COMPARISON OF AQUIFER CHARACTERISTICS IN THE PART OF CENTRAL DRY ZONE, MYANMAR

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Abstract

The study area, Mahlaing Township is located in the central dry zone of Myanmar. Historically this area has been hydrogeologically renowned for its high salinity, low groundwater yielding aquifers and low success rate in locating potable water suitable for irrigation and human consumption. Although this is the case in some of the fractured marine shale and fine sandstone aquifer of the Obogon and Kyaukkok Formations of Lower to Middle Miocene age. The study area is classified into two types of aquifer. There are Irrawaddian aquifer and Peguan aquifer. The recovery test shows that the transmissivity of the Irrawaddian aquifer is (89.47 m^2/day) in 4" diameter tube well and (2.8 m^2/day) in 6" diameter tube well of Peguan aquifer.

Keywords: aquifer, the transmissivity of the aquifer (KD) m^2/day, the constant well discharge (Q) m^3/day, drawdown difference (Δs) m, the residual drawdown (Δ s') m

Introduction

Water is essential commodity to mankind and the largest available sources of water lie in the underground. Extended irrigated lands, industrialization and increasing population will demand both underground and surface water. Adequate supplies of clean, safe fresh water are fundamental for human survival and well-being.

Location and Size

Mahlaing area is located near the northern extent of the Bego Yoma Anticlinorium. The majority of the ranges trend NNW-SSE in the direction of the strike of the rocks. The study area lies between North Latitude 20° 55′ to 21° 00′ and East Longitude 95° 25′ to 95°50′. It is bounded on the east by Wundwin Township, on the west by Taungtha and Kyaukpadaung Township, on the south by Meiktila Township and on the north by Ngwethoegyi Township. It is bounded by Taungtha range at the western part of the area. Generally, its length is about 20 miles from south to north and the width is about 24 miles from east to west. Roundly the whole area is approximately about 428.70 square miles. The location map of the study area is shown in Figure1.

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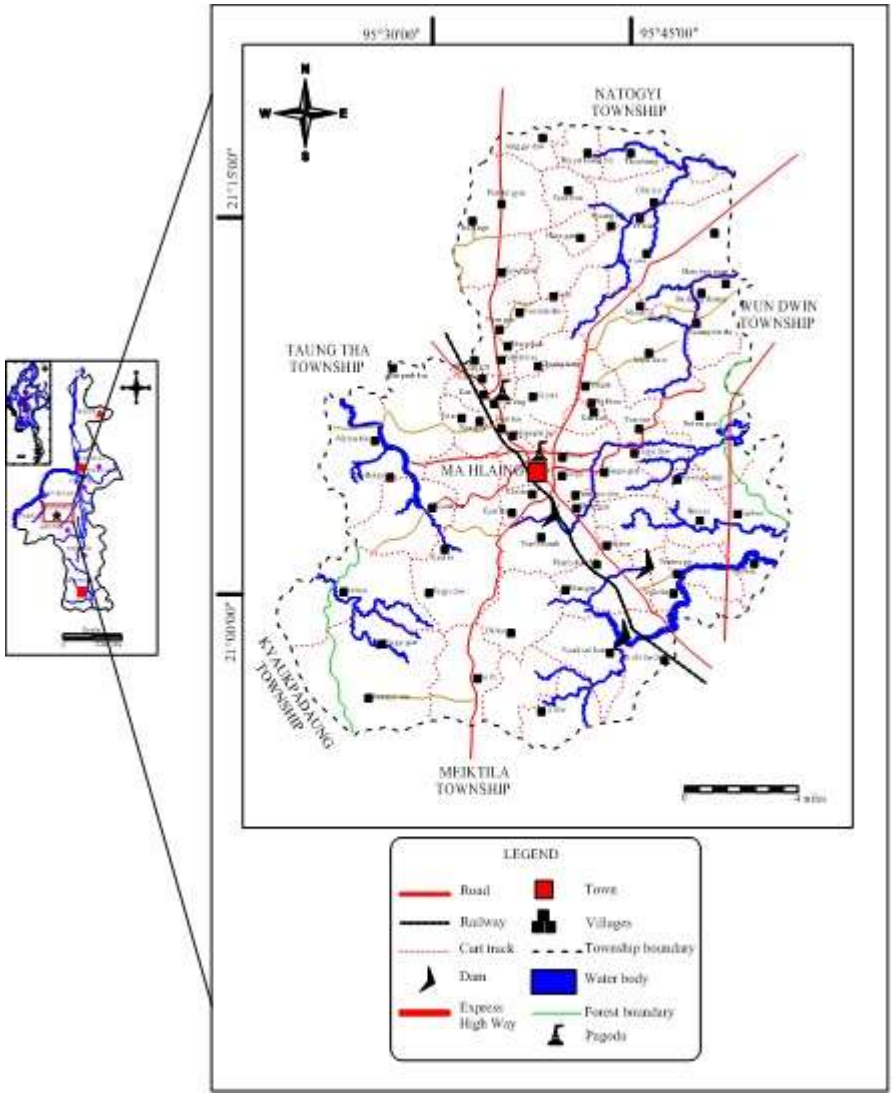


