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MINISTRY OF ENERGY AND WATER

GEOLOGICAL AND HYDROGEOLOGICAL STUDY OF BECHMIZZINE REGION (KOURA – NORTH LEBANON)

Final Report

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1 INTRODUCTION

Bechmezzine town is located on the Upper Koura Plain between the elevations of 250m and 330 m.a.s.l. It is surrounded by the following villages: Amioun to the south, Kfarhazir to the west, Bterram and Aafsdiq to the north and Bsarma to the east.

The yearly average rain precipitation on Bechmezzine area is 800 mm/year and it is characterized by hot weather in the summer and warm winter.

2 GEOLOGY OF BECHMIZZINE AREA

The outcropping rocks in Bechmezzine area belong to the third geological era (Cenozoic) but with the presence of recent Quaternary deposits.

The attached geological map (Map A) and its geological section give a clear picture about the stratigraphic succession prevailing in the area, as well as the geological structure.

The geological investigations in the study area are based on data obtained from Amioun geological map (scale 1/20000) done by Alain Guerre in 1969, and on the data obtained from the hydrogeological map (scale 1/20000) done by BTD in 1994. To these maps have been added the new information obtained from the aerial photographs, satellite images and the detailed field investigations.

2.1 LITHO-STRATIGRAPHY

The Cenozoic rocks cover the western part of the study area (Map A), while the Quaternary deposits cover the eastern part of the area.

The oldest rock formation in the study area are of the Lower Eocene ($e_{1\text{-}2a}$). These are overlan by the layers of the Middle Eocene (Vindobonian, m2a), with a complete absence of the Upper Eocene and Lower Miocene rocks, which means that the middle Miocene Layers are laid unconformably on the top of the Lower Eocene rocks.

2.1.1 Lower Eocene (e1-2a)

The rocks of this formation outcrop on the western part of the study area, and consist of gray marls, chalky marls and marly limestones. The stratigraphic thickness of ($e_{1\text{-}2a}$) is more than 300 m in the study area, and forms an impermeable layer hydrogeologically.

2.1.2 Vindobonian (m2a)

The Middle Miocene Layers, specially the Vindobonian (m2a), are composed of limestones, marly limestones and sandy limestones interbeded with marly layers.

The average thickness of these layers is around 250 m. They form the most important aquifer in the Koura plain and extend to Tripoli and Mount Terbol to the north.

2.1.3 Quaternary Deposits

Above the Miocene layers stratigraphically, and in the structural depression that has been formed around Bechmezzine and Bterram villages, different Quaternary deposits have been deposited as follows (Map A):

a- Conglomerates of the old Quaternary (q_{cg})
b- Conlluvial red clays of the Middle Quaternary (q_{ar})
c- Diverse fluvial alluviums of the recent Quaternary (q): sands, gobbles and clays.

These deposits have covered in variable ways and thicknesses the underneath limestone layers, so that the thickness of these deposits exceed sometimes 50 m, which make them suitable places for olive cultivation in Koura region.

2.2 STRUCTURAL GEOLOGY

The study area is characterized by the presence of Bechmezzine syncline. The Eocene and Miocene beds in Afsidik and Kfarhazir dip toward the east or in other terms toward Ouadi el Bayader in Bechmezzine and Bterram. The dip of the layers ranges between 13° and 21° (Map A). To the South, in Amioun, the beds dip toward the North of about 60°. Consequently a syncline is present in the area because, eastward, outside the study area, the Eocene and Miocene layers dip westward. The axis of this syncline would have a NE-SW trend and would be passing from Saqiet el Ghabbit toward Kroum el Thatne. This geological structure reflects the importance of the tectonic factors that took place in the third geological age.

In addition, the study area is crossed by a series of east-west trending faults, that appear especially in the western part of the study area in the Eocene and Miocene layers.

3 HYDROGEOLOGY

The study area consists of different hydrogeological units. These are the Miocene aquifer and the Lower Eocene and Quaternary aquicludes.

