How to Adapt With Environmental Effect on Ain El-Sira Spring, El-Imam El-Shaffie Pools and Hazards

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General Outline :

The area study lying to east of Cairo. It is bounded on the western side by the river Nile and in the eastern side by Gebel El- Giaushy a portion of Mokattam Plateau Fig. (1).

It is lies between latitudes 29° 45\ N and 30° 17\ N. It extend from longitudes 31° 5\ E, to 31° 27\ E. It has a maximum width of about 2.5 km.

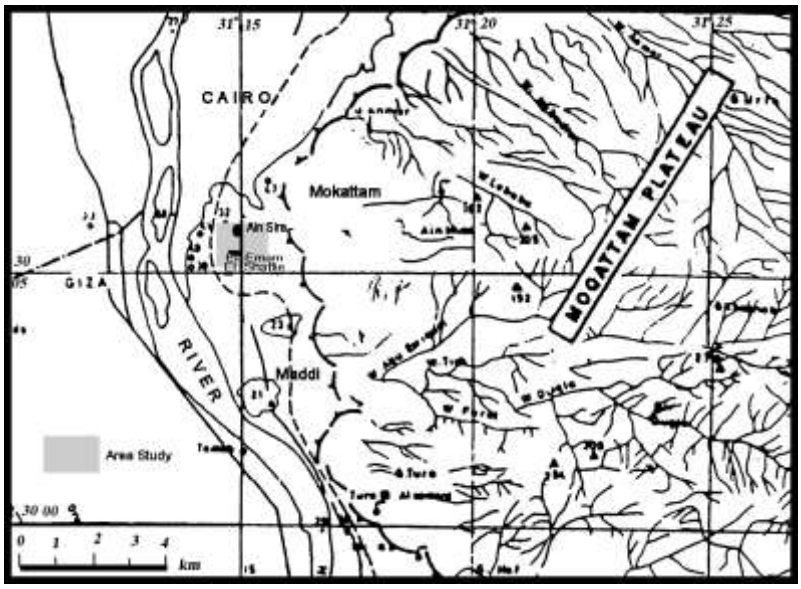

Fig. (1): Area study.

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Ain El-Sira spring and El-Imam El Shaffie pools are remarkable morphological features in the area study Fig. (2).

Fig. (2): Remarkable morphological features in the area study

Previous Work :

A little information is found about hydrogeochemisty of the area study in the work of ***Gastinel (1968), Sorour (1968), El-Ramly (1969) and Abu-Madour (1971)***. On the other hand, little information is found about the location and general features of the area study.

Objective :

The present study aims to realize the following :

(1) This study is focused on the Ain El-Sira spring and the El-Imam El-Shaffie pools.

(2) Studying Ain El-Sira spring, El-Imam El-Shaffie pools geometry and characteristic changes of water is essential for estimating future changes and how to adapt with them.

(3) This study also introduces simple attempt to establish some physical problems of the urban environment.

In this study, both field and laboratory work were used. In the field, general reconnaissance problems and hazards physical surveys, examination of the main water in Ain El-Sira spring and El-Imam El-Shaffie pools, and collection of samples of water for the chemical analysis carried out.

In the laboratory, the following investigation were carried out :

(1) Landsat ETM image used in /ERDAS Imagine, software to produce the physiographic map and physical hazards map.

(2) Chemical analysis of water samples collected from other localities.

1- Geomorphological Features :

Geomorphological features have a direct effect on the ground water resources. The following geomorphic features are bounded on Ain El-Sira spring and El-Imam El-Shaffie pools (Fig.).

(1) High land areas are formed of high topography, represented in Gebel-El-Gioushy, a portion of Gebel Mokattam.

(2) Narrow piedmont plains occupy a strip lying between the foot slopes of plateau and the flood plains deposits.

(3) Flood plains is more or less flat and slopes gently. It is composed of thick silt and sand deposits, which have accumulated during the Pleistocene.

