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PLAIN OF GHAZVIN, IRAN*

The background information for the plain of Ghazvin is as follows:

(a) Geography: the plain of Ghazvin is situated about 120 km west of Tehran, between the Elburz Mountains in the north and the central mountain ranges in the south. It forms the westernmost extension of the great Iranian plateau. The area is approximately rectangular, extending over a maximum of 100 km from east to west and 70 km from south to north; it covers about 5,000 sq km, of which about 1,300 sq km are under cultivation. The plain varies in elevation from 1,150 to 1,500 m above sea level while the mountain ranges reach elevations of 2,900 m in the north-east and 2,600 m in the south. The total areal extent of the basins draining into the area is about 13,000 sq km. The two major steams, the Khar Rud and Abhar Rud, flow into a salt marsh on the eastern boundary of the area. There is only a small outflow from this swamp, drained by the Rud-E-Shur in an easterly direction;

(b) Climate: continental, characterized by a wide range of temperatures between summer and winter and sudden transitions between hot days and cold nights. The rainy season lasts from October-November to May-June, with a maximum during spring; average annual precipitation is around 300 mm, including the water equivalent of snow;

(c) Reservoir type: alluvium;

(d) Methods of investigation: detailed surveys and measuresments, interpretation by routine methods and, recently, with the aid of an electric analogue model.

Ground-water reservoirs

The Plain of Ghazvin is a tectonic depression framed by the Elburz Mountains in the north and the central Iranian mountains in the south. In the mountains, and on their borders, Liassic to Miocene strata have been identified. The thickest stratum is composed of volcanic rocks, tuffs, andesites, trachytes, basalts etc.; it is of Eocene-Neogene age and reaches a thickness of 2,500 m. All the mountain strata have a predominantly impervious facies.

The flat alluvial plain is formed by sediments derived from the erosion of the surrounding mountains. A continuous aquifer of varying composition and thickness is formed by the alluvial Pleistocene-Recent strata in the plain. These are the principal aquifers. In the lower parts of the plain, confined conditions are frequently encountered owing to the inter-bedding of argillaceous formations with the elastic horizons. As is to be expected, coarse components predominate near the margins of the plain, whereas the proportion of fine material predominates towards its centre.

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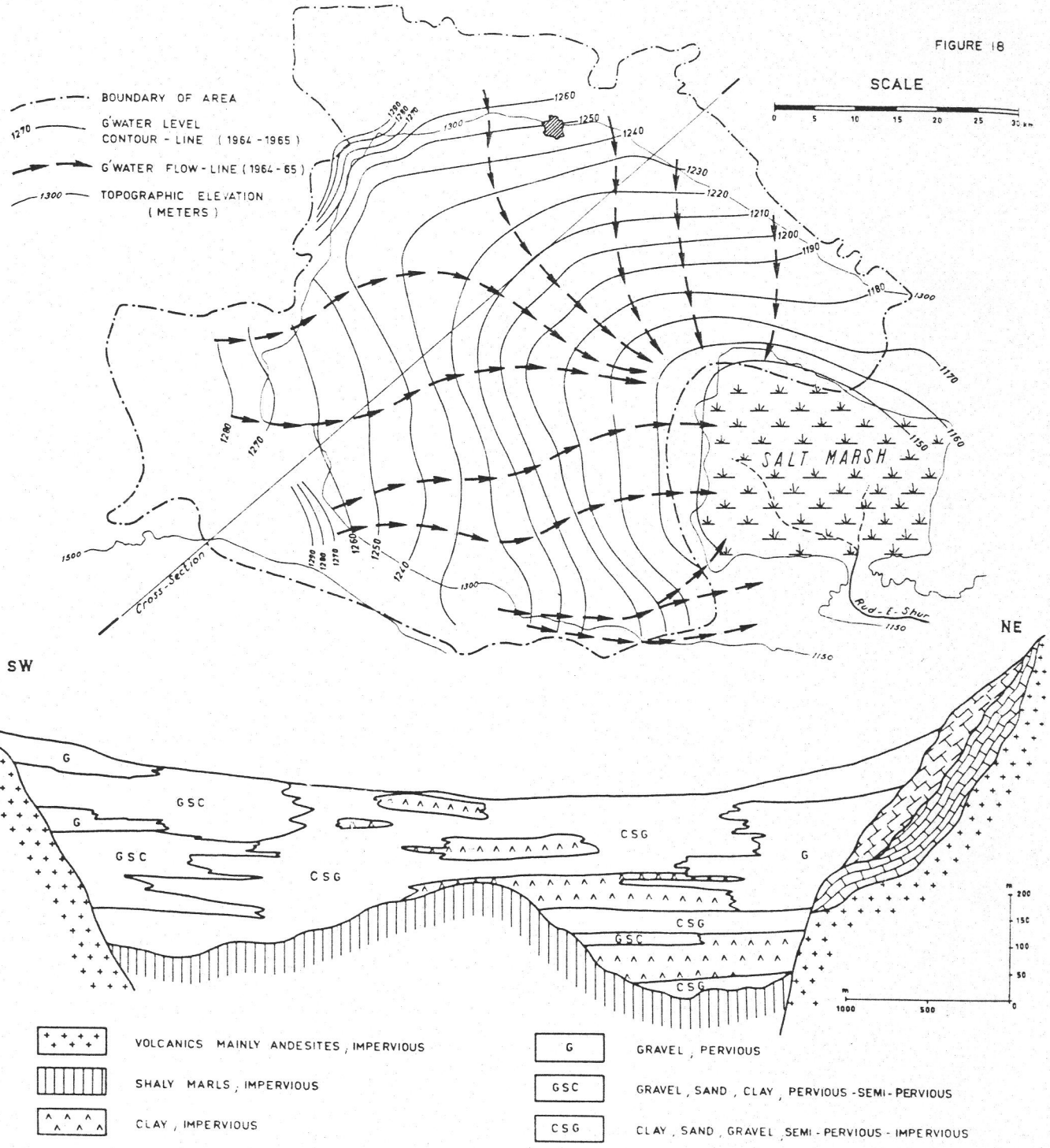
* Case study No. 10 prepared by S. Mandel (Israel).

