MULTIDISCIPLINARY APPLIED RESEARCH AND INNOVATION
e-ISSN: 2773-4773

MARI

Vol. 5 No. 1 (2024) 177-184
https://publisher.uthm.edu.my/periodicals/index.php/mari

Study on Water Quality of Groundwater Supplies of Selected Location in Selangor: Serendah, Meru and Saujana Rawang

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DOI: https://doi.org/10.30880/mari.2024.05.01.025

Article Info

Received: 1 September 2023
Accepted: 10 December 2023
Available online: 31 January 2024

Keywords

Underground Water, Water Quality, DOE Standard, Physical and Chemical Parameter, Survey

Abstract

Groundwater utilisation is mostly common in some urban and rural area mostly in Kelantan, Terengganu, Selangor, Malacca. Many citizen in this particular area continue to employ the antiquated method of digging a well at home to collect water, despite the risks involved in using water that has not been treated. A small locality in Selangor is one of the many villages that use this practice. This study's primary objective is to investigate the physical and chemical parameter of underground water in three different location in Selangor.The result of this study shows that the amount of Chemical Oxygen Demand (COD) and Ammonia Nitrogen (AN) is high in location M while Biochemical Oxygen Demand (BOD) is high in location SR. Location S is high in TSS whereas water hardness is high in location M and location SR. As the conclusion, the underground use as supply water should undergo treatment before consumption need to follow Department of Environment (DOE) underground water quality standard. Hence, it can be assure the safety and health of the water for the consumer.

1. Introduction

Groundwater is the water found underground in the cracks and spaces in soil, sand, and rock beneath the surface of the earth. These geological formations of soil, sand and rocks are called aquifers. The main processes of the groundwater cycle are the infiltration of rainwater into the soil and its flow within the rocks and finally its natural outflow at springs and into rivers. In tropical Malaysia, groundwater storage is estimated to be 5000 billion cubic metres and only less than 2% of the present storage has been used. The utilisation of groundwater in Malaysia is still relatively low at only 3% because surface water is the main source of water supply where most of the states in the country are using surface water to meet various water demands [1]. Most major cities in Malaysia face problems of potable water supply due to the population boom, industrialization, pollution of surface water, and drought condition. In Malaysia, the usage of underground water is minimal because the utilization of groundwater is relatively low at only 3% due to surface water is the main source of water supply but there are some citizens who are still using them [2].

1.1 Problem Statement

The recent water rationing in parts of Selangor, Kuala Lumpur and Putrajaya had prompted some parties to recommend the use of groundwater as backup. The groundwater resources available in the country is estimated at around 5,000 billion cubic metres and only a small percentage is being utilized [3]. Nonetheless, for environmental activists in particular, groundwater is not the best solution to address the nation's water woes. Therefore, some of the citizens are using the underground water as a source of their daily routine without checking the quality of water whether it is good or bad such as the people who consumed the contaminated underground water which is not suitable for commercial use, are most likely to get sick. Mostly, underground water is possible to get comminated by its surroundings of things that we can see with our eyes or things that we can't see with our eyes. The typical of contaminant typical for underground water such as microorganisms, heavy metals, pesticides, oil, and gasoline. To solve this problem, this study's purpose is to investigate the physical and chemical parameter of the underground water and compare with the DOE underground water quality standard.

1.2 Objective of Research

The objectives of this study are as follows:

- To investigate the physical parameter of underground water in three different locations in Selangor
- To investigate the chemical parameter of underground water in three different locations in Selangor.

2. Materials and Methods

Based on the case study, by extracting the important elements from the methodology such as the aim of the case study, technique of investigation, data gathering and analysis, sampling and strategy for research are used to determine the quality based on physical and chemical water quality parameters of the three different locations in Selangor. The experiment will be carried out as follows, where the 5-lab test were be conducted. Finally, the result obtain from the test is compare with the commercial and industrial standard DOE of Underground Water using Microsoft Excel software. Flowchart is a main outline to use in a way to ensure the procedure went off without a hitch. Fig. 1 shows the flowchart that demonstrates the methodology as a whole.

