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Assessment of some physical and chemical properties of the groundwater and its suitability for drinking and irrigation for the wells of Um Anij farms in Al-Zubair district

Basrah Governorate - southern Iraq

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Abstract:

The current study was conducted on 7 wells selected in the district of Al-Zubayr from Umm Anij farms to show some physical and chemical properties and the concentrations of nutritious salts of nitrate, nitrite, phosphates and silica in ground water. The results obtained for groundwater temperatures were almost equal between wells, with rates ranging between 22- 24 C°. For chloride ion, the highest rate was in well (W7), reaching to 6812 mg / l, and the lowest rate in well (W5), which was 2599 mg / l. As for electrical conductivity, the highest rate was found in the well (W7)reached to 8.540 mS/ cm ,and the lowest rate in well(W5) was 4.933 mS / cm ,the highest rate of total dissolved solids was recorded in the well (W7)8976 mg / l and the lowest rate in the well(W5) 3923 mg / l the results showed that the highest rate of pH reached to 8.78 in (W7) well, and the lowest rate was 7.21 in well (W5), As for the turbidity, the highest rate reached to 8.790 NTU in well(W7), and the lowest was 2.303 NTU in well (W5) proportion to the values of nutrients, the nitrite values ranged as the highest value was 0.932 µg / l in well (W3),and the lowest value was 0.094 µg / l in well (W1), and the highest concentration of nitrate reached to 28.299 µg / l in well (W3),and the lowest value reached to 4.959 µg / l in well (W1). As for phosphates, the highest value reached to 1.089 µg / l for well (W3) and the lowest value was 0.879 µg / l for well (W2), and the resuits showed that the highest value of silica reached to value 72.254 µg / l in well (W3), while the lowest value was 55.700 µg / l. Well (W1) during the study period. Well water was within the permissible limits for drinking and irrigation in proportion to nitrate and nitrite values, and the concentrations of chloride ions, electrical conductivity and total dissolved solids in the study wells did not match the standard specifications of drinking and irrigation water

Key words: Ground water - nutrient salts –physical and chemical properties

Introduction:

Al-Zubair district inAl- Basrah governorate is considered one of the agricultural cities that produce many agricultural crops, especially tomatoes, cucumbers, eggplant, watermelons, and others. In previous studies

that it was considered safe water for agricultural purposes, the steady expansion of agriculture and the increase in consumption of groundwater led to a decrease in the water level as well as a change in the quality of water, especially with the continued increasing pumping operations [1]. Recent studies have shown a general tendency to decrease in storage. Groundwater during recent years as a result of the irrigation pattern used and the increase in the number of wells exploited in the area, which leads to the with drawal of large quantities of water storage, and thus increased the depth of the groundwater, which leads to the deterioration of the groundwater quality due to the rise of saline water for this groundwater in the regions Central and southern Iraq are salty and suitable for cultivation only in some areas ,and for certain crops, as in the district of Al Zubair, where the soil has high permeability [2], and the accumulation of nitrates in the soil and its transfer from the soil to the water is also one of the problems resulting from the irrational interference of humans in the use of fertilizers [3], which leads to their high rates above the permissible limits. The deterioration of the quality of that water, and in recent years there has been an increasing interest in studying nitrate levels in soil, water and plants and their accumulation in vegetables as a result of nitrate being returned to nitrite, which affects human and animal health [4]. Nutrient salts are naturally present in all water environments and are concentrated in particular in artesian wells in agricultural areas, in order to use chemical and organic fertilizers, which leads to washing them from the soil by falling rain and consequently storing them naturally with ground water. Toxic effects of these salts may occur, especially the problem of water pollution with nitrates that It reaches groundwater through penetration into the soil or sewage water, or through industry and waste disposal, or when reclaiming land [5], and agricultural fields in southern Iraq use groundwater by 90% depending on artesian wells whose depths range from 20-30 m In Al- Zubair, Safwan and Al-Barjisia [1], and that the quality of water, which includes its physical, chemical and biological properties, is one of the basic aspects in determining the validity of water, so many countries of the world have tended to set specific standards for water, evaluate and classify it [6], and with a decrease in the groundwater level by about 1 meter, the quality of water it depends on the purpose for which it will be used, and that very groundwater is required and important in this region from an agricultural point of view, so its evaluation is required. [7]. To demonstrate the validity of the water of the selected wells, some physical and chemical characteristics were studied and evaluated the concentrations of the main nutrient salts of groundwater for seven wells from Umm Anij farms in Al-Zubair district. The study wells within this part of the Al-Zubair district, because of the importance of groundwater in general, and the study area in particular, through its impact on the economic and social life of the region.

