Assessment of Water Resources Quality at the Southeastern Part of the Nile Delta, Egypt

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Abstract

The Nile Delta is located in the arid zone belt of northeast Africa. The water resources include both surface water (canals and drains) and groundwater withdrawn from the Quaternary aquifer. The Quaternary aquifer classified into two hydrogeological units; the upper unit is the Holocene aquitard and the lower one is the Pleistocene aquifer. The changes of lithological composition and thickness of the Holocene aquitard make the Pleistocene aquifer more vulnerable to contamination. Besides, the water-seepage from a recently developed brackish-water pond at Abu Zaabal Quarries may contaminate shallow groundwater of the Pleistocene aquifer. The objective was to study the impact of local hydrogeological conditions and human activities on water resources at the southeastern part of the Nile Delta (El Khanka area). To achieve that, water level map of the Pleistocene aquifer, thickness map of the Holocene aquitard, hydrogeological cross sections are constructed. Surface water and groundwater samples chemically and bacteriologically analyzed. The distribution maps for different pollutants in groundwater are carefully studied. Results indicate that both surface water and groundwater in the study area are suffering from quality problems related mainly to natural and human-related factors. High concentrations of salinity, major elements, nitrate, and trace elements are detected in the water samples. The number of E. Coli bacteria is high in surface water and shallow groundwater. So, water treatment before drinking is a must.

Keywords: Environmental impact- water resources -SE Nile Delta

1-Introduction

The area under investigation lies in the southeastern part of the Nile Delta. It is bounded by longitudes 31° 15', 31° 30' E and latitudes 30° 05', 30° 20' N (Fig. 1). Groundwater of the Quaternary aquifer plays a vital role for satisfying water requirements for domestic, agricultural and industrial purposes. During the last few years, the problem of groundwater contamination has been intensified mainly due to natural and human-related factors. It is common practice in rural areas that people dispose sewage via earth closets and septic tanks, from which sewage water percolates to groundwater. Shallow groundwater (<40m depth) in dense populated areas require special considerations, particularly in rural area where it may used in domestic purposes. Groundwater vulnerability to pollution is mainly influenced by the thickness of clay cap; recharge rate to groundwater; and depth to water (RIGW / IWACO, 1998 and Awad et al., 2002).

2- Aim and methods of study

The present work aims to evaluate the impact of local hydrogeological conditions and human activities on water resources at El Khanka area. To achieve this purpose, field and laboratory measurements carried out for the collected surface water and groundwater samples (Figs. 1&2). Both surface water and groundwater samples analyzed for major ions, nitrates, and trace elements, in addition to detection of Coliform group and Escherichia Coli bacteria also done. Besides, constructions of water level map of the Pleistocene aquifer, thickness map of the Holocene aquitard, hydrogeological cross sections and distribution maps for different pollutants in groundwater.

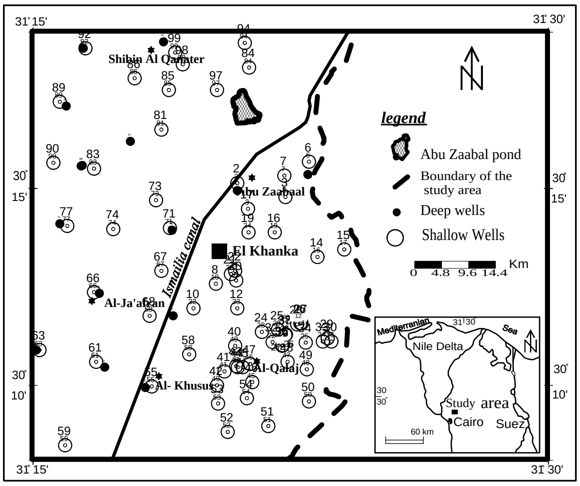


Fig. (1) Location map of the study area and well sites

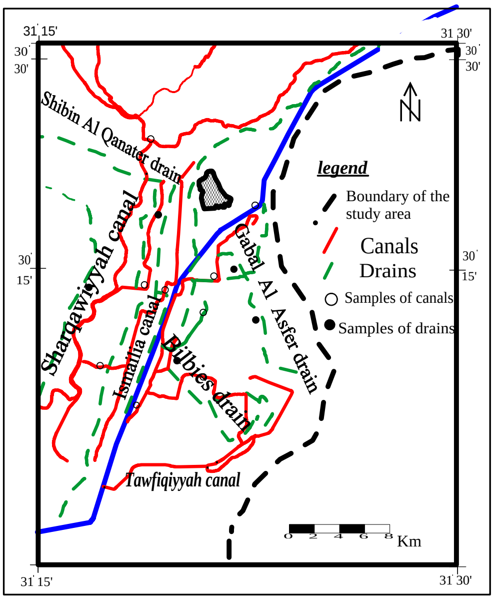


Fig. (2) irrigation canals and drains in the study aea

3- Geology

Many authors have discussed the geology of the eastern part of the Nile Delta area, including the study area, among them is: Shata and El Fayoumy (1970), El Diary (1980) and RIGW (1989). Generally, the Quaternary sediments belonging to the Pleistocene and Holocene mainly cover the study area. Basaltic rocks belonging to Upper Oligocene age exposed at Abu Zaabal Quarries while Miocene and Pliocene sediments outcrop at the eastern portions (Figs 3 and 4). The lithostratigraphy of the area summarized from base to top as follow:

1-Basaltic sheet belongs to Upper Oligocene is exposed at Abu Zaabal Quarries and has an average thickness of about 30 m. The basalt exists also at variable depths and appears to be structurally controlled. It is underlain by weathered Oligocene sandstone (30-100m thick) of Lower Oligocene and overlain by the Quaternary or/ and the Miocene sediments.

