THE USE OF GEOGRAPHICAL INFORMATION SYSTEM GIS TO PRESENT A GROUNDWATER MAP OF ALGIERS AREA

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Abstract—

Engineers, both agricultural and geotechnical engineers, are trying to determine the depth of the underground's water with characterization, because of their impact on the quality of agricultural products for the first and the techniques of the building foundation for the second, so, the geotechnical engineer is trying during the preliminary study of the project to identify the groundwater level by "piezometers", and to determine their chemical properties in the laboratory.

The main objective of this study is to map the groundwater depth in Algiers, to give an overview of Algiers' communes, to help geotechnical and agricultural engineers to predict its contents during the preliminary study for the project, and To ensure an effective study, using "Géo-base" program which contains data bank information of Algiers area, including 116 Profiling "piezometers" that will be employed in this study.

Keywords— Groundwater; Géo-base; geotechnical; piezometers; soil.

I. INTRODUCTION

Water resources are the strategic character in the overall development path for the country of Algeria, closely linked to sustainable development, where Algeria is classified among the moderately poor countries in the world in terms of water availability, where studies have proven an Algerian consumption per capita 123 L / per person a day [10] Compared to an average per capita in Europe larger than 200 L / per person a day, in USA greater than 400 L / per person a day during the Human Development Report 2006 [9], in addition the demand for this resource is increasing due to the demographic growth and the rising consuming sectors such as industry, agriculture, tourism.

There have been proposed many solutions to overcome this lack; Among them was the use of satellites in geological surveys to find out the groundwater and valleys; From this point the aim of the current study is to use the geographic information system "ARCGIS" in order to draw groundwater map of Algiers region, and through the collection of information from geotechnical laboratories for piezometer experiments that have been done before and then stored it in "Géo-base" program, which is a database relational readable through GIS.

Piezometers are simple strainers tubes used to control the level of changes in groundwater [5], natural or pumping. Furthermore, more complex piezometric lead to measure the pore pressure variation of massive clay precariously [6]; during this study it has been collected 119 tests.

The technic of highlight geotechnical information through a simple mapping was used for the first time in 1913 in Germany [3] where it was the formulation of a comprehensive definition of geotechnical maps through which carried a lot of research and developments in many international

laboratories. Works in France by (Peter 1969; Masson 1971; Broquet 1976 Mercieca 1977; Arnould et al 1980, Usseglio-Polatera 1980), Belgium (Ghiste 1971), Poland (Malinovsky 1971 Lozinka-Stepien 1979) and Canada (Morin 1979) [3]; and to Give the importance of this science, in 1976 UNESCO formed a working group of the International Association of Engineering Geology (IAEG) to develop this side of the maps and to write a guide for Geotechnical mapping [3].

II. MATERIAL AND METHOD

1.1. STUDY SITE

Algiers is situated on the Mediterranean Sea and in the north-central portion of Algeria, on the latitude 36.4635° north, longitude 3.0331° to the east of Greenwich line [7], characterized by a wild and an excellent maritime location; it's located on the edge of the north-eastern slopes of Mount Bouzareah [4], overlooking the Mediterranean Sea, which protects it from the northern winds, North West. Extends it's from Rais Hamidou bay, to tmnfouste, in the shape of an arc length of 31 km [7]. In 2011, the city's population was estimated to be around 3,500,000. Algiers has a Mediterranean climate with hot [8], dry summers (generally hot, especially from mid-July to mid-August) and mild and wet winters, the snow is rare [8] but not impossible, with the rain could be torrential rains. Its proximity to the Mediterranean Sea aids in moderating the city's temperatures. As a result, Algiers usually does not see the extreme temperatures that are experienced in the adjacent interior deserts.

Figure 2 shows the elevations of the studied area. It indicates that the elevations in the northern parts such as Bouzaréah exceed 500 m. In the west and east of the plain of Mitija, exists lowlands whose altitude is generally less than 30 m. In the western area, the marine terrace stands.

1.2. "GEO-BASE"

"GEO- base" is a relational database designed by MERISES' method [1] which uses visual basic language in order to gather and to store information on Algerian soil, and then to conduct research and exploration [1] [2]; Figure 1 illustrates "new project" window in géo-base software.

