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# Qualitative Evaluation of Water for a Number of Wells in Taza / Kirkuk District for Drinking and Human Use

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***Abstract:*** ***This study is considered descriptive and experimental in order to verify the quality and quality of the wells in the Taza / Kirkuk area for drinking and uses for different humanity, where the sports model (NFSWQI) used in this study, as the samples were collected from three wells randomly selected for a period of six months starting in October. For the year 2023 until the month of March 2024 in order to update the properties of the water of those wells within the studied area, periodic tests were conducted for a number of specific factors such as water temperature, umbrella, hydrogen or oxygen, and the vital requirement of oxygen, phosphate ions and nitrates as well as soluble solids and the total number of bacteria The stool colon, the results of the descriptive study showed that the NFSWQI Index for all well water samples within the Medium Quality, which is equivalent to 100 %of the total wells in order to overcome some factors of Iraqi and international standards such as the World Health Organization, and this does not prevent the use of water These wells are considered water suitable for human use and human use after adding some sterilizers such as chlorine in appropriate quantities.***

***Keywords:*** ***Taza Wells, Water Quality Index, NSFWQI, Physical Properties, Chemical Properties, Biological Properties.***

## 1. INTRODUCTION

Water is the basis for the continuation and existence of life on our planet Earth, and it represents an irreplaceable element from all neighborhoods. The quality of qualitative water is one of the most important factors that are taken into consideration when the water is

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evaluated, as water enters into the formation and building of living cells with rates of up to (75- (95 % of The vibrant block of the cells of the cells as well as the human composition of the human body animals and plants, and many vital processes are only done by the presence of water such as digestion, absorption and metabolism [1], and drinking water has several sections of standards and determinants such as physical, chemical and biological characteristics, physical characteristics represented With the degree of temperature, dirt, color, taste, smell, and chemical properties represented by hydrogen, hardness, hardship and unwanted elements, while biological includes bacterial and viral neighborhoods [2]. Global studies and research have shown that water in the ground is one of the important water resources and constitutes 71.7% of the water used for drinking, drinking water and human use include groundwater, springs and lakes, which are derived from rainwater falling [3] groundwater represents 96%) % of the freshwater resource, which is an important source of drinking water and human use [4]. Water should be healthy and unpopular, home drainage water contains many microorganisms such as viruses, bacteria and parasites carrying many diseases, unpleasant and polluted water negatively affects the balance of the vital surroundings of the Earth, causing harm to humans [5]. Water issues on the other hand are one of the necessary and important pillars for the national security of the country, especially in the dry and arid regions, and Iraq is one of the countries that depend in its water resources from the countries adjacent to it, so the scarcity and shortage of water may turn into political and economic problems with the source countries [6]. Therefore, it requires the collection of accurate information about this water and relying on modern technology to determine the quality of water for drinking and watering livestock to maintain the health of the human public through the use of simplified statistical methods to assess the quality and quality of water such as the use of the sports model (NFSWQI) for the qualitative evaluation of the ground and superficial water for drinking, It depends on collecting important information about water, its characteristics and quality in different periods of time and different locations [7] .

## 2. RELATED WORKS

[8] Indicated in their qualitative studies to assess the quality of the groundwater for drinking and multiple human uses in terms of the NFSWQI in the north and east of Kirkuk. [9] Indicated the evaluation of the specific properties of water such as physical, chemical and bacteriology of the water of a number of wells in the district of Daquq / Kirkuk, which showed that most of the water water is suitable for human consumption. While they pointed out [10] in their study of the physical, chemical and biological properties of the water of a number of wells in the district of Daquq / Kirkuk, which showed the results of the study that all well water is suitable for human consumption to comply with the standards of the World Health Organization and Iraq.

## 3. METHODOLOGY

### Study Area

The experimental descriptive study was conducted in the Taza / Kirkuk district to assess the quality and quality of water for three wells randomly, the depths of wells ranged between

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(150-80) m with a closed nozzle and classified wells in the deep category, and the random choice of wells in the experimental study area came to assess the quality and quality of water Which is characterized by a lack of information and scientific research on the quality of the groundwater of the region, especially since most of the dots residents depend on well water for drinking, human uses, watering animals and poultry.