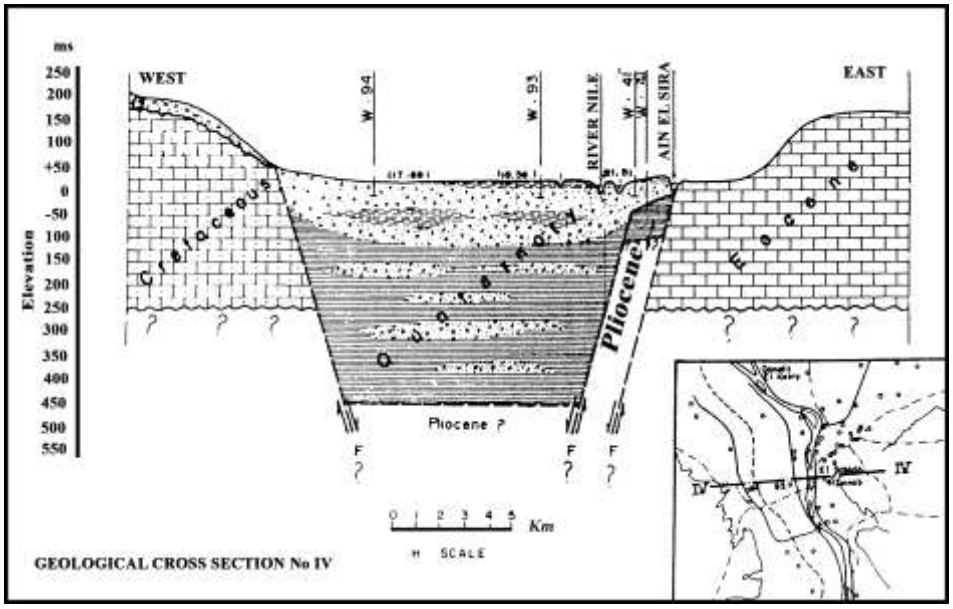
(4) The northern part of the plain is marked by both the Ismailie Canal and El Shashab Canal.

(5) River Nile bound Ain El-Sira spring and El-Imam El Shaffie pools at the west.

2- Surface and Subsurface Geology

Holocene deposits

The Holocene deposits form the base of the cultivated soil and most urban lands. These sediments composed of silty, clay and clay with fine sand. These sediment overly the Pleistocene graded sand and gravel unit. Most of the cultivated lands in the area study are built of these deposits. They are characterized by reflect great return-flow of water downward after irrigation in the western part, to replenish the groundwater in Quaternary aquifer.



Source: Institute for ground water Ministry of Irrigation 1982-1992.

Fig. (3): Geological cross section on Ain El-Sira spring

Pleistocene deposits

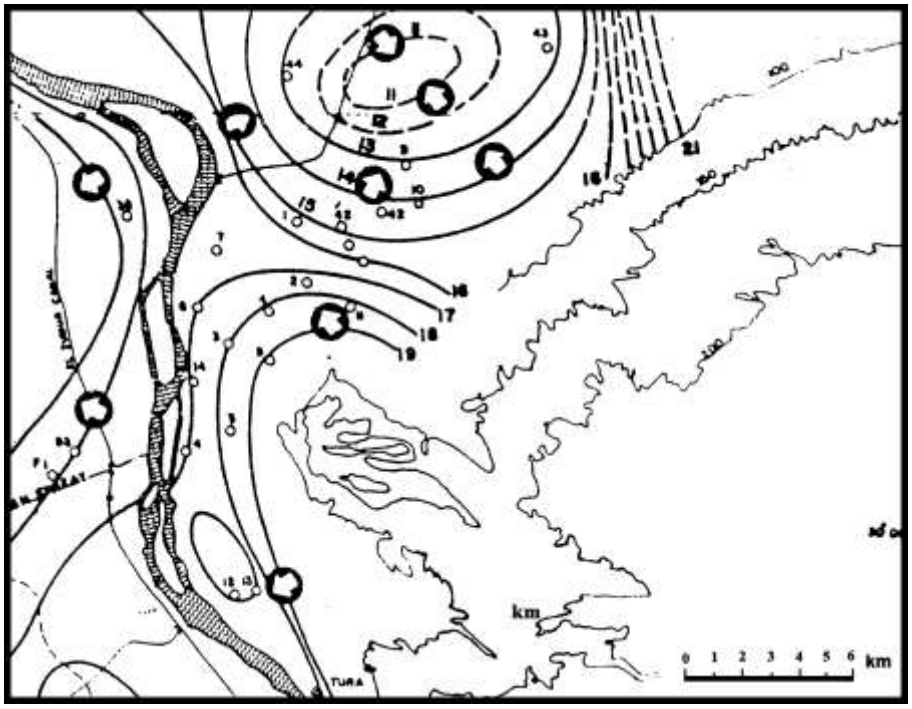
They are dominant above the flood plain and in subsurface in the studied area. At some places, these sediments consist of clay silt contains some sand ***(Said, 1975)***. It is built of sand and gravel layers with thin clay intercalations.

Tertiary rocks :

They consist of the Pliocene clay, the Miocene sand and sandy marl and limestone. Pliocene rocks have been recognized at the foot of Gebel El-Mokattam in the studied area. The Pliocene sediments consists of marine sandy limestone and marl rich in Ostrea and Foraminefera. The environments of deposition of the Pliocene sediments in the studied area is restricted to fluvial.

