D.T3.1.3 FUA-LEVEL SELF-ASSESSMENTS ON BACKGROUND CONDITIONS RELATED TO CIRCULAR WATER USE

Budapest	Version 1 12 2020

Content

A. CLIMATE, ENVIRONMENT AND POPULATION

A1) POPULATION

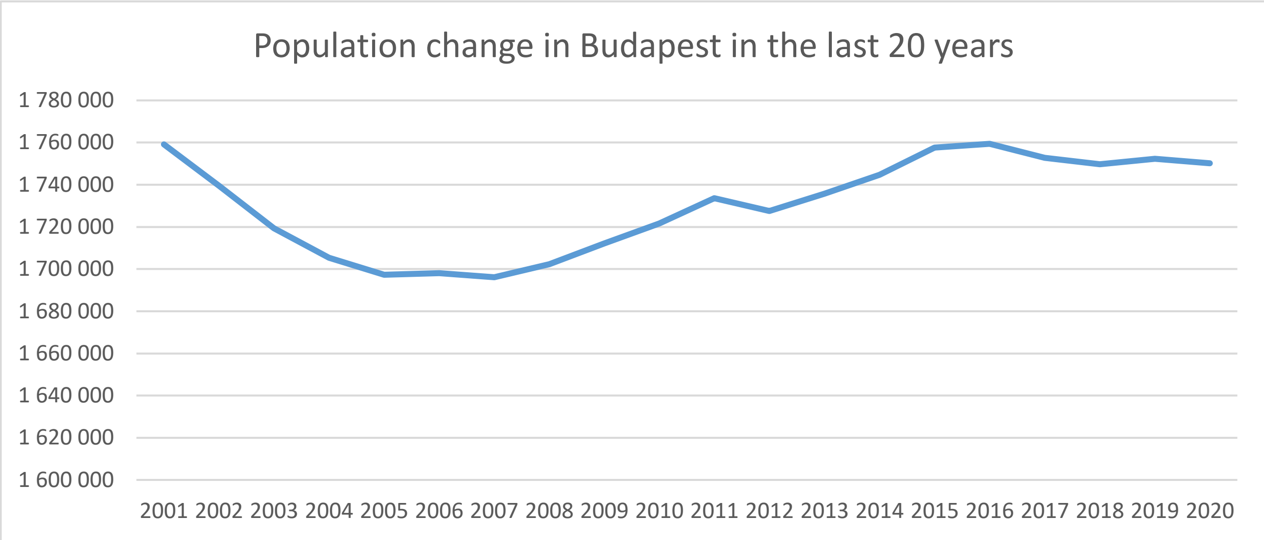
1) Population living in the FUA in 2018 [inh.]	
1 749 734	
X Measured at FUA level ☐ Estimated at FUA level	Estimate procedure and hypotheses: Source of data: Hungarian Central Statistical Office

2) Population change in the last 20 years in the FUA [inh.]

Table:

Year	Population	Year	Population
2001	1 759 209	2011	1 733 685
2002	1 739 569	2012	1 727 495
2003	1 719 342	2013	1 735 711
2004	1 705 309	2014	1 744 665
2005	1 697 343	2015	1 757 618
2006	1 698 106	2016	1 759 407
2007	1 696 128	2017	1 752 704
2008	1 702 297	2018	1 749 734
2009	1 712 210	2019	1 752 286
2010	1 721 556	2020	1 750 216

Chart:



X Measured at FUA level ☐ Estimated at FUA level	Estimate procedure and hypotheses:

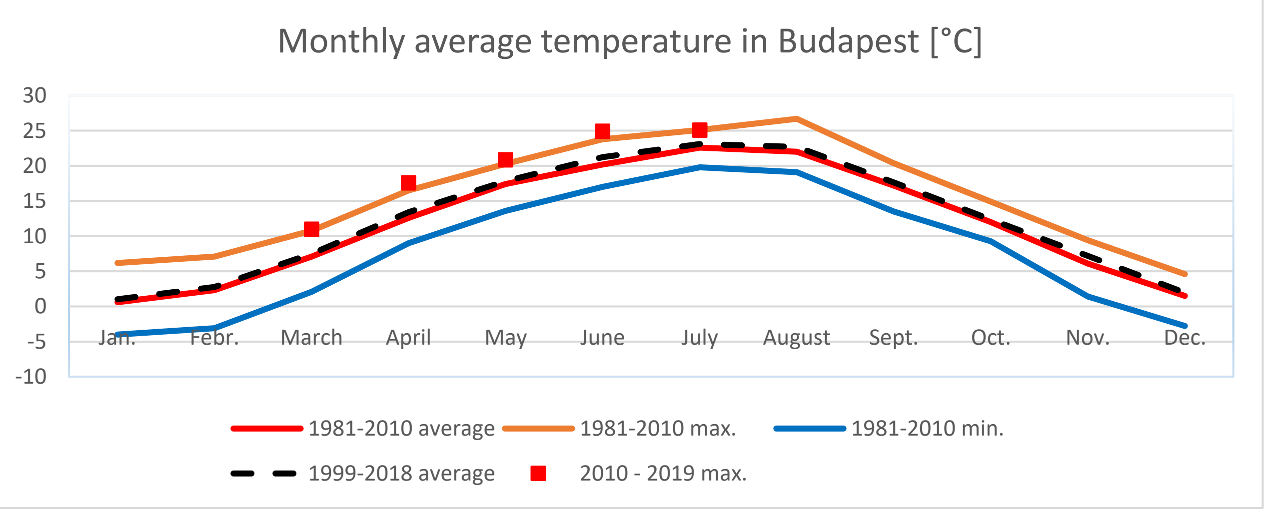
A2) CLIMATE

3) Monthly average temperature (max and min) [˚C]

Table:

Month	1981-2010 average	1981-2010 max.	1981-2010 min.	1999-2018 average	new max. 2010-2019
Jan.	0.6	6.2	-4	1.0	
Febr.	2.3	7.1	-3.1	2.8	
March	7.1	10.8	2.1	7.5	11
April	12.6	16.5	9	13.4	17.6
May	17.4	20.3	13.6	17.9	20.9
June	20.2	23.8	17	21.2	24.9
July	22.6	25.1	19.8	23.1	25.1
August	22	26.7	19.1	22.7	
Sept.	17.2	20.4	13.5	17.7	
Oct.	12	14.9	9.3	12.4	
Nov.	6.1	9.4	1.4	7.2	
Dec.	1.5	4.6	-2.8	2.0	

Chart:



X Measured at FUA level

☐ Estimated at FUA level

Estimate procedure and hypotheses:

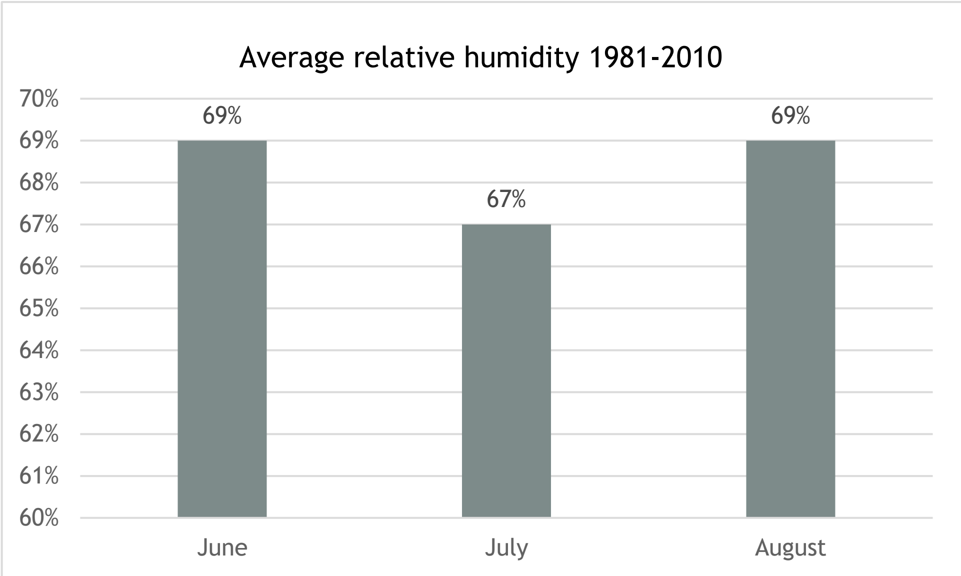
Source of data: National Meteorological Service

4) Average relative humidity in summer months [%]

Table:

