MISKOLCI EGYETEM
UNIVERSITY OF MISKOLC

LIFE CLIMCOOP

Challenges of heavy rain and related flash flood events in urban areas, cooperation of cities and local companies for climate change adaptation

Viskolcz Béla

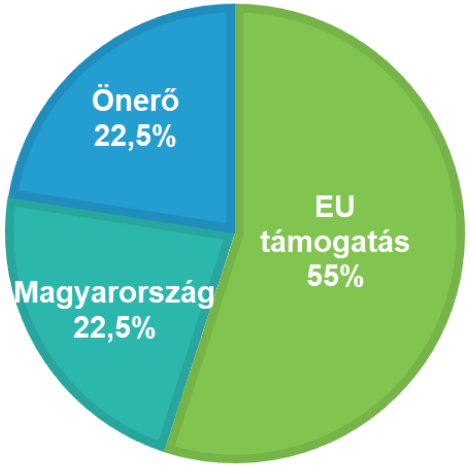
MISKOLCI EGYETEM
UNIVERSITY OF MISKOLC

LIFE CLIMCOOP

Local water use and climate change adaptation

Viskolcz Béla

P R O J E C T



- **Location:** Kazincbarcika
- **Duration:** 2020.09.01-2024.08.31
- **Total Budget:** 2 949 660 EUR

- **Consortium:**

Mining and Geological Survey of Hungary (MGSH)

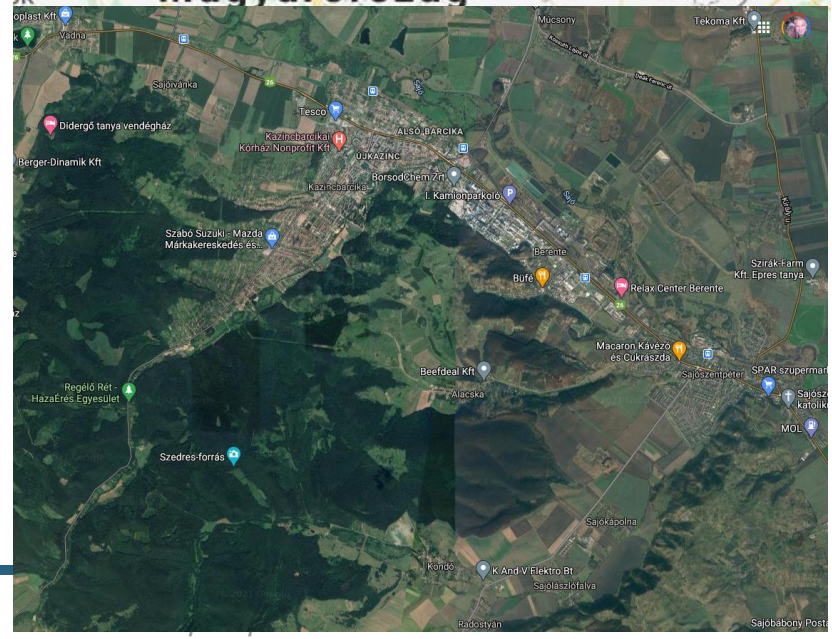
University of Miskolc (UM)

KÖVET Association for a sustainable economy (KÖVET)

BorsodChem Zrt. (BC)

GeoGold Kárpátia Ltd. (GG)

Municipality of Kazincbarcika (KB);



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Establishing mechanisms for cooperation

AIM: the establishment of cooperation, coordination and decision making platforms between municipality and company to promote joint action on climate change

Climate Platform

Climate Fund

Future Research Group

Replicable good practices

- Operational body implementing a climate adaptation strategy in city-company cooperation
- Financial support for local adaptation measures, from city, company budget
- Preparing consciously for the expected climate risks