2-The Miocene sediments are composed of course sand and gravel with limestone intercalations. The thickness of these sediments reaches 40 m in their outcrops at El-Menaiyer Quarries. The recorded subsurface Miocene sediment in Ismailia canal environs is 225m in thickness.

3-The Pliocene sediments are exposed at the eastern part of the investigated area. They are formed of clay, sand, gravelly sand with limestone interbeds. The Pliocene clay is overlain by the Quaternary deposits in the Nile Delta flood plain with a thickness of about 200m.

3-The Pleistocene sediments are exposed at the eastern parts of the studied area, composed of sand and gravel intercalated with clay lenses. They are overlain by the Holocene Nile silt and clay and rest unconformably on the Miocene sediments or the Oligocene Basaltic sheet. The Pleistocene sediments have a variable thickness, at the eastern parts, the thickness ranges from 0 to nearly 50m, while at the northwestern part of the investigated area, and they may reach 200m.

4-The Holocene Nile silt and clay deposits are occupying the majority of the western portions. Their thickness changes from place to place, ranges from 0 to 20m. Sand dunes belong to the same age are found at the eastern portion.

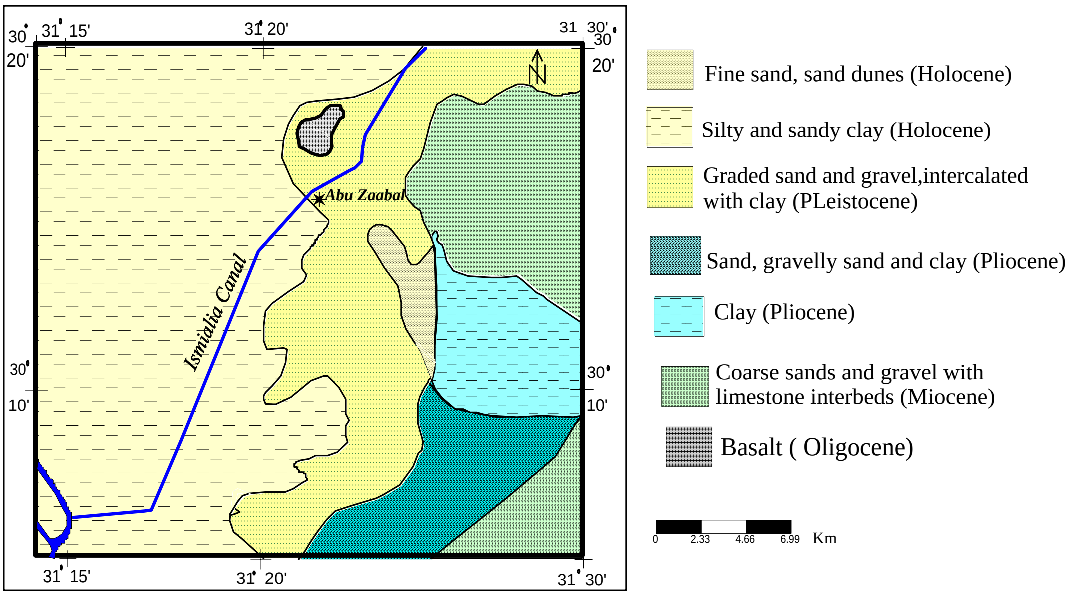
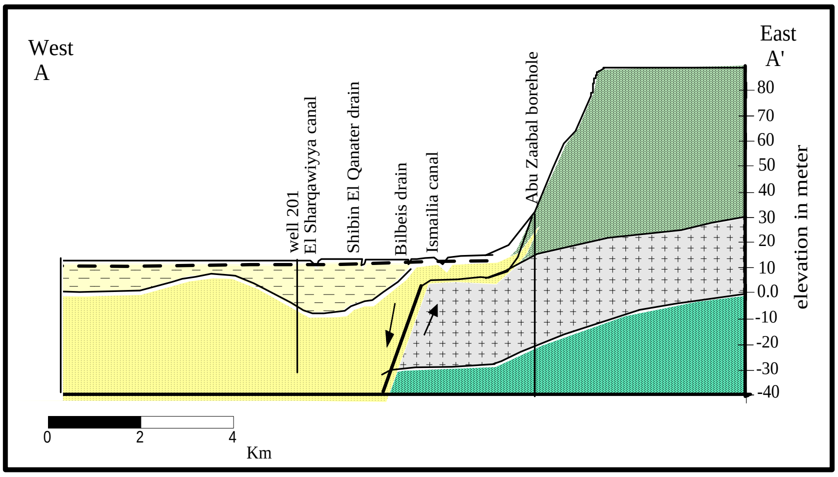
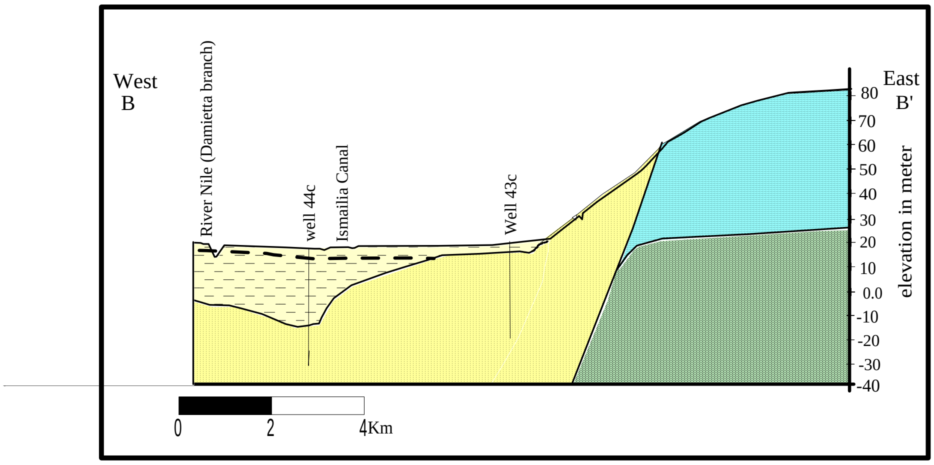