Average relative humidity 1981-2010 [%]	
June	69
July	67
August	69

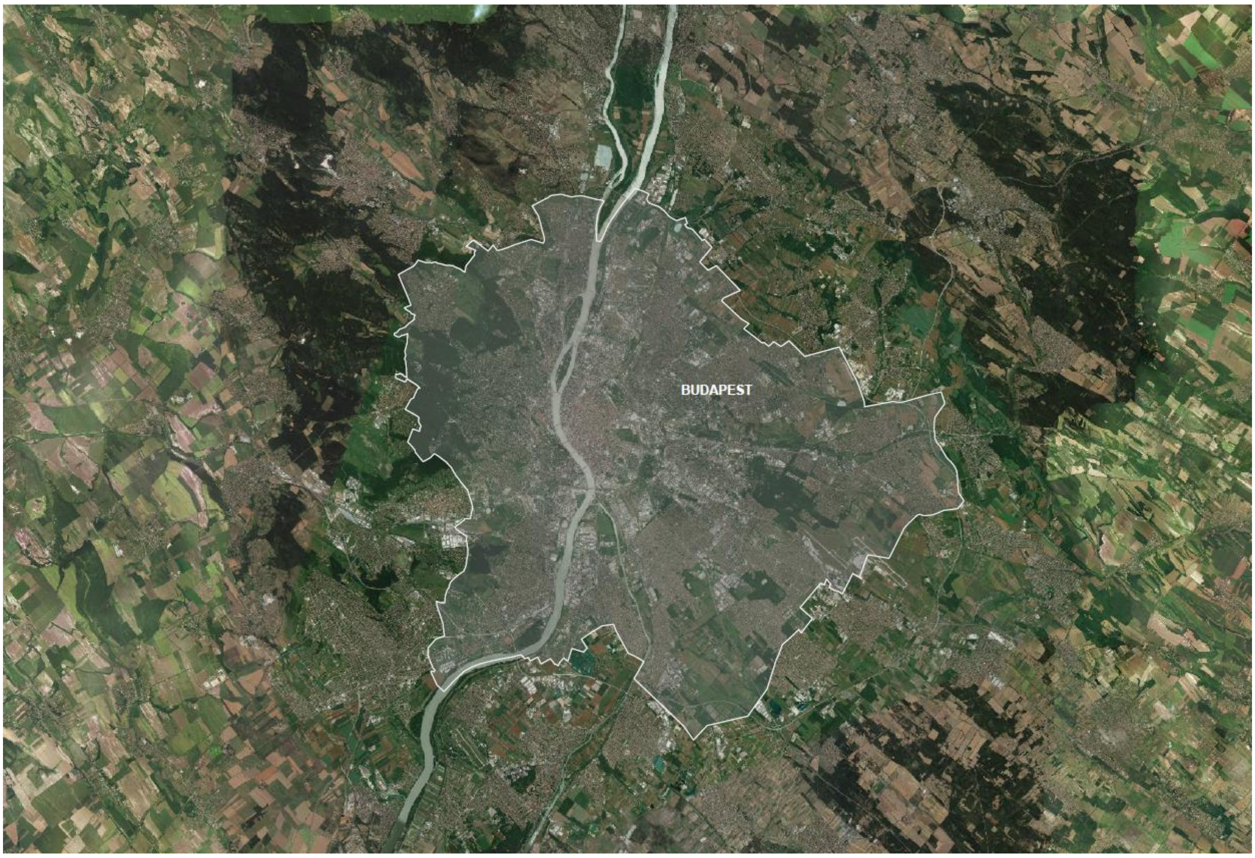
Chart:



X Measured at FUA level ☐ Estimated at FUA level	Estimate procedure and hypotheses: Source of data: National Meteorological Service

A3) SEALING SOIL

5) FUA total area [km^2]
525.13 km^2 Map:

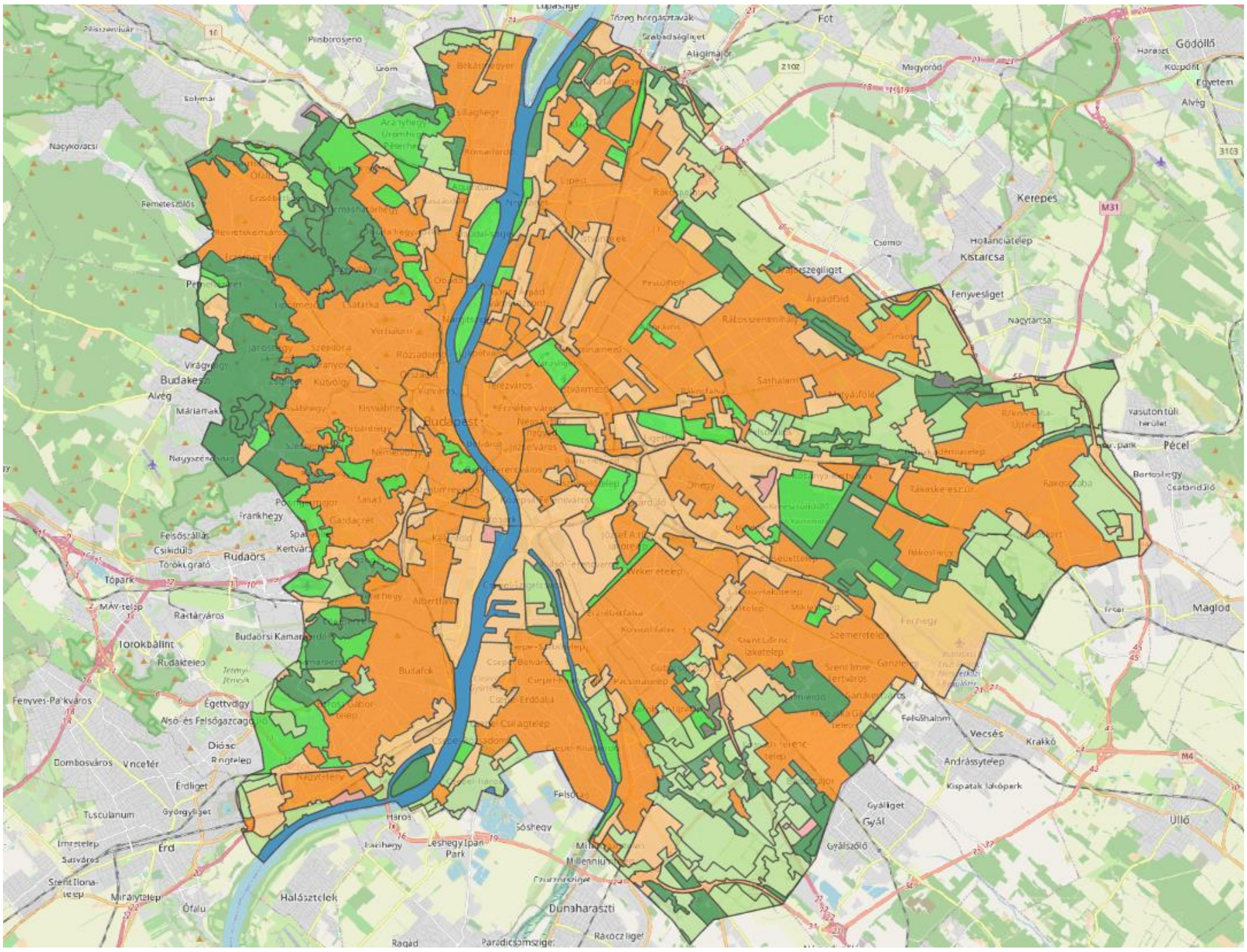


X Measured at FUA level ☐ Estimated at FUA level	Estimate procedure and hypotheses:

6) Percentage of sealed soil [%]

48,4%

Map:



Legend

- Urban fabric
- Industrial, commercial and transport units
- Mine, dump and construction sites
- Green urban areas
- Agricultural areas
- Forest and semi-natural areas
- Wetlands
- Water bodies

☐ Measured at FUA level X Estimated at FUA level	Estimate procedure and hypotheses: The estimation was made from CORNIE land cover databases. For every land use category appearing in Budapest FUA, a specific rate was determined for sealed and non-sealed soil. Since a large part of the FUA is within 'Discontinuous urban fabric', the evaluation is sensitive to the rate specified for this land cover category. 10% change in the rate causes 4% change in the result.

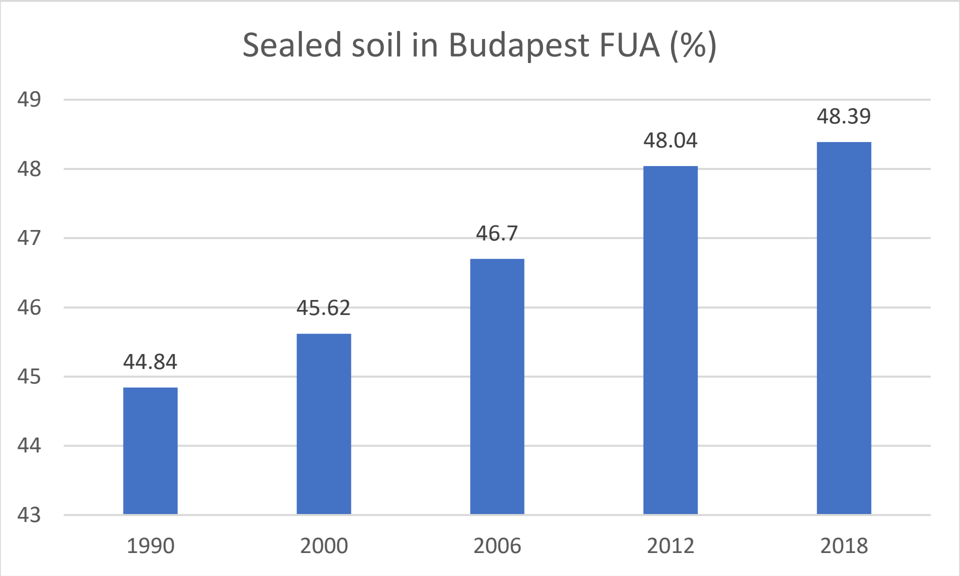
Category ID	Land cover name	Sealed soil %
1.1.1	Continuous urban fabric	100
1.1.2	Discontinuous urban fabric	70
1.2.1	Industrial or commercial units	90
1.2.2	Road and rail network and associated land	90
1.2.3	Port areas	80
1.2.4	Airports	20
1.3.1	Mineral extraction sites	10
1.3.2	Dump sites	10
1.3.3	Construction sites	20
1.4.1	Green urban areas	10
1.4.2	Sport and leisure facilities	10
2.1.1	Non-irrigated arable land	0
2.2.1	Vineyards	0
2.2.2	Fruit trees and berry plantations	0
2.3.1	Pastures	0
2.4.2	Complex cultivation patterns	10
2.4.3	Land principally occupied by agriculture, with significant areas of natural vegetation	0
3.1.1	Broad-leaved forest	0
3.2.1	Natural grasslands	0
3.2.4	Transitional woodland-scrub	0
4.1.1	Inland marshes	0
5.1.1	Water courses	0
5.1.2	Water bodies	0

