Water Quality Index of 11 Streams Pouring into Um-Alnaaj Marsh

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Abstract:

This paper assesses the water quality index of 11 streams (rivers) and the receiving UM- AL NAAJ marshland at Misan governorate and how the water quality is improved when entered the marshland. The assessment employ the Canadian Council of Ministers of the Environment Water Quality Index (CCME WQI) which incorporates three elements: Scope (F_1)- the number of water quality parameters not meeting water quality objectives; Frequency (F_2)- the number of times the objectives are not met; and Amplitude (F_3)- the extent to which the objectives are not met. The index produces a number between 0 (worst) to 100 (best) to reflect the water quality. Iraqi guidelines for drinking water and the site-specific measured values of 5 variables are used in the index calculation.Variables included in the index calculation were, water temperature, dissolved oxygen, total dissolved solids, pH, turbidity. The CCME WQI analysis show that the average water quality of the 11 streams, feeding Um-Alnaaj marshland is rated as fair based on 2010 data, meaning that the conditions of the streams were sometimes depart from natural or desirable levels while the quality of water inside the marsh was ranging from good to excellent.

Keywords: CCME water quality index, site specific values, water quality guidelines, Um-Alnaaj marshland.

Introduction

Water is vital to the existence of all living organisms, but this valued resource is increasingly being threatened in Iraq, especially in the last two decades, because the water resources have suffered remarkable stress in terms of water quantity due to different reasons such as the dams built on Tigris and Euphrates in the riparian countries, the global climatic changes and the local severe decrease of the annual precipitation rates and improper planning of water uses inside Iraq [1, 2, 3].One of the important procedures which should be taken to get the uttermost benefit of the available quantity of water is the assessment of its quality in order to keep our awareness and understanding of our environment and to take the required steps to stop any deterioration in the quality of available water or rather improve it. However, the ability to properly track progress toward minimizing impacts on natural environments and improving access of humans to safe water depends on the availability of data that document trends in both space and time. As such, ongoing monitoring of water quality in surface and water resources is a necessary activity at all governing levels, local and national [4].

Any number of water quality measurements can serve as indicators of water quality [5]. However, there is no single measure that can describe overall water quality for any one body of water. As such, a composite index that quantifies the extent to which a number of water quality measures deviate from normal, expected or 'ideal' concentrations may be more appropriate for summarizing water quality conditions across a range of inland water types and over time.

Water quality index:

Water quality indices (WQIs) are useful tools for comparing water quality across systems and overtime [6]. They can provide a benchmark for evaluating successes and failures of management strategies aimed at improving water quality. Most water quality indices rely on normalizing, or standardizing, data parameter by parameter according to expected concentrations and some interpretation of 'good' versus 'bad' concentrations [5]. Parameters are often then weighted according to their perceived importance to overall water quality and the index is calculated as the weighted average of all observations of interest

In general, water quality indices incorporate data from multiple water quality parameters into a mathematical equation that rates the health of ecosystem with a single number. That number is placed on a relative scale to justify the water quality in categories ranging from very bad to excellent

A number of indices have been developed to summarize water quality data in an easily expressible and easily understood format [7, 8 &9]. One of these indices which are used in this work is the Canadian Council of Ministers of the Environment (CCME).

Canadian Council of Ministers of the Environment (CCME) WQI:

Among the developed models was that informed by the Canadian Council of Ministers of the Environment (CCME). This index doesn't give any weighted numbers but treats the values of parameters in mathematical ways to ensure that all parameters contribute adequately in the final number of the index [6, 10].

The Canadian Water Quality Index (CWQI) compares observations to a benchmark, where the benchmark may be a water quality standard or site specific background concentration. The CWQI quantifies for one station, over a predetermined period of time (typically one year), the number of parameters that exceed a benchmark, the number of records in a dataset that exceed a benchmark, and the magnitude of exceedance of the benchmark. This model is flexible, allowing one to choose the parameters to use and standardize them according to the objectives and area of study [11], such as, guidelines for the protection of aquatic life may be used (when available) if the index is being calculated to quantify ecological health of the water, or drinking water quality guidelines may be used if the interest in the index is in drinking water safety. Alternatively, information describing natural background conditions for a station or region may be used as benchmarks when trying to quantify deviation from natural conditions, they can provide a benchmark for evaluating successes and failures of management strategies aimed at improving water quality [12]. Sites at which water quality measurements never or rarely exceed the benchmark have high CWQI scores (near 100), whereas sites that routinely have measurements that exceed benchmarks have low CWQI scores (near 0).

The parameters used in this work:

Total dissolved solid (TDS)

The sources which cause the increase in the amount of TDS or the total amount of dissolved ions in the streams may be due to: 1) Wastewater disposal, 2) runoff from roads salt when it rains and 3) nutrients (from fertilizers) and pesticides (insecticides and herbicides mostly) typically have significant negative impacts on streams receiving agricultural drainage water..

The level of TDS in aquatic systems is important to aquatic plants and animals as species can survive only within certain salinity ranges. Although some species are well-adapted to surviving in saline environments, growth and reproduction of many species can be hindered by increases in salinity [13]. .

PH and Alkalinity

The pH of an aquatic ecosystem is important because it determines the solubility and biological availability of chemical constituents such as nutrients and heavy metals, in addition to affecting how much and what form of phosphorus is most abundant in the water, pH may also determine whether aquatic life can use it. In the case of heavy metals, the degree to which they are soluble determines their toxicity. Metals tend to be more toxic at lower pH because they are more soluble. Although the tolerance of individual species varies, pH values between 6.5 and 8.5 usually indicate good water quality and this range is typical of most major drainage basins of the world.

