Project MIKAS – Most Important Karst Aquifers' Springs

Spring Survey
Instructions for filling

1) Spring Location and Hydrogeological Information

Spring name	**Kläfferquellen**	**Dominated aquifer's lithology and stratigraphy**	Limestone and Dolomite
Country / Region	Austria, Styria, Hochschwab		Middle (partly Upper) Triassic
Nearest settlement	Wildalpen, Mariazell	**Important or unique karst features in the catchment**	The catchment has an area of roughly 70 km² and reaches up to 2277 m asl. It is mainly a karstified plateau with thousands of dolines and caves. Most of the latter are vertical and up to 1082 m deep. Allogenic feeding from ponors (Sackwiesensee, Filzmoos) is rather the exception.
River/Hydrogeological basin	Salza, Enns, Danube	**Type of Spring**	Permanent, freshwater, several outlets: mainly from boulders, partly from caves (vauclusian)
Coordinates	*N 47° 38′ 53″* *E 15° 08′ 35″*	**Regime of spring discharge (Q in l/s, min/av/max)**	460 / 5380 / 48800 (1995-2020)
Z(altitude)m asl	651 – 746	**Specific characteristics**	Several spring outlets up to almost 100 m above the permanent ones become active during high discharge. Major spring for the 2nd Vienna Water Main.
Intake structure*	Spring was tapped in 1910 by an artificial gallery.		
Amount of used water* and ecological flow*	up to 1.6 m³/s		
Water physical and chemical characteristics	T 4.8-5.7°C, El. Cond. 145-215 µS/cm (25 °C)		

Fig. 1: Location map of Kläfferquellen in Austria.
Fig. 2: Oblique downward view on the outlets of the Kläfferquellen on Mai 9th, 2017 with an overall discharge during snowmelt of 14 m³/s (part of it is into the underground tapping gallery; with in the foreground 350 m.
Fig. 3: Part of the surface water during snow melt (Mai 24th, 2010).
Fig. 4: Ephemeral overflow "Hohe Kläffer" (80

Groundwater protection	The whole area is water protection zone. It is uninhabited and lacks public roads, but has touristic infrastructure (mountain huts), pastures, and silviculture.	*m above the permanent outlets) during snow melt (Mai 24th, 2010).* *Fig. 5: Major subsurface spring (in the artificial tunnel) "Große Kläffer" during low flow (Feb 28th, 2020).* *Fig. 6: The major subsurface spring (in the artificial tunnel) "Große Kläffer" emerges from the left in the background during snowmelt (April 26th, 2009).* *Fig. 7: Impressions form the 2nd Vienna Water Main (courtesy Vienna Water).* *Fig. 8: Kläffer Springs at flood situation (Anonym 1910).* *Fig. 9: Overview of the plateau catchment area with many dolines. Aflenzer Staritzen in the foreground; Hochschwab summit (2277 m a.s.l.) in the centre.*
Remarks (web pages)	*Guided trips enable a visit of the gallery where the water is tapped (www.wien.gv.at/wienwasser/versorgung/klaefferquelle).*	

*****/ in case of spring tapped

2) Spring Importance / Criteria

Criterion	Justification / Facts	Criteria order
Historic, H **Aesthetic, A** **Economic, E** **Scientific, S** **Ecological, Ec**	*The Kläfferquellen are the most important springs for the 2nd Vienna Water Main which was finished in 1910.* *Due to its economic importance numerous scientific studies have been carried out covering hydrology (including isotope studies), geology (lithology, structural geology), speleology, vulnerability mapping, microbiology, and ecology. Especially during snowmelt impressive amounts of water emerge out of a slope in an amphitheatre-like setting.*	*E* *A* *S* *H* *Ec*
Current status of spring	*The area of the spring is fenced and access is permitted except for guided trips. The catchment is water protection area.*	
Final proposal for list MIKAS or NIKAS	***MIKAS***	