Aims of the study:

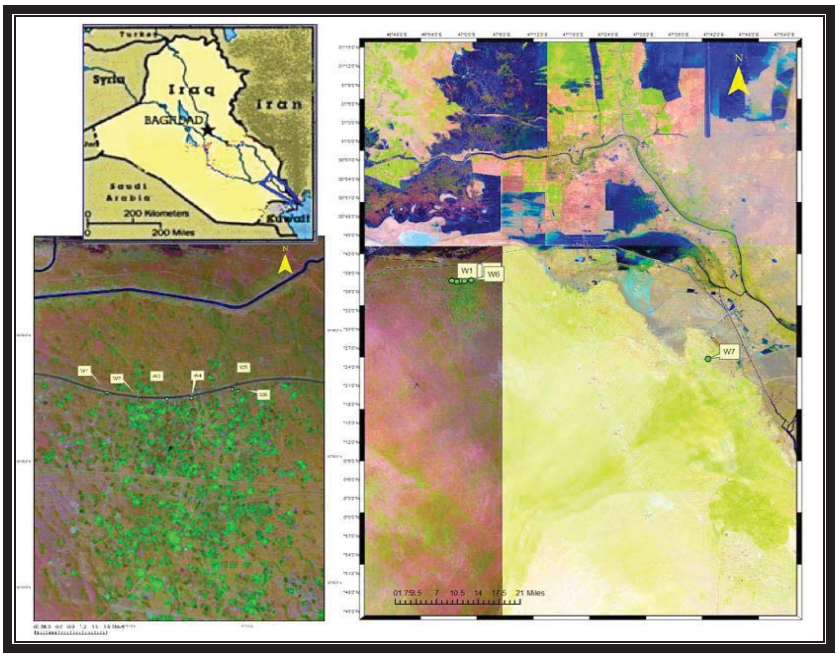
The presnt study aims to assess the quality of groundwater in Umm Anij farms through :

1- Study of its physical and chemical properties.
2- Estimating the concentrations of the nutrients, in its.
3- Determining its validity and conformity with Iraqi and international standards

Site and nature of the study area:

The study area is a flat and very sloping plain towards the northeast, located in Al- Zubair, Al-Basrah governorate, southern Iraq, and the studied aquifer is located within the formation of the Ice Age-Pliocene

Dibba and has a large extension over large areas in the south and central Iraq, and it consists of sand and sandy gravel with layers Secondary and lenses made of silty and sandy clay, and the main body of the aquifer includes lenses from clay stones of different thicknesses and a large variation in physical and chemical properties [8] and Figure No. (1) shows the detailed location of each of the study wells in addition to Table No. (1) It shows the



Figure(1) Location map shows the study area (Department of Marine Environmental Chemistry- Marine Sciences Center- University of Basra).

Table (1) Studied well depths

Well No.	Well depth (m)
W1	28
W2	26
W3	22
W4	23
W5	22
W6	22
W7	26

Materials and methods:

Samples were collected from 7 wells from Umm Anij farms in Al-Zubair district, Figure (1) by 3 replicates per well per month for the year 2019, and the annual rate of results was taken and a period of time around an hour was adopted after the start of the water withdrawal by the pump. Physical and chemical properties according to the standard methods of the American Public Health Association [9]. A set of environmental characteristics were determined in the field immediately after calibrating all devices with standard solutions before use, including water temperature, pH, electrical conductivity and Total dissolved solids (TDS) . The

water temperature was measured, directly in the field using 0.1-100 ˚m graduated mercury thermometer, the pH was measured using a pH meter, the electrical conductivity of the water were measured with an EC meter the results were expressed in mS/cm.The total dissolved solids were measured using a TDS meter, and the results were expressed in mg / l, and water turbidity was measured using a measuring device Nephelometric Turbidity Unit the results were reported in NTU and chloride volume by correction method with silver nitrate $AgNO_3$,and by using potassium chromate index K_2CrO_4, according to the method shown in [10] .The concentration of the nutrient salts was determined in a laboratory ,where the samples were placed in plastic containers of 1.5 liters and chloroform was added as a preservative in the laboratory. After filtering the samples, nitrates were estimated using a column of cadmium to reduce nitrates to nitrite and then measured with an optical absorption spectrophotometer at a wavelength of 453 nanometers, nitrite at a wavelength of 543 nanometers, and phosphates. at 885 nm and silicates at 810 nm [11].

