HTPO

ATCZ167

D.T1.4.2

CZE TECHNICKÝ POPIS SOUČASNÉHO VYUŽITÍ ZDROJŮ TERMÁLNÍCH VOD LAA - PASOHLÁVKY

AUT TECHNISCHE BESCHREIBUNG DER BESTEHENDEN NUTZUNGEN LAA - PASOHLÁVKY

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More information and other outputs on the project "HTPO – Hydrothermal potential of the area" Laa an der Thaya-Pasohlávky" can be found at:

https://www.at-cz.eu/cz/ibox/po-2-zivotni-prostredi-a-zdroje/atcz167_htpo

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INTRODUCTION

This report was written during the project "HTPO – Hydrothermal Potential of the Area “Laa an der Thaya-Pasohlávky”. Inserting into the project structure is shown in the following table:

WP T1	„Geovědní model výskytu termálních vod v oblasti Laa – Pasohlávky“	„Geowissenschaftliches Modell der Thermalwasservorkommen Laa – Pasohlávky“
Akt. T1.4	„Dynamický zásobníkový model výskytu termálních vod Laa-Pasohlávky“	„Dynamisches Reservoirmodell der Thermalwasservorkommen Laa - Pasohlávky“
T1.4.2	**„Technický popis současného využití zdrojů termálních vod Laa - Pasohlávky“**	**„Technische Beschreibung der bestehenden Nutzungen Laa - Pasohlávky“**

1. MUS 3G AND LAA TH N1 BOREHOLES

Two production boreholes using the thermal water from jurassic aquifer are Mus 3G borehole near Pasohlávky (CZ) and Laa Th N1 borehole in Laa an der Thaya (AT). The most important boreholes data are summarized in table 1.

Tab. 1: Mus 3G and Laa Th N1 boreholes characteristics (Adámek et al. 1990, Michalíček et al. 2005)

Borehole	Coordinates	Stratigraphy	Borehole casing
Mus 3G (1455 m)	N 48°54'17,8114" E 16°34'35,0305" Z: 184,11 m n. m.	**0–830 m:** Karpatian, Eggenburgian **830–1362 m:** Jurassic (malm), Altenmarkt formation **1362–1435 m:** Jurassic (dogger – callov): 1362-1416 m: Nikolčice formation 1416-1435 m: Gresten formation **1435–1455 m:** Granitoides	**0–349 m:** 244 mm **247,95-1198,11 m:** 168 mm **1167,59-1453 m:** 114 mm Screened intervals: **1203,7-1362,21 m** **1373,35-1418,18 m**
Laa Th N1 (1448 m)	N 48°43'53,7421" E 16°23'22,2877" Z: 183 m n. m.	**0–851,6 m:** Karpatian **851,6–1090 m:** Ottnangian **1090–1121 m:** Eggenburgian **1121–1125,3 m:** Egerian **1125,3–1448 m:** Jurassic (malm), Altenmarkt formation	**0–297,3 m:** 340 mm **297,3-1122,5 m:** 244 mm Screened interval (open hole): **1122,5-1448 m**

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Both boreholes are equipped with the measuring probes for pressure, flow rate, temperature and electrical conductivity measurement and automatic data saving. The well head pressure, temperature, pumping rate and electrical conductivity data are measured in 15 minutes interval at Laa Th N1 borehole from 2004 till today. Similar data are measured in 90 seconds interval at Mus 3G borehole, dataset also includes electrical conductivity measurement. The probes are placed directly in the borehole head at both Laa Th N1 and Mus 3G boreholes, respectively. The technical scheme of probes placing shows Fig. 1.

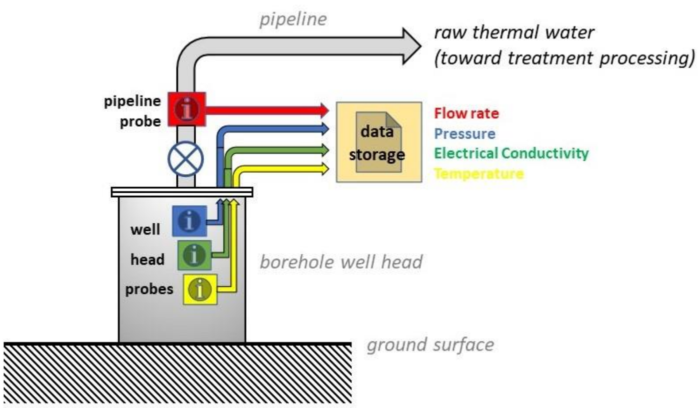

Fig. 1: Technical scheme of the thermal boreholes Mus 3G and Laa Th N1

For the project purposes, the daily averaged values were used, being calculated from the original extensive datasets. Placing of pressure probes directly in the boreholes head is necessary to avoid correct pressure dataset and to eliminate errors resulting from pressure changes in pipeline.