Fig. (3) Geologic map of the study area (after RIGW, 1989)



Cross section A



Cross section B

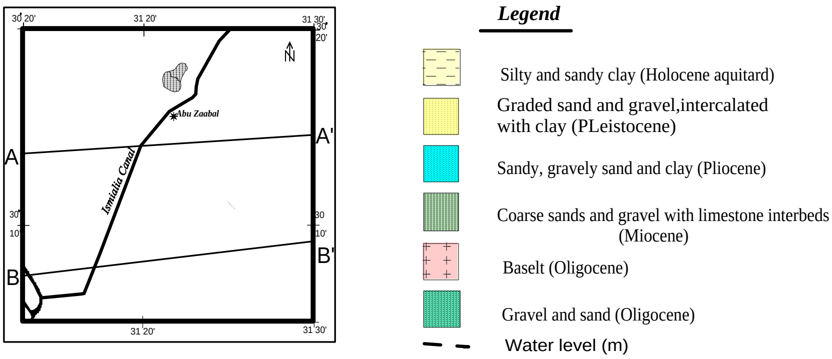


Fig. (4) Hydrogeological cross section at various location (after RIGW, 1989)

4-Hydrogeology

Many detailed works have discussed the hydrogeology of east Nile Delta area, among them are; Diab et al. (1984), Korany et al. (1993), Taha et al (1997), Eweida et al. (1999), and Yehia (2000). They have discussed the hydrogeological conditions, the type of aquifers and they investigate some problems in Abu zaabal quarries. Now new hydrogeological conditions developed in Abu Zaabal Quarries. The deepening of the Quarries and removal of basaltic sheet associated with continues groundwater flow either from the Oligocene aquifer or seepage from Ismailia canal lead to the development of a water pond filled with brackish water. The development of such pond may impair groundwater quality of the Quaternary aquifer due to the existence of the faults and joints, which facilitate the hydraulic connection between the existed water in the pond and the groundwater in the Quaternary aquifer.

4.1 Surface water system

The surface water system (Fig. 2) comprises a set of canals (Ismailia canal, El Sharqawiyah canal, El Tawfiqiyah canal, Kashmir El Yumna canal and Kashmer El Yusra canal) and a set of drains (Belbies drain, Shibin El Qanater drain and Gabal Al Asfer drain). Generally, the surface water levels of canals increase in summer and decrease in winter in response to the water quantities entered these canals. The canals and drains are passing through Nile silt and clay deposits belonging to Holocene. However, the Nile silt and clay deposits disappeared and the canals and drains are passing through the Pleistocene sediments. Generally, surface water system directed into large population densities and activated industrial areas. Untreated liquid wastes and effluents directly discharged into canals, drains and on land surface. Because of the small thickness of the clay cap, contaminated water infiltrates contaminating the Pleistocene aquifer.

4.2 Groundwater system

The Quaternary deposits in the Nile Delta form one of the most important aquifer in Egypt. The Quaternary aquifer is discriminated into two hydrogeological units; the upper unit is Holocene aquitard and lower one is the Pleistocene aquifer (RIGW 1989, Taha et al. 1997 and Yehia 2000).

The Holocene aquitard is composed of Nile silt and clay and changes locally from clay to silt and even sand. It has a reduced thickness, ranges between 0 m at the eastern portions to 20 m at the southwestern part of the investigated area. The changes of lithological composition and thickness of this unit makes the Pleistocene aquifer more vulnerable to contamination.

The Pleistocene aquifer consists of sand and gravel with clay lenses. It has a variable thickness, at the eastern parts, the thickness ranges from 0 to nearly 50m, while at the northwestern part of the investigated area, they may reach 200m. The Pleistocene aquifer is overlain by the Holocene aquitard and underlain by the Pliocene clay in the majority of the area. Around Abu Zaabal Quarries, it is underlain by Miocene sediments or the Oligocene

Basaltic sheet. Depending on the thickness and lithologic variations of the Holocene aquitard, the Pleistocene aquifer changes from semi-confined to unconfined in nature (Figs. 3, 4 and 5). The groundwater movements in the Pleistocene aquifer are mainly due north and northwest (Fig. 6). This means that Ismailia canal is the main recharging source as the surface water level in the canal is higher than the groundwater level. Beside, the recharges from irrigation canals and return flow after irrigation. Other local sources of recharge recognized such as septic tanks, landfill, and sewer system. The main discharge of the Pleistocene aquifer takes place artificially through pumping wells used for irrigation and domestic uses.

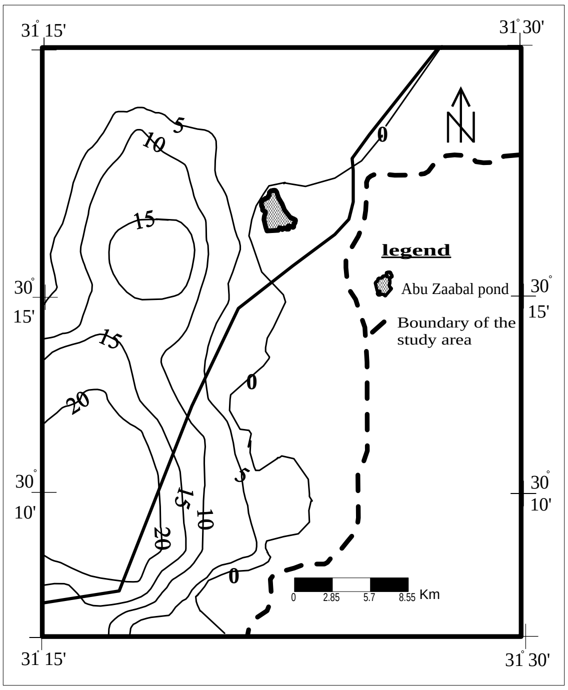


Fig. (5) Isothickness map of the Holocene aquitard (modefied after RIGW, 1989)