3- Subsoil Water Levels :

The vertical water movement through the silty-clay cap is very important since the greater part of the area is occupied by the inhabitant city, provided with intensive water supply and sewerage systems. The efficiency of these systems would play a role in increasing the subsoil water surface and affecting the recharge of the aquifer (Fig. 4) and increasing the piegometric pressures.



Source: Institute for ground water Ministry of Irrigation 1982-1992.

Fig.(4) : The direction of groundwater movement

Recent records Elevation of Ground surface (22.28 m), elevation of subsoil water (21.24 m) and elevation of groundwater (18 m) helped in the determination of both piezometric and shallow groundwater levels.

4- Climatic conditions :

The information about the climate of area study depend on the meteorological records of the stations at Almaza, Giza and Helwan. According to (Fig.) the climate of the area study can be summarized in the following :

(1) Air temperature ranges between 28° in June and 16° in January. The annual mean air temperature is 22° and almost the same for the whole area.

(2) The pitch evaporation (EPI) recorded in Almaza, Giza and Helwan station ranges between 14.5 mm in May and 4.8 mm in January with an average annual value of 23 mm.

(3) The rainfall is 30 mms/ annum.

(4) From the filed work the wind velocity recorded by wind watch varies between 8 knots in the east and 6.9 at the west of the area study.

(5) The relative humidity varies between 68% in November and 40% in June.

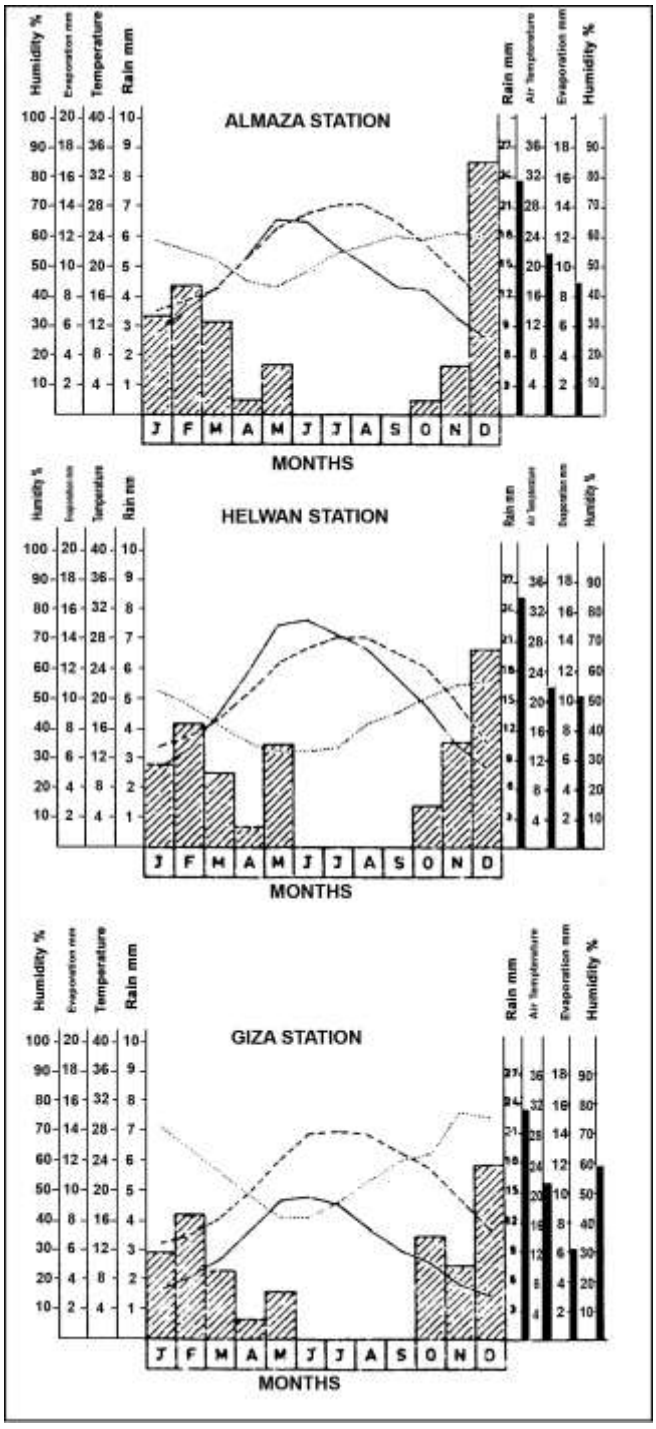


Fig. (5): Meteorological records of the area study

Ain El-Sira Spring

Spring is irregular depression of various size, created by the upward escape of groundwater. In older scientific literature they are sometimes called well.

