

Chemical analysis and data logging of groundwater quality from three monitoring wells at the SKEWS Site, Campus Lichtwiese of TU Darmstadt (2022-2023)

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For the construction of the seasonal crystalline borehole thermal energy storage (SKEWS-project) at the Lichtwiese campus of the Technical University (TU) of Darmstadt, three groundwater monitoring wells were installed for monitoring purposes from 15.02. to 18.02.2022. These wells with depths of 24.5 m (GWM 1 and 2N) and 36.5 m (GWM 3) have filter sections of 6 m to 22 m (GWM 1 and 2N) and 8 m to 32 m (GWM 3) in the upper aquifer (Figure 1 and Table 1). The height of the upper edge of the pipe (Pegeloberkante = POK) changed since the final completion under the surface took place on the 20th of July 2022. The wells are positioned at a distance of approx. 20 m to 40 m in a triangular arrangement. The groundwater flow is south to north. The aquifer is likely fracture based in highly weathered basaltic rock with an estimated hydraulic conductivity of about 10^{-5} m/s to 10^{-6} m/s.

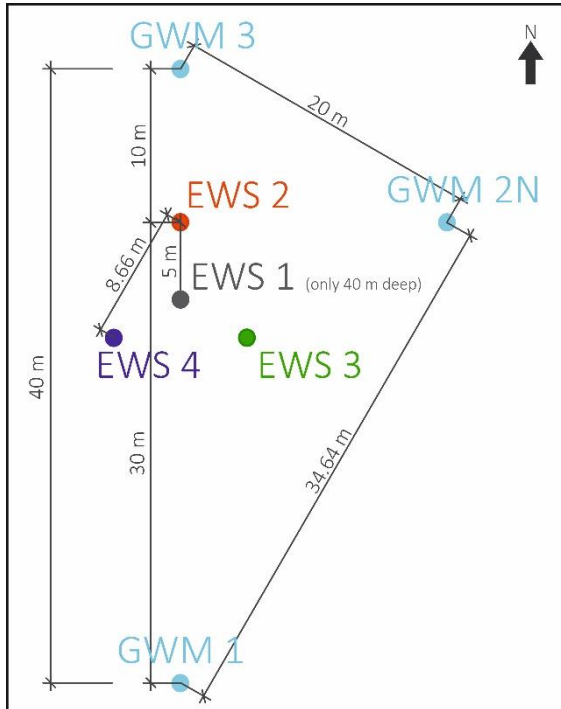


Figure 1: Arrangement of the three groundwater wells GWM 1 - 3 and the four Borehole heat exchangers EWS 1 – 4 (Landau et al. 2023).

Table 1: Location of the Groundwater well GWM 1 – 3. The height of the upper edge of the pipe (Pegeloberkante = POK) changed since the final completion under the surface took place on the 20th of July 2022.

	UTM 32 Easting [m]	UTM 32 Northing [m]	Height POK DHHN2016 15.02.22 – 11.07.22 [m]	Height POK DHHN2016 11.07.22 – 20.07.22 [m]	Height POK DHHN2016 from 20.07.22 [m]
GWM 1	477269,549	5523053,342	178,058	178,058	177,278
GWM 2N	477289,567	5523083,242	177,556	177,556	176,721
GWM 3	477269,106	5523092,645	178,137	177,337	176,707

Manual groundwater samples were taken twice a week. Automatic data loggers were installed for continuous hourly measurements. The measured depth of the logger in the water must be converted into absolute height values by calibrating it to the measurements on site. Missing readings from the data loggers related to low battery levels. Outliers resulting from battery changes and temporary extractions of the loggers from the well were removed.

From 09.06. to 25.06.2022, the approx. 40 m deep pipes of the 4 geothermal borehole heat exchanger (BHE) were installed using the rotary method. The deep drilling of the three geothermal BHEs up to 750 m depth took place from 18.07. to 25.10.22, using both pneumatic and hydraulic down-the-hole hammers, as well as the rotary method with a clay-based drilling fluid. Significant water inflows below 40 m were observed with the pneumatic hammer, as well as water losses from the upper aquifer with the hydraulic hammer. Due to borehole instabilities and fractured zones, intermediate cementations and the use of clay-freshwater drilling fluid were necessary. Consequently, groundwater fluctuations and changes in the chemical composition were to be expected during this period.

Short-term pumping tests were conducted on 07.06. - 08.06.22, 15.06. – 22.06.22, and on 08.06.23. Furthermore, from 05.10. to 17.11.2023, a Geothermal Response Test (GRT) was conducted on BHE 2 with a heating power of approx. 120 kW.

The dataset consists of tables and figures for manual and automatic sampling. Furthermore, the well configuration and location are included in a separate file.

References:

Landau, M., Seib, L., Bossennec, C., Handke, H., Muhl, J., Stumpf, J., Schindler, U., Sass, I., 2023. Drilling engineering experience gained from MD-BTES construction phase of SKEWS demo-site (No. EGU23-7241). Presented at the EGU23, Copernicus Meetings. <https://doi.org/10.5194/egusphere-egu23-7241>