The Groundwater Analysis using Geoelectric Method Wenner Rules in Rejosari Village, Tenayan Raya Pekanbaru

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Abstract. The interpretation of groundwater in Rejosari Village, Tenayan Raya, Pekanbaru City has been carried out using geochemical and geoelectrical methods using Wenner-Schlumberger rules. This study aims to identify aquifer layers, determine flow patterns, and groundwater quality. Measurements were made on two tracks with a length of 68 m and 100 m respectively. Based on the results of data processing, it is known that the groundwater aquifer layer is at a depth of up to 5–15 m below the surface with a resistivity value 9.4–160.40 m. The pattern of groundwater flow in the study area tends to spread and is located at a certain depth. In track one, the aquifer layer is on the upper surface, while for track 2 the distribution is to a depth of 18 meters. The lithology of the subsurface layer in this study area is a layer of peat with a resistivity value 138.9–170.8 m, gravel with a resistivity value 117.4–160.4 m, and sandstone with a resistivity value 117.4-170.8 m.

1. Introduction
Groundwater is one component in the circulation of water on earth known as the hydrological cycle where water is often used in everyday life by all living things after going through the process of evaporation (precipitation) from seas, lakes, and rivers then condense in the atmosphere, and then it becomes rain that falls on the earth's surface [1,2]. Some of the rainwater that falls on the earth's surface flows directly over the earth's surface (runoff) and some seeps below the earth's surface (infiltration). Rejosari Village, Tenayan Raya District, has clay and loose soil lithology. Based on observations, it turns out that the groundwater around the clay lithology is found to have a smell and rust in the community bore well water installations [3]. The condition of groundwater in the area with loose soil turns out to be brown and smells from community bore wells. Therefore, it is necessary to research identifying the depth and structure of the subsoil around the area [4].

The geoelectric method is one of the geophysical methods that study the nature of the flow of electricity on the earth and how to detect the flow on the earth's surface. This includes potential measurements and current measurements that occur both naturally and as a result of current injection into the earth. Therefore, the geoelectric method has many kinds, one of which is the resistivity geoelectric method [5]. The purpose of a geoelectric survey is to determine the distribution of subsurface resistivity by making measurements at the ground surface. Normal resistivity measurements are made by injecting a current into the ground through two current electrodes and measuring the resulting voltage difference across the two potential electrodes. So that the subsurface resistivity can be estimated. Soil resistivity is related to various geological parameters such as mineral
and fluid content, porosity, degree of fracture, percentage of fracture-filled with groundwater, and degree of water saturation in rock [6].

The study of electrical resistance can be understood in the context of the flow of current through a subsurface medium consisting of layers of materials with different resistivities. In simple terms, all layers can be assumed to be horizontal. Material resistivity is a parameter measuring how well the material inhibits the flow of electric current [7]. If a conductive material has a homogeneous cylindrical shape, the rock generally has electrical properties in the form of electrical conductivity (conductivity) and dielectric constant. The dielectric constant is the polarization of the material in an electric medium. The dielectric constant determines the effective inductive capacity of rock material and is a static response to both AC and DC electric fields [8,9].

The Wenner configuration is one of the configurations in the geoelectric method. The geoelectric method is one of the geophysical methods that aim to determine the electrical properties of the rock layers below the soil surface by injecting electric current into the soil. The Wenner configuration is a geophysical exploration with the electrode arrangement located in a line symmetrical to the midpoint. The main purpose of this method is actually to find the resistivity of the rock. Rocks that have a greater resistivity, indicate that the rock is difficult to flow by electric current. Rock resistivity can be measured by introducing an electric current into the soil through two electrode points on the ground surface and two other points to measure the potential difference on the same surface. The Wenner configuration is one of the configurations that can provide a resistivity distribution map in the form of a two-dimensional image below the earth's surface [10].

Water quality is the nature of water that is influenced by the content of living things, energy substances, or other components in the water [11]. Water quality is expressed by several parameters, namely physical parameters (temperature, turbidity, dissolved solids, and so on), chemical parameters (pH, dissolved oxygen, BOD, COD, metal content, and so on), and biological parameters (presence of plankton, bacteria, and so on) [12].

2. Methodology
This research was conducted using geoelectric and geochemical methods, while the research tools and materials can be explained in Table 1. The work scheme of geoelectric measurements carried out in the study can be seen in Figure 1.