Ain El-Sira spring is included between latitudes 30° 00′ 29″ N and 30° 00′ 40″ N, and between longitudes 31° 15′ 3″ E and 31° 15′ 6″ E. this is bounded on the eastern side by Ain El-Sira Road and on the southern side by El Imam El-Shaffie pool.

Fig. (6): Landsat ETM image of Ain El-Sira Spring

It is far from the River Nile about 2.424 meters. The distance between Ain El-Sira spring in the North and El Imam El-Shaffie in the South is about 863 meters.

It has oval sahpe Polygon perimeter is 1.85 Kilometers. The maximum length is about 459 meters from the North Eastern to South Western, and is 422 meter from the North to South Western. The maximum depth of water is about 4 meters in centeral part of spring. Water level is 20.12 meters above the sea level ***(El Ramly, 1969, p. 203)***.

Ain El-Sira locality increased their discharge after the earthquake of the year 1958 which affected the area. The slight variation in the level of water can be attributed to seasonal variation in rate of evaporation.

El-Imam El-Shaffie pools

Pool is a small area of usually still water in hollow places.

Land sat (ETM) image 2002 shows five of scattered pools, the largest pool called El-Imam El-Shaffie and four pools are very small area and far from each others.

El-Imam El-Shaffie pool is included between latitudes 29° 59′ 52″ N and 29° 59′ 58″ N, and between longitudes 31° 15′ 10″ E and 31° 15′ 12″ E.

Fig. (7): Landsat ETM image of El-Imam El-Shaffie pool

There was an issued in September 1966. It has perform. It lies South Ain El-Sira Spring the distance between them is 863 meter. The maximum length from the north to South is 2351 meters in the eastern side, and is 115 meters in the water side.

The maximum width is about 667 meters from the east to the west. The maximum depth of water is about 2.0 meter at the north eastern side and 1.5 at the south western side. Fig (7) show that the depth increased from the south west to North East side. Water level is about +20 meters above the sea level.

The slight variation in level of water in the pool can be attributed to seasonal variation in the rate of evaporation.

1- The characteristics of the chemical analysis of water

(A) Ain El-Sira Spring

Water of Ain El Sira spring is generally acidic. Water temperature increases with depth 22° at the surface 28°C at the bottom. The water acquire yellowish colour. Water level of Ain El-Sira spring is measured during the present work is +20.1 meters. The pH value is generally above 7 ranging between 7.4 and 8 (Al Kaline water).

Total dissolved solids (T.D.S) ranges between 168 g/L and 192 g/L. the chemical composition results in percent Table (1) are as follows :

$Na^{+} + K^{+}$ ranges between 84.2 and 90.9%.

$Ca^{++} + Mg^{++}$ ranges between 12.6 and 17.5%.

Cl^- ranges between 89.5 and 89.7%.

$HCO_3 + SO_4$ ranges between 10.2 and 10.4%.

From the chemical composition Table (1), this water is of the order.

$$Cl^- > SO_4^{--} > HCO_3^-$$

(B) El -Imam El-Shaffie Pools

The depth of El-Imam El-Shaffie ranges between 1-2 meters. Water is in the form of brine. Water level is about +20 metes above the sea level. The average of water temperature is 25°C. The water acquire yellowish colour. The pH value is above 7, ranging between 7.4 and 7.5, (It means Alkaline water). Total dissolved solids (T.D.S) ranges between 98 g/L and 180 g/L.

The chemical composition results in percent Table (1) are as follows :

$Na^+ + K^+$ ranges between 79.4 and 90.9%*.

$Ca^{++} + Mg^{++}$ ranges between 6.8 and 19.1%.

Cl^- ranges between 90.1 and 93.1%.

$HCO_3 + SO_4$ ranges between 5.79 and 9.98%.

From the chemical composition Table (1), this water is of the order.

$$Cl^- > SO_4^{--} > HCO_3^-$$

* % epm (Equivalent / million).

2- Quality of Water:

To investigate the quality of water Ain El-Sira spring and El-Imam El-Shaffie pools, 7 samples have been collected from other localities (Fig. 8). The total analyses are carried out by DRI laboratories.

Fig. (8): The location of sample for chemical analysis

(1) The pH values range from 7.5 in the large pool of El-Imam El-Shaffie and 8 in Ain El-Sira spring. It indicates safe water.

(2) Salinity values range from 500 to 120 ppm.

