DELIVERABLE D.T.3.2.2

FUA level potential analyses on place-based applicability of RW by FCSM

Draft Version 1

05 2021

1.PRESENTATION OF SELECTED LOCATION

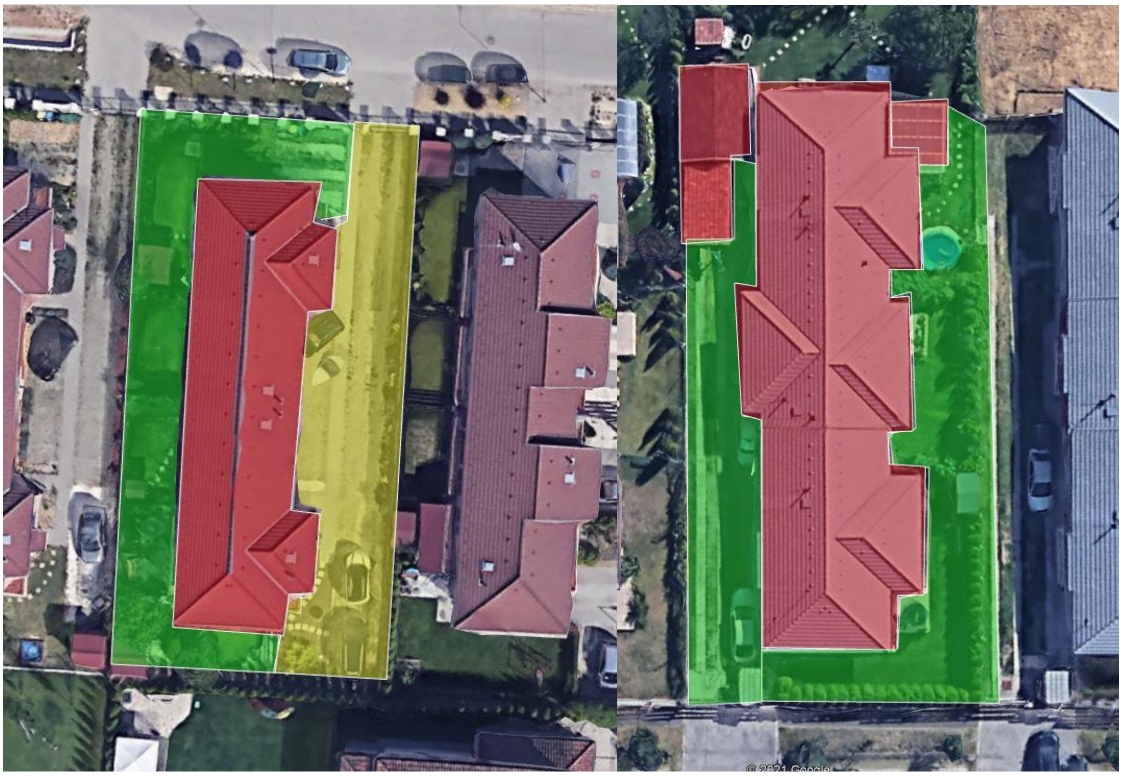
Summary from the D.T3.2.1 Concepts on carrying out FUA-level potential analysis of Rainwater and Wastewater utilisation

Presentation of the design area

Budapest XVI. District is on the left bank of the Danube, on the eastern part of the Pest side. The built-up area of the area is of a suburban nature, mostly residential. As a result of continuous urban development, the built-up area is increasing, more and more condominiums are being built with paved entrances, thus the proportion of green areas is decreasing. The current sewage and storm water network is not designed for this degree of integration. Due to heavy and sudden rains, flooding occurs. One solution to this is that rainwater is stored locally and used locally by residents during the drier period. Current population: 74,999 people, area 33.51 km2, population density 2,193 people / km2.

In this task, we considered two condominiums and a family house in the 16th district of Budapest. The selected images can be seen below. The tiled roofed areas are red, the orange areas are Uncoated stone cladding and the uncovered green areas are highlighted with green colour on the following images.