Statistics Analysis:

I used the ready-made statistical software Special Package for Social Science (SPSS) to analyze the data statistically at a probability level $P < 0.05$ and extracted the value of Standard Deviation.

Results and discussion:

Physical and chemical properties: -

The mean values of the physical and chemical variables recorded in this study are included in Table (2)The table shows the concentration rates of the physical and chemical properties of the seven wells water studied in Um- Anij farms .The temperature of the water was very close between the wells during the study season, where the highest temperature was in the wells W3 and W6 and reached to 24 C°, and the lowest degree was in the wells (W1-W2-W7) as it reached to 22 C°, so this water was classified within the warm water because it exceeds a temperature of 18 C°, as the temperature of the groundwater depends on the depth of its bearing layer, its geographical width, and the source and origin of this water [12] ,and the temperature values matched the water of the study wells Standards specifications for Iraqi drinking water, [13] ,and international [14], [15], [16] proposed drinking water of 15-35 C°.

Table (2) Average annual concentration of the physical and chemical properties of the studied well water during the study period.

Well NO.	Annual rate					
	temperature (c°)	Cl mg/l	EC ms/cm	Total dissolved solids (TDS) mg/l	pH	Turbidity NTU
W1	22	4900	5.882	6432	7.92	3.987
W2	22	6111	7.030	7791	8.33	6.943
W3	24	6631	7.940	8032	8.51	7.224
W4	22.5	4987	5.941	6977	7.99	4.901
W5	23	2599	4.933	3923	7.21	2.303
W6	24	5970	6.913	7000	8.10	5.998
W7	22	6812	8.540	8976	8.78	8.790

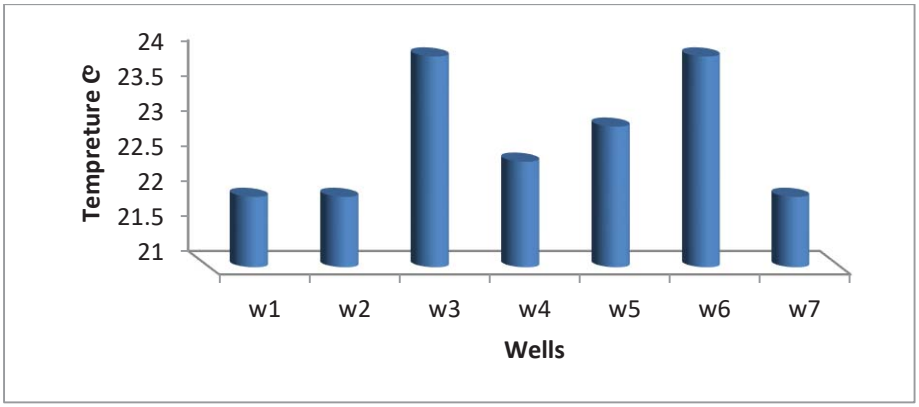


Figure (2) Temperature values (c°) in the study wells.

The chloride ion had the highest concentration of 6812 mg / l to irrigate well W7 and the lowest value of 2599 mg / l in well w5. The high concentration of chloride ion was due to the presence of evaporation deposits containing sodium chloride, and the process of evaporation and washed salts from the soil [17]. Another source of chloride in groundwater is ancient marine waters within sediments [18], and air masses containing NaCl particles may be transported internally, and leave the salt in another mechanism by washing when it rains [19]. The wells of the current study exceeded the permissible values in (Iraqi drinking water standards, [13], and the global [14, [15], [16] proposed for drinking water of 250 mg / L.