(3) The concentration of cations and anions differ from one location to another.

(4) The manganese concentration is above the permissible < 0.5 ppm.

(5) The most dominant cation is sodium while the most dominant anions.

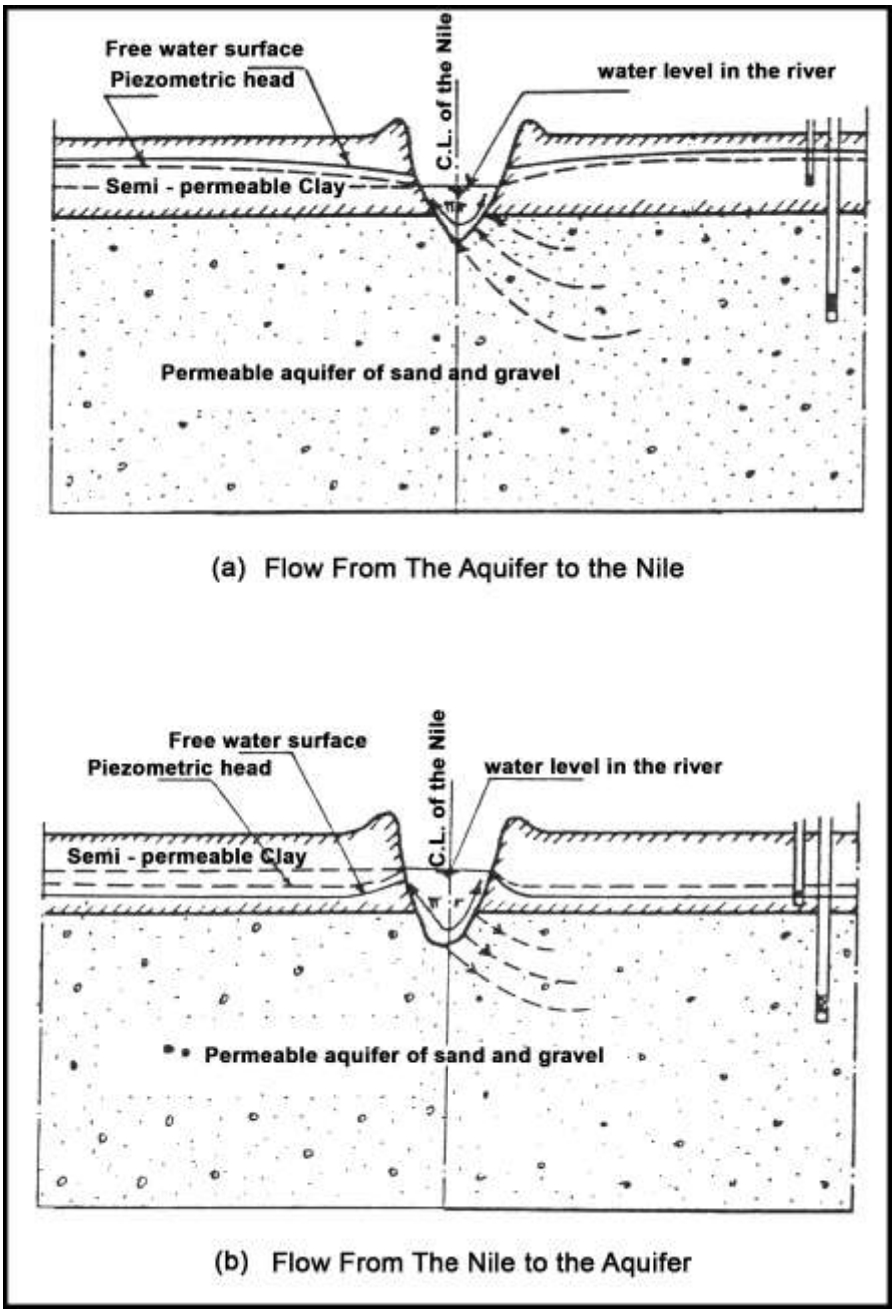
Compared chemical analysis of water 1969 with chemical analysis of about 7 single water samples collected from other localities including Ain El-Sira spring and El-Imam El-Shaffie pools gave the following results :

- The bicarbonate concentration is very low.
- The chloride ions generally increased with time in all pools in form of sodium and potassium chlorides.
- The increase in chloride concentration results from successive evaporation and increases the salinity.

3- Ground Water Levels :

(1) Before the construction of High Aswan DAM, water levels in the Nile were experiencing high stages during the flood period of (July - September) and low stages during (January - February). The piezometric heads were also attaining high levels during the flood period of a smaller magnitude and time lag and low levels. The Nile used to play two rules: recharging the aquifer during the flood period and draining it during the low river periods (Fig. 9a,b).