The head pressures data are the most important data proving the hydraulic processes in the aquifer. However, some of the evaluated short time pressure changes need to be evaluated together with the temperature and/or electrical conductivity data.

There are no other boreholes which enable monitoring of pressures, and/or temperatures and chemistry of thermal water in jurassic aquifer. However, several boreholes are placed in surrounding aquifers, including miocene aquifer north-westerly from Mus 3G borehole position, which allows monitoring of the hydraulic heads in the infiltration background of the jurassic thermal aquifer.

2. BOREHOLES TECHNICAL DATA

2.1 MUS 3G BOREHOLE DATA

The hydraulic heads in the Mus 3G borehole show obvious correlation to pumping rate (see figure 2). Compared to period before June 2013, when the borehole has started to be operated at higher pumping rate, hydraulic heads dropped about 5 m. The electrical conductivity values (green line in figure 3) show minor increase after June 2013 and stabilisation after 38 months in August 2016, which indicates reaching of the steady state equilibrium. However, the long-term declining trend of hydraulic heads occurs after August 2016 (see blue line in figure 2).

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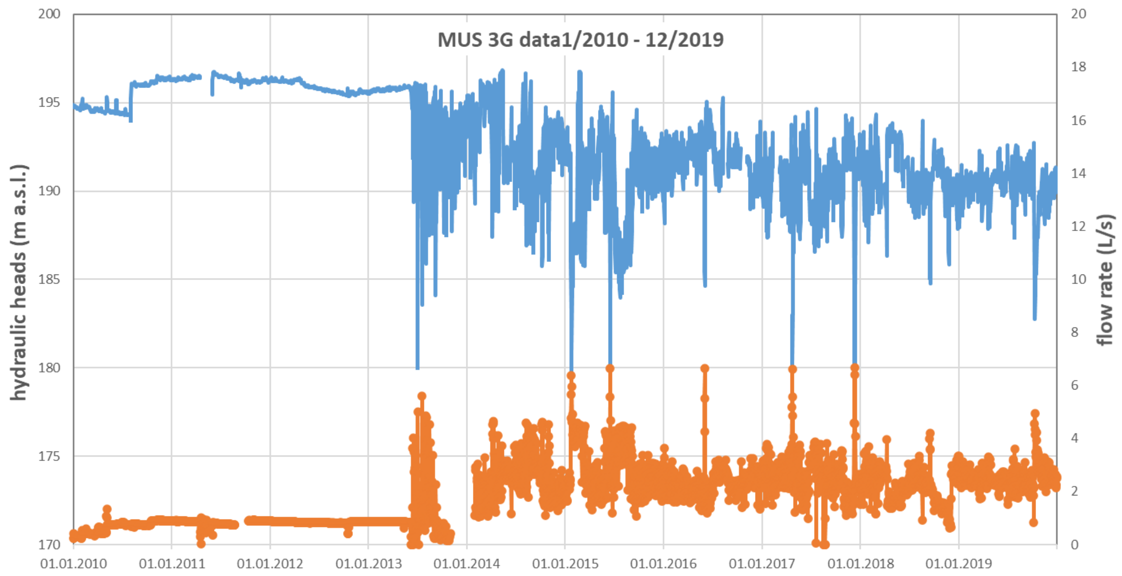

Fig. 2: Hydraulic heads (blue) and pumping rate (orange) from Mus 3G borehole in 2010-2019

