

## INVESTIGATION OF GROUNDWATER QUALITY VARIATIONS ALONG WADI NAJRAN, NAJRAN, KINGDOM OF SAUDI ARABIA

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### **Abstract:-**

*This paper aims to determine the groundwater quality at Najran town and nearby villages, Kingdom of Saudi Arabia. Physical and chemical analyses have been carried out for seven groundwater samples collected from Najran area. This study indicates that the groundwater quality in the study area is fit for human purposes except at the Al Uraisa bore hole, which contain high amounts of total dissolved solids (TDS) and electrical conductivity (EC) above the permissible limits of the World Health Organization standards. The groundwater is also fit for irrigation purpose and agricultural use.*

**Keywords:-** *Groundwater, Wadi Najran, Saudi Arabia*

## INTRODUCTION:

Water is an essential resource for all life on the planet. Of the water resources on earth only three percent of it is fresh and two-thirds of the freshwater is locked up in ice caps and glaciers. At present only about 0.08 percent of all the world's fresh water is exploited by mankind in ever increasing demand for sanitation, drinking, manufacturing, leisure and agriculture (Fry, Carolyn, 2008).

Water is a ubiquitous chemical substance that is composed of hydrogen and oxygen and is vital for all known forms of life (UNOSIA, 2005). In typical usage, water refers only to its liquid form or state, but the substance also has a solid state, ice, and a gaseous state, water vapor or steam. Water covers 71% of the Earth's surface (FAO, 1997a).

The oceans hold 97% of surface water, glaciers and polar ice caps 2.4%, and other land surface water, such as rivers, lakes and ponds 0.6%. A very small amount of the Earth's water is contained within biological bodies and manufactured products (UNEP, 1988). There are many water related diseases caused by water pollution, which includes those diseases spread by insects that breed or feed near contaminated water, such as malaria, and dengue fever. These diseases are not typically associated with lack of access to clean drinking water or sanitation services, and they are not included here in estimates of water-related deaths. It must be noted, however, that their spread is often facilitated by the construction of large-scale water systems that create conditions favorable to their hosts. (NHMRC (2004).

## Location and Geological Setting:

The climate in Najran is desert climate. There is much less rainfall in winter than in summer. The driest month is June with 0 mm rainfall, and most precipitation falls in March with an average of 59 mm. About 133 mm of precipitation falls annually. The average annual temperature in Najran is 23.6°C. The warmest month of the year is July with an average temperature of 29.9°C. In January, the average temperature is 16.6°C. It is the lowest average temperature of the whole year (<http://www.climate.data.org>) [8].

Najran Town (the study area), lies in the southern part of the Kingdom of Saudi Arabia (Figure 1). The study area is surrounded by many outcrops of different geological formation and contains different minerals with wide chemical composition and crystal structures which mainly characterize the acidic igneous rocks such as feldspars, biotite, micas and quartz. They are mainly metamorphosed pre Cambrian igneous rocks. Najran area which lies in the south western part of Saudi Arabia, lies within the area of the Great African Rift valley with its simple and complex fault zones which have different trends. The faults have trends north east to south west, or north west to south east. original name (with diacritics) is Najran. Najran is located in Saudi Arabia, its geographical coordinates are 17°30'20" North, 44°11'3" East and its Najran is located in the southwest corner of Saudi Arabia, close to the Yemeni border. It is one of the Kingdom's most modern cities and is also the capital city of Najran province. Najran town is surrounded by orchards and trees, and encircled by outcrops of metamorphosed pre-cambrian rocks.

