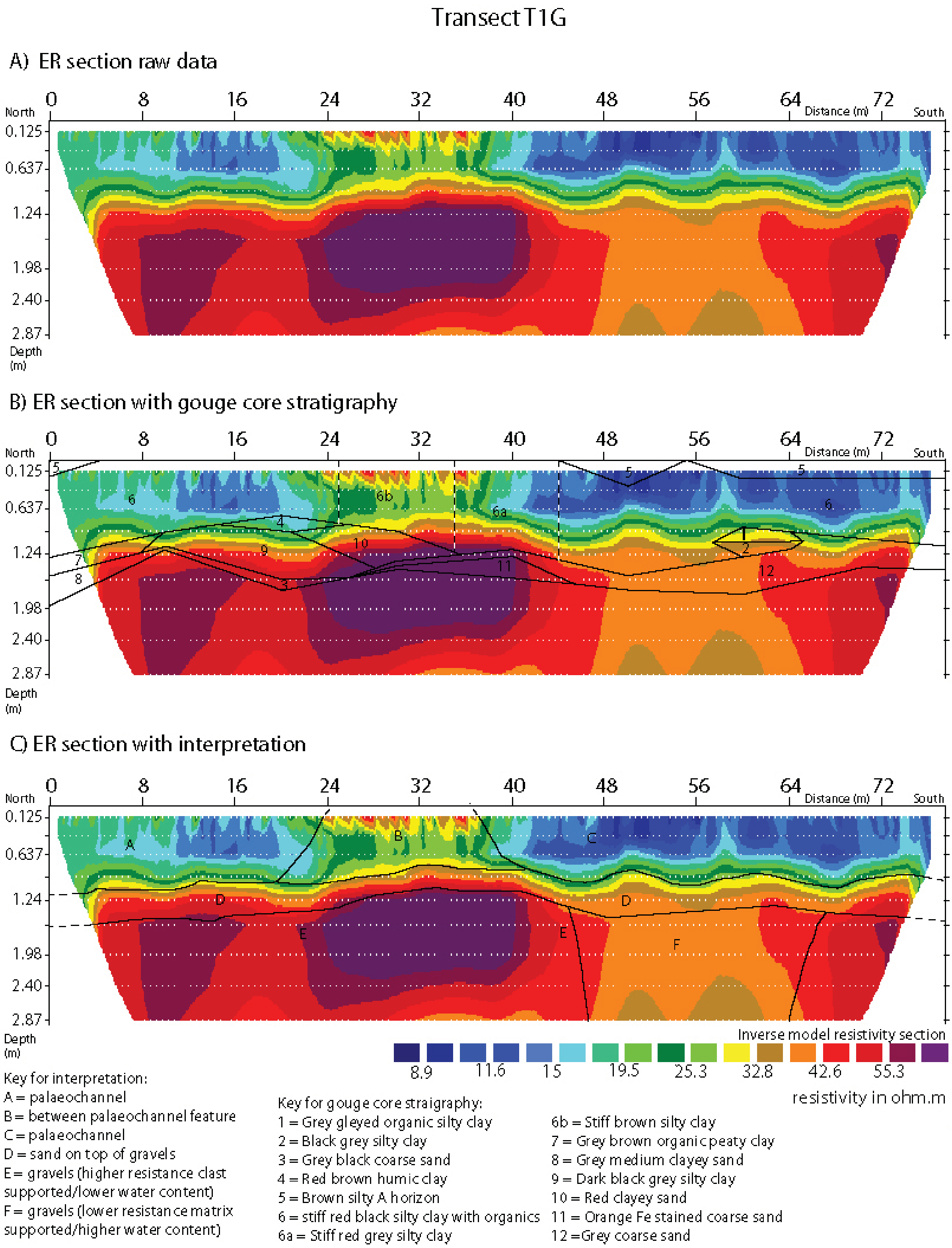


Fig 8.18: The ER transect T1G.

