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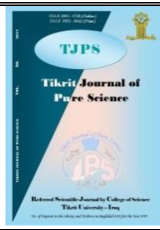

Using Arithmetic Weight Index for Study Quality Drinking Water of Al-Gharraf Stream

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Abstract

Water pollution is any physical or chemical change in water quality, directly or indirectly, adversely affects humans or makes water unsuitable for the required uses. This research is concerned with the study of the chemical and physical properties of water in the city of Nasiriya-Iraq and the quantity of pollution by applying the arithmetic weight index. The study was based on the concentrations of positive ions (Potassium $(k)^+$, Sodium $(Na)^+$, Calcium $(Ca)^+$) and negative ions (Sulfate $(SO4)^+$, Chloride $(CL)^+$) acidity (PH), Total Dissolved Solid (T.D.S), Alkalinity (ALK), Electrical Conductivity (E.C) Total suspended solids (T.S.S) and total hardness (TH), where the results of the analysis were compared with Iraqi standards adopted to show the validity of water drinking for the use of human.

The results of the study were explained:

1. The water of the study area is the basicity of the interaction where the pH ranged (7.85-8.8) (8.3-8.6) for two seasons.
2. All water in the study area is unsuitable for drinking according to the arithmetic weight index.
3. It is not good to apply the standard Iraqi drinking before treatment water.

Introduction

The word pollution is generally used to denote the environmental damage caused by the dumping of waste at sea. The difference between the term (contamination) and (pollution) the first term means the presence of concentrated substances in water beyond the normal level, second term The entry of materials or energy directly or indirectly by human into the marine environment has adverse effects, such as harming living resources, endangering human health, impeding marine activities, including fishing, and reducing the use of marine waters. Iraq embraces water bodies that constitute more (5%) of its area and includes stagnant water such as lakes, marshes and running water such as Tigris, Euphrates and Shatt al-Arab River [1]. The study of water resources has received increasing attention from specialists because of the increasing need to ensure the requirements of agricultural, industrial and environmental advancement. Water is defined as the lifeblood, and as water is one of the necessities of life, it may be a reason not to neglect it. The study of this science was accompanied by attention to the deterioration in the quality of water as a result of the continuous pollution in the sources of water resources, due to poor discharges due to agricultural, industrial and human uses [2]. Water Quality Index , which was developed in the early 1970s, can be used to monitor water quality changes in a particular water supply over time, or it can be used to compare a water supply quality with other water supplies in the region or from around the world[3]. The research aims at measuring the concentrations of eleven parameter and seventeen stations of the Gharraf River and its sediments to assess the extent of Contamination River these elements by comparing concentrations with standard Iraqi for drinking and apply arithmetic weight index.

Materials and methods

Study area: The characteristics of the water in the Gharraf stream are determined by several effects, which are a reflection of the effects of the climate, the nature of the soil, rocks, groundwater, and the vital activities in water, civil, industrial and agricultural uses. Nasiriya is located between latitude (30˚36´00˝ _ 32˚00´00˝ N) and longitude (45˚36´00˝ _ 47˚12´00˝ E), as showing figure (1),where it was Mediated five provinces of Wasit and Qadisiya in the north with Basra in the south for east of Maysan and Muthanna west. Gharraf stream branches off the current from the front of Kut dam. Kut dam was established on the Tigris River between (1934 and 1939), then the stream flowing to the south where it passes in the cities of ALfagr, Qala'at Sikar , Al Rifai and Al Nasr and the (168 km) distance from the beginning branches of the river into two branches Shatt Al bdai, While the stream becomes less width and enters the Shatt al-Shatra, which passes in Shatrah, Gharraf and ends in the marshes leading to Hammar also, a total length of (230) km from its start point to its outlet in the marshes of Nasiriya.

Field work and laboratory work

To complete the current study within the Gharaaf stream was chosen seventeen Stations, where water samples were collected two months FEB 2017 and MAY 2017 at each sampling station. Samples were analyzed Test results conducted by the Department of the Environment Water / Najaf Governorate in a Table (1), (2) according to Iraqi standard in a Table (3). Data were included on the values of physical and chemical variables represent concentration of positive ions (Potassium $(k)^+$, Sodium $(Na)^+$, Calcium $(Ca)^+$) and negative ions (Sulfate $(SO4)^+$, Chloride $(CL)^+$) acidity (PH), Total Dissolved Solid (T.D.S), Alkalinity(ALK), Electrical Conductivity (E.C) Total suspended solids(T.S.S) and total hardness (TH).