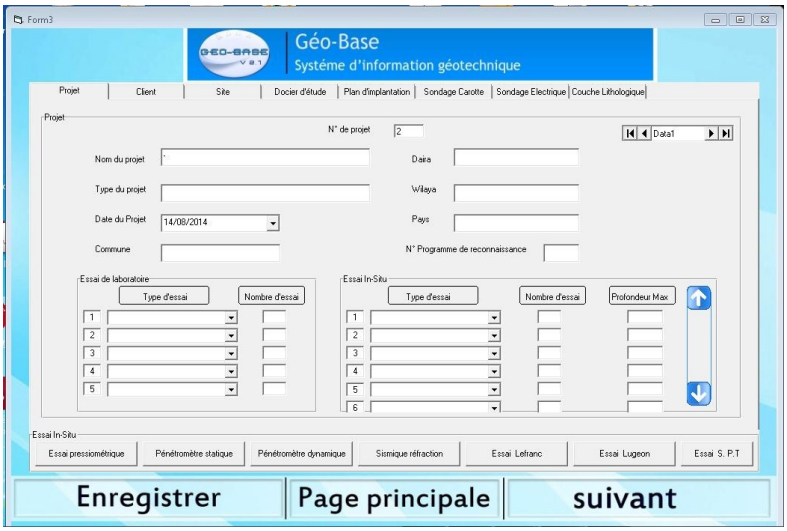

Fig.1. "new project" window in géo-base software.

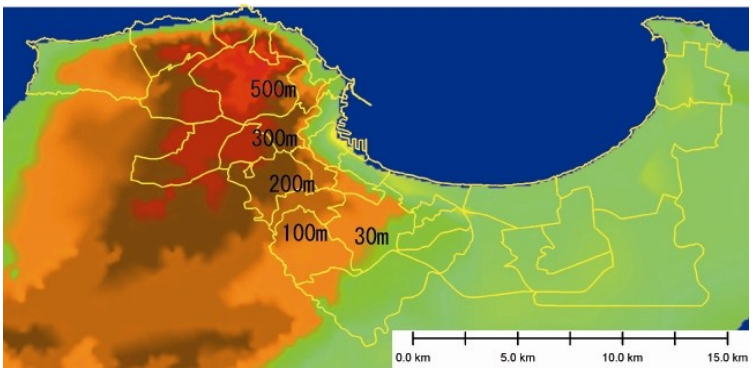

Fig.2. topographical mapping of Algiers area.

1.3. METHODOLOGY

"Géobase" is a relational database allows to store thousands of data on Algerian soil and then doing various searches and exploration, based on the opening of the database across geographical information system GIS like (ARCGIS for the current study) and then doing a thematic; spatial and statistical analysis will allow the display of data collected in the form of easy readable map for the various experts and engineers; the methodology used in this study can be shortened into the following steps:

1. Collecting information from geotechnical laboratories, where interest by geotechnical study has been accomplished, 154 projects were collected from Algiers area, including 119 studies were performed in which "piezometer"; fig 4 shows mapping of the polls piezometers collected in Algiers area (that we have collected into laboratories).

2. Storage gathered Information in "Géo-base" program.

3. Open database using GIS software; it has been used "ARCGIS" in this study and afterward doing a spatial, thematic and statistical analysis that would display the information in the form of easy readable map for each expert.

1.3. RESULTS AND DISCUSSIONS

After a spatial, thematic and statistical analysis of the data collected from the results of piezometers that were made in several borehole polls, it has been mapping groundwater of soil in the Algiers region, where the fig1 shows "groundwater map of Algiers area"; Table 1 demonstrates the statistical Analysis on groundwater of the borehole polls according to Algiers' communes and finally figure 4 illustrates superposition between topographical mapping and depth of borehole polls.

Table 1 and Figure 4 show analysis of groundwater depth observed during this study with the recorded data. As shown in this Figure, the water level is comparatively similar to the topography mapping especially in the plain of Mitidja; detecting the presence of groundwater in coastal areas, and Oued El Harrach peripheral; As an example, from this study Alger has detected the presence of groundwater between (1.3m-20m); EL MADANIA (3m-8m); BIR MOURAD RAIS (3.6 m -6.2m); EL HARRACH (2.5m;32m); BOUROUBA(4m-35m); DJISR KSENTINA (4m-31m); BORDJ EL KIFFAN(2.5m-5.7m) ….. And the rest of the regions can be scanned through table 1.

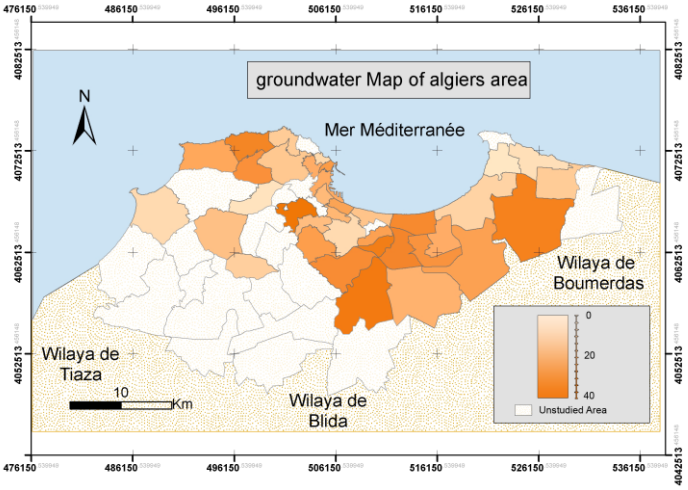

Fig.3. Groundwater map of Algiers area.