3) References and source

References, which validate spring importance	*Benischke, R., Stadler, H., Völkl, G. (2016) Karstquellen [in German; Karst springs]. In: Spötl, C., Plan, L. & Christian, E. (Ed.): Höhlen und Karst in Österreich [Caves and karst in Austria]. OÖ-Landesmuseum, Linz. pp. 645-660.* *Bryda, G., van Husen, D., Kreuss, O., Koukal, V., Moser, M., Pavlik, W., Schönlaub H.-P., Wagreich, M. (2013) Erläuterungen zu Blatt 101 Eisenerz. Geol. Bundesanstalt, Wien.* *Drennig, A. (1988) 75 Jahre II. Wiener Hochquellen Leitung. MA31 – Wasserwerke, Wien.* *Koppensteiner, S., Plan, L. (2019): Anspringverhalten der Tagwässer der Kläfferquellen (Hochschwab, Steiermark) [in German; Activity of the surface springs at Kläfferquellen (Hochschwab, Styria)]. Die Höhle, 70: 94-101.* *Plan, L. (2002) Speläologisch-tektonische Charakterisierung der Karstwasserdynamik im Einzugsgebiet der bedeutendsten Quelle der Ostalpen (Kläfferquelle, Hochschwab) [in German; Speleological-tectonical characterisation of the karst water dynamics in the catchment of the most important spring in the Eastern Alps (Kläfferquelle, Hochschwab)]. Speldok 11, Verband Österreichischer Höhlenforscher, Wien.* *Plan, L. (2016) Hochschwab. In: Spötl, C., Plan, L., Christian, E. (Ed.) Höhlen und Karst in Österreich. OÖ-Landesmuseum, Linz. pp. 645-660.* *Plan, L., Decker, K. (2006): Quantitative karst morphology of the Hochschwab plateau, Eastern Alps, Austria. Z. f. Geomorphologie, Supplement Vol. 147: 29-56.* *Plan, L., Decker, K., Faber, R., Wagreich, M., Grasemann, B. (2009) Karst morphology and groundwater vulnerability of high alpine karst plateaus. - Environmental Geology, 58: 285-297.*

	Plan, L., Kuschnig, G. Stadler, H. (2010) Kläffer Spring - The major Spring of the Vienna Water Supply (Austria). In: Kresic, N. & Stevanovic, Z. (Ed.) Groundwater Hydrology of Springs. Elsevier, Amsterdam. pp. 411-426. *Stadler, H., Strobl, E. & Benischke, R. (2001) Karstwasserdynamik und Karstwasserschutz Hochschwab [Karst water dynamic and karst water protection at Hochschwab]. unpublished Report, Joanneum Research, Graz.*
Data collected by:	Lukas Plan, Ralf Benischke
Assisted by (collaborators):	
Remarks	

4) Optional data

Grading criteria for proposing the spring	E = 5; A = 4; S = 3; H = 2; Ec = 1
Surface of catchment area (km^2)	70
Water distribution system*	Gravity transport by pipeline to storage reservoirs
Purpose of water used*	*Drinking water for Vienna*
Sort and number of beneficiaries*	*Nearly 2 Mio inhabitants*
Groundwater chemistry	*Fresh groundwater, low mineralized, prevalence of Ca and HCO_3 ions.*
Water treatment*	*minimal chlorination in the storage reservoirs*
Threats to spring water quality	*Pastures(cattle), tourism (hiking, rock climbing, ski touring), high game populations*

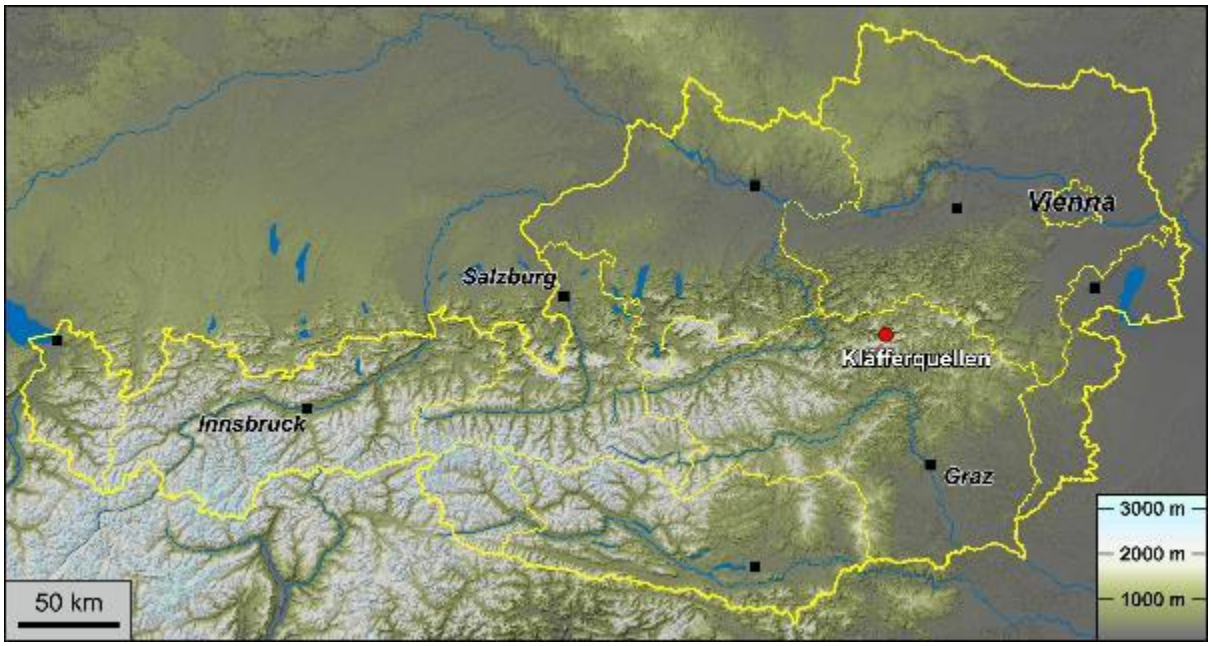

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Fig. 3: Part of the surface water during snow melt on May 24th, 2010 (Photo: L. Plan).