In this study, the values of concentrations of variables were analyzed Physical and chemical as follows:

PH:

Values in Figure (2) ranged between (7.85-8.8) (8.3-8.6) for the two seasons. This means that the water of the Gharraf stream is a base and is within the permissible limits of (6.5-8.5) for the use of human drinking.

Total Dissolved Solid (T.D.S):

Values in Figure (3) ranged between (1016-1040) and (450-680) mg/l for the two seasons. This means that the water of the Gharraf stream in 4/FEB Exceeded permissible limits of (1000) mg/l for the use of human drinking.

Electrical Conductivity (E.C):

Values in Figure (4) ranged between (1467-1568), (816-881) µs/cm 25 Cº for the two seasons. This means that the water of the Gharraf stream in 4/FEB Exceeded permissible limits of (1000) µs/cm 25 Cº for the use of human drinking.

Calcium (Ca):

Values in Figure (5) ranged between (120-127), (73-77) mg/l for the two seasons. This means that the water of the Gharraf stream within permissible limits of (200) mg/l for the use of human drinking.

Chloride (CL):

Values in Figure (6) ranged between (137-153), (88-102) mg/l for the two seasons. This means that the water of the Gharraf stream within permissible limits of (250) mg/l for the use of human drinking.

Sodium (Na):

Values in Figure (7) ranged between (142-146.8) and (88-102) mg/l for the two seasons. This means that the water of the Gharraf stream within permissible limits of (200) mg/l for the use of human drinking.

Sulfate (SO4):

Values in Figure (8) ranged between (281-497), (171-246) mg/l for the two seasons. This means that the water of the Gharraf stream within 4/FEB and 11/MAY Exceeded permissible limits of (250) mg/l for the use of human drinking.

Potassium (k):

Values in Figure (9) ranged between (4-4.4), (2.1-3.9) mg/l for the two seasons. This means that the water of the Gharraf stream within permissible limits of (20) mg/l for the use of human drinking.

Total suspended solids (T.S.S):

Values in Figure (10) ranged between (22-72), (24-60) mg/l for the two seasons. This means that the water of the Gharraf stream within 4/FEB and 11/MAY Exceeded permissible limits of (20) mg/l for the use of human drinking.

Total hardness (TH):

Values in Figure (11) ranged between (482-508) and (290-308)mg/l for the two seasons. This means that the water of the Gharraf stream within permissible limits of (500) mg/l for the use of human drinking.

Alkalinity (ALK)

Values in Figure (12) ranged between (126-136), (72-78) for the two seasons. This means that the water of the Gharraf stream within permissible limits of (200) mg/l for the use of human drinking.

Calculations of the wqi

The WQI was studied using the weighted arithmetic weight index method, which was suggested by Horton (1965), developed by Cude (2001).

Water quality index (WQI) = $\sum qi*wi$……… (1)

The sub-index(qi) of the ith parameter calculate using the following formula [4]:

qi = (water quality rating) 100 X (Va − Vi) / (Vs − Vi)……… (2)

Where:

Va = Actual value present in the water sample.

Vi = Ideal value (0 for all parameters except pH which is 7.0).

Vs = Standard value.

The weightage unit (Wi) of each parameter was calculated a value inversely proportional to the Iraqi standard (Sn), as shown in Table (3)

Wi = (Unit weight) = K/Sn ……… (3)

Where:

K = (constant) 1/ Vs1+1/Vs2-----+1/VSn,

Sn = Standard value.

Based on the calculated WQI, the classification of water quality types is given according to [5] as shown in Table (4).

Quality rating and weighting

The rating of water quality and weight parameters for all stations according to this WQI are given in Tables(5 and 6)for two seasons.

Results and Discussion

The month Water Quality for the seventeen stations along the stream was determined using the arithmetic weighted index method and the eleven physical and chemical parameters. There was a little difference between parameter values measured for the seventeen stations as a result of the same source of water and similar atmospheric conditions, but there were significant differences according to the two season 4/FEB and 11/MAY. The increase in WQI value means a decrease in water quality downstream due to natural factors like receive these Most of the sewage used for human use For this city can be observed drainage of heavy water to stream directly without treatment. Also, the waters of the eroding coming from the land of agriculture Surrounding the stream Gharraf. There are large monthly fluctuations in the river water level in the 4/FEB and 11/MAY; water comes from the reservoirs full of organic materials, algae, and plants with dark green color, reducing in pH and oxygen, total dissolved solids and affecting the overall water quality.

