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# Interpretation Patterns for The Distribution of The Turbidity of Soil Water Around TPA Supit Urang (Final Removal of Garbage) Using Geoelectric Resistivity Methods

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# Interpretation Patterns for The Distribution of The Turbidity of Soil Water Around TPA Supit Urang (Final Removal of Garbage) Using Geoelectric Resistivity Methods

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**Abstract**. We conducted measurements using the geoelectric method around the waste disposal site (Supit Urang landfill) in Malang City with 29 measurement data points with a distance between the measurement points of 100 meters. The results of the analysis of groundwater depth were obtained, namely the depth of the first layer variation from 0 meters to 5.34 meters, the second layer from 1.26 meters to 7.39 meters and the third layer from 3 meters to 88 meters. From the results of the study the measurement of groundwater resistivity types can provide an idea of the clarity of water where the closer to turbidity the resistivity value of the groundwater is smaller and vice versa the further the turbidity of the resistivity value. from greater ground water. From the results of the distribution pattern of resistivity we can describe the turbidity value of groundwater in the study area, which is around TPA Supit Urang (Malang City)

**Keywords**: Groundwater, Geoelectric Method, Resistivity, Turbidity, TPA Supit Urang.

## 1. Introduction

The increase of the human population, pollution of subsurface water and ground or ground water tends to increase, especially due to the accumulation of garbage, and in the end the ground water becomes cloudy or dirty, so that it will disrupt the comfort of the community in general. For this reason, there is a need for research on the spread of turbidity in contaminated areas due to the large amount of waste. Estimating the distribution of subsurface water turbidity can be done by direct and indirect measurements. Direct measurement is carried out by taking hydrogeological data from population wells or taking soil samples around the source of pollutants for analysis in the laboratory. Geoelectric is a geophysical method for indirect measurement. The geoelectric method can be done easily and quickly. The results of the geoelectric measurements are the type of resistance values possessed by each rock or soil layer. From the magnitude of the electrical conductivity and the apparent type of resistance value, it can be interpreted as the spread pattern of contaminants.

The geoelectric method has developed rapidly and shows optimal results. Estimation by the geoelectric method in principle is to determine the resistivity of rock layers. The work method of this method is by flowing electric current into the rock layer and then measuring the potential difference.

From the data in the form of current magnitude and potential difference, the type of resistance value will be obtained.

## 2. Basic Theory

### *2.1. Geoelectric Resistivity Method*

The resistivity geoelectric method aims to determine the subsurface geological state using rock type resistivity. The difference in resistance of various types of rocks represents the different characteristics of each rock layer. The amount of type of detention is measured by flowing electric current and treating rock layers as currents. This method can also be used to determine the presence of ground water, and mineral exploration. In measuring the geoelectric resistivity method the equipment that must be possessed includes current sources and measuring devices for potential currents and electrodes used to enter current into the earth [1].

The working principle of the resistivity method is to flow the current down to the earth's surface so that a potential difference is obtained, thus information on the type of subsurface rock layer will be obtained. This method is done by using four electrodes arranged in a row. One of the two different electrodes of charge is used to flow current into the ground, and the other two electrodes are used to measure the voltage generated by the current flow, so that the subsurface resistivity can be known.

Physical quantities that affect groundwater include:

a) Rock porosity: Rocks with water filled pores have a lower type of resistance than dry rocks.

b) Solubility of salt and calcium in water: this amount will result in increased ion content in water and turbidity, so that the resistance of rock types becomes low (serves as a conductor).

The resistivity method can be divided into two based on the measurement objectives in the field, namely [2] :

1. Sounding resistivity method: This method is used if you want to get an electric type resistivity distribution to depth below a point on the surface of the earth. In this method the space between the electrode and the measurement point is enlarged gradually (see Figure 2). When the spacing gets bigger, a deeper material effect will appear. The configuration of the electrode that can be used for this purpose is mainly wenner.

2. Method of resistivity mapping: The method of resistivity mapping aims to determine the variation of the type of earth resistance laterally or horizontally.