1. Figure. Areas of a residential building



2. Figure. Areas of a residential condominiums

1.1. Presentation of location and its utilization

According to the local building regulations of the 16th district, the maximum buildability is a maximum of 30% in suburban residential areas. Based on the measurement, it can be seen that this is not observed in many cases, outside the roof surface of the house, by covering the garden carports, it exceeds the installation limit.

Flow factor

The basic factor for determining the amount of rainwater entering the stormwater drainage works is the runoff factor for the given area, which shows what proportion of the rainwater falling into the area enters the stormwater drainage systems and channels. The runoff factor mainly depends on the quality and surface of the surface. The majority of the rainwater collected on the paved surfaces enters the sewer, while the rainwater falling on the green surfaces flows only in a smaller proportion, most of it seeps into the soil or evaporates. The slope of the terrain also has a significant effect on the runoff, in our case there is no significant slope.

Statistical data sets are also taken into account when determining runoff factors. Science examines the runoff factor as a long-term or multi-year average of runoff ratio. The runoff ratio is the quotient of the surface runoff and the measured precipitation reaching the surface. In relation to Budapest, statistical analyzes are typically of lesser importance, the runoff conditions are mainly determined by the proportion of built-in, paved and green surfaces.

Each surface has a different runoff factor. In the case of paved areas, the infiltration is small, so here the value of the runoff factor will be higher, while in the case of unpaved areas, much more water can seep in, so here the runoff factors will be smaller. Where there are many paved surfaces, ie runoff factors are greater, the water accumulating on the surfaces must be drained to prevent water damage, inland water, and flooding.

The following table shows these differences:

Tiled roof	0,90-0,80

Asphalt or concrete pavement	0,90-0,85
Uncoated stone cladding	0,70-0,50
Uncoated surfaces	0,15-0,10

1. Table. Surface runoff factors

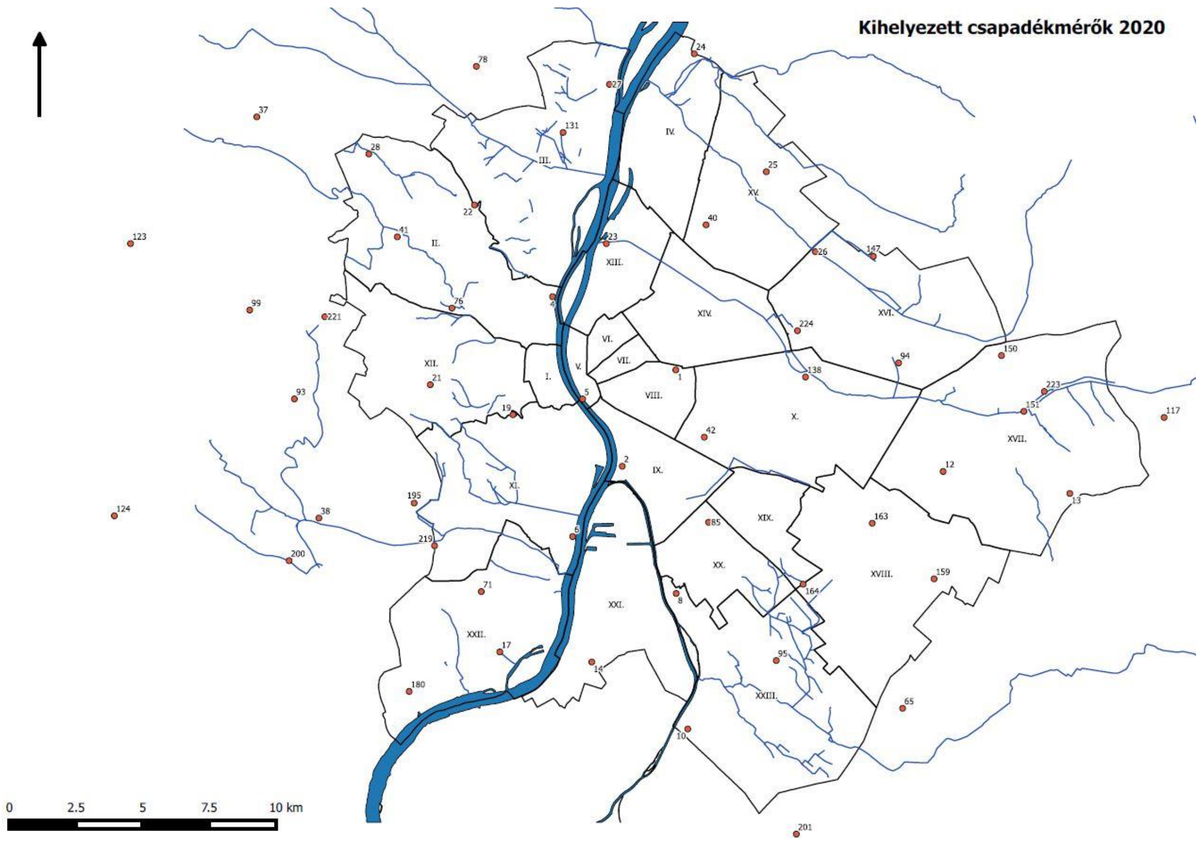
Surface type runoff factor, α. The amount of precipitation to be stored can be calculated as a function of the maximum precipitation as follows