Although small changes in pH are not likely to have a direct impact on aquatic life, they greatly influence the availability and solubility of all chemical forms in the water and may aggravate nutrient problems. For example, low pH may increase the solubility of phosphorus, making it more available for plant growth and resulting in a greater long-term demand for dissolved oxygen [14].

Turbidity and Suspended Solid.

Turbidity refers to water clarity. The greater the amount of suspended solids in the water, the murkier it appears, and the higher the measured turbidity. Suspended solids in streams are often the result of sediments carried by the water, as depicted by the relationship between discharge and suspended solids. The source of these sediments includes natural and anthropogenic (human) activities in the watershed, such as natural or excessive soil erosion from agriculture, forestry or construction, urban runoff, industrial effluents, or excess phytoplankton growth. Turbidity is often expressed as total suspended solids and the major impacts of turbidity on humans might be simply aesthetic because people don't like the look of dirty water. However, turbidity also adds real costs to the treatment of surface water supplies used for drinking water since the turbidity must be virtually eliminated for effective disinfection (usually by chlorine in a variety of forms) to occur. Particulates also provide attachment sites for heavy metals such as cadmium, mercury and lead, and many toxic organic contaminants such as PCBs, PAHs and many pesticides [14].

Temperature

Temperature affects the speed of chemical reactions, the rate at which algae and aquatic plants photosynthesize, the metabolic rate of other organisms, as well as how pollutants, parasites, and other pathogens interact with aquatic residents. Temperature is important in aquatic systems because it can cause mortality and it can influence the solubility of dissolved oxygen (DO) and other materials in the water column (e.g., ammonia). Water temperatures fluctuate naturally both daily and seasonally. The maximum daily temperature is usually several hours after noon and the minimum is around daybreak and varies seasonally with air temperature.

Aquatic organisms often have narrow temperature tolerances. Thus, although water bodies have the ability to buffer against atmospheric temperature extremes, even moderate changes in water temperatures can have serious impacts on aquatic life, including bacteria, algae, invertebrates and fish [14].

Dissolved Oxygen

Oxygen that is dissolved in the water column is one of the most important components of aquatic systems. Oxygen is required for the metabolism of aerobic organisms, and it influences inorganic chemical reactions. Oxygen is often used as an indicator of water quality, such that high concentrations of oxygen usually indicate good water quality. Oxygen enters water through diffusion across the water's surface, by rapid movement such as waterfalls or riffles in streams (aeration), through the roots of plants, or as a by-product of photosynthesis. The amount of dissolved oxygen gas depends highly on temperature and it is inversely proportional to the temperature of the water. Salinity also influences dissolved oxygen concentrations, such that oxygen is low in highly saline waters and vice versa[14].

CCME equations used to quantify WQI:

The index equation used in this work is based on the water quality index (WQI) endorsed by the Canadian Council of Ministers of the Environment (CCME, 2001) [6, 11].

$$\mathrm{WQI} = 100 - \frac{\sqrt{(\mathrm{F1})^2 + (\mathrm{F2})^2 + (\mathrm{F3})^2}}{1.732} \,..(1)$$

The CCME WQI model consists of three measures of variance from selected water quality objectives (Scope; Frequency; Amplitude). The "Scope (F1)" represents the extent of water quality guideline non-compliance over the time period of interest. The "Frequency (F2)" represents the percentage of individual tests that do not meet objectives or guidelines ("failed tests"). The "Amplitude (F3)" represents the amount by which failed tests do not meet their objectives or guidelines. These three factors combine to produce a value between 0 and 100 that represents the overall water quality. Therefore, the index reflects the quality of water for both health and acceptability, as set by the World Health Organization. The index is determined on an annual basis resulting in an overall rating for each station per year. This will allow both spatial and temporal assessment of national water quality to be undertaken.

$$\mathrm{F1} = \left(\frac{\mathrm{No.\,of\,failed\,parameters}}{\mathrm{Total\,No.\,of\,parameters}}\right) \times 100 \quad \ldots\ldots\ldots (2)$$

$$\mathrm{F2} = \left(\frac{N\mathrm{o.\,of\,failed\,tests}}{\mathrm{Total\,No.\,of\,tests}}\right) \times 100 \;\ldots\ldots\ldots.(3)$$

The Amplitude F3 is calculated in three steps:

A)-Excursion is the number of times by which an individual concentration is greater than (or less than, when the objective or guideline is a minimum) the objective. In the case of temperature and pH where a maximum and minimum guideline is given, the following two equations must be run to calculate the excursion:

- When the test value must not exceed the objective or guideline:

$$\mathrm{Excursion} = \left(\frac{\mathrm{failed\,tests\,value}}{\mathrm{Objective\,value}}\right) - 1 \,..(4)$$

- When the test value must not fall below the objective or guideline:

$$\text{Excursion} = \left(\frac{\text{Objective value}}{\text{failed tests value}}\right) - 1 \quad ..(5)$$

B)-The normalized sum of excursions (nse), is the collective amount by which individual tests are out of compliance. This is calculated by summing the excursions of individual tests from their objectives and dividing by the total number of tests (both those meeting objectives and those not meeting objectives).

$$\text{nse} = \frac{\sum \text{excursion}}{(\text{Total No. of tests})} \quad \ldots(6)$$

C)-F3 is then calculated using a formula that scales (nse) to range between 1 and 100:

$$\text{F3} = \frac{\text{nse}}{(0.01\text{nse} + 0.01)} \quad \ldots(7)$$

The WQI is then calculated using equation (1) which generates a number between 1 and 100, with 1 being the poorest and 100 indicating the best water quality.

Water quality classification

The water quality has been classified by CCME (2005) as poor, marginal, fair, good or excellent and the same designations were used in this work, table (1).