7) Time series of the percentage of sealed soil [%]

Table:

Sealed soil (%)	1990	2000	2006	2012	2018
	44.84	45.62	46.7	48.04	48.39

Chart:



☐ Measured at FUA level X Estimated at FUA level	Estimate procedure and hypotheses: The estimation procedure was the same that was described under question 6.

A4) GREEN SPACES IN URBANIZED AREAS

8) Green area in the entire FUA [km^2]

255,4 km^2 from the 525,1 km^2 area of the FUA is green area (48,7%)

☐ Measured at FUA level

X Estimated at FUA level

Estimate procedure and hypotheses:

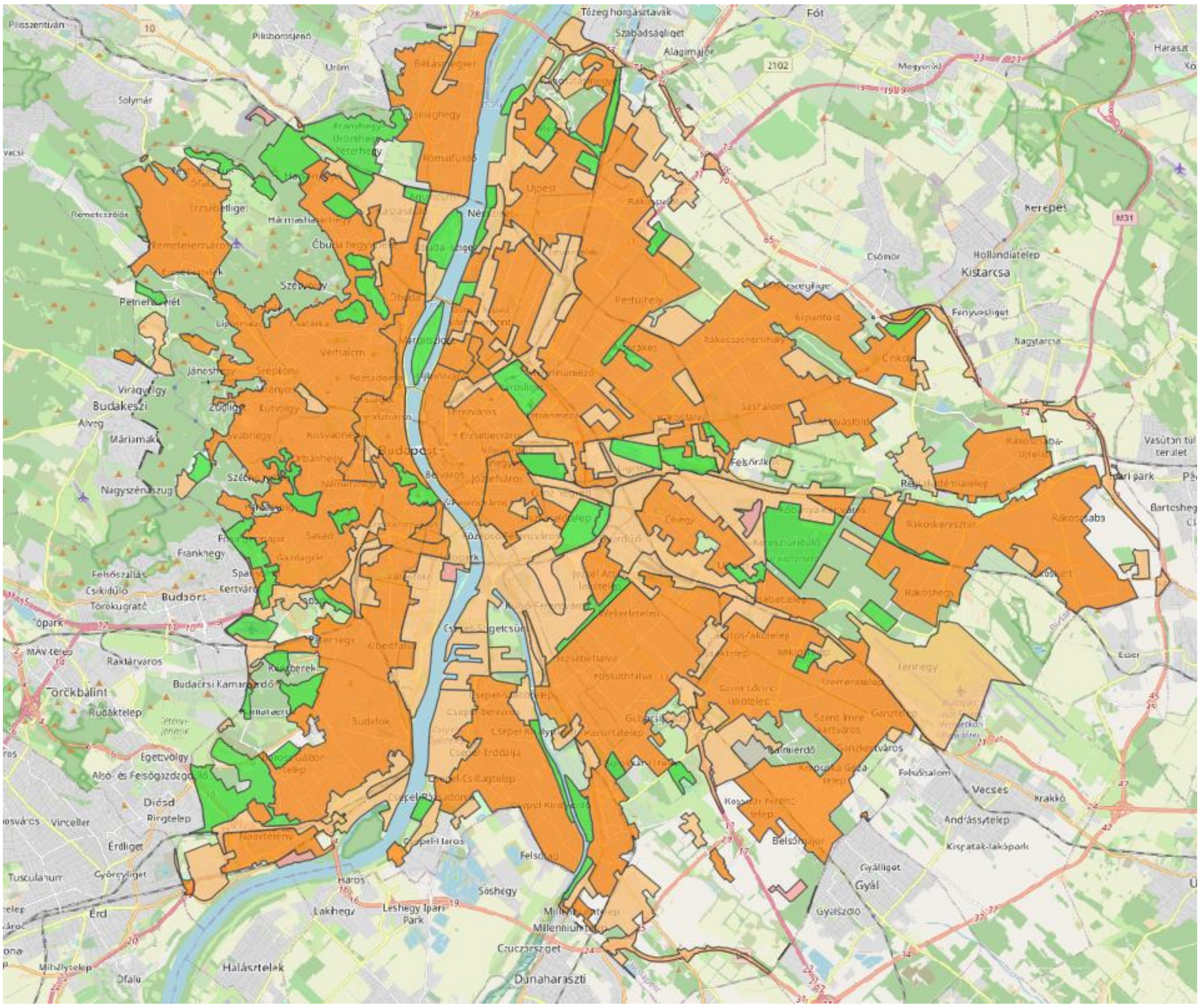
As well as in case of sealed soil amount the CORINE land cover databases has been used for the estimation.

Category ID	Land cover name	Green spaces %
1.1.1	Continuous urban fabric	0

1.1.2	Discontinuous urban fabric	30
1.2.1	Industrial or commercial units	10
1.2.2	Road and rail network and associated land	10
1.2.3	Port areas	20
1.2.4	Airports	80
1.3.1	Mineral extraction sites	70
1.3.2	Dump sites	70
1.3.3	Construction sites	60
1.4.1	Green urban areas	90
1.4.2	Sport and leisure facilities	90
2.1.1	Non-irrigated arable land	100
2.2.1	Vineyards	100
2.2.2	Fruit trees and berry plantations	100
2.3.1	Pastures	100
2.4.2	Complex cultivation patterns	90
2.4.3	Land principally occupied by agriculture, with significant areas of natural vegetation	100
3.1.1	Broad-leaved forest	100
3.2.1	Natural grasslands	100
3.2.4	Transitional woodland-scrub	100
4.1.1	Inland marshes	100
5.1.1	Water courses	0
5.1.2	Water bodies	0

9) Percentage of green spaces within urbanized areas [%]

Map:



Legend

- Urban fabric
- Industrial, commercial and transport units
- Mine, dump and construction sites
- Green urban areas

Description:

Urbanized area of Budapest FUA is 368 km^2. This was calculated from CORINE land cover database for 2018. The estimated green areas take 31,1% of the total area.

The green areas on the map show only the bigger green areas, but for the calculation the smaller, medium size parks, green places between building, gardens have been taken into consideration by the estimation described at question 8.

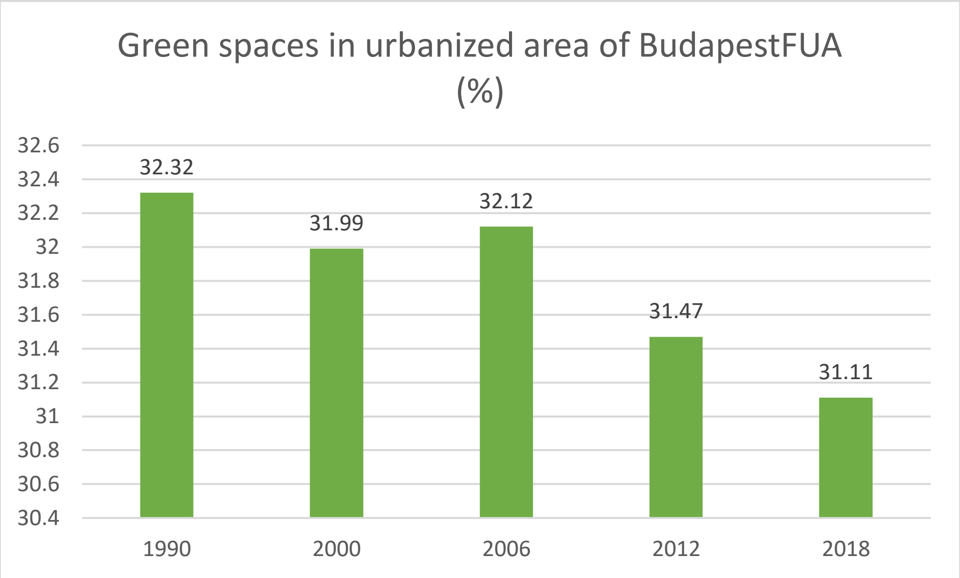
☐ Measured at FUA level X Estimated at FUA level	Estimate procedure and hypotheses: For the estimation, the same procedure was used that was described at question 8, but only the areas under 'Artificial surfaces' have been taken into consideration. These areas are urban fabric, industrial, commercial and transport units, mine, dump and construction sites and green urban areas.

