3.5.4 Conclusions and recommendations

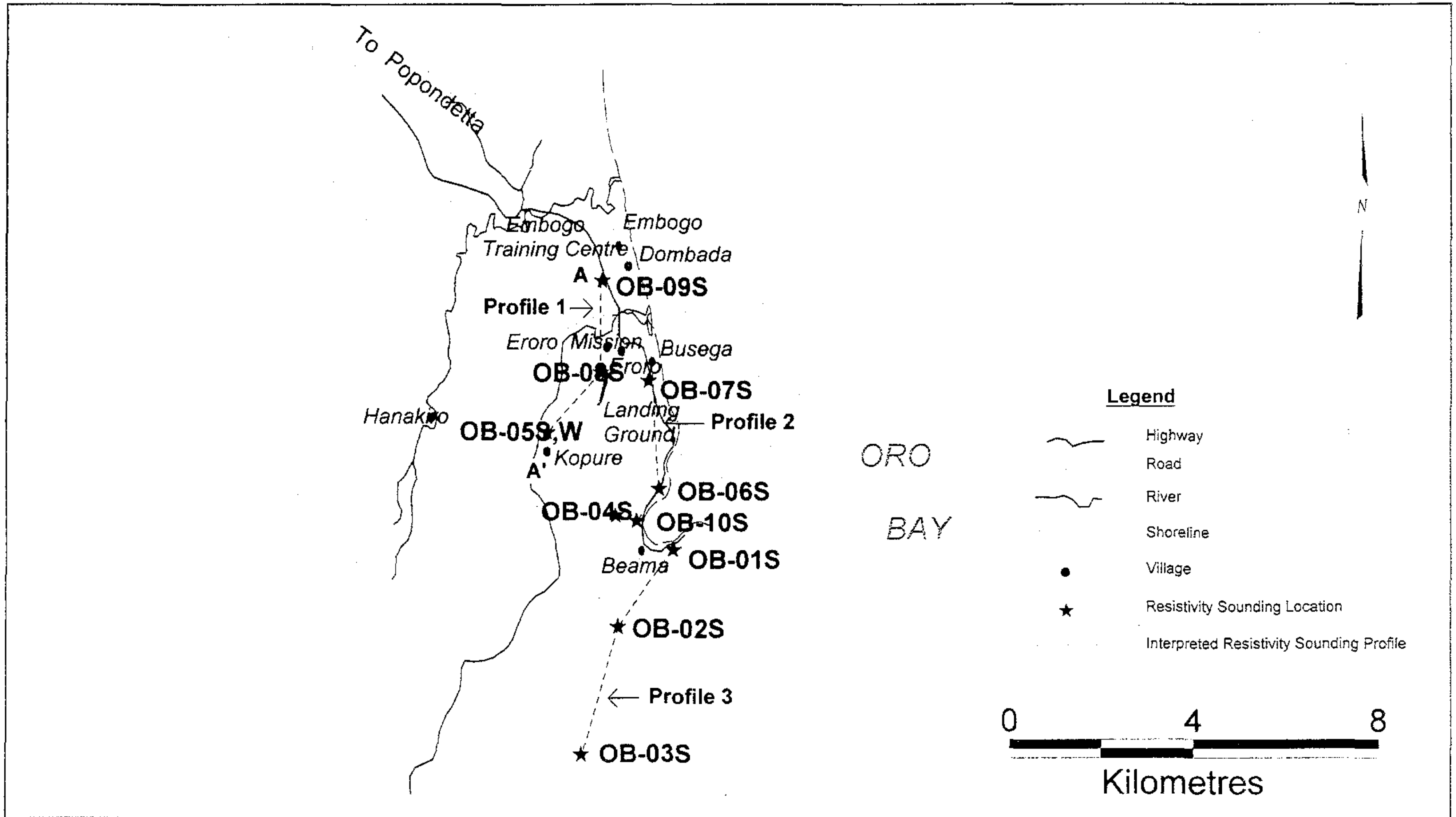
Interpretation of the sounding curves can be summarised as follows:

- Based on resistivity values, aquifers located in Quaternary volcanic areas appear more suitable than in other areas. However, the aquifers are shallow. Deeper aquifers in these areas have also been delineated. However the thickness of most of these aquifers could not be determined, except for sounding OB-02S, which is about 16 m.

- Depth to the aquifer layer appears to be shallower on the plains where OB-05S, OB-05W and OB-08S are located. Aquifers here are between 20 and 40 m deep

- The recommended location of a test drill hole is near to the position of soundings OB-05S and OB-08S for the following reasons:-

  Aquifers appear to be quite deep, almost 70 m below ground level, and the resistivity of the formation suggests potable water. Should the drill site be successful, delivery of water would be relatively easy. The site is at a higher elevation than the town which could then be fed by gravity.

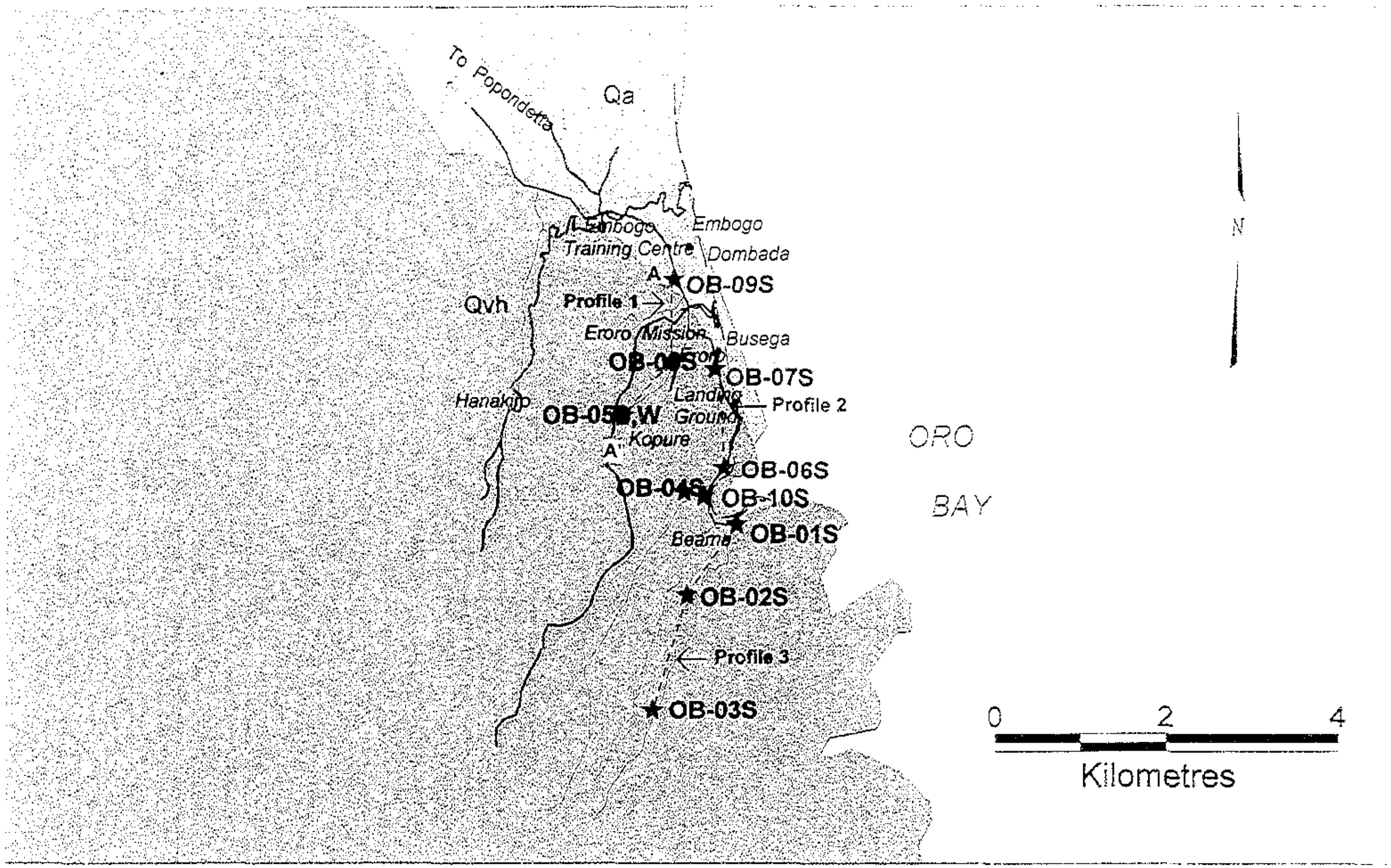


Location map of resistivity sounding, Oro Bay

Investigations of groundwater resources in Papua New Guinea, 2000

Geophysical Surveys Section
Geological Survey of PNG
Department of Mining

Figure 6a

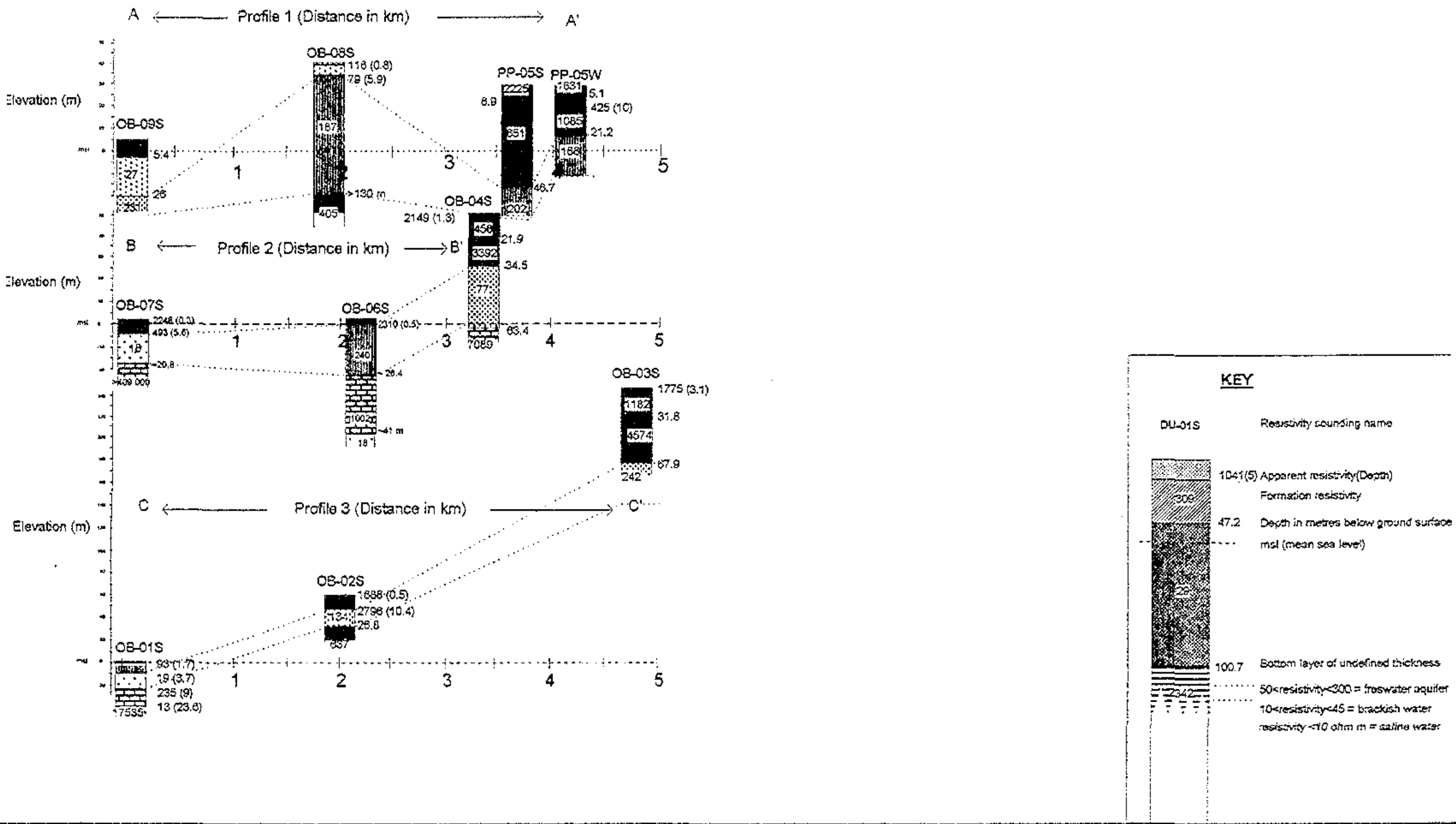


Map of resistivity sounding over regional geology, Oro Bay

Investigations of groundwater resources in Papua New Guinea, 2000

Geophysical Surveys Branch
Geological Survey Division
Department of Mining

Figure 6b



Interpreted resistivity sounding profiles, Oro Bay	Geophysical Surveys Section Geological Survey of PNG Department of Mining	Figure 6c
Investigations of groundwater resources in Papua New Guinea, 2000		

3.6 DARU, WESTERN PROVINCE

Sixteen geo-electrical soundings were conducted at selected sites around Daru Island, and also on the mainland (Figures 7a & 7b). Ten of the soundings were conducted using the Schlumberger configuration and eight used the Wenner array. Maximum AB/2 spacing for the Schlumberger soundings was 420 m while for the Wenner, a maximum electrode separation (a) of 240 m was achieved.

3.6.1 Geology

A brief description of the general geology of Daru Island is given in the 1:250 000 Explanatory Notes of the Daru – Maer geology map sheet (Wilmott, 1972). Pleistocene Maer Volcanics comprising basalt and tuff, underlie the central part of the island while the outer areas comprise mostly recent alluvial deposits.

On the mainland, the Boze and Kunini areas are underlain mostly by alluvium, which probably marks the mangrove swamps that extend along the shoreline. The geology of Ume is slightly older and may be underlain by limestone, dolomite, cherty mudstone and marl, while just to the south are the Quaternary alluvium deposits.

3.6.2 Resistivity sounding results

Sounding DU-1S

Sounding DU-1S was conducted at GPS location 742799 mE and 8996141 mN and was aligned on a bearing of 6 degrees.

The curve obtained for sounding DU-1S was modeled with 5 layers. The first layer with a resistivity of 36 Ωm and a thickness of about 0.7 m. Just below the top layer is a 2.5 m thick layer of resistivity 24 Ωm. The third layer has a higher resistivity, modeled at 428 Ωm and is approximately 24 m thick. The fourth layer has a very low resistivity, 4 Ωm, and is approximately 18 m thick. The fifth layer appears to be the bedrock layer, with a high resistivity at 1,193 Ωm.

Sounding DU-2S

Sounding DU-2S was conducted at GPS position 742720 mN and 8995757 mE and was aligned on a bearing of 006 degrees.

The sounding curve is similar to the one obtained for sounding DU-01S except that it does not have a prominent rise in resistivity at the end of the curve. The curve was modeled using only 4 layers. Layer one is approximately 0.3 thick, with resistivity 31 Ωm. The second layer was modeled with a resistivity of 18 Ωm, and is 27 m thick. A highly resistive layer, 748 Ωm and thickness 33 m, is present at a depth of about 27 m. The underlying layer has a low resistivity, 17 Ω m, and is assumed to be a formation saturated with saline water.

Sounding DU-02W

A Wenner sounding, DU-02W, was also conducted at the same location as sounding DU-02S. The curve was also modeled using the same number of model parameters as DU-02S. Both sounding curves failed to reach bedrock levels.

Sounding DU-03S

Sounding DU-03S was located at GPS position 742990 mN and 8995098 mE and was aligned on a bearing of 108 degrees.

The resulting sounding curve was interpreted using a four-layer model. The top layer is 0.9 m thick with a resistivity of 64 Ωm. The second layer was *modeled with a thickness of 2.5 m and resistivity 30 Ωm. Below the second* layer is a 4 m thick layer with high resistivity, 208 Ωm. The fourth layer was modeled with a low resistivity, 5 Ωm and is approximately 19 m thick. The bottom layer is highly resistive and presumed to be the bedrock layer with a resistivity of 1,862 Ωm.

Sounding DU-04S

Sounding DU-04S was conducted at the southern end of the Daru airstrip. The coordinates of the GPS sounding location are 742720 mE and 8995757 mN. The sounding was aligned parallel with the runway, on a bearing of 311 degrees.

The sounding was modeled with 4 layers. The top layer was modeled with a thickness of 0.5 m and a resistivity of about 40 Ωm. Beneath the thin top layer, is the second layer with a resistivity of 15 Ωm. The third layer, which is most probably the aquifer layer, has a modeled thickness of about 4.6 m and resistivity 50 Ωm. The underlying fourth layer was modeled with a resistivity of 300 Ωm.

Soundings DU-05S and DU-05W

Soundings DU-05S and DU-05W were conducted at the same location. The position of the soundings was approximately 700 m NW from the end of Daru airstrip and aligned on a bearing of 250 degrees.

The sounding curves were modeled with 3 layers. The top layer for both soundings was modeled with a thickness of about 0.9 m and a resistivity of about 241 Ωm. The thickness of the second layer varies in the two soundings. The Schlumberger result gave a much thinner layer (3 m) compared with 25 m for the Wenner. Furthermore the Schlumberger defines the layer slightly more conductive (6 Ωm) than for the Wenner (16 Ωm). Both soundings indicate a higher resistivity for the bottom layer, between 58 and 78 Ωm.

Sounding DU-06S

Sounding DU-06S was conducted at northern end of Daru airstrip. The sounding was aligned parallel to the airstrip runway, on a bearing of 311 degrees.

The sounding was interpreted using a 4-layer model. The first layer is 0.4 m thick and has a low resistivity, 14 Ωm. The second layer has a modeled thickness of about 2 m and a resistivity of 55 Ωm. The depth of the third layer was modeled at approximately 2.6 m, and a thickness of about 4.5 m with a low resistivity, 5 Ωm. The resistivity of the bottom layer is higher at 86 Ωm.

Sounding DU-07S

Sounding DU-07S was conducted near Daru Trading Warehouse. The location of the sounding has GPS coordinates 742237 mE and 8993622 mN. The sounding is orientation on a bearing of 189 degrees.

The curve obtained for the sounding was modeled with 4 layers. At the top is a 0.4 m thick layer with a resistivity of about 6 Ωm. Below that is a 2 m thick layer with a low resistivity, 1 Ω m. This layer most probably comprises saline water. The third layer, at a depth of approximately 2.5 m below ground level, is a slighlty more resistive layer at 11 Ω m and is about 41 m thick. The bottom layer is the very resistive layer at 3,056 Ω m.

Sounding DU-08S

Sounding DU-08S was conducted at the far northwestern end of the island, approximately 1 kilometre from the end of the runway. The sounding was aligned on a bearing of 297 degrees.

The sounding curve was modeled with 5 layers. The top layer is about 0.9 m thick. It was modeled with a resistivity of 3,1764 Ωm. The second layer is slightly conductive with a resistivity of 31 Ωm and thickness about 2.5 m. The third layer is most probably the water bearing layer, with a resistivity of 123 Ω m and thickness 6 m. Below the water bearing layer is a very conductive layer of thickness 11 m and is most probably the saline water layer. At the bottom is the highly resistive layer with a model value of 5,518 Ω m. This appears to be the bedrock layer.

Sounding DU-09W

Sounding DU-09W was conducted using the Wenner array. The coordinates for the GPS sounding location are 8996259 mN and 742395 mE and aligned on a bearing of 334 degrees.

The sounding curve for DU-09W was modeled with 5 layers. The top layer is approximately 0.5 m thick and has a resistivity of 43 Ωm. The second layer was modeled with a thickness of 4 m and has a resistivity of 13 Ωm. Below the second layer is a layer with resistivity 31 Ωm, which most probably is the aquifer layer and is approximately 60 m thick. The bottom layer is the bedrock layer with a resistivity of 624 Ωm.

Sounding DU-10W

Sounding DU-10W was conducted near the Treasury Office building. The GPS coordinates of the sounding location are 742966 mE and 8996580 mN and aligned on a bearing of 277 degrees.

The sounding was modeled with 3 layers. The first layer with a thickness of 2.3 m and an approximate resistivity of 49 Ωm. The second layer was modeled with a low resistivity, 11 Ωm, and has a thickness of 4 m. This layer is conductive and may contain saline water. The third layer has a higher resistivity, 36 Ωm, at an approximately depth of 5 m.

Sounding DU-11W

Sounding DU-11W was conducted near the Police Station. The coordinates of the GPS sounding location are 743069 mE and 89963150 mN and oriented on bearing of 185 degrees.