8.4.7 ER transect T1H

Transect T1H was undertaken at the junction between a palaeochannel and an area of terrace 1, in close proximity to transects T1C and T1D. Both the terrace and palaeochannel are evident through topographic expression, as shown through the LiDAR LP DTM (Fig. 8.19). The ER transect ran for 48m, using a 0.5m electrode spacing. The end of the ER data file corrupted, so the results are for the first 40m of the transect only. GPR and gouge core sections (10m core spacing) were run along the same transect. This palaeochannel was cored to retrieve the core T1C8 and the ER section aimed to provide further information on its morphology, stratigraphy and biotaphonomic potential.

The GPR transect provides an interesting contrast to the gouge core data. The depth to gravels is shown by the gouge core stratigraphy at c. 1.6m across the transect. However, the GPR trace reveals a strong reflecting unit at c. 2m and a weaker reflecting unit, varying between 1.4 and 1.7m. The depth to impenetrable gravel is not seen as a reflective discontinuity on the GPR trace. However, the angle of dip of the gravels on the west side of the transect is mimicked by the GPR trace, suggesting that the plane of deposition has been detected by the GPR.

The centre of the GPR trace is seen as a blank area of no reflectance and the gouge core data reveals the units of 2 (brown grey clay, with a trace of sand and Fe and Mn mottling), unit 3 (blue grey clay, with a trace of sand and Fe and Mn mottling), unit 4 (dark blue grey organic rich clay), unit 7 (brown grey sand clay) and unit 8 (grey pink sand) in this blank GPR area. There is a weak relationship between the GPR data and the stratigraphy revealed through the gouge core.

The relationship of the ER section to the gouge core stratigraphy is easier to interpret compared to the GPR data, but the relationship between the two data sets is still not precise. The palaeochannel A1 partially correlates with the two sediment units 3 and 4, both clay dominated units. Unit 4 is recorded as being organic rich and matches in a horizontal location with unit B, identified as the area of the lowest resistivity value within the palaeochannel. This stated, unit 4 is lower than unit B (c. 40cm difference). Palaeochannel A2 correlates with unit 2 (brown grey clay, with a trace of sand and Fe and Mn mottling), but unit 2 extends away from the palaeochannel. Underneath palaeochannel A2 a relatively deep pink grey sand (unit 8) is recorded, which correlates with the interpreted unit C, a sand layer above the gravels. The depth to gravels is not clear from the ER trace, but with the gouge core stratigraphy it is possible to interpret this junction.

In isolation the ER section allows the identification of the palaeochannel A1, with its morphology well defined. Palaeochannel A2 has a higher resistance feature roughly at its centre, but this is not witnessed in the gouge core stratigraphy, although it is located between the 20m and 30m coring stations. A relatively large unit of intermediate resistivity value (unit C) is seen between the gravels (units E and D) and the palaeochannels (units A1, A2 and B), and is interpreted as sands above the gravels. Again variation in the resistivity values of the gravels is seen.

T1H summary:

- There is little correlation between the GPR trace and the gouge core stratigraphy.
- There is a stronger correlation between gouge core stratigraphy and the ER section.
- The depth to impenetrable gravel on the ER section alone would be difficult to interpret.
- The interpretation of the ER section reveals two palaeochannels and sands lying above the gravels, an interpretation largely supported by the gouge core stratigraphy.
- More gouge cores at a closer spacing may have provided a closer correlation with the ER section.