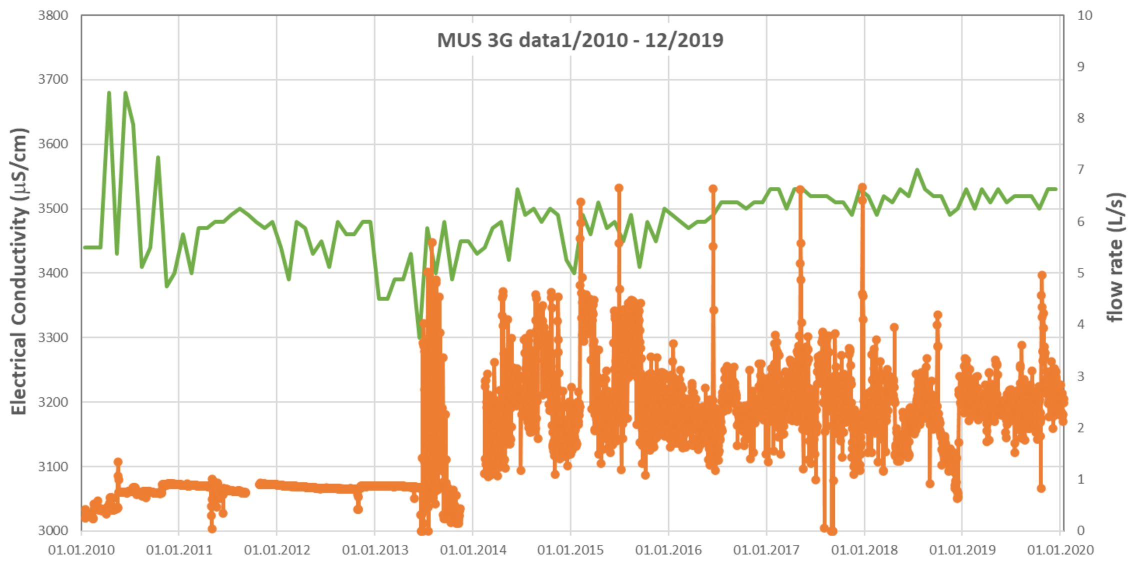

Fig. 3: Electrical Conductivity (green) and pumping rate (orange) from Mus 3G borehole in 2010-2019

There is evident correlation between hydraulic heads and pumping rate (presented as daily withdrawal in figure 4). The figure also shows slight declining trend in hydraulic heads – see shift of points from 2010 to 2019, which is in average 12 cm/year (from 2016 to 2019).

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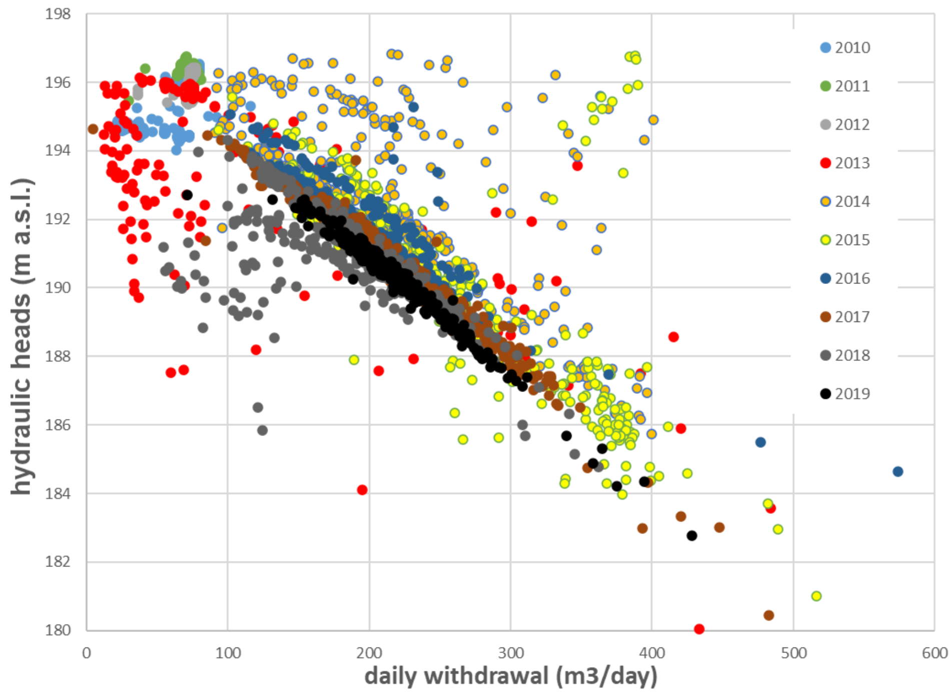

Fig. 4: Hydraulic heads vs. daily withdrawal rates in Mus 3G borehole in 2010 – 2019

2.2 LAA TH N1 BOREHOLE DATA

The dataset from Laa Th N1 borehole is difficult to evaluate in similar way. Despite of the pressure probe placement directly at the borehole head, there is no obvious correlation between well head pressures and pumping rate (figure 5). The most probable reason is in flow rate measurement, since the higher uncertainties are typical for small pumping rates.