**Models Collection**

The process of collecting the elected models of well water water in the morning from three random wells within the Taza / Kirkuk area and for once a month starting from the month of October 2023 to the month of March 2024, I used cleaning (uterene) bottles and washed with the water of the well three times before it is filled with water The well and at the lowest airflow to measure physical and chemical properties; The well pump operates for 10 minutes to get rid of calcification, pollutants, impurities and stagnant water [11]. For biological characteristics tests, narrow-mouthed bottles with glass metal were used, the capacity of the bottle is up to (200-250) ml, these bottles were sterilized before each use by the sterilization device closed for 15 minutes and at a temperature of 121 ° C under pressure (1.5) pounds / ang, well water samples are transported by a dark cork container and cooled with pieces of ice at a degree (4-6) ° C until they reach the laboratory and complete the vital tests directly [12].

Table 1 Specifications of wells under experimental study.

| No. | well code | Location | Depth | water pumping diameter | well sheathing | well age | Use |
|---|---|---|---|---|---|---|---|
| 1 | W1 | Aleibada | 80 | 4 | 8 | 10 | Multiple |
| 2 | W2 | Askari | 60 | 4 | 8 | 7 | Multiple |
| 3 | W3 | Chirdaglu | 150 | 4 | 8 | 20 | Multiple |

**Water Quality Index**

To determine the groundwater quality and quality index in the study area, using the mathematical model (NFS-WQI), the number of parameters necessary in the research was determined (pH, dissolved total solids, total hardness, dissolved oxygen, sulfates, phosphates, nitrates and fecal coliform bacteria) [13] (NFS-WQI) was calculated by applying the following equation:

NSFWQI $\sum_{i=0}^{n} QiWi$

Wi : represents the relative importance of the trait as shown in table 2 [14].

Qi: Represents the quality of each parameter, which gets its value from the final rate of each parameter and then compares the rate value with special curves, which range between (100-0) [15] .

Table 2 shows the relative weight of the trait used for each parameter to calculate (NFSWQI) [16].

| Parameter | Weight |
|---|---|
| T( C°) | 0.1 |

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| | |
|---|---|
| PH | 0.11 |
| DO | 0.17 |
| BOD | 0.11 |
| TDS | 0.01 |
| $PO_4$ | 0.1 |
| $NO_3$ | 0.1 |
| Turb | 0.08 |
| F.C | 0.16 |
| Total | 1.00 |

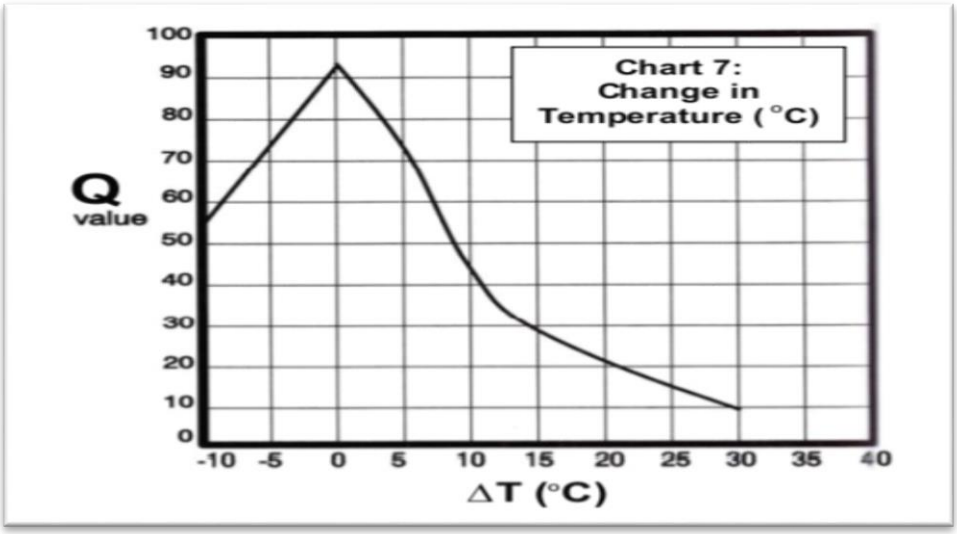


Fig. 1 The relationship between the quality of Qi and temperature.