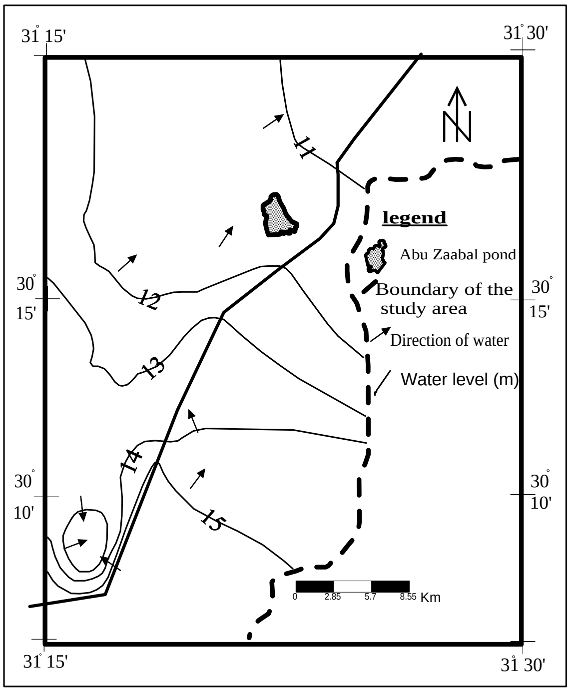


Fig. (6) Water level contour map of the Quaternary aquifer(after RIGW, 1989)

5-Water quality problems

Both surface water and groundwater in the study area are suffering from quality problems. Pollution can impair the use of water and can create hazards to public health through toxicity or the spread of disease. Problems of groundwater quality degradation related mainly to natural and human-related factors. The following discussion based relevant on chemical and bacteriological analyses of surface water and shallow groundwater samples collected from the study area and compared with WHO (2004) standards.

5.1- Surface water quality

The studying of the hydrochemical compositions of surface water indicate that the salinity ranges between 258.9 and 375.8 ppm in canals, while they varies from 406.6 to 1454.4ppm in drains. The concentrations of trace elements (barium, copper, vanadium, chromium, lead, arsenic, nickel, zinc, cadmium, strontium, selenium, antimony and tin), phosphate and nitrate (Table 1) are within the permissible limits of drinking water. With the exception of some elements such as iron, manganese and aluminum show high concentrations in some canals (Ismailia, El Sharqawiyyah and El Salamainaya) and drains (Gabal Al Asfer and Belbies drains).

Table (1) Average salinity and ions contents (ppm) in surface water

Ions	**Canals**	**Drains**	**Ions**	**Canals**	**Drains**
TDS	258.8 - 375.8	406.6-1454.4	Sodium	24- 46	45- 300
Cl	30 - 36	59-242	Potassium	4.5-7	13.5-21.5
SO4	8 - 156.5	105.4 -521.4	Magnesium	12.96- 17.28	17.76-53.76
HCO3	81.74 -201.3	113.46 - 566.1	calcium	27.2- 77.5	40.6-113.6
NO3	0.7 – 0.75	13.8 – 14.7	Nickel	0.005 - 0.01	0.005 – 0.03
Phosphate	< 0.2	< 0.2	Aluminum	0.014 - 1.21	0.087 – 0.412
Iron	0.03 – 0.5	0.4 – 0.55	Barium	0.016 – 0.23	- 0.092
Manganese	0.078 – 0.202	- 0.368	Zinc	0.007 – 0.022	- 0.117
Copper	0.002 - 0.017	0.002 – 0.021	Cadmium	0.0005– 0.002	0.0005- 0.001
Vanadium	0.005- 0.053	0.015- 0.033	Strontium	0.021 – 0.228	0.207 - 1.83
Cobalt	- 0.032	- 0.024	Selenium	<0.01	<0.01
Chromium	- 0.048	- 0.002	Antimony	<0.02	<0.02
Lead	0.005 – 0.063	0.005 – 0.038	Tin	<0.03	<0.03
Arsenic	<0.01	<0.01			

Results of bacteriological analyses indicate that the number of total Coliform group reaches 43/100ml and E. coli reaches 5/100ml in water samples collected from Ismailia canal at El Khusus and El Sharqawiyyah canal.

5.2- Groundwater quality

5.2.1- Total dissolved salts

Shallow groundwater samples classified as fresh to brackish water, where the total dissolved salts ranges between 299.9 and 2241.9ppm. Deep groundwater samples classified as fresh water, where the total dissolved salts varies from 370.2 to 976.7 ppm (Table 2). The salinity content of shallow groundwater is higher than the deeper one. The areal distribution of salinity content in shallow groundwater wells (Fig. 7) shows the presence of three zones located at the center; the northeastern and the northwestern portions of the study area are characterized by good potable water of low salinity (TDS < 500ppm). These zones surrounded by a major zone characterized by fresh water of salinity content ranges between 500 and 1000 ppm. The eastern, southwestern and the northwestern parts of the study aquifer classified as polluted zones where the salinity content varies from 1000 to over 2000ppm and exceeds the permissible limits for drinking.

5.2.2- Major elements

The major constituents of dissolved solids in groundwater samples are the following cations calcium, magnesium, sodium, and potassium and the following anions chloride, sulfate and bicarbonates. The average ions contents (ppm) in groundwater listed in table (2). Ions contents of shallow groundwater are higher than the deeper one.