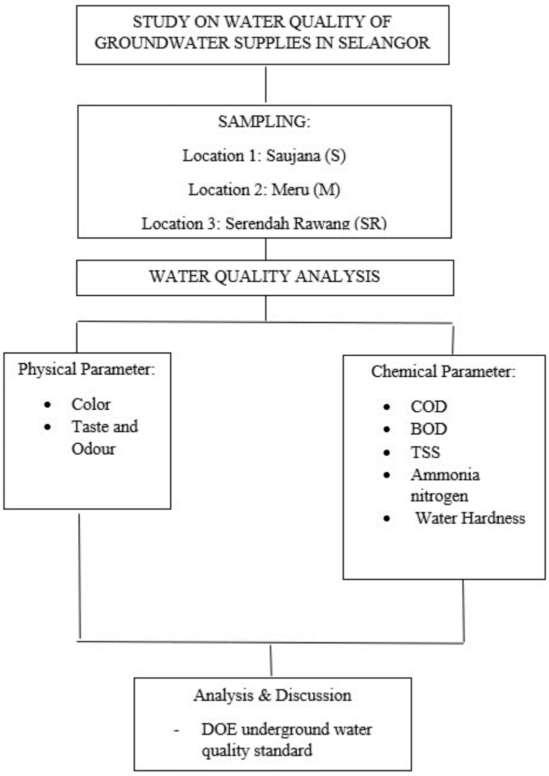


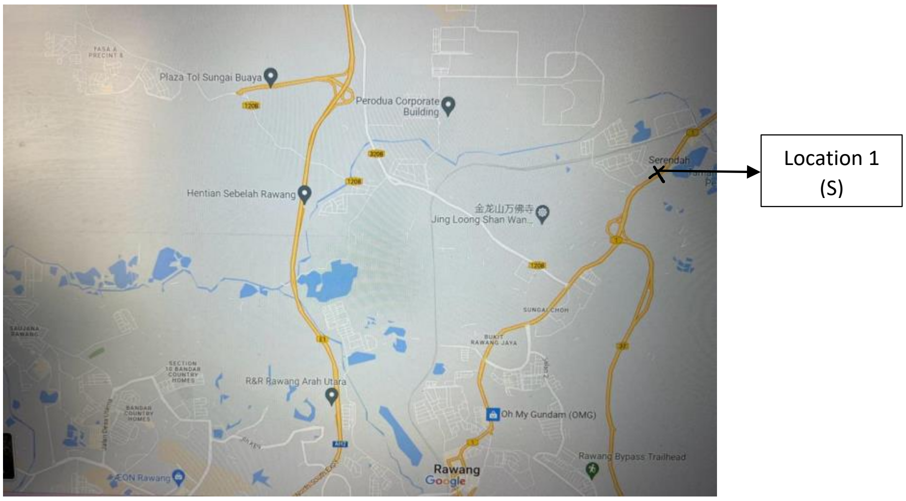
Fig. 1 *Research Methodology Flowchart*

2.1 Study Area

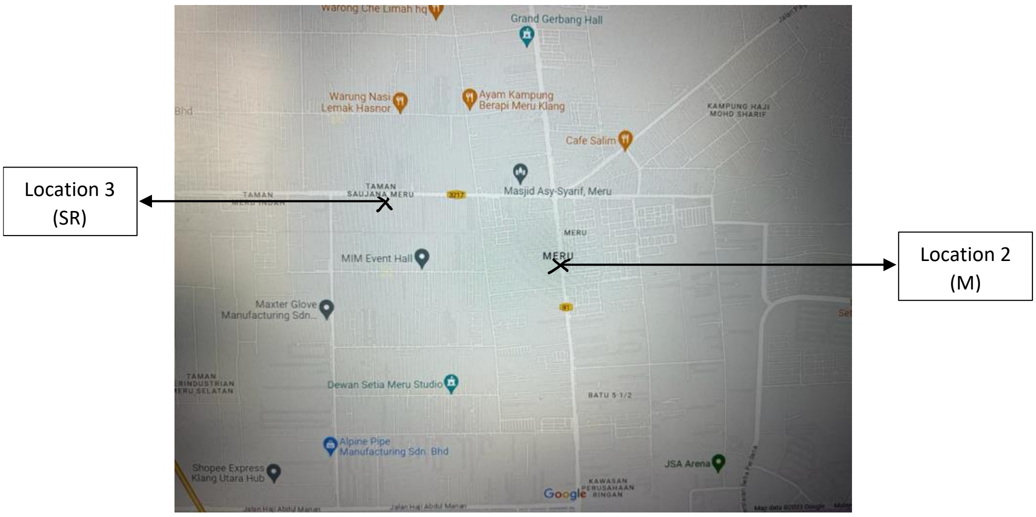
These three different locations are located in Selangor. The location is in different areas approximately 20 to 40km away from each location. Each location is surrounded by the housing area, forest, and rivers. In this study, the three samples were taken from the well of the housing area and from the hillside. Fig. 2 (a) & (b) show the exact location of these three sampling locations. The details of the research area as shown in Table 1.