Figure 1. Location Map of Mahlaing Township

Materials and Methods

Types of Aquifer

On the basis of the data of the tube wells drilled by the Irrigation Department, in conjuction with the author's own investigation and hydrogeologic testing and the lithologic composition and stratigraphic position, the following aquifers are classified into two types.

- Groundwater in Irrawaddian Aquifer
- Groundwater in Peguan Aquifer

Groundwater in Irrawaddian Aquifer

The exposures of the Irrawaddian aquifer is found at the east and west of the study area. Depth of the Irrawaddian aquifer lying in eastern and western parts of the area is variable in place to place. Irrawaddian aquifers are found at the depth range from 180 ft to 260 ft below the surface of the study area. In the Irrawaddian aquifer sediments are composed of unconsolidated, distinguishable blue to bluish grey colored sand and gravel of various sizes with stiff blue silty clay and yellow to yellowish brown clay as a confining bed. However, blue clay is not always present

as confining bed at some places. The alternation of sand, gravel and thin clay layers are also found in some well logs.

Usually medium to coarse sand are found at the top of the aquifers. Gravel mixed with sand is found at the lower portion. Most of the aquifer materials are well rounded to sub-angular. Sand and gravel of the aquifer materials are quartz, chert, fragments of sandstone and quartizite.

Recharge to the Irrawaddy Formation aquifers occurs by direct rainfall on the permeable sandy soil, surface runoff along chaungs during the wet season or throughflow of saline water from the Pegu Group. The salinity of the groundwater in aquifers of the Irrawaddy Formation is quite variable and is largely dependent on its relative location to that of the Pegu Group. The discharge rate of the study area is 1314 gph for 4 inches diameter tube well. According to well log data, the water bearing horizon is at 180-260 ft depth.

Groundwater in Peguan Aquifer

The groundwater flow system within aquifers of both the Irrawaddy Formation and Pegu Group is complex. Due to their low hydraulic characteristics, the relatively impermeable marine shale of the Obogon Formation forms distinct hydrogeological boundaries throughout the area. This is especially so along the major anticlines. Flow is mainly from the anticlines to the Irrawaddy Formation located on the anticlinal flanks and thin the synclines. The exception appears to be the highly faulted region north of the Indaw Anticline, where groundwater flow is east through rocks of the Kyaukkok and Obogon Formations towards Thinbon Chaung. The rater of the rock and hydraulic gradient.

The Pegu Group rocks are highly fractured, especially along the anticlinal fold axis and fault systems. Recharge to the fractured aquifer systems of the Pegu Group occurs as rainfall and intermittent surface flow on rock outcrops. Discharge occurs as salt springs