The results of the analysis physical and chemical parameters for 4/FEB (Table 1) supported the water quality between unsuitable and very poor. The values of electrical conductivity were 1467 to 1568 µS/cm (High conductivity results from higher salinity due to mineral contaminants. In addition, the greater the concentration of soluble solids in water, the greater the water potential for transmitting electricity), it was always more than the Iraqi standard of 1000 µS/cm. The observed values for sulfate were 281to 497 mg/l (Some metals, such as calcium sulfate or carbon dioxide, are dissolved in the air and mixed with rainwater during their fall), which is high the 250 mg/l recommended by the Iraqi standard. The TDS level within the stream water fluctuated from 1016 to 1040 mg/l (Due to high electrical conductivity), and Water containing more than 1000 mg/L of TDS is not palatable as drinking water. The values of T.S.S were 22 to 72 mg/l(Suspended solids consist of two parts, a non-precipitated part and a grainy part, and the difference between them is determined by the size and shape of the minutes, which increases or decreases the amount of contaminants), that was over Iraqi standard.

The results of the analysis physical and chemical parameters for 11/MAY (Table 2) supported the water quality among poor, very poor and unsuitable. The values of electrical T.s.s were 24 to 60 mg/l(Waste of factories, sewage, iron compounds, a growth of algae and the resulting interactions), it was always more than the Iraqi standard of 20 mg/l.

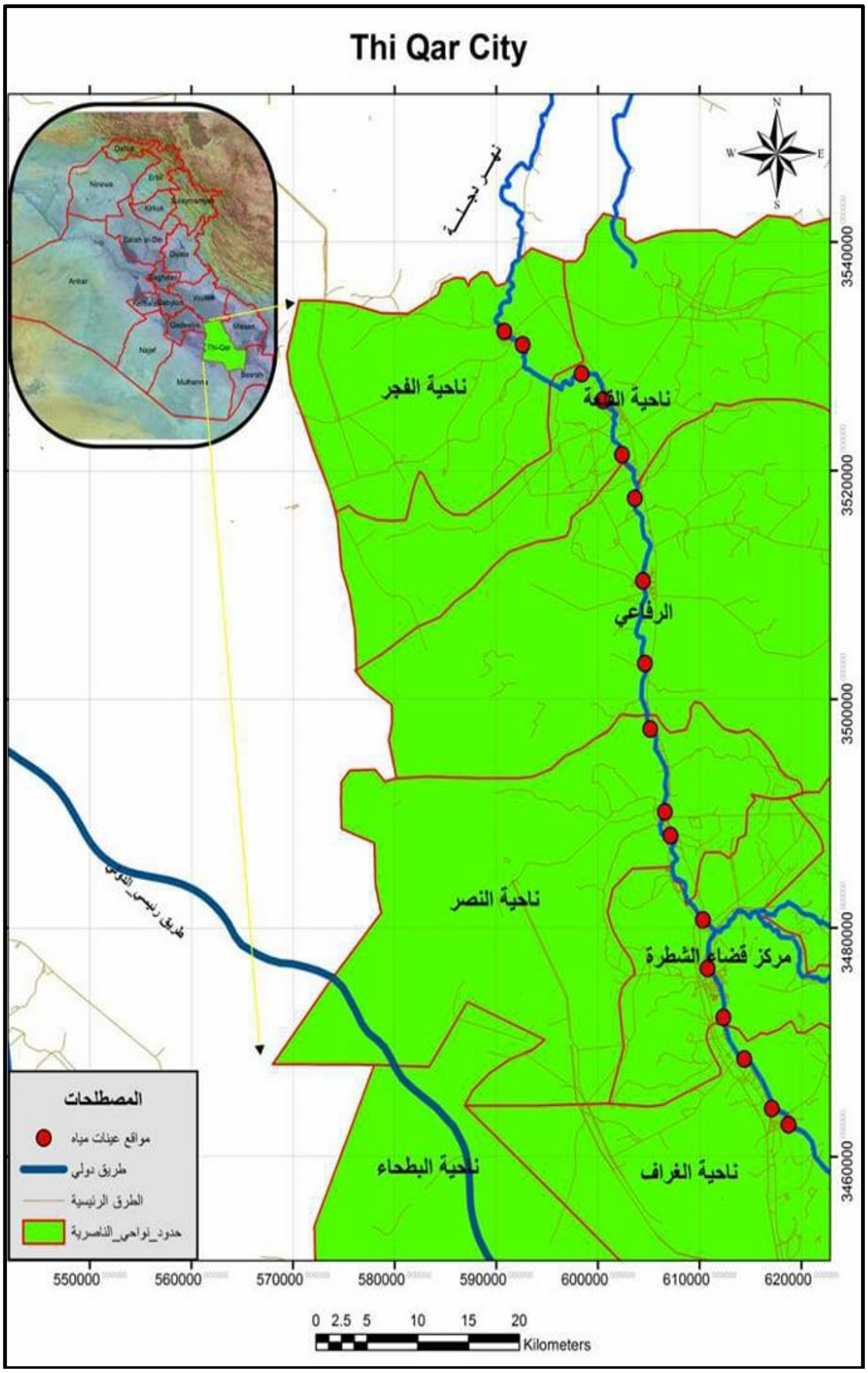

Figure (1): Location of the study area (Al- Gharraf stream)