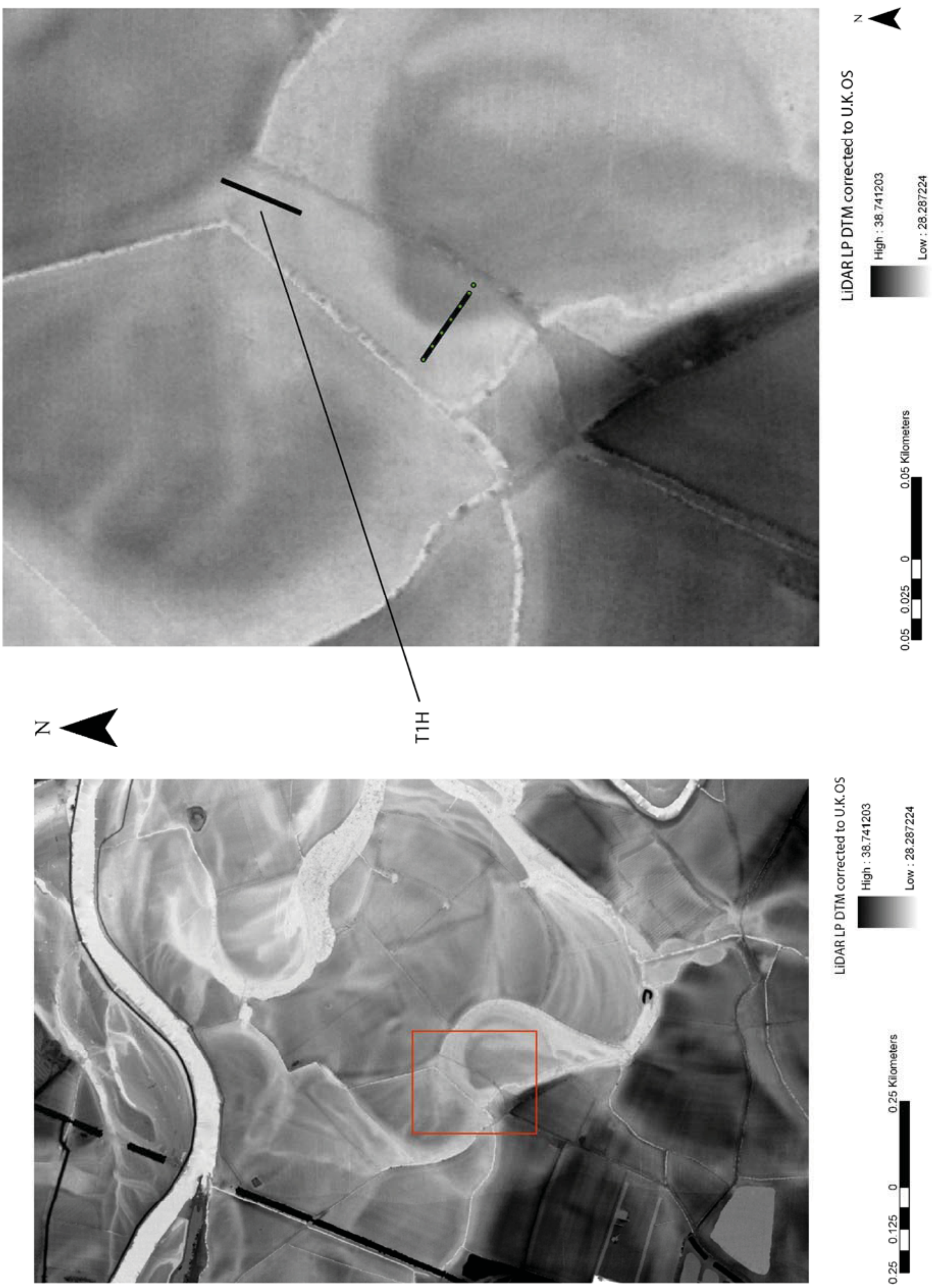


Fig 8.19: Location of transect T1H on terrace 1.

