# REPORT ON RESISTIVITY SURVEY: PANIT-AN, CAPIZ

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**Abstract**---*Groundwater is found almost everywhere beneath the ground surface. However, poor-well site selection plus improper well design contributes to high investment and operation costs and sometimes lead to the failure of the well. The results of a Geo-resistivity test conducted on each of the proposed well sites in Panit-an, Capiz are presented. Three (3) Vertical Electrical Sounding Points were conducted in the project area with a maximum spread of 350 m. Projected penetration depth was about 200 meters or more. Among the three (3) Vertical Electrical Sounding Points, VES-03 which has the least resistive material was considered, as having the most groundwater potential.*

## INTRODUCTION

In every groundwater exploration, a complete assessment of the location, topography, climate, physiology and drainage, and lithology of the project area is important. Likewise, a thorough understanding of the principles governing the occurrence and movement of groundwater, extent, depth and quality of an aquifer present in the area is also necessary.

### Location and topography

The project area described in this report is located almost a kilometer away from the Municipality of Panit-an, Roxas. Roxas City bounds the area on the north, the Municipality of Sapian on the north-east, the Municipality of Sigma on the south-east and the Municipality of Pontevedra on the north-west. The topography of the project site can be described as rolling to moderately flat. The average elevation along the midpoint of the project side is around 17 meters above the mean sea level.

### Climate

The area, according to Coronas Classification belongs to the type where seasons are not very pronounced, relatively dry from November to April and wet during the rest of the year. Two rainfall stations are located near the projected area. At the northern part is the Culasi rainfall station and at the western side is the Mambusao station. The Mambusao station has a longer period of observation (1950 to 1983) while the Culasi station has only 3 years of record (1971 to 1973). The rainfall data show rainy months start in June and end in November lagging one month behind the Coronas description. The actual record of rainfall for dry and wet seasons are 350.8 mm and 1492.8 mm respctively for Culasi while for Mambusao, the average seasonal rainfall for dry is 946.4 mm and 1651.0 mm for wet. The annual rainfall is 1857.0 mm and 2500.0 for Culasi and Mambusao respectively. It can be seen that rainfall is higher at Mambusao.

### Lithology

The oldest rock in the area are the completely folded and faulted sequence of paraschists, chert metaquartzite, marble, phyllites, meta-sediments, meta-volcanics and greywackes. They are exposed in the greater portion of the Busuanga Peninsula.

Igneous rocks of Cretaceous to Oligocene in age particularly the basalt and andesite lava flows, breccia and agglomerate are extensive with the serpentized peridotite, quartz diorite, diorite and gabbro occurring at a lesser extent. The serpentinized rocks are assumed to have intruded through older structures during the late Miocene. Likewise, the intrusions of basalt and andesite are also inferred to have accompanied faulting. The Sara Diorite, the largest intrusive body in the area, is highly weathered and the main body is roughly rectangular in shape. It was formed during the Oligocene period. Thick, swollen intrusive bodies are also found at the Western Cordillera, Guimaras and in the Busuanga Peninsula.

The greywackes which are the oldest dated sedimentary rocks in the island are exposed mostly on the northeastern part of Panay Island. This tertiary rock is intercalated with spillitic basalt.

Overlying uncomformably the basement schists are the sequence of volcanic and sedimentary rocks. During the middle Miocene volcanism intervened with the depositionof the younger Oligocene to middle Miocene sedimentary rocks. This was followed by the continuous accumulations of sediments in this subsiding basin which gave rise to the formation of late Miocene to Pliocene sandstone, shale, limestone and conglomerate. The last formation to be deposited before the upliftment of the area are the Pliocene to Pleistocene claystone, sandstone, siltstone, conglomerate lenses and calcarenite lenses.

### Physiology and Drainage

Capiz is one of the four (4) provinces in Panay Island. This island is roughly triangular in shape with its main cordillera running almost north-south starting in the extreme northwest corner of the island, swinging a little to the east then turning to the southwest corner, almost paralleling the western coast. The highest peak elevation is 2,180 meters. The mountains found on the eastern part of the island, forming the south end of the "eastern cordillera" are moderate in height. Their peak elevations range from 400 to 600 meters.

Between the mountain ranges lies the Iloilo Basin with an area of about 40 by 100 kilometers. It is formed by the Panay River, flowing north and the Jalaur River flowing south. A low Divide separates the northern portion of the plain from the southern area.

The streams of the western cordillera are by far the largest and most numerous in the region. From the north to south, the most prominent rivers are the ; Jalaur River, Alibunan River, Tagbacan River, Ulian River, Sirange River, and Tarrao River. These streams are emptying into the protected waters of Iloilo Strait from broad lowlands that extend continuously along the southeast coast.