Table (1): Test results using (PH-meter &oakton pcs testr 35) devices and Test results conducted in the Department of the Environment Water / Najaf Governorate (date: 4/FEB/2017)

ID		Location		Physical Properties				CatIon (mg/l)				Anion (mg/l)		
	Name	**E**	**N**	**Ph**	**EC(μs/cm)**	**TSS**	**TDS**	**Ca**	**TH**	**Na**	**K**	**Cl**	**So4**	**ALK**
Loc_01	ALfagr	590787	3532154	7.85	1494	60	1016	121	486	142.8	4.0	153	413	128
Loc_02	ALfagr	592576	3530998	8.01	1568	44	1022	127	508	146.0	4.4	148	281	136
Loc_03	ALfagr	598393	3528445	8.18	1471	30	1018	120	482	143.2	4.0	146	405	128
Loc_04	Gala sgar	600462	3526145	8.24	1477	58	1020	120	482	142.4	4.0	148	408	128
Loc_05	Gala sgar	602363	3521365	8.25	1476	60	1026	120	482	145.2	4.0	140	386	128
Loc_06	Gala sgar	603622	3517553	8.31	1474	36	1030	120	482	146.4	4.0	143	395	128
Loc_07	Al-Rifai	604402	3510336	8.31	1472	70	1032	120	482	144.8	4.0	144	392	126
Loc_08	Al-Rifai	604618	3503113	8.39	1467	42	1036	120	482	145.2	4.0	146	497	126
Loc_09	Al-Rifai	605139	3497376	8.43	1497	22	1026	121	486	142.0	4.0	144	397	128
Loc_10	Alnsar	606572	3490151	8.40	1480	56	1030	121	486	145.2	4.0	140	374	128
Loc_11	Alnsar	607111	3488073	8.42	1480	72	1028	121	486	143.2	4.0	143	404	128
Loc_12	Albdai	610310	3480678	8.42	1478	66	1024	120	482	144.4	4.0	144	408	128
Loc_13	Alshatra	610775	3476436	8.43	1481	28	1022	120	482	145.2	4.0	153	408	128
Loc_14	Alshatra	612325	3472145	8.58	1485	36	1018	120	482	144.8	4.0	149	413	128
Loc_15	Alshatra	614373	3468526	8.80	1484	28	1022	120	482	145.6	4.0	144	394	128
Loc_16	Algarraf	617100	3464176	8.67	1502	40	1036	121	486	145.2	4.0	149	398	130
Loc_17	Algarraf	618738	3462765	8.34	1532	56	1040	122	490	146.8	4.4	137	402	132
Max.				8.8	1568	72	1040	127	508	146.8	4.4	153	497	136
Min.				7.85	1467	22	1016	120	482	142	4	137	281	126
Mean				8.355	1489.294	47.294	1026.2353	120.8	485.2	144.6	4.047	145.4	398.5	128.6
SD				0.224	25.45772	15.999	6.9957971	1.704	6.366	1.408	0.133	4.358	39.62	2.32

Table (2): Test results using (PH-meter &oakton pcs testr 35) devices and Test results conducted in the Department of the Environment Water / Najaf Governorate (date: 11/MAY/2017)