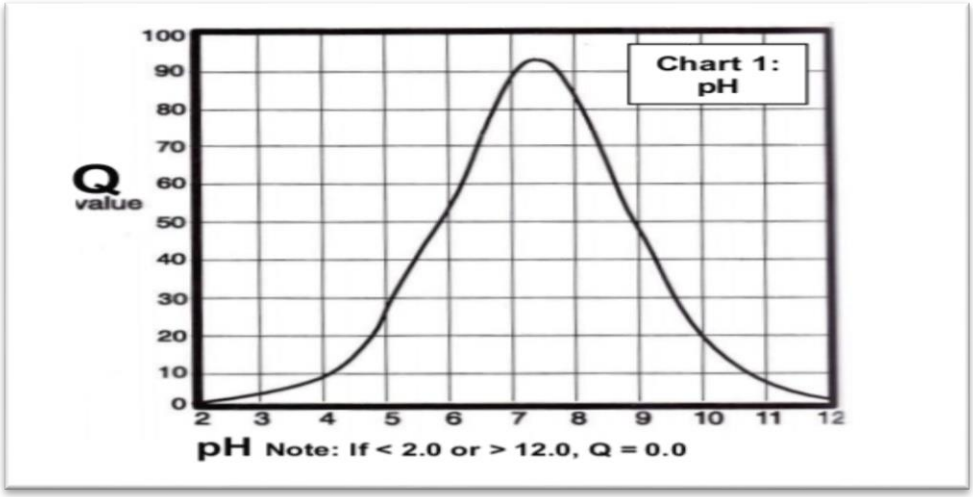


Fig. 2 The relationship between quality of Qi and pH.

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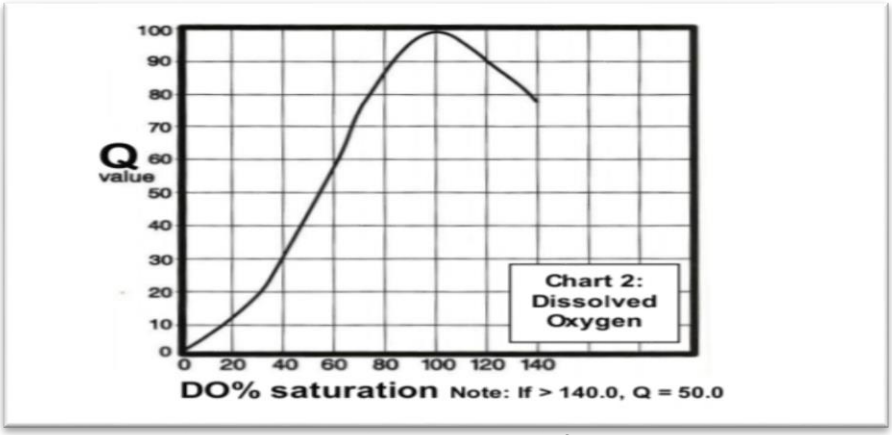


Fig. 3 The relationship between the quality of Qi and dissolved oxygen.

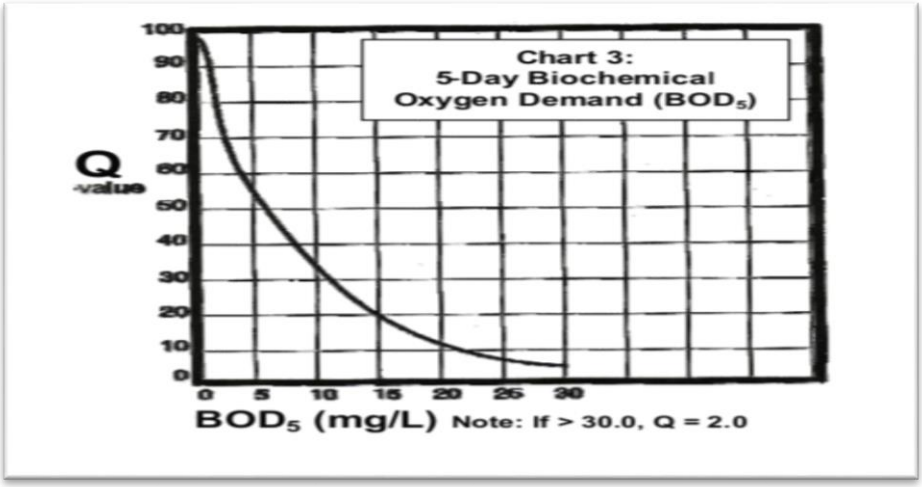


Fig. 4 The relationship between the quality of Qi and the biological requirement of oxygen.