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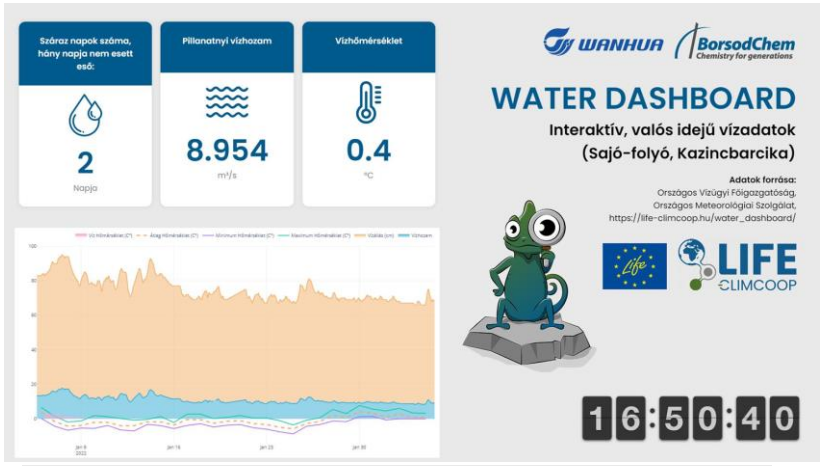
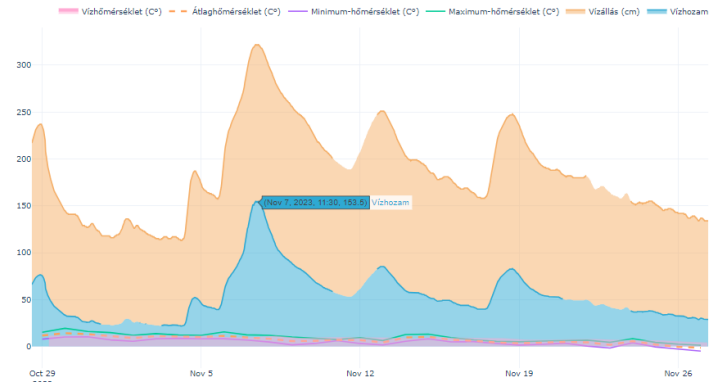
SMART

AIM: channelling modern SMART solutions into the field of climate action



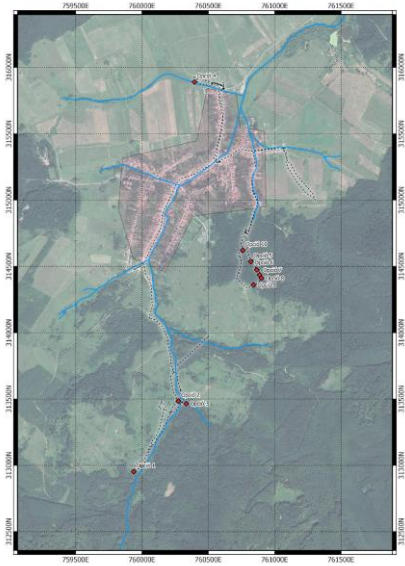


Water Dashboard

Adaptation information service

Tree cadastre

Small watercourse inventory + NWRM



Replicable good practices

- Inventory of local green infrastructure to optimise management
- Developing natural water retention solutions, exploring further options
- Reducing the likelihood of flash floods and the damage they cause
- Promoting water-aware data tracking and preparation

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Smart

- CITY AND COMPANY
- Water
  - River Sajó critical flow with large fluctuations (153 m3/s – 3.7 m3/s)
  - Wastewater
  - Urban and industrial waste water → Process water
  - Havaria - flash flood water
  - For irrigation and cooling purposes
  - Domestic "water retention" capacity

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Inventory of small watercourses and potential places for Natural Water Retention Measures(NWRM)

The aim of the action

- Investigation of small watercourses and possible water retention solutions along the Sajó river and Tardona creek