$$Q = \alpha * \mathrm{A} * \mathrm{i}$$

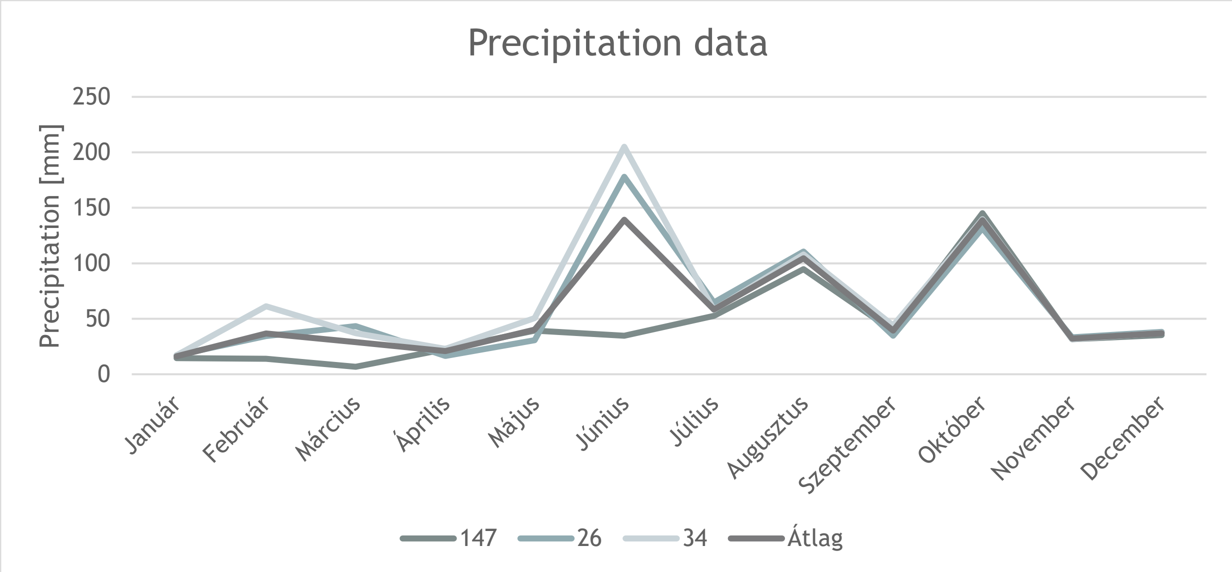
During the design of the reservoir, we calculate a 4-year 10-minute precipitation event at which i = 270 l/s

Precipitation data

From the precipitation meters placed by Fővárosi Csatornázási Művek in the territory of Budapest, the amount of precipitation falling on the area can be determined on an annual basis. There are 3 measuring instruments in the 16th district.



