2-DIMENSIONAL GEORESISTIVITY SURVEY AT ISABELA STATE UNIVERSITY – ECHAGUE CAMPUS

SMART WATER INFRASTRUCTURE AND MANAGEMENT R&D CENTER

PHYSIOGRAPHY

The municipality of Echague has a land area of 648.38 km^2 comprising of 64 baranggays highlighting San Miguel as the largest with approximately 156 km^2 (PhilAtlas). Its terrain varies across the region where the western and central part appear to have a relatively flat to gently sloping terrain making it suitable for agriculture and infrastructures. The eastern part of the municipality is a mountainous region and where the Sierra Madre Mountain Ranges lie.

LOCAL GEOLOGY

The geology of Echague, Isabela, consists of different rock formations that influence its terrain, land use, and natural resources. The northwest part is dominated by fertile Quaternary alluvial deposits, making it ideal for agriculture, while the central region contains older Paleocene to Pleistocene sediments that also suitable for farming. In the southeastern part, the topography becomes more steep due to igneous and sedimentary rocks from the Miocene and Cretaceous periods, forming hilly and mountainous areas. These regions are less suitable for farming but support forestry and agroforestry. Limestone deposits in the south suggest potential mineral resources. The lowlands are prone to flooding, while the uplands face erosion and landslide risks.

