Identification of aquifer using geoelectric resistivity method of reciprocal schlumberger array (case study: Tanggamus, Lampung Province)

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Abstract. Tanggamus district known as an area indicated to have a potential aquifer layer because there are many areas of groundwater infiltration. This study aims to obtain the depth of aquifer layer and aquifer type found in Tanggamus area. This research was carried out using geoelectric resistivity method of reciprocal Schlumberger array. Based on the results of data processing in correlated with geological data, aquifer layer is identified in rough sand rocks with resistivity value 35-100 Ωm. The confined aquifer layer lies at a depth of 20.6-136 m in the measuring lines of 3, 4 and 5. The unconfined aquifer layer lies at a depth of 1.71-151 m in the measuring line of 1. The leaked aquifer layer lies at a depth of 2-169 m in lines 2 and 5. The characteristics of the layers of rock consists of sandstone as an aquifer, breccia as an aquifuge and tuff as an aquiclude.

1. Introduction
Tanggamus District is an area indicated to have a sufficient potential aquifer layer because it has high enough rainfall and in those areas there are hills, mountains and lowlands that allow a groundwater absorption area. Aquifers are layers or groups of formation of consolidated (clay) and unconsolidated (sand) permeable units (sand) with water saturated conditions and have a hydraulic conductivity, so that they can carry water (or water can be taken) in an economical amount [1]. Common geoelectric resistivity methods were used to identify the aquifer layers, including in the case studies in the Tanggamus area used the geoelectric resistivity method.

Geoelectric resistivity methods is a geophysical method that utilizes the resistivity properties (resistance type) of a rock to study the state of the subsurface. Resistivity is an important parameter for characterizing the subsurface physiology, which is coordinated with subsurface materials and coating [2].

In the case study in Tanggamus area the configuration of the Reciprocal Schlumberger electrode was used (see Figure 1). The Reciprocal Schlumberger configuration is one configurations that can be used to estimate the aquifer layer [3]. In addition the Reciprocal Schlumberger configuration was chosen because it can be optimized to maximize the number of potential electrode pairs measured by signal current injection [4].

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2. Methods

This research was conducted in Tanggamus Districts of Lampung Province (Figure 2). This region is dominated by young quarter volcanic rock formations. Layers of sand and tuffs in the measurement area are often found. Sand rocks have a high porosity that can store water and are indicated as an aquifer layer while their porosity tuff coating is not very high and is identified as an aquiclude layer. Aquiclude layer is a layer or rock formations that can store water but cannot pass water.

Data acquisition method used in measurement using the Electrical Resistivity Tomography method. The ERT method is a method of measuring ground surface resistivity using many electrodes, in order to obtain variations of resistivity distribution in the sub-surface [6]. Measurements will be made on 5 tracks. On the tracks 1, 2, 4 and 5 the length of each track is 950 m and has 96 pairs of electrodes with a distance between 10 m electrode, on the track 3 the length is 720 m and has 72 pairs of electrodes with a distance of 10 m electrode. The position of each track is shown in Figure 2. The configuration used is the Reciprocal Schlumberger. The data obtained in ERT measurements are still in the form of apparent resistivity values, to obtain the actual resistivity value, resistivity modeling is performed with the Least-Square Inversion Method [7].
3. Result and Discussion

Based on the inversion result of the resistivity value false obtained a cross section of resistivity of 5 cross sections. The distribution of resistivity values in the study area varied from 12 Ωm to> 800 Ωm, then the lithologic interpretation for each path. Based on the results of lithologic interpretation from path 1 to path 5 and correlated with sub surface geology data of the research area, it is expected that the type of rock in the research area based on the resistivity value.

The aquifer layer on track 1 lies at a depth of 1.71-151 m with a distance of 190-690 m, this aquifer layer is a layer of unconfined aquifer with a sandstone as a layer of constituent rock (see Figure 3) and the aquifer layer on track 2 is at a depth of 2-169 m at a distance of 400-640 m and is a type of semi-confined aquifer layer (see Figure 4). The aquifer layer on track 3 are at depths of 20.6-35.9 m and 104-119 m where the aquifer layer is a type of confined aquifer layer because the upper and lower parts are confined by an aquifuge layer (see Figure 5) then the aquifer layer on track 4 is located at a depth of 21.8-46.2 m with a distance of 160-950 m where this aquifer layer belongs to the type of confined aquifer layer because the top and bottom are limited by the aquifuge layer, (see Figure 6) and the last one the aquifer layer on track 5 is a composite of a confined aquifer type and a leaked aquifer layer. At a depth of 44.6-136 m with a distance of 460-950 m is a confined aquifer layer because it is limited by the top of the aquifuge layer which is a layer of breccia rock that is associated with fine sand rocks and underneath is limited by a layer of tuff rock. At a depth of 20.6-119 m with a distance of 0-460 m is a leaky aquifer layer (see Figure 7).

Figure 3. 2D resistivity crossing on path 1 along with topography, (b) 2D resistivity cross section on track 1.

Figure 4. 2D resistivity crossing on path 2 along with topography, (b) 2D resistivity cross section on track 2.
4. Conclusion
Based on research result, can be conclude that: 1). Aquifer layer in the study area indicated in coarse sand rock layers with a range of resistivity values (35-100) Ωm. The indicated aquifer layer consists of 3 types, namely a confined aquifer layer, a unconfined aquifer layer and a leaking aquifer layer, and 2).Confined aquifer layer is located at depth (20.6-136) m at measurement paths 3, 4 and 5. Unconfined aquifer layer is located at depth (1.71-151) m on track 1. Leaking aquifer layer is located at depth (2-169) m on tracks 2 and 5.
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