

Geological Study of Groundwater Using Design Investigation Survey in Amdasa Village, Tanimbar Islands District

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<https://doi.org/10.18280/ijesca.123456>

Received: 20 September 2025

Accepted: 08 November 2025

Keywords:

Groundwater, Aquifer, Geoelectric, Resistivity

ABSTRACT

Water is a primary human need that must be met, but overtime the rate of population growth, the need for water in Amdasa Village, Wertamrian District, Tanimbar Islands Regency is decreasing. Increased water use is sometimes not accompanied by the management of new water sources due to the lack of information about the potential of groundwater sources. Geoelectric surveys will provide potential difference values, current strength, and rock specific resistance values. The value of the rock's specific gravity is then further processed to obtain the value of the specific gravity of each rock layer. The research location has good aquifer potential indicated by the discovery of aquifer layers at shallow depths from the surface of 6 meters and up to 13 meters with various aquifer thicknesses and groundwater well design with a drilling depth of ± 16 meters for points 01 and 03.

1. INTRODUCTION

Every human needs water to live, it is not uncommon for water to become a primary human need that must be fulfilled, but as the population growth rate increases, the need for water is increasingly unmet. This also happens in the outermost area, which is increasingly developed, namely Amdasa Village, Wertamrian Subdistrict, Tanimbar Islands Regency so that the need for clean water will increase along with the increase in human activity, the needs of the community that must be met are cooking, bathing and washing and other needs. For this reason, one solution to meet the needs of the people of Wertamrian village is to find groundwater aquifers using one of the methods that can be used is the type resistance geoelectric method.

Water use is sometimes not accompanied by the management of new water sources due to the lack of information about the potential of groundwater sources. The potential of groundwater resources in each region varies according to the geological conditions around the area. Groundwater contained in the aquifer layer has a certain depth, so a study is needed to determine the characteristics of groundwater. Geoelectric estimation is one of the geophysical methods used to study conditions below the earth's surface by utilizing the electrical properties of rocks against the physical properties of the rocks themselves. This electric current injection uses 2 'Current Electrodes' A and B which are stuck into the ground with a certain distance. The longer the distance of electrode AB will cause the flow of electric current to penetrate deeper rock layers.

Geoelectric methods are often used to determine the condition of subsurface rocks through resistivity analysis or the ability to conduct electricity from materials in the earth. Through this method, the water-bearing layer can be known for its depth, thickness, and distribution. Geoelectric surveys will provide potential difference, current strength, and rock specific

resistance values. The value of the rock's specific gravity is then further processed to obtain the value of the specific gravity of each rock layer. Based on this, the subsurface layer can be described by the difference in the value of the specific gravity of each layer. So that these results can be a good illustration for the existence of potential groundwater sources in accordance with the type of rock layer.

This research was conducted in Amdasa Village, Wertamrian District, Tanimbar Islands Regency. Amdasa Village is one of the areas with a water crisis where water collection by most of the community can be consumed through existing shallow wells through community self-help, but at the peak of the dry season it is difficult for people to get clean water due to decreased water discharge. This research area is an area that is utilized and can be developed to carry out various activities for many parties, so the need for clean water is important. This research is aimed at finding good water sources and the location of aquifers in the area. In addition, it can also predict the potential of deep and shallow groundwater in the study area. The selection of this location is also based on the land area that is sufficient to conduct research and can support the lives of people in villages prone to water availability.

2. LITERATURE REVIEW

2.1. Survey Design Investigation (SID)

Design Investigation Survey is a survey process carried out prior to the building design preparation process. The goal of this technical survey is to obtain data/information on the actual condition/situation of the infrastructure development site. The type of data/information required depends on the type of infrastructure to be built. Such as: Physical conditions of the location (area, boundaries, topography), soil conditions (hard/soft), groundwater conditions, land use, details of land use, pavement, greenery, and others. The data or information

will then be used in determining the design or design and drawing of the building plan to be built.