As the goal was to develop a national index, the parameters selected were based on those in the Iraqi standard for Drinking Water No. 417/2001 (Table 2).

Calculation and Analysis:

The analysis of water quality conditions of 11 streams pouring into Um Alnaaj Marshland at Misan governorate relied upon available water quality data conducted by the marshland unit of the ministry of environment at Misan governorate during 2010.Therefore, the evaluation of the water quality in this study is based on a qualitative evaluation of existing data and a consolidation of the associated findings.

Data Collection:

The data was obtained from the marshland unit of the ministry of environment at Missan governorate which included monthly measurement of six parameters, total dissolved solid (TDS), pH, electrical conductivity (EC), turbidity(TU), Temperature and dissolved oxygen (DO) during 2010 for 11 streams as well as the Um Alnaaj marsh, in which the streams pour their water into, are used in this assessment work (tables 3-7). The water measurements were made twice a month from one selected position in each stream and five positions inside the body of Um Alnaaj marsh.

Data calculation & Representation:

The "Scope (F1)" which represents the extent of water quality guideline non-compliance over the time period of interest, The "Frequency (F2)" which represents the percentage of individual tests that do not meet objectives or guidelines ("failed tests") and The "Amplitude (F3)" which represents the amount by which failed tests do not meet their objectives or guidelines were calculated for each parameter and for each stream using equation (2) for F1, equation (3) for F2 and equations (4),(5),(6) and (7) for F3 , than the value for WQI for each stream and the marshland was calculated using equation (1), (tables8&9).

Data analysis:

Tables (8&9) and chart (1) shows that the WQI of stream Al-kasarah was rated as marginal which indicate that its conditions often depart from natural or desirable levels (table1), 7 other streams were rated as fair indicating that their conditions sometimes depart from natural or desirable levels and the remaining 3 streams were rated as good with conditions rarely depart from natural or desirable levels. However, when all these streams join and pour their water into Um Alnaaj marsh the water quality was improved and the WQI of the marsh becomes good throughout the year and this can be explained through the capability of the different types of plants and bacteria, usually present in natural wetland, in removing pollutant and improving water quality [15, 16].

TDS data analysis:
From table (3) and chart (2) we can see the TDS readings of 2 out of the 11 streams were deviating from the guideline used in this study (Iraqi standard No.417/2001 for drinking water) and the readings of the other 9 streams were within the guideline value through the whole year. However, after the streams water entered the marshland its TDS quality has improved and all the measured TDS values, inside the marshland, were well below the upper limit of the guideline.

PH and Alkalinity data analysis: Table 4 and chart 3show that during cold weather most of the streams have low pH during January, February and to lower extent in November and December. However, all other pH values recorded meats the guideline of the Iraqi standard No.417/2001 for drinking water.

Turbidity and Suspended Solids
Table 5 and chart 4 show that the turbidity of all streams exceeds the guideline value. The causes of high turbidity may include clays and silts from shoreline erosion and organic detritus from stream and/or wastewater discharges. However, when the water from the streams enter the (Um Alnaaj) marshland the turbidity was improved dramatically and that is due to the capability of the plants in marshland to slow the flow of water and adsorb suspended particles which improve the sedimentation process [15].

Temperature
Table 6 and chart 5 show that during summer season the temperature values were somewhat exceeding the guideline in all streams and marshland.

Dissolved Oxygen
Table 7 and chart 6 show that all the dissolved oxygen values were good and above the acceptable lower limit.

Table (1) water quality classification and designation according to CCME (2005)

Designation	Index value	Description
Excellent	95-100	All measurements are within objectives virtually all of the time
Good	80 - 94	Conditions rarely depart from natural or desirable levels
Fair	65 - 79	Conditions sometimes depart from natural or desirable levels
Marginal	45 - 64	Conditions often depart from natural or desirable levels
Poor	0 - 44	Conditions usually depart from natural or desirable levels

Table (2) Iraqi Standard No.417/2001 for drinking water.

parameters	**units**	**Iraq standard**
Temperature	^0C	
turbidity	NTU	5
Alkalinity as CaCO3	Mg/l	
T. Hardness as CaCO3	Mg/l	500
Calcium as Ca	Mg/l	150
Chloride as Cl	Mg/l	350
Magnesium as Mg	Mg/l	100
pH	units	7-8.5
Color	units	10
Conductivity	µs/cm	
Free chlorine	Mg/l	
Sulfate as SO4	Mg/l	400
Total dissolved solids	Mg/l	1000
Suspended solids	Mg/l	
Iron as Fe	Mg/l	0.3
Fluoride as F	Mg/l	1.0
Aluminum as Al	Mg/l	0.2
Nitrite as NO2	Mg/l	3
Nitrate as NO3	Mg/l	50
Ammonia as NH3	Mg/l	
Silica as SiO2	Mg/l	
Orthophosphate as PO4	Mg/l	

Table 3- TDS monthly measurement.

