D.T2.7.1 FINAL SELF-EVALUATION REPORT

RAINWATER HARVEST AND GREYWATER REUSE
BUDAPEST ZUGLÓ, HÉTSZÍNVIRÁG KINDERGARTEN

Version 2
05 2022

Prepared by Zugló Municipality

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Background and objectives

Challenges and solutions

Describe what concrete problem/challenge your pilot reflects to, and what is the solution it provides. Shortly describe the expected results as well.

On the impact of climate change the average precipitation in Budapest is slightly increasing, but the yearly consistence of distribution is changing radically: the dry periods are even longer, while the heavy rains are more often. The changes in precipitation cause increased needs of water supply of green areas in the vegetation period and high pressure and overflow situations in sewage system. The increasing water and sewage prices are additional motivation factors.

The increase of urban areas with sealed soil surfaces and decrease of green areas with high capacity of water retention encourages the municipality to find solutions for retention and proper use of rainwater and reuse of greywater, as a sustainable source for non-potable water use.

The location of the rainwater harvest and greywater reuse pilot is the Hétszínvirág Kindergarten, in a detached house, green area of Zugló, very close to the Rákos creek.

The pilot action provides opportunity to learn more about the technical solutions, the market, and the reception of the innovative technologies on the stakeholder's side.

A kindergarten is a member of the "Hungarian Green Kindergartens Network" and provides priority green pedagogical programme. This represents optimal potential for dissemination, and ensures a proper target location for a pilot action in aspect of connection between generations and room for early education.

The municipality expects benefits from the pilot in economic (less potable water consumption, water lower bills), environment (less water extract from natural sources, on site water retention, improved microclimate), infrastructure (alleviated water press on the sewage system) and social impacts (education, awareness raising, improved green image)

Experience of the pilot implementation

This chapter is to describe the experience, lessons learned during the whole implementation process of the pilots. Please, think about what went easy, what was hard, what problems you encountered during the piloting process etc. What practice would you suggest to follow and what to avoid by any other actors who would think on starting similar initiatives. Of course, you don't have to write to all sub-chapters, but this is an important part of the report, as these are important experience to be rolled out.

Here, we would not set any page limits, as every experience is important.

Lessons learned from the planning phase

The pilot institute was selected in the preparation phase of the application form, so there was no flexibility in to find more feasible location in the concept phase.

The planning phase started in Summer 2020 with the early concept draft of a wide range possible inventions in the Kindergarten e.g. green roofs, water playground with creative games and permeable cover, reuse of old basin for rainwater storage, open air toilets with greywater flush etc.

The early concept plans were presented to the teachers of kindergarten, the municipality received positive feedback and maximum support from the staff of the institute.

Finding the experts for architecture concept plans and mechanical planning were relatively easy and the subcontracted partners were contacted in an early phase, but procurement phase has been delayed.

The contribution of fbr's experience provided added value to the project and helped to refine the plans (however we faced several problems during the construction phase)

There are no national standards and official permit procedure on the use of greywater and rainwater. On one hand it made the technical engineering design easy, on other hand, the missing standards result a lot of uncertainty in the project.

One of the biggest challenges in the planning was the economic impact of Covid-19 pandemic. By the initial retrofit plans of the municipality, the kindergarten should be gone under a complex renovation and the circular water management elements should be harmonized with other renovations. Referring to the Covid, the central government made radical financial restrictions in municipal budgets, that cancelled the complex renovation plans. It had radical impact on the CWC concept plans as well. For example, green roofs are not suitable for the obsolete structure of the existing roofs in poor statical conditions, so we need to delete it from the concept plan.

It was also challenging to find the accordance with the parallel interventions of the Zugló Asset company. The CWC plans were calculated with old basin as a water storage, but before finalizing the plans it was filled in with rocks and buried.

The plans had to calculate also with the needs of extra space for the pilot in a very limited yard with existing functions: gravel bed, pipes, underground tanks, engineering equipment etc.

Due to the Covid economic restrictions and the increasing prices in the construction industry, the pilot needed to be redesigned with reduced content, some innovative and creative concept elements were left out from the final plans.

Only a small part of the concept plans was transferred to the final plans: greywater collection from the handwashing taps and rainwater collection from a 290 m2 roof section. All water sources are purified with a gravel and root filter system and reused in the toilets and watering system of the garden.

Lesson learned from the procurement phase

Due to difficulties in the cash-flow of the municipality, the project procurements were banned for several months in 2020, that hindered the technical planning and the implementation of the pilot.