In general, the components that must be considered in a technical survey include;

- 1) Primary and secondary data collection Primary data includes; site survey, water sources, road plan, population data, Secondary data: topographic maps, hydrology/climatology literature review, demographics;
- 2) Land area/road length to be constructed;
- 3) Administrative boundaries/topographic boundaries;
- 4) Create location maps and situation drawings;
- 5) Physical condition of surface soil/Surface geology;
- 6) Land use and land covering;
- 7) Land layout/land allotment;
- 8) The initial elevation of the building;
- 9) Quarry material/landfill/soil disposal site;
- 10) Local materials;
- 11) Work path/entrance;
- 12) Local climate data records;
- 13) Unit price of materials;
- 14) Wage prices; and
- 15) Create a preliminary photo document.

2.2. Groundwater

Groundwater is water that exists in cavities in geological layers. Groundwater can also be interpreted as water below the earth's surface. According to Bouwer (2002); groundwater is water that is found below the earth's surface in the pore space of the soil and in the fractures of rock formations.

Groundwater flows in the underlying structural layer of the earth called an aquifer. An aquifer is a layer, formation or group of formations of permeable geology that is either consolidated (e.g. clay) or unconsolidated (sand) with a water-saturated state and has a magnitude of hydraulic conductivity (K) so that it can carry water.

Aquifers are divided into several types as shown in Figure 1.

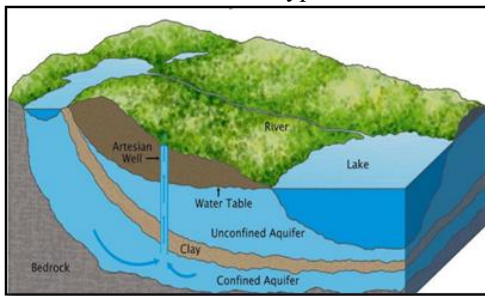


Figure 1. Types of aquifers (Rizal et al., 2015)

- 1) Unconfined aquifer is an aquifer where the water table is the upper boundary plane of the water-saturated zone.
- 2) Confined aquifer is an aquifer with groundwater located under an impermeable layer and has a pressure greater than atmospheric pressure.
- 3) Leakage aquifer is an aquifer where groundwater is located beneath a semi-impermeable soil layer. Thus, the aquifer is located between a free aquifer and a depressed aquifer.
- 4) Perched aquifer is a groundwater mass that is separated from the parent groundwater by an impermeable layer that is not very wide.

2.3. Geoelectric Method

The geoelectric method is one of the methods in geophysics used to investigate subsurface conditions by utilizing the properties of electricity by flowing DC (Direct Current) electric current that has a high voltage into the ground. This electric current injection uses two current electrodes A and B which are stuck into the ground with a certain distance. The longer AB is, the deeper the electric current flow can penetrate the rock layer. Meanwhile, two potential electrodes in the configuration are used to measure the potential difference.

If a point electrode flowing current (C1) is located on the surface of an isotropic homogeneous medium, then the current will be spread in all directions with equal size. The flowing current will cause an equipotential field and the equipotential field has a distance r (Figure 2). because the price of air conductivity is zero, then when the current flows under the surface it will cause an equipotential field in the form of a hemispherical circumference area.

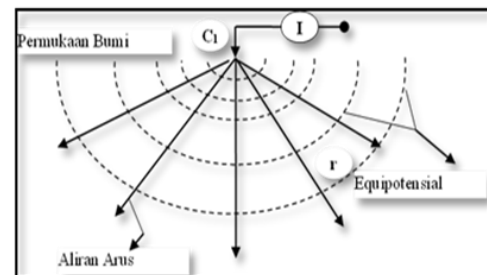


Figure 2. Single-current flow in an isotropic homogeneous medium

The electrode configuration used in this research is the Wenner configuration in which this configuration places an arrangement of 2 (two) potential electrodes (MN) placed between 2 (two) current electrodes (AB). At the time of measurement, the current electrode (AB) and potential electrode (MN) are moved according to a predetermined distance, provided that the distance of the potential electrode (MN) $\leq 1/5$ of the current electrode (AB). In this study we assume the earth is an isotropic homogeneous layer, but actually the earth is not isotropic homogeneous.