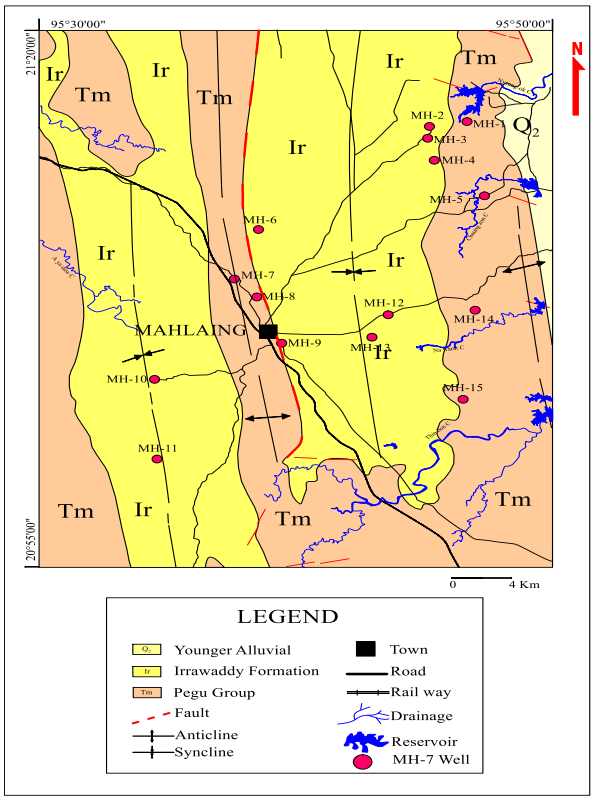
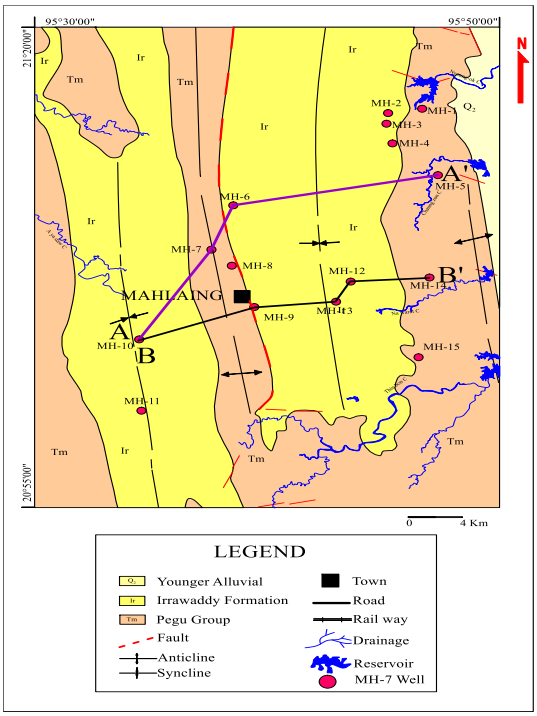


Figure 2. Map Showing Existing Tube-Well on the Geological Map of the study area

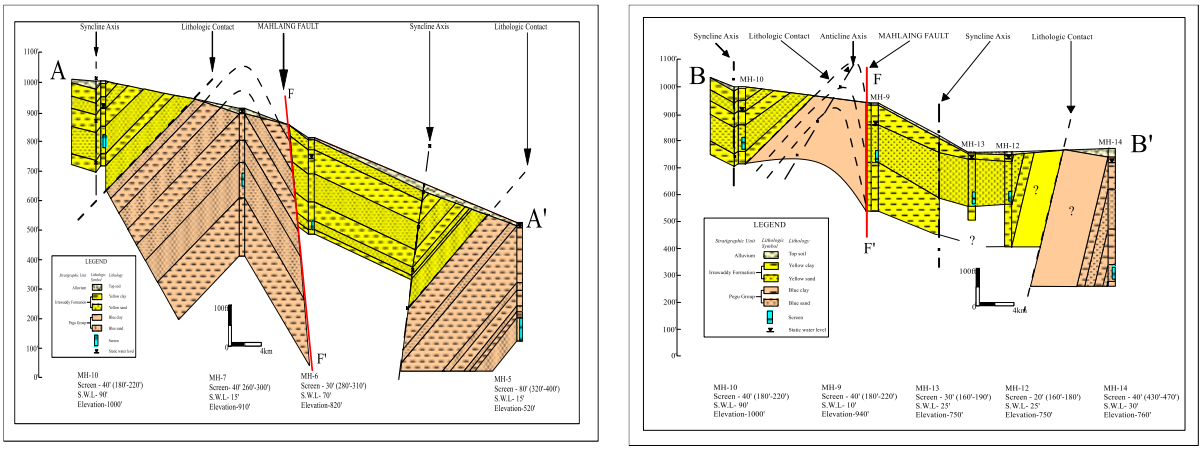
along fault lines, through flow into the more permeable aquifers of the Irrawaddy Formation and artificially from tube wells and dug wells. The elevation of aquifers in the Pegu Group is largely controlled by geological structure. It is located at the center of the study area. The lithology is noted as sandstone interbedded with blue shaly sand and clayey sand. Generally, the colors of the rocks are white, yellowish brown, greenish blue and blue. Thick bedded sandstone is usually interbedded with clay and shale. The discharge rate of the study area is 1998 gph for 6 inches diameter tube well. According to well log data, the water bearing horizon is at 455-485 ft depth. Static water level is at 50 ft depth.