### 2.2. Factor Geometry

When on the surface of the earth injected two opposite current points at a certain distance, then the two points will influence each other. If there is a potential electrode between the currents, then the measured potential difference at the potential electrode is determined by the specified current price. In general, this can be seen in the following Figure 1.

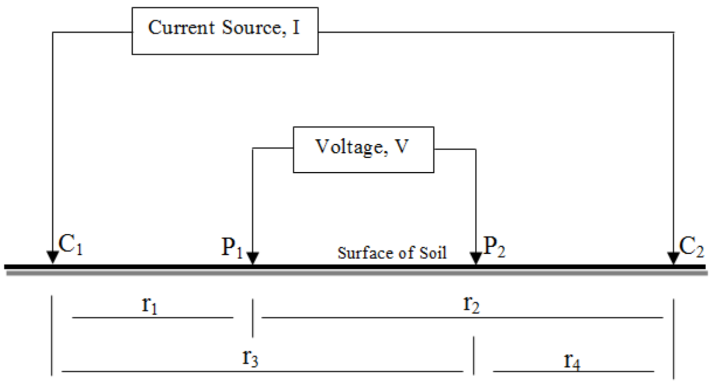


**Figure 1.** Current electrode and potential electrode [3]

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From equation potential following :

$$V = \frac{I\rho}{2\pi r} \quad (1)$$

Assuming that the right-hand electrode is the negative pole and the left-hand current electrode is the positive pole, the effect on the potential electrode is

1. Potential influence on $P_1$
   a. Influence $C_1$ on Potential $P_1$

$$V_1 = \frac{I\rho}{2\pi r_1} \quad (2)$$

   b. Influence $C_2$ on Potential $P_1$

$$V_2 = -\frac{I\rho}{2\pi r_2} \quad (3)$$

Minus (-) mean caused by reversing injection current.
Because the current at two points is the opposite direction, then the total sum of the two is :

$$V_1 + V_2 = \frac{I\rho}{2\pi r_1} - \frac{I\rho}{2\pi r_2}$$
$$= \frac{I\rho}{2\pi}\left(\frac{1}{r_1} - \frac{1}{r_2}\right) \quad (4)$$

2. Influence Potential on $P_2$
   a. Influence $C_1$ on Potential $P_2$

$$V_3 = \frac{I\rho}{2\pi r_3} \quad (5)$$

   b. Influence $C_2$ on Potential $P_2$

$$V_4 = -\frac{I\rho}{2\pi r_4} \quad (6)$$

Then total potential $P_2$ following :

$$V_3 + V_4 = \frac{I\rho}{2\pi r_3} - \frac{I\rho}{2\pi r_4}$$
$$= \frac{I\rho}{2\pi}\left(\frac{1}{r_3} - \frac{1}{r_4}\right) \quad (7)$$

So that the total potential difference (V) between P1 and P2 is the difference between equation (2.13) and equation (2.16), become:

$$\Delta V = (V_1 + V_2) - (V_3 + V_4)$$
$$= \frac{I\rho}{2\pi}\left(\frac{1}{r_1} - \frac{1}{r_2}\right) - \frac{I\rho}{2\pi}\left(\frac{1}{r_3} - \frac{1}{r_4}\right)$$
$$= \frac{I\rho}{K} \quad (8)$$

Equation become,

$$\frac{1}{K} = \frac{1}{2\pi}\left(\frac{1}{r_1} - \frac{1}{r_2}\right) - \left(\frac{1}{r_3} - \frac{1}{r_4}\right) \quad (9)$$

And then get :

$$\rho = \frac{VK}{I} \quad (10)$$

At Wenner method [3] ,distance r3 = r2 dan r4 = r1, and then value of constan K is :

$$K = \frac{2\pi}{\left(\frac{1}{r_1} - \frac{1}{r_2}\right) - \left(\frac{1}{r_3} - \frac{1}{r_4}\right)} \quad (11)$$

Where is,

K = Geometry Factor (meter)
ρ = resistivity (ohm meter)
I = current of electric (ampere)
V = Potential between two electrode (volt),

### 2.3. *Data acquisition*

*2.3.1. Vertical Sounding.* This method is used to determine the distribution of resistivity prices at a target point under the surface of the sounding earth. This method is often called 1 D sounding because the resulting resolution is only vertical.