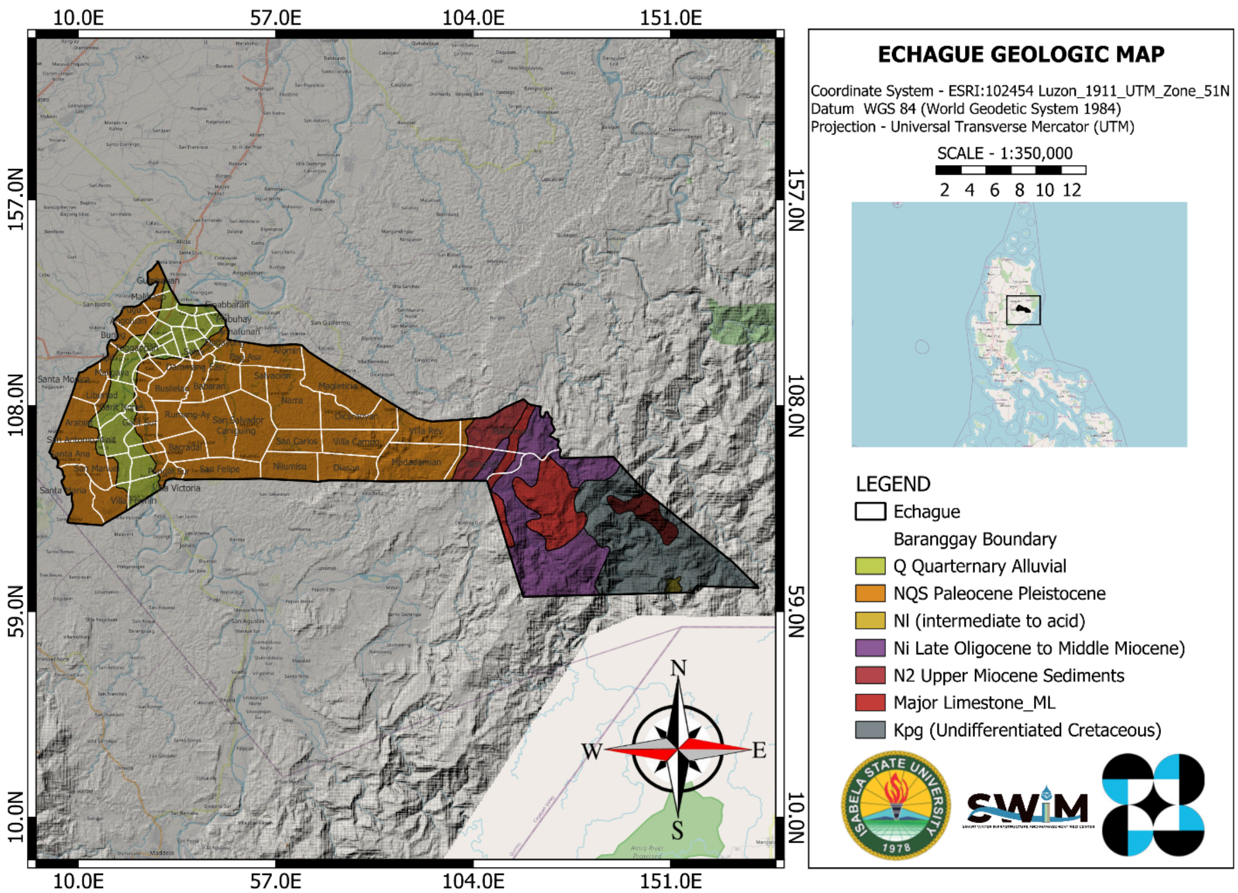

Figure 1. Geologic Map of Echague

GEOLOGICAL STRUCTURE

There are no perceptible geologic structures that could significantly affect the groundwater storage and flow. The only identifiable features and structures are found in the uppermost most of the soil and wells extending on the saturated zone or aquifer.

GEORESISTIVITY SURVEY

PRINCIPLES

Resistivity is a geophysical surveying technique that utilizes electrical measurements conducted on the ground surface to identify the depth and thickness of subsurface resistivity layers. In groundwater investigations, resistivity surveys help improve the understanding of underground formations and reduce the likelihood of drilling unsuccessful wells.

Since soil and rocks generally act as electrical insulators with high resistance, electrical currents primarily pass through moisture-filled pore spaces. The resistivity of these materials is influenced by factors such as porosity, permeability, the amount of pore water, and the concentration of dissolved solids. Various soil and rock types exhibit different resistivity values depending on their composition, texture, degree of fracturing or weathering, and groundwater content. This method involves injecting a known and often constant electrical current into the ground using two electrodes, called current electrodes. This process generates a potential field (voltage), which is then recorded through another pair of electrodes known as potential electrodes. The resistance obtained from these measurements is adjusted using a geometric factor to calculate the apparent resistivity.

Resistivity surveys can be conducted to analyze the sequence of resistivity layers beneath a specific location, a technique known as vertical electrical sounding (VES). The resistivity values obtained are then interpreted to determine the possible types of rock present below the surface.

SURVEY DETAILS

Figure 2. Survey Site

The 2-Dimensional geo-resistivity survey was carried out in the Isabela State University – Echague complex. The wire is laid out horizontally with a unit electrode spacing of 5 meters apart. The area is relatively flat with minilmal presence of stones and boulders making it suitable for conducting a resistivity survey with minimal topographical interference. The surrounding vegetation suggests that the soil retains a decent amount of moisture.