Fence Diagram

Fence diagram of the study area shows that sand and clays are dipping towards the north and north-east (Figure 3).



Map showing line of cross-section in the study area



Hydrogeological Cross-section along (A-A') section and (B-B') section

Figure 3 Fence diagram of the study area

Results

Pumping Out Test in Mahlaing Area

Pumping out test is the measurement of discharge rate and drawdown that occur in a pumped well and also measuring the drawdown of the piezometers surrounding the pumped well in certain time during pumping of the well. This measurement indicates how much volume of water that store in the aquifer can be release and cone of depression at a certain time during pumping. Theis's measurements can show hydraulic characteristics of the aquifer of storativity and transmissivity after proper calculation.

Discharge rate of the well was measured by container method. In study area, pumping out test for 1 hours and 25 minutes and recovery test for 3 hours duration were performed at 4 inches diameter tube well in Irrawaddian aquifer at Yon Daw Village, Ma Hlaing Township, Fig. (4) and Fig (5).

Pumping Out test in Irrawaddian Aquifer

The Jacob's method (Copper and Jacob's), 1946 is based on the Theis's equation.

$$KD = (2.3\ Q) / (4\pi\Delta s) \text{ (Jacob's Straight Line Method)}$$

$Q = 217.92\ m^3/day$

$\Delta s = 0.3m$

$KD = 2.3Q/4\pi\Delta s = (2.3\times217.92)/ (4\times3.14\times0.3) = 501.22/3.77 = 118\ m^2/day$

The constant well discharge is 217.92 m^3/day and the drawdown difference is (0.45) m and the transmissivity of the aquifer is 118 m^2/day.

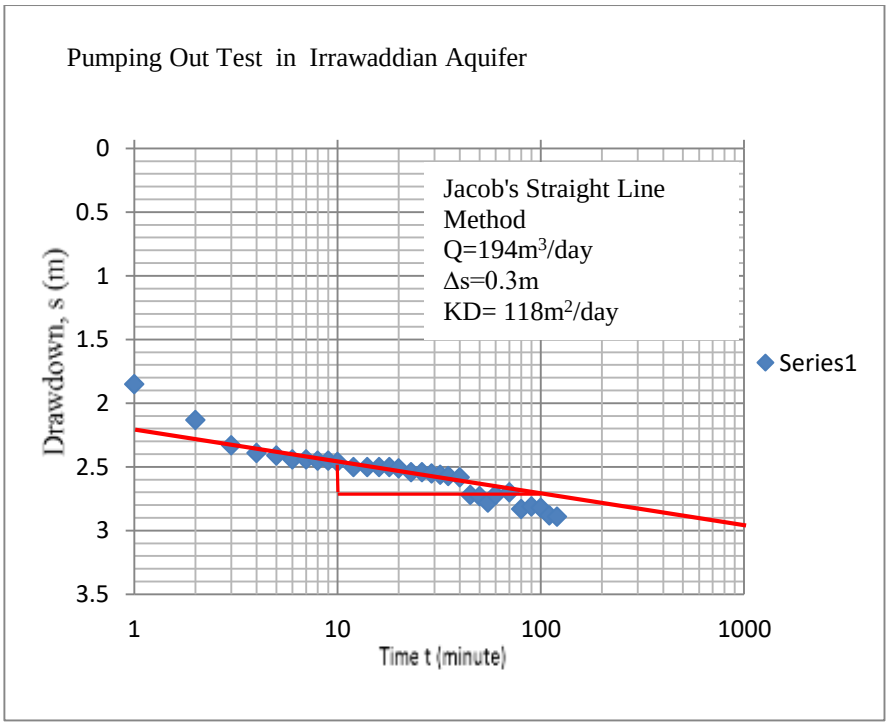


Figure 4. Pumping Out test in Irrawaddian Aquifer at Yon Daw Village

Recovery Test in Irrawaddian Aquifer

The objectives of the recovery test are to measure the residual drawdown, to calculate the transmissivity of the aquifer and check the result of pumping test data. Residual drawdown is the difference between the original water level before the start of pumping and water level measurement at a time after the cessation of pumping in a well.