TDS												
Rivers feeding Um Alnaaj marsh	TDS Values for 2010											
	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sept	Oct	Nov	Dec
Nadim Almesharah R0705178 38 UTM3525371	675	640	785	755	810	700	760	710	750	745	860	920
Almesharah river end R0742395 38 UMT3513891	1048	1070	1205	1300	780	835	900		1465	940	945	1030
Nadim Alkahla R0705178 UTM 38 3525371	710	620	820	755	740	700	720	710	745	810	875	940
Alhusaigy R0737409 UTM 38 3495265	785	700	855	760	725	685	775	760	710	790	940	1050
Um altos R0742131 UTM 38 3500791	765	700	825	790	730	685	760	750	735	795	910	890
Al- R0740466 38kasarah UTM 3485923	1655	1430	1320	999	865	1410	1395	860	1450	1390	1635	1800
Albraida front R0681465 UTM 38 3504021	780	680	695	680	840	700	710	780	755	800	865	830
Albraida end R0676051 UTM 38 3503607	905	795	815	755	1225	735	740	770	820	775	935	970
Abo Ejel bridge R0713629 UTM 38 3478056	908	775	755	850	805	780	800	810	740	820	945	990
Alwadeya R06711714 UTM 38 3480534	880	690	710	805	735	790	720	810	630	840	950	900
Albtaira R0699920 UTM 38 3483195	855	810	810	755	1040	765	840	730	750	740	875	930
Um Alnaaj marsh		710	742	736	724	680	806	760	750	816	896	936
Guideline	≤1000											

Table 4- Monthly measurement of pH.

pH												
Rivers feeding Um Alnaaj marsh	قراءات pH حسب الاشهر لسنة 2010											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Nadim Almesharah	6.9	6.3	7.6	7.2	8.4	7.2	7.0	7.5	6.3	7.6	7.3	8.5
Almesharah river end	5.8	6.4	7.5	8.5	7.7	6.6	6.5		7.3	7.2	7.5	6.8
Nadim Alkahla	6.4	7.1	7.7	7.3	7.3	7.1	7.4	7.9	7.4	6.7	6.6	6.5
Alhusaigy	5.6	6.3	7.0	7.0	7.2	6.3	7.2	7.0	7.3	6.6	5.5	5.1
Um altos	5.5	6.8	7.4	7.5	6.9	7.2	7.4	7.1	7.1	6.9	6.8	7.7
Al-kasarah	5.6	5.9	6.6	7.4	7.0	7.1	7.3	6.9	7.0	6.1	5.7	7.1
Albraida front	5.7	6.6	6.9	7.8	8.0	7.6	6.3	7.4	6.9	6.9	6.8	7.9
Albraida end	5.7	7.4	7.5	7.8	7.1	6.7	6.6	7.1	6.5	6.4	6.6	6.2
Abo Ejel bridge	4.8	6.3	6.6	7.4	6.9	7.1	7.4	6.5	6.9	7.3	7.1	6.5
Alwadeya	6.4	5.6	6.2	6.8	6.9	6.6	6.9	6.6	6.8	7.0	6.3	8.4
Albtaira	5.5	6.0	6.9	7.3	6.9	7.0	6.4	7.0	6.9	6.9	6.4	6.0
Um Alnaaj marsh		6.5	7.1	7.1	7.2	7.5	7.0	7.0	6.4	7.6	5.6	6.4
Guideline	6.5-8.5											

Table 5- Turbidity monthly measurement

TU (mg/l)												
Rivers feeding Um Alnaaj marsh	TU Values for2010											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Nadim Almesharah	35.0	27.1	18.8	25.5	58.5	51.8	55.0	27.7	29.8	15.9	12.0	8.8
Almesharah river end	11.8	21.6	1.0	16.1	75.5	19.5	22.0		15.4	17.0	27.0	20.0
Nadim Alkahla	41.8	32.1	20.6	28.1	84.0	48.4	43.0	35.7	30.0	13.7	23.5	16.7
Alhusaigy	9.3	17.6	12.1	19.0	71.7	79.0	58.2	27.0	31.0	44.5	15.8	2.1
Um altos	22.9	20.9	26.8	16.0	92.0	68.0	58.5	32.5	39.5	42.5	35.5	9.9
Al-kasarah	7.8	9.5	11.2	8.1	41.7	18.2	20.4	13.1	19.1	19.5	3.7	3.5
Albraida front	10.8	11.1	11.9	21.0	16.1	24.2	26.6	20.1	15.1	19.0	18.9	17.0
Albraida end	33.3	18.9	27.2	24.0	32.3	27.6	25.7	35.7	23.5	35.7	9.7	6.5
Abo Ejel bridge	9.0	10.8	14.5	30.4	37.9	16.6	30.0	15.9	14.4	14.7	9.5	12.7
Alwadeya	12.6	5.0	10.9	19.6	20.5	18.4	17.0	39.2	27.3	22.3	12.8	12.0
Albtaira	2.8	0.5	12.9	5.4	13.2	6.5	6.9	9.0	5.8	7.0	7.6	4.5
Um Alnaaj marsh		0.7	0.8	0.4	0.3	4.6	2.7	1.8	1.5	4.2	2.4	0.3
Guideline	≤5											

Table 6- Temperature monthly measurement.

Temperature (Centigrade)												
Rivers feeding Um Alnaaj marsh	Values for 2010Temperature											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Nadim Almesharah	14.3	13.6	18.2	21.0	25.8	28.7	27.0	30.5	36.2	22.5	19.1	19.3
Almesharah river end	15.3	14.0	23.5	24.0	34.0	28.5	30.0		31.8	23.5	19.5	18.0
Nadim Alkahla	14.7	13.1	18.5	25.5	25.2	30.0	27.0	30.3	25.0	22.3	17.6	19.8
Alhusaigy	15.1	13.8	25.2	26.0	26.1	27.2	27.5	39.0	27.3	24.0	16.5	14.0
Um altos	15.6	13.8	20.7	21.3	25.7	29.7	27.9	39.4	27.3	24.0	17.4	15.0
Al-kasarah	15.8	12.5	10.7	18.8	26.5	30.3	27.7	29.9	29.0	24.2	17.5	15.1
Albraida front	15.0	14.5	13.7	21.5	25.7	27.9	25.5	29.3	28.0	24.7	17.9	22.0
Albraida end	15.4	13.9	17.5	21.5	25.8	30.1	26.3	29.8	26.5	25.2	17.8	23.0
Abo Ejel bridge	14.5		19.4	22.0	27.6	29.6	28.3	30.7	28.7	25.0	16.8	13.5
Alwadeya	14.5	14.0	18.1	23.0	27.1	28.8	26.5	30.3	23.7	24.7	17.0	23.0
Albtaira	14.7	13.1		23.5	27.4	28.4	28.0	30.5	28.7	22.0	18.3	17.0
Um Alnaaj marsh		16.3	20	25.8	26	27.2	27.9	33.3	28.2	21.4	15.1	13.1
Guideline	8-25											