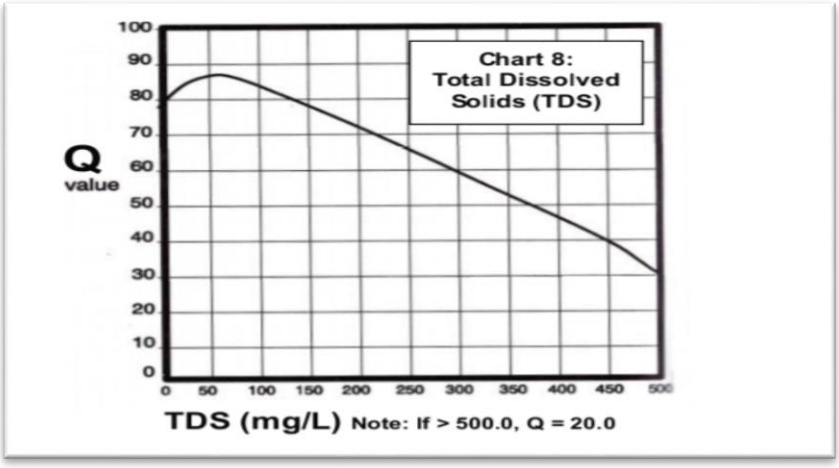


Fig. 5 The relationship between the quality of Qi and dissolved solids.

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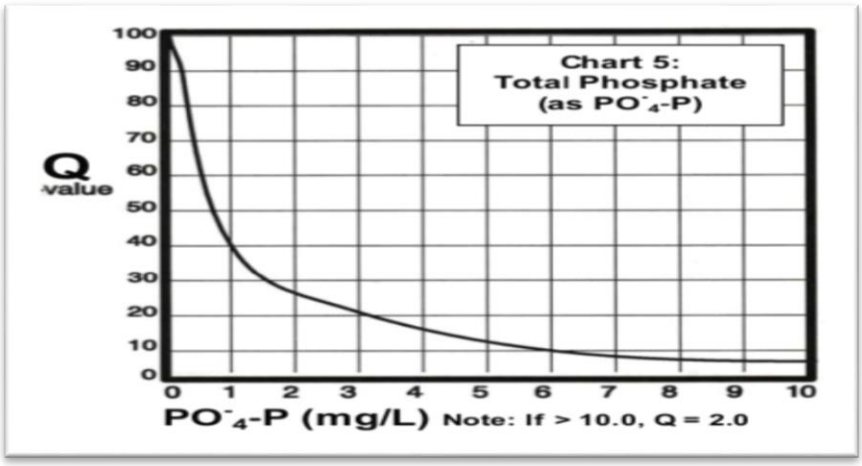


Fig. 6 The relationship between the quality of characteristic Qi and phosphate.