Results to be achieved until the date of mission

- Small watercourse and NWRM inventory prepared
- Field trips and complex report on the on the results of the small watercourse and NWRM inventory; consultation on the permit plan for log dams
- Geophysical measurements in the vicinity of the Sajó river, geophysical report; revision of the surrounding wells; mapping active surface run-off zones
- Archive data collection, study on the preparation of hydrogeological model

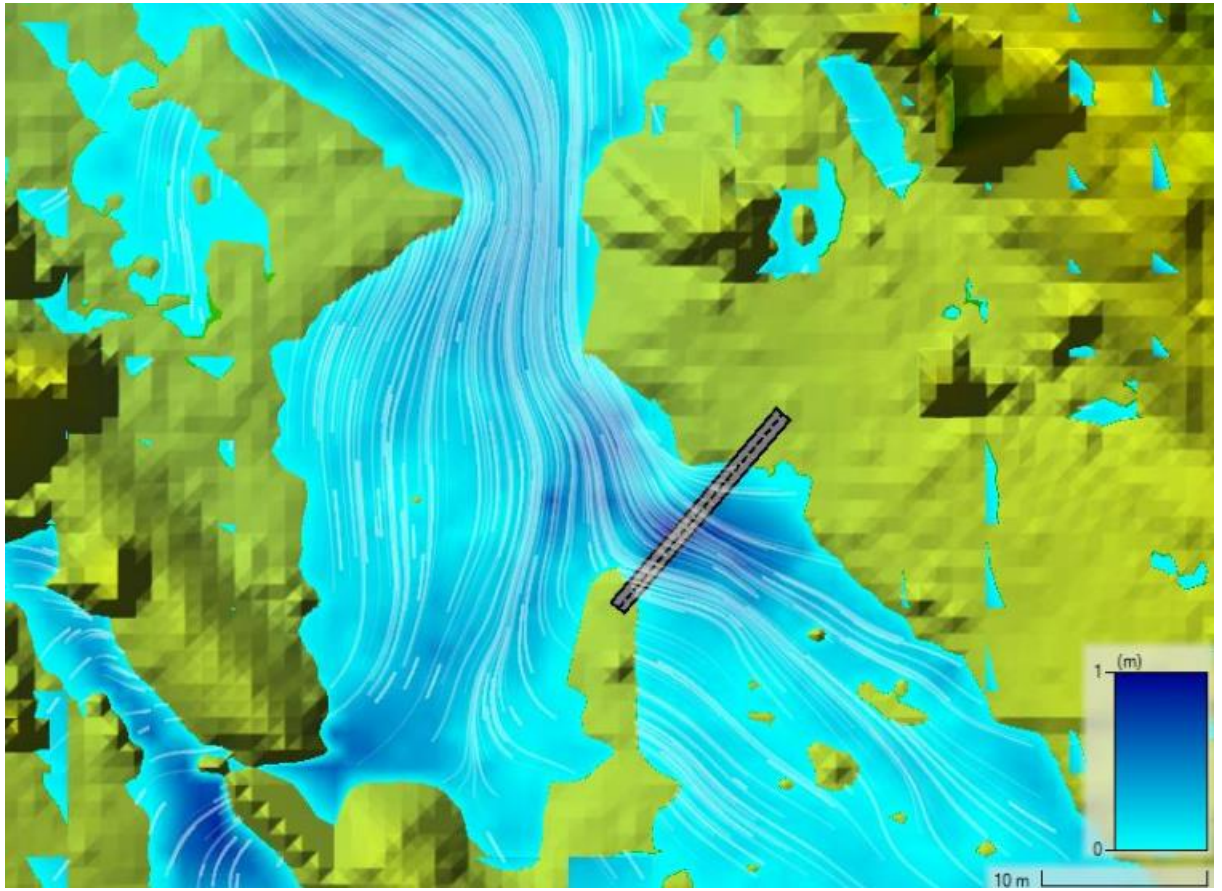
NWRM inventory prepared (08/2022) and complex report (12/2022)