		Location		Physical Properties				CatIon (mg/l)				Anion (mg/l)		
	Name	E	N	Ph	EC(μs/cm)	TSS	TDS	Ca	TH	Na	K	Cl	So4	ALK
Loc_01	ALfagr	590787	3532154	8.4	828	34	564	73	294	74.7	2.4	90	181	74
Loc_02	ALfagr	592576	3530998	8.4	790	58	446	72	290	73.5	2.1	88	186	72
Loc_03	ALfagr	598393	3528445	8.3	808	34	482	73	294	75.6	1.8	89	171	72
Loc_04	Gala sgar	600462	3526145	8.3	808	24	598	73	294	74.7	2.4	89	181	72
Loc_05	Gala sgar	602363	3521365	8.3	818	48	560	73	294	75.6	2.4	88	171	74
Loc_06	Gala sgar	603622	3517553	8.4	816	56	486	73	294	76.2	2.4	88	176	74
Loc_07	Al-Rifai	604402	3510336	8.5	836	52	598	76	304	77.7	2.4	98	217	76
Loc_08	Al-Rifai	604618	3503113	8.4	816	60	562	73	294	77.4	2.4	89	202	74
Loc_09	Al-Rifai	605139	3497376	8.4	816	38	556	73	294	76.8	2.4	89	204	74
Loc_10	Alnsar	606572	3490151	8.4	827	42	494	73	294	76.5	2.1	90	182	76
Loc_11	Alnsar	607111	3488073	8.3	851	68	488	76	304	78.0	2.1	94	208	76
Loc_12	Albdai	610310	3480678	8.6	848	38	680	76	304	79.5	2.4	92	246	76
Loc_13	Alshatra	610775	3476436	8.4	846	36	450	76	304	75.9	2.4	93	205	76
Loc_14	Alshatra	612325	3472145	8.4	855	40	646	76	304	76.5	2.4	94	214	76
Loc_15	Alshatra	614373	3468526	8.6	881	36	602	77	308	89.7	3.9	98	208	78
Loc_16	Algarraf	617100	3464176	8.5	866	54	526	77	308	79.2	2.4	100	214	78
Loc_17	Algarraf	618738	3462765	8.5	872	16	628	77	308	76.5	2.4	102	220	78
Max.				8.6	881	68	680	77	308	89.7	3.9	102	246	78
Min.				8.3	790	16	446	72	290	73.5	1.8	88	171	72
Mean				8.418	834.2353	43.176	550.94118	74.53	299.2	77.29	2.4	92.41	199.2	75.06
SD				0.095	25.43504	13.566	69.401432	1.841	6.366	3.553	0.424	4.57	20.7	2.015

Table (3). Irrigation water standards and unit weights.

Water quality parameters	Standards	Unit Weights (w_i)
PH	**6.5-8.5**	**0.480884**
Total Dissolved Solid (T.D.S) mg/l	**1000**	**0.004087**
Alkalinity(ALK)mg/l	**200**	**0.020437**
Electrical Conductivity (E.C)mg/l	**1000**	**0.004087**
Calcium(Ca)mg/l	**200**	**0.020437**
Chloride(Cl)mg/l	**250**	**0.016350**
Sulfate (SO4)mg/l	**250**	**0.016350**
Potassium (k)mg/l	**20**	**0.204376**
Total suspended solids (T.S.S)mg/l	**20**	**0.204376**
Total hardness (TH)mg/l	**500**	**0.008175**
Sodium(Na)mg/l	**200**	**0.020437**

Table (4). Water quality index scale.

WQI	Water quality
0-25	**Excel-lent**
26-50	**Good**
51-75	**Poor**
76-100	**Very poor**
>100	**Unsuited-able**

Table (5): Arithmetic weight index calculation for 04/FEB/2017

No	Sites	par.	PH	EC	TDS	TSS	ALK	TH	Ca	Na	K	Cl	SO4	WQI
		Wi	0.4808	0.004	0.004	0.2043	0.0204	0.0081	0.0204	0.0204	0.2043	0.0163	0.0163	
1	Loc_01		56.666	149.4	101.6	300	64	97.2	60.5	71.4	20	61.2	165.2	102.176
2	Loc_02		67.333	156.8	102.2	220	68	101.6	63.5	73	22	59.2	112.4	90.713
3	Loc_03		78.333	147.1	101.8	150	64	96.4	60	71.6	20	58.4	162	81.98
4	Loc_04		82.666	147.7	102	290	64	96.4	60	71.2	20	59.2	163.2	112.54
5	Loc_05		83.333	147.6	102.6	300	64	96.4	60	72.6	20	56	154.4	114.742
6	Loc_06		87.333	147.4	103	180	64	96.4	60	73.2	20	57.2	158	92.23
7	Loc_07		87.333	147.2	103.2	350	63	96.4	60	72.4	20	57.6	156.8	126.927
8	Loc_08		92.666	146.7	103.6	210	63	96.4	60	72.6	20	58.4	198.8	101.58
9	Loc_09		95.333	149.7	102.6	110	64	97.2	60.5	71	20	57.6	158.8	81.77
10	Loc_10		93.333	148	103	280	64	97.2	60.5	72.6	20	56	149.6	115.405
11	Loc_11		94.666	148	102.8	360	64	97.2	60.5	71.6	20	57.2	161.6	132.591
12	Loc_12		94.666	148	102.4	330	64	96.4	60	72.2	20	57.6	163.2	126.48
13	Loc_13		95.33	148.1	102.2	140	64	96.4	60	72.6	20	61.2	163.2	88.04
14	Loc_14		105.33	148.5	101.8	180	64	96.4	60	72.2	20	59.6	165.2	101.029
15	Loc_15		120	148.4	102.2	140	64	96.4	60	72.8	20	57.6	157.6	99.759
16	Loc_16		111.33	150.2	103.6	200	65	97.2	60.5	72.6	20	59.6	159.2	107.95
17	Loc_17		89.33	153.2	104	280	66	98	61	73.4	22	54.8	160.8	114.15