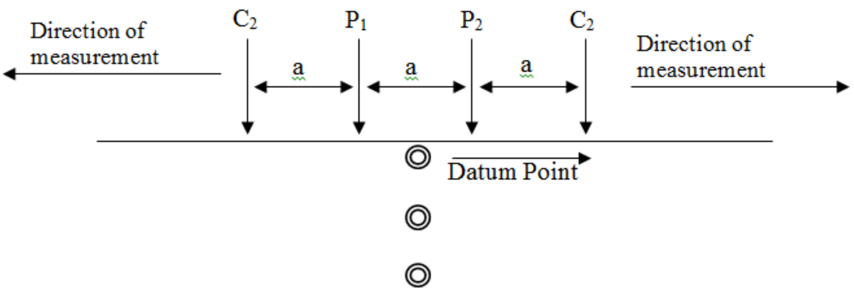


**Figure 2.** Displacement of electrode sounding.

In Figure 2. that is Wenner configuration measurement, the first measurement is done by making a spacing a and from this measurement one measurement point (datum point) is obtained. The second measurement is done by making the distance between C1 to P1 and P2 to C2 to be a and the next measurement point is obtained. Measurements continue to be made until the survey area is covered.

*2.3.2. Location research Area.* The study was conducted in the area of Supit Urang Final Disposal Site (TPA), Sukun Subdistrict, Malang City, East Java Province.

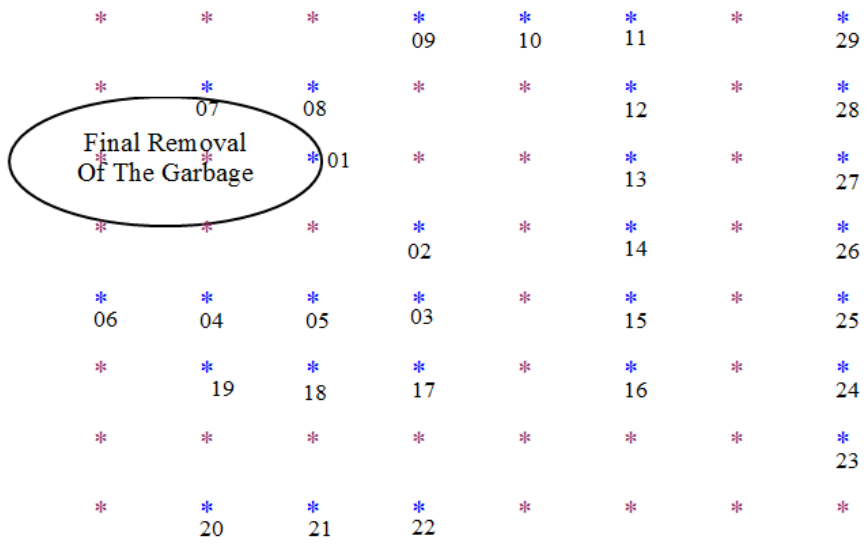


**Figure 3.** Distribution datum point measurement

Where is :
*** : Datum Point**
*** : Datum Point empty**
**Distance between Datum * : ± 100 Meter**


**Figure 4.** Location TPA Supit Urang

## 3. Data measurement and discussion

Once calculated using IP2Win or Progress software from each sounding point and by using the interpretation from the Telford table 5.2 p.452, that soil water with a variation of resistivity values from 0 to 100 ohm m, then using the surfer the following results are shown as shown in figure 4 and figure 5 the following:

Groundwater layer 1:

The highest resistivity value at the olive image coordinates on the coordinates (7; 5) means that the cleanest is more towards the north, the lower the resistivity value.