Table 1 *Research area of the sampling locations*

Sample	Research Area	Coordinate	Description
Location 1	Saujana (S)	3° 9' 36.00"N 101° 28' 12.00"E	Hillside, forest
Location 2	Meru (M)	3° 07' 60.00" N 101° 25' 59.99" E	Farmer's garden, construction side, forest
Location 3	Serendah Rawang (SR)	3° 21' 52.56" N 101° 36' 14.76" E	Housing area, concentrated side



(a)



(b)

Fig. 2 *(a) Sampling Location 1 (S) at Serendah, (b) Sampling Location 2 (M) at Meru and Location 3 (SR) at Saujana Rawang*

3. Results and Discussion

Five tests were conducted using the sample of underground water from the three locations. From all the experiment were analyzed and discussed. Besides that, this chapter is to assess the quality of underground water by comparing with the DOE Underground Water Standard among the three different locations. There are two types of underground water standard based on the usage which are commercial use and industrial use. The results were analyzed and discusses based on the physical and chemical parameters only.

3.1 Chemical Parameter

3.1.1 Chemical Oxygen Demand (COD)

Fig. 3 shows COD reading of three different locations of underground water in Selangor. Based on the result that had obtained, it can be clarified that the result in location M is higher compared to other two location. Besides that, it can also be seen that location S is higher than commercial use and below than industrial use according to the standard of DOE compared to other two location. It is shown that the underground water in location M is located deep inside the ground at 50 feet and the water has been used for agriculture usage. Hence, it can be said that the water is contaminated by the fertiliser in the soil. Moreover, organic fertilisers release nitrates, potassium, and phosphates into the environment, polluting the water. Groundwater contamination occurs because of nitrate leaching. Heavy metals are prevalent in ground and surface waters, posing a threat to humans and animals [4] [5].