Table (6): Arithmetic weight index calculation for 11/MAY/2017

No	Sites	par.	Ph	EC	TDS	TSS	ALK	TH	Ca	Na	K	Cl	SO4	WQI
		Wi	0.4808	0.004	0.004	0.2043	0.0204	0.0081	0.0204	0.0204	0.2043	0.0163	0.0163	
1	Loc_01		93.33	82.8	56.4	170	37	58.8	36.5	37.35	12	36	72.4	87.16
2	Loc_02		93.33	79	44.6	290	36	58	36	36.75	10.5	35.2	74.4	111.29
3	Loc_03		86.66	80.8	48.2	170	36	58.8	36.5	37.8	9	35.6	68.4	83.22
4	Loc_04		86.66	80.8	59.8	120	36	58.8	36.5	37.35	12	35.6	72.4	73.72
5	Loc_05		86.66	81.8	56	240	37	58.8	36.5	37.8	12	35.2	68.4	98.191
6	Loc_06		93.33	81.6	48.6	280	37	58.8	36.5	38.1	12	35.5	70.4	109.58
7	Loc_07		100	83.6	59.8	260	38	60.8	38	38.85	12	39.2	86.8	109.16
8	Loc_08		93.33	81.6	56.2	300	37	58.8	36.5	38.7	12	35.6	80.8	113.88
9	Loc_09		93.33	81.6	55.6	190	37	58.8	36.5	38.4	12	35.6	81.6	91.41
10	Loc_10		93.33	82.7	49.4	210	38	58.8	36.5	38.25	10.5	36	72.8	95.05
11	Loc_11		86.66	85.1	48.8	340	38	60.8	38	39	10.5	37.6	83.2	118.68
12	Loc_12		106.66	84.6	68	190	38	60.8	38	39.75	12	36.8	98.4	98.276
13	Loc_13		93.33	84.6	45	180	38	60.8	38	37.95	12	37.2	82	89.427
14	Loc_14		93.33	85.5	64.6	200	38	60.8	38	38.25	12	37.6	85.6	93.67
15	Loc_15		106.66	88.1	60.2	180	39	61.6	38.5	44.85	19.5	39.2	83.2	97.67
16	Loc_16		100	86.6	52.6	270	39	61.6	38.5	35.6	12	40	85.6	111.24
17	Loc_17		100	87.2	62.8	80	39	61.6	38.5	38.25	12	40.8	88	72.47