(2) After the construction of the High Aswan DAM the water stages in river have attained slight rises excluding the flood period than the pre-flood period. The differences between peaks highest water levels (peaks) and lowest water levels (toes) indicate the capability of the area study aquifer to be utilized as seasonal storage basin (Fig. 9a,b).



Source : Maha Abd El-Salam 1996.

Fig. (9): Flow from The Aquifer to Nile and Flow from the Nile to the Aquifer

4- Origin :

Gastinel (1968) came to the conclusion that part of water of the spring is coming from very deep depths and is primary inorigin so the origin of water might be due to the presence of some subterraneous water within the reaches of the Wadies east of our area. This might infiltrate into jointed limestone's. On the way, the water tends to attain a certain chemical equilibrium with the host rocks and acquirers mineral (Azer, 1962 pp 7-11) came to the fact that there should be a fault parallel to the Mokattem face between both sides with a down throw on the Ein El-Sira side and a vertical displacement of about 60-70 meters. On its way, the rising of water takes place and the Ein El-Sira spring appears.

Said (1962) mentioned that this water is issued from the deep ground water invading basement formation and or of volcanic origin.

Hazzaa, et al., (1966) stated that this water is gained from seepage zone at foothills.

Sorour (1968) considered that both deep circulation and direct infiltration from the surface water are responsible for the recharge of this pools.

(***El Ramly, 1969*** p 203) showed that Ain El-Sira new spring came into existence, while the other old springs in Ain El-Sira locality increased their discharge after the earthquake of the year 1958, which affected the area.

Problems and Hazards

(1) Effect of development, use and reuse of water represented of the following:
    - Irrigation return water.
    - Interchange between aquifers due to differentials in pressure levels remote from excessive withdrawal.
    - Contamination from the surface due to improperly constructed spring.

(2) Mineralization resulting from evaporation. The analysis of Satellite imagine and field work show in some smaller depressions in the north of Ein El-Sira spring and El-Imam El-Shaffie pools the deposition of salts takes place all the year owing to the rapid evaporation. So, Gastined noticed that the salt content of water is variable during the two periods of low Nile and high Nile ***(Azer, 1962, p 6)***.

(3) Some of unplanned urban area and Burial ground area are unserved with a sewered system (Local networks) or septic tanks.

(4) Local variation in mineralogy and man's local influences make increase of the rate and degree of change of quality water of Ein El-Sira spring and El-Imam El-Shaffie pools.

(5) The ground water levels in the area study are experiencing continual increase. This may be attributed to the leakage from the water supply and sewerage systems.

(6) The increase of $\overline{SO_4}$ anion may have a bad effect on the concrete of the building's foundation. The increase of SO_4 anion than the permissible concentration limits (400 p.p.m), particularly where it is associated with rising of ground water level may cause a problem to building foundations on such areas.

It was clear after the field study of the areas surrounding each of Ain El Sira spring and El-Imam El-Shaffie pools that the increase of the water level from the land varies between 0.5 meter and 1 meter. We have found out this through what tomb owner's have done. They threw about 0.5 meter to 1 meter of materials in the tombs. This also was clearly obviously after the establishment of the habitant project placed to the east of Ain El Sira and also from the reports of Magra El Oion gate. In

addition to this it was recognized during the regional study that the walls of the tambs weathered ranges between 20 cm to 1.5 m at the tombs of El Emam El Shafei either from the interior or the exterior sides.

The form of salt weathering is produced by the growth of salt crystals in surface cracks which cause damage by the exertion of pressures due to crystal growth. It usually occurs in a relatively narrow vertical zone extending from down ground level to up to 0.5 m 1.5 m above the ground surface.

The map Fig. (10) shows the dangerous regions of El Ain El-Sira spring and El-Imam El-Shaffie pools according to the following basis.

- **Medium dangerous zones**

  The raise of water levels during the last ten years didn't exceed 50 cm, the percentage of ion $\overline{SO_4}$ in sediment surface, and the surrounding water doesn't exceed (300 p.p.m).

- **Very dangerous zones**

  The water level exceeds 50 cm. The sediment surface contains salts in which ions $\overline{SO_4}$ percentage exceeds (300 p.p.m). This is in addition to lack of Sewage network.