In the open basin, streams almost everywhere follow meandering courses through broad valleys whose floors are terraced or covered with alluvium that largely conceals bedrock. Inter-stream areas are occupied by hilly tracks or isolated high terrace remnants.

## GEO-RESISTIVITY SURVEY

A Geo-resistivity test was conducted on each of the proposed well site to assess its groundwater potential. Three (3) Vertical Electrical Sounding Points were conducted in the project area with a maximum spread of 350.0 meters. Projected penetration depth is about 200 meters or more.

### Survey Specification

Instrumentation: OYO Mc-Ohm
Electrode Array: Schlumberger Configuration
Array Lengths: Maximum Power = 200 mA
Potential Spacing (MN)
Maximum Potential Electrode Spacing = 50 m
Electrode Spacing (AB)
Maximum Current Electrode Spacing = 350 m

### Methodology

In conducting the resistivity survey, the Schlumberger configuration was adopted. In this method, four electrodes are placed in the ground as shown in Figure 1.

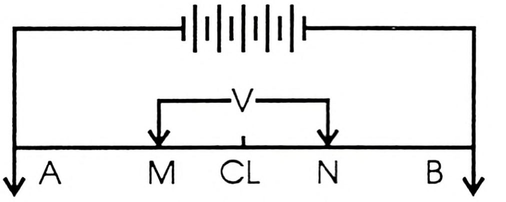


*Figure 1. The Schlumberger Configuration*

The method involves the application of electric current through the ground across a pair of current electrodes (outer electrodes) and the measurement of potential difference from two potential (inner) electrodes. By increasing the spacing between electrodes progressively, the depth of current penetration is also increased and earth resistance for increasing depths are obtained. Apparent resistivity is obtained by multiplying the earth resistance by a factor "K".

Apparent Resistivity = K x R

where:

$$K = \pi \frac{(AB - MN)(AB + MN)}{4MN}$$

$$R = \frac{V}{I} \quad (Ohms)$$

### Groundwater Recharge

Groundwater recharge into the aquifers is rainfall percolating into the catchment areas of Panay: Aklan, Mambusao and Maayon Rivers and smaller drainage systems within the two Provinces. The aquifers found in the area are only for limited, small scale development in view of unfavorable low permeability of the aquifers, relatively fast surface run-off due to the almost denuded forest cover of the region and moderate to steep slopes.

Annual groundwater recharge range from less than 0.01 m to over 0.20 m per year. On the other hand, annual replenishable storage in the sand and gravel deposits is estimated at less than 0.50 meter to over 1.0 meter per year.

## ANALYSIS AND DISCUSSION OF RESULTS

Surface geologic mapping within and around the property show that the project area is underlain by a volcanic rock, namely basalt grading to andesitic basalt. These rocks are massive and frequently fractured/jointed. Overburden in the area is relatively thin, less than 2.00 meter thick.

The results of resistivity investigation are shown in Table 1. Three (3) different materials were detected underlying the Project Area. They are the overburden, weathered rock formation and a fresh rock formation namely the volcanic flow. The overburden material has a resistivity value of 14.90 ohm-meter in VES-01, 19.70 ohm-meter in VES-02 and 34.40 ohm-meter in VES-03 (Table 1). Thickness range from 1.80 meters in VES-01, 1.50 meters in VES-02 and 0.30 meters in VES-03. The next layer, weathered material, has a resistivity value that range from 9.90 ohm-meter to as high as 37.10 ohm-meter in VES-01. Their thickness range from 1.90 meters in VES-03 to 6.30 meters in VES-02. The third layer which is the volcanic flow composed of basalt grading to andesitic basalt has a resistivity value of 156.10 ohm-meter in VES-01, 192.80 ohm-meter in VES-02 and 122.50-129.30 ohm-meter in VES-03. The thickness of the third layer in VES-01 is 430.30 meters, in VES-02 311.60 meters and in VES-03 196.80 meters.

Although all three (3) Vertical Electrical Sounding Points contain the volcanic flow material, only VES-03, which has the least resistive material can be considered as having the most groundwater potential in the surveyed area. The other two VES Points, 1 and 2, which are also underlain by the same material have much higher resistivity values, in the order of 156.10 (VES-01) to 192.80 ohm-meter (VES-02).