The architect and mechanical engineering planning works were procured by the municipality itself in a simple (3 offer) procurement process. It went relatively easy.

All other investment management, procurement, and implementation tasks of the CWC project were delegated to the Zugló Asset PLC., the in-house company of the municipality.

However, the in-house company was not involved from the beginning of the project, they didn't take part in the planning phase of the pilot and received lack of information about the overall goals and complex activities of the CWC project, they were responsible for the subcontracts and implementation. This quite long information and decision-making chain of stakeholders (from the transnational project team to the subcontracted construction companies) results challenges in the information flow.

Limited market of profession

The calculated costs of construction works remained below the public procurement threshold. The Zugló Asset PLC managed a simple 3 offer procurement.

The limitations of the Hungarian market made challenging the procurement. There is limited number of companies with proper experiences, competence, and references for the specific investment of rainwater harvest, gravel bed filtration and greywater reuse.

Lessons learned from the construction/installation phase

All investment management tasks of the CWC project were delegated to the Zugló Asset PLC., the in-house company of the municipality. However, the company was not involved from the beginning of the project, they didn't take part in the planning phase of the pilot and received lack of information about the overall goals and complex activities of the CWC project, they were responsible for the subcontracts and implementation.

There is quite long information and decision-making chain of stakeholders from the transnational project team to the subcontracted construction companies, that complicates the information flow.

Delays of construction works

By the initial time planning, the construction works should have been finished by the end of the summer break, August 2021. Due to several amendments in the final technical plans, the construction works of the pilot project were scheduled to December 2021-January 2022, with normal operation of the kindergarten. Coordination of the site works and the daily pedagogical work was challenging and required high tolerance from the building users.

Shortage of components

Due to difficulties in the global supply chains, the procurement of the water tanks needed more time than planned.

Limited space in the kindergarten

The pilot needs extra space for the pipes, underground tanks, engineering equipment etc, it occupies the space during the constructions from playing, green area, trees, bushes etc.

Significant changes during the planning and implementation

The significant changes in the technical plans (compared to the preliminary concept plans) needed extra work and additional time from the technical and construction team, that lead to significant delays. E.g. the outdoor greywater flush toilet was deleted from the plans and an indoor toilet block with 6 toilets and taps were involved to the greywater system.

Long rainless period

In winter and early spring of 2021-2022 there was a long drought period in Hungary without significant precipitation to fill in the water tanks. The system was operated with the mix of greywater and tap water. Due to this, the water quality analysis is in delay.

Unexpected objects under the ground

During the excavation works, an unexpected metal object was detected. The works were blocked for one day, and the official disaster management authority had to be come to the kindergarten. It turned out it was not a bomb, but the old oil tank of the former heating system, buried abandoned and forgotten.

The inaccurate map of public utilities caused amends in the construction works too. A gas pipe was not indicated on the map.

Damaged tree

The excavator damaged the roots of an old, huge tree, so it had to be cut down, as it was not to be safe anymore. (Replacement is mandatory, 6-10 new trees will be planted in the yard.)

It should be noticed that some elements of the construction are still not finished in April 2022: plants of the roof filtration zone, reconstruction of the damaged grass and playground in the garden, replacement of damaged bushes and trees, automatic sensors and water refill system, and rain garden.

Lessons learned from operation

The daily operation lays on the caretaker of the kindergarten.

Due to the long rainless period the water tanks should be refilled with drinking water from the regular network.

The automatic refill system is still not in operation, the control and intervention in case of lack of water in the tanks results extra work for the caretaker.

Regular water quality analysis and detailed maintenance plan is needed on order to keep the system safe.

Timeline and responsibilities

Concept plan	May 2020	October 2020	approved	Mr. Viktor Merker/dep. tenders	Mr. Gábor Zimborás/arch. eng.	
Procurement of mechanical plans	April 2021	May 2021	approved	Mr. Viktor Merker/dep. tenders	Mr. József Pál/mech. eng.	
Procurement of architectural planning	May 2021	June 2021	approved	Mr. Viktor Merker/dep. tenders	Mr. Gábor Zimborás/arch. eng.	
Architectural design	June 2021	August 2021	approved	Mr. Viktor Merker/dep. tenders	Mr. Gábor Zimborás/arch. eng.	
Mechanical planning	May 2021	June 2021	approved	Mr. Viktor Merker/dep. tenders	Mr. József Pál/mech. eng.	
In house procurement of construction and other executive works	July 2021	July 2021	approved	Zugló Asset PLC		
Re-design and amendments of original plans	August 2021	November 2021	approved	Zugló Asset PLC		
Procurement of subcontractors	August 2021	November 2021	approved	Zugló Asset PLC	Hidroconsulting Ltd.	
Basic construction works Water management system: rain and greywater storage, filters, dual pipes, gray water flush toilets	Dec 2021	January 2022	approved	Zugló Asset PLC	Hidroconsulting Ltd.	
Additional construction works: water measurement,	May 2022	May 2022	in progress	Zugló Asset PLC	Hidroconsulting Ltd.	