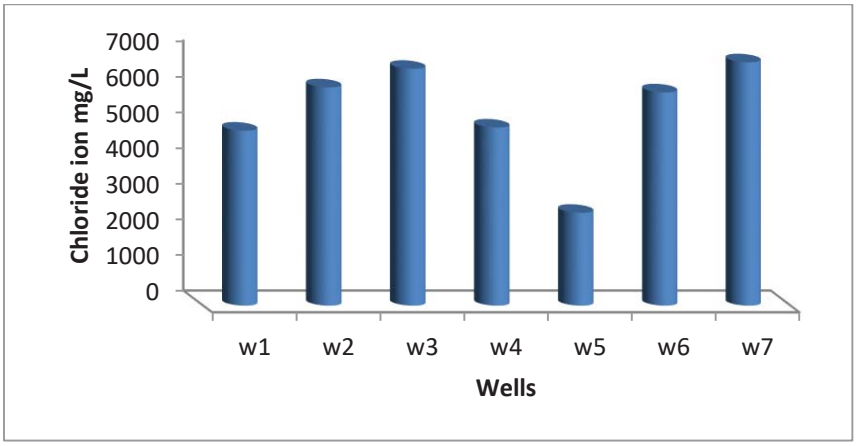


Fig. (3) Annually mean values of chloride ion concentrations (mg / l) in the study wells.

The results of in electrical conductivity the current study indicate that the highest value was recorded at 8.540 mS / cm in well W7, and the lowest value was 4.933 mS / cm in well W5. 0.01 r = 0.921, conductivity and chloride ion r = 0.930, P <0.01 and in the

study of Labar Al-Zubair it was classified as unsuitable for human consumption depending on the values of electrical conductivity, dissolved salts and chloride ion [20], and may be due to the difference in the geological formations of the regions as they depend on the type of rocks and soils that are in contact with [21], the results of the current study exceeded the permissible limits of 1600 microsmins / cm in (Iraqi drinking water standards [13], and [14], [15], [16].

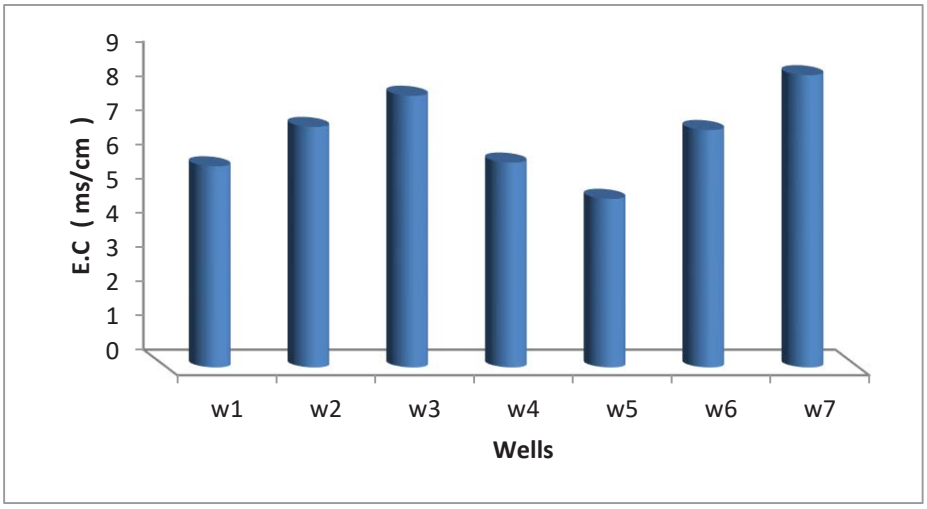


Fig.(4) Annual mean values of electrical conductivity concentrations (mS / cm) in the study wells.

The highest value of Total Dissolved Solids (TDS) reached to 8976 mg / l in well W7, and the lowest value reached to 3923 mg / l in well W5. The study wells were classified as high salinity, the water is suitable for plants tolerant of salinity on permeable soil, and high values. The dissolved salts in the water of the studied wells may be the result of their exposure to drainage water discards from agricultural lands, as the drainage water increases the natural salts of the water and the washing of the soil by the falling rain and consequently its drift ,and stored naturally with the groundwater [22], or the reason may be due to soil washing operations The salinity that is carried out during the winter and spring seasons with rainwater and

which is washed with salt from the neighboring lands [23]. The results of the current study exceeded the permissible limits of 1000-430 mg / L In (Iraqi drinking water standards, [13]), and [14],[15],[16].