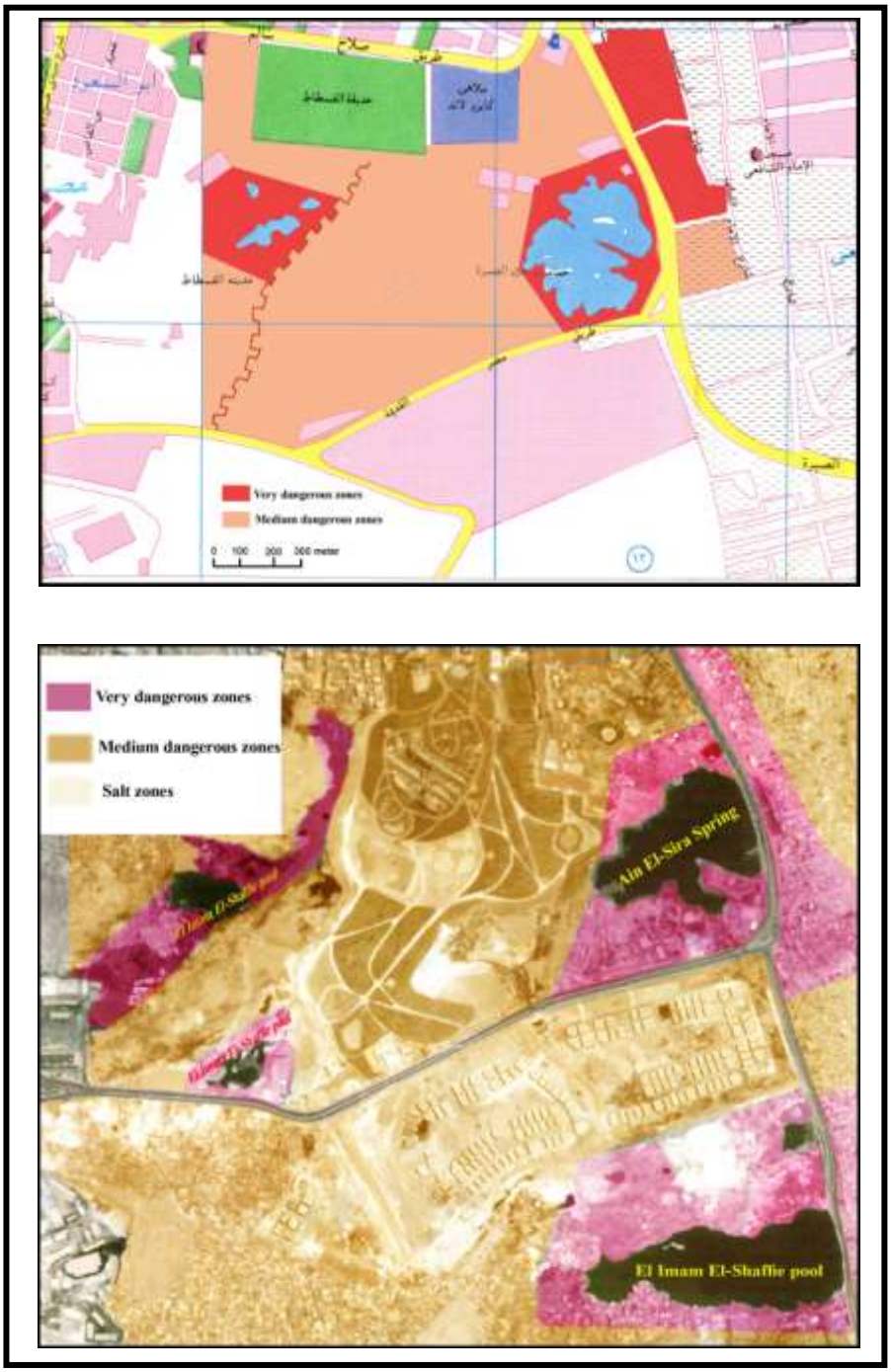


Fig. (10) : Dangerous regions of El Ain El-Sira spring and El-Imam El-Shaffie pools

(7) Water pollution:

The movement of polluted water is important hazards physical factors. Liquid sewage that has not created or that has under gone partial treatment is spray done the land surface application of liquid sewage and sewsludge to the lands provides nutrients such as Nitrogen (N), Phosphorus and heavy metals to soil and subsurface.

The magnitudes of the leakage from municipal network amounting about 0.22×10^6 cubic meters/day from the sewerage system.

Sewage effluent contains dissolved organic compounds some of these compounds may eventually be shown to be more significant in turns of degradation of ground water quality than nitrate, bacterial and viruses.

In conclusion, surface water of El-Imam El-Shaffies pools can be considered more polluted than ground water of Ain El-Sira both chemically and bactgeriologically.