The sounding was modeled with 4 layers. The first layer with a thickness of 1.4 m and a resistivity of 69 Ωm. The second and third layers have progressively lower resistivities, 27 Ωm and 22 Ωm, and thicknesses 22 m and 43 m respectively. The bottom layer has a higher resistivity at 67 Ωm.

Sounding DU-12S

Sounding DU-12S was conducted along the road leading to the CIS compound. The coordinates of the GPS sounding location are 743069 mE and 8995483 mN and aligned on a bearing of 185 degrees.

The sounding was modeled using a 3-layer model. The first layer was modeled with a thickness of 2 m and resistivity 62 Ωm. The second layer was modeled with a resistivity of 13 Ωm and is 21 m thick and may contain saline water. The third layer, at a depth of approximately 23 m, has a higher resistivity, 120 Ωm, and most probably is highly weathered bedrock.

Sounding DU-13S

Sounding DU-13S was conducted along the road to the site of the town dump. The coordinates of the GPS sounding position are approximately 742359 mE and 8994161mN and aligned on a bearing of 189 degrees.

The sounding was modeled with 4 layers. The first layer with a thickness of 2 m and a resistivity of 150 Ωm. The second layer was modeled with a resistivity of 25 Ωm and thickness 4 m and is the most conductive of all the layers at this site. The third layer is approximately 30 m thick and at a depth of approximately 6 m. It is a higher resistivity layer, and most probably represents strongly weathered bedrock. The fourth layer is the most resistive layer, 763 Ωm, and most likely is fresh bedrock.

Sounding DU-14W

Sounding DU-14W was conducted at the Daru Town water supply intake site at Ume. The GPS coordinates of the sounding position are 728741 mE/ 8999651 mN and aligned on a bearing of 199 degrees magnetic north.

The sounding was modeled with 3 layers. The first layer with a thickness of 3.6 m and resistivity 466 Ωm. The second layer was modeled with a resistivity of 40 Ωm and a thickness of 60 m. This layer most probably contains freshwater. The third layer, at a depth of approximately 64 m, is the conductive layer with a resistivity of 14 Ωm, and most probably contains saline water.

Sounding DU-15W

Sounding DU-15W was conducted at Boze village. The position of the sounding has GPS coordinates approximately 723865 mE/ 8997786 mN and aligned on a bearing of 224 degrees.

The curve obtained for the sounding was modeled with 4 layers. The first layer with a thickness of almost 2 m (1.7 m) and resistivity 157 Ωm. The second layer was modeled with a resistivity of 3 Ωm and thickness 10 m. This layer almost certainly contains saline water, as it is very conductive. The third layer, at a depth of approximately 12 m, appears to be the aquifer layer. The layer is approximately 10 m thick and has a resistivity of 61 Ωm. The bottom layer is a very conductive with a resistivity of 0.04 Ωm.

Sounding DU-16W

Sounding DU-16W was conducted at Kunini village. The GPS coordinates of the sounding position are 720690 mE and 8994241 mN.

The curves obtained for the soundings were modeled with 3 layers. The first layer was modeled with a resistivity of 55 Ωm and thickness 1.7 m. The second layer was modeled with a resistivity of 22 Ωm and thickness 32 m. This layer may be the aquifer layer. The third layer, at a depth of approximately 34 m, is the saline water layer.

3.6.3 Electromagnetic survey (conductivity) results

Electromagnetic surveys, DU-EM01 – DU-EM03, were conducted at four sites to determine depth to the freshwater/saline water interface (Plate 3). The locations of the EM sites are shown on Figure 7b. Images of the EM profiles are shown in Figures 7c.1 – 7c.3. The data were gridded using Surfer Surface Mapping System.

Conductivity profile DU-EM01

Figure 7c.1 shows the conductivity profile for DU-EM01, between the airport and the waste dump site. Figure 7c.1a are the profiles without applying filters. The figure clearly shows areas of high conductivity, up to less than 10 m depth. These areas, between 300 m and 1,400 m, are due to saline water intrusion in the alluvium. The effect of the intrusion is much more severe when the profiles are filtered to show the areas of high conductivity (Figure 7c.1b). The figure shows that the depth to areas affected is much less than indicated.

Conductivity profile DU-EM02

Figure 7c.2 shows the conductivity profile for site DU-EM02. Results of the survey did not show any obvious trend. In the horizontal mode of exploration, the area shows zones of high conductivity up to just over 10 m depth (Figure 7c.2a). In the vertical dipole mode, the profile shows a very conductive subsurface (Figure 7c.2b)

Conductivity profile DU-EM03

Figure 7c.3 shows the conductivity profile of site DU-EM03. A very distinct boundary is shown between high and low conductivity zones (Figure 7c.3a). The approximate boundary is at a depth of 8 m.

In horizontal mode of exploration, there appears to be three anomalous areas, at 300 m and near 650 m (Figure 7c.3a). The anomalies are also present but not so clearly defined as in the vertical mode (Figure 7c.3b). These anomalies could be representative of the sealed road, as they are not very deep. However, at depth there are high conductivity zones which could be influenced by the underlying geology. These anomalies are at approximate positions 300 m and 400 m.

3.6.4 Discussion

The soundings carried out on the island of Daru were divided into three main groups, based on the nature of the curves :-

Group one comprises DU-01S, DU-02S and DU-02W, DU-04S, and DU-09W. This group begins with a low resistivity layer and is followed by layers which are progressively more resistive with depth.

Except for sounding DU-01S, all the soundings used a 4-layer model. The top layer is very thin, between 0.3 and 0.6 m. The second layer is the conductive layer with resistivity levels between 9 and 30 Ωm and 4 and 24 m thick. This most probably is the water bearing layer but resistivity levels suggest that water would be very brackish and unsuitable for consumption. The water bearing layer is followed by a higher resistivity layer most probably, highly weathered bedrock which is underlain by a saline water layer.

Group two comprises DU-03S, DU-07S and DU-08S. This group shows a high resistivity layer ibetween two conductive layers, before finally reaching the high resistivity bedrock layer. This higher resistivity layer is most probably the highly resistive layer observed in the first group. However this time, the layer is better defined than in the first group. The saline water layer that follows the highly weathered layer is bounded at the bottom by a more compact bedrock layer. This group is an extension of the first group in that there is an extra layer, which is the bottom bedrock layer. The aquifer would most probably be the second layer with a resistivity of around 30 Ωm. The resistivity falls within the range of values modeled for the first group. Again the low resistivity indicates high salinity, making it unsuitable for human consumption.

Group three comprises soundings DU-5S and DU-05W, DU-6S, DU-10W, DU-11W, DU-12S and DU-13S. These soundings have a high resistivity top layer followed by a conductive layer, before finally reaching bedrock levels.

The conductive second layer here is interpreted as the saline water layer. The thickness of this layer is about 4 m near the coast (DU-10W and DU-13S) and 22 m at DU-11W and DU-12S. The orientation of the sounding spread probably has some effect on the interpreted thickness of this layer. This can be observed between soundings DU-10W and DU-11W where DU-10W is oriented parallel to the coastline while DU-11W is oriented almost perpendicular to the coastline. Interpretation of sounding DU-10W may be less affected by errors than DU-11W. Thus depth and thickness of the layers obtained for sounding DU-10W may be more realistic.

Soundings obtained for the mainland sites are descending curves. The only exception is sounding DU-15W with a resistive third layer. The second layer has been interpreted to represent the aquifer layer. The resistivity of the layer is 20 to 40 Ωm and is between 10 and 30 metres thick. The low resistivity of the formation suggests an aquifer containing brackish water. However the aquifer may be worth drilling for observation purposes because of its thickness. The conductive second layer modeled for the Boze sounding (DU-15W) most probably comprises clay-rich sediments. Information provided from local sources indicates the area is heavily flooded during rainy season. The 10 metre thick third layer may be the freshwater layer with a resistivty of about 61 Ωm and is indicative of potable water.

Three profiles were created from the interpreted resistivity soundings (Figure 7d) :-

Profile 1 shows the variation in resistivity from the inland sounding at Ume to the coast, at Kunini. The profile does not show prospective aquifers trends, however, it defines the effect of saline water intrusion into the inland areas. At Kunini, brackish water begins at a depth less than 2 m, compared to 3.6 m at Ume. There is no indication of reaching bedrock around this area.

Profile 2 shows the west-east variation in resistivity. Bedrock appears at slightly shallower depths towards the ends of the profile. Between soundings DU-05 and DU06 there are no signs of bedrock. The shallow aquifers at the end of the profile are about 4-5 m thick and are immediately followed by the saline water layer, and then bedrock. In the middle of the profile, aquifers appear very shallow and thin.

Profile 3 shows the north-south soundings. The depth to bedrock appears to be around 26 m gradually becoming deeper towards the south. Except for sounding DU-07S, the layer immediately above bedrock is probably the aquifer layer. Resistivity values however suggest the layer is very brackish.

3.6.5 Conclusions and recommendations

The following is a summary of the results of the interpretation:

- Daru is covered by a very thin (0.2 – 1.0 m) layer of alluvium.

- The depth of the aquifer layer is between 1 and 3 m, the resistivity however is very low, less than 30 Ωm, and may be indicative of brackish water.

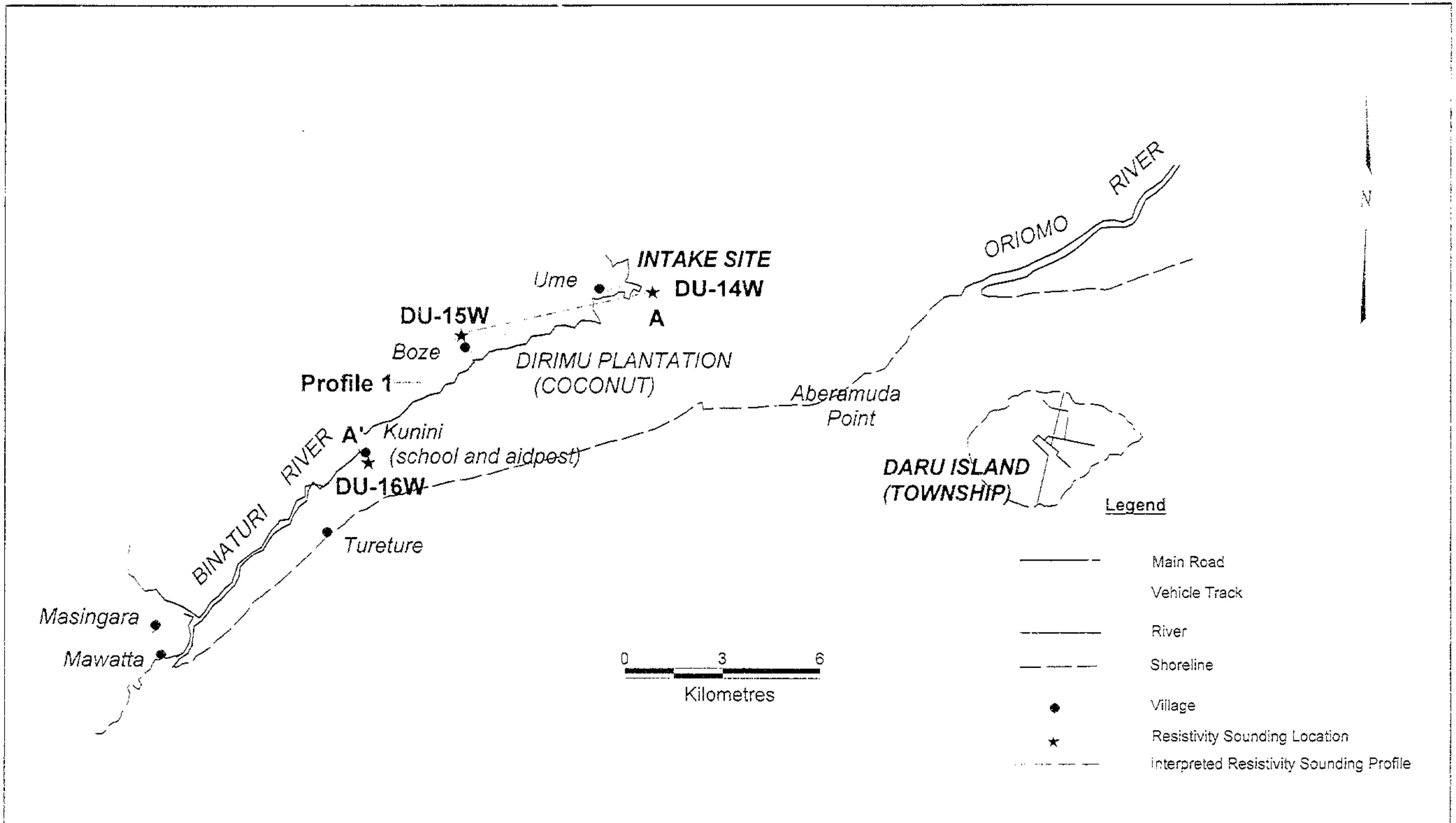
- No deeper aquifer could be detected using either resistivity or conductivity methods.

- No sounding site on Daru island has been interpreted to have an aquifer layer with a resistivity higher than 30 Ωm. Hence, it is probable that no suitable site for potable water can be found on the island.

- On the mainland, two sites, Ume and Boze, have higher aquifer formation resistivities. The site at Ume appears more suitable with an aquifer thickness of 60 m, compared to Boze with a thickness of only 10 m.

- Ume should be given priority as a test drill site because it may be less affected by flooding than Boze.

Plate 3. Electromagnetic survey in progress on Daru Island. Both transmitter and receiver coils are required to be parallel to each other during measurement, but as shown above (at Horizontal mode), that is quite difficult to achieve.



Location map of resistivity sounding, Daru

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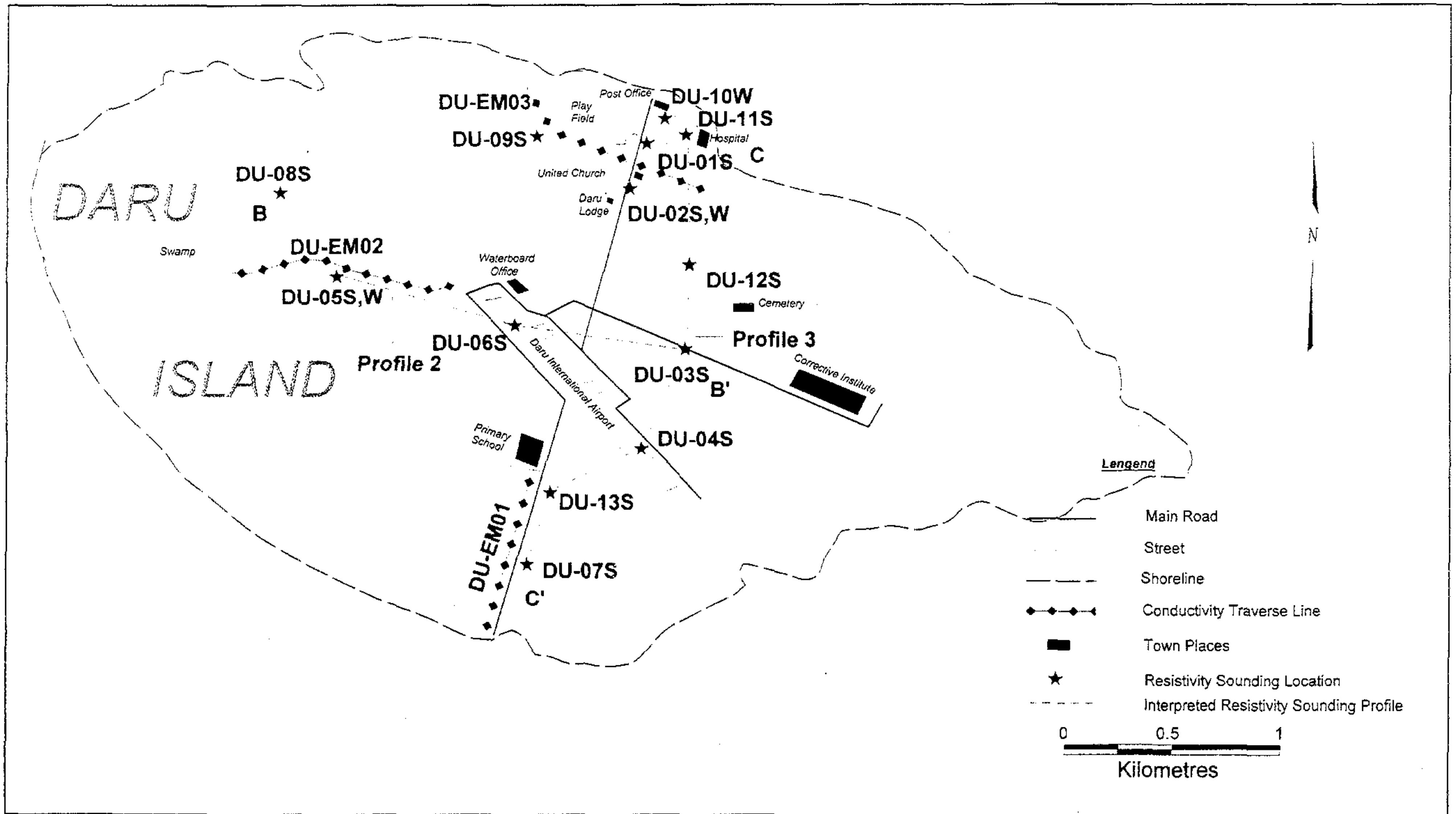
Figure 7a



Location map of resistivity and conductivity sounding, Daru Town

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Figure 7b

Daru Island electromagnetic survey

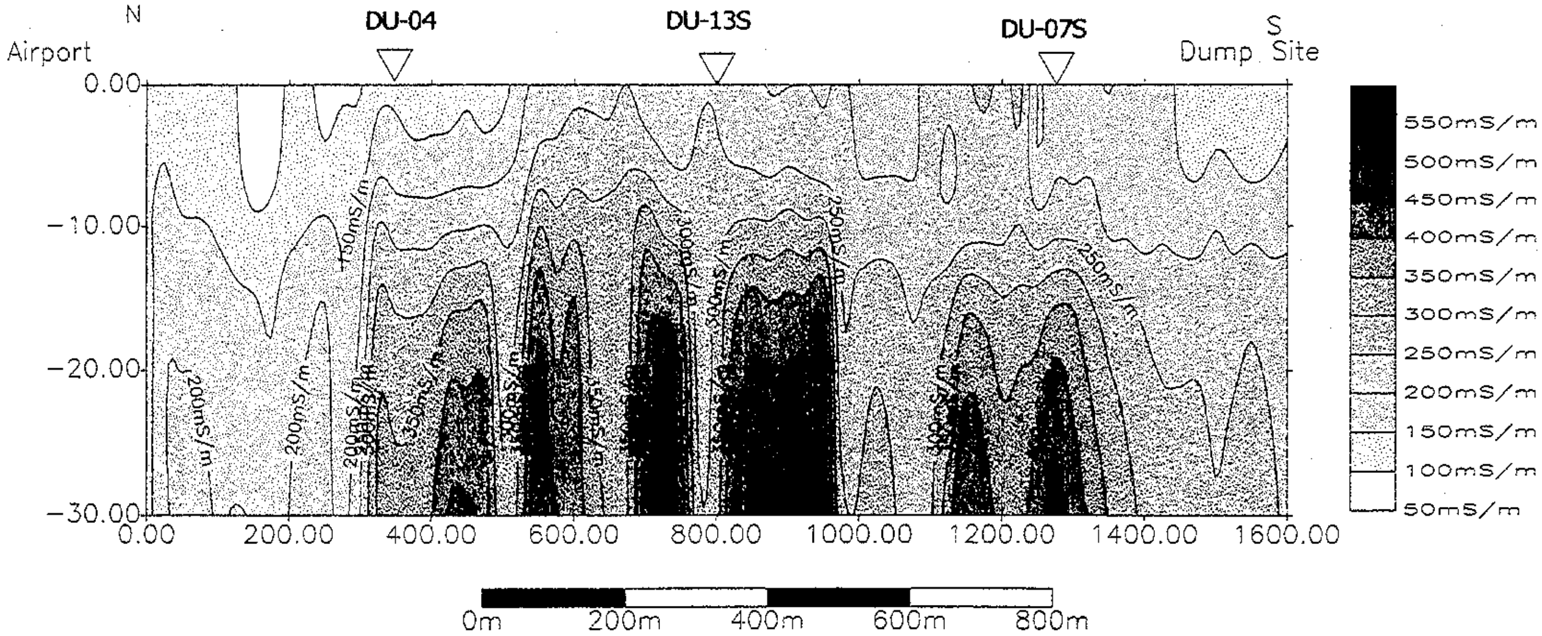


Figure 7c.1a EM image of profile EM-DU01 in Horizontal Mode.