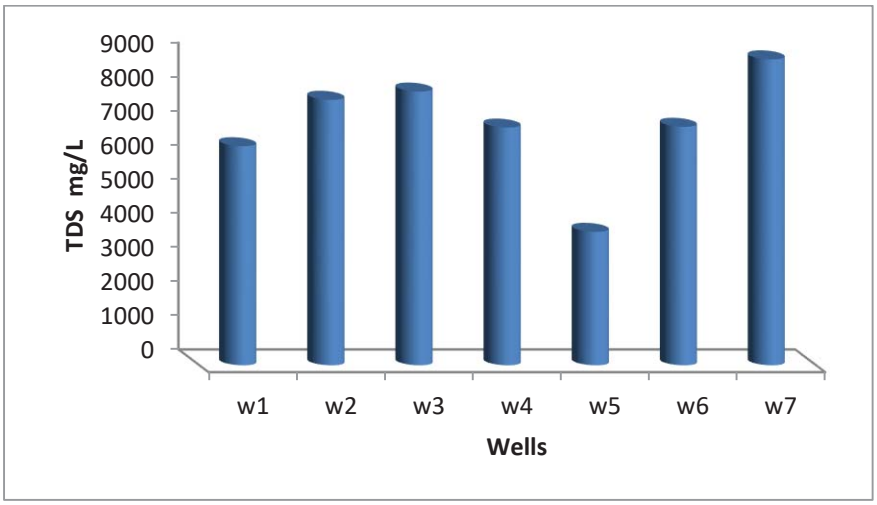


Figure (5) Annual mean values of Total dissolved solids (mg / l) in the study wells.

The highest value of pH reached to 8.78 in well W7. The lowest value reached to 7.21in well W5, Carbon dioxide in the water, and this increase can be explained on the basis of the amount of dissolved salts as the increase in water salts then increases its acidic function and thus it is basic and the results showed that the concentrations pH was accompanied by an increase in the amount of salts, and this is in accordance with the study [20]. This is confirmed by the results of the statistical analysis of the existence of a positive significant correlation between the pH and salinity at a probability level ($P < 0.01$). The pH results of the study wells matched the standard specifications ranging from (8.5-6.5). In (Iraqi drinking water standards, [13], and [14],[15],[16].

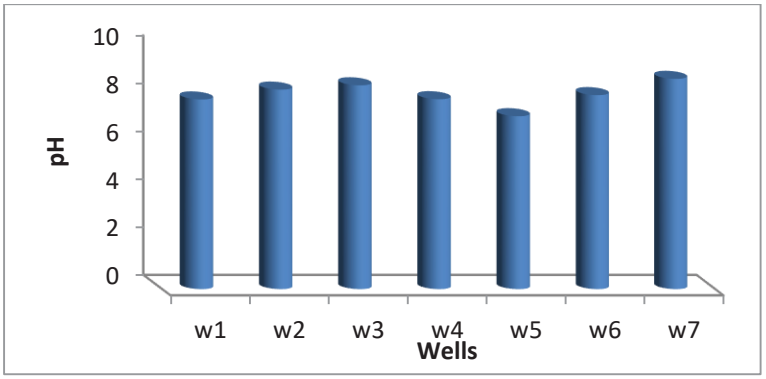


Figure (6) Annual mean values of pH concentrations in the study wells.

Turbidity The results of the current study recorded values that ranged between the highest value in well W7, which was 8.790 NTU, and the lowest value of 2.303 NTU in well W5. In the wells of the study, it is due to the fact that the groundwater is relatively stagnant [24].

relatively stagnant [24]. The turbidity of the groundwater is mainly caused by the mud, silt and other particles entering the well from the water-bearing rock formations. [25] that the study wells conformed to the standard specifications for drinking water from Iraq, [13], and refer [14],[15],[16] proposed and reported > 10 NTU.

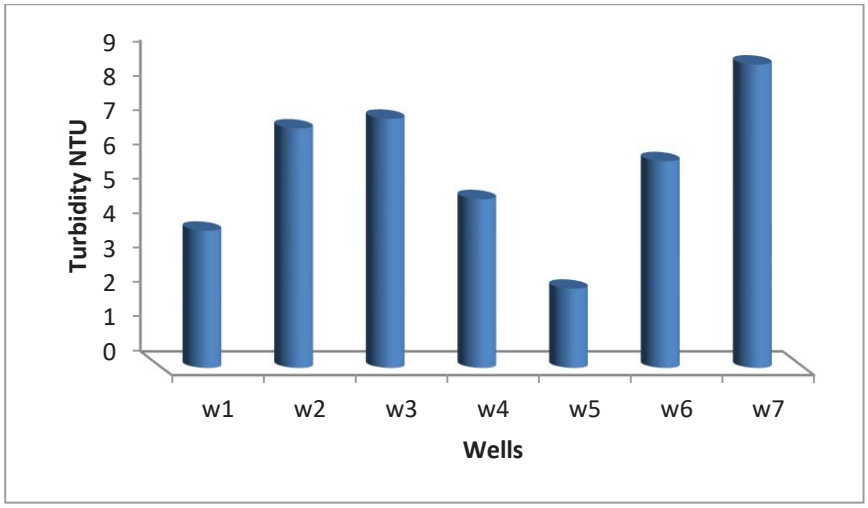


Figure (7) Annual mean values of (NTU) in the study wells.