Method of Recovery Test

Theis's recovery method is widely used for analysis of recovery test. Theis's recovery equation (1935) is described as follows:

$$KD = (2.3\ Q)/4\pi\Delta s' \text{ (Theis's Recovery Method)}$$

Q = 194.5 m3/day

Δ s' = 0.4 m

$KD = (2.3\ Q)/(4\pi\Delta s')$

$= (2.3\times194.5)/ (4\times3.14\times0.4)$

$= (447.35)/ (5.02) = 89.47\ m^2/day$

The constant well discharge is 194.5 m^3/day and the drawdown difference is (0.4) m and the transmissivity of the aquifer is 89.47 m2/day.

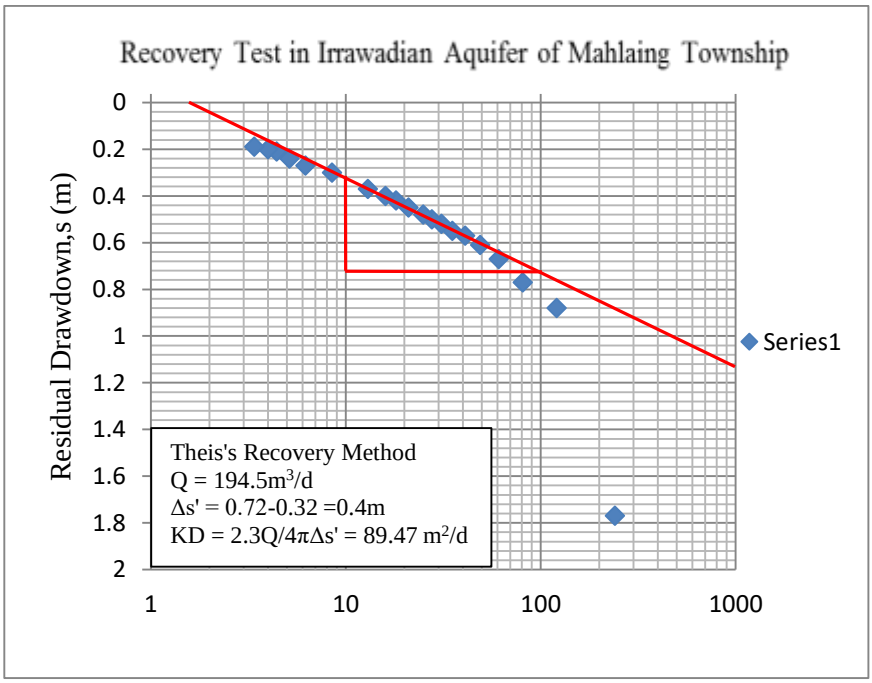


Figure 5. Recovery Test in Irrawaddian Aquifer at Yon Daw Village

Recovery Test in Peguan Aquifer

Unfortunately, piezometer was absent and only recovery analysis was done. The objectives of the recovery test are to measure the residual drawdown, to calculate the transmissivity of the aquifer and check the result of pumping test data. Residual drawdown is the difference between the original water level before the start of pumping and water level measurement at a time after the cessation of pumping in a well.

Discharge rate of the well was measured by container method. In study area, pumping out test for 1 hours and 25 minutes and recovery test for 3 hours duration were performed at 6 inches diameter tube well in Peguan aquifer at Kan Pyar quarter, Ma Hlaing Township, Fig. (6).

Method of Recovery Test

Theis's recovery method is widely used for analysis of recovery test. Theis's recovery equation (1935) is described as follows:

$$KD = (2.3\ Q)/4\pi\Delta s' \text{ (Theis's Recovery Method)}$$

Q = 217 m^3/day

Δ s' = 14 m

KD = (2.3 Q)/ (4πΔs')

= (2.3×217)/ (4×3.14×14)

= (499.1)/ (175.84) = 2.8 m^2/day

The constant well discharge is 217 m^3/day and the drawdown difference is (14) m and the transmissivity of the aquifer is 2.8 m^2/day.