Inventory of small watercourses and potential places for Natural Water Retention Measures(NWRM)

Possible location of a log dam at the Kazincbarcika 0536/1 parcel (left) and an existing concrete/rock dam that should be rehabilitated at the Kazincbarcika 0231/28 parcel (right)

Natural Water Retention Measures (NWRM)

- The purpose of installing the log dams is the retention of water and sediment in the upper catchment before it reaches the built environment. The woody dams slows the water down and spreads it out, they are not hermetic.
- There are two locations appointed for implementation - topographical numbers: 0536/1, 1118

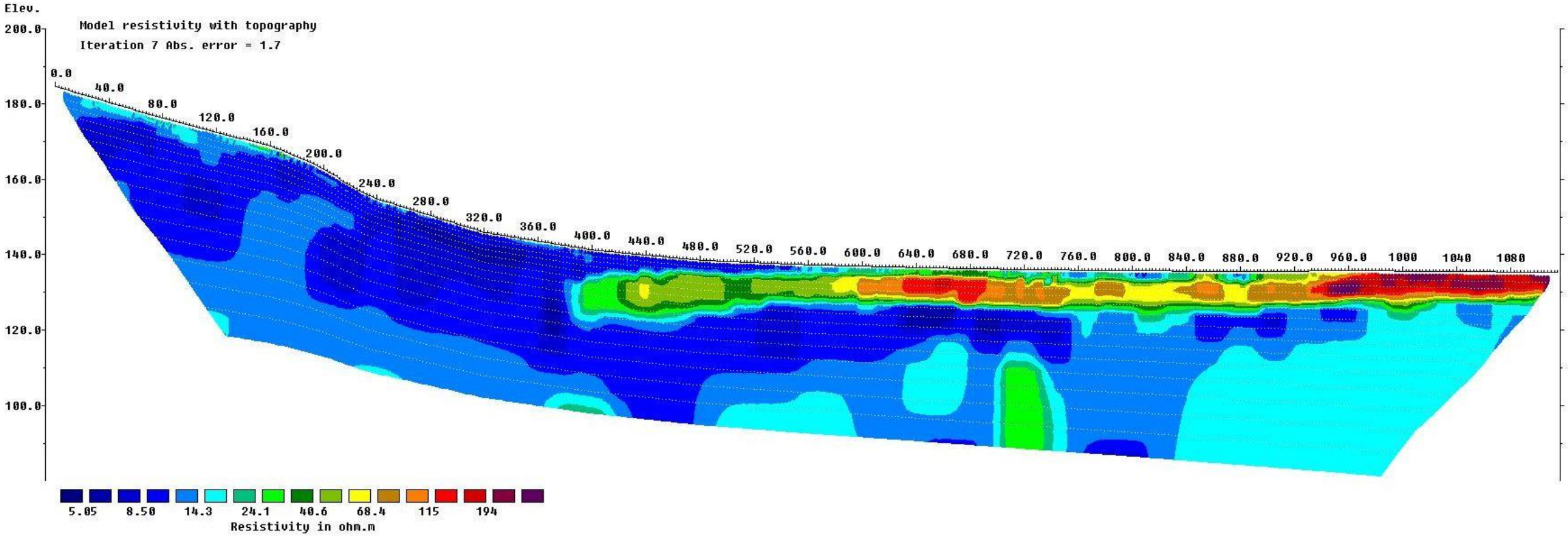


Inventory of small watercourses and potential places for Natural Water Retention Measures(NWRM) – Geophysical measurements