Daru Island electromagnetic survey

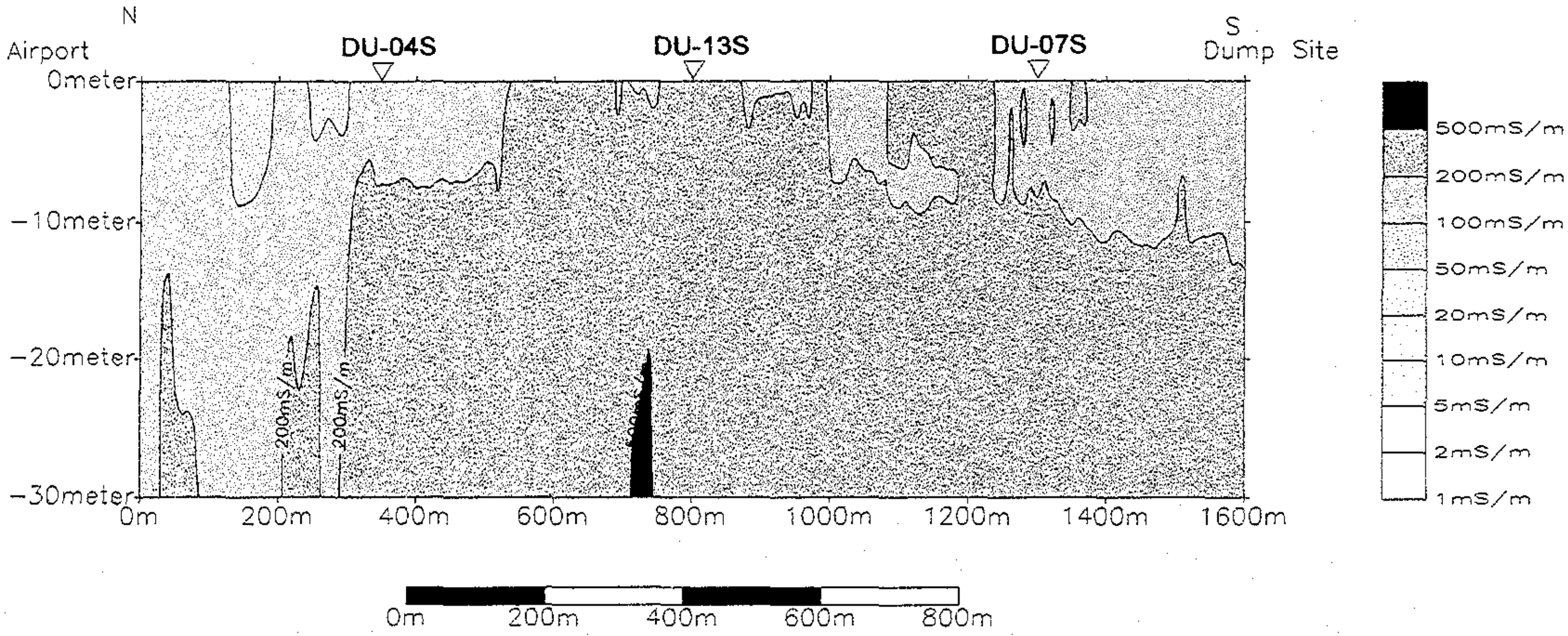


Figure 7c.1b EM image of profile EM-DU01 in Vertical Mode.

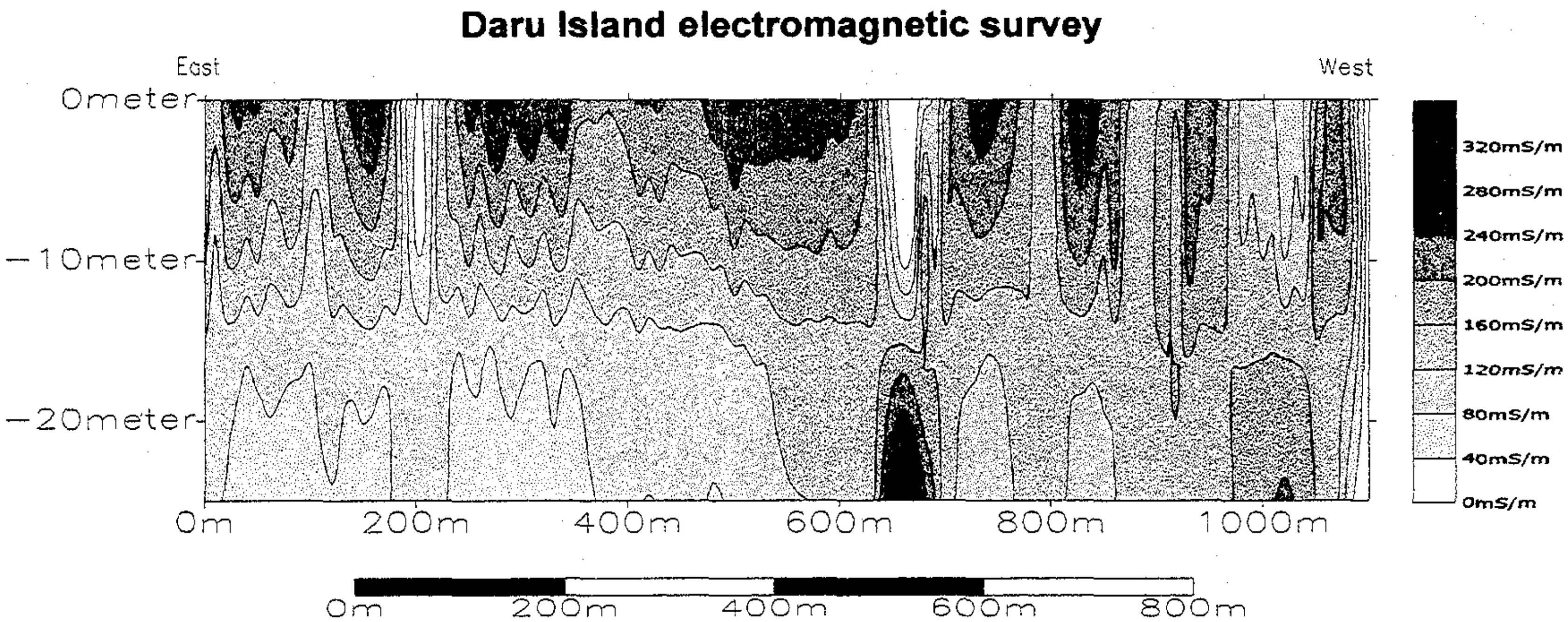


Figure 7c.2a EM image of profile EM-DU02 in Horizontal Mode.

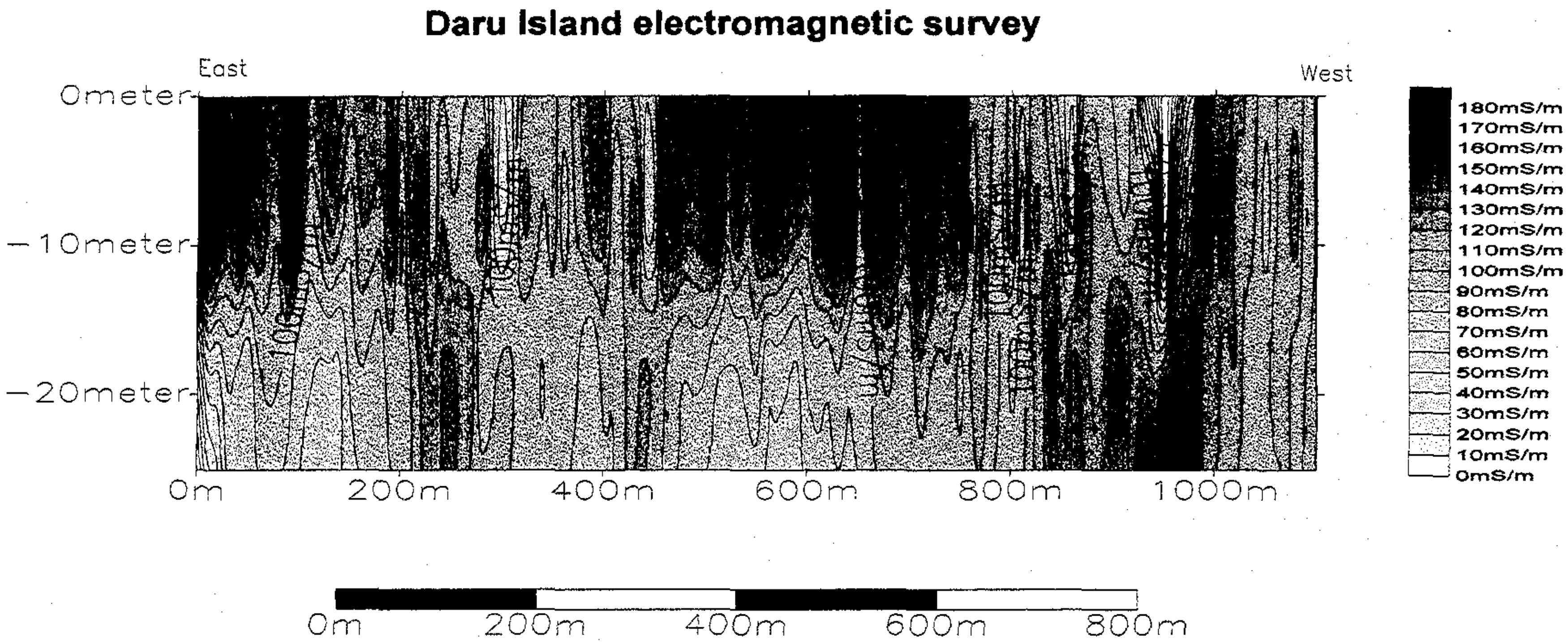


Figure 7c.2b EM image of profile EM-DU02 in Vertical Mode.

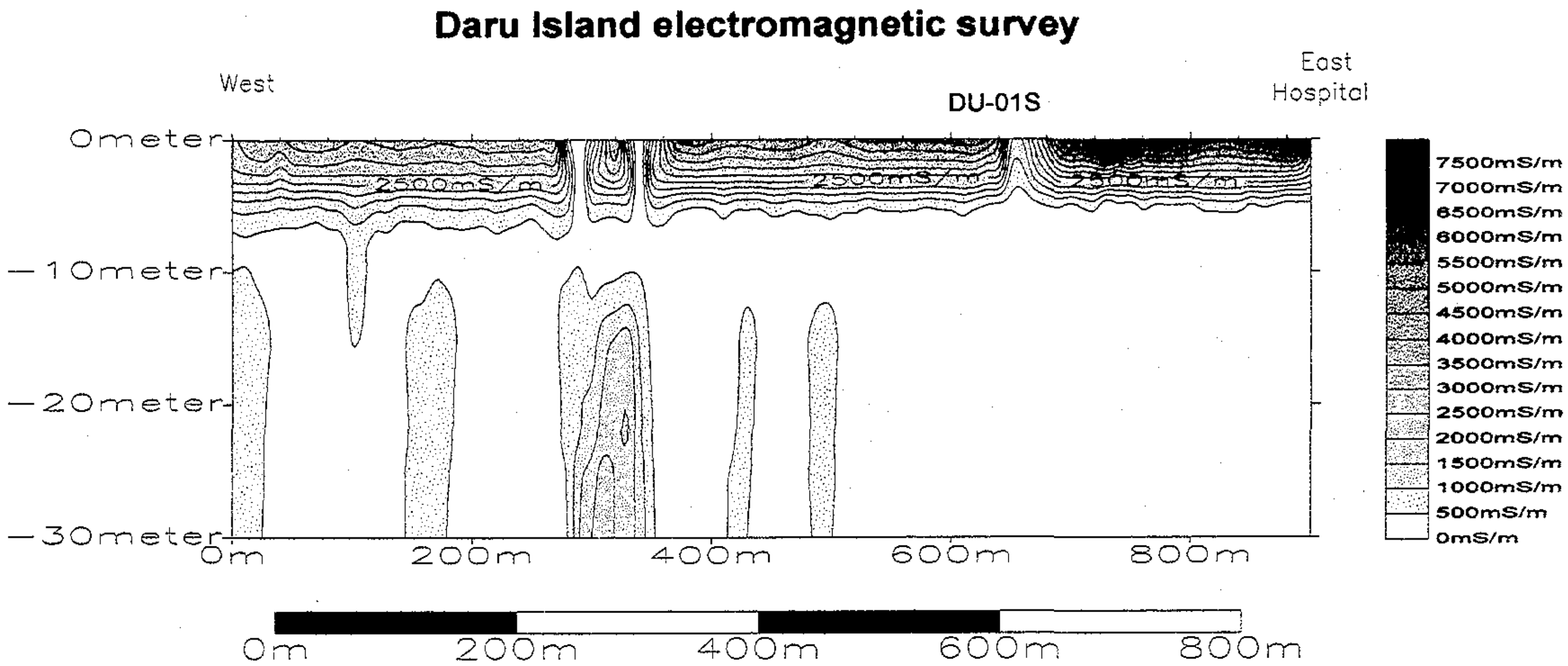


Figure 7c.3a EM image of profile EM-DU03 in Horizontal Mode.

Daru Island electromagnetic survey

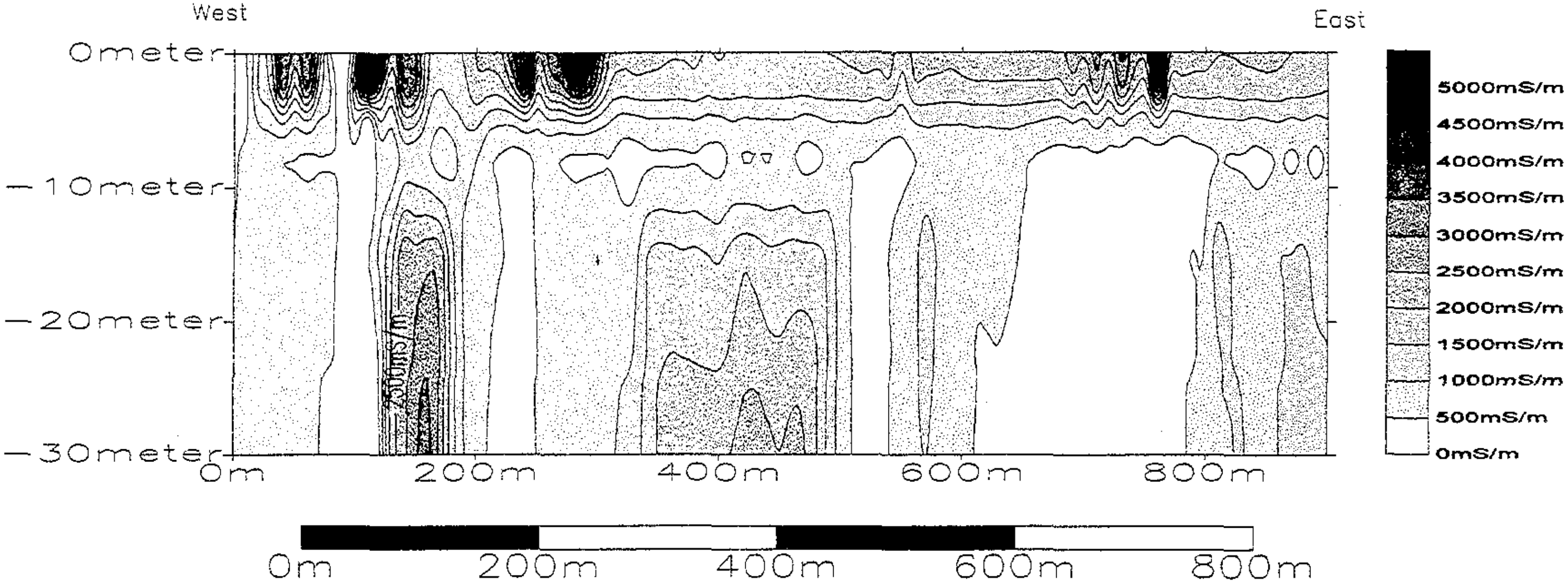
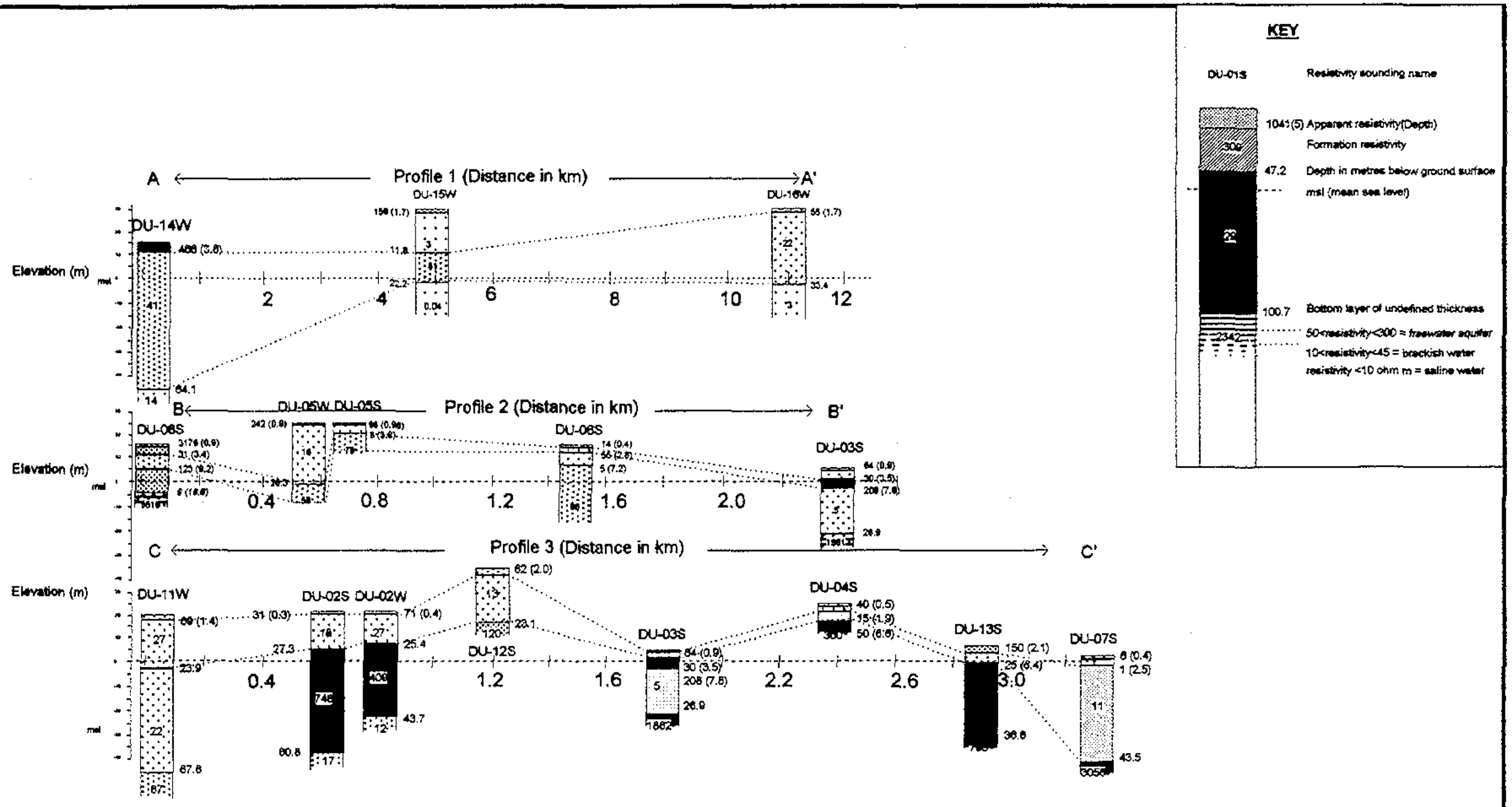


Figure 7c.3b EM image of profile EM-DU03 in Vertical Mode.