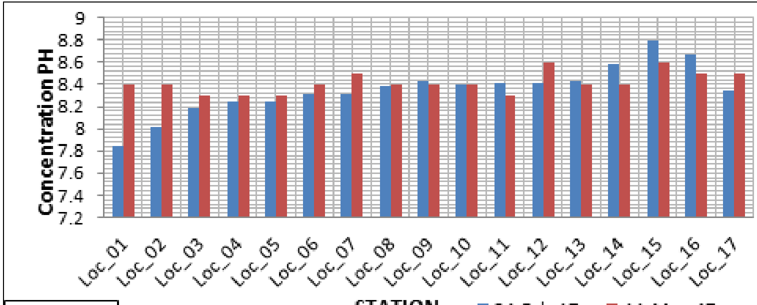

Figure 2

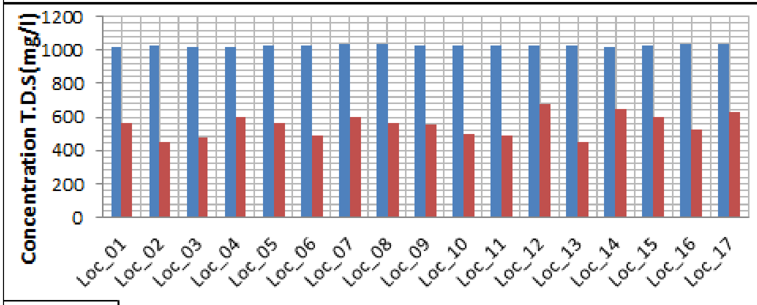

Figure 3

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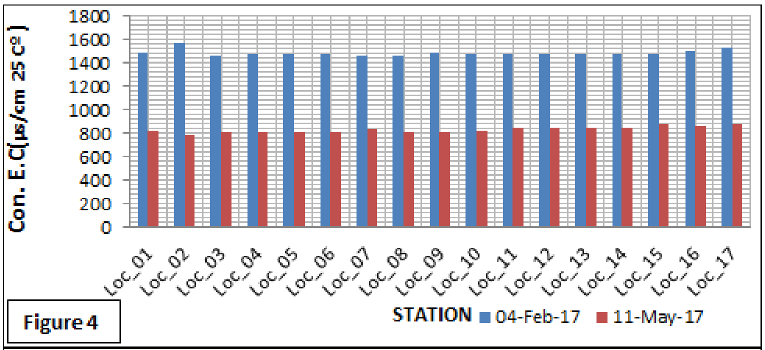


Figure 4

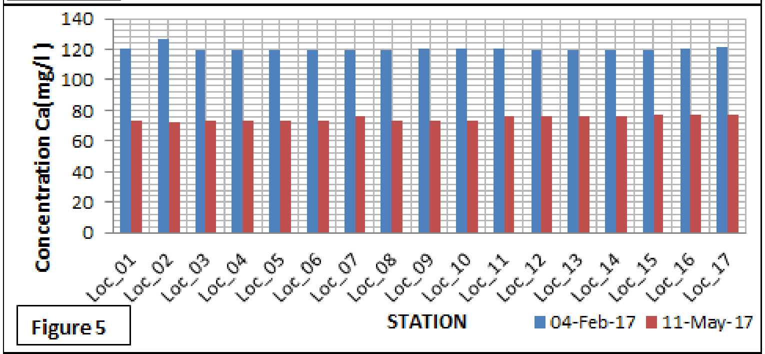
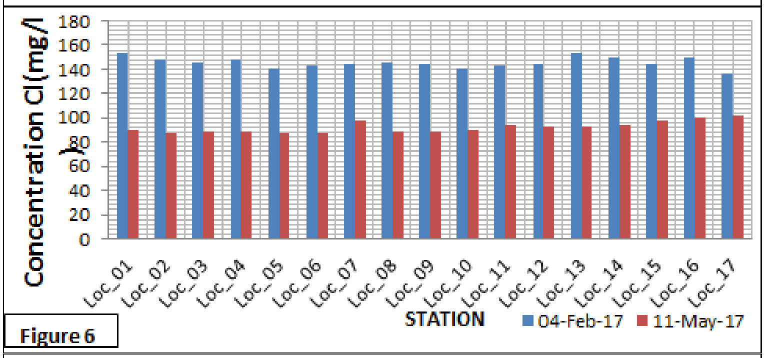


Figure 5



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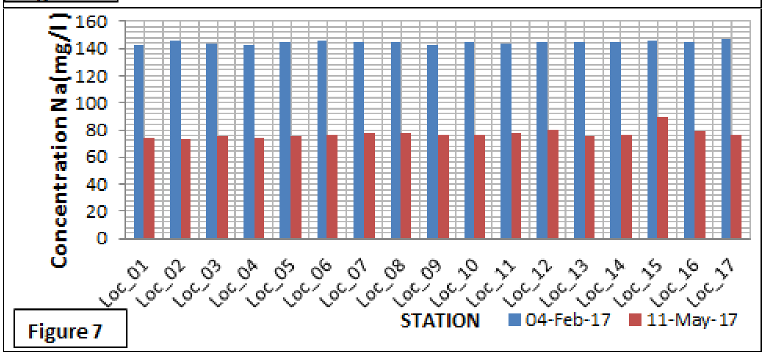
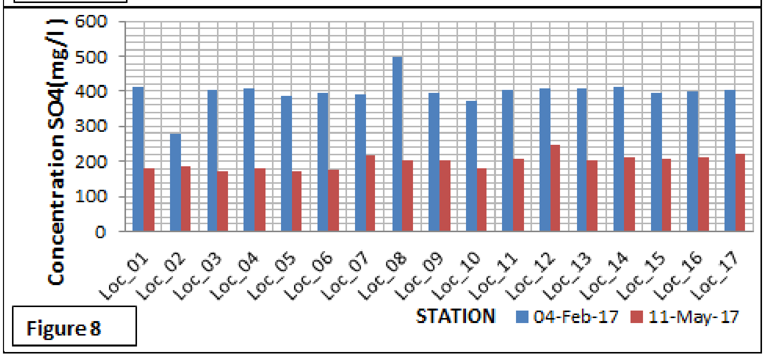