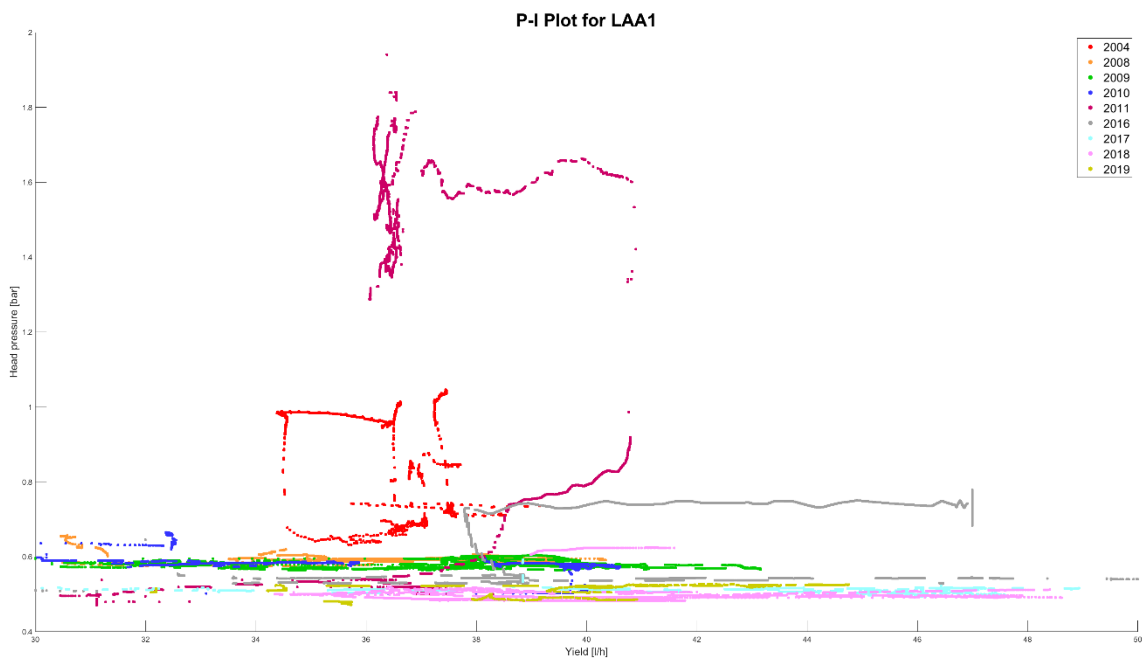

Fig. 5: Head pressures vs. daily withdrawal rates in Laa Th N1 borehole in 2010 – 2019

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However, the detailed data evaluation proved, there is no evidence of impact of the Mus 3G borehole pumping to Laa Th N1 borehole well head pressures. Starting of operation of the Mus 3G borehole at higher pumping rate in June 2013 was not recognized neither in pressure drop and/or temperature and electrical conductivity values changes in Laa Th N1 borehole.