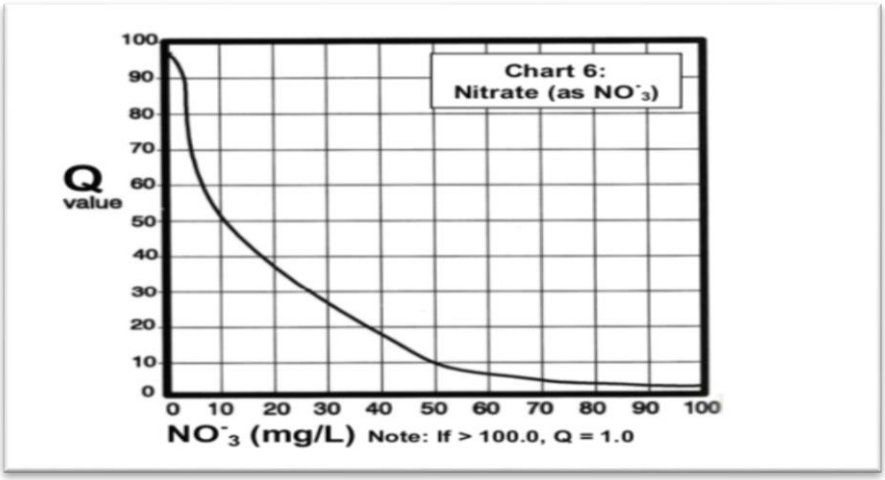


Fig. 7 The relationship between the quality of the characteristic Qi and nitrates.

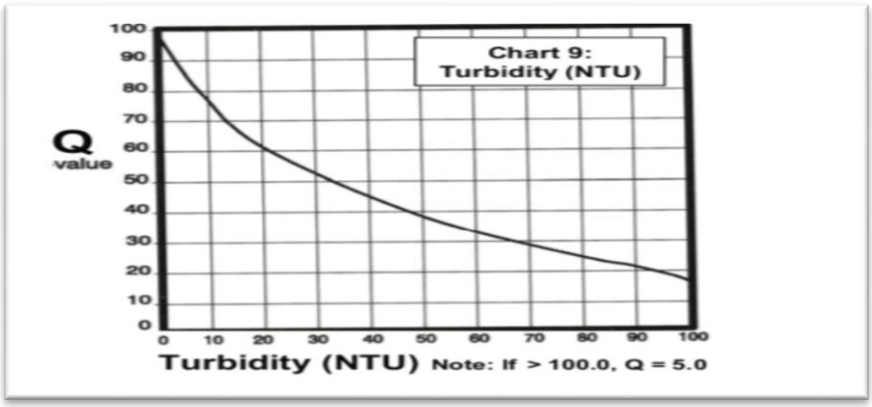


Fig. 8 The relationship between the quality of the adjective Qi and the turbidity.

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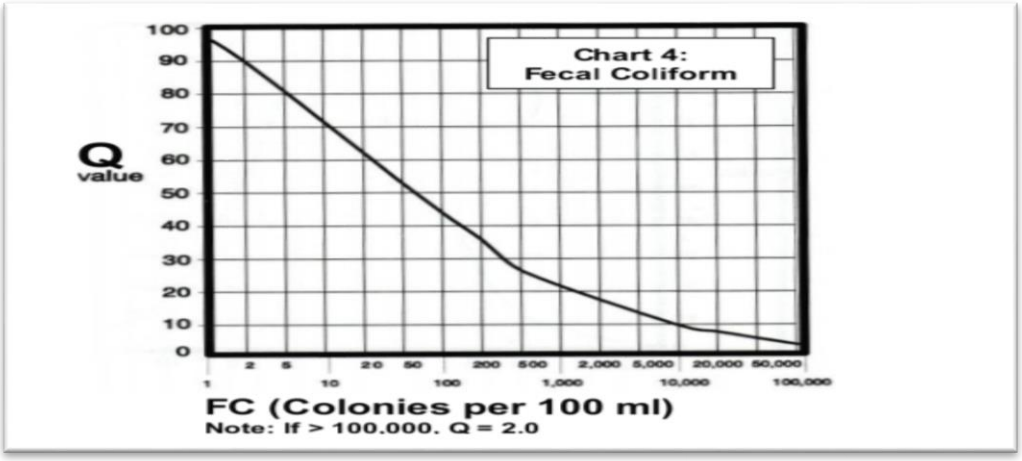


Fig .9 The relationship between the quality of Qi and fecal coliform bacteria.

After there is a quality value for each Qi characteristic of the special curves, the equation is applied to measure the water quality index (NSFWQI) and then the results are compared with the classifications for drinking water quality as in table 3 [17].