10) Time series of the percentage of green spaces within urbanized areas [%]

Table:

Green spaces (%)	1990	2000	2006	2012	2018
	32.32	31.99	32.12	31.47	31.11

Chart



☐ Measured at FUA level X Estimated at FUA level	Estimate procedure and hypotheses: The estimation procedure was the same that was described under question 8.

B. WATER RESOURCES

B1) ANNUAL PRECIPITATION

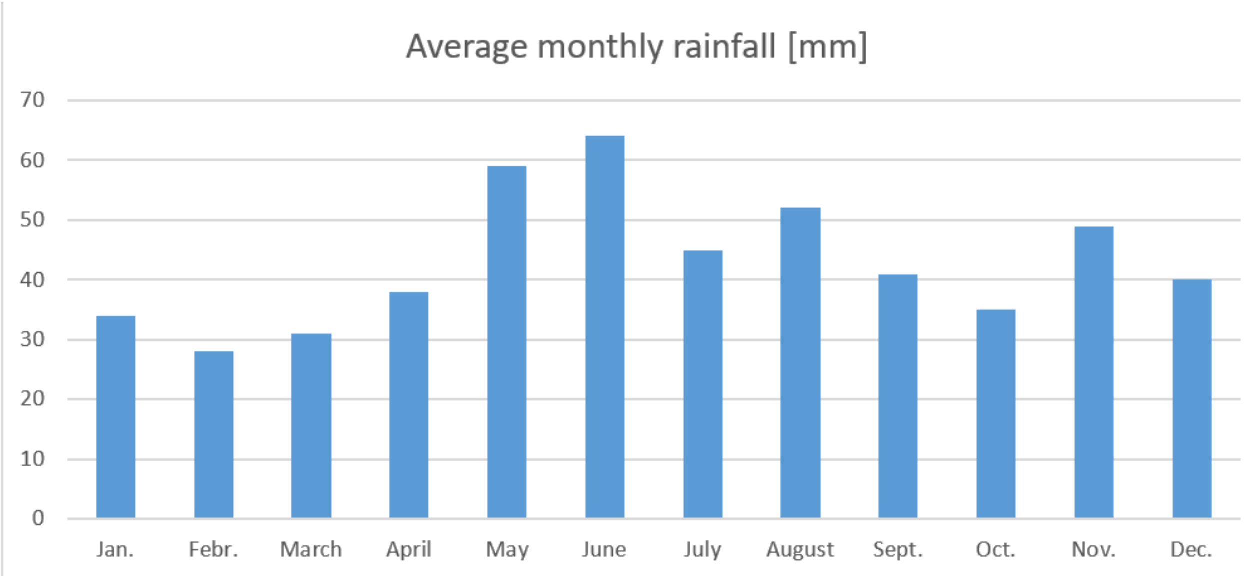
11) Average annual precipitation [mm]	
516 mm	
X Measured at FUA level ☐ Estimated at FUA level	Estimate procedure and hypotheses:

12) Monthly precipitation [mm]

Table:

Month	Jan.	Febr.	March	April	May	June	July	August	Sept.	Oct.	Nov.	Dec.
Precipitation [mm]	34	28	31	38	59	64	45	52	41	35	49	40

Chart:



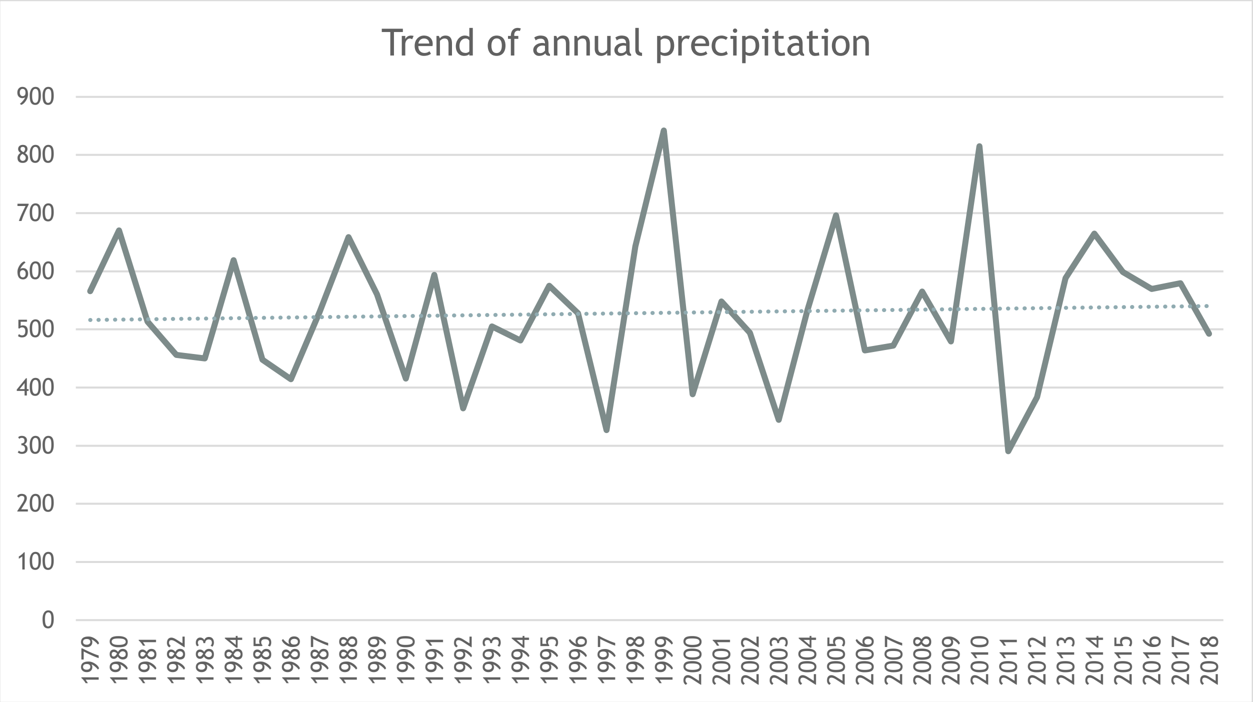
X Measured at FUA level ☐ Estimated at FUA level	Estimate procedure and hypotheses:

13) Trend of annual precipitation [mm]

Table:

Year	Rainfall [mm]	Year	Rainfall [mm]	Year	Rainfall [mm]	Year	Rainfall [mm]
1979	565.7	**1989**	560.5	**1999**	842.2	**2009**	479.1
1980	670.1	**1990**	415.7	**2000**	388.6	**2010**	815.2
1981	513.3	**1991**	594	**2001**	548.2	**2011**	290.5
1982	456.2	**1992**	364.1	**2002**	494.1	**2012**	383.6
1983	450.3	**1993**	505.4	**2003**	344.7	**2013**	588.2
1984	619.4	**1994**	481.1	**2004**	533.6	**2014**	664.9
1985	448.1	**1995**	574.9	**2005**	696.1	**2015**	598.7
1986	414.1	**1996**	527.5	**2006**	464	**2016**	569.4
1987	530.5	**1997**	326.6	**2007**	472.2	**2017**	579.4
1988	659	**1998**	643	**2008**	565	**2018**	492.5

Chart:



X Measured at FUA level

☐ Estimated at FUA level

Estimate procedure and hypotheses:

B2) RIVER, CHANNELS AND LAKES

14) List of main rivers and channels within the FUA, and their flow rate (average 2018 and monthly flow 2018) [-]

Water body name	Flow rate [m^3/s]
Danube*	Avg. 2018: 1837 m^3/s

Month	Average discharge (m^3/s)
Jan.	3177
Feb.	2179
March	1839
Apr.	2452
May	2197
June	2026
July	1714
Aug.	1174
Sept.	1383
Oct.	1093
Nov.	1121
Dec.	1720

Water body name	Flow rate [m^3/s] (estimated long term average)**
Rákos-patak	0.41
Szilas-patak	0.42
Mogyoródi-patak	0.22
Csömöri-patak	0.09
Gyáli-patak	0.11
Aranyhegyi-patak	0.32
Nagy-Ördögárok	0.11
Hosszúréti-patak	0.28

*Discharge of the Danube was calculated from daily water level measured at water gauge called Vígadó tér (1646.5 rkm) based on rating curve.

**Estimated discharge of creeks was calculated from the watershed area and long-term specific runoff [mm/year] map.

15) Synthetic water quality evaluation (ecological and chemical status) for each of the rivers and channels identified (include quantitative parameters, if available) [-]

Water quality data comes from measurements carried out to determine the water bodies' status. The data was published in the Review of Water Management Plans in 2015. The Water Management Plans are created according to the Water Framework Directive.