How to Adapt and what should be done :

Knowledge of urban geomorphology and urban hydrology of area study is not only a key to "what is situation today" but should also be available to answer two questions "what is should be and what should be done". These steps (Fig. 11) contribution can be made to adapt with physical problems of the area study :

(1) Spring and pools should be selected in such a way that pollution hazards are for from there area of influence.

(2) Making initial conaissance surveys select suitable sites for urban development. Mapping potentially hazardous zones and monitoring of environment changes.

(3) Analyzing weathering problems to affect building materials and increasing of subsurface water.

(4) For the long-time, the area study and around it should be served by a sewerage network and the effluent could be either treated on-site and outflow transported outside the skirt of spring and pools. The area study should not be used for disposal of all types of wastes.

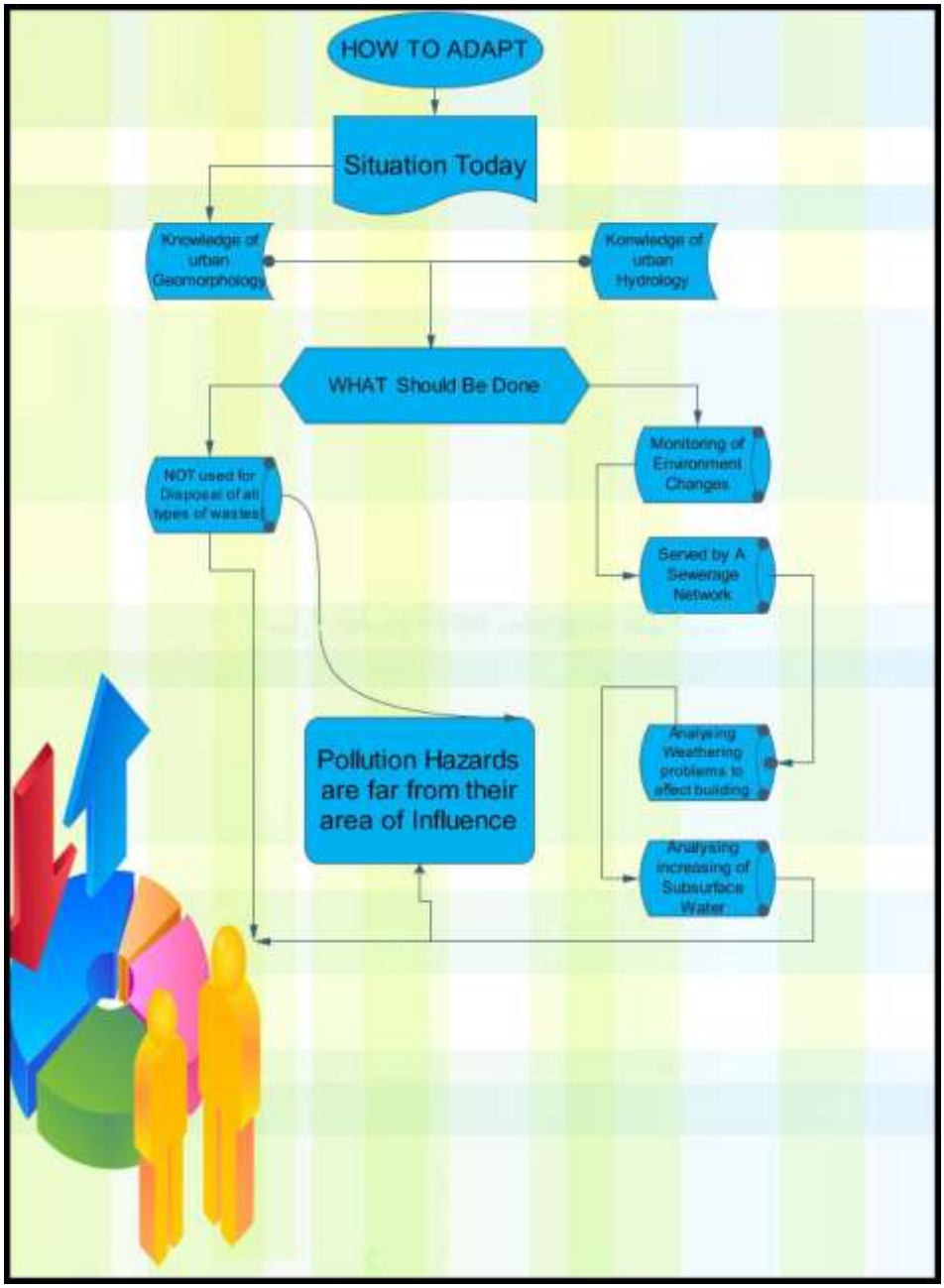


Fig. (11) : How to Adapt and what should be done

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