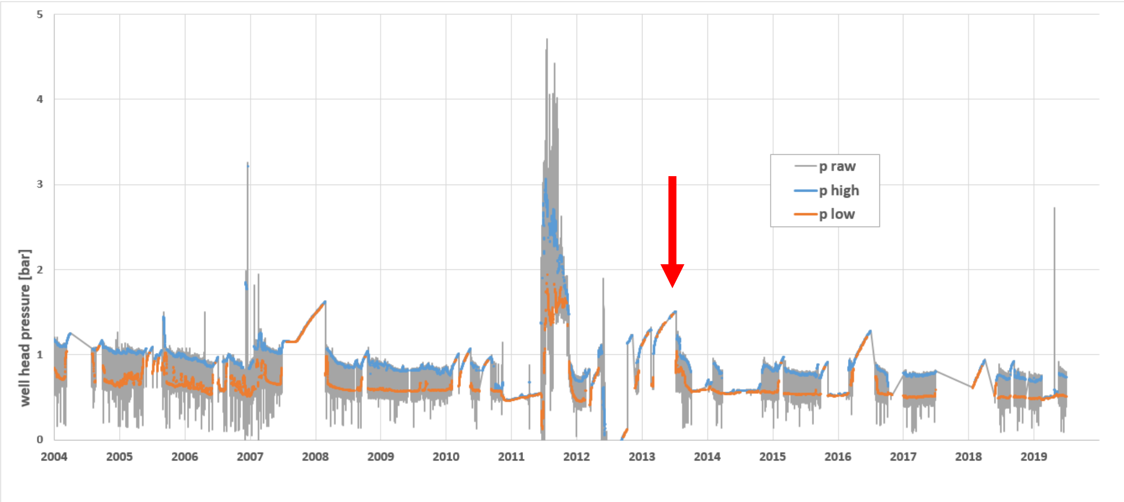

Fig. 6: Well head pressure data from Laa Th N1 borehole in 2010-2019 (red arrow shows the starting of operating the Mus 3G borehole at higher pumping rate)

When evaluating the data in detail, the production and recovery periods in Laa Th N1 cause the changes in well head pressures, shown in figure 7 as daily low- and high-pressure values.

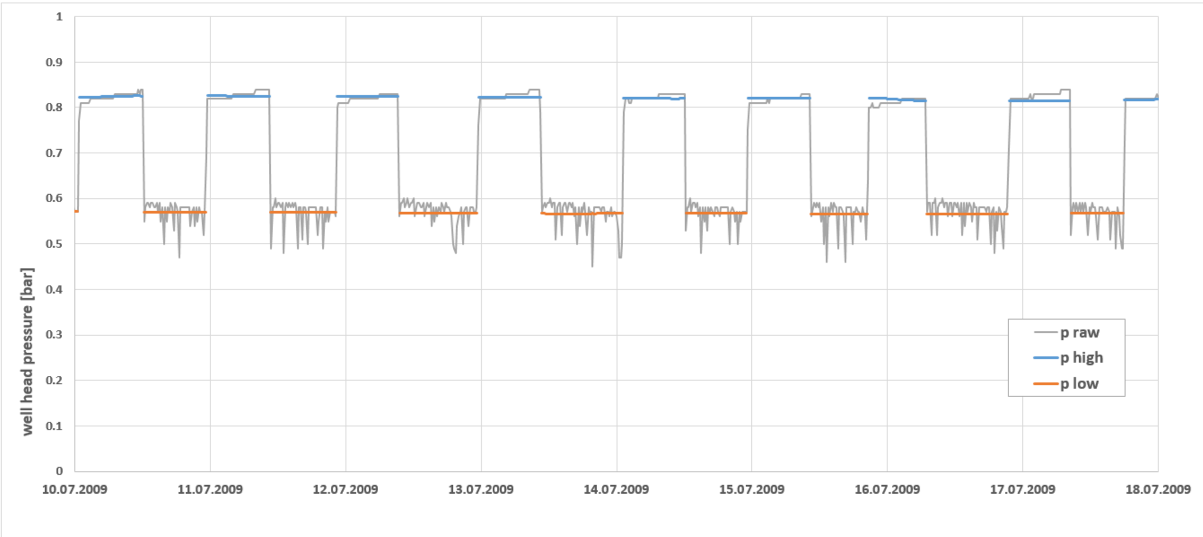

Fig. 7: Detailed well head pressure data from Laa Th N1 borehole (example of July10-July18th 2009)

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3. LONG-TIME TRENDS

As mentioned above, the long-term declining trend is evident in hydraulic heads at Mus 3G borehole from 2013-2019, giving in average of 12 cm/year over the period 2016-2019. Hydraulic heads long-term trend in miocene aquifer, in the infiltration background of the jurassic aquifer, is shown in figure 8. Two boreholes operated by the Czech Hydrometeorological Institute (CHMI) are presented. The obvious declining trend is related to the declining infiltration trend, which reflects the precipitation and climate characteristics, not the artificial impacts to the aquifer. Average linear decline reaches 19 cm/year in the Borotice VB9751 borehole and 10 cm/year in the Slup VB9758 borehole, respectively. These values are comparable to values calculated at Mus 3G borehole. We concluded that the slight decline trend of hydraulic heads in Mus 3G borehole is the results of (a) possible slightly increasing skin effect and (b) predominantly the general declining hydraulic heads in aquifer forming the infiltration background of jurassic thermal aquifer.