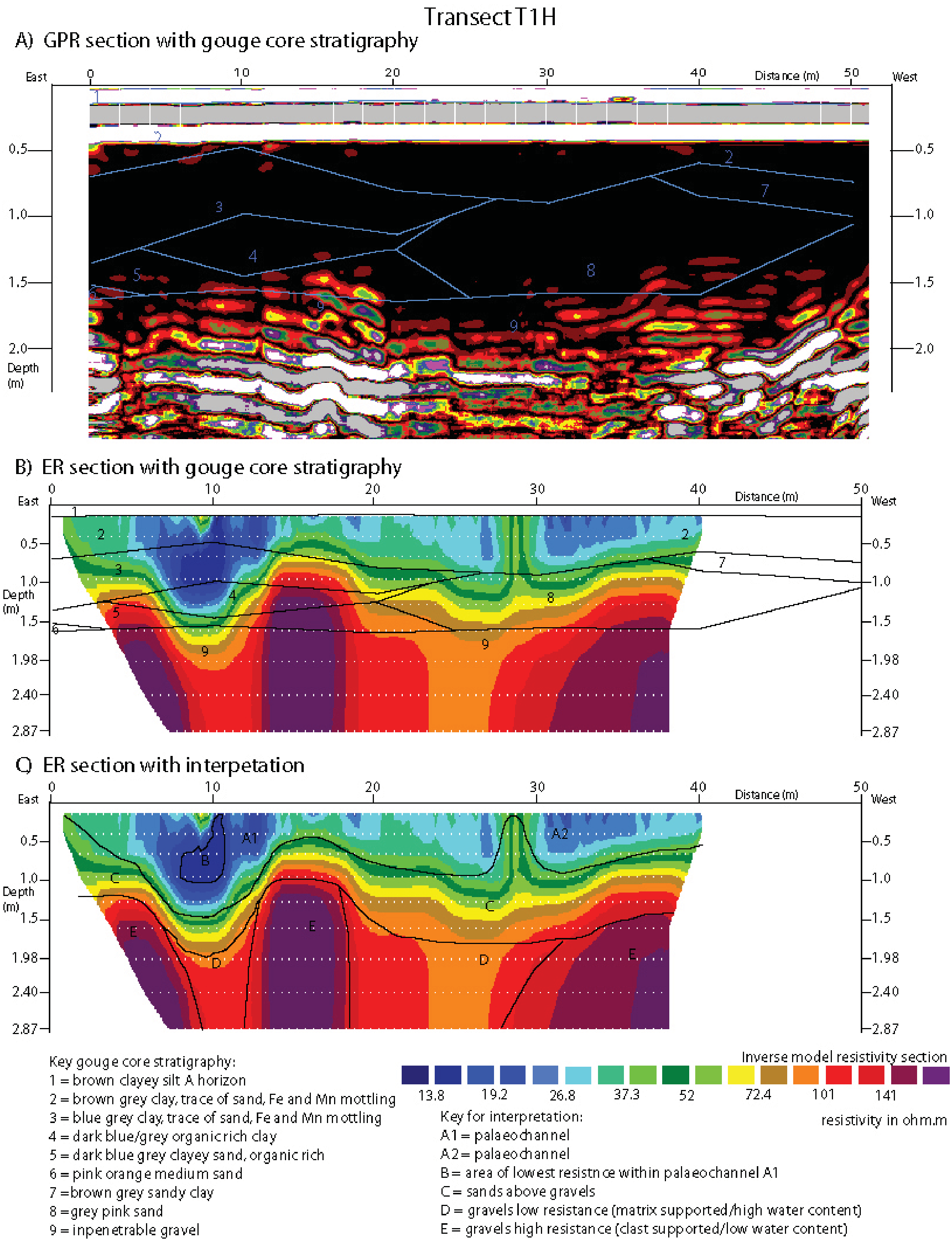


Fig 8.20: ER transect T1H.

8.4.8 ER transect T1J

The ER transect T1J was conducted on an area of terrace 1, targeting a palaeochannel that separates the Holocene Hemington terrace 1 deposits from the more recent floodplain deposits (Fig. 8.21). The palaeochannel can be seen as a topographic feature from the LiDAR LP DTM and is visible in 'the field'. The transect ran for 135m and used a 1m electrode interval. A gouge core transect (10m core spacing) and a GPR transect were also conducted to provide complementary data. The gouge core transect revealed a complicated stratigraphy (Fig. 8.22). The GPR section produces a depth to gravel that agrees with the gouge core data. The level of alluvium above the gravels gets noticeably shallower at c. 45m, with the GPR sections showing a strongly reflecting unit at this point, interpreted as gravel bar.