Interpreted resistivity sounding profiles, Daru

Investigations of groundwater resources in Papua New Guinea, 2000

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Figure 7d

3.7 KWIKILA, CENTRAL PROVINCE

Eleven geo-electrical soundings were conducted around Kwikila Station (Figures 8a and 8b). Ten of the soundings were done using the Schlumberger configuration and one using the Wenner. The Schlumberger soundings used a maximum AB/2 spacing of 420 m while the Wenner had a maximum electrode spacing (a) of 260 m.

3.7.1 Geology

A description of the geology of the area is given in the 1:250 000 Explanatory Notes of the Port Moresby-Kalo-Aroa geology map sheet (Pieters, 1978). Figure 8c shows part of the map sheet. The oldest rocks in the area are the Mesozoic peridotite, gabbro, and basalts of the Guava and Sibium Ranges.

Kwikila town is underlain mostly by Upper Eocene to Middle Oligocene gabbro, basalt and dolerite intrusives. The area is bounded to the north by Upper Cretaceous to Lower Eocene mostly fine grained turbiditic clastic sediments and to the south by mostly calcareous and pelagic sediments of Paleocene to Middle Eocene. Volcanics and minor fluviatile sediments of Upper Miocene to Holocene dominate the northwestern regions.

3.7.2 Resistiviy sounding results

Sounding KK-01S

Sounding KK-01S was along the Kwikila-Port Moresby section of the road. The coordinates of the GPS sounding position are 569000 mE and 8916200 mN. The sounding was oriented on a bearing of 275 degrees.

Sounding KKS-01S was modeled with 3 layers. The first layer has a resistivity of 30.2 Ωm and thickness 4.59 m. The top layer is followed by a higher resistivity layer, 195.6 Ωm, approximately 60 m thick. The bottom layer has a lower resistivity, modeled at 80 Ωm.

Sounding KKS-02S

Sounding KKS-02S was conducted just outside the Station, along the disused Tauruba road. Coordinates for the GPS sounding location are 573424 mE and 8914910 mN and oriented on a bearing of 087 degrees.

Sounding KK-02S was modeled with 3 layers. The first layer was modeled with a resistivity of about 10 Ωm and a thickness of 3 m. The second layer has a higher resistivity at 32 Ωm and is approximately 12 m thick. The third layer is the bedrock layer with a higher resistivity at 104 Ωm.

Sounding KK-03S

Sounding KK-03S was conducted along the Tauruba road, approximately 1 km north of KK-02S. The GPS coordinates of the sounding are 572490 mE and 8913157 mN and oriented on a bearing of 025 degrees.

Sounding KK-03S was interpreted using a 4-layer model. The first layer was modeled with a resistivity of 42 Ωm and a thickness of 0.7 m. The second layer has a slightly lower resistivity than the top layer, at approximately 38 Ω m, and is 6 m thick. The third layer is higher in resistivity than the second layer and has a modeled resistivity of 89 Ωm and is approximately 9 m thick. At the bottom is a higher resistivity layer at 170 Ωm.

Sounding KK-04S

Sounding KK-04S was conducted along the road to Vinigibara village. The GPS coordinates for the sounding are 576722 mE and 8916785 mN and oriented on a bearing of 238 degrees.

The sounding curve for KK-04S was modeled with 3 layers. The first layer has a resistivity of 44 Ωm and a thickness of approximately 0.5 m. The second layer is lower in resistivity, modeled at approximately 22 Ωm, and is 2.6 m thick. The third layer has a higher resistivity at 115 Ωm.

Sounding KK-05S

Sounding KK-05S was conducted along the Kwikila-Kupiano portion of the highway. GPS coordinates for the sounding location are 577079 mE and 8914050 mN and oriented on a bearing of 077 degrees.

The sounding curve obtained was modeled with 4 layers. The first layer was modeled with a resistivity of 20 Ωm and thickness 0.6 m. This layer is followed by a 5 m thick low resistivity layer modeled at 9 Ωm. The resistivity of the third layer is higher at 30 Ωm and is approximately 10 m thick. At the bottom is another layer with higher resistivity at 200 Ωm.

Sounding KK-06S

Sounding KK-06S was conducted inside the Kwikila High School boundary. Coordinates for the GPS location of the sounding are 574243 mE and 8916085 mN and oriented on a bearing of 125 degrees.

The curve obtained for sounding KK-06S was modeled with 5 layers. The first layer was modeled with a resistivity of 48 Ωm and thickness 0.3 m. The second layer has a thickness of 16 m and resistivity 8 Ωm. The resistivity of the third layer at 173 Ω m and thickness 33 m is higher than the second layer. Another very conductive layer with a resistivity of about 2 Ωm, and a thickness of 20 m was modeled as the fourth layer. The bottom layer has a very high resistivity, with a model value of 1,802 Ωm.

Sounding KK-07S

Sounding KK-07S was conducted near the Salvation Army Quarters. GPS coordinates of the sounding position are 574056 mE and 8915645 mN and oriented on a bearing of 123 degrees.

The sounding curve was modeled with 4 layers. The first layer has a resistivity of 48 Ωm and thickness 3 m. The second layer has a slightly higher resistivity at 189 Ωm and thickness 16 m. The third layer is less resistive than the second, with a resistivity of 27 Ωm and is approximately 24 m thick. The fourth layer was modeled with a resistivity of approximately 100 Ωm.

Sounding KK-08S

Sounding KK-08S was conducted along the road leading to Gelesi village. The coordinates for the GPS location of the sounding are 573597 mE and 8916168 mN. The sounding was oriented parallel to the highway, on a bearing of 315 degrees.

The curve obtained for sounding KK-08S was modeled with 4 layers. The first layer was modeled with a resistivity of 29 Ωm and thickness 0.9 m. The second layer is lower in resistivity, with a model value of 16 Ωm and thickness approximately 2 m. The third layer has a higher resistivity at 157 Ωm with a thickness of approximately 133 m. Resistivity again increases at the fourth layer to 2,014 Ωm and is most probably the bedrock layer.

Soundings KK-09S and KK-09W

Soundings KK-09S and KK-09W were conducted at the same location, along the road leading to the District Office. The GPS coordinates for location of the soundings are 574753 mE and 8915607 mN and oriented on a bearing of 037 degrees. Both soundings were modeled with 5 layers.

Sounding KK-09S

For sounding KK-09S, the top layer, was modeled with a resistivity of 37 Ωm and thickness 3 m. The second layer has a low resistivity at 8 Ωm, and thickness 5 m. The third layer also has a low resistivity at 13 Ωm and a model thickness of 8 m. The fourth layer is also conductive with a resistivity of 9 Ωm and thickness 21 m. The final layer has a higher resistivity at 103 Ωm.

Sounding KK-09W

As for sounding KK-09W, the first layer was modeled with a resistivity of 44 Ω m and thickness 0.7 m. The second layer was modeled with a resistivity of 24 Ωm and a model thickness of 6 m. The resistivity of the third layer is higher at 32 Ωm and thickness 9 m. Resistivity decreases at the fourth layer to a 8 Ωm and thickness 19 m. The fifth layer appears to be the bedrock layer with a resistivity of 470 Ωm.

Sounding KK-10S

Sounding KK-10S was conducted along the back road, leading to the Police Commander's residence. The GPS coordinates for the sounding are 573695 mE and 8915674 mE and oriented on a bearing of 048 degrees.

The sounding curve obtained for KKS-10 was modeled with 4 layers. The top layer is 1.4 m thick with a modeled resistivity of 23 Ωm. Below is a second layer with a resistivity of 14 Ωm and thickness 1.5 m. The third layer has a higher resistivity, 53 Ωm, and is approximately 70 m thick. The fourth layer has a resistivity of 64 Ωm.

Sounding, KK –11S

The last sounding, KKS -11, was conducted along the back road leading to the market. The GPS coordinates of the sounding position are 574271 mE and 8915316 mN and oriented on a bearing of 246 degrees.

The sounding was interpreted using a 3-layer model. At the top is a 4 m thick layer with resistivity 11 Ωm. A very thick layer, approximately 126 m thick and of slightly higher resistivity, 22 Ωm, follows. The bottom layer is most probably bedrock with a high resistivity at 2,064 Ωm.

3.7.3 Discussion

Resistivity soundings done in and around Kwikila Station fall into three groups according to their curve types :-

Group One comprises soundings KK-01S, KK-02S and KK-11S; group two is made up of soundings KK-03S – KK-05S, KK-08S, and KK-10S; group three comprises soundings KK-06S, KK-07S, KK09S and KK-09W.

Group One is defined as having ascending-type curves. This implies that resistivity increases with depth of penetration of the sounding. It is difficult to delineate the freshwater bearing layer with this type of curve. The continuos increase in resistivity may imply that subsurface layers are progressively drier than the top layers. Hence there is almost no possibility of detecting an aquifer.

Group Two are double ascending-type curves. Most sounding curves obtained in the investigations are of this second group. The curves mean that there are at least two high resistivity layers, the second being higher in resistivity than the preceding one.

From the curves there appears to be no real correlation in either the resistivities or thicknesses of the layers, except maybe for the top layers, which are between 0.5 and 1.0 m thick. The resistivity of the top layer is in the range 20 to 40 Ωm and is most probably dry clay. The conductive second layer is most likely to contain wet clay, which contributes a lot to the low conductivity of the formation. The third layer, judged only by its resistivity, may be the freshwater bearing layer. Depth to this layer varies between 2 and 6 m, and the resistivity between 30 and 150 Ωm. While there is also a lot of variation in the thickness of this layer, an average would be approximately 10 m. Sounding KK-08S gives a thickness of just over 100 m, which is comparable only with sounding KK-10S with a thickness of 70 m.

Group Three may be described as the extreme of the other two groups. The curves have a minimum between the double ascents. This implies that there is a conductive layer sandwiched between two higher resistivity layers. Depth of this layer is approximately between 15 m at sounding KK-09S and increasing to 19 m at sounding KK-07S. This most likely is the freshwater layer, which is thickest (33 m) at sounding KK-06S. Weathered bedrock may be encountered below 35 m at sounding KK-09S. Depth to bedrock may be deeper between soundings KK-07S and KK-06S, ranging between 43 m and 70 m.

In Figure 8d the interpreted soundings are arranged in three profiles to show the horizontal variation in the possible aquifer layer :-

Profile 1 comprises the E-W soundings, and shows a very shallow aquifer at a depth between 2 and 4 m. The aquifer may be as thick as 50 m near Gidobada, with an undefined thickness near the Kemp Welch River. Along this profile, depth to bedrock is not so well defined, except at KK-08S, where it is interpreted to be at 136 m.

Profile 2 comprises the S-N soundings. A possible aquifer is deeper at the southern end (15 m) than at the north (3 m). The thickness of the aquifer at the southern end however is not very well defined. To the north, bedrock is intercepted at 136 m and so the potential aquifer is relatively thick (>100 m).

Profile 3 comprises soundings conducted within the station. Only sounding KK-06S shows a favourable aquifer, approximately 24 m thick at a depth of 16 m. Towards the south, the aquifer is shallower and thinner near the Police Station and ceases to exist further south. The highly conductive layer that delineates the aquifer and bedrock becomes progressively thicker towards the south.

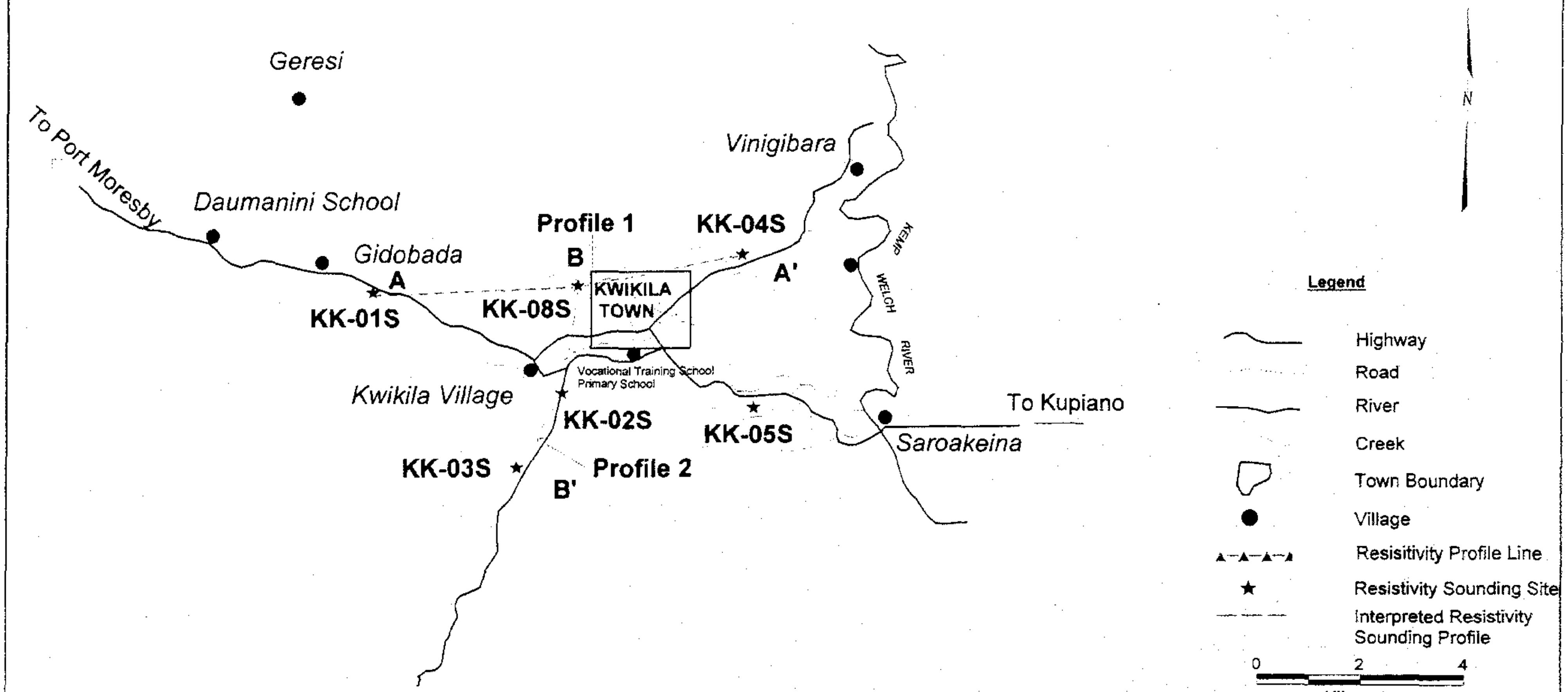
3.7.4 Conclusions and recommendations

The following conclusions were derived from the sounding models:

- The sounding curves show a very inhomogeneous geological subsurface. This is clearly shown by three distinct types of curves obtained from soundings within a radius of not more than a kilometre.

- The chance of intercepting freshwater aquifers is thus very limited.

- Deeper freshwater may be located between soundings KK-06S, KK-07S, and KK-09S and KK-09W. Between KK-06S and KK-07S the freshwater aquifer would be at a depth of about 24 to 33 m.
- Due to the highly inhomogeneous nature of the subsurface geology, aquifers may be discontinuous and recharge may not be very high. In such a case, a series of boreholes drilled within the vicinity of KK-06S, KK-07S, and KK-09, may be necessary to meet the Station's water supply demands.



Location map of resistivity sounding, Kwikila

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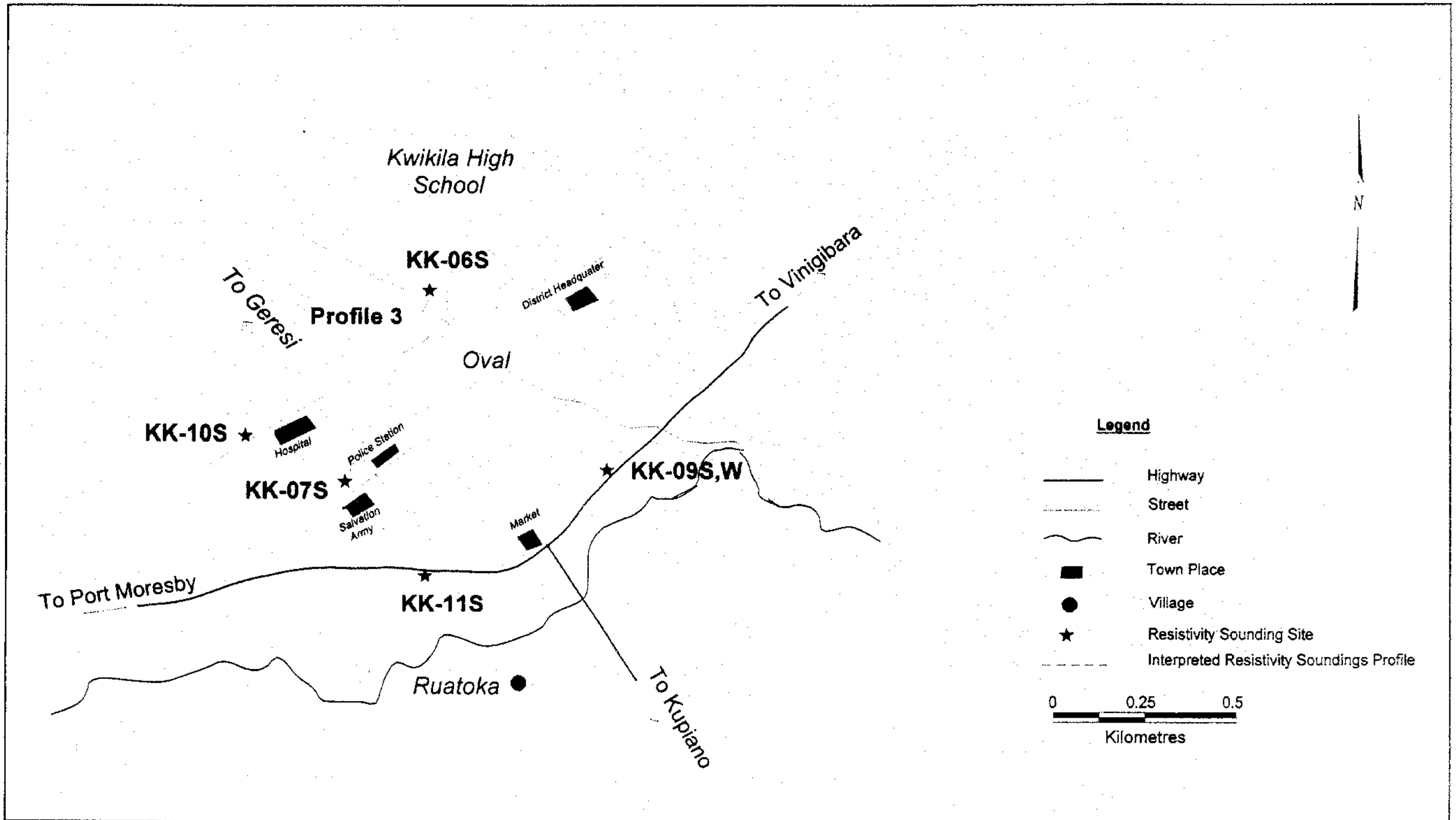
Figure 8a