3. METHODOLOGY

The research was conducted in Amdasa Village, Wermaktian District, Tanimbar Islands Regency. The data collection process uses the GF IRES Instrument geoelectric tool and data processing using RES2DINV software and will then be continued with well drilling with the aim of confirming the estimation or interpretation that has been done with the geoelectric method.



Figure 3. Research Location

The Survey Investigation Design (SID) research flow chart starts from the data collection stage through observation, interviews or discussions.

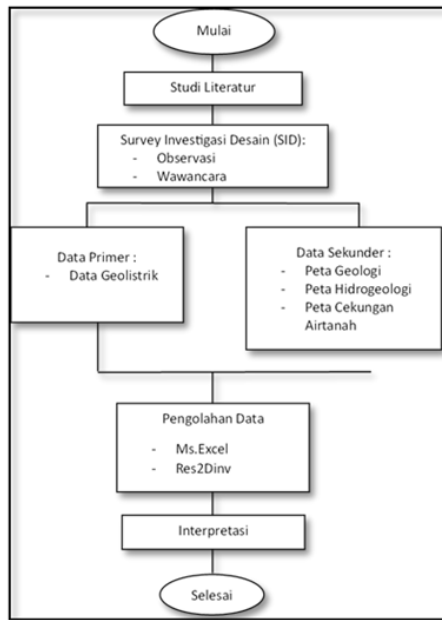


Figure 4. Research Flow Chart

In addition, primary data collection is carried out through the use of geoelectric equipment to obtain primary data and is complemented by various literature such as geological data, hydrological data and groundwater basins in the West Southeast Maluku Regency area. Researchers then analyzed the data through Microsoft Excel and Res2DinV applications to produce data interpretation as a recommendation for well design planning for drilling by providing an initial concept for drilling implementation in Amdasa Village, Wertamrian District, West Southeast Maluku Regency.

4. RESULT AND DISCUSSION

The apparent resistivity data obtained from data acquisition is processed or inversed with mathematical equations to obtain the actual specific gravity value. The data is processed based on the apparent specific gravity equation, so that the apparent specific gravity value (ρ_a) is obtained by entering the values of ΔV , I , a and K into the Microsoft Excel program. Then processed using RES2DINV software. The research was conducted by taking 6 lines or trajectories with a length of 100 meters each. The configuration used is the WennerAlpha configuration with the position of the current electrode C and the potential electrode (P) sequentially C1 P1 P2 C2 with spacing and shifting between electrodes 5-30 meters.

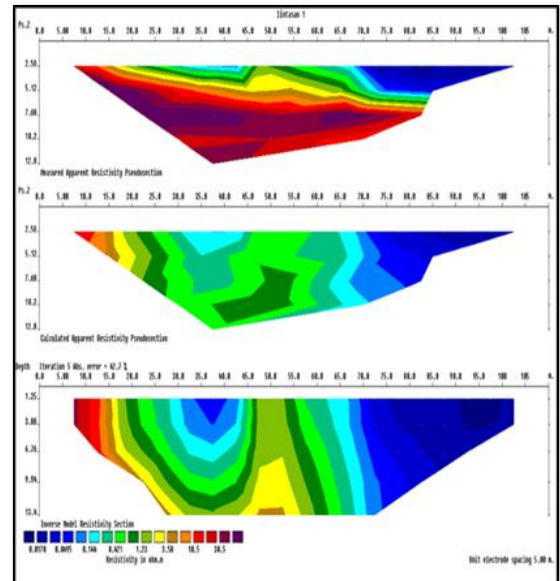


Figure 5. 2D cross section at location AM – 02

From the cross section produced after data processing, it can be interpreted that ;

- Free aquifer at 13 meters depth at 45 meters to 50 meters electrode spacing
- There is a confined aquifer at a depth of 2 meters to 12 meters at an electrode spacing of 15 to 30 meters.
- Drilling recommendations can be made at depths of up to 9 meters at electrode spacings of 45 to 55 meters.
- At 70-100 meters electrode distance is not recommended because the aquifer or groundwater can be brackish, this is because the location of the drilling plan is a low-lying area and is a coastal area.