For the most part of the GPR trace there is a blank 'middle area of the section', which corresponds to the above gravel alluvium and palaeochannel fills. The sediment stratigraphy of these units is complex and consists of a series of sandy clays, clays and clayey sands, sands and a very dense fine grey sand (unit 19). From the GPR section the terrace and the palaeochannel are not identifiable. The only identifiable features are the areas of denser gravel at the junction between the top of the gravels and the alluvium.

The ER section provides a much clearer picture of the subsurface features (Figs. 8.22 and 8.23). From the ER section it is clear that there is either a bificated channel or two separate palaeochannels (units E1 and E2). Palaeochannel E2 is the larger of two channels and correlates with a series of sediment units representing a palaeochannel fill such as unit 19 (a very dense fine grey sand), unit 20 (light brown clay with bone, shell fragments and fired clay), unit 21 (blue grey clay with organic staining and pieces of flint), unit 22 (blue grey green clay, with pieces of flint) unit 23 (dark brown grey clay with organic staining), unit 14 (brown grey clay trace of sand), unit 15 (brown grey clay, Fe and Mn mottling), unit 16 (orange grey clay, Fe and Mn mottling), unit 17 (blue grey clay, Fe and Mn mottling) and unit 18 (dark grey clay organic rich). All of these units are clay dominated, with units 20 and 21 being strong candidates for containing cultural material.

Palaeochannel E1 is much smaller than E2, both in width and depth. It contains unit 3 (orange brown clay, trace of silt and sand), unit 5 (gleyed orange brown clay) and unit 6 (orange brown clayey sand). Again these are all clay dominated sediment units and would be expected to have these low resistivity values. The ER section also has a close correlation between areas of higher resistivity values and areas of terrace/gravel. For example, at c. 50m an interpreted gravel bar is visible, with the units above the gravel being recorded as unit 10 (orange brown sand clay), unit 11 (grey brown clay with organics) and unit 12 (pink grey sandy clay, Fe and Mn mottling). These units have higher sand contents and therefore produce higher resistivity values.

The interpretation of the ER section shows the two palaeochannels E1 and E2, with basal sands in the palaeochannels identified as unit D. From the ER section it is clear that palaeochannel E1 has a lower biotaphonomic potential than palaeochannel E2. Palaeochannel E2 is wider, deeper and has its lowest resistivity value highlighted as unit F. Unit F is where biotaphonomic potential is likely to be highest due to higher water/clay contents.

The alluvium on top of the gravels is interpreted as a lower resistivity unit A (clay silt dominated), with a higher resistivity unit B (sand dominated) located beneath it. The gravels again show variation in resistivity values with the higher resistivity units C and the lower resistivity units G.

The higher resistivity units C clearly correlate with the gouge core data and also the GPR trace. The large high resistance unit C at c. 45m is interpreted as a clast supported gravel bar. It is visible on the GPR section as a strongly reflecting unit and the gouge core stratigraphy shows a rise in gravel at this point. Again the lower resistivity gravels unit (G) correlates with the gravels underneath the palaeochannels and could either be the product of matrix-supported gravels, higher water content or a combination of the two factors. The junction between the Mercian Mudstone bedrock (unit H) and the gravels is evident (unit C and H). The Mercian Mudstone is seen as a lower resistance unit compared to the gravels, due to its higher clay and water contents.

Over transect T1J is an excellent example of ER survey in alluvial environments and the correlation of ER with other techniques. A summary of the main features is:

- ER penetrates deeper than either GPR or gouge core data (using a 1m electrode spacing).
- There is a strong correlation of features between the GPR and ER sections, such as the hard reflecting/higher resistance gravel units.
- The relationship of the depth to impenetrable gravels between the GPR and gouge core survey is almost exact.
- The GPR section revealed no detail of the above gravel stratigraphy.
- The ER section shows a good degree of correlation with the gouge core survey, especially the depth to gravel across the survey.
- The ER section revealed the geomorphological units of two palaeochannels, silt clay dominated alluvium over the terrace, sand dominated unit above the gravels, low resistivity gravels, high resistivity gravels and the gravel/bedrock junction.
- The protrusion of the high resistivity gravel unit G at c. 45m is interpreted as a clast supported gravel bar.
- Palaeochannel E2 is interpreted as having a higher level of biotaphonomic potential than palaeochannel E1.