Locations of geophysical measurements in Kazincbarcika

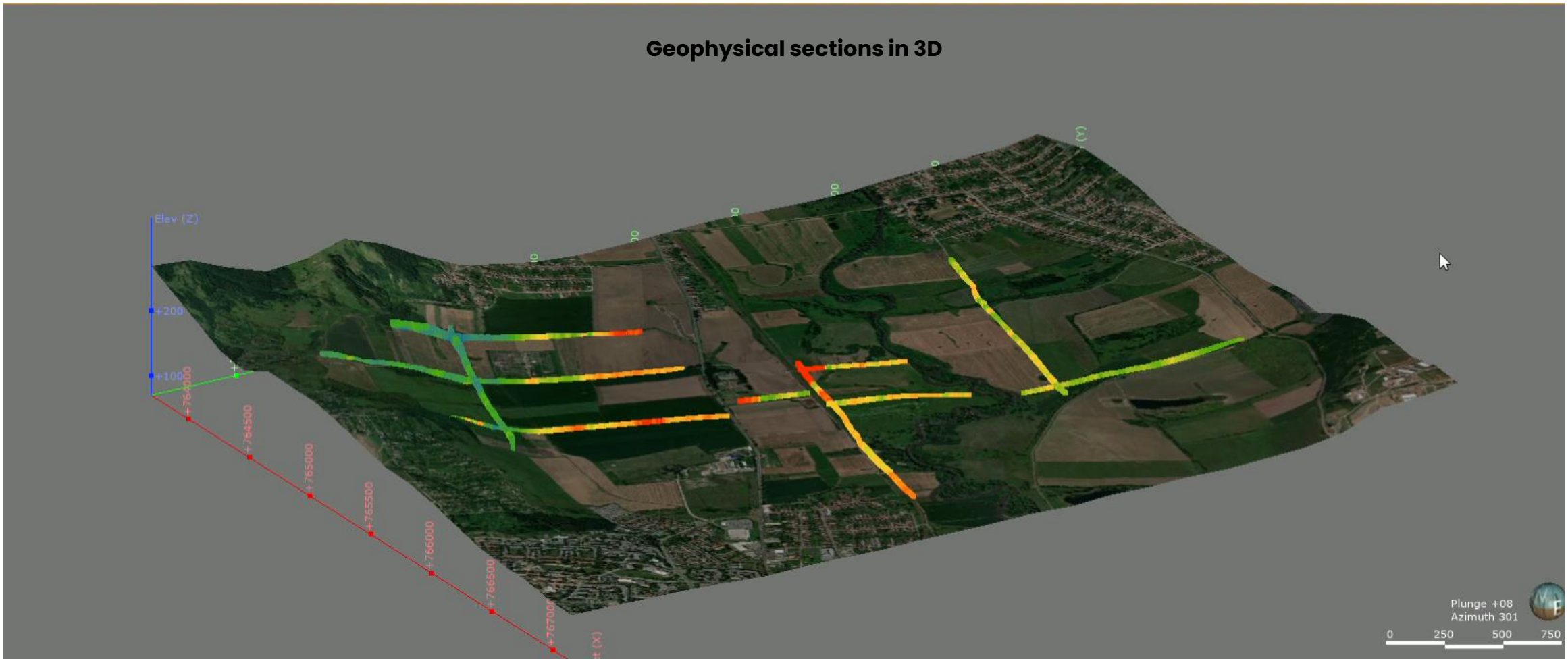
Ongoing geophysical measurement in the LIFE-project

C4.2 – Inventory of small watercourses and potential places for Natural Water Retention Measures(NWRM) – Evaluation of geophysical measurements