Location map of resistivity sounding, Kwikila Town

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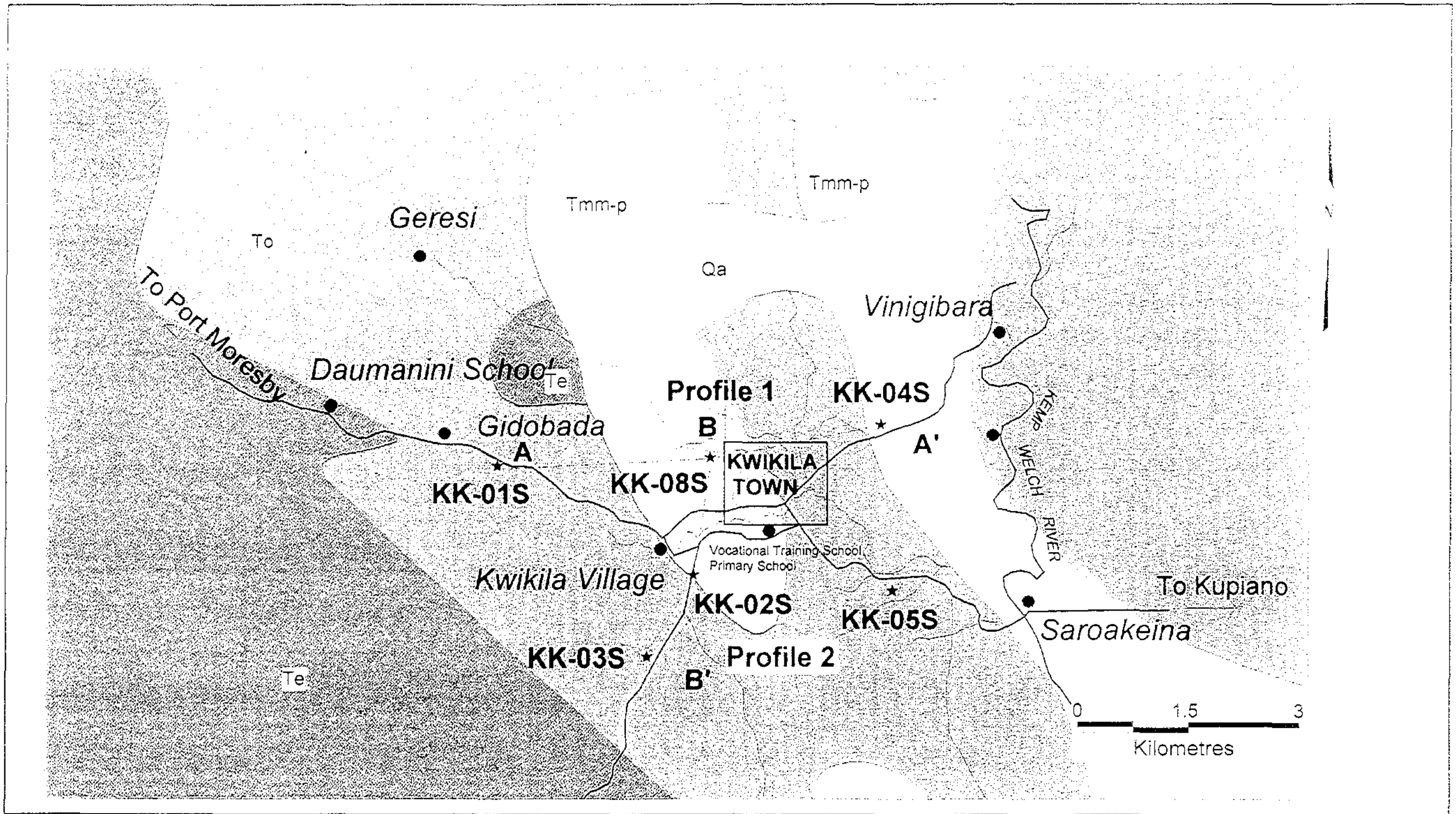
Figure 8b



Map of resistivity sounding over regional geology, Kwikila

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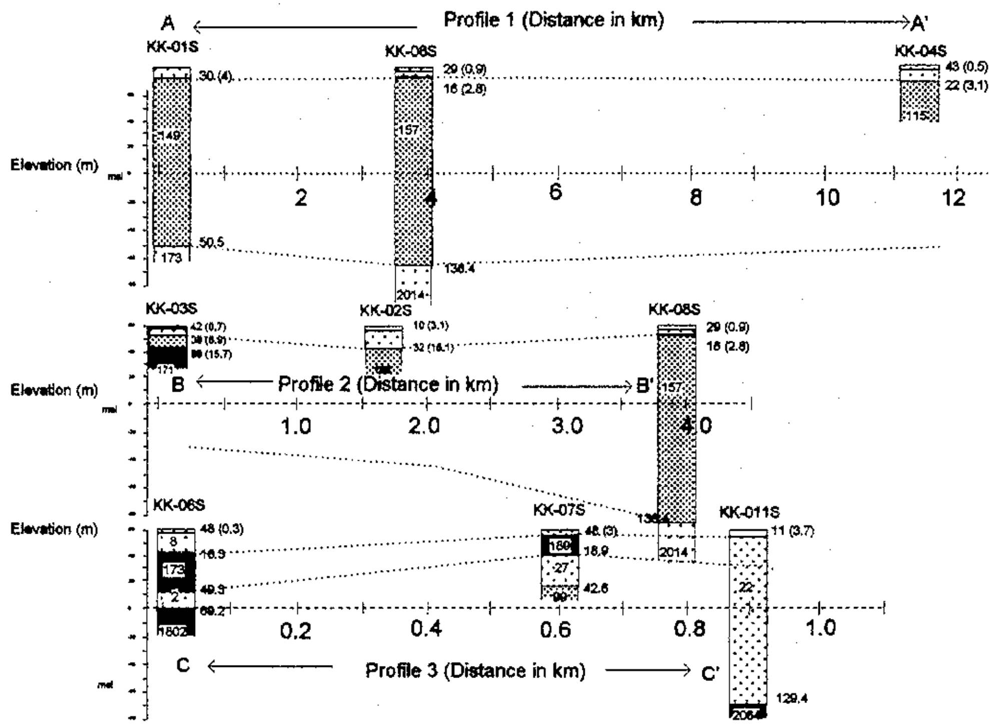
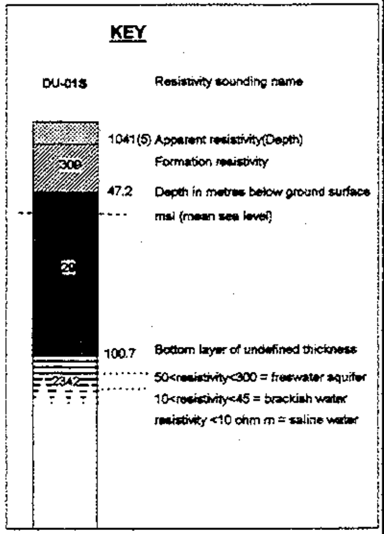
Figure 8c





Interpreted resistivity sounding profiles, Kwikila

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Figure 8d

3.8 KUPIANO, CENTRAL PROVINCE

Eleven vertical electrical soundings were performed in and around Kupiano Station (Figures 9a & 9b). Eight of the soundings used the Schlumberger configuration, and three used the Wenner array. For the Schlumberger soundings, a maximum AB/2 of 420 m was used, while for the Wenner array, soundings were performed with a maximum electrode separation (a) of 300 m.

3.8.1 Geology

The geological setting of Kupiano is described in the 1:250 000 Explanatory Notes of the Port Moresby - Kalo - Aroa geology map sheet (Pieters, 1978), of which part is shown in Figure 9c.

The oldest rocks around Kupiano are the Eocene Bomguina Beds. These contain well-bedded calcilutite, siltstone, sandstone and minor chert. They are overlain by Early Miocene to Late Pliocene Kupiano Beds. These include sandstones, siltstones, mudstones, and minor conglomeratic limestones. On top of the Kupiano Beds is the Pleistocene Ararabu Conglomerate. Most of the area is occupied by recent fluviatile and littoral deposits and made up of gravel, sand, silt and clay.

3.8.2 Resistivity sounding results

Sounding KP-01S

Sounding KP-01S was located along the road at lopara. The GPS coordinates of the sounding position are 632411 mE and 8886821 mN and aligned parallel to the road on a bearing of 115 degrees. A Wenner sounding KP-01W was also conducted at this location.

The sounding curve for KP-01S was noisy, most probably due to insufficient power being applied to the equipment. The curve was interpreted using a 4-layer model. At the top is a 7 m thick layer of resistivity 21 Ωm. The second layer, approximately 31 m thick, is very conductive and has a resistivity of 4 Ω m. The third layer, at a depth of approximately 38 m, was modeled with a resistivity of 176 Ωm, and is 33 m thick. The bottom layer is also a conductive with a resistivity of 4 Ωm.

Sounding KP-01W

Sounding KP-01W was modeled with 5 layers. The top layer is very thin, 0.3 m, and has a resistivity of 56 Ωm. Below is a 10 m thick layer of resistivity 12 Ωm. The third layer is higher in resistivity, 76 Ωm, and is approximately 23 m thick. The fourth layer is another conductive layer with resistivity, 15 Ωm, and is approximately 28 m thick. A fifth layer with a higher resistivity, about 33 Ω m, is present at a depth of approximately 63 m below ground level.

Sounding KP-02S

The second sounding, KP-02S was located at the junction of the Kupiano-Moreguina roads. The GPS position of the sounding is approximately 636275 mE and 8884464 mE and orientated on a bearing of 289 degrees.

The sounding was modeled with 5 layers. The top layer was modeled with a resistivity of 42 Ωm and thickness 0.9 m. Below is a 7 m thick layer of resistivity 24 Ωm. The third layer follows and has a resistivity of 69 Ωm and is about 27 m thick. As with KP-01W, after the resistive third layer is another conductive layer which is about 27 m thick and has a resistivity of 15 Ωm. The bottom layer has a higher resistivity at 61 Ωm and most probably is the surface of highly weathered bedrock.

Sounding KP-03S

Sounding KP-03S was conducted along the Kupiano-Port Moresby road, north of KP-02S. The coordinates of the GPS position of the sounding are approximately 638224 mN, and 8887072 mE. The sounding was oriented on a bearing of 260 degrees.

KP-03S was modeled with 5 layers. The top layer was modeled with a thickness of 0.8 m and resistivity 8 Ωm. The second layer, approximately 6 m in thickness, was modeled with a resistivity of 5 Ωm and most probably is composed of wet clay. The third layer also has a low resistivity at 11 Ωm and and is 4 m thick. The fourth layer is conductive with a low resistivity of 2 Ωm. and is approximately 32 m thick. The underlying fifth layer is weathered bedrock, modeled with a resistivity of 115 Ωm.

Sounding KP-04W

The fourth sounding, KP-04W, was conducted using the Wenner configuration. The sounding was conducted along the back road to the market. The GPS coordinates of the sounding position are 629789 mN and 8886319 mE.

This sounding was modeled with only 3 layers and shows a progressive decline in resistivity with depth. The first layer is approximately 3 m thick and has a resistivity of about 97 Ωm. The second layer was modeled with a thickness of 47 m and resistivity 31 Ωm and is most probably the freshwater layer. The bottom layer is the saline water layer and was modeled with a resistivity of 16 Ωm.

Sounding KP-05S

Sounding KP-05S was located near the Station's water supply intake point. The GPS coordinates of the sounding position are 629438 mN and 8888955 mE and on a bearing of 110 degrees magnetic north.

KP-05S was also modeled with 3 layers. The top layer is approximately 8 m thick and has a resistivity of 27 Ωm. The second layer is 10 m thick and is very conductive with a resistivity of 3 Ωm. The third layer, which is most probably the aquifer layer, has a resistivity of 64 Ωm.

Sounding KP-06S

Sounding KP-06S was located within the Station area, with GPS coordinates 629497 mE and 8886113 mE. The sounding orientation was on a bearing of 127 degrees relative to magnetic north.

The sounding was modeled with 4 layers. The top layer was modeled with a thickness of 3 m and a resistivity of 146 Ωm. The second layer was modeled with a resistivity of 46 Ωm and thickness 40 m. The third layer, at a depth of approximately 43 m, has a resistivity of 64 Ωm, and is 16 m thick and most probably is the water bearing layer. The fourth layer is weathered bedrock with a resistivity of 84 Ωm.

Sounding KP-07S

Sounding KP-07S was located near the Health Centre. The GPS co-ordinates of the sounding position are 629855 mE and 8885701 mN and aligned on a bearing of 127 degrees. A Wenner sounding was also conducted here and used a maximum electrode separation of 220 m.
The sounding curve for KP-07S was modeled with 3 layers. At the top is a 6 m thick layer with a resistivity of 146 Ωm. The resistivity of the second layer is higher than the first layer at 193 Ωm and is approximately 61 m thick and most probably is weathered material. The third layer is conductive with a resistivity of only 25 Ωm and most probably represents saline water.

Sounding KP-07W

The sounding curve for KP-07W was modeled with 4 layers. The first layer was modeled with a resistivity of 48 Ωm and thickness 2 m. The second layer is approximately 36 m thick with a resistivity of 72 Ωm. The third layer is about 35 m thick and has a resistivity of 16 Ωm, suggesting most probably a saline water layer. The bottom layer has a high resistivity at 526 Ωm and is most likely to be a weathered bedrock layer.

Sounding KP-08W

Sounding KP-08W was conducted near the Elementary School within the Station area. The orientation of the sounding was 242 degrees relative to magnetic north.

The sounding was modeled with 5 layers. At the top is a 0.5 m thick layer with a low resistivity of 39 Ωm and most probably represents wet gravel. The second layer was modeled with a resistivity of 73 Ωm and is about 6 m thick. The third layer is approximately 7 m deep with a resistivity 17 Ωm and is 13 m thick. Probably this is the water bearing layer. The fourth layer also has a high resistivity at 302 Ωm and is 37 m thick. The bottom layer is the conductive layer with a resistivity of 24 Ωm and most probably contains saline water.

Sounding KP-09W

Sounding KP-09W was also conducted using the Wenner configuration. The GPS coordinates of the approximate sounding position are 630186 mE and 8886158 mN.

KP-09W was modeled with 5 layers. The top layer, modeled with a resistivity of 53 Ωm, is approximately 0.4 m thick. Below is a 2 m thick layer of resistivity 91 Ωm. The third layer is a conductive layer with a resistivity of 27 Ωm and is 9 m thick. The fourth layer has a higher resistivity at 61 Ωm and approximately is 13 m thick. The bottom layer is a conductive layer with a resistivity of 29 Ωm and represents saline water.

Sounding KP-10S

Sounding KP-10S was conducted opposite Kupiano Station Water Supply Treatment Plant with GPS coordinates 630594 mE and 8886566 mN.

Sounding KP-10S was modeled with 4 layers. The top layer is relatively conductive with a resistivity of 20 Ωm and is approximately 2 m thick. The second layer, approximately 14 m thick has a resistivity of only 5 Ωm. Below is a higher resistivity layer at 19 Ωm, and is approximately 41 m thick. At the bottom is the bedrock layer with a resistivity of 2,117 Ωm.

3.8.3 Discussion

From observation, the soundings can be divided into three main groups :-

Group One comprises only one sounding, KP-04W and represents a double descending-type curve. This indicates a progressively conductive subsurface with increasing depth. This means the first descent is due to a freshwater layer and the second descent can only be the effect of saline water. The proximity of the sounding to the coastline may suggest that the saline water layer is not very deep. However, sounding KP-04W does not support this as depth to the saline water layer has been modeled at approximately 50 m.

A possible explanation may be that the second layer is thicker because of the heavy build up of sediments due to flooding of the Lako River. This results in the saline water layer being deeper than would normally be expected.

At sounding KP-04W the freshwater layer is at a depth of 3 m below ground level. The resistivity of the formation (31 Ω m) however indicates that it may be too brackish for human consumption. At site KP-09W, depth to the freshwater layer has been interpreted to be around 2 m. The resistivity of the formation is 27 Ωm, within the value interpreted for sounding KP-04W. This layer is about 9 m thick, and is separated from the saline water layer by what appears to be a weathered bedrock layer.

Group Two comprises KP-07S and KP-07W, KP-08W and KP-09W. The group begins with an intermediate resistivity layer, then a high resistivity layer, through a conductive layer and finally reaching the bedrock layer.

Group Three comprises the rest of the soundings. This group begins with a low resistivity second layer, reaches a high resistivity layer, then through another conductive layer before reaching the bedrock layer.

The above groups can be interpreted together as the layers appear to be the same, but may be in different sequences. The second group has a resistive second layer while the third has a conductive second layer.

The soundings that make up the second group were all conducted within the town area. These soundings are located in areas covered mostly by poorly consolidated conglomerates. It is probable that the top layer (between 2 and 5 m thick) is composed mostly of fluviatile and littoral deposits comprising gravel, sand, silt and clay with intersections of raised coral reefs.

The conductive layer thus becomes the third layer but is not a saline water layer. Instead this layer would most probably consist of wet, poorly consolidated conglomerates. As this layer is poorly consolidated, it enhances the flow of electrical current making it appear very conductive. Around the town area this layer is between 6 and 10 m thick.

The freshwater layer then is the fourth layer with a resistivity between 61 and 301 Ωm. The depth of the layer is between 13 m at the coast (KP-09W) to 57 m, further inland (KP-08W).

The freshwater layer for the third group is the third layer, much shallower than the second group. There is a lot more consistency in the thickness of this layer which has been interpreted as being between 23 and 31 m thick between KP-01W and KP-02S. The resistivity of the layer is between 69 and 76 Ωm, which may suggest potable water. Around the town area, the resistivity of this layer is low, between 10 Ωm (KP-03S) and 64 Ωm (KP-06S) and is not very thick, between 4 m (KP-03S) and 16 m (KP-06S).

Three profiles were constructed from the interpreted soundings (Figure 9d) :-

Profile 1 comprises the outer soundings, KP-05S, KP-01S and KP-01W, and KP-02S. The models show a progressive increase in resistivity towards the east. It also appears that the bedrock is deeper towards the east. Depth to possible aquifer appears to gradually decrease between KP-01S and KP-02S, from 11 m to 8 m.

Profile 2 comprises the W-E soundings conducted inside the Station. The profile indicates a very shallow aquifer (3 m) that becomes progressively shallower and thinner to the east. It may be possible to intercept a deeper aquifer at the site of sounding KP-08S.

Profile 3 is a NW-SE cross-section. The profile shows a shallow aquifer (3 m) that becomes progressively deeper and thicker towards the southeast. Again the only possible deeper aquifer may be intercepted at the site of sounding KP-08S.

3.8.4 Conclusions and recommendations

Interpretation of the soundings conducted in and around Kupiano are summarised as follows:

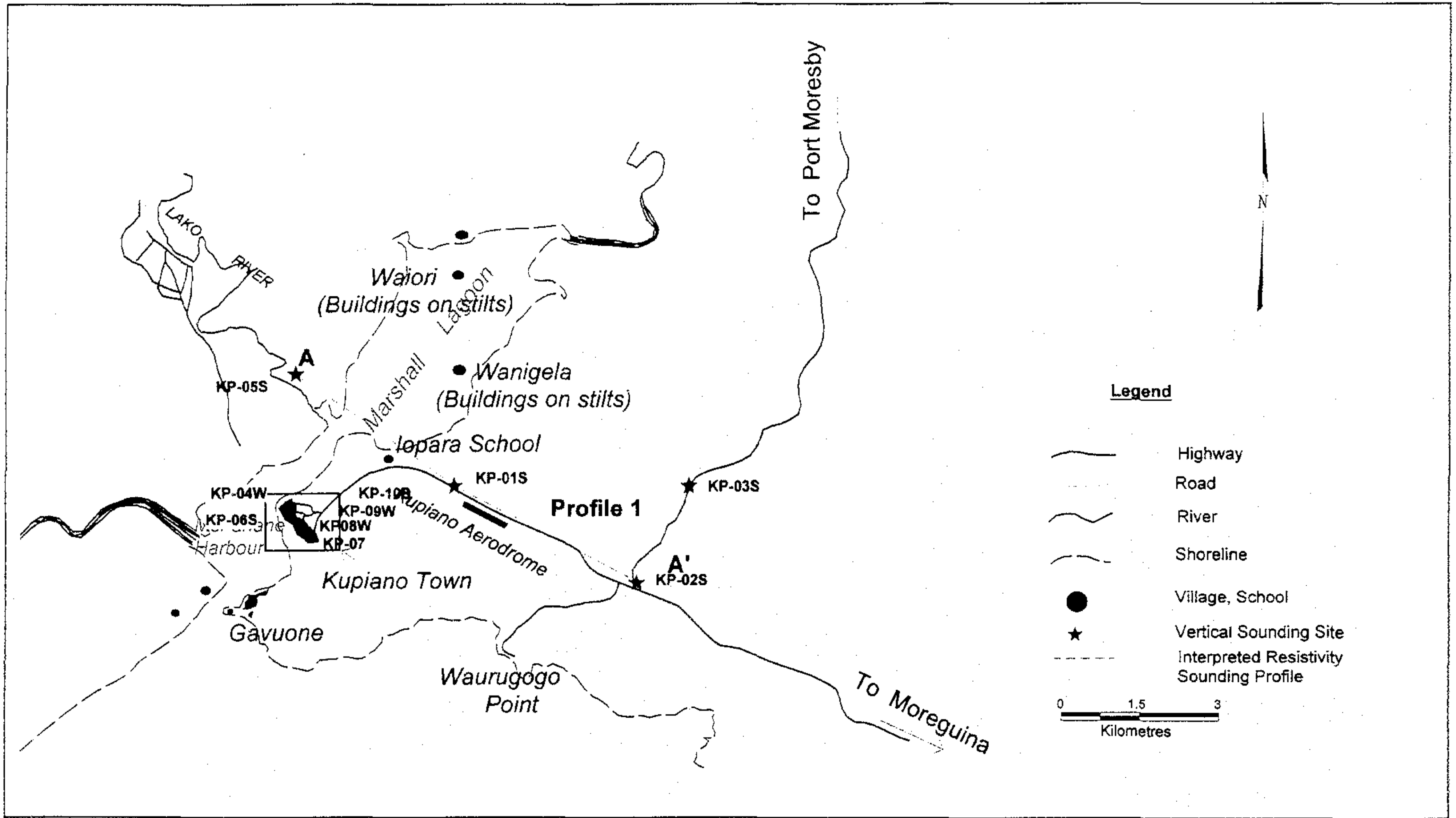
- Around the town area, the aquifer layer is between 10 and 38 m deep, increasing inland from the coast. The resistivity of the formation is also low, 17 Ωm, near the coast at KP-09W to a high of 300 Ωm further inland at KP-07S. The formation varies in thickness between 12 and 57 m.