3. Figure. Map of FCsM Zrt. Rainwater monitoring system



4. Figure. The monthly distribution of precipitation data in 2020

Total potential water use per year from 2020 rainfall data (taken from the average of three meters):

Avg. Precipitation mm]	Yearly prec. qty. [m3]
781	341,57
781	327,87
781	218,58

2. Table. Yearly precipitation data

Calculation of total precipitation quantity

$$V = \alpha * A * h$$

1.2. Goals of potential investment

The purpose of the investment is to be able to utilize the rainfall on the property locally, thus not burdening the public sewer. Local use of precipitation for irrigation, thus reducing the water fee for residents.

2. ASSESEMENT OF POTENTIAL INVESTMENT USE CASE

Place-based and qualitative assessment of one potential investment/measure to improve rainwater and wastewater utilisation. We planned rainwater collection and irrigation for the selected suburban area. We scaled the project based on the previously discussed precipitation data and surface integration of District XVI. The calculation best applicable to the chosen site, however can provide a good basis for future project. The selected technology is very simple, and does not require special training or chemicals to operate. Also has minimal operating cost.

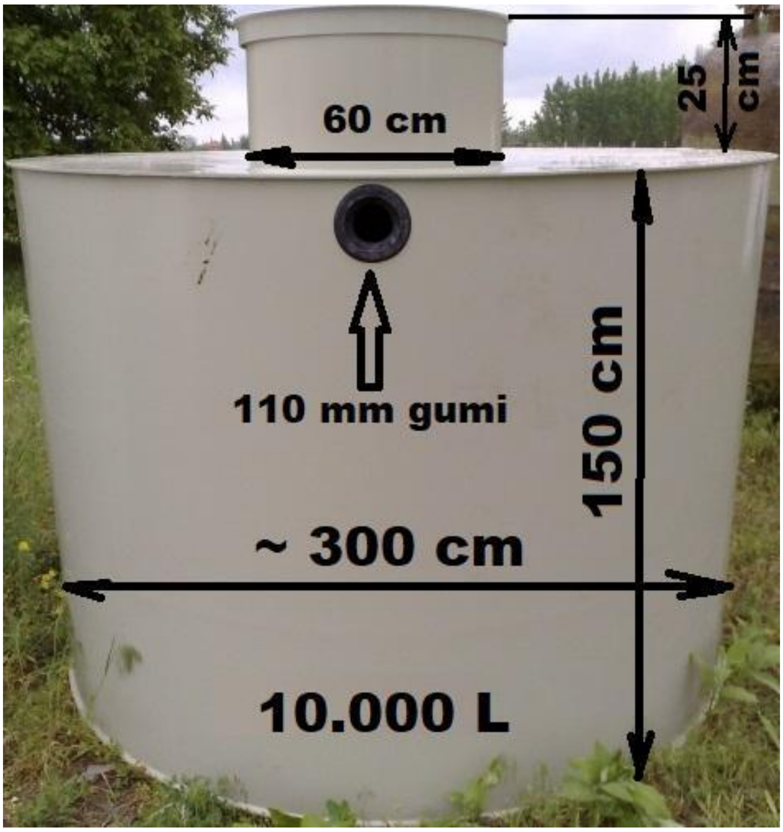
2.1 Presentation of the potential technical solution for chosen location

Short presentation of possible technical solution, which could be used to implement the measure planned on chosen location.

The placement and selection of a suitable storage tank is limited by the highly built-up area and also construction regulations. Concerning the above mentioned issues, we selected a tank with a smaller horizontal area, thus a standing tank should be installed. According to preliminary calculations, a rainwater collection tank with a volume of 10 m^3 is required, considering the 4-year 10-minute precipitation event and some extra storage capacity. We do not consider with overflow water, this tank should be capable of holding all the available water, or the excess water can use the already available rainwater drainage system.

Its parameters are as follows:

Technical parameters: 10m3 PE. Plastic rainwater collection tank with step-resistant lid.	
Material	PE
Design	standing cylindrical
Volume	10 m3
Diameter	3 m
Height	1,5 m + a 25 cm high neck
Weight	300 kg
Wall width	8 mm



5. Figure. Rainwater storage tank

The following pump has been selected for emptying the tank: BBC SEMISOM 190M + G pump.