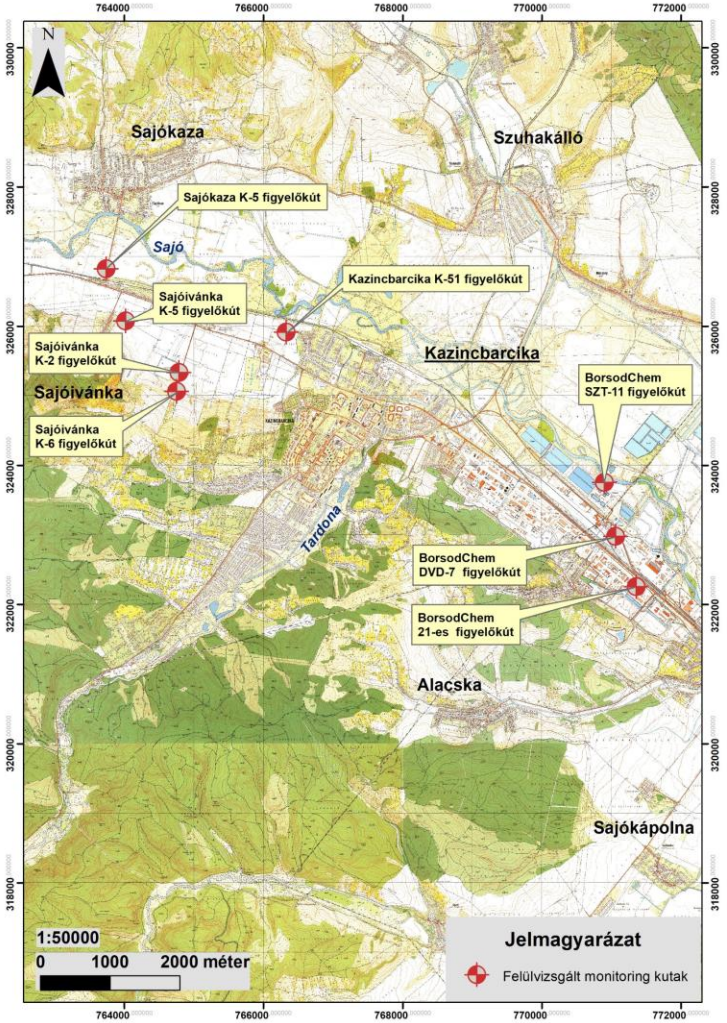


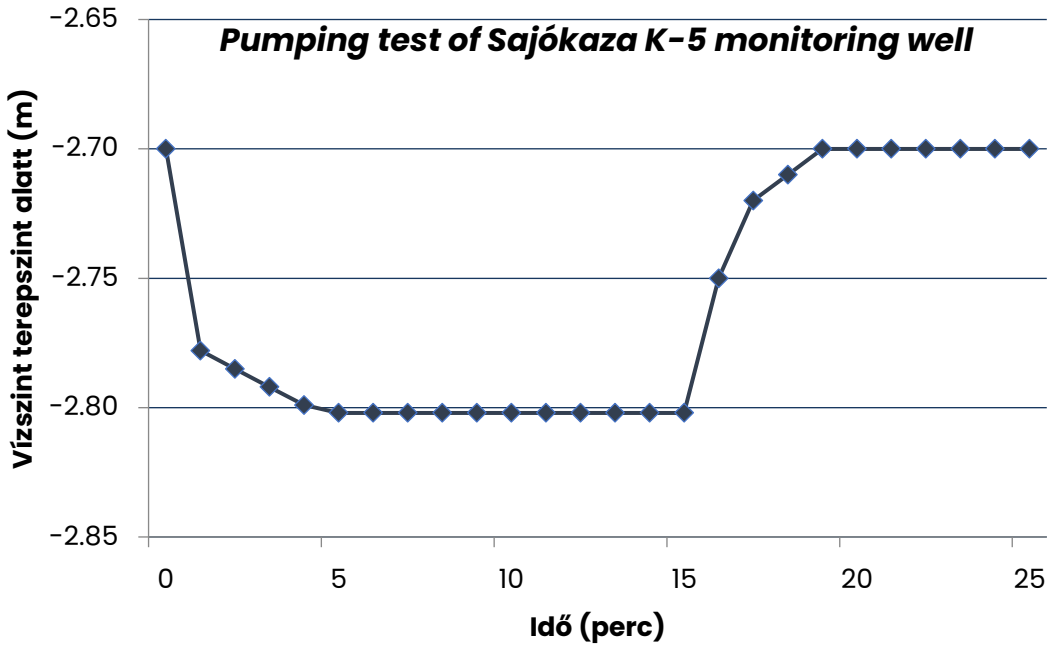
Geophysical evaluation of section 8 with the high-resistance gravel terrace of Sajó river