Table (2) Average salinity and ions contents (ppm) in groundwater

Ions	shallow wells (10-20m)	deep wells (80-100m)	Ions	shallow wells (10-20m)	deep wells (80-100m)
TDS	299.8-2241.9	-370.2 976.7	Sodium	30-980	44-205
Chloride	31- 593	41-192	Potassium	3-110	4.5-21.5
Sulfate	10.6-740	100.3-479.7	Magnesium	7.2-161.76	20.64-91
Bicarbonate	93.94-562.4	101.26-294.02	calcium	8.8-372	39.2-81.6
Nitrate	4.6 – 65.3	-	Nickel	0.005-0.022	0.005-0.022
Phosphate	< 0.2	< 0.2	Aluminum	0.01-0.6	0.01-0.6
Iron	0.2-1.46	0.2-1.25	Barium	0.005-0.22	0.007-0.105
Manganese	0.2-1.9	0.03-1.33	Zinc	1-3.4	0.1-0.75

Copper	0.02-0.058	0.02-0.058	Cadmium	0.0005-0.004	0.0005-0.004
Vanadium	0.005 - 0.115	0.003-0.03	Strontium	0.2-3.54	0.19-1.6
Chromium	0.002-0.003	0.002-0.003	Selenium	<0.01	<0.01
Lead	0.02-0.05	0.02- 0.05	Antimony	<0.02	<0.02
Arsenic	<0.01	<0.01	Tin	<0.03	<0.03

The areal distribution of sodium, calcium, magnesium, sulfate and chloride contents in shallow groundwater wells (Figs. 8 -12, inclusive) shows the following:

1- The lowest concentrations of these ions noticed beside the Ismailia canal, this reflect the positive hydrochemical impact of this canal on groundwater quality.

2- The concentrations of these ions increase in the northern, eastern and western portions of the study area. The probable sources of these high contents of pollutants are mainly due to infiltration of domestic, agricultural and industrial wastes arise from the development of human activities.

3-The sodium content in the shallow wells varies from 30 to 570 ppm (Table, 2). High concentrations of sodium (>200 ppm) are recorded at Abu Zaabal, El Khanka, El Marj, Al Qalaj, Shibin Al Qanater and Balqs (Fig. 8).

4-The concentration of sulfate in groundwater ranges between 10.6 ppm and 740ppm in shallow wells. The areal distribution of sulfate content in shallow groundwater (Fig. 11), indicate that the majority of study area characterized by high concentration of sulfate (250 ppm to 740 ppm). The lowest concentrations of sulfate noticed beside Ismailia canal.

5-The chloride contents in shallow groundwater vary from 31 to 593 ppm (Table 2). The majority of study area is characterized by low chloride concentration (<250 ppm). Local polluted zones of high chloride contents (ranges between 250 ppm and 593 ppm) recorded at the northern, eastern and western portions of the study area (Fig. 12).

The discharge of human, animal, industrial wastes and irrigation return flows may add substantial quantity of sodium, chloride and sulfate to groundwater. Consumption of water with high concentrations of sodium may affect persons with cardiac difficulties and hypertension. High concentrations of sulfate and chloride ions (>250 ppm) may produce objectionable taste and act as laxative on unacclimated users (Hem, 1985 and Probe et al., 1999). Chloride and sulfate ions accelerate the corrosion of metals used in water-supply wells at shallow depths (El-Fakharany et al., 1997).

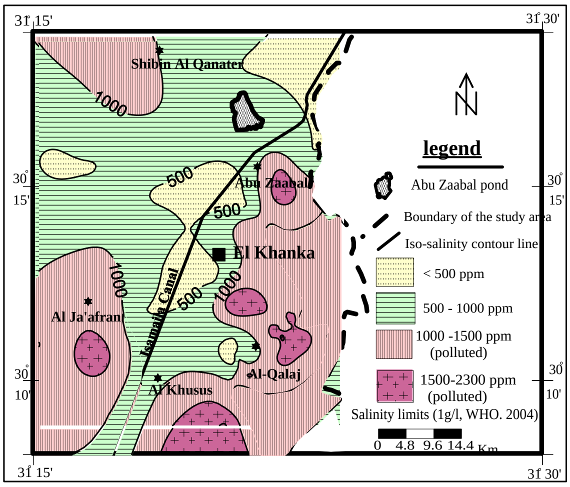


Fig. (7) Salinity content distribution map of the Quaternary aquifer (shallow wells)

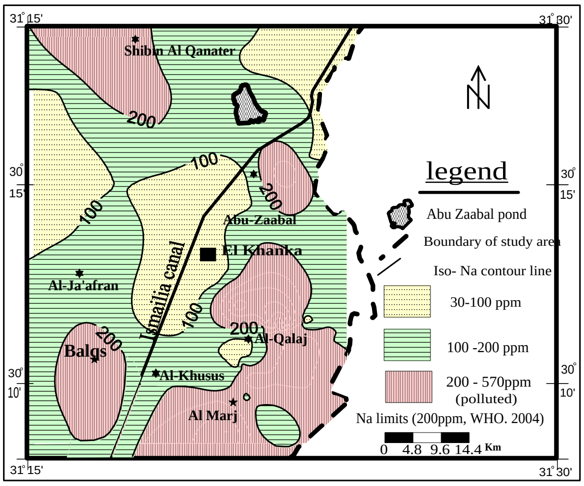


Fig. (8) Sodium content distribution map of the Quaternary aquifer (shallow wells)