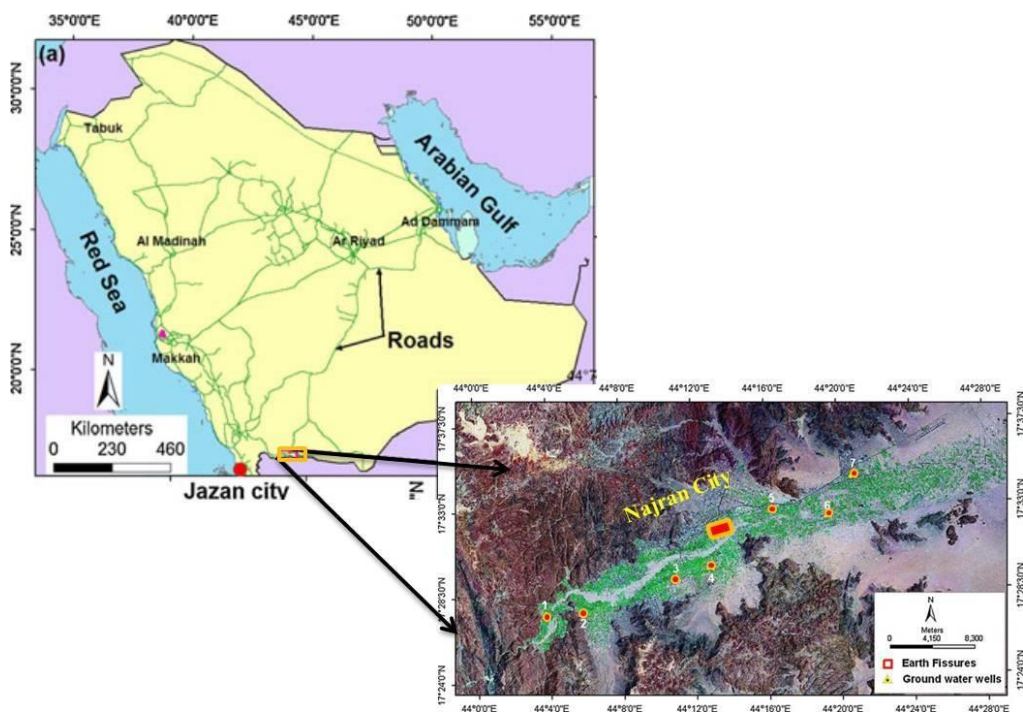


Figure 1: Location of the study area

From the field observation and satellite images (Fig. 2a) the study area can be divided into three geomorphological units: (1) high-mountain areas surrounding the region (Fig. 2b), (2) flood plain areas along the wadi (Fig. 2c), and (3) sandy dunes along the borders of the Empty Quarter (Fig. 2d). The highest point in the Empty Quarter region is 2,897 m above sea level. The rocks in the Najran area belong to the Proterozoic (Precambrian) era and consist of igneous rocks, as well as some stratified rocks of the Wajid sandstone of Cambrian– Ordovician age, and occasional Tertiary bedrock (Sable 1985; Shanti 1993).