FIGURE 18



PLAIN OF GHAZVIN,
SCHEMATIC CROSS - SECTION,
IRAN

CASE STUDY Nº 10

The ground-water balance was determined by a hydrogeological method for the period 1964/65, for a large sample area covering 2,274 sq km and comprising almost the entire plain. The balance gave the following results:

Replenishment on balance area	189.1 x 10^6 m^3
Inflow into balance area through boundaries	92.2 x 10^6 m^3
Total	281.3 x 10^6 m^3

The estimated safe yield is about 260 x 10^6 m^3/year, leaving the remainder to overflow into the salt marshes.

Utilization of ground water

Ground water has been exploited in the area by ghanats since the tenth century. A ghanat may be described as a slightly inclined, almost horizontal, hand dug gallery, excavated stretch-by-stretch from a line of vertical shafts. The digging of the gallery is begun at ground level at its lower end, and carried upslope at a gradient of about 0.025 per cent. This slope, being less than the slope of the ground and less than the slope of the ground-water table, the gallery goes deeper below ground until it reaches the ground water table. The gallery is then continued so as to tap ground water over a sufficient length, in order to give the desired yield. The last of the row of shafts is known as the "mother-well". In the Ghazvin area the longest ghanat is 11 km and the deepest mother-well is 70 m. The ghanat has a wet section into which the ground water seeps, and a dry section serving as a conduit for the water until it reaches ground level; from this point onward the water continues to flow in an open ditch. In some cases, where the material is too friable, the gallery is lined with oval shaped rings made of burnt clay or concrete.

The construction of a ghanat demands amazing engineering skills and a deep understanding of natural conditions, and has proved highly successful throughout many centuries. A ghanat is actually an artificial spring and, thus, its discharge strongly depends upon the height of the water-table. This, indeed, is its main drawback. High discharges commonly occur at the end of the rainy season, whereas in the dry season the flow decreases and, in some cases, ceases completely.

In the Ghazvin area there are 498 ghanats; 184 of them exploit perched horizons, about 70 to 80 m higher than the local water table; but only 149 yield water now, the rest being dry. There are 314 ghanats in the plain proper; 207 now yield water and the rest are dry. Their combined discharge amounted to about 190 x 10^6 m^3 in 1965. About 25 per cent of the discharge is lost by seepage, and returns to the ground-water reservoir before it reaches the irrigated areas.

The ghanats are in the process of drying up owing to cave-ins and the lack of maintenance. Owners now prefer to drill wells, instead of laboriously repairing ghanats or lengthening their wet section.

Wells in the area are of two kinds: hand-dug shaft wells and machine drilled bore-holes. In 1965, there existed 136 shaft wells equipped with pumps and motors, yielding about 52 x 10^6 m^3/year, and 198 deep wells yielding about 135 x 10^6 m^3/year.

It will be noted that present ground-water abstraction already exceeds replenishment. Therefore, the water-table will necessarily be lowered and the process of drying up of the ghanats will be accelerated. It is intended gradually to replace ghanats completely by bore-holes, with a controlled programme of exploitation.

In future, exploitation of ground water from the aquifer will be linked with the provision of surface-water supplies from rivers outside the area, so that the planned exploitation of part of the regulative reserves can be envisaged. As these reserves are very large, about 2,000 x 10^6 m^3, it will be comparatively easy to manage the aquifer as a seasonal and long-term storage reservoir.

Many additional bore-holes have been drilled, and are now being put into operation. Hydrological observations are being continued and interpreted with the aid of an electrical analogue model. Accompanying the hydrological development of the area, agricultural development is being pushed by the introduction of fertilizers, new crops, new techniques of combating pests etc.

References:

Unpublished reports prepared for the Government of Iran.