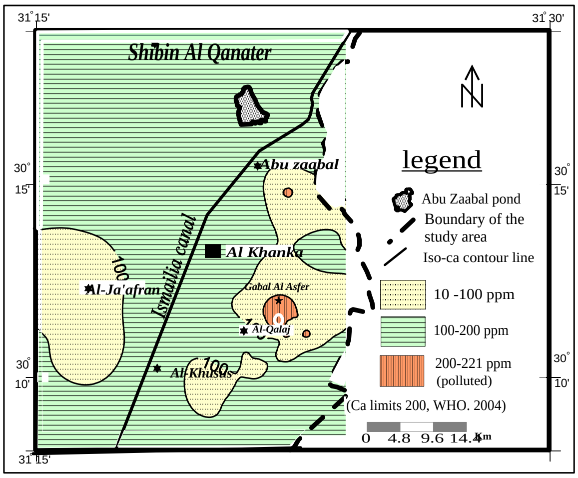


Fig.(9) Calcium content distribution map of the Quaternary aquifer (shallow well)

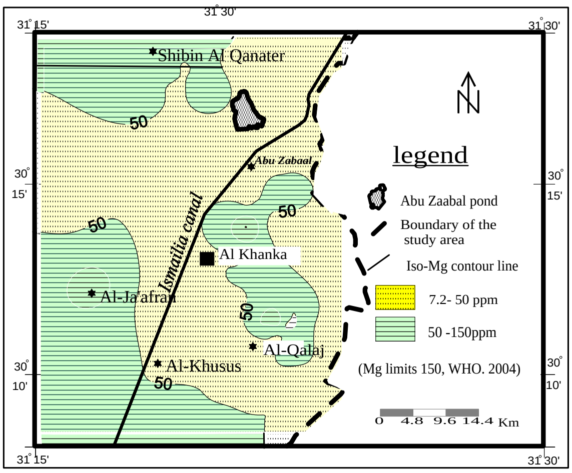


Fig.(10) Magnesium content distribution of the Quaternary aquifer (shallow well)

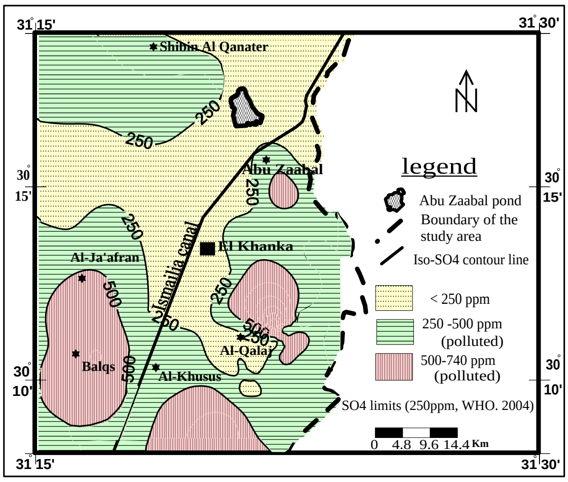


Fig. (11) Sulfate content distribution map of the Quaternary aquifer (shallow wells)

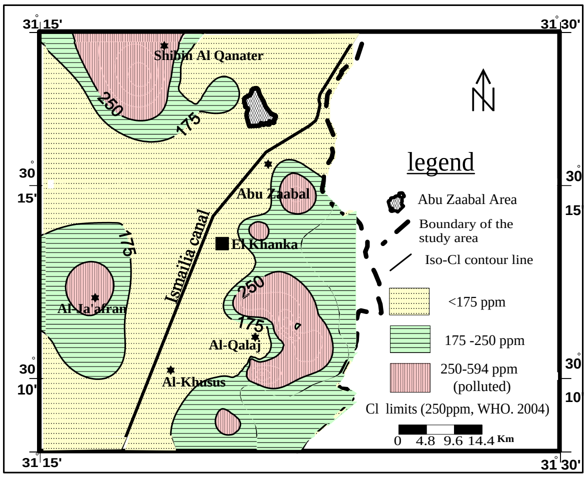


Fig. (12) Chloride content distribution map of the Quaternary aquifer (shallow wells)

5.2.3- Nutrients

Sources of groundwater contamination by nitrate are classified into point and non-point sources. Non-point sources of nitrogen include fertilizers, manure application, leguminous crops, dissolved nitrogen in precipitation, irrigation return-flows, and dry deposition. Point sources such as septic systems and cesspits can also be major sources of nitrate pollution (Almasri and Kaluarachchi, 2005; Santhi et al., 2006; Tait et al., 2008).

The areal distribution of nitrate in shallow groundwater (Fig. 13) shows that the majority of the studied area characterized by nitrate concentration > 10 ppm. High nitrate concentrations (40 - 65ppm) recorded at the southern parts (at Al Qalaj, El Khusus and Bahtim), while low contents (< 10 ppm) noticed at the northeastern portion (along Ismailia canal). The phosphorus is one of the macronutrients essential for plant growth, agricultural, domestic detergent and industrial sewage effluents represents important source of phosphorous in natural water. The phosphate concentrations in shallow and deep wells are less than 0.2 ppm and still under the permissible limits.

5.2.4- Trace elements

The concentrations of the trace elements found in groundwater (Cu, Fe, Mn, Zn, V) are much higher in shallow aquifer due to anthropic activities (Heredia and Cirelli, 2009). Trace elements such as copper, lead and zinc are used as structural or decorative components of buildings and as protective coating against corrosion and oxidation of framework or base metal. Large quantities of some trace metals have been released with effluent discharge from industrial activities (Probe et al., 1999). Based on the limits presented by WHO (2004), the concentrations of trace elements (barium, copper, vanadium, chromium, lead, arsenic, nickel, zinc, cadmium, strontium, selenium, antimony and tin) in groundwater are within the acceptable limits for drinking and domestic uses. Iron, manganese and aluminum contents are over the acceptable limits. Excess of absorbed iron being stored primarily in the liver, bone marrow and spleen resulting in many dangerous diseases (WHO, 1984b). High manganese contents cause stain laundry and objectionable in food processing, dyeing, bleaching ice manufacturing, brewing and certain other industrial processes (Heath, 1987).