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Groundwater layer 2:

The highest resistivity value is more around the coordinates of the image (4; 1) which is south of the research area and around the coordinates (5; 6) and (3; 7), namely the western part of the image coordinates.

Groundwater layer 3:

The highest resistivity value around image coordinates (5; 5) and image coordinates (3; 3)

**Table 1.** Data measurement

Area : Supit Urang

Datum Sounding : 01

Array : Wenner

| A | V(mv) | I(mA) | Factor of Geometry | R (Ohm) | ρa (Ohm meter) |
|---|---|---|---|---|---|
| 2 | 36 | 158 | 12.57143 | 0.227848 | 2.864376 |
| 5 | 34.1 | 156 | 31.42857 | 0.21859 | 6.869963 |
| 7 | 32 | 154 | 44 | 0.207792 | 9.142857 |
| 10 | 30.3 | 153 | 62.85714 | 0.198039 | 12.44818 |
| 12 | 29.1 | 160 | 75.42857 | 0.181875 | 13.71857 |
| 15 | 26 | 168 | 94.28571 | 0.154762 | 14.59184 |
| 17 | 21 | 187 | 106.8571 | 0.112299 | 12 |
| 20 | 24.6 | 186 | 125.7143 | 0.132258 | 16.62673 |
| 25 | 20.1 | 185 | 157.1429 | 0.108649 | 17.07336 |
| 30 | 17.3 | 185 | 188.5714 | 0.093514 | 17.63398 |
| 35 | 15.1 | 186 | 220 | 0.081183 | 17.86022 |
| 40 | 14 | 187 | 251.4286 | 0.074866 | 18.82353 |
| 45 | 12.2 | 150 | 282.8571 | 0.081333 | 23.00571 |
| 50 | 9.7 | 110 | 314.2857 | 0.088182 | 27.71429 |
| 55 | 11 | 150 | 345.7143 | 0.073333 | 25.35238 |
| 60 | 12 | 206 | 377.1429 | 0.058252 | 21.96949 |