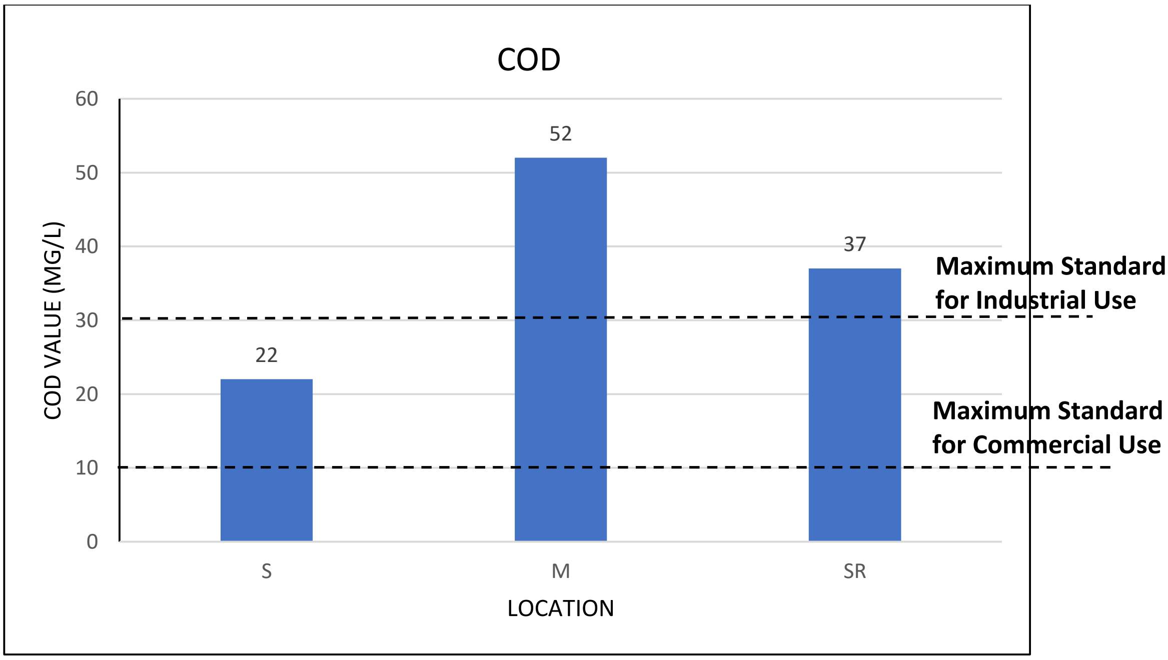


Fig. 3 *COD value of underground water*

3.1.2 Biochemical Oxygen Demand (BOD)

Fig. 4 shows the reading of BOD in each location from the test that have been conducted. Based on graph shown the value of BOD in location SR is higher compared to other two locations. Thus, the three location is higher than the limit of commercial use based on the DOE underground water standard. Factors may contribute of the high use of dissolve oxygen in underground water such as water temperature, the number of dissolved salts present in the water and atmospheric pressure. For this location, the underground water sample is not used for a long time, and it is kept close in an uncleaned well for years. The water is only used for daily purposes by the residents of that area, such as washing clothes, cleaning vehicles, and watering plants. Therefore, the BOD level is high because the underground water is contaminated by the dirt and moss of the well. It is because the dirt and moss of the well contains microorganisms which use oxygen in the process. The amount of oxygen by organisms lead to high in BOD.