The BBC SEMISOM 190M + G pump is made with a float switch design. Suitable for lifting rainwater and leachate, filling and emptying pools, flood irrigation.

The pump is characterized by a stainless steel shaft, filter and motor shield, plastic impeller and cast iron pump housing.

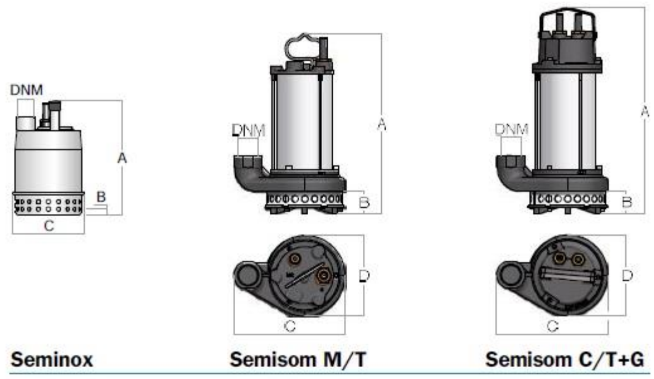
The upward-facing 5/4 ″ internally threaded discharge port is located on the side of the pump housing.

Thanks to the built-in float switch, it does not require constant monitoring. Maximum particle size: D5 m.

Technical parameters:	
Operating voltage	230 V, 50 Hz
Motor power	370 W, 2.5 A
Max. Lifting height	10.5 m
Max. Fluid delivery	210 l / min
Working point	4 m / 150 l / p
Max. Particle size	5 mm
Compression fitting size	5/4 ″

* C : Monofase con condensatore interno e galleggiante
M : Monofase con condensatore esterno con o senza galleggiante
T : Trifase senza galleggiante
T+G : Trifase con galleggiante

Tipo			Misure mm				Peso
			A	B	C	D	Kg
Seminox	155	C	273	20	167		4,6
Seminox	155 L	C	304	45	167		5,0
Semisom	190	C	393	50	225	164	12,8
Semisom	320		418	50	225	164	14,9
Semisom	465	C/T+G	484	60	250	172	21,8
Semisom	190	M/T	335	50	225	164	10,8
Semisom	320	M/T	360	50	225	164	13,0
Semisom	465	M/T	440	60	250	172	19,5



6. Figure. Selected pump and its parameters

Elettropompe sommergibili SEMISOM per acque torbide
Electric submersible pumps SEMISOM for dirty water **2 poles 50 Hz** Girante Aperta • Open impeller

Monofase • *Single-Phase* 230 V 50 Hz Trifase • *Three-Phase* 400 V 50 Hz	Caratteristiche Nominali *Nominal Characteristics* HP	KW	A 1~	A 3~	450 V µF	Cavo *Cable* m	DNM	Passaggio solidi Ø *Ø Solids passage*	m³/h l/min	0 0	1,8 30	6 100	9 150	12 200	15 250	18 300	21 350	24 400	27 450
SEMINOX 155 C	0,33	0,25	1,9		8	5	1"1/4	10		7,6	6,8	4,2	1						
SEMINOX 155 L C	0,33	0,25	2		8	5	1"1/4	20		6,5	5,9	4,2	2,4	0					
SEMISOM 190 C/M/T	0,5	0,37	2,5	1,2	10	5	1"1/4	5		10,5	9,5	7	4	1					
SEMISOM 320 C/M/T	0,75	0,55	4,2	1,7	16	5	1"1/4	13		11,5	11	9	7,5	5,5	3	0,5			
SEMISOM 465 C/M/T	1,5	1,1	7,3	2,7	20	5	2"	5		19	18,5	17,5	16,5	15,5	14	12	9,5	6,5	1

C : Monofase con condensatore interno e galleggiante • *C: Single-phase with internal capacitor and float switch*
M: Monofase con condensatore esterno con o senza galleggiante • *M: Single-phase with external capacitor with or without float switch*
T : Trifase • *T: Three-phase*

7. Figure. Selected pump and its technical parameters

2.2 Assess the investment and operating costs

By using the information from presentation of possible technical solution (2.1) and we assessed the investment costs for realization and operating costs.