The recommended maximum concentration of iron in drinking is 0.3 ppm (U.S.EPA 2000) to avoid staining. The concentration of iron in shallow groundwater of the Quaternary aquifer ranges between 0.2 ppm and 1.46 ppm, while it varies from 0.2 ppm and 1.25 ppm in deep groundwater (Table, 2). The distribution contour map of iron in shallow groundwater (Fig. 14) shows that, the majority of the studied area characterized by iron concentration more than 0.3 ppm. Therefore, the shallow groundwater of the Quaternary aquifer is unsuitable for drinking in the majority of the study area.

The concentration of manganese in the shallow groundwater of the Quaternary aquifer ranges between 0.107 ppm at Gabal Al Asfer to 0.8 ppm at El Khanka, while it varies from 0.016 at El Khusus to 1.37 ppm at Kawm Ishfin in deep groundwater. Therefore, the concentration of manganese in shallow groundwater is unfit for drinking as the manganese content > 0.4 (WHO, 2004) except the area along the Ismailia canal (Fig. 15). Deep groundwater is suitable for drinking, except at Kawm Ishfin village (manganese content > 0.4 ppm).

The concentration of aluminum in shallow groundwater of the Quaternary aquifer ranges between 0.005 ppm at Izbet Youssef and 0.585 ppm at Shibin Al Qanater (Fig. 16), while it varies from 0.01 ppm at Abu Zaabal and 0.55 ppm at Nawa in deep groundwater (Table, 2). Shallow groundwater and deep groundwater is unfit for drinking (Al > 0.2 ppm), except the area along Ismailia canal.

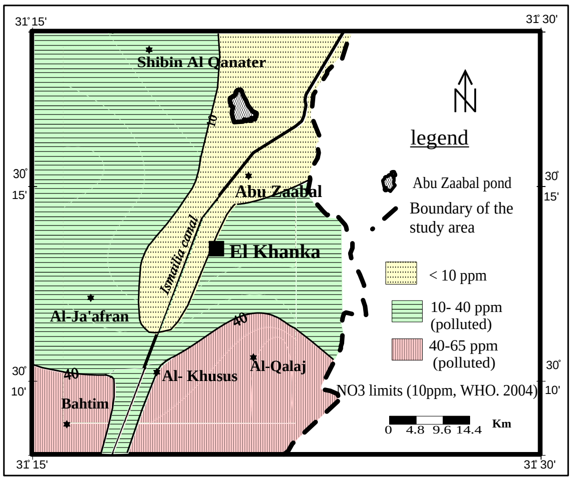


Fig. (13) Nitrate content distribution map of the Quaternary aquifer (shallow wells)

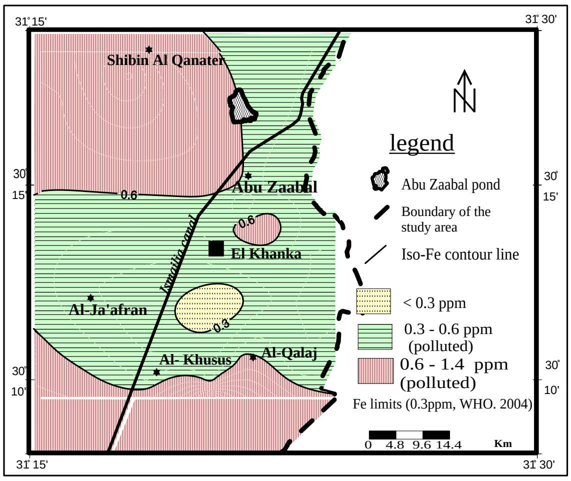


Fig. (14 Iron content distribution map of the Quaternary aquifer (shallow wells)

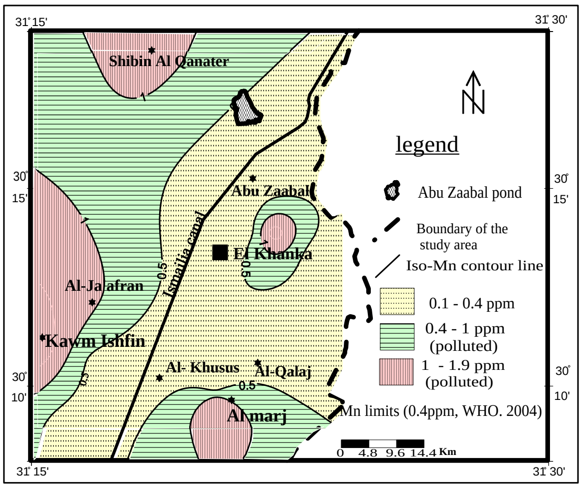


Fig. (15) Manganses content distribution map of the Quaternary aquifer (shallow wells)

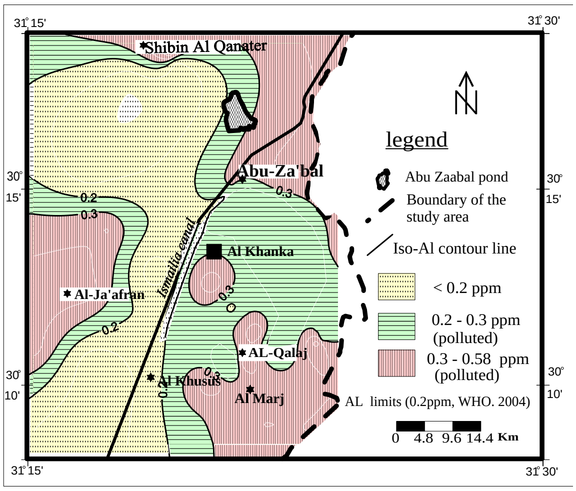


Fig.(16) Alumnium content distribution of the Quaternaryaquifer (shallow well)

5.2.5- Bacteriological analyses

The results of bacteriological analyses for shallow groundwater samples (Table, 3) indicates that the total Coliform count/100ml various from 3 to 1200/100ml. The MPN of E. Coli bacteria ranges between 1 and 110/ 100ml. Generally, it is concluded that the number of Coliform and E. Coli decreases with depth. Deep groundwater (at more than 40m depth) has no bacteriological pollution (El-Fakharany and El-Refaee, 2001).