RESULT

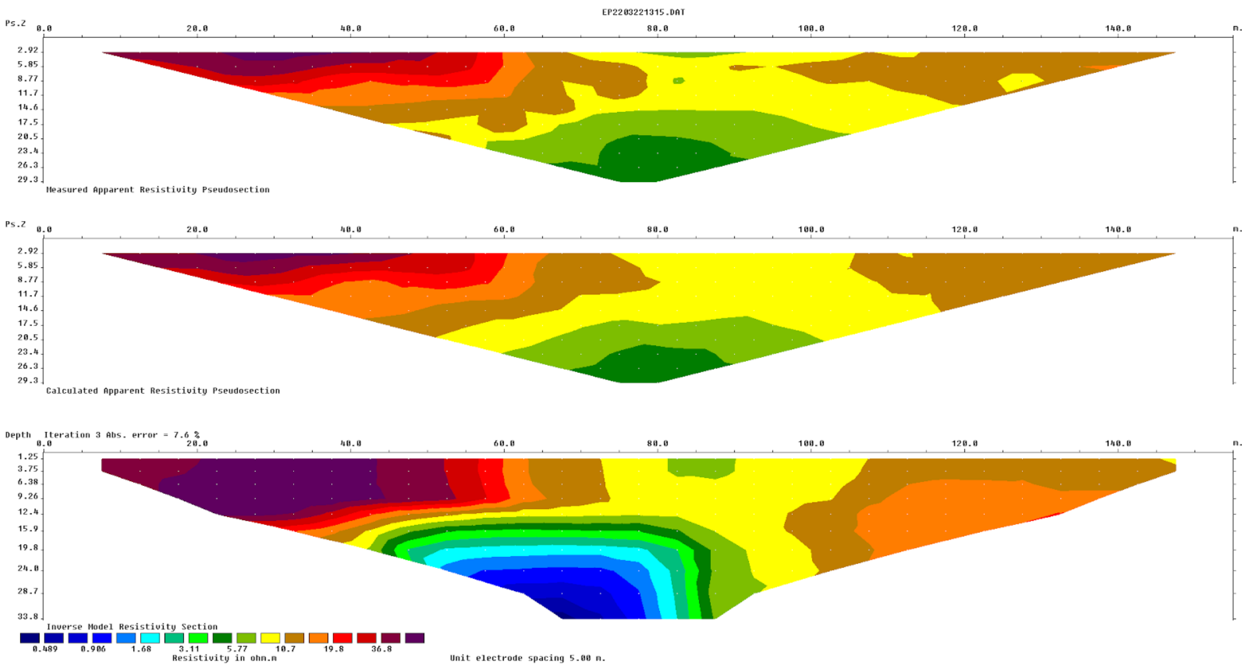

Figure 3. 2-Dimensional geo-resistivity survey result

The 2D geo-resistivity analysis above shows a significant variations of measured resistivity value relative to time. As shown in the figure, the measured Apparent Resistivity Pseudosection and the calculated Apparent Resistivity Pseudosection is relatively close making sure that the data is accurate and reliable. The Inverse Model Resistivity section carries the final interpretation of the data, the primary groundwater zone is found at depths of approximately 12.5 meters to 28 meters, exhibits resistivity values ranging from 0.4 to 5.7 ohm-m (blue to green shades). This suggests a saturated aquifer, likely composed of porous materials such as sandy-clay layers or fractured bedrock capable of storing and transmitting water. This deep aquifer appears to be the most promising target for groundwater extraction.

A light color yellow is found at depths 5 m to 12.5 meters indicating a shallow saturated zone. This layer could be a perched water table. While it suggests that it contains moisture at some level, it does not guarantee that it is a fully develop aquifer and may expect water unavailability due to seasonal variation. The uppermost layers, from the surface extending to 5 meters deep shows darker colors which varies to higher resistivity values indicating that is dry. This zone may compose of compacted sediments and rocks with minimal water retention. Furthermore, there are notice lateral variation between the left and right section which could mean that there is a barrier for groundwater movement.

CONCLUSION

The 2D geo-resistivity survey effectively identifies the different resistivity variations and locate the potential groundwater-bearing formations. Based on the results, the optimal drilling depth for groundwater extraction should target the 12.5m to 28m range, where the deep aquifer is located. The uppermost layers from the surface to 5 meters deep, exhibits high resistivity indicating dry or compacted materials with minimal water retention. Additional surveys, such as vertical electrical sounding (VES) or borehole logging, could help confirm the thickness and quality of the groundwater source. This analysis provides important insights for water resource management, guiding well placement and ensuring sustainable groundwater extraction.

REFERENCES

"Echague, Isabela Profile – PhilAtlas." *Www.philatlas.com*, www.philatlas.com/luzon/r02/isabela/echague.html.

"Mining in Province of Isabela." *The Diggings^{TM}*, 2025, thediggings.com/phl/province-of-isabela-phl3164. Accessed 4 Apr. 2025.