3.1 THE MIOCENE AQUIFER

The limestones of the Miocene formation form the major aquifer in Bechmezzine and its surroundings. These limestones are in good tectonic position (syncline), which allows the water to store inside the karstic limestone layers so that the syncline of Bechmezzine-Bterram region forms since the seventies – a rich ground water area that has been tapped by more than 100 private wells. The Ministry of Energy and Water previously drilled a well for Bechmezzine town, to the depth of 250 m and it yielded a flow of 600 m3/day. Another well has also been drilled for Amioun town to the depth of 251m and and it yielded a flow of 800 m3/day, as well as a third well drilled in Kfarhazir village, of 256m yielded a flow of 500 m^3/day.

The ground water stored in this aquifer, which is recharged annually in the rainy seasons, allows drilling a new well to a depth of 300 m. It should be noted that the sead new aquifer which is the limestone layers related to the Upper Turonian (C5b), is at a depth exceeding

900m. These karstic limestone layers are very deep and there are many difficulties to reach them due to the presence of these marly layers of the whole Eocene and Senonian formations (C6); which will create caving in problems while drilling.

3.1.1 Lower Eocene and Quaternary Deposits Aquicludes

The clay and marl horizons within the Lower Eocene and Quaternary deposits act as relatively impermeable zones that minimize the flow between the different underlying and overlying aquifers, and consequently characterized by no exploitable yield.

4 DESIGN OF THE WATER WELL

4.1 BOREHOLE LOCATION

The proposed well is located in a plot belonging to Bechmezzine municipality in Bir et Taouileh. This plot has an area more than 350 m2 and in its middle is an ancient well located to collect water with old pumps which were maintained by the municipality. The exact location of the well is at the northern part of the plot (No number on cadastral map), and is at the following coordinates:

X = -308328 m
Y = +18030 m
Z = 265 m
(Amioun map, P-6, 1/20.000)

4.2 ACCESS TO BOREHOLE

The access of the site is easy because of the presence of a secondary road. Excavating a pool in order to receive the drilling cuttings is necessary not to harm the nearby plots.

4.3 DEPTH

300 m

4.4 EXPECTED DISCHARGE

432-605 m^3/day (or 5-7 l/s).

4.5 STATIC WATER LEVEL

130 m below ground level.

4.6 LAYERS THAT WILL BE PENETRATED

The layers that will be penetrated by the drilling are:

a) The clays of the Quaternary deposits (qar) to the depth not more than 20 m.
b) The limestones and marly limestones of the Middle Micoene (Vindobonian m2a) to the depth of around 280 m.

The drilling operation shall be stopped when reaching the marly grey layers of the Lower Eocene (e_{1-2a}).

4.7 SCHEDULE OF DRILLING, CASING AND GROUTING

The Contractor shall present the schedule for drilling in order to have a final casing and screen diameter of 12". The well is to be drilled with a rotary rig and provide for all additional equipment such as water and fuel, as well as treating collapsing rocks at his own expense.

Nevertheless, the schedule of the proposed works could be as follows (Fig. 2):

- Drilling by rotary methods with a 17.5" bit from 0 to 20m, with samples collection from this depth and onwards.

- Installing 15" I.D. casing (black steel, thickness 5mm)

- Grouting the annular space from the bottom to the surface, then waiting between 36 to 48 hours for the cement to set, and then continue the drilling works.

- Drilling with a 14.75" bit from 20m to the depth of 300 m.

- Installing 12" casing and screens as shown below:
  a) Casing:
     Diameter: 12" OD
     Type: Carbon steel
     Thickness: 6 mm
     Total length: 260 m

  b) Screens:
     Diameter: 12" OD
     Type: Carbon steel, bridge slotted 12.2% void, 1.5-2mm slots.
     Thickness: 6 mm
     Total length: 40 m.

  The installation of the casing and screens will be in accordance with the general specifications, and in particular, the welding and closure of all openings such that the water only enters the well through the screen openings, in order to minimize the pollution from zones above the SWL.