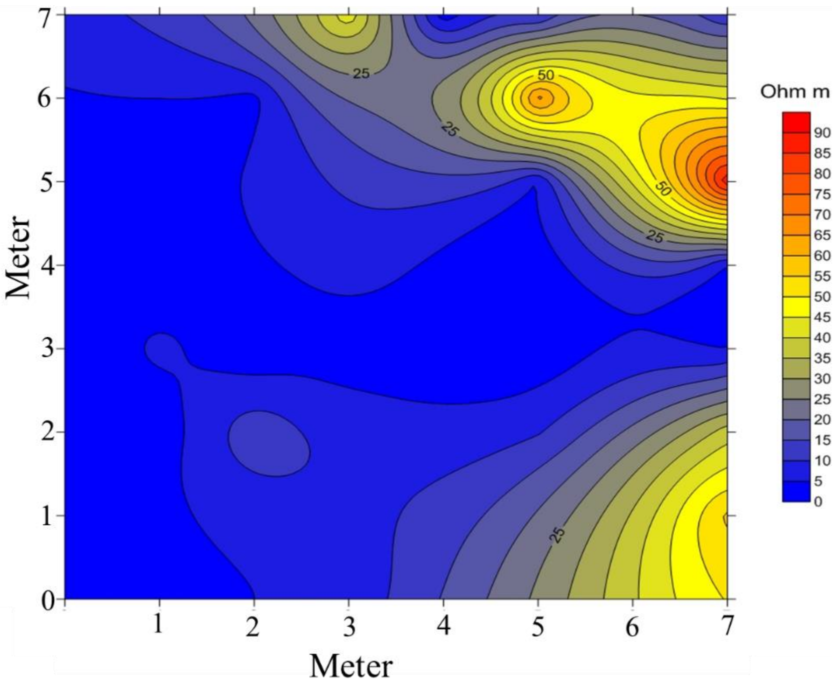


**Figure 5.** Distribution resistivity of the first layer soil water

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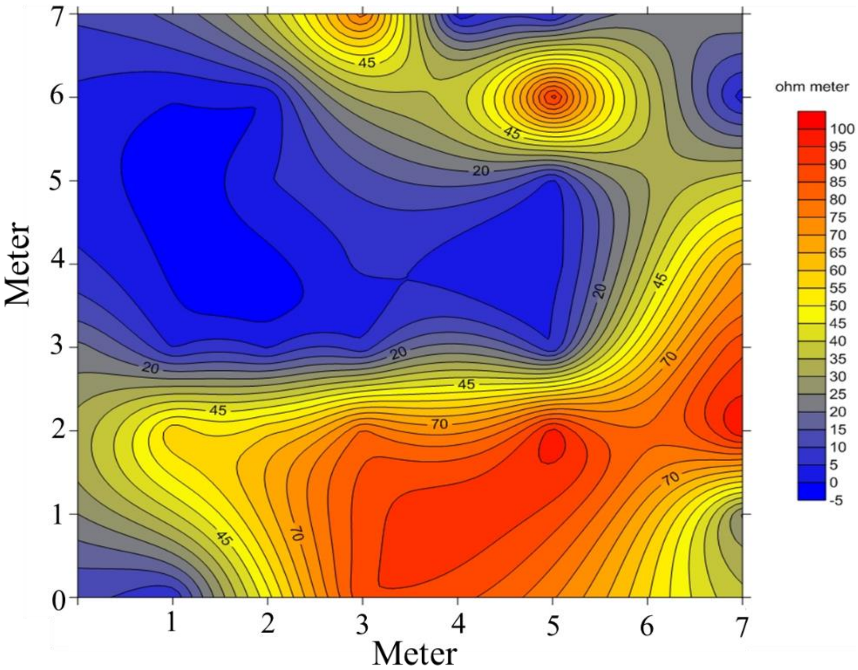


**Figure 6.** Distribution resistivity of the second layer soil water

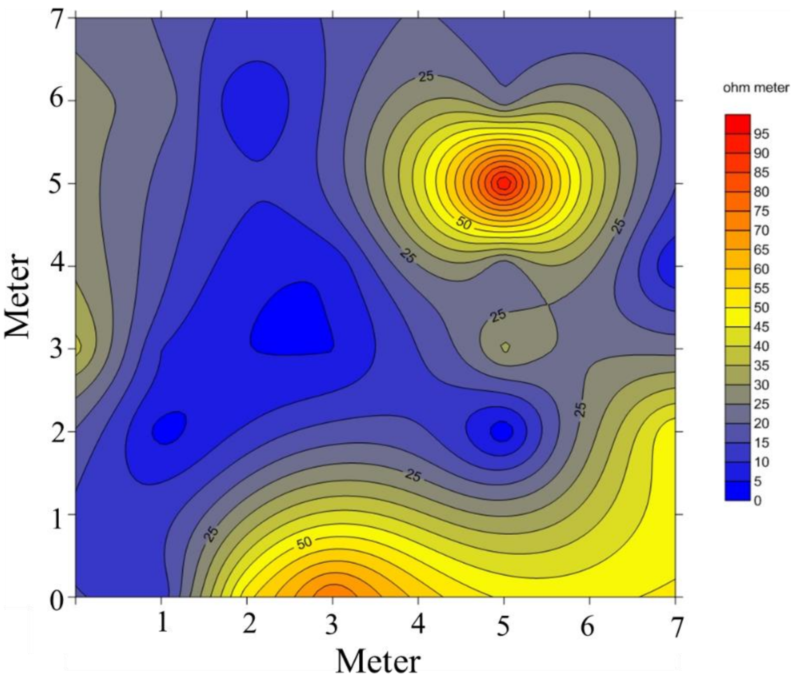


**Figure 7.** Distribution resistivity of the third layer soil water

## 4. Conclusion and recommendation

We can draw conclusions from data analysis, namely the first layer of groundwater and the second layer of groundwater, when compared to the wider area of clean water in the second layer. Likewise when compared to the third layer.

Need to analyze resistivity log data or groundwater well data to check its content, especially heavy metal content.

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