automatic refill system, garden reconstruction, planting, raingarden						
Monitoring	April 2022	June 2022	in progress	FCSM	Budapest Water Works Water Analytics Laboratory	

Costs

Cost type (e.g. planning, construction, etc.)	Description of cost (what is included into the contract, what was delivered, etc.)	Planned amount in AF (EUR)	Real amount (based on contract) (EUR)	Description (e.g.: *how well the prices were estimated, any problems that came up, what changes needed etc)*
Concepts and architectural plans	Concept plans, background calculations, static plans, architectural planning	5000	14 000	Due to the complex planning tasks, offers exceeded the planned limit
Mechanical plans	Detailed technical, mechanical planning of the system	-	5 490	Involvement of further external needed for the additional planning task
Deconstruction	materials and works	595	595	
Temporary construction facilities	materials and works	515	515	
Removing plants, earthworks	materials and works	6 261	6 535	unexpected underground items
Basement piping	materials and works	8 916	8 916	

Foundation	materials and works	872	872	
Concrete works	materials and works	2 085	2 085	
Manson works	materials and works	1 048	1 048	
Insulation	materials and works	684	684	
Sewage network	materials and works	5 620	5 787	N/A
Public utilities	materials and works	1 250	1 462	N/A
Installation of technology	materials and works	7 804	7 804	
Electric supply works	materials and works	3 060	3 342	N/A
Building engineering pipelines, facilities	materials and works	6 665	10 446	Additional tile works
Garden and park works	materials and works	0	still in progress	
Finalization works	materials and works	509	509	
SUM		45 885	51 309	

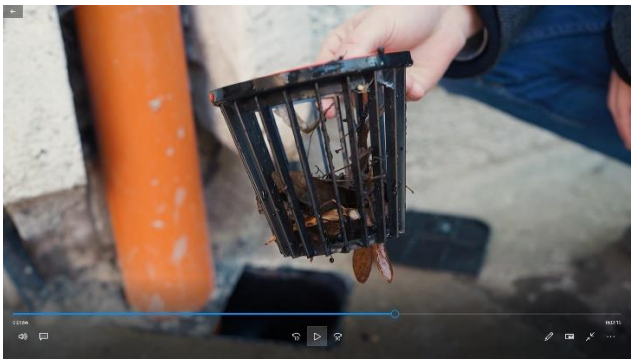
Results

Rainwater & greywater collection and reuse system

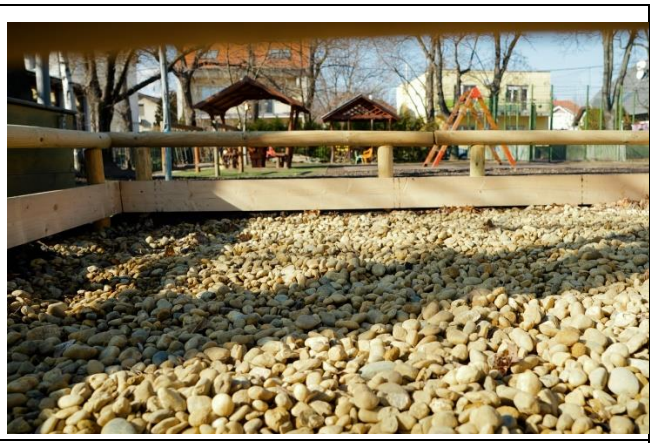
	
Yard in Hétszínvirág Kindergarten	To be reused

The rainwater run-off is harvested by 5 gutters from a 200 m2 section of the roof. Solid contamination (mainly leafs) are filtered by a filter chamber, unloaded manually.

The greywater from the handwashing units of the nursery are collected and drained in the same system.

	
Indoor construction works	Collection of leafs

The two water sources (rainwater and greywater) are drained to a pre-filtration zone: a waterproof ditch, filled with fractions of different sized gravel and planted with herbs. The gravel and roots perform the filter effect.