Table 3 Classification of water quality and quality for drinking by NSFWQI value

| **Water quality** | **NSFWQI** |
|---|---|
| Very Bad | 0.0-25 |
| Bad | 26-50 |
| Medium | 51-70 |
| Good | 71-90 |
| Very Good | 91-100 |

## 4. RESULTS AND DISCUSSIONS

To evaluate the quality of well water and its quality for drinking and human uses, the mathematical model (NSFWQI) applied a specific number of physical, chemical and biological criteria represented by DO, F.C, Turbidity, BOD5, TDS, PO4-3, NO3-2, pH, Temperature in order to evaluate the quality of the studied well water and its quality for drinking and multiple human uses.

Table 4 shows the highest and lowest value of the studied factors and the average averages of the sites.

| **Parameters** | **Aleibada** | **Askari** | **Gardaglu** |
|---|---|---|---|
| T | (25.6-19.1)<br>21.7a | (23.3-19.7)<br>21.3a | (24.3-19.8)<br>21.5a |
| Tur | (0.8-0.3)<br>0.51a | (2-0.7)<br>1a | (2.5-1.3)<br>1.66a |
| pH | (8.2-7.4)<br>7.83a | (8.1-7)<br>7.53a | (8-7.6)<br>7.86a |

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| | | | |
|---|---|---|---|
| DO | (4.1-2)<br>3.26b | (5.1-1.2)<br>2.93a | (4.8-3.3)<br>3.76b |
| BOD | (3.5-0.7)<br>2.11b | (3-0.8)<br>1.80a | (3.1-0.6)<br>1.81a |
| $PO_4$ | (1.39-0.99)<br>1.20b | (1.49-0.39)<br>1.13b | (1.45-0.3)<br>0.73a |
| $NO_3$ | (184-98)<br>142.8b | (173-70)<br>110.5a | (156-58)<br>127.9a |
| TDS | (2298-2086)<br>2219b | (2164-1708)<br>1939a | (2304-2153)<br>2248b |
| F.C | (24-13)<br>18.6b | (2-0)<br>0.6a | (31-17)<br>21.8b |

The results of our current study shown in the table 4, The temperature values for well water ranged between (25.6-19.1) m °, where the highest value and less value in the Worship well recorded, the results of the contrast analysis and a dinar test for the values of the average samples sites were documented. The lack of moral differences at a level Moral (P≤0.05), and the contrast in temperatures can be explained until the distance of the groundwater from the surface of the earth, so it is not greatly affected by climatic factors [17] , the results of the temperature values are higher than the results of the study[15] and whose values range between (24-16) m, while the temperature values registered in our study were an approach to the results of a study [18] whose values range between (18-26) m °. While the values of Turbidity for the results of our study were between (2.5-0.3) NTU, as it recorded the highest value in the well of the Gardaglu while the lowest value recorded in the Aleibada well, the results of the statistical analysis showed that there were no moral differences for the average samples sites at a moral level (P≤0.05), attributed The reason for the rise in the values of the Turbidity in the well of the Gardaglu to the movement of the slow groundwater or the reason for the movement of the relativity of the water current when pumping water from the well, which moves the mud and grenade molecules with the water stream causing the water of the water, The decrease in the value of the turbidity in the well of Aleibada is due to the filtration of groundwater through the geological layers of the earth as well as the nature of the formation of rocks and soils in which the water of the wells is found [19] , the results of our study of the values of the turbidity are not identical to the results of the study [10] which ranged between (4.67-084) NTU. The results of our study of the pH values of well water between (8.2-7) ° C where the highest value was recorded in the well of Aleibada while the lowest value was recorded in the well of the Askari district, the results of the statistical analysis showed that there were no significant differences for the averages of the sites at a significant level (P≤0.05) and explains the variation in the results of the study months to the rise and fall of the sulfur and chlorine phase due to the increase in groundwater salinity concentrations, which made the pH close to parity [20]. The pH value recorded in our current study scored lower than the results of the study of [21], whose pH value ranged between (8.4 – 7.3), while the results of the current study of pH values were incompatible with the results of the study [22] as its values ranged between (7.76 – 6.29). The value of the dissolved oxygen in our current studies shown in the table 4 ranged between (5.1-2), as the highest value was recorded in the Askari well and the lowest