Fig. 4: Ephemeral overflow "Hohe Kläffer" (80 m above the permanent outlets) during snow melt on *May 24th, 2010 (Photo: L. Plan).*

Fig. 5: Major subsurface spring (in the artificial tunnel) "Große Kläffer" during low flow on *Feb 28th, 2020 (Photo: L. Plan).*

Fig. 6: The major subsurface spring (in the artificial tunnel) "Große Kläffer" emerges from the left in the background during snowmelt on April 26th, 2009 (Photo: L. Plan).

Fig. 7: Impressions form the 2nd Vienna Water Main (courtesy Vienna Water).

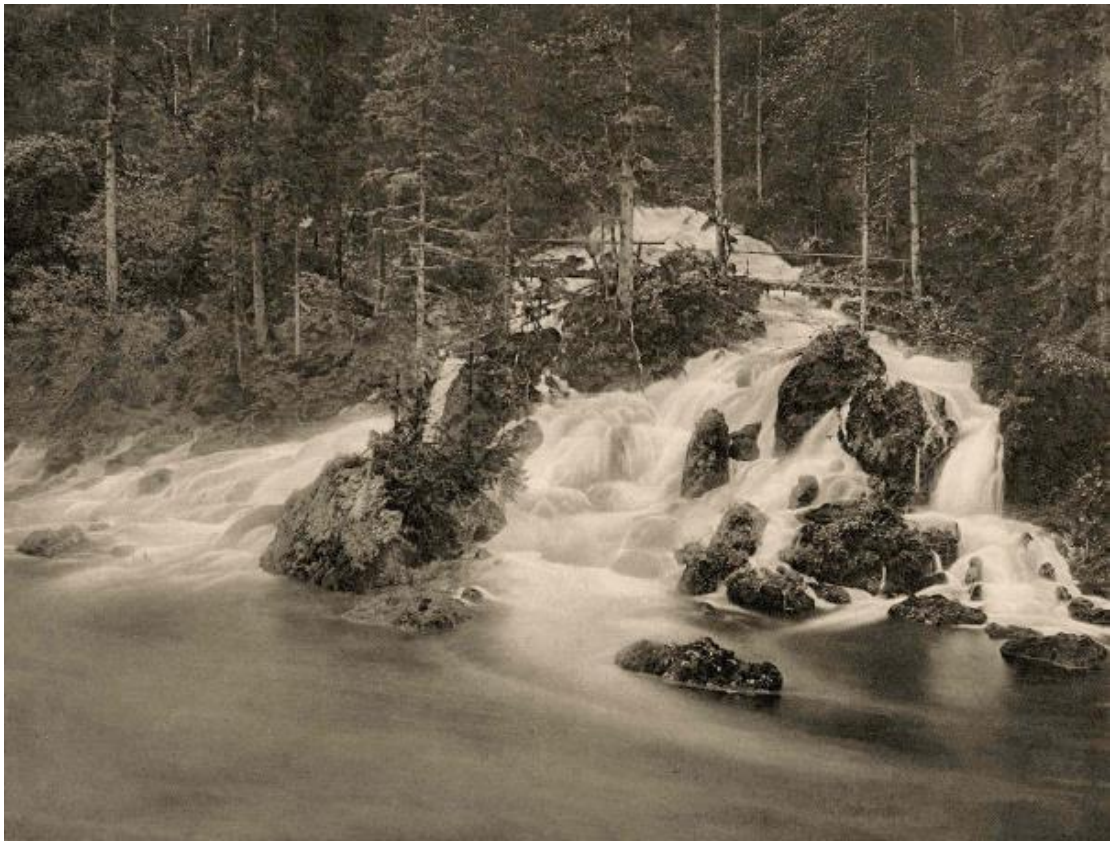

Fig. 8: Kläffer Springs at flood situation (Anonym 1910).

Fig. 9: Overview of the plateau catchment area with many dolines. Aflenzer Staritzen in the foreground; Hochschwab summit (2277 m a.s.l.) in the centre (View to the west; drone photo L. Plan).