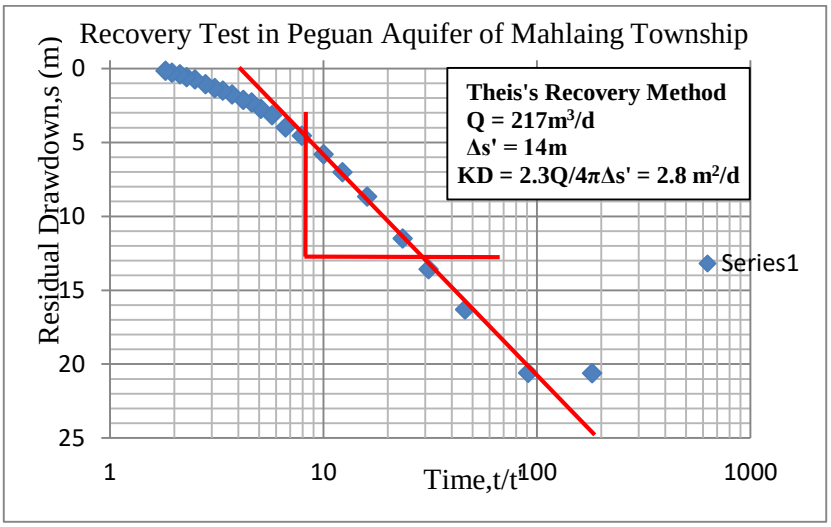


Figure 6. Recovery Test in Irrawaddian Aquifer at Kan Pyar quarter

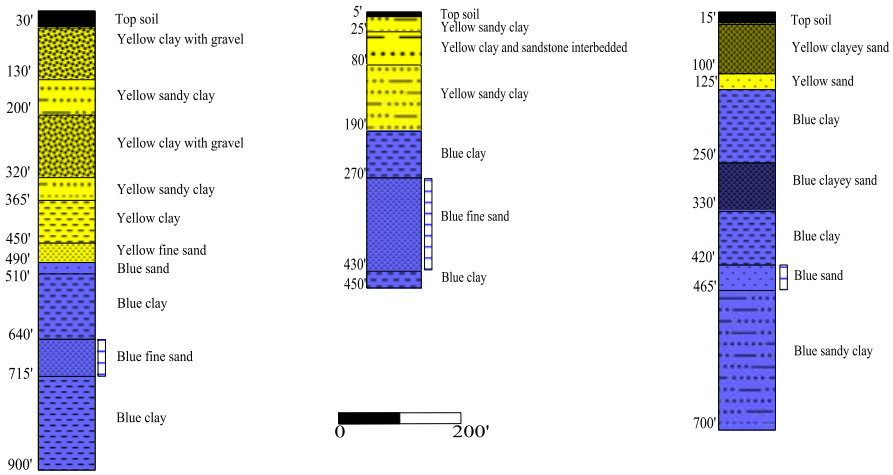


Figure 7. comparison of well logs data in the study area

Summary and conclusion

1. The study area is located in Mahlaing Township, Mandalay Region. It lies between North Latitude 20 55′00 "and 21˚ 00′00" and East Longitude 95˚ 25′00 " and 95˚ 50′00 ". It can be referred to 84 O/12, 13, 14, 15, 16 of one-inch topographic maps.
2. On the basis of lithologic character and stratigraphic position, the aquifer recognized in this area are classified generally into (2) major types such as, Irrawaddian Aquifer and Peguan Aquifer.
3. The Irrawaddian Aquifer are composed of unconsolidated blue to ash-grey coloured gravel and sand with thin blue silty clay layers are intercalation. Most of the aquifer materials are well rounded to sub-angular, medium to coarse sand and gravels. Irrawaddian aquifer is found at the depth range from 180 ft to 260 ft below the surface and it yields 1314 gph from 4" diameter tube well. Static water level is noted at 20.6 feet depth.
4. The Peguan aquifer is covered by yellow to brownish clayey soil. It is mainly composed of sandstone interbedded with shale. Water bearing layer of Peguan aquifer is very thin and about 20' to 30'. Peguan aquifer is found at the depth range from 455 ft to 485 ft below the surface and it yields 1998 gph from 6" diameter tube well. Static water level is noted at 21.83 feet depth.

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