Table 7- Dissolved Oxygen monthly measurement

DO (mg/l)												
Rivers feeding Um Alnaaj marsh	DO values for 2010											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Nadim Almesharah	8.9	10.7	11.0	8.4	10.8	9.2	8.0	17.9	7.8	10.5	17.1	7.0
Almesharah river end	10.3	10.8	9.5	9.8	11.5	11.0	11.0		6.9	6.0	11.0	6.0
Nadim Alkahla	9.9	11.3	12.0	8.5	10.3	8.8	8.0	17.0	7.0	9.9	12.0	7.8
Alhusaigy	11.7	12.5	9.4	10.0	10.1	8.4	9.1	11.0	8.0	8.3	10.1	4.8
Um altos	12.5	14.0	10.0	9.0	8.2	9.0	8.4	12.2	9.8	9.3	9.4	5.8
Al-kasarah	8.9	8.0	8.1	9.4	10.1	9.5	9.4	10.4	17.3	7.8	9.5	4.5
Albraida front	12.1	10.9	11.0	7.0	10.4	8.3	8.7	7.7	9.5	7.5	8.7	6.8
Albraida end	9.8	12.1	13.0	8.8	12.6	8.9	9.6	10.1	10.0	6.8	7.4	7.0
Abo Ejel bridge	8.7	13.1	11.9	8.0	9.2	8.5	8.9	19.3	9.3	7.9	12.8	8.1
Alwadeya	9.5	11.2	13.2	11.5	8.2	11.5	9.4	8.0	8.7	8.2	9.0	9.0
Albtaira	13.5	14.0	12.5	8.8	10.2	9.4	8.7	8.0	10.9	10.5	10.7	11.0
Um Alnaaj marsh		12.3	9.1	11.6	10.7	11.1	10.1	12.6	9.9	12.2	8.7	5.7
Guideline	≥5.0											

Table (8):- The calculated Water Quality Index during 2010 and Quality classification.

Name of water body	Calculated WQI using equation (1)	Quality classification from table (1)
Nadim Almesharah	78.3	fair
Almesharah river end	76.1	fair
Nadim Alkahla	80.9	good
Alhusaigy	78.0	fair
Um altos	78.8	fair
Al-kasarah	64.2	marginal
Albraida front	80.0	good
Albraida end	73.8	fair
Abo Ejel bridge	76.9	fair
Alwadeya	77.8	fair
Albtaira	81.3	good
Um Alnaaj marsh	87.7	good

Table (9):- Monthly & yearly averaged values of WQI for all the streams and marshland

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Average
WQI of the 11 streams	68.4	71.1	82.8	83.6	69.1	66.4	67.1	67.0	67.6	79.9	79.6	69.4	**73 FAIR**
WQI of marshland	88	100	100	86.5	83.7	83.7	81.8	83.7	78.2	95.3	85.2	86.5	**88 GOOD**

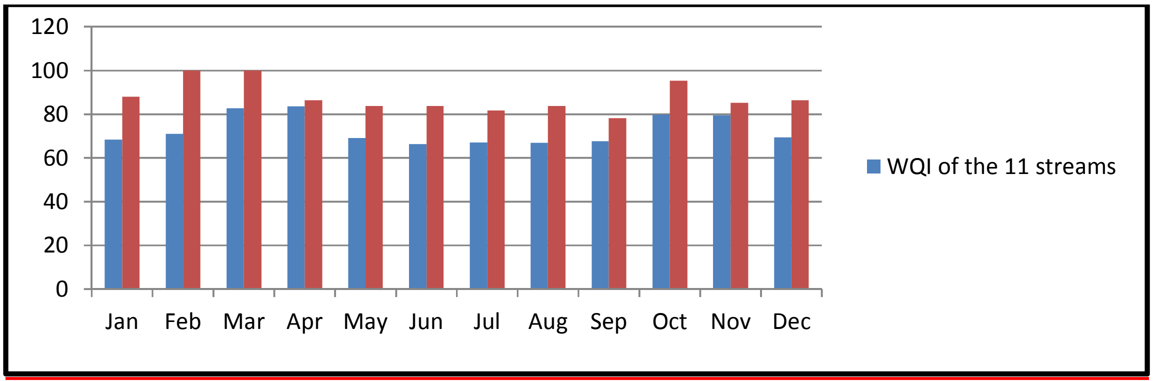

Chart (1) Comparison of WQI monthly values of the 11 streams with that of the marshland