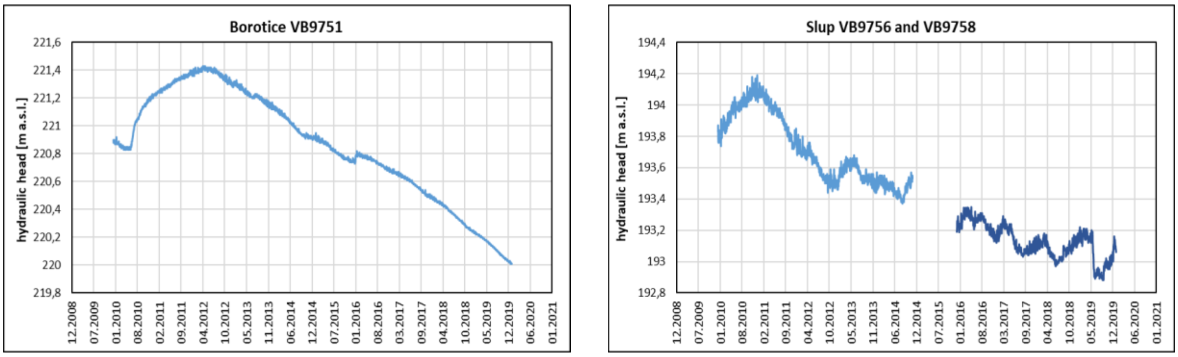

Fig. 8: Hydraulic heads in CHMI observation boreholes VB9751 and VB9756 (VB9758)

Similarly, the long-term declining head pressures trend is observed in Laa Th N1 borehole (figure 9). The declining trend is linear from 2004 to 2018, with no increase of pressure drop after June 2013, when the Mus 3G borehole started to operate with higher withdrawal rates (in average increase from 0,7 l/s to 2,7 l/s). According to head pressures data evaluation, the linear declining trend in Laa Th N1 was quantified to an average of 2,2 cm/year.

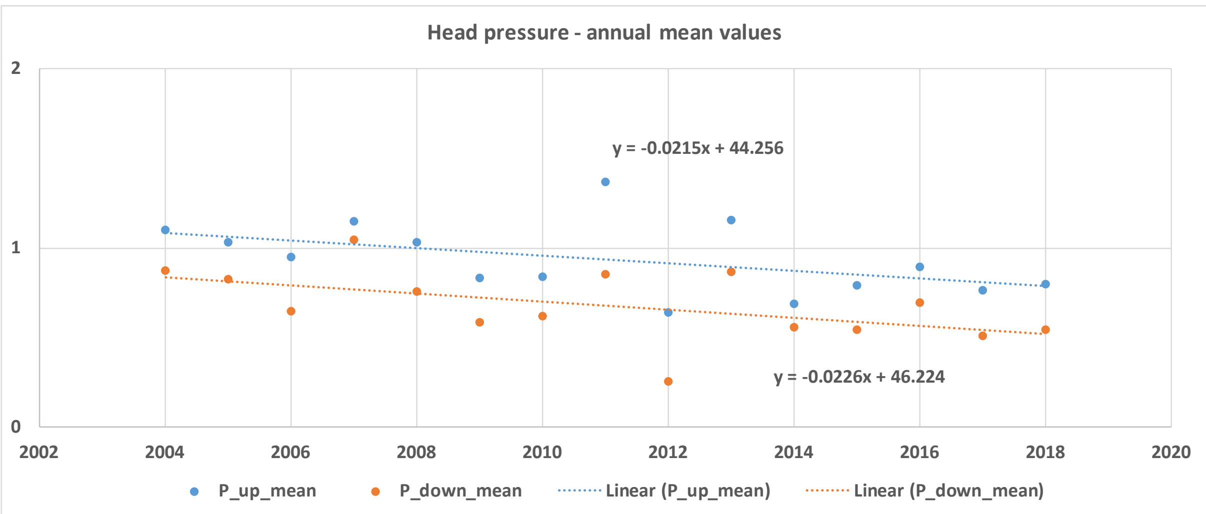

Fig. 8: Long-term (2004 – 2018) well head pressure trend in Laa Th N1 borehole

Evaluation of the Mus 3G and Laa Th N1 boreholes data proved, there is no evidence of impact of the Mus 3G borehole pumping to Laa Th N1 borehole. The observed long-term slow declining trends are related to the natural processes in aquifer infiltration zone, not by the artificial impact related to the exploitation of thermal water from jurassic aquifer. Such a result needs to be proved by the correct data measurement and evaluation, with cross-border cooperation and data sharing.

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