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HYDROGEOLOGICAL INVESTIGATIONS CARRIED OUT FOR THE WATER SUPPLY OF SVETI NIKOLE

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Abstract. An exploration borehole was drilled in the Quaternary–Eocene sediments 100 m to depth for the for the water supply system of Sveti Nikole. Water-bearing layers were discovered only in the Quaternary sediments 12 m in depth with a free level aquifer. The maximum capacity of the well is 4.5 l/s.

Key words: Sv. Nikole, water supply, alluvial sediments, Eocene, Pliocene Gorubinski livadi.

Introduction

The town of Sveti Nikole is situated in the central part of the Republic of Macedonia, some 70 km southeast of Skopje. The wider vicinity of the town lies 280 meters above sea level with prevalence of continental and Mediterranean climate characterized by dry summers and cold winters. The municipality has a population of 18 500 of which 14 000 live in the town.

The Ovce Pole valley is the driest part of the south Balkans with average annual precipitation from 400 to 500 ml/m^2.

The town and rural settlements satisfy their water needs from the Mavrovica water reservoir located in the River Oreolska.

Recently, some problems have emerged regarding water supply in the whole region. The problem is twofold – water shortage and poor water quality received from the water reservoir. Increased contents of harmful organic and chemical materials have been determined in the water. Hydrological investigations for the discovery of new ground waters were carried out in order to solve the issue of water supply of the whole region.

Geological-hydrogeological characteristics

The wider area of Sv. Nikole is composed of Eocene and Pliocene rocks overlain by Quaternary sediments. The Eocene sediments are present as Eocene flysch composed of sandstones, clays, alevrolites, marls and conglomerates as well as a series of platy limestones occurring in the upper portions. According to available data, the Eocene sediments in the wider region are believed to be waterless lithological formations.

The Pliocene sediments consist of medium to well permeable and water-bearing sands, gravels and detritus.

Wells drilled so far in the sediments indicated that that the sediments might contain water-bearing layers.

The Quaternary is present as alluvial, deluvial and proluvial sediments built of sands and gravels. Hydrogeological investigations indicate that the most promising are the alluvial sediments developed along the River Sv. Nikolska and the deluvial-alluvial sediments at Gurubinski Livadi.

Hydrogeological investigations

In order to define the capacity, composition and hydrogeological characteristics of the Quaternary and Eocene sediments one hydrogeological exploration drill-hoil was drilled in the Gorubinski Livadi.

The hole was dilled 100 meters to depth with diameter amounting to 268 mm. After drilling, a plastic pipe the diameter 168-mm (10 bar) was placed 100 m to depth. The pipe was perforated with slots, the per cent of perforation being 5 to 8%.

Testing of the well was performed with three different capacities and three lowering of water levels within 24 hours. The test results are shown in Table 1.

The hydrogeological cross-sectionprofile of the drill-hole indicates that water-bearing layers can be found only in Quaternary sediments 12 m to depth. as a free level aquifer. Eocene sediments are water impermeable at depth and waterless.

Dip's formula was used in the calculation of coefficient of filtration for perfect well located in free level aquifer.

For the first drawdown $Q_1 = 2$ l/s and $S_1 = 1.7$ m a coefficient of filtration of 1.62×10^{-4} m/s were obtained. For the second drawdown $Q_2 = 3.5$ l/s and $S_2 = 3.9$ m a coefficient of filtration of 1.43×10^{-4} m/s and for the third drawdown $Q_3 = 4.5$ l/s and $S_3 = 6.5$ m a coefficient of filtration of 1.09×10^{-4} m/s were obtained.

The mean filtration coefficient obtained after three drawdowns amounts to 1.38×10^{-4} m/s.

The coefficient of filtration was also calculated according to USBR of the laboratory data of all four granulometric analyses. The results obtained are given in Table 2.

Table 1. Test results obtained by exploration drill-holle.

Ground water level Static	Ground water level Dynamic	Q (l/s)	S (m) Lowering of water level	Q (l/s/m')	T of testing (h)
3.8	5.5	2	1.7	1.17	8
3.8	7.7	3.5	3.9	0.90	8
3.8	10.0	4.5	6.2	0.72	8

The mean coefficient of filtration obtained from laboratory data amounts to 1.17×10^{-4} m/s and is lesser than that from the field.

Table 2. Coefficient of filtration according USBR.

Sample collected at depth	4.20 m	6.50 m	8.70 m	11.0 m
Calculated coefficient to filtration (m/s)	2.193 h 10^{-4}	5.453 h 10^{-5}	8.142 h 10^{-5}	1.131 h 10^{-5}

Conclusion

Bearing in mind the yield of water-bearing horizon of 9.2 m and the drawdown achieved of 6.2 m with the capacity of 4.5 l/s amounting to 2/3 of the water-bearing layer, it can be inferred that during the calculation of prognosis yield, one can not rely on greater lowering of level. On the contrary, a well of concrete rings the diameter of 1 000 mm of up to 14 to 15 m at depth should be drilled. The yield of a well of that kind, calculated according to Dip's formula for perfect well should amount to 5.5. l/s.

Based on obtained and known hydrogeological data for the terrain, it can be inferred that hydrogeological investigations should continue in the Quaternary sediments with shallow drill-holes of 30 m to depth and in the Pliocene sediments southwest of Sveti Nikole with a drill hole of up 100 to 150 m to depth.

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