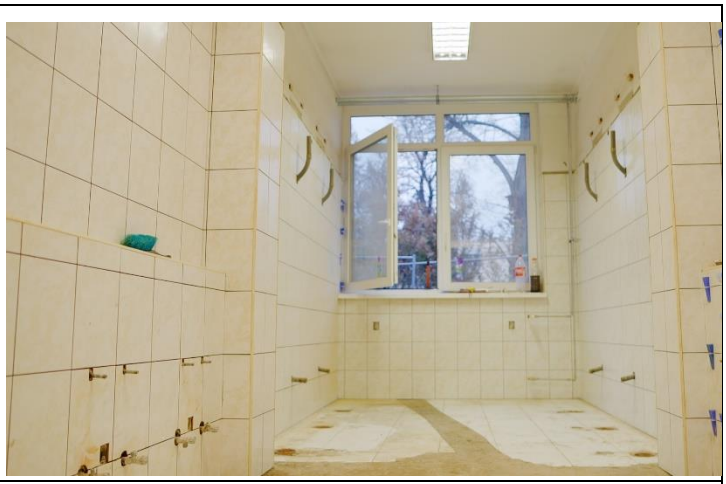
	
Supplies	Gravel bed

The pre-filtered water is collected in two, 7 m3 (14 m3 in total) capacity tanks sunk into the ground in the courtyard.

	
Water tanks (2×7 m3)	Water tank embedding

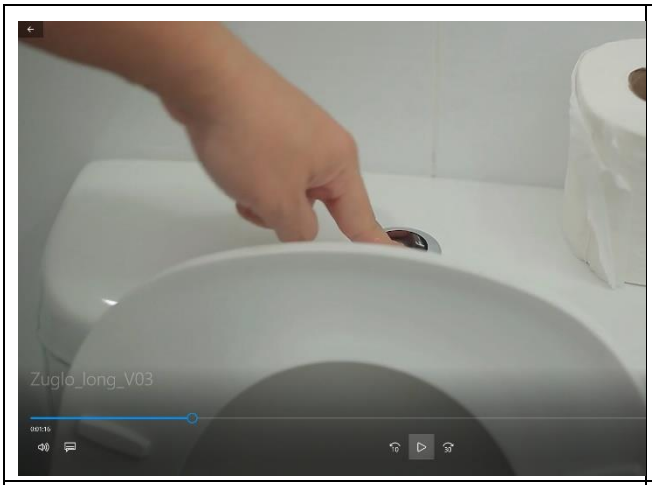
This purified and stored water is reused in two ways:

A part of it is used for flushing the toilets in the building. Currently 8 toilets are connected to the greywater system. The wastewater from the toilets (blackwater) will follow the „traditional route" into the public sewer.

	
Indoor construction works	Indoor construction works

The other part of the collected water will be used to irrigate the garden.

If the 14 m3 storage capacity is not sufficient, for example in a persistent heavy rainstorm, the excess water can be simply discharged into the public sewer. If there is too little greywater and rainwater collected from the roofs and handwashing taps, the water tanks are filled with drinking water from the city water network. Due to the lack of the automatic refill system, it needs manual interventions.

	
Toilet flush with greywater	Plant beddings in the garden

Additional works in progress:

automatic refill system

planting and garden reconstruction

water retention with rain gardens: garden in a container system

Peer review visit

The peer review meeting was on 30th March 2022 on line with participation peer partners: Maribor and Bydgoszcz. Thanks to the online format, the event was open for further participants as well, so we organized the meeting with cca 30 participants.

The peer review visit event was structured along the template guidelines with some local twists. After a quick introduction of the topic by project management, the specifics of the technical solution were showcased by the developing engineer and the representative of the implementing company. As an extra point of view, the representatives of the kindergarten itself were invited to present the aspect of the users/beneficiaries and provide feedback to consider in interventions to come. Lively discussion followed each one.

Mentoring visit

The mentoring visit took place on 18th March 2022. Team of fbr were joined online, the Zugló team were located on the site of the investment: in the yard of the Hétszínvirág Kindergarten. From Zugló 5 persons took part on the meeting: the caretaker, the project manager, the communication manager, the mechanical engineer, and project coordinator of Grans Europe. Unfortunately, Hidroconsulting, the subcontracted company couldn't take part.

The outdoor online meeting resulted several technical challenges. There were problems with the Wi-fi service and the quality of the streaming devices.