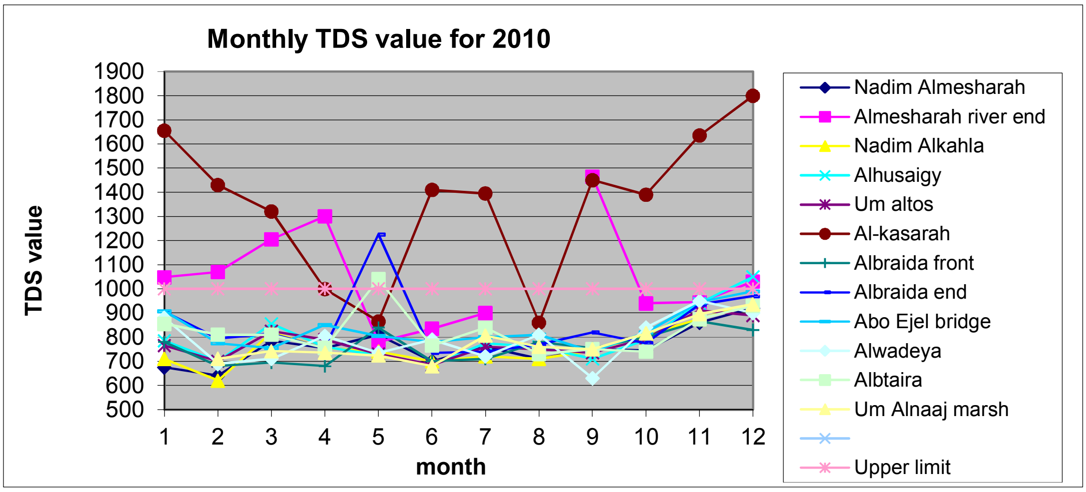

Chart 2- monthly TDS values for 2010

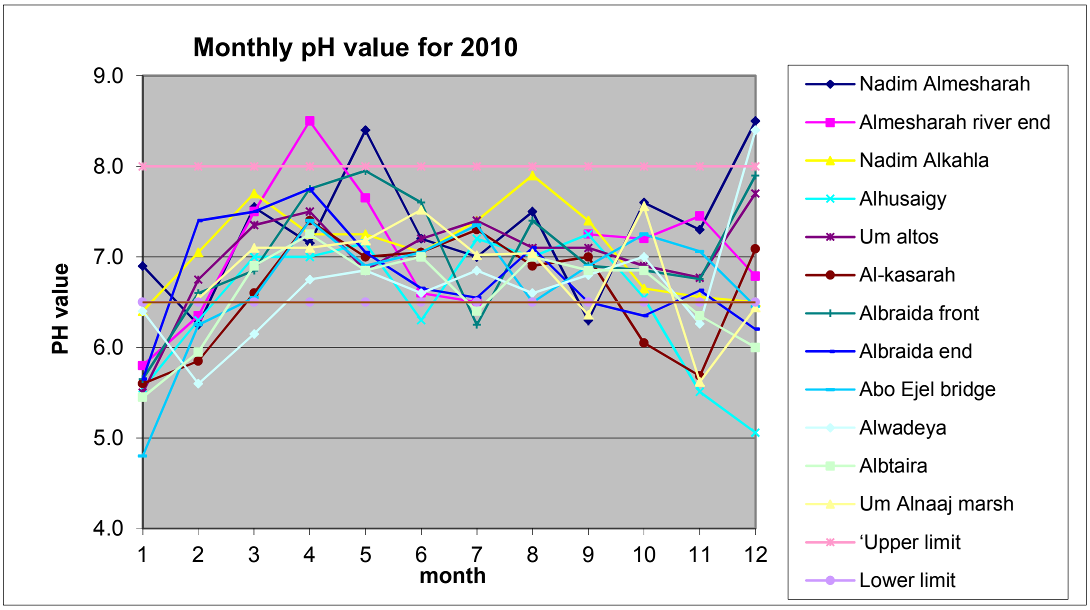

Chart 3- monthly pH values for 2010

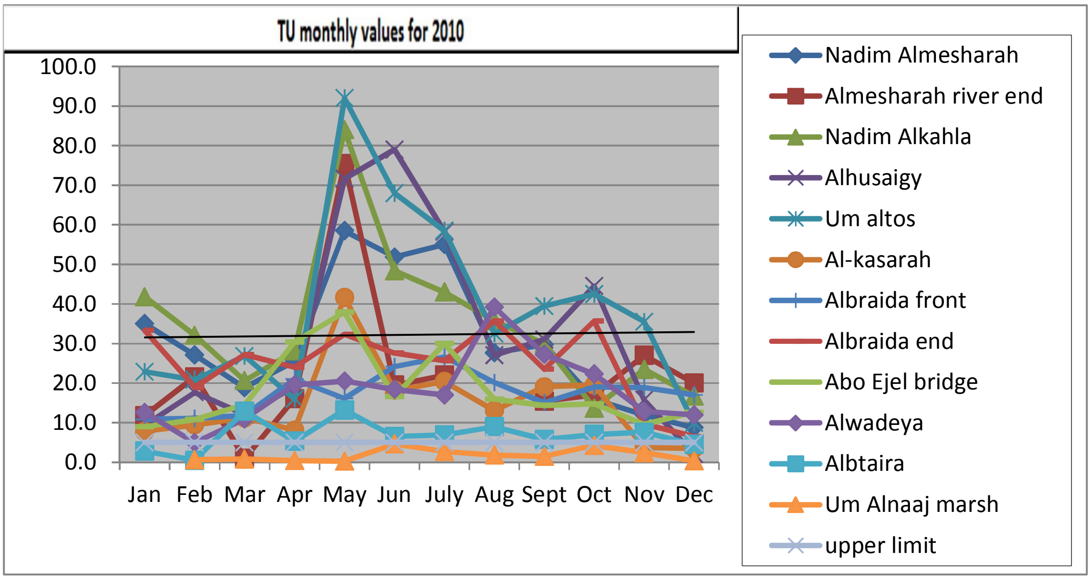

Chart 4- monthly turbidity values for 2010

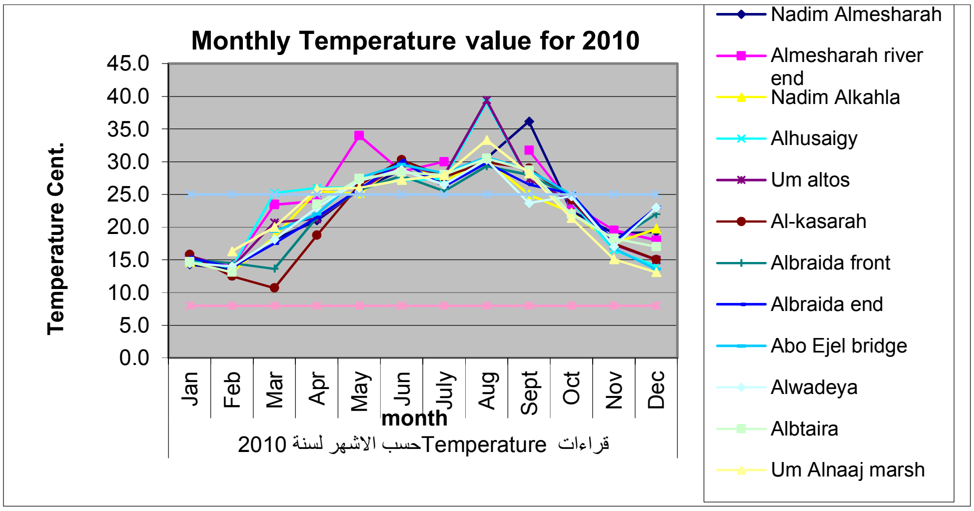

Chart 5- monthly temperature values for 2010

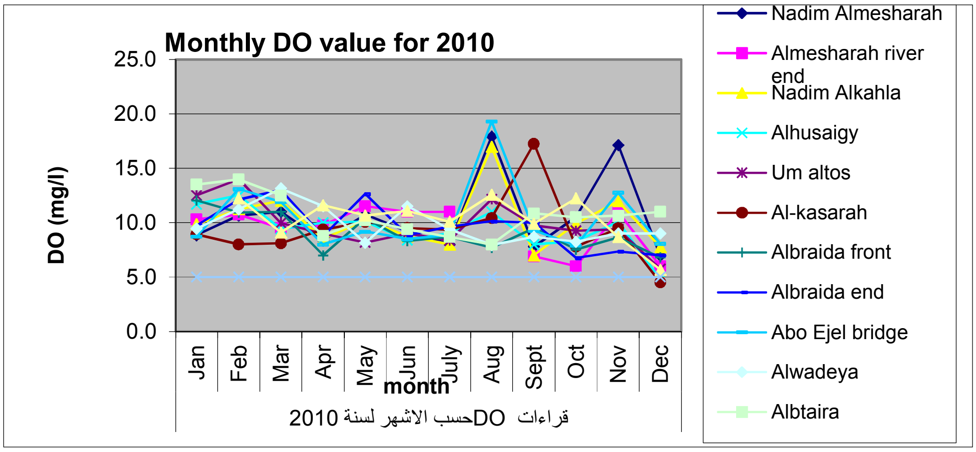

Chart 6- monthly dissolved oxygen values for 2010

Discussion:

The general finding of this work showed that the average WQI value (table9)of the 11 streams, feeding Um-Alnaaj marshland was rated as fair based on 2010 data while the quality of water inside the marsh was ranging from good to excellent.

However the evaluation of the WQI of each stream showed (table 8) that stream Al-kasarah had the worst quality and was rated as marginal which indicate that its conditions often depart from natural or desirable levels (see table1), 7 other streams (Nadim Almesharah,Almesharah river end, Alhusaigy,Um altos, Albraida end, Abo Ejel bridge, Alwadeya) were rated as fair indicating that their conditions sometimes depart from natural or desirable levels and the remaining 3 streams (Nadim Alkahla, Albraida front, Albtaira) were rated as good with conditions rarely departed from natural or desirable levels and when all these streams join and pour their water into Um Alnaaj marsh the water quality was improved and the WQI of the marsh was good throughout the year.

Effect of concerned parameters:

Turbidity effect: The turbidityin all the streams was consistantly exceeding the maximum concentration acceptable in the Iraqi standard, No.417/2001 for drinking water, which was used as a guideline (table 5 and Chart 4). In order to improve the overall WQI of the streams,the source of turbidity