- Outside the town area, aquifer depths have been interpreted at between 7 and 10 m. Resistivity of the formation is between 69 and 76 Ωm and a thickness of between 20 and 30 m.

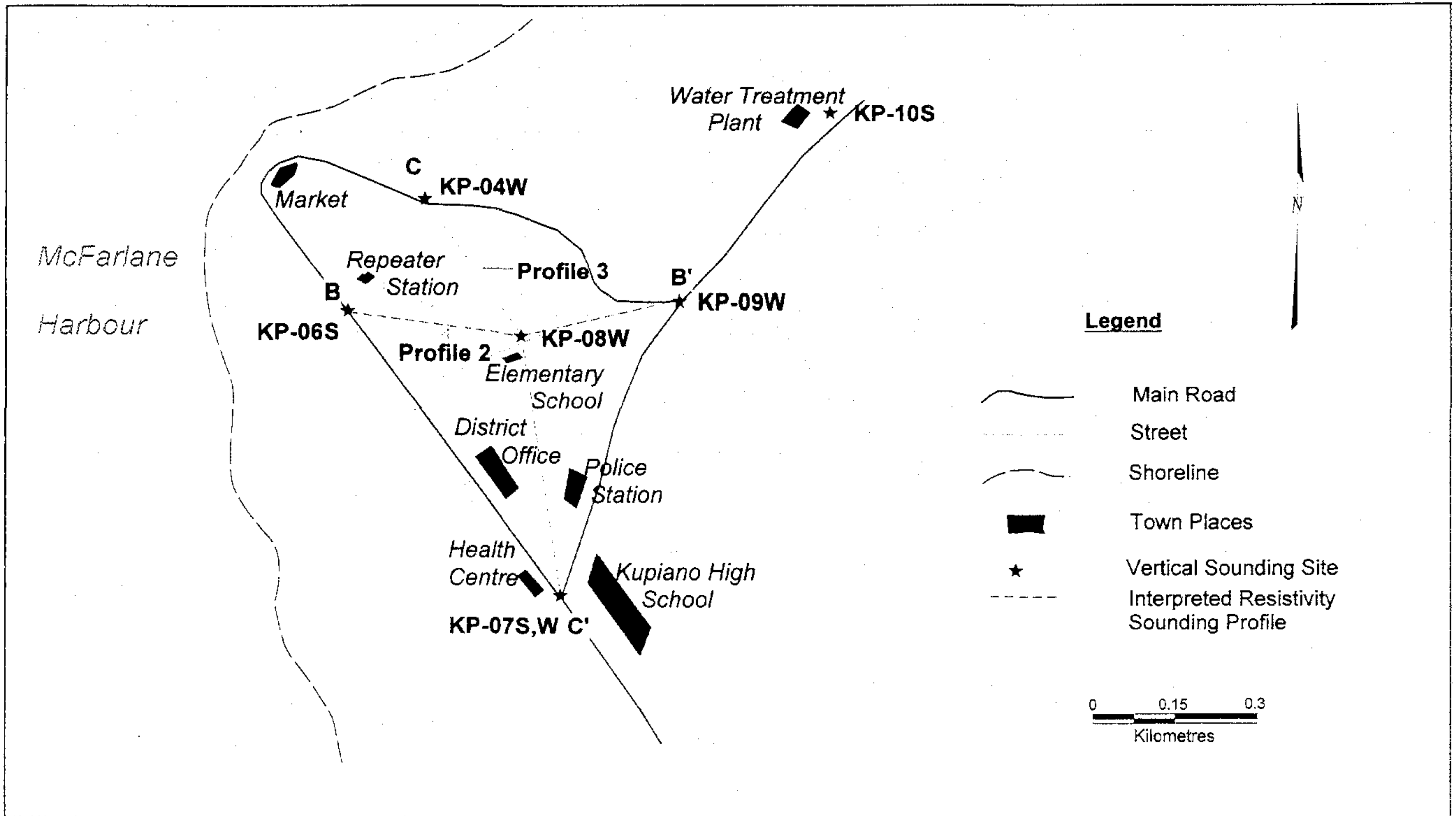
- The subsurface geology is almost the same with the conductive conglomerates visible only in soundings conducted outside the town area. Inside the town area, conglomerates are overlain by fluviatile and littoral deposits.

- Soundings conducted using both Wenner and Schlumberger arrays could not correlate with each other due to the high sensitivity of the Schlumberger array to the geology of the area. The sounding results were too noisy.

- Based only on the resistivity of the aquifer formations, the most suitable site for drilling purposes would be the area between KP-01S and KP-02S. Inside the Station area, the most suitable drill site would be between soundings KP-08S and KP-07S.



Location map of resistivity sounding, Kupiano	Geophysical Surveys Section Geological Survey of PNG Department of Mining	Figure 9a
Investigations of groundwater resources in Papua New Guinea, 2000		



Location map of resistivity sounding, Kupiano Town

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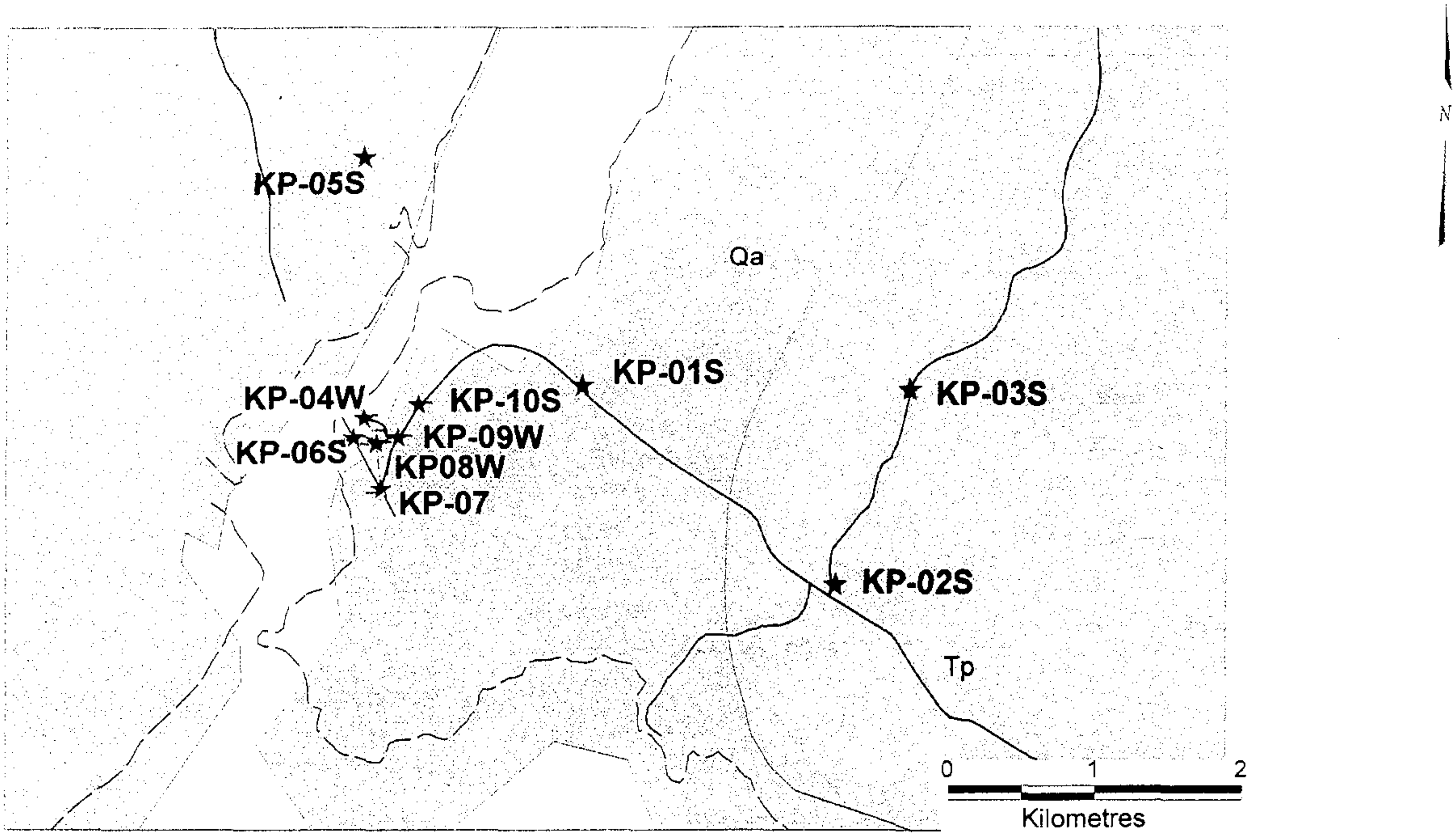
Geophysical Surveys Section
Geological Survey of PNG
Department of Mining

Figure 9b



Map of resistivity sounding over regional geology, Kupiano

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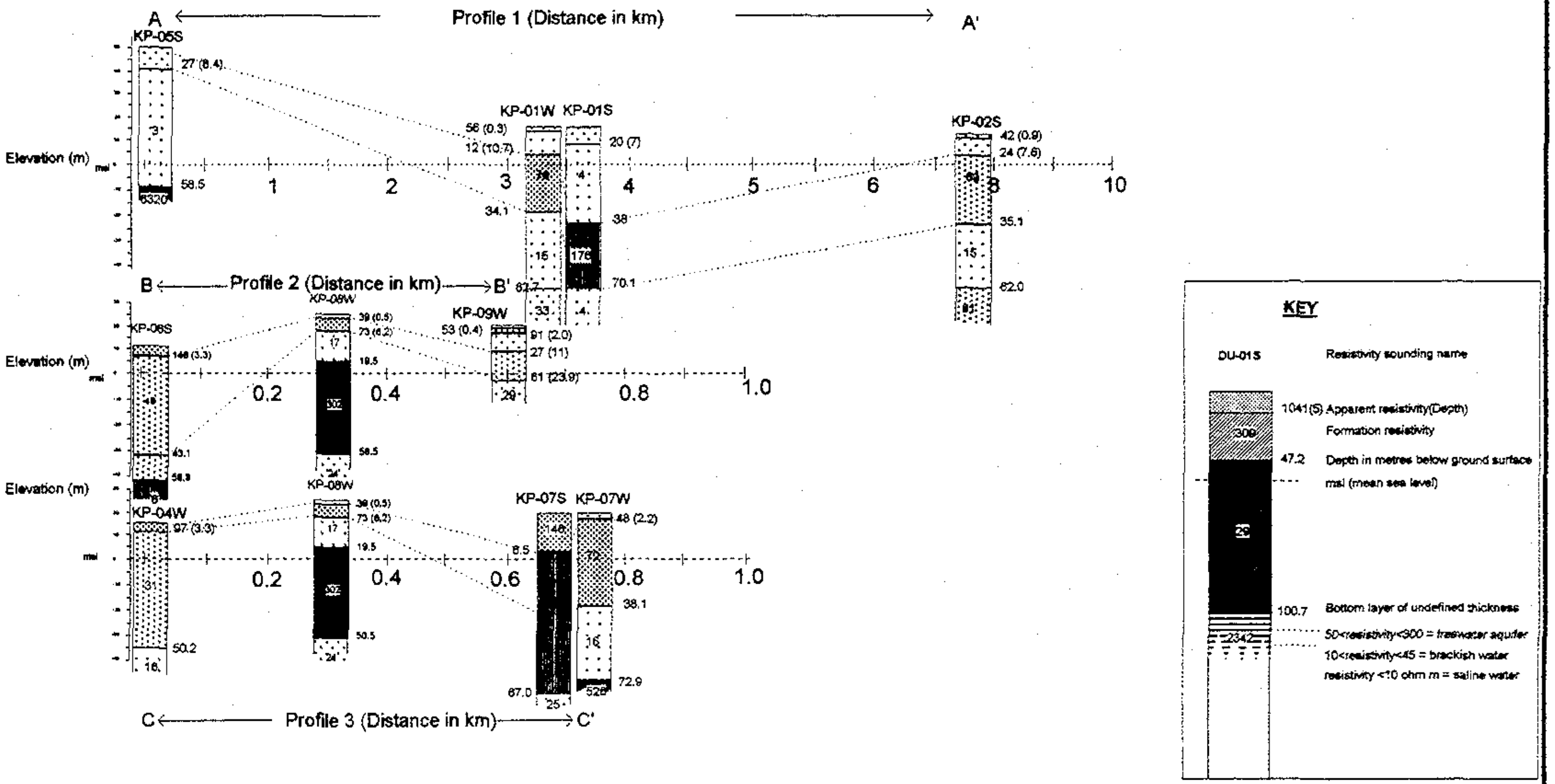
Figure 9c



Interpreted resistivity sounding profiles, Kupiano

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Figure 9d

4. GENERAL CONCLUSIONS

1. Geophysical investigations for groundwater using the resistivity and conductivity methods were successful in delineating potential water bearing formations in eight selected provincial centres in Papua New Guinea.

2. The primary investigative instruments, the ABEM Terrameter and the Geonics EM-34XL generally performed according to expectations. The cables of the conductivity instrument however had to undergo serious repairs, and the Terrameter results had to be adjusted for very low resistivity measurements.

3. Hand sets need improvement to enhance communications between operator and receiver stations, to increase the speed at which surveys can be carried out. Spare Terrameter batteries should also be purchased to avoid using a vehicle battery, which may be destructive to geophysical equipment.

4. The Schlumberger array, the main sounding method used, proved too sensitive in certain areas. This was particularly the case at Kupiano and Finschhafen where the subsurface geology was coral limestone. The Wenner performed better but the results could not complement those obtained using the Schlumberger method.

5. The survey results suggest there is freshwater present in exploitable amounts in all the towns except Daru. However, the quality and quantity of groundwater at Kupiano may not be as high as in other towns.

6. These investigations are only a preliminary and further investigations should be conducted in selected areas to obtain more detailed assessment of their groundwater potential.

5. RECOMMENDATIONS

1. Results from the geophysical surveys did not confirm the presence of freshwater aquifers at Daru. Hence it is recommended that the town continue using the current water supply system, or pursue appropriate alternate methods, for instance desalination.

2. Undertake further geophysical surveys in those areas where Schlumberger and Wenner arrays failed to complement each other. Another geophysical method may be applied, for example seismic refraction, to determine the thickness of the underlying layers.

3. Undertake further geological and hydrological studies to determine the factors affecting inconsistency in the sounding models within close proximity of each other.

4. Borehole information should be made available to calibrate geophysical sounding models for more accurate interpretation of the result.

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Bereina		Ground Level base				No. of	Layer - 1		Layer - 2		Layer - 3		Layer - 4		Layer - 5		Layer - 6		Layer - 7	
X	Y	Z	ST No.	Array	Max AB/2	Layers	Resistiv	Bottom	Resistiv	Bottom	Resistivity	Bottom	Resistivity	Bottom	Resistiv	Bottom	Resistiv	Bottom	Resistiv	Bottom
					metres		ΩDD	metres	ΩDD	metres	ΩDD	metres	ΩDD	metres	ΩDD	metres	ΩDD	metres	ΩDD	metres
446.947	9052.64746	45	BR-01S	SCHL	420	4	42.3	0.8	418.2	16.3	8.6	44.7	97.2	0	0	0	0	0	0	0
446.571	9049.31445	12	BR-02S	SCHL	420	3	71.6	7.7	9.3	22.9	116516.6	0	0	0	0	0	0	0	0	0
450.016	9050.66211	39	BR-03S	SCHL	420	4	111.3	0.6	3611.1	5.2	19.0	22.7	98.0	0	0	0	0	0	0	0
452.362	9046.08008	41	BR-04S	SCHL	420	4	189.2	0.9	252.3	11.3	64.6	60.2	394.6	0	0	0	0	0	0	0
446.198	9043.70215	20	BR-05S	SCHL	420	4	119.7	0.6	152.4	5.5	49.7	89.7	9219.3	0	0	0	0	0	0	0
445.616	9047.06738	45	BR-06S	SCHL	420	5	10.5	0.4	3.1	2.4	111.0	16.9	10.2	78.9	442.1	0	0	0	0	0
448.098	9046.96582	30	BR-07S	SCHL	420	4	479.2	0.2	430.9	35.8	5.2	44.3	5433000.0	0	0	0	0	0	0	0
445.778	9045.36426	29	BR-08S	SCHL	420	4	442.4	1.8	732.9	6.4	31.6	21.3	7302.0	0	0	0	0	0	0	0
446.054	9045.61621	45	BR-09S	SCHL	320	4	11.8	1.3	224.7	6.1	9.2	28.3	4203.0	0	0	0	0	0	0	0
446.058	9045.21387	31	BR-10S	SCHL	360	4	165.2	4.1	34.5	15.2	1430.4	37.8	4349.9	0	0	0	0	0	0	0
446.058	9045.21387	31	BR-10W	WENN	330	5	469.2	5.0	74.3	15.1	1186.3	42.7	114.2	70.2	1873.3	0	0	0	0	0

Bereina		Sea Level base					Layer - 1		Layer - 2		Layer - 3		Layer - 4		Layer - 5		Layer - 6		Layer - 7	
X	Y	Z	ST No.	Array	Max AB/2 or 1.5a	No. of Layers	Resistiv ity	Bottom Level	Resistiv ity	Bottom Level	Resistivity	Bottom Level	Resistivity	Bottom Level	Resistiv ity	Bottom Level	Resistiv ity	Bottom Level	Resistiv ity	Bottom Level
		meteres			meteres		ΩDD	meteres	ΩDD	meteres	ΩDD	meteres	ΩDD	meteres	ΩDD	meteres	ΩDD	meteres	ΩDD	meteres
446.947	9052.647	45	BR-01S	SCHL	420	4	42.3	44.161	418.2	28.731	8.6	0.311	97.2	0	0	0	0	0	0	0
446.571	9049.314	12	BR-02S	SCHL	420	3	71.6	4.26	9.3	-10.92	116516.6	0	0	0	0	0	0	0	0	0
450.016	9050.662	39	BR-03S	SCHL	420	4	111.3	38.412	3611.1	33.792	19.0	16.282	98.0	0	0	0	0	0	0	0
452.362	9046.080	41	BR-04S	SCHL	420	4	189.2	40.144	252.3	29.654	64.6	-19.166	394.6	0	0	0	0	0	0	0
446.198	9043.702	20	BR-05S	SCHL	420	4	119.7	19.404	152.4	14.534	49.7	-69.746	9219.3	0	0	0	0	0	0	0
445.616	9047.067	45	BR-06S	SCHL	420	5	10.5	44.561	3.1	42.561	111.0	28.051	10.2	-33.869	442.1	0	0	0	0	0
448.098	9046.966	30	BR-07S	SCHL	420	4	479.2	29.846	430.9	-5.764	5.2	-14.324	5433000.0	0	0	0	0	0	0	0
445.778	9045.364	29	BR-08S	SCHL	420	4	442.4	27.21	732.9	22.57	31.6	7.7	7302.0	0	0	0	0	0	0	0
446.054	9045.616	45	BR-09S	SCHL	320	4	11.8	43.71	224.7	38.86	9.2	16.74	4203.0	0	0	0	0	0	0	0
446.058	9045.214	31	BR-10S	SCHL	360	4	165.2	26.92	34.5	15.81	1430.4	-6.79	4349.9	0	0	0	0	0	0	0
446.058	9045.214	31	BR-10W	WENN	330	5	469.2	26.03	74.3	15.86	1186.3	-11.74	114.2	-39.21	1873.3	0	0	0	0	0