Water body name	Water quality	
Aranyhegyi-patak	Chemical **status**: adequate	
	pH [-]	8,3
	Conductivity [μS/cm]	1212,0
	Dissolved oxygen [mg/l]	8,1
	Oxygen saturation [%]	77,7
	BOC5 [mg/l] average	6,6
	TOC [mg/l] average	8,7
	Cl [mg/l] average	111,8
	NH4-N [mg/l] average	2,37
	NO2-N [mg/l] average	0,19
	NO3-N [mg/l] average	4,6
	Total Organic N [mg/l] average	7,1
	Total N [mg/l] average	7,4
	PO4 [mg/m^3] average	630
	PO4-P [mg/m^3] average	206
	Total P [mg/m^3] average	420
	Ecological status: poor	
	Chlorophyll-a [mg/m^3]	3,5
Hosszúréti-patak	Chemical status: poor	
	pH [-]	8,3
	Conductivity [μS/cm]	1585,9
	Dissolved oxygen [mg/l]	7,5
	Oxygen saturation [%]	70,8
	BOC5 [mg/l] average	6,8
	TOC [mg/l] average	8,5

	Cl [mg/l] average: 153,0 NH4-N [mg/l] average: 1,59 NO2-N [mg/l] average: 0,37 NO3-N [mg/l] average: 6,9 Total Organic N [mg/l] average: 8,9 Total N [mg/l] average: 9,2 PO4 [mg/m³] average: 1603 PO4-P [mg/m³] average: 523 Total P [mg/m³] average: 695 Ecological status: poor Chlorophyll-a [mg/m³]: 6,9
Szilas-patak	Chemical status: bad pH [-]: 7,9 Conductivity [µS/cm]: 1131,3 Dissolved oxygen [mg/l]: 6,0 Oxygen saturation [%]: 57,7 BOC5 [mg/l] average: 8,2 TOC [mg/l] average: 9,5 Cl [mg/l] average: 113,2 NH4-N [mg/l] average: 1,40 NO2-N [mg/l] average: 0,23 NO3-N [mg/l] average: 10,8 Total Organic N [mg/l] average: 12,4 Total N [mg/l] average: 13,0 PO4 [mg/m³] average: 2283 PO4-P [mg/m³] average: 745 Total P [mg/m³] average: 1245 Ecological status: poor Chlorophyll-a [mg/m³]: 10,0
Rákos-patak	Chemical status: poor pH [-]: 8,2 Conductivity [µS/cm]: 1095,0 Dissolved oxygen [mg/l]: 9,0 Oxygen saturation [%]: 84,0 BOC5 [mg/l] average: 7,3 TOC [mg/l] average: 10,7

	Cl [mg/l] average: 125,6 NH4-N [mg/l] average: 0,68 NO2-N [mg/l] average: 0,16 NO3-N [mg/l] average: 9,0 Total Organic N [mg/l] average: 9,8 Total N [mg/l] average: 10,2 PO4 [mg/m^3] average: 1231 PO4-P [mg/m^3] average: 402 Total P [mg/m^3] average: 636 Ecological status: bad Chlorophyll-a [mg/m^3]: 19,7

16) List of main lakes and reservoirs within the FUA, and their water storage (average 2018 and monthly variation 2018) [-]

Water body name	Water storage [m^3]
Naplás-tó	280 000*

* Water storage on operating water level

17) Synthetic water quality evaluation (ecological and chemical status) for each of the main lakes and reservoirs identified (include quantitative parameters, if available) [-]

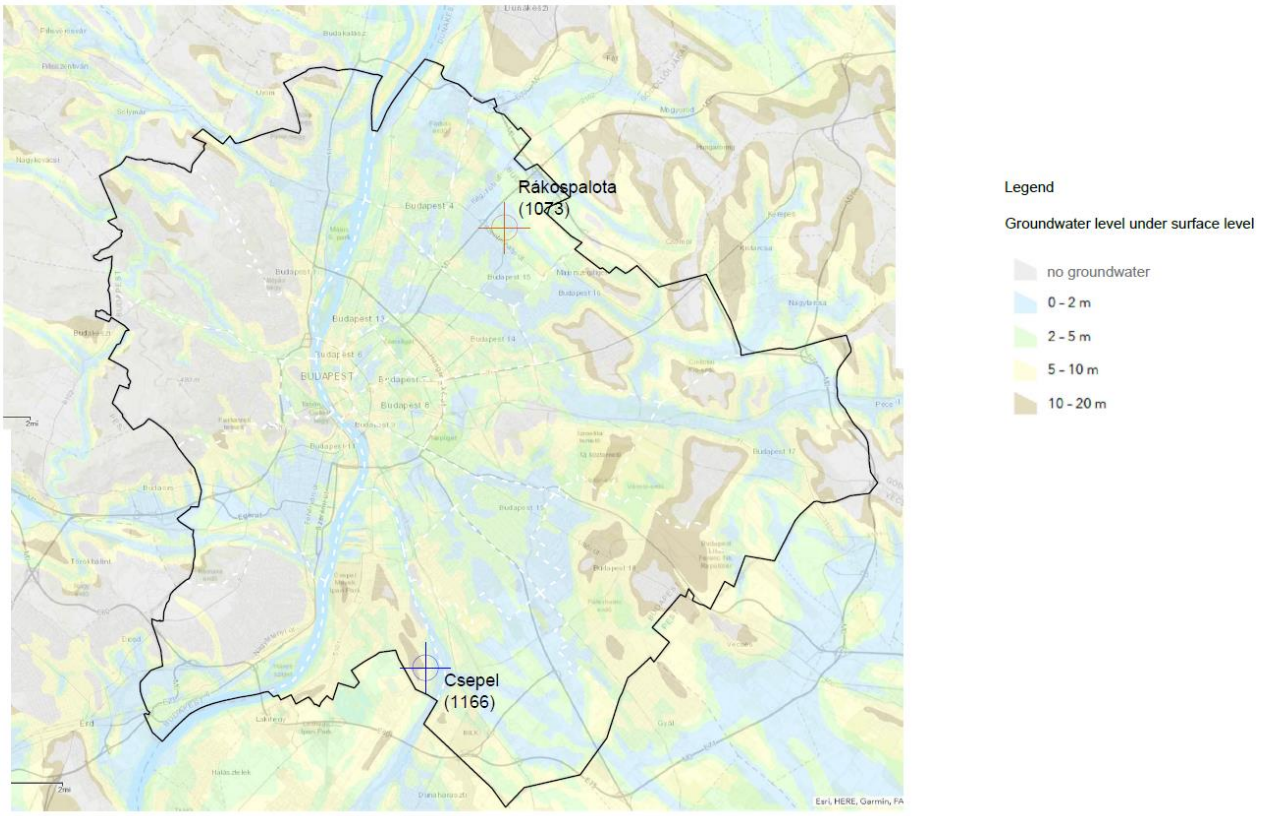
Water body name	Water quality			
Naplás-tó water samples from 2015:		Sample I	Sample II	Sample III
	pH [-]	8.9	9.09	9.07
	Conductivity [µS/cm]	748	752	747
	Dissolved oxygen [mg/l]	10.02	10.4	10.2
	BOC5 [mg/l] average	<10	<10	<10
	TOC [mg/l] average	15	14.85	14.82
	Cl [mg/l] average	76	73	72

	NH4-N [mg/l] average	<0.1	<0.1	<0.1
	NO2-N [mg/l] average	<0.1	<0.1	<0.1
	NO3-N [mg/l] average	1.5	0.5	0.5
	Total Organic N [mg/l] average	2.4	2.6	2.4
	Total N [mg/l] average	2.7	2.7	2.5
	PO4-P [mg/m^3] average	0.55	0.31	0.43
	Total P [mg/m^3] average	0.28	0.68	0.28
	Quality from oxygen balance parameters:			moderate
	Quality from nutrient balance parameters:			heavily contaminated
	Quality from micropollutants, toxicity and inorganic micropollutants parameters:			good
	Quality from other parameters:			excellent