Nutrient salts

From a note of the results of Table (3): -

Nitrite the results of the current study showed that its highest rate was in well W3, which reached to 0.932 µg /l , and the lowest value was 0.094 µg /l in well W1. The majority of the current study wells matched the nitrate concentrations with the standard specifications for Iraqi, [13] ,and international drinking water [14],[15],[16] amounting to 1-3 µg / l As shown in the figure(8)

Table (3) Average annual concentration of nutrients in the studied wells during the study period

Well NO.	annual rate			
	No_2^- µg /L	No_3^- µg /L	Po_4^{-3} µg /L	Sio_4 µg /L
W1	0.094	4.959	0.924	55.700
W2	0.801	15.988	0.879	67.971
W3	0.932	28.299	1.089	72.254
W4	0.199	6.929	0.991	61.810
W5	0.900	22.900	1.041	70.032
W6	0.60	20.765	1.011	69.973
W7	0.832	18.979	0.997	68.801

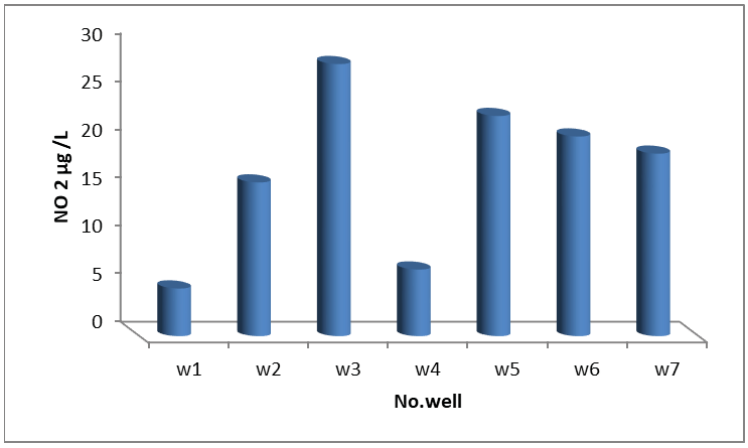


Figure (8) Annual mean values of nitrite concentrations (mg / l) in the study wells.

Nitrates recorded their highest value in well W3, where it reached to 28.299 µg /l, and the lowest value was in Well W1, it reached to 4.959 µg /l as the study wells were in conformity with the standard specifications of Iraqi drinking water [13], and international [14],[15],[16] and amounting to 50-10 µg /**L**, with a slight rise in one of the wells, which is well W3, and the reason for this is that most of these fields are located in agricultural fields where nitrogen fertilizers are used, as well as because of less rain in recent years, which leads to The decay of groundwater reserves and their low levels [22].

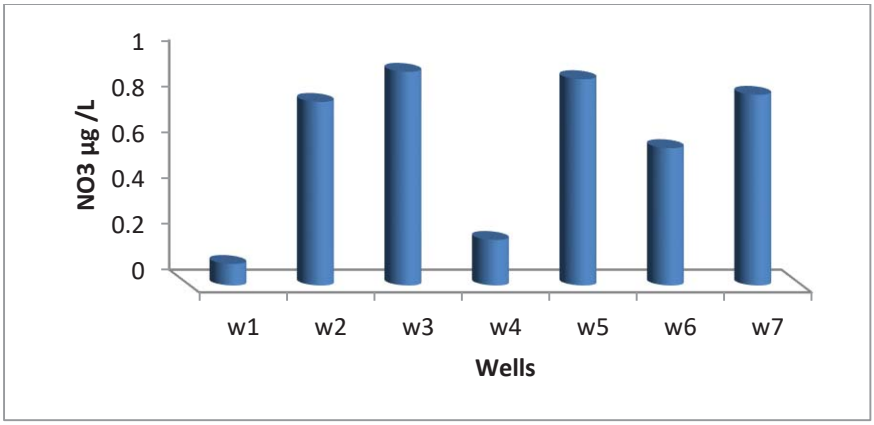


Figure (9) Annual mean values of nitrate concentrations (µg /l)in the study wells.