Multidisciplinary Applied Research and Innovation Vol. 5 No. 1 (2024) p. 177-184

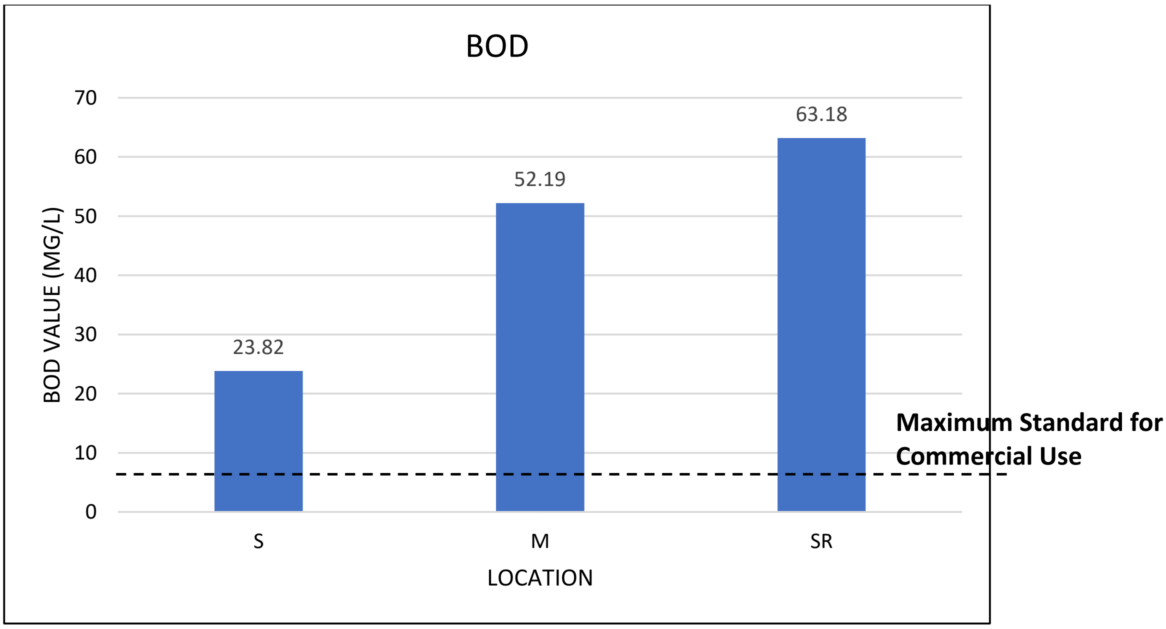


Fig. 4 *BOD value of underground water*

3.1.3 Ammonia Nitrogen (AN)

The results of Ammonia Nitrogen of three different location are shown in Fig. 5. From the results obtain, it indicates that the reading result in location M is higher compared to location S and location SR. In additional, the three location is stated below the commercial use which is 1.5. This means the three underground water sample can be used by the people for their daily usage. This is due to the surrounding of the location. Hence, the underground water in this location is located below the ground at 50 feet and it is mainly for farmers used. It used to showcase that high implication of Ammonia Nitrogen can cause severe effect to the living organisms like human being, flora, and fauna. Therefore, the underground water must be contaminated by the chemicals that contain high ammonia nitrogen of the fertiliser used and insecticide used by the famers.

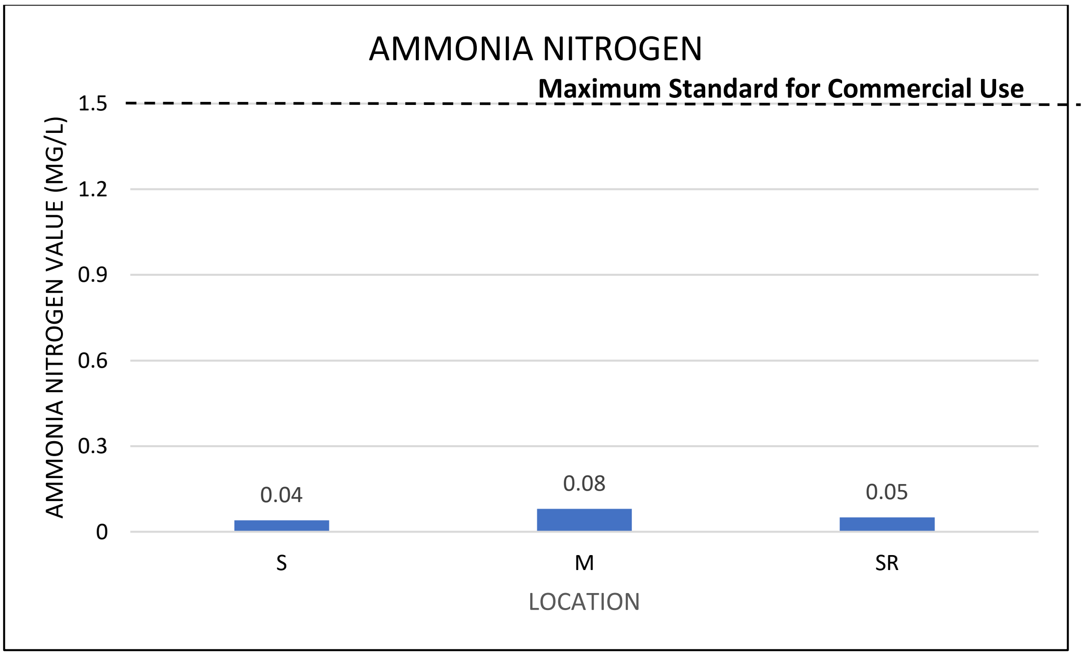


Fig. 5 *Results of Ammonia Nitrogen in three locations*

3.1.4 Total Suspended Solid (TSS)

The results of TSS of three different location is shown in Fig. 6. Based on the results, the reading of TSS in location S is higher compared to other two locations which is 6420mg/l. In the graph, it can also be seen that location S is higher compared to the commercial use limit stated by the standard DOE of underground water. This drastic result occurs due to the circumstance of the location. The underground water from that location flows from the hill to the PVC piped that have been installed by the people in that area. During the underground water flow from the hill, it soaks up the dirt on the ground and is carried along into the pipes that have not been cleaned in years. Therefore, there are high chances that the underground water in location S have high amount of TSS due to the contamination from the underground water flow sources.