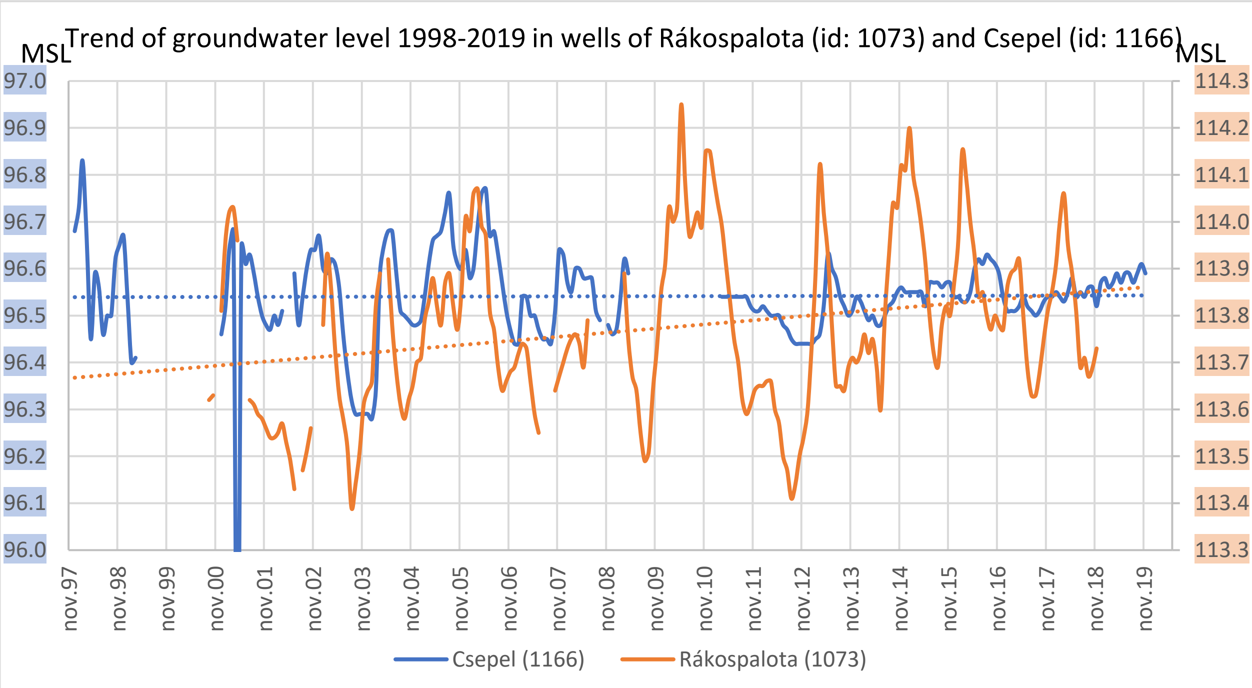
B3) GROUND WATER

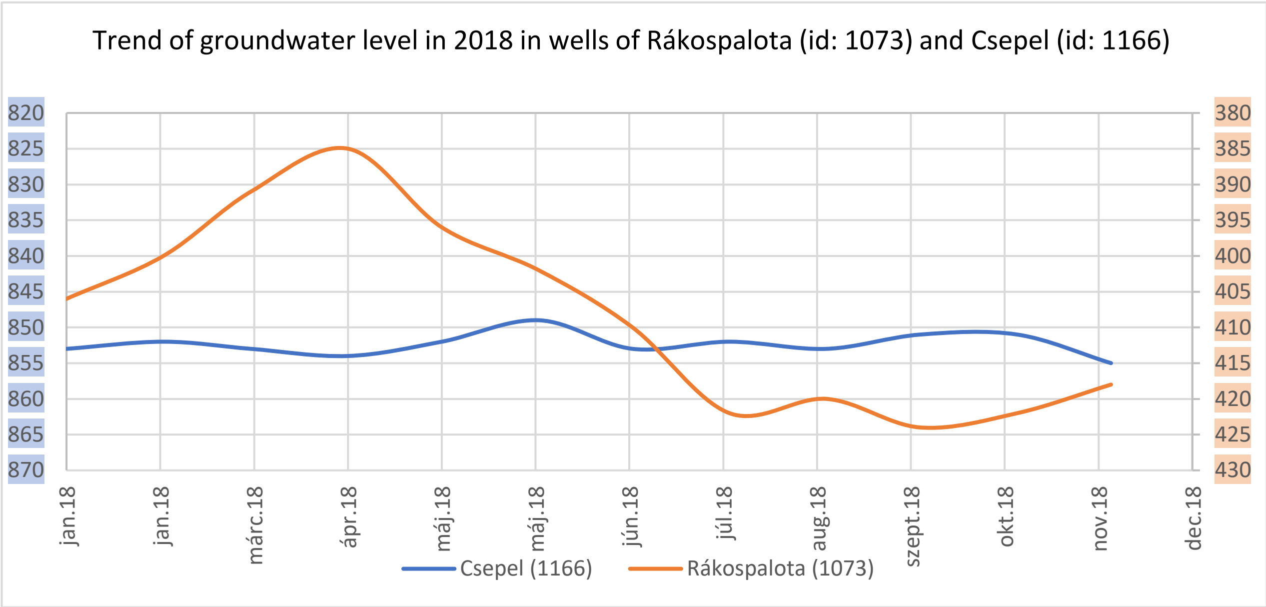
18) Trend of water level of ground water [m]

Map: Groundwater level under surface level (source: https://map.mbfsz.gov.hu)



Charts:





Trend of groundwater level in 2018 in wells of Rákospalota (id: 1073) and Csepel (id: 1166)
820
825
830
835
840
845
850
855
860
865
870
380
385
390
395
400
405
410
415
420
425
430
jan.18
jan.18
márc.18
ápr.18
máj.18
máj.18
jún.18
júl.18
aug.18
szept.18
okt.18
nov.18
dec.18
Csepel (1166)
Rákospalota (1073)

C.INFRASTRUCTURES

C1) WATER DISTRIBUTION SYSTEM - POPULATION WITH ACCESS TO FRESH WATER

19) Percentage of population with access to the water supply network [%]

100%

X Measured at FUA level ☐ Estimated at FUA level	Estimate procedure and hypotheses:

20) What kind of water purification/treatment are in use, what is planned? [-]

Budapest's water supply is based on riverbank-filtrated water resources. The raw water from radial collector wells on Csepel Island needs to be treated to reduce the iron and manganese content. The wells on other water bases such as Szentendrei Island or Margaret Island produce water with so good quality that only disinfection is required to maintain microbiological stability. For disinfection, either UV radiation or chlorine can be used. Since UV radiation as well as O3 (ozone) treatment have only on-site effects, chlorine usage is widespread to avoid secondary pollution from the distribution network.

The Budapest Waterworks tries to minimise the chlorine usage with an innovative operation system to meet the public health requirements and lower the amount of residual chlorine in all parts of the distribution system at the same time. The optimisation of the location and dosage of chlorination can ensure the same quality regardless of the daily and seasonal changes in water consumption.

21) Tap water quality - lab test results (2019 average)

• PH [-]: 7.6
• Fixed residue 180 ° C [mg/l]: -
• Hardness [mg/l CaO]: 139
• Conductivity [μS/cm a 20°C]: 465
• Calcium [mg/l]: -
• Magnesium [mg/l]: -

• Ammonium [mg/l]: <0.04
• Chlorides [mg/l]: 25
• Sulphates [mg/l]: -
• Potassium [mg/l]: -
• Sodium [mg/l]: -
• Arsenic [mg/l]: 1,3
• Bicarbonate [mg/l]: -
• Residual chlorine [mg/l]: 0.2
• Fluorides [mg/l]: -
• Nitrates [mg/l]:8,8
• Nitrites [mg/l]: <0,03
• Manganese [mg/l]: 0,0021

other parameters:

lead [µg/l]: 1,3

iron [µg/l]: 9,7

X Measured at FUA level ☐ Estimated at FUA level	Estimate procedure and hypotheses:

C2) WATER DISTRIBUTION SYSTEM LOSS

22) Percentage of loss in the water supply network [%]	
Water loss in 2018 was 15.5%. This was a 0.8% decrease over the previous year. Reasons include less pipe fractures, less failures and the mild winter.	
X Measured at FUA level ☐ Estimated at FUA level	Estimate procedure and hypotheses: Source: Budapest Waterworks annual report 2018

C3) DUAL WATER DISTRIBUTION SYSTEM

23) Description of eventual dual system water supply network within the FUA [-]	
There is no dual system water supply network.	
☐ Measured at FUA level ☐ Estimated at FUA level	Estimate procedure and hypotheses:

C4) FIRST FLUSH RAINWATER COLLECTION

24) Qualitative description of the first flush rainwater collection technique implemented, if any [-]
In practice there is no separation of first flush rainwater. The collected water goes through the same system whether it falls in the beginning of a precipitation event or not. On the area where CH pollution can occur, for example car parks over 25 parking spaces or loading areas, oil (CH) separators or filters should be installed. Most common equipment is the underground filtering tanks, but separators built in gully or filter substrate channels are also in use. Example of filter substrate channel: commonly used equipment / filters efficiency of treatment: - Total suspended solids (TSS): 99,5 % - Total petroleum hydrocarbons (TPHs): 99,9 % - Zn: 99,8 % - Cu: 99,8 %
Is your description representative of the entire FUA? Please give a short explanation.

There is no general requirement of cleaning rainwater. However, for a new parking lot CH separation is required, if the rainwater drainage network is under reconstruction in an area, there is no need to install such cleaning equipment for existing parking spaces.

C5) WASTEWATER COLLECTION

25) Percentage of households and percentage of industries, connected to the wastewater collection network [%]	
households: 96% industries: no data	
X Measured at FUA level ☐ Estimated at FUA level	Estimate procedure and hypotheses: Source of data for households: Hungarian Central Statistical Office For the estimation of the industrial usage there is no available data. What can be known is that 885 000 m^3 industrial water was sold in 2018 while the non-residential collected wastewater data (32,8 million m^3) includes the public and other costumers in addition to industrial ones.