Despite all technical problems, Zugló team presented the main elements of the investments: the building and the yard, gutters, gravel bed, water tanks, toilets, mechanical shaft.

However, the fbr team asked several questions regarding the technical details, due to absence of the executive company, most of the questions remained unanswered. We are still working on collecting proper answers.

Monitoring activities and results

The monitored parameters are the chemical and microbiological parameters of the collected and used rain and greywater.

The first water quality assessment was realised by the accredited laboratory of Budapest Water Works in early April 2022, after the first significant rain of the year. The timing was important, as until April, due to drought, the tank was filled mainly with tap water.

By the formal protocol all chemical parameters (pH, ammonium, chloride, nitrate, Fe, Mg, Pb) are under the thresholds of drinking water. Only the microbiological parameter (E.coli) is over the standard of drinking water. As there are no legal standard parameters for greywater, the data need further investigation by water quality experts.

Indicators

Please, use the table form your intermediate report and update the information accordingly.

Indicators	Description	Baseline	Achieved so far	Target value	Measurement/ monitoring method	Regularity of measurement
Output 1	Rainwater collection and reuse system	0	200 m^2 roof surface connected	200 m^2	N/A	verified
Output 2	Greywater collection and reuse system	0	9 taps + 1 shower connected to the greywater collection system	10 r	N/A	verified
Output 3	Gravel bed and root filter system	0	10 m2	10 m2	N/A	verified
Output 4	Storage tank for harvested rainwater and greywater	0	Storage volume: 14 m^3	14 m3		verified
Output 5	Toilets connected to the water reuse system	0	8 toilets	8 toilets	N/A	verified
Output 6	Garden in a container rain garden	0	0	3 m2	Built surface of rain garden	
Results 1	Volume of rainwater and greywater harvested and	0 m^3/year (no rainwater	N/A	No target defined	The volume of collected and reused rainwater is estimated to 100 m3/year	

Indicators	Description	Baseline	Achieved so far	Target value	Measurement/ monitoring method	Regularity of measurement
Harvested rainwater and greywater [Unit: m^3/year]	reused for toilet flush and irrigation	harvesting and no reuse)			(average precipitation × roof surface) Collected grey water 10-20 m3/year (Very rough estimation, no water use for handwashing was not measured)	
Results 2 Savings of potable water consumption [Unit: m^3/year]	The harvested rainwater and reused greywater result decreasing water use from the city network	0 m^3/year (no rainwater harvesting and no reuse)	no data	No target data defined	Yearly consumption check on water meter	Yearly
Results 3 Water retention in raingarden [Unit: m^3/year]	Volume of rainwater drained in the raingardens	0 m^3/year	0	No target defined		
Results 4 Environmental education	Children, parents, and teachers informed about	0	n°200	n°200	N° of directly informed persons	Yearly

Indicators	Description	Baseline	Achieved so far	Target value	Measurement/ monitoring method	Regularity of measurement
	the environmental impacts of the investment					
Impact 1 Adaptation to climate change and improve resilience to extreme weather events						
Impact 2 Alleviation of the sewage networks from heavy rains						
Impact 3 Economical benefits of decreased water consumption						
Impact 4 Raised awareness of local citizens, decision makers						

Indicators	Description	Baseline	Achieved so far	Target value	Measurement/ monitoring method	Regularity of measurement
Impact 5 Improved knowledge of local stakeholders						

Pilot upscaling plans

The additional elements – recommended by fbr - to finalize the pilot (e.g. standard automatic water refill system, reconstruction of the green areas, replacement of trees, rain garden etc.) will be implemented in May-June 2022. Beyond these works, no further circular water management improvements are planned in the kindergarten.

In 2022 Zugló Municipality focuses on improvement and awareness raising in residential water management. Local residents can apply for rainwater tanks at the municipality and can receive them for reduced (supported) price.

By a new project idea the municipality supports the water supply harvest of city community gardens by rainwater harvest, in strong cooperation of multi-residental houses nearby.

Project follow-up

Lessons learnt

- Investments should be harmonized to the local water related strategies.
- The pilot needs better informed decision-making, already at the preparatory and concept stage of the project in consideration of selection of the location, feasible investment elements, scheduling, complex project management.
- The involvement of stakeholders, particularly the partner in charge for the investment management, from a very early stage of the planning is a crucial condition of success, as well as clear expectations regarding information flow, documentation, and transparency and clear definition of responsibilities and decision-making process.
- Indicators, monitoring, and measurement methodology should be defined at a very early stage of the pilot.