must be pinpointed and measures must be taken to reduce the cause of this high turbidity or the suspended solid which might be due to inorganic substances as clay, rock flour, silt, calcium carbonate, silica, iron, manganese, sulfur, or industrial wastes and /or by organic substances such as various microorganisms, finely divided vegetable or animal matter, grease, fat and oil. However, the turbidity inside Um-Alnaaj marsh was good throughout the year because most of the sources of turbidity were resolved due to the capability of marshes, as wetlands, in the degradation of organic pollutant and reducing water flow rate, by the marshland plants, which also helps the sedimentation and adsorption processes of suspended particles.

TDS effect:

The TDS values for all the streams and the marsh were good except for: a)Al-kasarah stream TDS exceeded the standard limit, by big margin, in 9 months of the year 2010 and this had participated in its low WQI value (marginal table 3). b)Almesharah river end TDS exceeded the standard limit, but with smaller margin than Al-kasarah stream, but for six (6) months of the year only.

The causes that increased the TDS or the total amount of dissolved ions in the streams might be attributed to, 1) Wastewater disposal, 2) runoff from roads salt upon raining and 3) nutrients from fertilizers and pesticides such as insecticides and herbicides which typically have significant negative impacts on streams receiving agricultural drainage water

Effect of pH

The pH values (table 4 and chart3) of all the streams and the marsh were good all round the year except few scattered values, during cold weather, showed low pH which may be caused by acid compounds from roads and river shore dissolved by heavy rains or high inflow rate.

