Ground water exploration using geo-electric method for Sumber Cemung pool development

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Abstract. The existence of springs cannot be obtained in each region; therefore it will be very detrimental if the presence of springs is not optimally utilized. This encourages Sumbercemung Villager, Wlingi Regency to take advantage of the potential of the existing spring. It is planned that in this area a tourist pool will be built using water sources. So there needs a research to support the development of the pool. This study aims to determine the potential of ground water that will be planned for the location of pool. With the existence of this pool, it is expected to be a source of income for the Sumbercemung villager. This study was conducted by measuring soil resistivity using the Geo-electric method to determine the condition of groundwater around a spring. Analysis of geo-electric data uses Zondres software in 2D which is then analyzed in 3D using Voxler software. Based on the results of the analysis of groundwater from geo-electric data, no artesian aquifer were found in the location reviewed and only a water basin with a volume of 25291 m³ was found. Thus, the needs of pool water is filled with dependable flow.

1. Introduction

Water is a vital element for human life. Humans cannot survive without water, because every sector of human life need water for its survival. The existence of a spring cannot be obtained in every region, therefore it will be very disadvantageous if the existence of a spring is not utilized optimally. In today's society, awareness of the sport of water is increasing and becoming a human lifestyle today.

The catchment area at spring location in Wlingi covering 34 hectares, with the highest elevation at +298 m and the lowest elevation at +283 m. The direction of water flow from the North to the South. The average land slope is 1.61% in the flat category.

It’s encourages residents of Sumbercemung, Beru Village, Wlingi Sub-District to take advantage of the potential of spring water in the village. So far, potential of water in the area is only used for irrigating fields and fulfilling amount of villager water required only, so that a lot of water is wasted and not utilized. Amount of water that is wasted and not utilized is encouraging the villagers to build a tourist pool by utilizing the existence of a spring in the area.

So there needs a research to support the development of the pool. This study aims to determine the potential of ground water that will be planned for the location of pool. With the existence of this pool, it is expected to be a source of income for the Sumbercemung villager.
2. Metodology
Geoelectric resistivity is one of the geophysical methods that used to determine the subsurface condition based on the resistivity value of the rocks. Resistivity, the inverse of electrical conductivity, is the resistance of the geologic medium to current flow when a potential difference is applied [4]. The purposes of the geoelectric survey is to quantify the resistivity value of the rock based on the measurement at the surface. Resistivity values between about 500 and 1000 ohm-meters are interpreted as weathered zones, fractures zones, or faults within the hard carbonates [6]. The actual resistivity value can be obtained from the measurement value [2]. This is the easiest and cheapest method that not required too high specification and software. The reading that can be obtained from this method are aquifer parameter, groundwater table depth, salinity rock permeability and bedrock [1].

Some of the most common electrode arrays are Wenner, Schlumberger, pole-pole, pole-dipole and dipole-dipole array [3]. However, these arrays are most sensible to noise, whereas the often used Wenner array and the gamma array are less sensible to noise. This method was introduced by Wenner (1915). Wenner configuration is one configuration that is often used in geoelectric exploration with a spacing arrangement of equal length (r1 = r4 = a and r2 = r3 = 2a). The distance between the current electrodes is three times the distance of the potential electrode, the potential distance with the sounding point is 2/a, then the distance of each current electrode with the sounding point is 2/3a. The depth target that can be achieved in this method is 2/a. In field data acquisition the current and potential electrode arrangements are placed symmetrically with sounding points [5].

In the Wenner configuration the distance between the current electrode and the potential electrode is the same. As shown in figure 1.

![Figure 1. Current and potential electrodes in Wenner configuration.](image)

From the picture above it can be seen that the distance AM = NB = a and distance AN = MB = 2a, using equation (1.3) is obtained:

\[ K = \frac{2\pi}{\left(\frac{1}{a} - \frac{1}{2a}\right) - \left(\frac{1}{2a} - \frac{1}{a}\right)} \]

\[ K = 2\pi a \]  

(1)

(2)

So, the geometry factor for Wenner configuration is:

\[ K_w = 2\pi a \quad \text{and} \quad \rho_w = K_w \cdot R \]  

(3)

3. Results and Discussions
The survey location is in Sumbercemung village located at 8° 05'04.1" LS, 112° 19'08.2" BT as shown in Figure 2. Sumbercemung has four water source locations. To obtain a water deposit, a geoelectric survey was conducted using the Wenner method with 4 (four) tracks. Given the terrain is the planting season rice field, electrode installation cannot be done in a straight path. the survey line can be seen in Figure 1 which is marked with a red line with the names L1, L2, L3, and L4. L1 track to the west and L4
to the east. The geoelectric results data are processed with Zondres, obtained contours as shown in Figure 3.

![Survey Location](image)

**Figure 2.** Survey Location

![2D contours of each survey line based on resistivity values](image)

**Figure 3.** 2D contours of each survey line based on resistivity values

The contour in Figure 3 shows the underground structure L1 to L4. Groundwater resistivity values are between 10-100 Ωm in color scales ranging from green to orange. Pink is a rock region. The contour shows that the Sumbercemung spring is only a rock basin that holds water. There is no artesian and it is water trapped in a rock basin. Possible artesian are in other locations outside the survey area. The results of this contour are then made into a grid and processed by Voxler to determine the volume of groundwater and the results can be seen in Figure 4.

The volume of groundwater is calculated using Voxler. Voxler calculation shows that the volume for resistivity 0 - 100 is 42221 m³, and the volume for resistivity below 10 is 16930 m³ so the volume of groundwater is around 25291 m³.
**Figure 4.** The isosurface results from the Source 3D contour are displayed by displaying a resistivity limit of 100 for dark blue, and 10 for black

### 4. Conclusion

Based on the results of the ground water analysis from geoelectric data, there is no artesian found and there was only a water basin. Thus, the needs of pool water is filled with dependable flow. Catchment area must be maintained to preserve water resources. It is not permissible to use large-powered water pumps, because it will disturb and even damage ground water or water sources.

### References

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