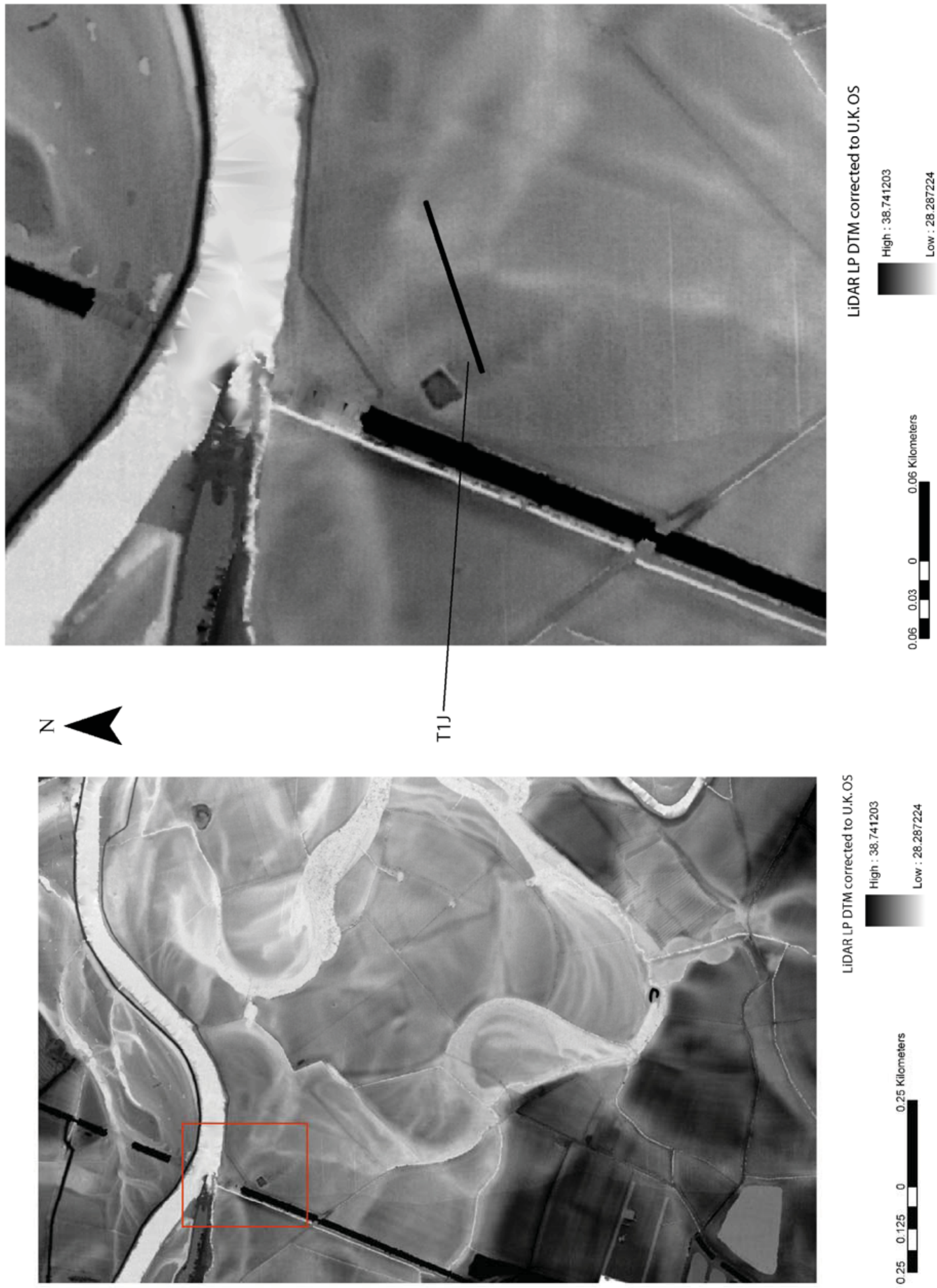


Fig 8.21: The location of transect T1J.