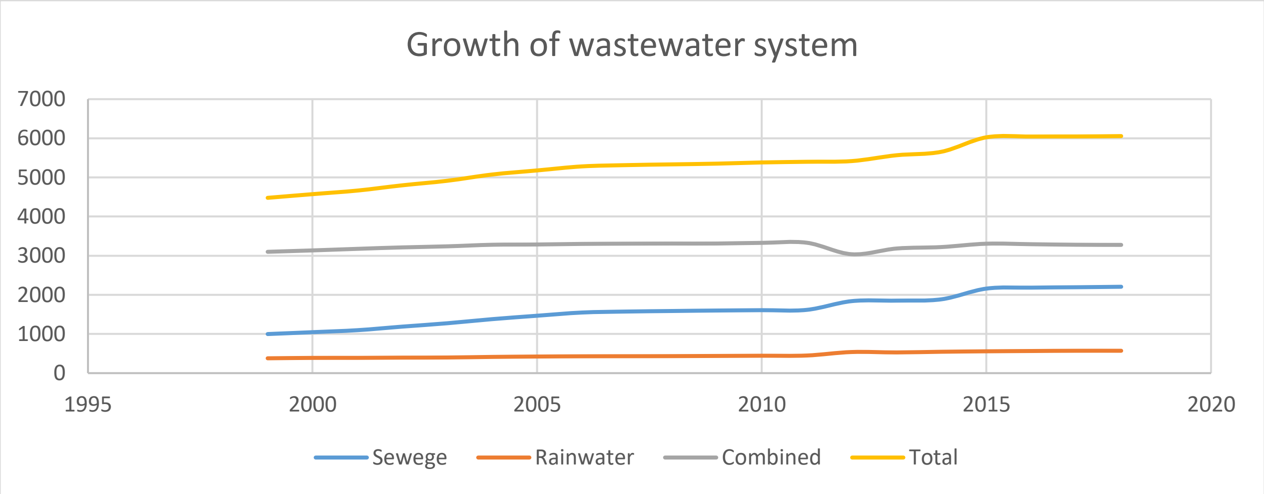
C6) DUAL WASTEWATER COLLECTION SYSTEM

26) Description of eventual dual system wastewater collection network within the FUA [-]

Mostly in the uptown districts of the capital there is a separated pipe system for rainwater and wastewater collection. In central areas rainwater and wastewater is collected by the same network and transferred to the wastewater treatment plants. The table and chart show above the growth of the network in the past 20 year.

Year	Sewage network	Rainwater network	Combined network	Total
1999	999	380	3100	4479
2000	1047	390	3136	4573
2001	1098	391	3176	4665
2002	1189	397	3213	4799
2003	1275	400	3240	4915
2004	1380	415	3280	5075
2005	1467	425	3287	5179
2006	1549	431	3302	5282
2007	1574	433	3308	5315
2008	1588	435	3311	5334
2009	1600	440	3312	5352
2010	1609	445	3329	5383
2011	1617	451	3332	5400
2012	1840	540	3038	5418
2013	1853	530	3184	5567
2014	1887	547	3222	5656
2015	2160	558	3307	6025
2016	2185	566	3294	6045
2017	2195	572	3280	6047
2018	2207	572	3277	6056

table: Growth of network length in km (source: FCSM.hu)



X Measured at FUA level	Estimate procedure and hypotheses:

☐ Estimated at FUA level	

C7) WASTEWATER TREATMENT PLANTS

27) List of wastewater treatment plants and their population equivalent capacity compared to the actual population [-]

Wastewater treatment plants	**Inhabitant equivalent (IE)**
Budapest Central Wastewater Treatment Plant	1 633 333
Northern Pest Wastewater Treatment Plant	1 333 333
Southern Pest Wastewater Treatment Plant	300 000

Comment:

The capacity is now adequate to treat the whole amount of wastewater collected in Budapest however the capacity of the Southern Pest Wastewater Treatment Plant is planned to be increased from 80 000 m^3/d to 120 000 m^3/d, and in a longer term a new wastewater treatment plant is planned to be established in Southern Buda.

X Measured at FUA level ☐ Estimated at FUA level	Estimate procedure and hypotheses:

28) What kind of wastewater treatment is realised, what is planned? [-]

All the three treatment plants use mechanical, biological and chemical steps. A heavy rainfall can overload the plants and in that case a part of the incoming wastewater will be treated only mechanically.

Main technology steps at Budapest Central Wastewater Treatment Plant

- fine grids,
- sand and fat traps with lamellar pre-settlers in one structure (SEDIPAC 3D),
- cleaning with active sludge, connected with post-settlers and disinfection basins,
- separated sludge thickening: gravity concentrators for the raw sludge and belt filters for the excess sludge,
- sludge pasteurization and thermophilic sludge digestion,
- extraction of the biogas' energy content,

- sludge dewatering using a centrifuge and sludge storage in silos **Main technology steps at Northern and Southern Pest Wastewater Treatment Plant** - stone trap (for rolled materials) - fine grids - sand traps basins - fat traps structures - chemical treatment for phosphorous removal - pre-settler basins - active sludge basins for removal of organic matter - post-settler basins for separate treated water from active sludge - compress, stabilise and dewater the residual sludge - generate electricity from the biogas arise in the fermentor

☐ Measured at FUA level ☐ Estimated at FUA level	Estimate procedure and hypotheses:

C8) TREATED EFFLUENT

29) Annual volume of wastewater treated by the wastewater plants [m^3]
Budapest Central Wastewater Treatment Plant: 230.000 m^3/day → **84 million m^3/year** - Energy produced from the biogas covers about 60% of our electricity needs Northern Pest Wastewater Treatment Plant: 140.000 m^3/day → **51 million m^3/year** - Amount of annual dewatered sludge: 50.000 m^3 Southern Pest Wastewater Treatment Plant: 53.000 m^3/day → **19.3 million m^3/year** - Amount of annual dewatered sludge: 39.000 m^3, the composted biogas covers the whole amount of electricity needs - The capacity of the plant planned to be increased from 80 000 m^3/d to 120 000 m^3/d The treated effluent is driven back to the Danube.

X Measured at FUA level ☐ Estimated at FUA level	Estimate procedure and hypotheses:

D. WATER CONSUMPTION

D1) FRESHWATER EXTRACTED

30) Annual volume of freshwater extracted from the ground, surface water, other sources. (Specify sources) [m^3]

166 million m^3 water has been extracted in 2018 from Budapest and suburb water base. For usage in Budapest the estimated amount is **156 million** m^3. The water is based on riverbank-filtrated water resources which is a type of groundwater. The water of river Danube is filtered by the sand and gravel layers at the coastline. The water is extracted through radial collector wells.	
☐ Measured at FUA level X Estimated at FUA level	Estimate procedure and hypotheses: The amount of 166 million m^3 based on the annual report of the Budapest Waterworks. The estimation based on the population and does not take into consideration the distribution of industrial usage between the capital and its surrounding. The population of Budapest uses 94% of the freshwater of the whole area supplied by this company, so that the estimated value for Budapest is the 94% of 166 million m^3. Since most part of the freshwater extraction take place out of Budapest (on Szentendrei-island and Csepel-island), this value shows the amount of extraction for usage in the territory of Budapest and not the amount of extracted water in Budapest.

D2) FRESHWATER USED/CONSUMED BY POPULATION

31) Daily volume of freshwater used by each person for civil uses [l/day per capita]	
190 l/day per capita (industrial usage included)	
☐ Measured at FUA level X Estimated at FUA level	Estimate procedure and hypotheses: No public data for industrial usage. The estimation was made from the total amount of billed drinking water for the whole population supplied by Budapest Waterworks.

32) Consumption of bottled water for drinking purposes [l/day per capita]

0.35 l

☐ Measured at FUA level X Estimated at FUA level	Estimate procedure and hypotheses: Estimated value was calculated from a study about mineral water consumption of Hungary. The consumption of mineral water for the country in 2019 was a 131 l/year per capita (source: asvanyvizek.hu). Since Hungary is rich in mineral water, nearly the whole amount of bottled water is mineral water (around 99%). Assuming if there are no regional differences in water consumption habits means that in Budapest FUA, as well as on the other part of the country the bottled water consumption is 0,35l/day per capita.

33) Initiatives to reduce consumption of bottled water [-]
Despite in Hungary and in Budapest the quality of tap water fits to the international standards, behind the exponentially growing consumption of bottled water the most common reason is the worry about health issues of tap water. Campaigns to popularize tap water and to draw attention of environmental problems of the enormous volume of PET bottles can lead to change consumption habits. For those who worry about residual pollutant in tap water the usage of osmosis filters can be a solution. The prices of these equipment in a household can return in a year compared to drink bottled water. Awareness raising campaign of the National Institute of Pharmacy and Nutrition for schoolchildren - annual event since 2010. "HAPPY WEEK" Hungarian Aqua Promoting Program for the Youth.
Please specify which municipalities within the FUA are involved in these initiatives. There was a campaign to popularize drinking tap water in 2012 with the involvement of districts 7., 14., 16., and 17 in Budapest.

