

Isbre Holding

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STATUS OF THE WELL TESTING OSA, NORWAY, JUNE 4th 2004

The well drilling in Osa started April 14th and was completed by May 20th. Due to some problems with an extreme coarse-grained layer, the work was delayed by 3 weeks.

Two production wells with diameter 263 millimetres and depth of 30.5 and 33 meters and 5 monitoring wells are constructed. The locations of the wells are illustrated in figure 1.

The following work have been performed after finishing the wells:

- 1: Regular measurement of groundwater levels
- 2: Informing technical staff of Ulvik Municipality
- 3: Short term testing of each well
- 4: Testing of the two wells together included water sampling.

The most important information needed was

- What is the yield of the wells?
- How will water abstraction influence the municipal water works?
- How is the quality of the water?

The information in the letter dated April 29th is better documented regarding the confined water bearing strata (aquifer) of interest. Regular measurements in the different aquifers reveal a true difference in the water levels in the aquifer the municipality is utilizing from the aquifer the one Osa Vanneksport is planning to utilize.



Figure 1. Photo of the area tested in Osa . Red dots illustrate the location of the new production wells. Blue dots illustrate the most important monitoring stations. Green dots are the municipal water works.

The change of water level in some monitoring wells during the pumping test (draw-down) is illustrated in figure 2. The figure reveals the difference between the depths to static water level prior to pumping with the depth during the pumping test. Positive values illustrate a lowering of the water level, negative values shows a rise in water level.

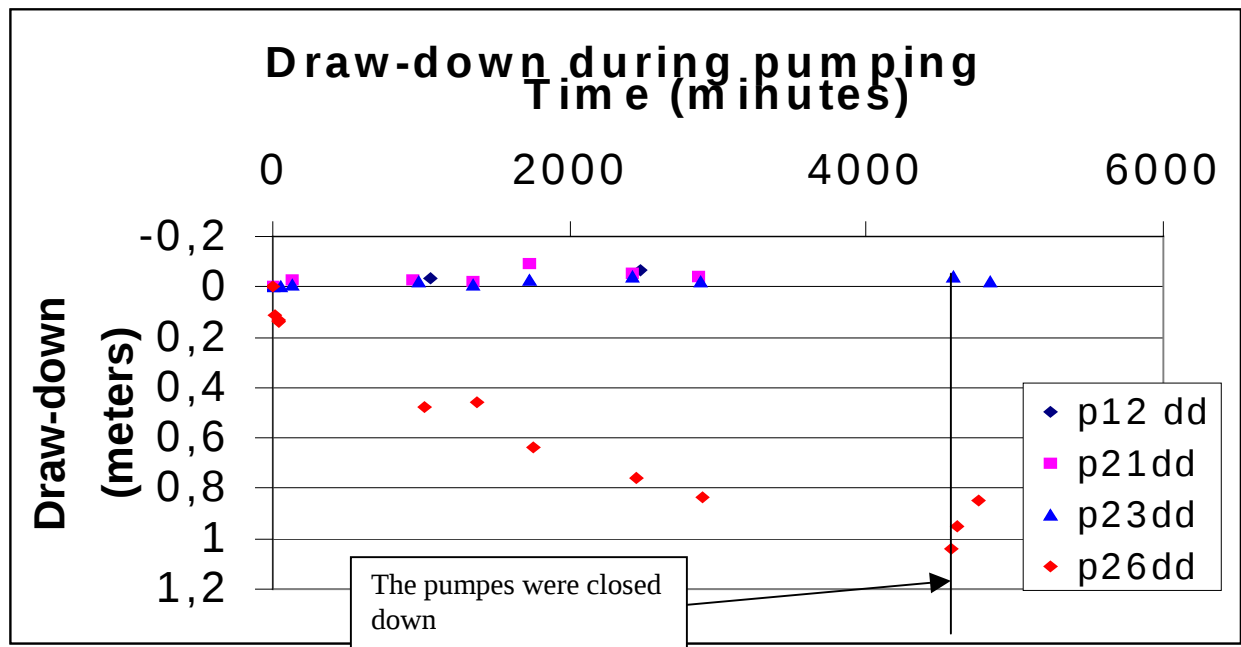


Figure 2. Draw down during pumping. Only wells in the deeper aquifer close to the pumping wells react on the water abstraction

In the monitoring well between the two pumping wells (p26), maximum draw down after pumping in 93 hours (3,8 days) is c. 1 m. In the critical points close to the municipal water works (p21 and 23), there is no registration of effect of the pumping. The total pumping rate was 67 litres per second. Due to small stops of the pumps (electrical failure) the total amount of water was c. 18.000 tons. The recharge of the aquifer is illustrated by the rise in water level in p26 after the pumps were stopped. Both the small draw-down and the fast recharge reveals a safe yield of minimum 67 litres/second.