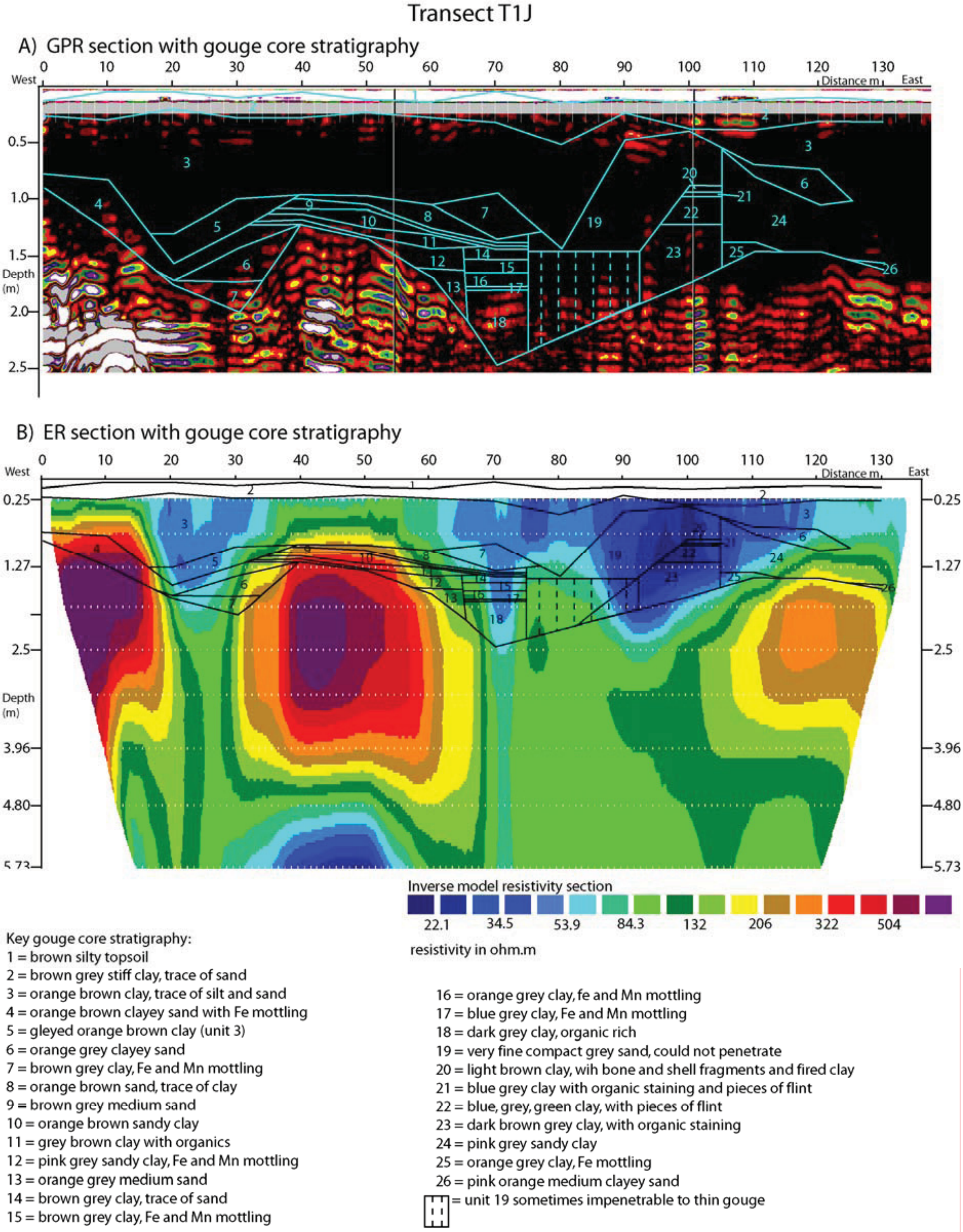


Fig 8.22: The ER transect T1J, gouge core stratigraphy combined with GPR and ER sections.