Figure 7



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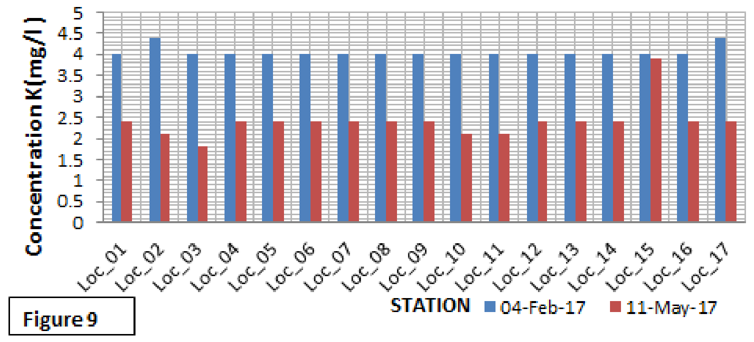

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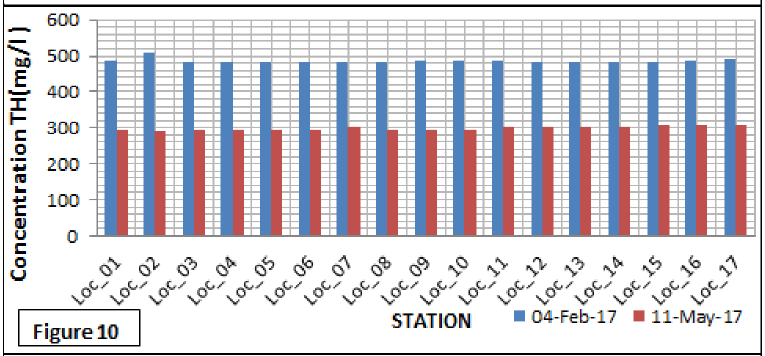

Figure 10

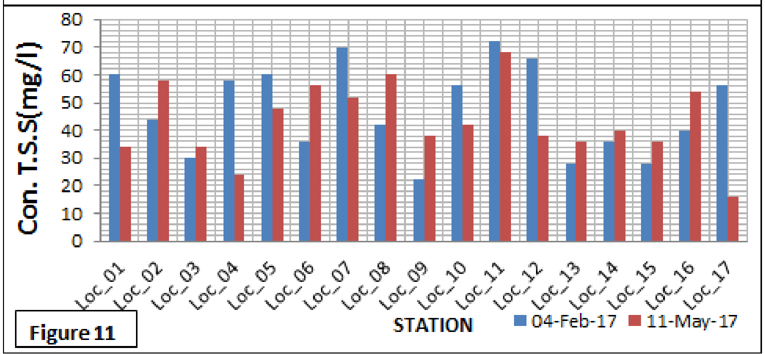

Figure 11

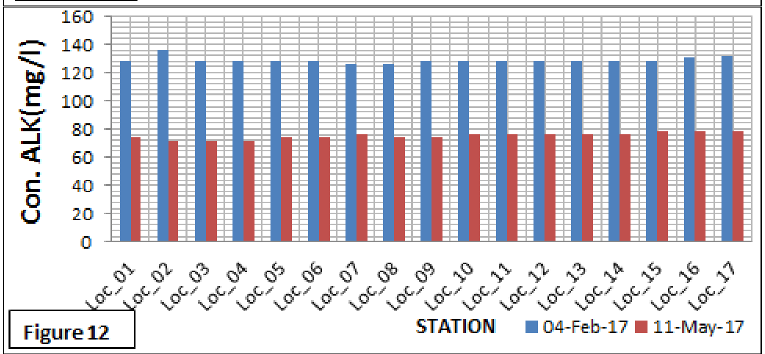

Figure 12

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استخدام مؤشر الوزن الحسابي لدراسة جودة مياه الشرب في جدول الغراف

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الملخص

تلوث المياه هو أي تغير فيزيائي أو كيميائي في نوعية المياه، بشكل مباشر أو غير مباشر، يؤثر سلبا على الكائن الحي أو يجعل المياه غير مناسبة للاستخدامات المطلوبة. هذا البحث مهتم بدراسة الخصائص الكيميائية والفيزيائية للمياه في مدينة الناصرية– العراق وكمية التلوث بتطبيق مؤشر الوزن الحسابي. الدراسة كانت معتمده على تراكيز الأيونات الموجبة (البوتاسيوم, الصوديوم، الكالسيوم) والأيونات السالبة (كبريتات، كلوريد) الاس الهيدروجيني، المواد الذائبة الكلية، القلوية، الموصلية الكهربائية, المواد العالقة الكلية والصلابة الكلية، حيث نتائج التحليل كانت مقارنه بالمعايير العراقية المعتمدة لبيان صلاحيه مياه للشرب للاستخدام البشري.