Figure 3 shows the change in electrical conductivity (a measure of the amount of dissolved solids) during pumping. The electrical conductivity is very low, illustrating water with very low content of dissolved solids. Another important finding is that there's a constant difference between the water in River Austdøla close to well B-II-3 and the groundwater. Thus, there are no indications of shortcuts between the river and the wells.

Water samples are collected from the two pumping wells (B-II-3 and B-II-4) and from the municipal waterworks in the start of the pumping test, after one day and after two days of pumping. The samples will be analysed for a lot of elements (anions 30 and 70 elements, cations, PAH, PCB, oil, dry residue, bacteriological).

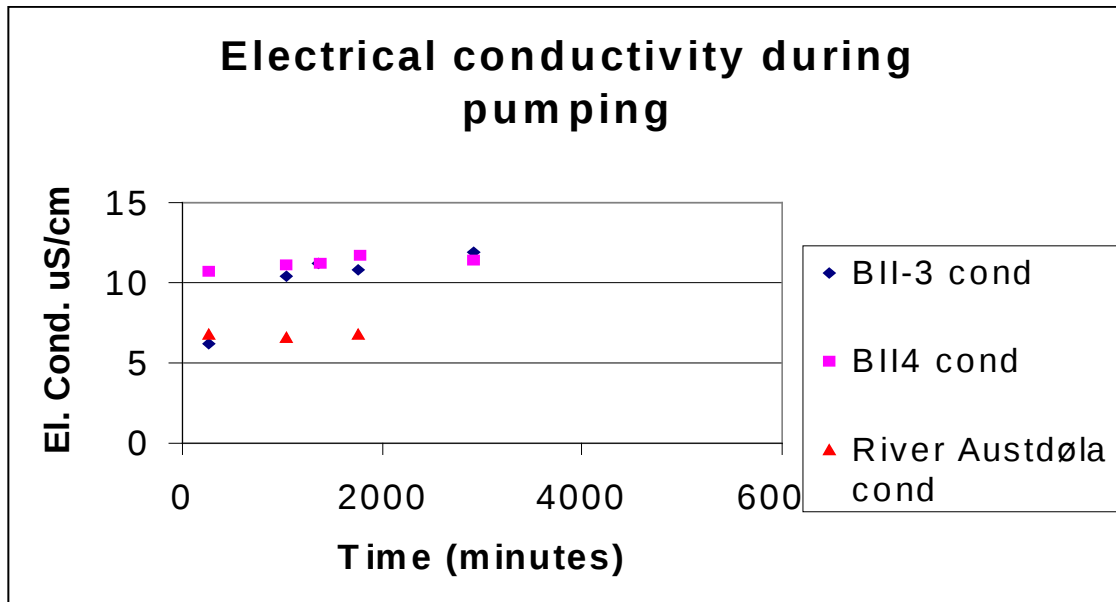


Figure 3. Change of water quality during pumping.

There is a very positive attitude to the project by all relevant authorities.

According to other hydrogeologists in Norway, other new projects that have received a licence for water abstraction had no time restriction on the licence.

Based on these investigations the following preliminary conclusions can be made:

- The well yield is limited by the pump capacity
- A safe yield is minimum 67 litres/second
- There seems to be a stable water quality during pumping
- Water level changes are only revealed in the lower aquifer close to the wells.
- The recharge of the aquifer seems to be fast
- No negative findings that may influence the chance to get licence are found.

The water analysis will be finished by June 18th. The first results are expected early next week and will be available on an on-line service. I will give you a username and a password as soon as I receive it from the laboratory.

Best regards

Oddmund Soldal
PhD Hydrogeologist