D3) WATER USE SHARES (CIVIL, INDUSTRY, AGRICOLTURE, …)

34) Percentages of water used by the civil, industry, and agriculture sectors [%]	
There is no public data of water usage shares between different areas. Since the FUA of Budapest is a typically urban area, the civil purpose dominates the water usage.	
☐ Measured at FUA level X Estimated at FUA level	Estimate procedure and hypotheses: 885000 m^3 industrial water and 140 Mm^3 drinking water was sold in 2018 by Budapest Waterworks. A significant part of industrial area supplied by the Waterworks is out of Budapest what means that the industrial water usage is less than 1%. Agricultural water usage in Budapest is not quantifiable.

D4) WATER STRESS INDICATOR

35) Class of water stress of the FUA according to Falkenmark Indicator (water availability per capita per year within the FUA) [-]

Falkenmark Indicator: based on the measure of water availability per capita per year within the FUA.

Index (m^3/capita/year)	Class
>1,700	**No stress**
1,000 – 1,700	Stress
500 – 1,000	Scarcity
< 500	Absolute scarcity

The capacity of existing wells on the water bases is now 1.000.000 m^3/day, which means 183 m^3/year per capita availability. The establishment of more wells and involvement of dedicated future water bases in the surrounding of Budapest can multiply this capacity by using the riverbank-filtrated water resources. Furthermore, thanks to the river Danube discharges through the capital, the surface water volume reduces the water stress of the FUA.

☐ Measured at FUA level X Estimated at FUA level	Estimate procedure and hypotheses: For 1.700 m^3/year/capita water availability the average daily volume should be 9.3 million m^3. The average discharge of the Danube is around 2000 m^3/s, meaning 173 million m^3/day, which is around 5% of the quantity needed for no water stress.

D5) WATER MANAGEMENT COMPANIES

36) List of the private/public companies that manage the anthropic water cycle (extraction, sanitation, distribution, collection, depuration) [-]

Companies	**Area served**	**Public/private**	**Function**
Budapest Waterworks	Budapest (and other settlements in the agglomeration)	Public	extraction, sanitation, distribution, (collection), depuration
Budapest Sewage Works	Budapest	Public/Private	collection, depuration

	(and other settlements in the agglomeration)		

Is the list complete at FUA level?

Yes

E. CLIMATE CHANGE

E1) ISSUES ARISING DUE TO CLIMATE CHANGE

37) Description of the issues, if any, raised by climate change (e.g. floods, high temperature, water scarcity, …) [-]

Floods on Danube – flood protection – flood risk management

The climate change raises the frequency and risk for severe floods. In the past 20 years there were four flood events on the Danube in Budapest when the water level exceeded the 3rd grade of flood alarming level. In the past 100 year there were only two more floods with such height. At the same time the highest water levels increased. For that reason, the official flood level has been raised by law and should be reviewed every 6 years. In order to ensure the safety of the city the flood protection works should be additionally 1.3 m higher than the official flood level. Only the 1/3rd of the whole length of flood protection line meets this new regulation so the development became necessary. The main sections with structural damages and weaknesses has been reinforced but to reach the required protection level on whole of the 88.9 km of the flood protection line further preparation, design and financial support are needed.

Critically low water level on Danube

Due to droughty weather conditions the periods with low water level on the Danube are increasing and occur more frequently than decades earlier. This causes problems in the shipping area especially cargo transportation in Budapest. The barges can transfer less cargo or should wait for higher water level to go on their way. For example, in 2018 there were 33 days when the water level was under 70 cm, means critically low level. The low navigable water level is 102 cm.

However, the discharge and water level of the Danube could influence the available water supply it did not cause any problem in low water conditions, and due to the Waterworks it will not happen in the future neither thanks to the developments and the size of the river.

Rising temperature - Heat island effect

The annual mean temperature in Budapest in the past 30 years increased nearly by 2°C. The number of heat days is increasing while the number of frosty days is decreasing. In 2018 the number of heat days exceeded the number of frosty days. The rising of the temperature is more significant in the densely built-in areas. More and more paved roads, buildings and less green spaces can be blamed for higher temperatures in the city centre than in its surrounding. The heat island effect can be shown in the number of warm nights, when the temperature does not fall under 20°C. While in the middle of the 20th century this number mostly was between 4 and 16, in the past ten years it was between 15 and 41.

Heavy rainfalls - Sewer overloads - flooding

However, there is no significant change in the amount of annual precipitation, the highest daily precipitation amount in central Budapest was in 2015 since the beginning of measurements in 1901. The heavy rainfalls occur more frequently what can lead to the overload of sewer networks. In that cases the sewage is transferred to creeks without purification increasing ecological and public health risk. If the gullies cannot manage the quantity of rain that falls in heavy rains or storms, the rainwater flows through streets, flooding areas. This can endanger cars, cellars or other values, making the transportation impossible.

F.RULES, LAWS AND GOOD PRACTICES

F1) PRICING SYSTEM FOR WATER

38) Pricing system for different water uses (e.g. Irrigation, Civil, Industrial) [€/m^3]

Water use price in Budapest

Residential consumers		
Water fee	218,95 Ft/m^3	0.61 €/m^3
Basic fee over 0 m^3 monthly water consumption	179,95 Ft/mont h	0.50 €/month
Business consumers		
Water fee	252,60 Ft/m^3	0.70 €/m^3
Basic fee (yearly)		
average daily consumption between 0 m^3 and 7.5 m^3	18 897,60 Ft/year	52.49 €/year
average daily consumption between 7.5 m^3 and 15 m^3	69 037,20 Ft/year	191.77 €/year
average daily consumption over 15 m^3	112 623,60 Ft/year	312.84 €/year

Sewer use price in Budapest:

Residential consumers		
Sewer use fee	381.29 Ft/m^3	1.06 €/m^3
Administration fee	86 Ft/month	0.24 €/month
Non-residential consumers		
Sewer use fee	423.67 Ft/m^3	1.18 €/m^3
Administration fee	97 Ft/month	0.27 €/month

For watering a garden in a family house or an apartment house, a watering discount can be applied from the sewer use prices. The discount is 10% from May to September. If the service provider installs a separate water meter for watering, after that amount no sewer use price will be invoiced.

Is the pricing system described above valid for the entire FUA? Please specify

Yes, the pricing system is the same all part of Budapest.

F2) RESTRICTION IN WATER USE

39) Description of restrictions in water use, if any [-]
There are no restrictions in water usage.
Are the restrictions described above valid for the entire FUA? Please specify Yes.

F3) LEGISLATION ABOUT DUAL WATER DISTRIBUTION SYSTEM

40) Description of the legislation about dual water distribution system, if any [-]
No regulation is available.
Is the legislation described above valid for the entire FUA? Please specify

F4) LEGISLATION ABOUT WATER REUSE

41) Description of the legislation about water reuse, if any [-]
There is no national legislative background or public health regulation for the reuse grey water or rainwater. The local municipalities can help to increase the amount of rainwater harvesting among the population. For example, the municipality of district XVII. in Budapest made a regulation to give rainwater containers for free to harvest and use rainwater within the plot.
Is the legislation described above valid for the entire FUA? Please specify There is no general regulation for the capital, only local regulations try to help rainwater uses.

F5) LEGISLATION ABOUT FIRST FLUSH RAINWATER COLLECTION (e.g. streets)

42) Description of the legislation about first rainwater collection, if any [-]
There is no legislation about first flush rainwater collection. The regulatory plans contain rules about how to manage the accumulating rainwater on a plot regardless its pollutant content. These rules mostly say that rainwater needs to be hold back in site and should be driven to collection system delayed to avoid overloading of the network.
Is the legislation described above valid for the entire FUA? Please specify

Every district has its own regulatory plan.

F6) RULES FOR GREEN SPACES IRRIGATION

43) Description of the rules about urban green spaces irrigation, if any [-]

In case of some municipality the regulatory plans contain specifications about green spaces irrigation. Mostly that means the opportunity of irrigation needed to be ensured at the area where trees are planted or on new green spaces. Unfortunately tap water is used for irrigation. In a study, the Budapest Green Infrastructure Concept from 2017 draws up that rainwater should be used for irrigation, but at present there are no infrastructural background and legislative incentives to do so.

Are the rules described above valid for the entire FUA? Please specify

No, the rules are specified in local regulatory plans.

F7) DIFFUSION OF WATER SAVING GOOD PRACTICES

44) List of good practices in place for water saving [-]

Budapest Water Summit

Budapest hosted Budapest Water Summit in 2013, 2016 and 2019. During the Summits there was an exhibition where Hungarian companies, institutions and organizations could present their sustainable, innovative, and environmentally friendly technologies and solutions in water industry for the participants of the Water Summit. The summit of 2019 had the motto "Preventing Water Crises". Every summit has a final documentation with messages and political recommendations. On the summit in 2019 an appeal was presented focusing on further steps, which are:

- Develop cooperation at all levels
- Strengthen the role and capacity of institutions
- Facilitate knowledge sharing
- Build capacities through education, vocational training and reviving local and indigenous/traditional knowledge
- Encourage a radical reorientation of financing flows
- Frame every development policy with the environment in mind

Washing machine replacement

State financial support can be used to replace washing-machine to energy and water efficient equipment. The amount of the support depends on the energetic class and can be maximum 50% of the price.

Public information on Budapest Waterworks webpage for water saving

The information helps to detect leakage in households and give advices how to reduce tap water consumption.