The table below contains all the investments cost, from earth works, the tank and irrigation equipment, to installation and operation costs.

ASESSMENT OF COSTS FOR REALIZATION	IN EUR
INVESTMENT COSTS	
1. Earth works	617
2. 10m3 PE tank	2645
3. PVC pipes, fittings	129,69
4. Semison pump	229,68
5. Electrical installations	95,25
6. Other costs	254
Totals costs	3970,62

OPERATION COSTS	
Continous costs	76,2
Electricity fee (kWh)	0,52
Total:	76,72

2.3 Assess/describe the potential economic benefits (savings)

ASESSMENT OF BENEFITS	IN EUR
Water fee (1 m^3):	0,63
Sewage fee (1 m^3):	1,05
Total:	1,68
The amount that can be saved in one year:	**240*1,68= 403,2**

By using rainwater collected from roof surfaces and paved surfaces, the amount of drinking water used for watering can be reduced. This will also reduce the amount of the monthly wastewater fee.

The amount of water that can be collected: 240 m3 / year. Pump capacity: 210 l / min.

Annual pump operating time: 19 hours.

Investment costs are significant, although as a condominium they are split. The payback time is considerable.

Investment cost (€) / amount that can be saved in one year (€): 3970.62 / 403.2 = 9.84 years - the payback period.

2.4 Assess environmental impacts of investment

ASESSMENT OF ENVIRONMENTAL IMPACTS
Municipal water management Considering the water balance, it is important to leak enough water back into the soil. Currently, storm water is drained directly through the urban storm water network. The future goal is to manage rainwater supplies. There are several solutions for this (desiccation, storage, gradual release of rainwater). In the present concept, the collected precipitate is used to improve the water management of the microenvironment. This utilization can provide irrigation of green surfaces, cooling of paved surfaces, thus improving microclimatic conditions. Furthermore, by improving the water balance of the microenvironment, we reduce the drying of the area, thus helping to preserve the condition of the local ecosystem. The focus should be on the management of the accumulating rainwater at the local, residential level. This also makes pollutants more filterable.
Hydraulic strokes The communal use of desiccants and reservoirs reduces the load on the utility network. They moderate peak yields and prolong the recession of flood waves. The method can be used to retain contaminants and sand, which spares the equipment of sewage plants. It improves the water supply of plants, thus reducing the need for irrigation.

Circular economy The shift towards a circular economy has become one of the key objectives of EU environmental and economic policy in recent years. There is a need to reduce the use of non-renewable resources, and this can be achieved by starting to use renewable resources in an integrated way in most areas. Precipitation storage is a suitable solution for this.

2.5 Assess social impacts of investment

ASESSMENT OF SOCIAL IMPACTS
Environmental awareness In today's society, environmentally conscious living and waste management are becoming more widespread. An integral part of this is global thinking, the condition for success is to encourage people to take local solutions, to have a variety of liveable and sustainable environmental conditions with our number of customer coins.
Consumer psychology There should always be only potential users at the start of a fraction of the desiccant or storm water reservoir formed within the plot, it is already starting to promote their use, and this is triggering a wave of demand in the population. If you have a modern, up-to-date solution, most would like to keep up with the trend so you can promote local rainfall management. Investments such as storm water catchments contribute to the industrial economic and technological development of the environment.
Cost recovery Investments for environmental purposes are also economically viable. It is also economical for the settlement, as this reduces the use of water utilities.
Involvement of the population In general, the greatest social change can be achieved by involving the population. It is therefore worth encouraging civilians and organizations to use state-of-the-art solutions for rainfall management. It can be achieved more effectively with applications and grants.
Environmental hygiene The improved microclimate and green environment, have positive effects on the human psyche and on the overall health of the residents.