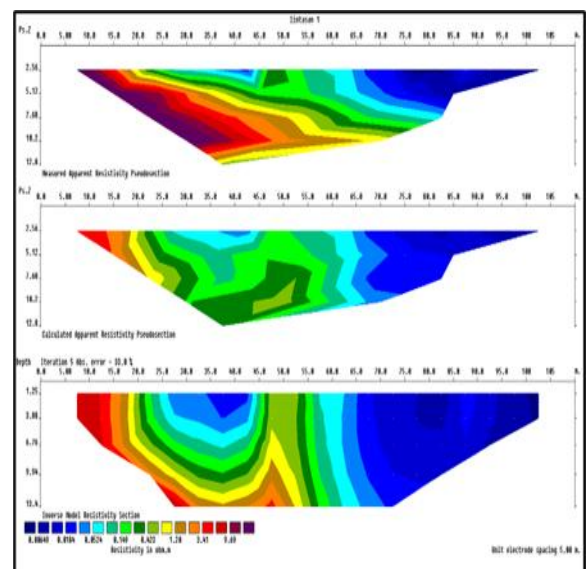


Figure 6. 2D cross section at location AM - 02

For Point AM-02, it can be interpreted as follows:

- There is a confined aquifer at a depth of 3 meters to > 10.5 meters at electrode spacing of 20 to 49 meters.
- For drilling recommendations, it can be done at depths up to > 14 meters at electrode spacing at 50 to 70 meters.
- At 70-100 meters electrode distance is not recommended because the aquifer or groundwater can be brackish, this

is because the location of the drilling plan is a low-lying area and is an area.

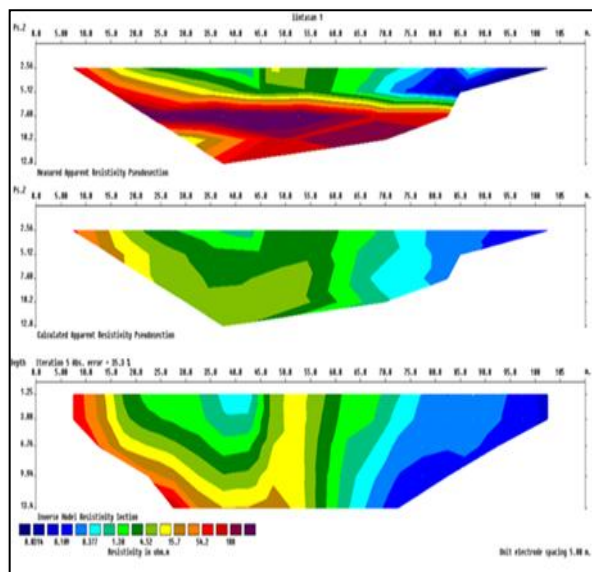


Figure 7. 2D cross section at location AM – 03

The of the AM-03 Point modeling can be seen in the resulting model that the lowest resistivity value is 0.0314 ohm.m while the highest value is 188 ohm.m. The difference in resistivity values is represented by color where low resistivity values are colored blue and high resistivity values are colored red to purplish. There is a free aquifer at a depth of 13 meters to 14 meters at an electrode distance of 50 meters to 50 meters, There is a confined aquifer at a depth of 2.5 meters to 12 meters at an electrode distance of 15 to 85 meters, For drilling recommendations can be made at a depth of up to > 14 meters at an electrode distance of 50 meters to 55 meters.

5. CONCLUSIONS

The data is processed based on the apparent specific gravity equation, so that the apparent specific gravity value (pa) is obtained by entering the values of ΔV , I, a and K into the Microsoft Excel program. Then processed using RES2DINV software. Based on the Geoelectric Survey in Amdasa Village, Wertamrian District, West Southeast Maluku Regency, the following conclusions can be drawn:

- The research location has good aquifer potential characterized by the discovery of aquifer layers at shallow depths starting from the surface of 6 meters and up to 13 meters with various aquifer thicknesses.
- Design groundwater wells with a drilling depth of $\pm$ 16 meters for points 01 and 03.

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