Finschhafen		Ground Level base					Layer - 1		Layer - 2		Layer - 3		Layer - 4		Layer - 5		Layer - 6		Layer - 7	
X	Y	Z	ST No.	Array	Max AB/2 or 1.5a	No. of Layers	Resistivity	Bottom Depth	Resistivity	Bottom Depth	Resistivity	Bottom Depth	Resistivity	Bottom Depth	Resistivity	Bottom Depth	Resistivity	Bottom Depth	Resistivity	Bottom Depth
					meteres		Ω□□	meteres	Ω□□	meteres	Ω□□	meteres	Ω□□	meteres	Ω□□	meteres	Ω□□	meteres	Ω□□	meteres
595.190	9268.178	32	FN-01S	SCHL	420	4	1040.8	4.7	308.8	47.2	28.8	100.7	2342.0	0	0	0	0	0	0	0
594.190	9268.215	21	FN-01W	WENN	330	4	981.5	9.8	417.9	40.2	32.9	102.5	2110.3	0	0	0	0	0	0	0
594.365	9267.370	19	FN-02S	SCHL	420	5	4882.1	0.8	153.6	2.4	5827.2	7.3	14.4	23.8	94624.9	0	0	0	0	0
594.112	9265.491	21	FN-03S	SCHL	420	5	191.9	1.4	426.6	4.5	1100.7	6.7	27.4	36.0	391.1	0	0	0	0	0
593.290	9264.187	14	FN-04S	SCHL	420	5	443.1	0.3	1185.0	2.5	438.9	34.8	39.0	60.3	7797.3	0	0	0	0	0
591.687	9264.196	14	FN-05S	SCHL	420	5	1066.4	0.3	2253.5	3.8	246.1	31.6	139.1	41.6	445.4	0	0	0	0	0
592.837	9266.477	85	FN-06S	SCHL	420	4	50.7	5.3	12.8	19.9	484306.1	45.1	9.7	0	0	0	0	0	0	0
590.314	9267.561	240	FN-07S	SCHL	420	4	16.5	0.3	67.4	24.2	1932.0	36.8	268.7	0	0	0	0	0	0	0
592.112	9269.016	255	FN-08S	SCHL	420	3	81.6	0.6	59599.5	9.5	11.2	0	0	0	0	0	0	0	0	0
592.112	9269.016	255	FN-09S	SCHL	420	5	141.6	0.8	243.2	39.4	363.2	118.1	68.3	177.6	2252.9	0	0	0	0	0
594.137	9270.032	45	FN-10S	SCHL	180	5	107.9	1.5	592.9	5.4	150.0	33.2	28.4	80.8	494.7	0	0	0	0	0
589.610	9270.196	64	FN-11W	WENN	330	4	332.5	2.2	143.8	9.0	1909.6	20.8	23.8	0	0	0	0	0	0	0

Finschhafen		Sea Level base					Layer - 1		Layer - 2		Layer - 3		Layer - 4		Layer - 5		Layer - 6		Layer - 7	
X	Y	Z	ST No.	Array	Max AB/2 or 1.5a	No. of Layers	Resistivity	Bottom Level	Resistivity	Bottom Level	Resistivity	Bottom Level	Resistivity	Bottom Level	Resistivity	Bottom Level	Resistivity	Bottom Level	Resistivity	Bottom Level
		meteres			meteres		Ω□□	meteres	Ω□□	meteres	Ω□□	meteres	Ω□□	meteres	Ω□□	meteres	Ω□□	meteres	Ω□□	meteres
595.190	9268.178	32	FN-01S	SCHL	420	4	1040.8	27.3	308.8	-15.2	28.8	-68.7	2342.0	0	0	0	0	0	0	0
594.190	9268.215	21	FN-01W	WENN	330	4	981.5	11.2	417.9	-19.2	32.9	-81.5	2110.3	0	0	0	0	0	0	0
594.365	9267.370	19	FN-02S	SCHL	420	5	4882.1	18.2	153.6	16.6	5827.2	11.7	14.4	-4.8	94624.9	0	0	0	0	0
594.112	9265.491	21	FN-03S	SCHL	420	5	191.9	19.7	426.6	16.5	1100.7	14.3	27.4	-15.0	391.1	0	0	0	0	0
593.290	9264.187	14	FN-04S	SCHL	420	5	443.1	13.7	1185.0	11.5	438.9	-20.8	39.0	-46.3	7797.3	0	0	0	0	0
591.687	9264.196	14	FN-05S	SCHL	420	5	1066.4	13.7	2253.5	10.2	246.1	-17.6	139.1	-27.6	445.4	0	0	0	0	0
592.837	9266.477	85	FN-06S	SCHL	420	4	50.7	79.7	12.8	65.1	484306.1	39.9	9.7	0	0	0	0	0	0	0
590.314	9267.561	240	FN-07S	SCHL	420	4	16.5	239.7	67.4	215.8	1932.0	203.2	268.7	0	0	0	0	0	0	0
592.112	9269.016	255	FN-08S	SCHL	420	3	81.6	254.4	59599.5	245.6	11.2	0	0	0	0	0	0	0	0	0
592.112	9269.016	255	FN-09S	SCHL	420	5	141.6	254.2	243.2	215.6	363.2	136.9	68.3	77.4	2252.9	0	0	0	0	0
594.137	9270.032	45	FN-10S	SCHL	180	5	107.9	43.5	592.9	39.6	150.0	11.9	28.4	-35.8	494.7	0	0	0	0	0
589.610	9270.196	64	FN-11W	WENN	330	4	332.5	61.8	143.8	55.0	1909.6	43.3	23.8	0	0	0	0	0	0	0

Mutzing		Ground Level base					Layer - 1		Layer - 2		Layer - 3		Layer - 4		Layer - 5		Layer - 6		Layer - 7	
X	Y	Z	ST No.	Array	Max AB/2 or 1.5a	No. of Layers	Resistivity	Bottom Depth	Resistivity	Bottom Depth	Resistivity	Bottom Depth	Resistivity	Bottom Depth	Resistivity	Bottom Depth	Resistivity	Bottom Depth	Resistivity	Bottom Depth
					meteres		Ω00	meteres	Ω00	meteres	Ω00	meteres	Ω00	meteres	Ω00	meteres	Ω00	meteres	Ω00	meteres
414.851	9300.386	264	MZ-01S	SCHL	420	6	54.8	0.9	248.1	32.2	60.7	77.3	144.3	130.9	29.0	280.2	823.0	0	0	0
417.330	9308.705	355	MZ-02S	SCHL	420	5	666.7	8.3	124.9	20.7	656.0	44.7	51.1	106.5	2167.1	0	0	0	0	0
419.714	9303.720	265	MZ-03S	SCHL	420	6	134.0	1.9	194.6	6.9	57.6	14.7	173.9	29.8	32.1	68.4	6103.4	0	0	0
417.717	9299.992	255	MZ-04S	SCHL	420	4	166.5	1.4	70.6	27.3	309.6	41.4	88.6	0	0	0	0	0	0	0
414.187	9303.958	284	MZ-05S	SCHL	420	4	48.6	1.4	155.5	9.6	217.8	127.9	108.6	0	0	0	0	0	0	0
415.853	9298.628	240	MZ-06S	SCHL	420	3	47.3	1.8	163.3	91.7	40.0	0	0	0	0	0	0	0	0	0
415.853	9298.628	240	MZ-06W	WENN	450	4	75.5	1.8	265.0	81.6	31.2	139.1	1157.9	0	0	0	0	0	0	0
415.822	9298.081	240	MZ-07S	SCHL	420	5	208.6	7.4	69.1	20.5	604.3	45.5	28.4	127.7	1233.4	0	0	0	0	0
420.356	9295.173	183	MZ-08S	SCHL	420	4	212.9	1.5	39.6	7.8	120.6	32.8	220.1	0	0	0	0	0	0	0
424.139	9295.247	169	MZ-09S	SCHL	420	5	238.4	0.8	136.1	12.9	390.7	44.1	27.3	108.4	577.7	0	0	0	0	0
423.935	9299.336	240	MZ-10S	SCHL	420	4	14.3	5.8	104.2	19.8	5.6	35.8	560.9	0	0	0	0	0	0	0

Mutzing		Sea Level base					Layer - 1		Layer - 2		Layer - 3		Layer - 4		Layer - 5		Layer - 6		Layer - 7	
X	Y	Z	ST No.	Array	Max AB/2 or 1.5a	No. of Layers	Resistivity	Bottom Level	Resistivity	Bottom Level	Resistivity	Bottom Level	Resistivity	Bottom Level	Resistivity	Bottom Level	Resistivity	Bottom Level	Resistivity	Bottom Level
		meteres			meteres		Ω00	meteres	Ω00	meteres	Ω00	meteres	Ω00	meteres	Ω00	meteres	Ω00	meteres	Ω00	meteres
414.851	9300.386	264	MZ-01S	SCHL	420	6	54.8	263.1	248.1	231.8	60.7	186.8	144.3	133.1	29.0	-16.2	823.0	0	0	0
417.330	9308.705	355	MZ-02S	SCHL	420	5	666.7	346.8	124.9	334.3	656.0	310.3	51.1	248.5	2167.1	0	0	0	0	0
419.714	9303.720	265	MZ-03S	SCHL	420	6	134.0	263.1	194.6	258.1	57.6	250.3	173.9	235.2	32.1	196.6	6103.4	0	0	0
417.717	9299.992	255	MZ-04S	SCHL	420	4	166.5	253.6	70.6	227.7	309.6	213.6	88.6	0	0	0	0	0	0	0
414.187	9303.958	284	MZ-05S	SCHL	420	4	48.6	282.7	155.5	274.4	217.8	156.1	108.6	0	0	0	0	0	0	0
415.853	9298.628	240	MZ-06S	SCHL	420	3	47.3	238.2	163.3	148.3	40.0	0	0	0	0	0	0	0	0	0
415.853	9298.628	240	MZ-06W	WENN	450	4	75.5	238.2	265.0	158.4	31.2	100.9	1157.9	0	0	0	0	0	0	0
415.822	9298.081	240	MZ-07S	SCHL	420	5	208.6	232.6	69.1	219.5	604.3	194.5	28.4	112.3	1233.4	0	0	0	0	0
420.356	9295.173	183	MZ-08S	SCHL	420	4	212.9	181.5	39.6	175.3	120.6	150.3	220.1	0	0	0	0	0	0	0
424.139	9295.247	169	MZ-09S	SCHL	420	5	238.4	168.2	136.1	156.1	390.7	124.9	27.3	60.6	577.7	0	0	0	0	0
423.935	9299.336	240	MZ-10S	SCHL	420	4	14.3	234.2	104.2	220.2	5.6	204.3	560.9	0	0	0	0	0	0	0

Poondetta		Ground Level base					Layer - 1		Layer - 2		Layer - 3		Layer - 4		Layer - 5		Layer - 6		Layer - 7	
X	Y	Z	ST No.	Array	Max AB/2 or 1.5a	No. of Layers	Resistivity	Bottom Depth	Resistivity	Bottom Depth	Resistivity	Bottom Depth	Resistivity	Bottom Depth	Resistivity	Bottom Depth	Resistivity	Bottom Depth	Resistivity	Bottom Depth
					meteres		Ω00	meteres	Ω00	meteres	Ω00	meteres	Ω00	meteres	Ω00	meteres	Ω00	meteres	Ω00	meteres
641.893	9039.954	30	PP-01S	SCHL	420	4	529.7	0.8	28.2	22.7	158.8	34.5	39501.1	0	0	0	0	0	0	0
639.014	9035.705	75	PP-02S	SCHL	420	5	2305.6	1.3	213.2	14.2	374.2	23.7	226.8	38.1	28959.1	0	0	0	0	0
631.153	9031.452	138	PP-03S	SCHL	420	5	565.7	1.2	1290.3	8.6	1049.2	64.6	43.3	121.1	4720.8	0	0	0	0	0
633.168	9030.707	141	PP-04S	SCHL	420	3	2194.9	7.1	506.3	29.5	14320000.0	0	0	0	0	0	0	0	0	0
638.505	9029.278	107	PP-05S	SCHL	320	4	5148.5	0.8	1181.9	20.9	494.4	493.8	1211.0	0	0	0	0	0	0	0
635.976	9025.605	213	PP-06S	SCHL	420	4	712.8	1.2	1400.5	5.6	363.5	259.4	20233.7	0	0	0	0	0	0	0
640.199	9027.154	145	PP-07S	SCHL	420	6	204.1	0.4	82.0	1.2	1674.3	10.1	166.0	37.5	516.1	74.6	1710.0	0	0	0
638.997	9023.609	208	PP-08S	SCHL	420	6	1667.4	0.6	204.0	1.3	4007.8	5.4	289.9	14.0	836.8	30.9	364.5	0	0	0
642.506	9024.669	135	PP-09S	SCHL	420	4	2250.8	3.3	1021.7	28.0	88.8	57.4	3350.1	0	0	0	0	0	0	0
646.154	9026.345	55	PP-10S	SCHL	420	4	6848.3	2.7	2538.3	12.4	339.1	240.1	36885.8	0	0	0	0	0	0	0
637.128	9032.705	98	PP-11S	SCHL	420	5	914.3	1.8	208.0	11.3	1260.7	23.3	4.4	41.8	12969.1	0	0	0	0	0
636.295	9032.056	107	PP-12S	SCHL	420	5	384.2	1.9	405.1	5.0	97.4	13.6	323.7	32.4	272.1	0	0	0	0	0
635.416	9030.143	120	PP-13S	SCHL	420	4	2356.3	3.0	442.4	33.7	229.8	59.0	408.5	0	0	0	0	0	0	0
635.310	9029.210	151	PP-14S	SCHL	420	5	878.0	0.4	131.0	1.9	607.0	65.6	99.6	137.6	2457.4	0	0	0	0	0
636.614	9029.486	151	PP-15S	SCHL	420	4	1364.6	2.2	80.3	9.0	860.0	25.2	245.0	0	0	0	0	0	0	0
636.614	9029.486	15	PP-15W	WENN	330	4	5253.3	2.1	290.1	8.3	594.2	21.6	343.6	0	0	0	0	0	0	0

Popondetta		Sea Level base					Layer - 1		Layer - 2		Layer - 3		Layer - 4		Layer - 5		Layer - 6		Layer - 7	
X	Y	Z	ST No.	Array	Max AB/2 or 1.5a	No. of Layers	Resistivity	Bottom Level	Resistivity	Bottom Level	Resistivity	Bottom Level	Resistivity	Bottom Level	Resistivity	Bottom Level	Resistivity	Bottom Level	Resistivity	Bottom Level
		meteres			meteres		Ω00	meteres	Ω00	meteres	Ω00	meteres	Ω00	meteres	Ω00	meteres	Ω00	meteres	Ω00	meteres
641.893	9039.954	30	PP-01S	SCHL	420	4	529.7	29.3	28.2	7.3	158.8	-4.5	39501.1	0	0	0	0	0	0	0
639.014	9035.705	75	PP-02S	SCHL	420	5	2305.6	73.7	213.2	60.8	374.2	51.3	226.8	36.9	28959.1	0	0	0	0	0
631.153	9031.452	138	PP-03S	SCHL	420	5	565.7	136.8	1290.3	129.4	1049.2	73.4	43.3	17.0	4720.8	0	0	0	0	0
633.168	9030.707	141	PP-04S	SCHL	420	3	2194.9	133.9	506.3	111.5	14320000.0	0	0	0	0	0	0	0	0	0
638.505	9029.278	107	PP-05S	SCHL	320	4	5148.5	106.3	1181.9	86.1	494.4	-386.8	1211.0	0	0	0	0	0	0	0
635.976	9025.605	213	PP-06S	SCHL	420	4	712.8	211.8	1400.5	207.4	363.5	-46.4	20233.7	0	0	0	0	0	0	0
640.199	9027.154	145	PP-07S	SCHL	420	6	204.1	144.6	82.0	143.8	1674.3	134.9	166.0	107.5	516.1	70.4	1710.0	0	0	0
638.997	9023.609	208	PP-08S	SCHL	420	6	1667.4	207.4	204.0	206.7	4007.8	202.6	289.9	194.0	836.8	177.1	364.5	0	0	0
642.506	9024.669	135	PP-09S	SCHL	420	4	2250.8	131.7	1021.7	107.0	88.8	77.6	3350.1	0	0	0	0	0	0	0
646.154	9026.345	55	PP-10S	SCHL	420	4	6848.3	52.5	2538.3	42.6	339.1	-185.1	36885.8	0	0	0	0	0	0	0
637.128	9032.705	98	PP-11S	SCHL	420	5	914.3	96.2	208.0	86.7	1260.7	74.7	4.4	56.3	12969.1	0	0	0	0	0
636.295	9032.056	107	PP-12S	SCHL	420	5	384.2	105.1	405.1	102.0	97.4	93.4	323.7	74.6	272.1	0	0	0	0	0
635.416	9030.143	120	PP-13S	SCHL	420	4	2356.3	117.0	442.4	86.3	229.8	61.0	408.5	0	0	0	0	0	0	0
635.310	9029.210	151	PP-14S	SCHL	420	5	878.0	150.6	131.0	149.1	607.0	85.4	99.6	13.4	2457.4	0	0	0	0	0
636.614	9029.486	151	PP-15S	SCHL	420	4	1364.6	148.8	80.3	142.0	860.0	125.8	245.0	0	0	0	0	0	0	0
636.614	9029.486	15	PP-15W	WENN	330	4	5253.3	12.9	290.1	6.7	594.2	-6.6	343.6	0	0	0	0	0	0	0

OroBay		Ground Level base					Layer - 1		Layer - 2		Layer - 3		Layer - 4		Layer - 5		Layer - 6		Layer - 7	
X	Y	Z	ST No.	Array	Max AB/2 or 1.5a	No. of Layers	Resistivity	Bottom Depth	Resistivity	Bottom Depth	Resistivity	Bottom Depth	Resistivity	Bottom Depth	Resistivity	Bottom Depth	Resistivity	Bottom Depth	Resistivity	Bottom Depth
					meteres		Ω□□	meteres	Ω□□	meteres	Ω□□	meteres	Ω□□	meteres	Ω□□	meteres	Ω□□	meteres	Ω□□	meteres
663.978	9015.722	1	OB-01S	SCHL	420	5	93.0	1.7	19.0	3.7	235.2	9.0	13.2	23.6	17535.5	0	0	0	0	0
662.491	9014.649	60	OB-02S	SCHL	420	4	1688.3	0.5	2796.2	10.4	133.6	26.8	637.2	0	0	0	0	0	0	0
661.421	9012.113	245	OB-03S	SCHL	420	4	1775.4	3.1	410.8	31.8	4573.5	67.9	241.5	0	0	0	0	0	0	0
662.243	9016.140	91	OB-04S	SCHL	420	5	2148.9	1.3	455.9	21.9	3392.2	34.5	77.4	63.4	7088.5	0	0	0	0	0
660.355	9017.861	30	OB-05S	SCHL	420	3	2225.4	6.9	651.0	46.7	201.8	0	0	0	0	0	0	0	0	0
660.355	9017.861	30	OB-05W	WENN	330	4	1630.5	5.1	424.8	10.0	1085.2	21.2	167.8	0	0	0	0	0	0	0
663.443	9016.813	2	OB-06S	SCHL	420	4	2310.1	0.5	239.9	26.4	1002.4	41.0	17.9	0	0	0	0	0	0	0
663.235	9019.035	24	OB-07S	SCHL	420	4	2248.2	0.3	493.1	5.6	17.8	20.8	4096000.0	0	0	0	0	0	0	0
661.816	9018.815	25	OB-08S	SCHL	420	4	115.6	0.8	78.5	5.9	186.5	139.8	405.2	0	0	0	0	0	0	0
662.027	9020.852	5	OB-09S	SCHL	420	3	1317.1	5.4	27.4	26.0	231.4	0	0	0	0	0	0	0	0	0
662.984	9016.167	1	OB-10S	SCHL	420	6	350.0	0.5	21.3	2.6	11.7	5.5	584.3	21.9	98.5	107.0	888.6	0	0	0