Effective phosphates the results of the current study were its highest value in well W3, reaching to 1.089 µg /l and the lowest value obtained in well W2 0.879 µg /l. The results showed an increase in the concentration of effective phosphates, which is due to agricultural activities, the use of fertilizers rich in phosphorous elements, and to excessive irrigation and seepage into wells the study wells did not match the standards for drinking water in Iraq, [13], and the world [14], [15], [16] proposed for drinking water of 0.4 µg /L.

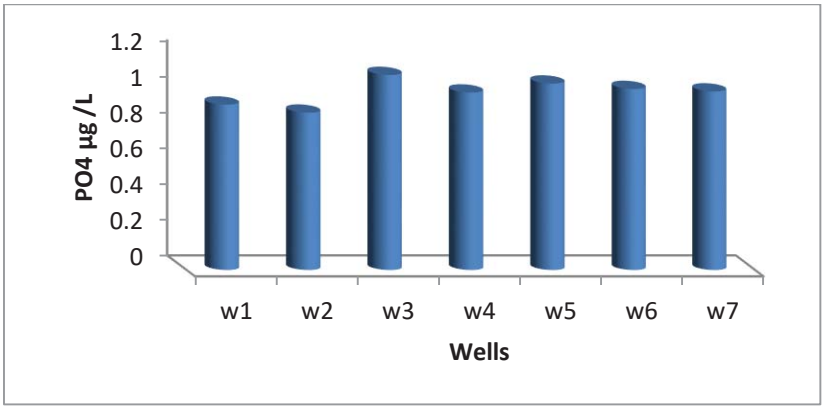


Figure (10) Annual mean values of phosphate concentrations (µg /l) in the study wells.

Silica the results of the current study showed that the highest value of silica reached to W3, 72.254 µg /l, and the lowest value in W1 well as it was 55.700 µg /l. It has been observed that the high silica material in the study wells may be attributed to the process of dissolving some silicate rocks during recharge of the groundwater, so that the silica comes from the soil of the neighboring wells. From 50-80% of the sources of silica in the soil, the concentrations of silica increased in their waters [26] .No proposed determinants of the maximum permissible limits for the concentration of silica in the water used for drinking from [15], but the limits proposed for drinking by [14],[16] range from 1-30 mg / l The results show that the study wells do not match the suggested limits.

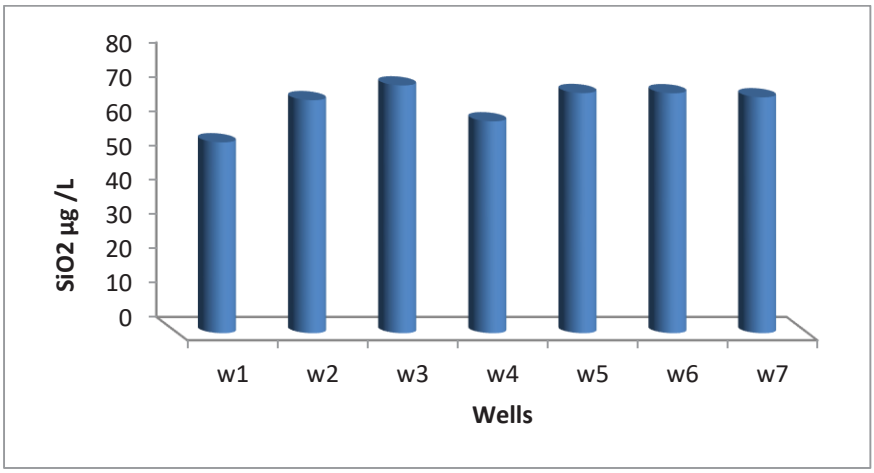


Figure (11) Annual mean values of silica concentrations (µg /l) in the study wells

Conclusions:

The results of the nutrient salts (silica and phosphate) were high in wells during the study period. The water wells were within the permissible limits for drinking and watering in proportion to the values of nitrates and nitrites during the study period and the concentrations of chloride ions, electrical conductivity and total dissolved solids in the study wells did not match the standard specifications for drinking and irrigation water.

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