The availability of groundwater in a volcanic rock depends on their secondary porosity, fracture/joint system that they contain. The big difference in the resistivity value (VES-01 and VES-02 to VES-03 ) might be due to the above mentioned phenomena. The highly resistive material in VES-02 has lesser fracturing thus offers lesser groundwater than the other VES Points, 1 and 2. VES-01 which has a moderately resistive volcanic flow material has also been considered as an aquifer but due to its moderate resistivity value, groundwater availability in this well is limited. Thus among the three (3) VES Points only VES-03 which has a much lesser resistivity value in the order of 122.50 ohm-meter to 129.30 ohm-meter, is believed to have the greatest potential in terms of groundwater availability. In terms of groundwater recharge, it

| VES POINTS | RESISTIVITY LAYER (M) | (OHM-M) | THICK (METER) | DEPTH (METER) | INFERRED GEOLOGY | GROUNDWATER CONDITION |
|---|---|---|---|---|---|---|
| VES-01 | 1st | 14.90 | 1.80 | 1.80 | Overburden | No groundwater available |
| | 2nd | 37.10 | 2.40 | 4.20 | Weathered materials | No groundwater available |
| | 3rd | 9.90 | 1.80 | 6.00 | Weathered materials | No groundwater available |
| | 4th | 156.10 | 430.30 | 436.30 | Volcanic flow | Aquifer |
| | 5th | 69.30 | | | | |
| VES-02 | 1st | 19.70 | 1.50 | 1.50 | Overburden | No groundwater available |
| | 2nd | 20.10 | 6.30 | 7.80 | Weathered materials | No groundwater available |
| | 3rd | 192.80 | 311.60 | 319.40 | Volcanic flow | Aquiclude |
| | 4th | 59.60 | | | | |
| VES-03 | 1st | 34.40 | 0.30 | 0.30 | Overburden | No groundwater available |
| | 2nd | 10.80 | 1.90 | 2.20 | Weathered materials | No groundwater available |
| | 3rd | 129.30 | 70.30 | 72.50 | Volcanic flow | Aquifer |
| | 4th | 122.50 | 126.50 | 199.00 | Volcanic flow | Aquifer |
| | 5th | 380.00 | | | | |

PROJECT: Oyster Processing Plant LOCATION: Panit-an, Capiz

*Table 1. Tabulated Result of Geo-Electric Survey*

has also the advantage over the other two VES Points since it is located in a lagoon-like depression.

### Design of the well

A preliminary well design was prepared based on the result of the resistivity survey (Fig. 2). The design or diameter of the well can accomodate a pump with a discharge capacity of 60 to 115 gallons per minute (gpm) which is the anticipated yield and an assumed total dynamic head of 50 meters.

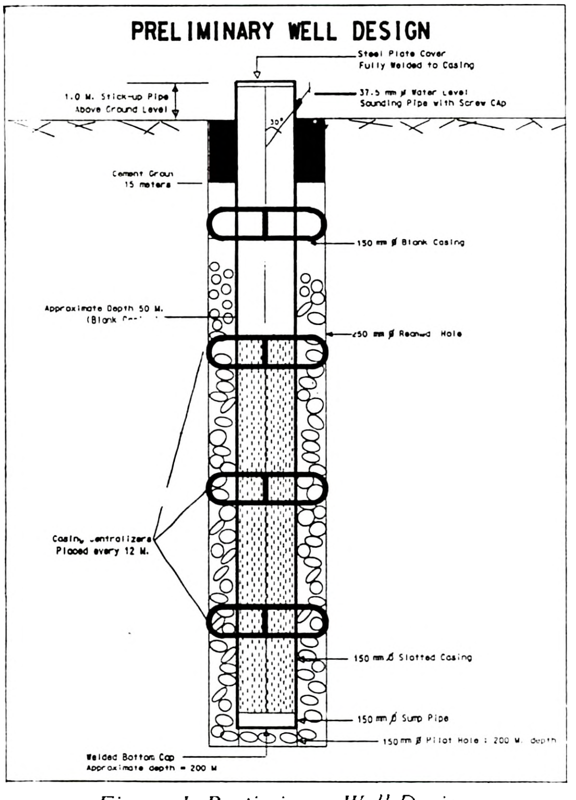


*Figure 1. Preliminary Well Design*

Increasing the diameter of the well will give a minimal increase in yield as this is controlled by the type of aquifer and recharge. Final lengths of casings, blank and screen will depend on the result of well logs. An experienced Hydrogeologist should interpret the geologic and electric logs of the well where the final design will be based. Pea gravel placed 2 inches on both sides of screen will filter out small particles that may enter the well. Final design of pump will depend on the result of the pumping test conducted on the well.

## CONCLUSIONS/RECOMMENDATIONS

After evaluating and correlating the gathered field data on the local geology and other existing records of nearby wells the following were recommended:

1. The site for exploratory drilling should be in VES-03.
2. If the yield in VES-03 is not sufficient to meet the water supply demand, additional well maybe drilled on VES-01.
3. The well will have the configuration described in Figure 1.
4. Final length and depth of screens will depend on the result of geologic and electric logs performed by an experienced Hydrogeologist.
5. For proper construction of well, grouting should be done after the pumping test, to alloe the settlement and compaction of the pea gravel. Additional 5 meters of gravel pack from the uppermost part of the screen/perforation is reserved for future development of wells.