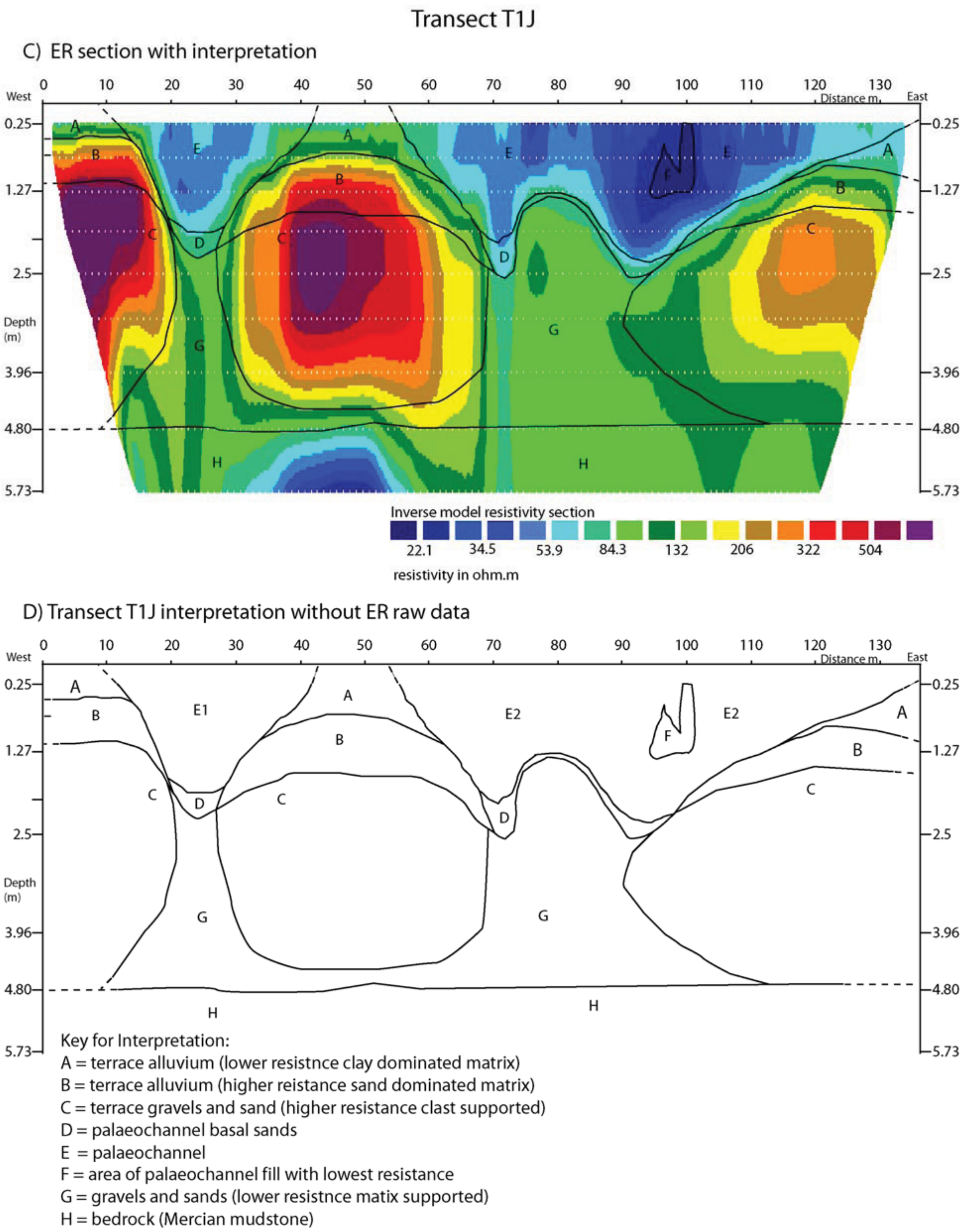


Fig 8.23: The ER transect T1J with interpretation.