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value in the well of Aleibada. At a moral level (P≤0.05), a relative disparity in the oxygen values of the average samples of wells for well water. This relative contrast is due to the city depths of large wells, the difference and the difference in the variable temperatures continuously as well as the air pressure and the total content of the waters of the microorganism. The results of our study recorded the lowest value of the results of [23] .The value of the dissolved oxygen in the water ranged between (6.91 - 4.14). It also did not correspond to the results of a study(18)which the values of the dissolved oxygen in the water ranged between (6.9 - 3.5). While the results of our current study indicated that the values of the biological requirement for oxygen for well water ranged between (3-5-0.6), where the highest value was recorded in the Aleibada well while the lowest value recorded in Gardaglu , the results of the statistical analysis of the average locations of the vital requirements of the oxygen clarified the presence of moral differences at a level Moral (P≤0.05), the reason for the decrease in the vital requirements of oxygen in wells to the natural filtering operations during the rocky land layers as well as from the sources of organic pollutions, health drainage water, rain water and the items it contains , As for the values of the high vital requirement of oxygen for BOD5 due to the leakage of pollutants such as sewage through pores and cracks to groundwater, especially since most wells are close to the surface and the occurrence of oxidation processes for organic materials through biological neighborhoods [24], the results of our study were higher Among the results of the study [25] which ranged between (2.9 - 0.1) and the results of our school were not identical to the study of [26] the vital requirements for oxygen ranged between (3.7 - 0). The results of our current study of the values of phosphate ions, which ranged between (1.49-0.3), were recorded as the highest value was recorded in the Easkari well of the military while the lowest value recorded in the Gardaglu, the results of the contrast analysis and the Denkin test for phosphate ions values showed the presence of moral differences for the average samples sites at a moral level (P≤0.05) The reason for the contrast in the values of phosphate ions is due to the contrast in the values of phosphate ions and the high concentrations of some wells due to agricultural activities and excessive irrigation and nominated them to groundwater and the use of chemical fertilizers rich in phosphorus as well due to the nature of the geological land [27] .The height also coincides with heavy rains, which works to dissolve the rocks and soil containing the phosphate and its access to the groundwater in addition to the leakage of home and industrial pollutants rich in residue of organic materials, washing powders and detergents containing phosphorus, which contains Tripolyphosphate, which interacts with water, producing phosphate ions, producing phosphate ions [28], our current study came higher than the results of a study [29] for the values of phosphate ions that ranged (0.581 - 0.051) and is not compatible with the results of a study [30] whose values ranged between (0.09 - 0.02. ).Our current study of nitrate ions values ranged between (184-58 ), where the highest value was recorded in the well of Aleibada and the lowest value recorded in Gardaglu, the results of the statistical analysis of the average sites of the sites showed the values of nitrate ions. The values of nitrate ions in the water water to excessive agricultural activities, especially the chemical fertilizer used in them as well as the various human activities and the lack of residential neighborhoods within the region studied for the systems and poor health drainage systems containing protein materials to well water that are biologically degraded by microbia in the Nitrification that transforms The amino acid to Ammonia and then the nitrate ion, As for the reason for the low levels of nitrate values due to the reduction process of nitrate ions by bacteria, especially the decrease in agricultural activity and the lack of use of chemical fertilizer [31], the results of our

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current study of nitrate ion values were contradictory to the results of the study of [18], whose values ranged between (100.1 – 4.39). The results of our study of the values of the total soluble solids that ranged between (2330-1708) as the highest value in Gardaglu, recorded the lowest value in al-Askari, the results of the discipline analysis and a Denkin test for the average sites of solid solid material values that have spatial moral differences at a moral level ( P≤0.05), the reason for the high and low concentrations of the values of soluble solid materials to the geological formations of the water that the water touches and passes through and works to dissolve and dissolve the rocks [25], the results of our study of the values of melted solid materials came less than the results of the study [2] which It ranged between (5913-937). The results of our study of the total number of stool colon bacteria for well water samples, which recorded an imperceptible values from them, ranged between (31-0), as it recorded the highest value in Gardaglu. As for the lowest value recorded in Al-Askari, the results of statistical analysis recorded the presence of spatial moral differences for averages Sites of the values of the stool colon bacteria at a moral level (P≤0.05), the reason for the low concentration of the number of stool colon bacteria to the large depths of the wells and closed the nozzle in a tight manner as well as from the sources contaminated with domestic, agricultural and industrial health drainage [32] as for the reason for its high concentrations due to Its high ability to stay in the stool for a long time before it is bulldozed with rain water to the groundwater as well as near the distance between wells and sources contaminated in huge numbers of bacteria, whether they are home, agricultural or industrial pollutants.