OroBay		Sea Level base					Layer - 1		Layer - 2		Layer - 3		Layer - 4		Layer - 5		Layer - 6		Layer - 7	
X	Y	Z	ST No.	Array	Max AB/2 or 1.5a	No. of Layers	Resistivity	Bottom Level	Resistivity	Bottom Level	Resistivity	Bottom Level	Resistivity	Bottom Level	Resistivity	Bottom Level	Resistivity	Bottom Level	Resistivity	Bottom Level
		meteres			meteres		Ω□□	meteres	Ω□□	meteres	Ω□□	meteres	Ω□□	meteres	Ω□□	meteres	Ω□□	meteres	Ω□□	meteres
663.978	9015.722	1	OB-01S	SCHL	420	5	93.0	-0.7	19.0	-2.7	235.2	-8.0	13.2	-22.6	17535.5	0	0	0	0	0
662.491	9014.649	60	OB-02S	SCHL	420	4	1688.3	59.5	2796.2	49.6	133.6	33.2	637.2	0	0	0	0	0	0	0
661.421	9012.113	245	OB-03S	SCHL	420	4	1775.4	241.9	410.8	213.2	4573.5	177.1	241.5	0	0	0	0	0	0	0
662.243	9016.140	91	OB-04S	SCHL	420	5	2148.9	89.7	455.9	69.1	3392.2	56.5	77.4	27.6	7088.5	0	0	0	0	0
660.355	9017.861	30	OB-05S	SCHL	420	3	2225.4	23.2	651.0	-16.7	201.8	0	0	0	0	0	0	0	0	0
660.355	9017.861	30	OB-05W	WENN	330	4	1630.5	24.9	424.8	20.0	1085.2	-11.0	167.8	0	0	0	0	0	0	0
663.443	9016.813	2	OB-06S	SCHL	420	4	2310.1	1.5	239.9	-24.4	1002.4	-39.0	17.9	0	0	0	0	0	0	0
663.235	9019.035	24	OB-07S	SCHL	420	4	2248.2	23.7	493.1	18.4	17.8	3.2	4096000.0	0	0	0	0	0	0	0
661.816	9018.815	25	OB-08S	SCHL	420	4	115.6	24.2	78.5	19.1	186.5	-114.8	405.2	0	0	0	0	0	0	0
662.027	9020.852	5	OB-09S	SCHL	420	3	1317.1	-0.4	27.4	-21.0	231.4	0	0	0	0	0	0	0	0	0
662.984	9016.167	1	OB-10S	SCHL	420	6	350.0	0.5	21.3	-1.6	11.7	-4.5	584.3	-20.9	98.5	-106.0	888.6	0	0	0

Daru		Ground Level base					Layer - 1		Layer - 2		Layer - 3		Layer - 4		Layer - 5		Layer - 6		Layer - 7	
X	Y	Z	ST No.	Array	Max AB/2 or 1.5a	No. of Layers	Resistiv ity	Bottom Depth	Resistiv ity	Bottom Depth	Resistivity	Bottom Depth	Resistivity	Bottom Depth	Resistiv ity	Bottom Depth	Resistiv ity	Bottom Depth	Resistiv ity	Bottom Depth
					meteres		Ω00	meteres	Ω00	meteres	Ω00	meteres	Ω00	meteres	Ω00	meteres	Ω00	meteres	Ω00	meteres
742.799	8996.140	20	DR-01S	SCHL	420	5	36.4	0.7	23.5	11.1	428.7	35.2	4.5	53.6	1193.3	0	0	0	0	0
742.720	8995.757	17	DR-02S	SCHL	420	4	30.9	0.3	18.5	27.3	748.0	60.8	17.0	0	0	0	0	0	0	0
742.720	8995.757	48	DR-02W	WENN	360	4	71.0	0.4	26.8	25.4	408.6	43.7	11.9	0	0	0	0	0	0	0
742.990	8995.098	14	DR-03S	SCHL	420	5	64.5	0.9	30.3	3.5	208.1	7.8	5.5	26.9	1861.5	0	0	0	0	0
742.833	8994.427	12	DR-04S	SCHL	420	4	40.0	0.5	14.8	1.9	50.0	6.6	300.0	0	0	0	0	0	0	0
741.478	8994.993	3	DR-05S	SCHL	420	3	96.1	1.0	6.1	3.9	78.5	0	0	0	0	0	0	0	0	0
741.478	8994.993	21	DR-05W	WENN	330	3	241.8	0.9	16.1	26.4	57.6	0	0	0	0	0	0	0	0	0
742.288	8994.844	15	DR-06S	SCHL	420	4	14.3	0.4	55.2	2.6	4.9	7.2	85.8	0	0	0	0	0	0	0
742.231	8993.622	3	DR-07S	SCHL	420	4	5.9	0.4	1.1	2.5	10.5	43.5	3055.7	0	0	0	0	0	0	0
741.260	8995.288	6	DR-08S	SCHL	420	5	3176.4	0.9	30.5	3.4	123.1	9.2	8.5	19.8	5518.4	0	0	0	0	0
742.395	8996.259	16	DR-09W	WENN	210	4	42.5	0.5	13.2	4.5	31.4	72.2	623.9	0	0	0	0	0	0	0
742.966	8996.288	20	DR-10W	WENN	195	3	48.8	2.3	11.2	5.4	35.6	0	0	0	0	0	0	0	0	0
743.069	8996.315	45	DR-11W	WENN	255	4	69.2	1.4	27.2	23.9	22.8	67.6	67.3	0	0	0	0	0	0	0
743.067	8995.483	35	DR-12S	SCHL	420	3	62.1	2.0	12.7	23.1	120.0	0	0	0	0	0	0	0	0	0
742.359	8994.161	3	DR-13S	SCHL	420	4	150.0	2.1	25.0	6.4	253.1	36.6	762.9	0	0	0	0	0	0	0
720.690	8994.241	22	DR-14W	WENN	180	3	466.3	3.6	40.8	64.2	13.9	0	0	0	0	0	0	0	0	0
728.747	8999.651	25	DR-15W	WENN	180	4	157.5	1.7	2.6	11.8	61.3	22.2	0.0	0	0	0	0	0	0	0
723.863	8997.786	25	DR-16W	WENN	165	3	55.0	1.7	22.3	33.4	3.3	0	0	0	0	0	0	0	0	0

Daru		Sea Level base					Layer - 1		Layer - 2		Layer - 3		Layer - 4		Layer - 5		Layer - 6		Layer - 7	
X	Y	Z	ST No.	Array	Max AB/2 or 1.5a	No. of Layers	Resistiv ity	Bottom Level	Resistiv ity	Bottom Level	Resistivity	Bottom Level	Resistivity	Bottom Level	Resistiv ity	Bottom Level	Resistiv ity	Bottom Level	Resistiv ity	Bottom Level
		meteres			meteres		Ω00	meteres	Ω00	meteres	Ω00	meteres	Ω00	meteres	Ω00	meteres	Ω00	meteres	Ω00	meteres
742.799	8996.140	20	DR-01S	SCHL	420	5	36.4	19.3	23.5	8.9	428.7	-15.2	4.5	-33.6	1293.3	0	0	0	0	0
742.720	8995.757	17	DR-02S	SCHL	420	4	30.9	16.7	18.5	-10.3	748.0	-43.8	17.0	0	0	0	0	0	0	0
742.720	8995.757	48	DR-02W	WENN	360	4	71.0	47.6	26.8	22.6	408.6	4.2	11.9	0	0	0	0	0	0	0
742.990	8995.098	14	DR-03S	SCHL	420	5	64.5	13.1	30.3	10.5	208.1	6.2	5.5	-12.9	1861.5	0	0	0	0	0
742.833	8994.427	12	DR-04S	SCHL	420	4	40.0	11.5	14.8	10.1	50.0	5.4	300.0	0	0	0	0	0	0	0
741.478	8994.993	3	DR-05S	SCHL	420	3	96.1	2.0	6.1	-0.9	78.5	0	0	0	0	0	0	0	0	0
741.478	8994.993	21	DR-05W	WENN	330	3	241.8	20.1	16.1	-5.4	57.6	0	0	0	0	0	0	0	0	0
742.288	8994.844	15	DR-06S	SCHL	420	4	14.3	14.6	55.2	12.4	4.9	7.8	85.8	0	0	0	0	0	0	0
742.231	8993.622	3	DR-07S	SCHL	420	4	5.9	2.5	1.1	0.5	10.5	-40.5	3055.7	0	0	0	0	0	0	0
741.260	8995.288	6	DR-08S	SCHL	420	5	3176.4	5.1	30.5	2.6	123.1	-3.2	8.5	-13.8	5518.4	0	0	0	0	0
742.395	8996.259	16	DR-09W	WENN	210	4	42.5	15.5	13.2	11.5	31.4	-56.2	623.9	0	0	0	0	0	0	0
742.966	8996.288	20	DR-10W	WENN	195	3	48.8	17.7	11.2	14.6	35.6	0	0	0	0	0	0	0	0	0
743.069	8996.315	45	DR-11W	WENN	255	4	69.2	43.6	27.2	21.1	22.8	-22.6	67.3	0	0	0	0	0	0	0
743.067	8995.483	35	DR-12S	SCHL	420	3	62.1	33.0	12.7	11.9	120.0	0	0	0	0	0	0	0	0	0
742.359	8994.161	3	DR-13S	SCHL	420	4	150.0	0.9	25.0	-3.4	253.1	-33.6	762.9	0	0	0	0	0	0	0
720.690	8994.241	22	DR-14W	WENN	180	3	466.3	18.4	40.8	-42.2	13.9	0	0	0	0	0	0	0	0	0
728.747	8999.651	25	DR-15W	WENN	180	4	157.5	23.3	2.6	13.2	61.3	2.8	0.0	0	0	0	0	0	0	0
723.863	8997.786	25	DR-16W	WENN	165	3	55.0	23.3	22.3	-8.4	3.3	0	0	0	0	0	0	0	0	0

Kwikila — Ground Level base

X	Y	Z	ST No.	Array	Max AB/2 or 1.5a	No. of Layers	Layer - 1 Resistivity	Layer - 1 Bottom Depth	Layer - 2 Resistivity	Layer - 2 Bottom Depth	Layer - 3 Resistivity	Layer - 3 Bottom Depth	Layer - 4 Resistivity	Layer - 4 Bottom Depth	Layer - 5 Resistivity	Layer - 5 Bottom Depth	Layer - 6 Resistivity	Layer - 6 Bottom Depth	Layer - 7 Resistivity	Layer - 7 Bottom Depth
					meteres		ΩΩΩ	meteres	ΩΩΩ	meteres	ΩΩΩ	meteres	ΩΩΩ	meteres	ΩΩΩ	meteres	ΩΩΩ	meteres	ΩΩΩ	meteres
569.135	8916.104	162	KK-01S	SCHL	420	3	30.0	4.0	148.5	50.5	173.2	0	0	0	0	0	0	0	0	0
573.424	8914.091	74	KK-02S	SCHL	420	3	9.6	3.1	31.8	15.1	104.5	0	0	0	0	0	0	0	0	0
572.490	8913.157	107	KK-03S	SCHL	420	4	41.6	0.7	38.1	6.9	89.5	15.8	170.5	0	0	0	0	0	0	0
576.722	8916.785	45	KK-04S	SCHL	420	3	43.8	0.5	21.8	3.1	115.0	0	0	0	0	0	0	0	0	0
577.079	8914.050	35	KK-05S	SCHL	420	4	20.0	0.6	9.0	5.6	30.0	15.6	200.0	0	0	0	0	0	0	0
574.243	8916.085	78	KK-06S	SCHL	420	5	47.8	0.3	7.7	16.3	173.4	49.3	1.6	69.2	1802.0	0	0	0	0	0
574.056	8915.645	68	KK-07S	SCHL	420	4	48.2	3.0	189.4	18.9	27.3	42.6	98.8	0	0	0	0	0	0	0
573.597	8916.168	80	KK-08S	SCHL	420	4	29.1	0.9	15.5	2.8	156.5	136.4	2014.3	0	0	0	0	0	0	0
574.753	8915.607	76	KK-09S	SCHL	420	5	37.7	3.2	7.8	8.2	13.1	16.2	8.9	37.5	102.7	0	0	0	0	0
574.756	8915.616	69	KK-09W	WENN	390	5	44.2	0.7	24.1	6.7	32.3	16.2	8.5	35.5	469.9	0	0	0	0	0
573.695	8915.674	89	KK-10S	SCHL	420	4	23.4	1.4	14.4	2.9	53.6	69.9	64.4	0	0	0	0	0	0	0
574.271	8915.316	60	KK-11S	SCHL	420	3	10.7	3.7	21.9	129.4	2063.8	0	0	0	0	0	0	0	0	0

Kwikila — Sea Level base

X	Y	Z	ST No.	Array	Max AB/2 or 1.5a	No. of Layers	Layer - 1 Resistivity	Layer - 1 Bottom Level	Layer - 2 Resistivity	Layer - 2 Bottom Level	Layer - 3 Resistivity	Layer - 3 Bottom Level	Layer - 4 Resistivity	Layer - 4 Bottom Level	Layer - 5 Resistivity	Layer - 5 Bottom Level	Layer - 6 Resistivity	Layer - 6 Bottom Level	Layer - 7 Resistivity	Layer - 7 Bottom Level
		meteres			meteres		ΩΩΩ	meteres	ΩΩΩ	meteres	ΩΩΩ	meteres	ΩΩΩ	meteres	ΩΩΩ	meteres	ΩΩΩ	meteres	ΩΩΩ	meteres
569.135	8916.104	162	KK-01S	SCHL	420	3	30.0	158.0	148.5	111.5	173.2	0	0	0	0	0	0	0	0	0
573.424	8914.091	74	KK-02S	SCHL	420	3	9.6	70.9	31.8	58.9	104.5	0	0	0	0	0	0	0	0	0
572.490	8913.157	107	KK-03S	SCHL	420	4	41.6	106.3	38.1	100.1	89.5	91.2	170.5	0	0	0	0	0	0	0
576.722	8916.785	45	KK-04S	SCHL	420	3	43.8	44.5	21.8	41.9	115.0	0	0	0	0	0	0	0	0	0
577.079	8914.050	35	KK-05S	SCHL	420	4	20.0	34.4	9.0	29.4	30.0	19.4	200.0	0	0	0	0	0	0	0
574.243	8916.085	78	KK-06S	SCHL	420	5	47.8	77.6	7.7	61.7	173.4	28.7	1.6	8.7	1802.0	0	0	0	0	0
574.056	8915.645	68	KK-07S	SCHL	420	4	48.2	65.0	189.4	49.2	27.3	25.5	98.8	0	0	0	0	0	0	0
573.597	8916.168	80	KK-08S	SCHL	420	4	29.1	79.1	15.5	77.2	156.5	-56.4	2014.3	0	0	0	0	0	0	0
574.753	8915.607	76	KK-09S	SCHL	420	5	37.7	72.8	7.8	67.8	13.1	8.8	8.9	38.5	102.7	0	0	0	0	0
574.756	8915.616	69	KK-09W	WENN	390	5	44.2	68.3	24.1	62.3	32.3	52.2	8.5	33.5	469.9	0	0	0	0	0
573.695	8915.674	89	KK-10S	SCHL	420	4	23.4	87.6	14.4	86.1	53.6	19.1	64.4	0	0	0	0	0	0	0
574.271	8915.316	60	KK-11S	SCHL	420	3	10.7	56.3	21.9	-69.4	2063.8	0	0	0	0	0	0	0	0	0

Kupiano		Ground Level base					Layer - 1		Layer - 2		Layer - 3		Layer - 4		Layer - 5		Layer - 6		Layer - 7	
X	Y	Z	ST No.	Array	Max AB/2 or 1.5a	No. of Layers	Resistivity	Bottom Depth	Resistivity	Bottom Depth	Resistivity	Bottom Depth	Resistivity	Bottom Depth	Resistivity	Bottom Depth	Resistivity	Bottom Depth	Resistivity	Bottom Depth
					meteres		ΩDD	meteres	ΩDD	meteres	ΩDD	meteres	ΩDD	meteres	ΩDD	meteres	ΩDD	meteres	ΩDD	meteres
632.411	8886.821	15	KP-01S	SCHL	420	4	20.8	7.0	3.7	38.0	175.9	70.9	4.3	0	0	0	0	0	0	0
632.413	8886.817	41	KP-01W	WENN	450	5	55.7	0.3	12.2	10.7	76.4	34.1	14.6	62.7	32.9	0	0	0	0	0
632.275	8884.464	50	KP-02S	SCHL	420	5	42.3	0.9	24.0	7.6	69.2	35.1	14.8	62.0	61.3	0	0	0	0	0
638.224	8887.072	60	KP-03S	SCHL	320	5	8.3	0.8	5.0	7.3	10.7	11.1	1.8	42.8	115.2	0	0	0	0	0
629.789	8886.319	18	KP-04W	WENN	330	3	96.8	3.3	31.5	50.2	15.9	0	0	0	0	0	0	0	0	0
629.438	8888.955	17	KP-05S	SCHL	320	3	26.8	8.4	2.7	58.5	6319.5	0	0	0	0	0	0	0	0	0
629.497	8886.113	11	KP-06S	SCHL	320	4	146.3	3.3	46.4	43.1	64.5	58.8	84.2	0	0	0	0	0	0	0
629.497	8886.113	43	KP-07S	SCHL	420	3	145.7	6.5	192.6	67.0	25.2	0	0	0	0	0	0	0	0	0
629.855	8885.701	25	KP-07W	WENN	330	4	48.2	2.2	72.3	38.1	16.2	72.9	525.8	0	0	0	0	0	0	0
629.898	8886.048	18	KP-08W	WENN	270	5	39.4	0.5	73.4	6.2	16.8	19.5	301.8	56.5	24.5	0	0	0	0	0
630.186	8886.158	17	KP-09W	WENN	330	5	52.7	0.4	91.3	2.0	27.4	11.0	61.3	23.9	29.4	0	0	0	0	0
630.594	8886.566	20	KP-10S	SCHL	420	4	19.7	1.9	4.7	16.4	19.4	57.9	2117.2	0	0	0	0	0	0	0

Kupiano		Sea Level base					Layer - 1		Layer - 2		Layer - 3		Layer - 4		Layer - 5		Layer - 6		Layer - 7	
X	Y	Z	ST No.	Array	Max AB/2 or 1.5a	No. of Layers	Resistivity	Bottom Level	Resistivity	Bottom Level	Resistivity	Bottom Level	Resistivity	Bottom Level	Resistivity	Bottom Level	Resistivity	Bottom Level	Resistivity	Bottom Level
		meteres			meteres		ΩDD	meteres	ΩDD	meteres	ΩDD	meteres	ΩDD	meteres	ΩDD	meteres	ΩDD	meteres	ΩDD	meteres
632.411	8886.821	15	KP-01S	SCHL	420	4	20.8	8.0	3.7	-23.0	175.9	-55.9	4.3	0	0	0	0	0	0	0
632.413	8886.817	41	KP-01W	WENN	450	5	55.7	40.7	12.2	30.3	76.4	6.9	14.6	-21.7	32.9	0	0	0	0	0
632.275	8884.464	50	KP-02S	SCHL	420	5	42.3	49.1	24.0	42.4	69.2	14.9	14.8	-12.0	61.3	0	0	0	0	0
638.224	8887.072	60	KP-03S	SCHL	320	5	8.3	59.2	5.0	52.7	10.7	48.9	1.8	17.2	115.2	0	0	0	0	0
629.789	8886.319	18	KP-04W	WENN	330	3	96.8	14.7	31.5	-32.2	15.9	0	0	0	0	0	0	0	0	0
629.438	8888.955	17	KP-05S	SCHL	320	3	26.8	8.6	2.7	-41.5	6319.5	0	0	0	0	0	0	0	0	0
629.497	8886.113	11	KP-06S	SCHL	320	4	146.3	7.7	46.4	-32.1	64.5	-47.8	84.2	0	0	0	0	0	0	0
629.497	8886.113	43	KP-07S	SCHL	420	3	145.7	36.5	192.6	-24.0	25.2	0	0	0	0	0	0	0	0	0
629.855	8885.701	25	KP-07W	WENN	330	4	48.2	22.8	72.3	-13.1	16.2	-47.9	525.8	0	0	0	0	0	0	0
629.898	8886.048	18	KP-08W	WENN	270	5	39.4	17.5	73.4	11.8	16.8	-1.5	301.8	-38.5	24.5	0	0	0	0	0
630.186	8886.158	17	KP-09W	WENN	330	5	52.7	16.6	91.3	15.0	27.4	6.0	61.3	-6.9	29.4	0	0	0	0	0
630.594	8886.566	20	KP-10S	SCHL	420	4	19.7	18.1	4.7	3.6	19.4	-37.9	2117.2	0	0	0	0	0	0	0