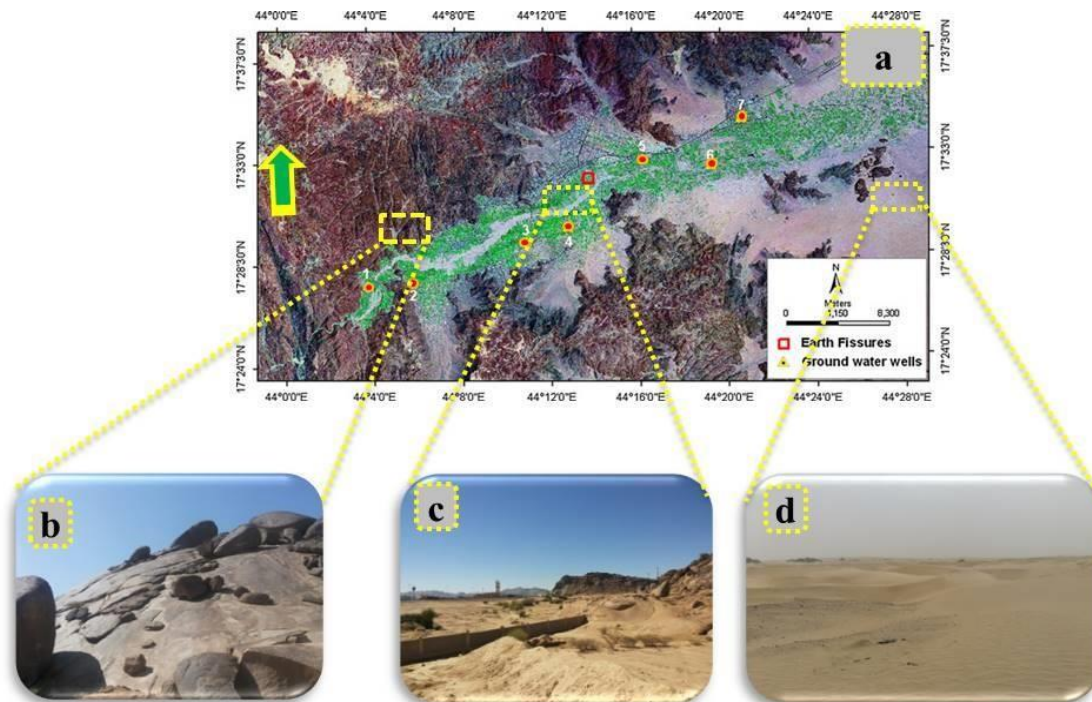


Fig. (2): 2 a, b, c, and d, the geomorphological units along WadiNajran

### Materials and Methods

The groundwater samples were collected in 1-litre polyethylene plastic bottles from the different bore holes examined in the study area. The available productive bore holes in the study area were chosen. The physical parameters contain the pH measured with HANA pH meter, model Hi 8424, turbidity was measured with Lovibond turbidity meter, electrical conductivity and total dissolved solids were measured using Conductivity-TDS-Salinity meter (850,038), The cations and other chemical parameters in the study area comprise, ammonia (NH<sub>3</sub>), total hardness, Ca hardness, Mg hardness, iron (Fe), and total alkalinity have been analyzed using OPTIMA spectrophotometer model SP-3000 plus. The anions nitrite (NO<sub>2</sub>), nitrates (NO<sub>3</sub>), chlorides (Cl), and fluoride (F), were determined by titrimetric methods using the relevant reagent. Sulfates (SO<sub>4</sub>), was carried out following turbidity method using spectrophotometer.

### Results and Discussion

The physical parameters studied and analyzed in the area surveyed (Table 1), comprise the following: Hydrogen ion concentration (pH), total dissolved solids (TDS), electrical conductivity (EC) and Turbidity. Tables 1 shows the results of physical parameters for water samples collected from bore holes. Table 2 shows the results of chemical parameters.

Table 1: Results of physical parameters of groundwater collected from boreholes from WadiNajran

NO.	LOCALITY (BOREHOLE)	PH	TDS (MG/L)	EC(μS/CM)	TURBIDITY (NTU)
1	AL SAD	8.0	375	751	0.7
2	AL JURBA	7.8	302	604	0.2
3	AL GABIL	8.3	296	592	0.4
4	AL WADI	8.2	305	610	0.1
5	AL URAISA	8.0	1310	2620	0.34

Table 2: Results of chemical parameters of groundwater collected from boreholes from WadiNajran

NO.	LOCALITY (BOREHOLE)	NH <sub>3</sub>	NO <sub>2</sub>	NO <sub>3</sub>	CL	SO <sub>4</sub>	TOTAL HARDNESS	CA HARDNESS	MG HARDNESS	FE	F	TAL K
1	AL SAD	0.07	0.006	5.0	94.6	47	223	200	23	0.0	0.02	-
2	AL JURBA	0.2	0.009	10.6	26.6	38	216	180	36	0.0	0.0	122
3	AL GABIL	0.04	0.007	11.5	37	34.7	200	180	20	0.0	0.03	140
4	AL WADI	0.06	0.012	17.8	33.6	42	205	190	15	0.0	-	136
5	AL URAISA	0.3	0.017	98.7	288	216	1112	900	212	0.03	0.04	140

## Conclusion and Recommendations

From the work done during the period of this study carried out for the investigation of groundwater quality variations collected from bore holes along WadiNajran, the following can be concluded:

\*The groundwater quality in the studied area along WadiNajran, is fit for drinking and other domestic uses as compared with the international drinking water standards except the water sample collected from Al Uraisa bore hole.

\*The results of chemical investigation and analysis carried out in the study area, showed that iron (Fe) was not detected in the study area except in trace amounts at Al Uraisa bore hole. Also trace amounts of fluoride and ammonia were detected in the study area.

\*The unfitness of groundwater in the study area was reported at Al Uraisa bore hole because the groundwater contain high levels of nitrates, chlorides, sulfates and total hardness.

\* It was recommended that more detailed analysis should be done in far eastern side of WadiNajran to assure groundwater unfitness in this area.

## References:

- [1].FAO, 1997a. FAO (1997). Chemical analysis manual for food and water; 5th Ed, food and agriculture organization, Rome 1:20 – 26. (Peter H. Gleick 2002).
- [2].UNOSIA, 2005 .Water for life the United Nations office to support the International Decade for Action 2005 – 2015 / UN. [http://www.org/water for life decade/background.html](http://www.org/water%20for%20life%20decade/background.html).
- [3].Fry, Carolyn (2008). The Impact of Climate Change: The World's Greatest Challenge in the Twenty-first Century, New Holland Publishers Ltd.
- [4].NHMRC (2004). Australian drinking water guidelines. National health and medical research council. Australian government.
- [5].Sable, E.G. (1985) Explanation notes on the geologic map of the Najran quadrangle Sheet 17G, Kingdom of Saudi Arabia.
- [6].Shanti, A.M. (1993) Geology of the Arabian Shield.
- [7].UNEP, 2002 UNEP (1988). Assessment of freshwater quality, UNEP, Nairobi, Kenya.
- [8].Youssef, A.M, Sabtan, A.A., Maerz, N.H. and Zabramawi, Y.A., (2013) Earth Fissures in WadiNajran, Kingdom of Saudi Arabia. Nat. Hazards. Doi: 10.1007/s11069-013-0991-5