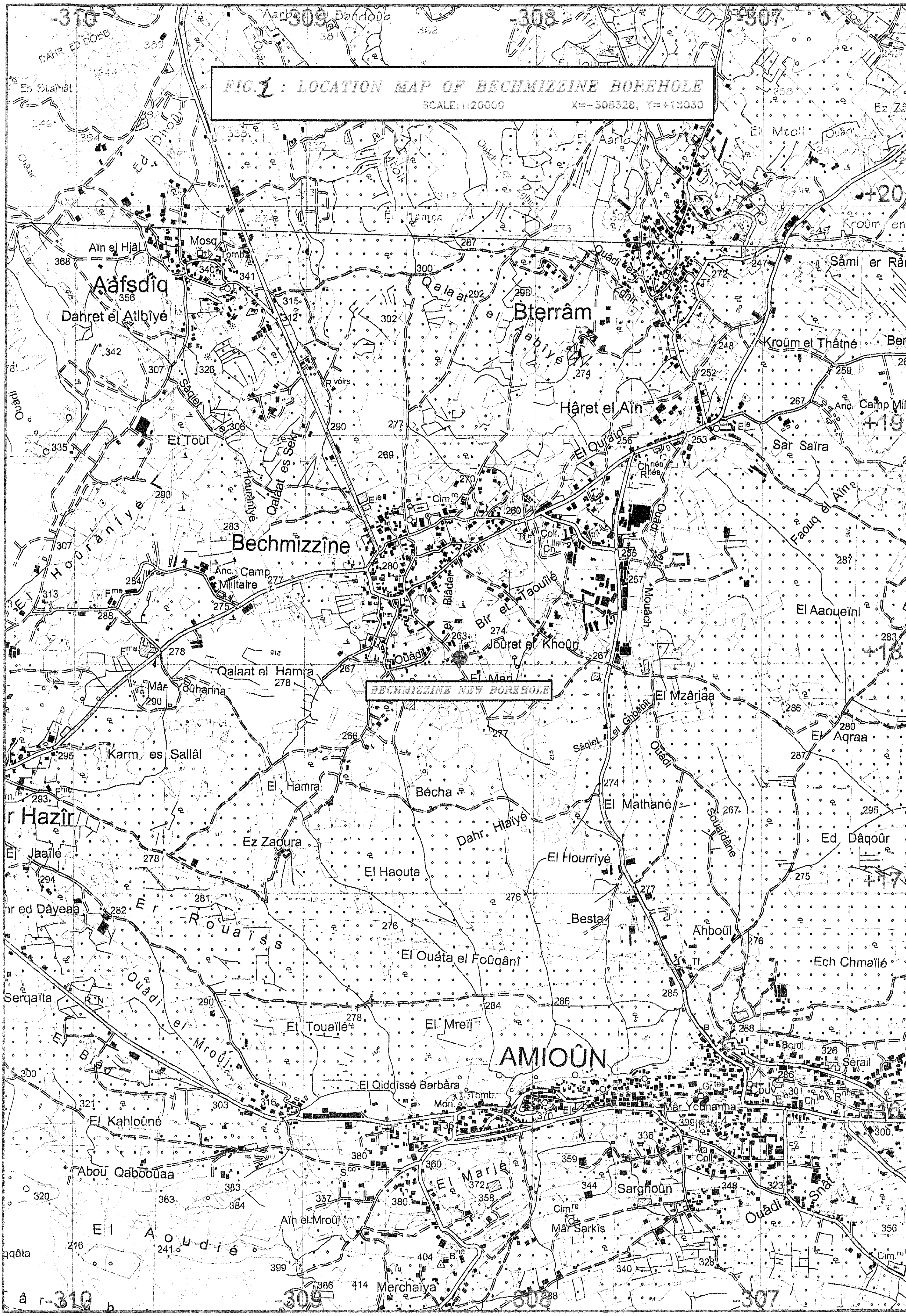

FIG. 1 : LOCATION MAP OF BECHMIZZINE BOREHOLE

SCALE:1:20000 X=-308328, Y=+18030

FIG. 2 : VERTICAL CROSS SECTION OF BECHMIZZINE BOREHOLE