

Chemical composition of groundwater in wells around the Hellisheidi Power Plant in 2019

Well	HK-24	HK-07	HK-25	HK-12	HK-31	HK-18	KH-50	HK-13	LK-1	KH-05	KH-06	HU-1	HK-14		
Groundwater flow	Selvogsstraumur							Selvogsstraumur/ Ellidaarsstraumur	Ellidaar- straumur	Thingvallastraumur					
Sample no.	19-5299	19-5338	18-5228	19-5302	19-5301	19-5340	19-5339	19-5345	19-5298	19-5348	19-5347	19-5300	19-5346		
Date	20.8.2019	4.9.2019	19.6.2018	21.8.2019	21.8.2019	4.9.2019	4.9.2019	11.9.2019	19.8.2019	12.9.2019	11.9.2019	20.8.2019	11.9.2019		
Chemical properties	Unit	Maximum value													
Acidity	pH		7.96	7.53	7.85	8.22	8.22	8.00	7.05	7.17	7.64	7.70	6.66	7.62	7.48
T (pH)	°C		22.4	22.6	23.2	22.4	22.4	22.7	23.0	22.6	22.5	22.7	23.1	22.5	22.6
Conductivity	µS/cm	2,500	133.0	182.2	182.0	151.3	271.0	137.9	258.0	123.1	119.1	137.2	93.3	78.2	69.2
T (Conductivity)	°C		22.1	23.1	21.6	22.1	22.1	23.1	23.1	23.1	22.1	23.1	23.1	22.1	23.1
CO ₂	mg/kg	*	33.2	57.8	54.2	39.0	39.0	41.2	92.4	25.8	19.8	47.4	29.2	22.9	20.0
F	mg/kg	1.5	0.087	0.122	0.036	0.107	0.800	0.105	0.113	0.086	0.102	0.112	0.083	0.101	0.072
Cl	mg/kg	*	9.86	7.88	7.28	8.47	8.39	9.29	9.16	13.22	15.74	6.47	5.04	6.63	5.85
SO ₄	mg/kg	200	10.68	14.05	6.95	13.86	9.56	5.13	23.13	6.13	2.37	3.01	1.83	1.77	1.57
Ca	mg/kg	100	8.06	9.37	10.90	10.20	1.65	8.34	10.9	5.02	4.17	9.14	4.44	4.23	2.90
Fe	mg/kg	0.2	0.01	0.01	0.04	0.01	0.01	0.01	0.01	0.014	0.03	0.01	0.04	0.01	0.003
K	mg/kg	12	1.05	0.97	1.39	1.11	1.28	0.85	1.16	1.00	0.89	0.82	0.54	0.80	0.67
Mg	mg/kg	50	4.36	9.64	7.21	4.93	0.14	4.43	16.90	2.92	2.54	5.65	3.89	2.44	2.00
Na	mg/kg	200	9.13	10.30	12.30	9.63	58.70	10.40	10.80	10.50	9.82	7.71	5.30	5.95	5.83
SiO ₂	mg/kg	*	19.35	30.43	24.00	20.98	52.29	18.94	39.86	18.84	15.02	28.29	15.45	22.93	14.36
Al	µg/kg	200	3.38	1.27	14.10	5.81	95.00	3.62	1.17	7.51	16.80	2.21	7.34	9.55	4.18
As	µg/kg	10	<0.05	<0.05	0.06	0.07	1.15	0.07	<0.05	<0.05	0.0536	<0.05	<0.05	0.0805	<0.05
Ba	µg/kg	700	1.09	0.30	1.10	1.15	0.44	0.53	0.69	0.63	0.45	0.21	1.01	0.51	0.24
Cd	µg/kg	5	0.003	<0.002	<0.002	<0.002	0.003	<0.002	<0.002	0.0027	0.0044	<0.002	0.005	0.0021	<0.002
Co	µg/kg	*	0.10	0.03	0.03	0.02	<0.005	0.008	0.017	0.362	0.020	0.01	0.04	0.017	0.015
Cr	µg/kg	50	0.46	0.92	0.70	1.22	0.06	1.71	0.47	2.53	0.34	0.70	0.63	0.55	1.03
Cu	µg/kg	2,000	0.776	2.01	0.65	0.44	0.50	0.45	2.31	1.24	0.33	0.278	1.21	1.10	0.55
Hg	µg/kg	1	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Mn	µg/kg	50	22.60	5.61	6.17	1.91	0.79	1.08	4.11	3.07	0.95	1.43	8.68	0.36	0.79
Mo	µg/kg	*	0.85	0.34	0.39	0.31	2.49	0.23	0.19	0.44	0.09	0.18	0.08	0.19	0.10
Ni	µg/kg	20	2.77	2.55	3.04	0.82	0.34	1.01	4.79	3.07	0.15	1.40	3.59	0.57	1.06
P	µg/kg	5,000	22.3	39.0	34.8	31.3	17.7	40.5	21.2	14.2	19.3	51.8	5.7	50.2	17.8
Pb	µg/kg	10	0.014	0.030	0.104	<0.01	0.015	0.011	0.022	0.064	0.095	<0.01	0.129	0.015	0.022
Sb	µg/kg	5	0.03	0.079	0.034	0.020	0.010	0.012	0.103	0.118	0.014	<0.01	0.015	0.011	0.012
Se	µg/kg	10	0.69	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.585	<0.5	<0.5	<0.5	<0.5	<0.5
Sr	µg/kg	*	19.3	22.8	20.7	21.7	5.7	15.1	27.0	15.4	8.8	16.1	9.8	8.9	7.5
Ti	µg/kg	*	0.118	0.131	1.030	0.092	0.272	0.073	0.097	0.304	1.750	0.0921	0.723	1.030	0.195
V	µg/kg	*	13.0	13.0	14.5	19.9	28.0	20.8	5.3	5.1	10.7	9.3	1.6	7.1	4.5
Zn	µg/kg	3,000	12.5	16.1	50.2	5.2	6.4	5.5	26.3	-	133.0	6.6	20.4	12.9	10.8

* Maximum value not specified in Icelandic regulation

The impact of the Hellisheidi Power Plant on groundwater is closely monitored in surveillance wells at and around the plant. Samples are collected to analyse overall chemical content and trace elements, in addition to measuring their temperature, conductivity and acidity. The concentration of dissolved solids is far below the limits set for potable water. However, the concentration of sulphate has risen considerably above background limits in well HK-7 (reached maximum at the end of 2014) without any substantial increase in silica, sodium and chlorine, usually associated with separated water. Since reaching their maximum values, the concentrations of sulphate have been falling. The concentrations of sulphate and silica in well KH-50 have been fluctuating and chemical monitoring will be ongoing. Sulphate is created from the oxidation process of hydrogen sulphide which follows the steam released from the plant. Up until 2016, when the gas abatement unit at Hellisheidi was relaunched after its capacity was increased, the bulk of the hydrogen sulphide filtered through the cooling towers, along with condensate water, where the oxidation occurs. Approximately 10 kg of water per second goes into each cooling tower's overflow before it's released into shallow wells at the plant. This release was stopped in 2016 and this water is currently injected back into the geothermal reservoir. Moreover, trace elements, which are mostly in gas form, have been measured in well KH-50 selenium and mercury, although both well below the limits set for potable water), while other substances which mostly follow separated water, e.g. arsenic, have not been detected in the same well. These impacts are likely to be reduced with the ongoing operation of the gas abatement unit and the reinjection of hydrogen sulphide. The chemical composition will continue to be monitored in the surveillance well to gain a better picture of groundwater flows and the release of geothermal water from the Hellisheidi Geothermal Power Plant.