Table (3) Bacteriological analyses of shallow groundwater samples.

location	Total colony count/ ml	Coliform count/ 100ml	MPN E.coli/ 100ml	Location	Total colony count/ml	Coliform count/ 100ml	MPN E. coli/ 100ml
Abu Zaabal	5300	63	4	Al Marj	700	7	1
Gabal A Asfer	400	3	0	El Khusus	110000	1200	11
Al Khanka	110000	1200	110	Balqs	1500	15	2
Al Qalaj	400	5	1	Kom Ashfin	1500	15	2
Qaryat 2 July	350	3	0	Kafer El Shobak	300	5	0
Shibin Al Qanater	450	4	1	Kafer Shibi	1610	15	2

6- Conclusion

The Quaternary sediments dominating the study area classified into two hydrogeological units, the upper unit is the Holocene aquitard and the lower one is the Pleistocene aquifer. The Holocene aquitard is completely disappeared at the eastern portion of the area and the Pleistocene aquifer become more vulnerable to contamination.

Chemical and bacteriological analyses of water samples indicate that both surface water and groundwater in the study area are suffering from quality problems. The concentrations of sodium, sulphate, chloride, nitrate, iron, manganese and aluminum in shallow wells (at Abu Zaabal, El Khanka, El Marj, Al Qalaj, Balqs and Shibin El Qanater) exceed the permissible limits for drinking. The probable sources of these high contents of pollutants are mainly due to infiltration of domestic, agricultural and industrial wastes arise from the development of human activities. The lowest contents of such pollutants noticed beside the Ismailia canal, reflecting the positive hydrochemical impact of this canal on groundwater quality. The number of E. Coli bacteria is high in surface water and shallow groundwater. So, water treatment before drinking is a must.

7- Recommendations

1-Treatment of surface water and shallow groundwater before drinking is a must.

2-Sanitary drainage must be generalized or well-designed septic tanks could be used.

3-The use of pesticides and fertilizers should be controlled and minimized according to environmental law and farmers must be advised to its applications.

4-Human and industrial wastes should not direct to the canals and drains.

5-Upgrading of villager's information on defecting of throwing dumps in canals and drains is necessary.

6-Introducing restrictions on the use of untreated or partially treated sewage water for irrigation.

7-The drains must be covered and lined to prevent seeps directly into groundwater

8-Water level in Abu Zaabal pond is controlled by groundwater simulation

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التأثير البيئي علي مصادر المياه فى الجزء الجنوبي الشرقي من دلتاِ النيل، مصر

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تقع دلتاِ النيلِ في الحزام الجاف من شمل شرق أفريقيا، ويشهد الجزء الجنوبي الشرقي من الدلتا في الوقت الحاضر نموُ حضريُ سريعُ ولذلك فإنّ مصادر المياهَ تَعاني الآن من مشاكلِ التّلوثَ بسبب الظروف الهيدروجيولوجية المحلية و تزايد أنشطة الإنسان التي تفسد نوعيتها.

تهدف الدراسة إلى تقييّمَ التأثير البيئي على مصادر المياه السطحية والجوفية . ولأنُجازَ ذلك تم دراسة الظروف الجيولوجية والهيدروجيولوجية لمنطقة الدراسة ، وتم جمع عينات من المياه السطحيةِ و الجوفية وتم تحَلَيَّلهاُ كيميائيا وبكتريولوجيا. وقد تم دراسة توزيع الملوثات المختلفة فى المياه الجوفية ومقارنتها بالنسب المسموح بها للشرب.

وقد تبين أن مصادر المياه بمنطقة الدراسة تشمل المياه السّطحيةِ (الترع والمصارف) والجوفية المستخرجة من خزان الحقب الرابع ، والذي ينقسم إلي وحدتين هما طبقة الهولوسين شبه المنفذة وخزان البليستوسين ، وأن التغير في الليثولوجي وسمك طبقة الهولوسين شبه المنفذة واختفائها تماما في الجزء الشرقي من المنطقة يجعل خزان البليستوسين أكثر عرضة للتلوث. وقد بينت نّتائِج. التحَاليَّلُ الكيميائِيَةِ أن الملوحةِ وتركيز الأيونات الرئيسية، والعناصر الشحيحة والنترات فى المياه السطحية والجوفية يَتجاوزُ الحدود المسموح بها للشُّرْبِ من قبل منظمة الصحة العالمية وخاصة مياه المصارف والآبار الضّحلةِ. وهذا أكد وجود مصادرِ محليةِ للتلوثِ نَتجتْ من تسرّبِ مياه المجارى، والصرف الزراعي والصناعي . وقد استدل على تلوث المياه بمياه المجارى بوجود كائن الإشريشيا كولاى فى عينات المياه الجوفية والسطحية. لذلك فإن المياه السطحية والجوفية الضحلةِ يَجِبُ أنْ تُعاملَ بشكل كيميائي قبل الشُّرْبِ . هذا وقد انتهت الدراسة إلى مجموعة من التوصيات.