**Table 1.** Research tools and materials for aquifer layers and their functions.

| No | Tools and materials | Function |
|----|---------------------|----------|
| 1  | Resistivity meter   | Measuring material resistivity |
| 2  | DC current source   | Current source |
|    | battery             |          |
| 3  | Current Electrode   | Inject current into the ground |
|    | 2 pieces            |          |
| 4  | Potential Electrodes| Determine the magnitude of the voltage difference that is generated |
|    | 2 pieces            |          |
| 5  | Meter               | Measuring track length |
| 6  | Power cable         | Cable connecting electrodes with battery |
| 7  | Hammer              | Auxiliary tools drive potential electrodes and current electrodes into the ground |
| 8  | Res2Dinv . Software | Determine the lithological image in each layer |
| 9  | Excel Software      | Input and calculate the resulting data |
| 10 | Notepad             | Input data that will be used in the Res2Dinv software |
| 11 | GPS                 | Knowing the coordinates of the research location |
Figure 1. Schematic of the electrode arrangement in the Wenner configuration resistivity survey [13].

3. Results and discussion

3.1. Interpretation of data from line 1
Data interpretation is carried out after the data acquisition and data processing is complete. Track 1 in this study stretches from West-East with a track length of 68.5 m and a depth of 80 m below ground level. This trajectory is located at the coordinates X = 0.526850° and Y=101.487110°. Based on the results of data processing, it produces a cross-sectional image of the subsurface as shown in Figure 2.

Figure 2. Interpretation of Line 1 in Rejosari Tenayan Raya Village.

In this study, the peat layer containing fluid is found at a depth of 2.5–12.7 m with a resistivity 8.79–149.71 m in Figure 2. The subsurface layer of the soil in the study area is composed of various
layers with different resistivity values. Layer interpretation is obtained based on the resistivity value and the conditions in the study area. The layer that has the potential as an aquifer is located from a depth of 3.0–12.7 m with a resistivity value of resistivity 9.42–149.71 m. Layers with resistivity values 154.4–170.8 m were interpreted as gravel layers located at a depth of 1.2–2.0 m with the dominant distribution indicated by light green to moss green. Layers with resistivity values of 9.42–149.71 m are interpreted as sand layers indicated by bright green to brown colors. Layers that are orange to dark purple with resistivity values 170.8 m are interpreted as sandstone layers located at a depth of 3.0–5.1 m.

3.2. Interpretation of data from line 2
Line 2 extends along the track of 100 meters and is spaced 4 below ground level. The Gradient Line of this trajectory is located at the coordinates X=0.529926” and Y=101.488192”. The field data obtained produces a subsurface image shown by the contour of the resistivity value and can be seen in Figure 3.

![Figure 3](image)

**Figure 3.** Interpretation of line 2 data in Rejosari Tenayan Raya Village.

The subsurface layer of the soil in this path is composed of layers that have different resistivity values. Layer interpretation is obtained based on the resistivity value and the conditions in the study area. The layer that has the potential as an aquifer layer that allows storing groundwater is located at a depth of about 5.2–12.7 m with its distribution to the west with a resistivity value range of 138.9–160.40 m. The layer with resistivity values 138.9–160.40 m is a layer of peat-containing fluid at a depth of 5.3–12.0 m with the distribution to the east. The layers indicated by light green to moss green are interpreted as gravel with a resistivity value range of 117.4–160.40 m and is located at a depth of 1.0–12.0 m with dominant distribution in the west direction. Layers with resistivity values 117.4–138.99 m are interpreted as sand layers located at a depth of 1.00–5.10 m which are indicated by bright green to brown colors with a dominant evenly distributed distribution.

4. Conclusion
Based on the results of the research that has been carried out, it can be concluded that the resistivity value, the aquifer layer in this research area is located at a depth of up to 5–15 m below the surface with a resistivity value 9.42–160.40 m. The pattern of groundwater flow in the study area tends to spread and is located at a certain depth. In track 1, the aquifer layer is on the upper surface, while for line 2 the distribution is to a depth of 18 m. At certain depths in the aquifer layer, there are indications of peat water, so this water cannot be directly used for various daily needs, namely for cooking, but must first be processed into clean water suitable for consumption.

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