Temperature effect:

During summer season (table 6 and chart 5) temperature values of all streams and marsh were higher than the drinking water standard (417\2001), but it is normal at this time of year.

DO effect: the values for dissolved oxygen (DO) were all accepted (table 7 and chart 6) which create suitable environment for fish and other living creatures.

Conclusion:

-The CCME method for WQI calculation was successfully used in this work and gave good water quality indication.

-In this work, where the standard for drinking water was used in the calculations, the WQIs of all streams and Um-Al-Naaj marsh was ranging from fair to good, however if the standard for river water quality was used instead of the standard for drinking water all WQI values would have been excellent

References:

1. Abdul Hameed M. Jawad Alobaidy, Haider S. Abid, Bahram K. Maulood, Application of Water Quality Index for Assessment of Dokan Lake Ecosystem, Kurdistan Region, Iraq Journal of Water Resource and Protection, 2010, 2, 792-798

2. K. A. Rahi and T. Halihan, “Changes in the Salinity of the Euphrates River System in Iraq,” Regional Environment Change, Vol. 10, No. 1, 2010, pp. 27-35.

3. C. Jones, M. Sultan, E. Yan, A. Milewski, M. Hussein, A. Al-Dousari, S. Al-Kaisy and R. Becker, “Hydrologic Impacts of Engineering Projects on the Tigris-Euphrates System and its Marshlands,” Journal of Hydrology, Vol. 553, No. 1-2, 2008, pp. 59-75.

4. United Nations Environment Program GEMS/Water program2008, loaded from http://www.gemswater.org/

5. Global Drinking Water Quality Index Development and Sensitivity Analysis, 2007 United Nations Environment Program Global Environment Monitoring System/Water Program.

6. Azhar Al-Saboonchi, Abdul-Razak M. Mohamed, Abdul Hameed M. Jawad Alobaidy, Haider S. Abid3, Bahram Maulood Journal of Environmental Protection, 2011, 2, 316-322.

7. M.B. Chougule, A. I. Wasif and V. R. Naik, “Assessment of Water Quality Index (WQI) for Monitoring Pollution of River Panchganga at Ichalkaranji” Proceedings of International Conference on Energy and environment, Chandigarh, March 2009, pp. 122-127.

8. R. D. Harkins, "An Objective Water Quality Index," Journal of Water Pollution Control Federation, Vol. 46, No. 5, July 1974, pp. 588-591.
9. D.Hallock,"Water Quality Assessment of the Nooksack River between Brennan and North Cedarville," Technical Report, Washington Department of Ecology, Environ-mental Assessment Program, 2002.
10. Ibrahem Abed & Ghasak Sabah, "Water Quality Index for Iraqi Marshlands" Nature Iraq, Vol. 4, No.1, summer 2008.
11. Canadian Council of Ministries of the Environment (CCME), "Canadian Water Quality Index 1.0 Technical Report and User's Manual," Canadian Environmental Quality Guidelines, Technical Subcommittee, Gatineau, 2001.
12. C. J. Rickwood and G. M. Carr, "Development and Sensitivity Analysis of a Global Drinking Water Quality Index," Environmental Monitoring and Assessment, Vol. 156, No. 1-4, September 2009, pp. 73-90.
13. Friedl, G., Teodoru, C. and Wehrli, B. 2004. "Is the Iron Gate I reservoir on the Danube River a sink for dissolved silica?" Biogeochemistry 68:21-32.
14. Michaud, J.P.A citizen's guide to understanding and monitoring lakes and streams. Washington State Dept. of Ecology, Publications Office, Olympia, Publ. No.94-149 (1991), WA, USA (360) 407-7472.
15. M. Alsaad. "Municipal wastewater treatment using reed bed eco-technology" Al-Nahrain University College of engineering Journal, Vol.11, No.3, 2008, pp 494-505.
16. M. Alsaad. "Improving nutrient removal in constructed wetland wastewater treatment" Iraqi petroleum research center magazine, Journal of petroleum research & studies, No.3, 2011, pp. 44-64

معامل النوعية لمياه عدد من الأنهرالتي تصب في هور أم النعاج

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الخلاصة:
تم تقيم نوعية المياه في هور أم النعاج مع أحد عشر (11) نهرا, أو جدولا تصب فيه باستخدام معامل النوعية المقر من قبل لجنة البيئة لمعامل نوعية المياه في مجلس الوزراء الكندي و الذي يعتمد في احتسابه على ثلاثة عوامل : المجال (F1) وهو يمثل ذلك العدد من المواصفات التي استخدمت في حساب معامل النوعية ولكنها لاتحقق أهداف المواصفة المطلوب تحقيقها , التردد (F2)يمثل عدد المرات التي لاتتحقق فيها ألأهداف المطلوبة, السعة F3)) وهو المدى الذيلاتتحقق فيه ألأهداف. يتراوح الناتج من احتساب معاملالنوعية بين (0) صفر ويدل على النوعيةالرديئة و(100) يدل على النوعية الممتازة. وقد تم استخدام المواصفة العراقية لمياه الشرب وخمسة متغييرات وهي درجة الحرارة وألاوكسجين المذاب والمواد الصلبة الذائبة ودرجة الحموضة و كدرة الماء لاحتساب معامل نوعية المياه في هذه الدراسة. تم تحليل نتائج حساب معامل النوعية لسنة 2010 والتي أظهرت بأن معدل مواصفة ألأنهر المغذية لهور ام النعاج كانت مقبولة وهذا يعني بأن مواصفة المياه في هذه ألأنهركانت في بعض ألأحيان خارج السماحات المقبولة في المواصفة العراقية بينما مواصفة المياه في هور أم ألنعاج كانت تتراوح بين جيدة الى ممتازة.