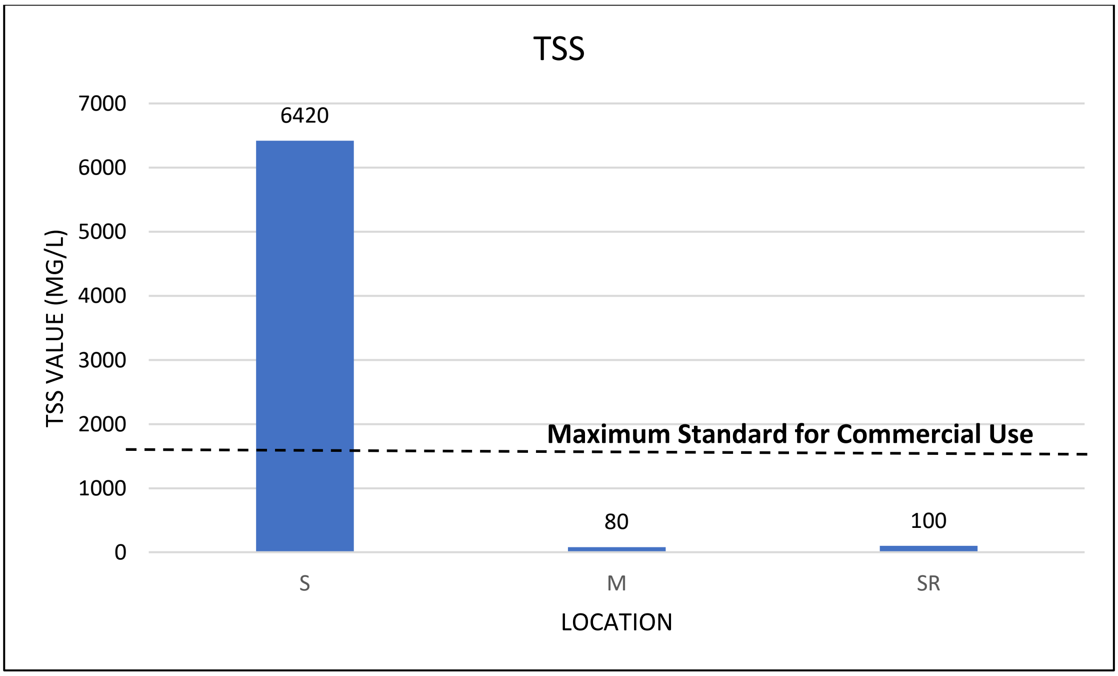


Fig. 6 *Results of TSS in three different locations*

3.1.5 Water Hardness

Based on the Figure 8, the results of water hardness of the three different locations are stated by testing the samples using test strips [6] which is shown in Figure 7, where it changes colour to indicate the water hardness of the underground water. The result of water hardness in location M and SR is higher compared to location S. This is because, the underground water of location M and SR are in the open well for many years. Hence, it can be contaminated with the surroundings for example fertilisers and intecide in location M whereas the unclean open well of location SR. Therefore, eventually the texture of underground water became hard.