**Evaluation of the Quality of Well Water for Drinking and Human Use**

Table 5 shows the QI values taken from special curves.

| Qi | W1 Aleibada | W2 Al-Askari | W3 Gardaglu |
|---|---|---|---|
| DO | 17 | 30 | 28 |
| F.C | 98 | 80 | 68 |
| pH | 91 | 79 | 93 |
| BOD | 100 | 85 | 80 |
| T | 19 | 20 | 19 |
| PO4 | 62 | 38 | 35 |
| NO3 | 1 | 5 | 9 |
| Tur | 96 | 95 | 100 |
| TDS | 20 | 20 | 20 |

Table 6 shows the product of (Qi × Wi), the values of (NSFWQI) and the quality of the water of the studied wells.

| Wi×Qi NSFWQI | (W1) | (W2) | (W3) |
|---|---|---|---|
| DO | 2.89 | 5.1 | 4.76 |

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| | | | |
|---|---|---|---|
| F.C | 51.68 | 12.8 | 10.88 |
| Ph | 10.01 | 8.69 | 1023 |
| BOD | 11 | 9.35 | 8.8 |
| T | 1.9 | 2 | 1.9 |
| $PO_4$ | 6.2 | 3.8 | 3.5 |
| $N0_3$ | 0.1 | 0.5 | 0.9 |
| Tur | 7.66 | 7.6 | 8 |
| TDS | 1.4 | 1.4 | 1.4 |
| NSFWQI | 56.86 | 51.24 | 50.37 |
| Quality | Medium | Medium | Medium |

According to the results of table 6 and the values of NSFWQI obtained for the qualitative evaluation of well -studied wells for drinking and human use, and when we compare the results of NSFWQI values with table 3 for the qualitative classification of drinking water and human use we find that all well -studied wells within the medium medium class Quality for drinking and human human use and this does not prevent the use of that water and is considered a water suitable for human drinking after adding some sterilizers such as chlorine, while none of the well water was registered in the Very Good field and this considers that all well water was not fully purified And free of pollutants, no quality (BAD, Verry Bad) has been recorded for the water of these wells. The reason is due to the distance of those wells from the sources of pollution and leaks of the sewage systems network and then from residential neighborhoods,While the reason for the relative deterioration of all well water and its occurrence is due to the Medium Quality field, it is due to the transgression of some specific standards allowed by the top and Iraqi health organizations, especially dissolved solids, phosphate ions, nitrates, and eating number for stool colon bacteria, which negatively affected the values of (QI) effects. This negative is reflected in the quality of the water and its quality (NSFWQI) and as shown in table 6, as the use of water of these wells of medium quality can negatively affect human health such as the occurrence of diarrhea and the transmission of diseases transmitted by drinking water, this water is used When necessary, after it is treated well in some easy technical methods, such as slow melting technology, freezing technique, exposing them to direct sunlight, or placing chlorine in specific quantities to eliminate pathogens [32].

## 5. CONCLUSIONS

Water in the study area was within a medium-quality category, i.e. drinking, after being treated with easy techniques such as adding chlorine in small quantities. The wells of wells were distinguished by the high values of some factors from the internationally permissible limits, such as phosphate ions, nitrates and solid solids, as well as varied in preparing the stool colon bacteria. The high number of stool colon in the well of worship and the Bir al -Jardaglu from the limits of the World Health Organization, which caused the deterioration of the quality of well water and its occurrence within a medium -quality category. The oxygen dissolved in the waters of the wells within the international and Iraqi standard limits in the well of worship and the well of Gardaglu, because most of the water is stagnant, while the well of Al -Askari neighborhood exceeded the

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limits of the melted oxygen, the international and Iraqi specifications. Hydrogenic values were characterized by being basic and low

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