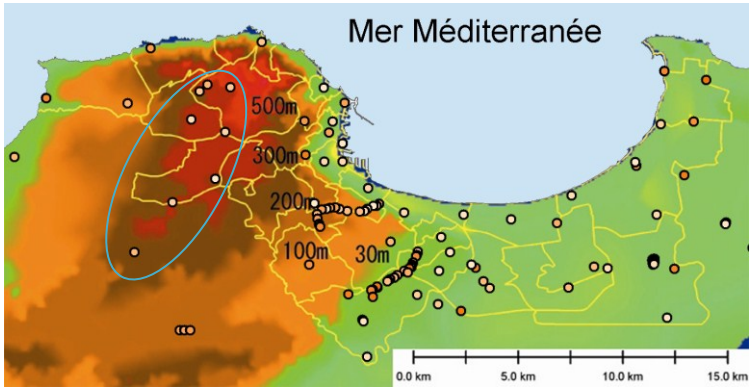

Fig.4. Superposition between topographical mapping and depth of borehole polls.

TABLE I. statistical Analysis on groundwater of the borehole polls according to Algiers' communes

commune CODE	commune	Sample's number	Z min (m)	Z max (m)	Z average (m)	the standard deviation
1601	ALGER	5	1.3	20	6.8	6.770229
1602	SIDI M'HAMED	1	6	6	6	0
1603	EL MADANIA	7	3	8	6.071429	1.656773
1604	HAMMA ANASSERS	3	6	11.2	8.166667	2.209575
1605	BAB EL OUED	1	3	3	3	0
1607	CASBAH	1	8.6	8.6	8.6	0
1608	OUED KORICHE	1	6.5	6.5	6.5	0
1609	BIR MOURAD RAIS	8	3.65	6.2	5.21875	0.744118
1611	BOUZAREAH	3	1.5	10.6	4.533333	4.289781
1612	BIR KHADEM	1	8.4	8.4	8.4	0
1613	EL HARRACH	5	2.5	32	12.42	10.817837
1614	BARAKI	1	15	15	15	0
1615	OUED SMAR	1	9	9	9	0
1616	BOUROUBA	6	4	35	14.166667	10.188501
1617	HUSSEIN DEY	2	4	6	5	1
1618	KOUBA	1	2.5	2.5	2.5	0
1619	BACH DJERRAH	8	5	14	8.2375	2.79461
1620	DAR EL BEIDA	8	5	14	8.2375	2.79461
1621	BEB EZZOUAR	2	5	8	6.5	1.5
1623	DELY BRAHIM	2	0.5	3	1.75	1.25
1624	BAINS ROMAINS	1	13.5	13.5	13.5	0
1625	RAIS HAMIDOU	1	4.2	4.2	4.2	4.2
1626	DJISR KSENTINA	18	4	31	11.355556	7.02347
1628	HYDRA	1	44	44	44	0
1629	MOHAMMADIA	2	5	18	11.5	6.5
1630	BORDJ EL KIFFAN	4	2.2	5.7	3.7	1.301922
1632	BENI MESSOUS	2	5	14	9.5	4.5
1633	LES EUCALYPTUS	2	4.5	8	6.25	1.75
1638	AIN TAYA	3	1	2.5	1.833333	0.62361
1639	BORDJ EL BAHRI	1	0.5	0.5	0.5	0
1641	HARAOUA	2	3	5.4	4.2	1.2
1642	ROUIBA	5	12	20	13.6	3.2
1644	AIN BENIAN	2	5.3	8.5	6.9	1.6
1645	STAOUELI	1	2.5	2.5	2.5	0
1651	OULED FAYET	1	5.2	5.2	5.2	0
1655	BABA HASSEN	3	2.8	5.4	3.933333	1.0873
	Algiers Wilaya	116	5.976388	11.538888	8.021501889	2.194509333

CONCLUSION

Through this work, 116 soundings of experience piezometers was analyzed in the Algiers region using "Géo-base" software, then these data output in the form of geotechnical map in order to help engineers and experts in predicting groundwater depth in the Algiers area during the initial study of the project because it is of a paramount importance in building foundations techniques. It was also noted that there is a relative similarity between groundwater depth and topography.

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