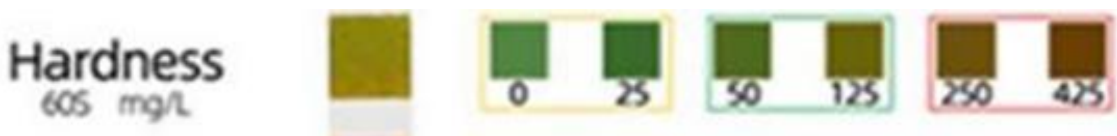
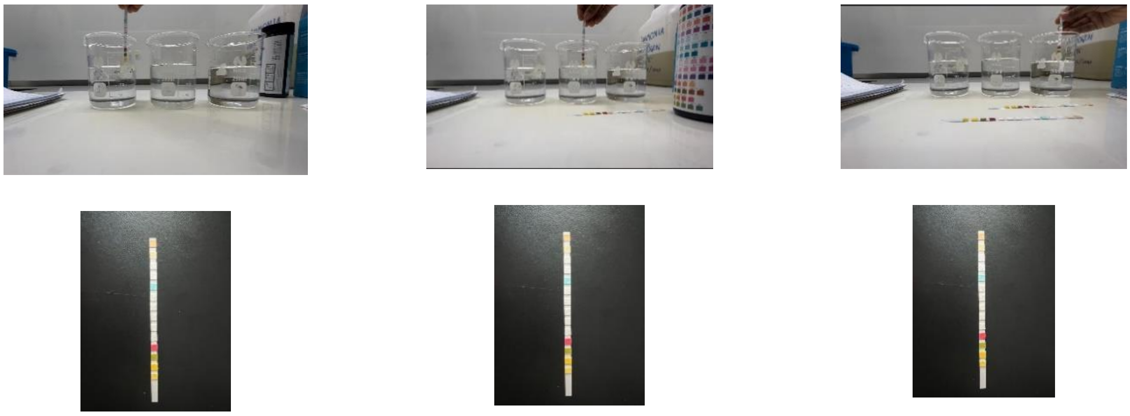


Fig. 7 *Water Hardness Indicator of the test strips*

Location S **Location M** **Location SR**



MEDIUM HIGH HIGH

Fig. 8 *Reading of Water Hardness in three different locations*

3.2 Physical Parameter (Taste, Odour and Color)

In Table 2, it shown that location S, the water taste & odour is described as medium (mild), indicating a moderately noticeable scent in the water. The water colour is noted as yellow-clear in location S and location SR, suggesting a light tint or no significant coloration in the water. For Location M, the water taste & odour is reported as high (strong), indicating a pronounced and distinct smell in the water. The water colour is stated as brown in location M, indicating a significant presence of colour-causing substances, resulting in a brownish hue.This is due to the high Chemical Oxygen Demand (COD) and Ammonia Nitrogen (AN) presence in the underground water sample. For Location SR, the water taste & odour is again described as medium (mild), suggesting a mildly noticeable scent in the water. The water colour is also noted as yellow-clear, indicating a similar light tint or no significant coloration as observed in Location S. These findings highlight variations in water odour and water colour among the different locations. Location M stands out with a strong water odour and a brown colour, potentially indicating a higher presence of organic matter or other contaminants. In contrast, Locations S and SR exhibit milder water odours and yellow-clear coloration, suggesting relatively better water quality in terms of odour and colour. By this, location M have higher amount of physical parameter compared to other two locations.

Table 2 *Data on water taste, odour and watercolor*

Locations	Water Taste & Odour	Water Colour
S	Medium (Mild)	Yellow-Clear
M	High (Strong)	Brown
SR	Medium (Mild)	Yellow-Clear

4. Conclusion

To put it in a nutshell, the aim of this study has been achieved. By conducting all the five-laboratory test, it can be concluded that the three underground water samples have its own characteristic of physical and chemical parameter as it is in different surroundings. For example, location S is high in TSS compared to other two location and exceed the standard DOE commercial use limit. Meanwhile, location M is high in COD and AN respectively where the reading of COD exceeds the limit of industrial use whereas the reading of AN is still below the commercial use limit. Besides that, location SR is high in BOD then location S and location M. Therefore, it can be showcase that each sample of underground water have its own good and bad quality, get to know the uses in daily routine when compared to the standard DOE underground water where the standard is essential to identify chemical and physical parameters that is obtain in the water not just underground water. Hence, it would also be beneficial to capture subjectively the knowledge and opinions of research partners who have had mixed or adverse experiences, as they may be less likely to volunteer to participate in studies of involvement in research like ours. Similarly, future research could investigate the (relatively unusual) experiences of disadvantaged and underrepresented communities involved in research.

Acknowledgement

We like to express our gratitude to the Department of Civil Engineering, Center for Diploma Studies, Universiti Tun Hussien Onn Malaysia for its constant support.

Conflict of Interest

The authors declare that there is no conflict of interests regarding the publication of the paper.

Author Contribution

The author confirms sole responsibility for the following: study conception and design, data collection, analysis and interpretation of results, and manuscript preparation.

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