Geophysical sections in 3D



Inventory of small watercourses and potential places for Natural Water Retention Measures(NWRM) – revision of surrounding wells



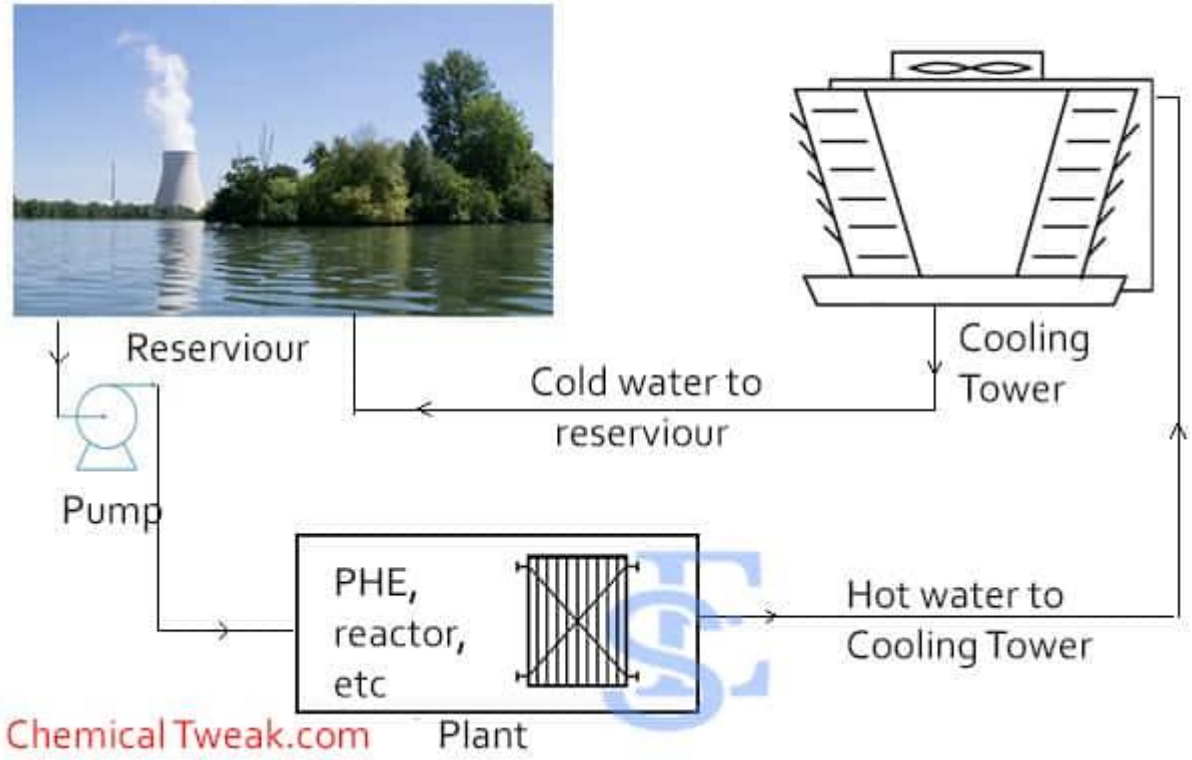


- *GPS coordinates*
- *Initial piezometric level (water level)*
- *Pumping tests*
- *Drawdown as a result of water production*
- ***Input parameters for hydrogeological model (e.g. filtration coefficient)***

Locations of examined monitoring wells around Kazincbarcika

Heatwave and drought

- Borsodchem: 0,7 m^3/s
- SUMMER
  Sajó water flow: 3,7 m^3/s



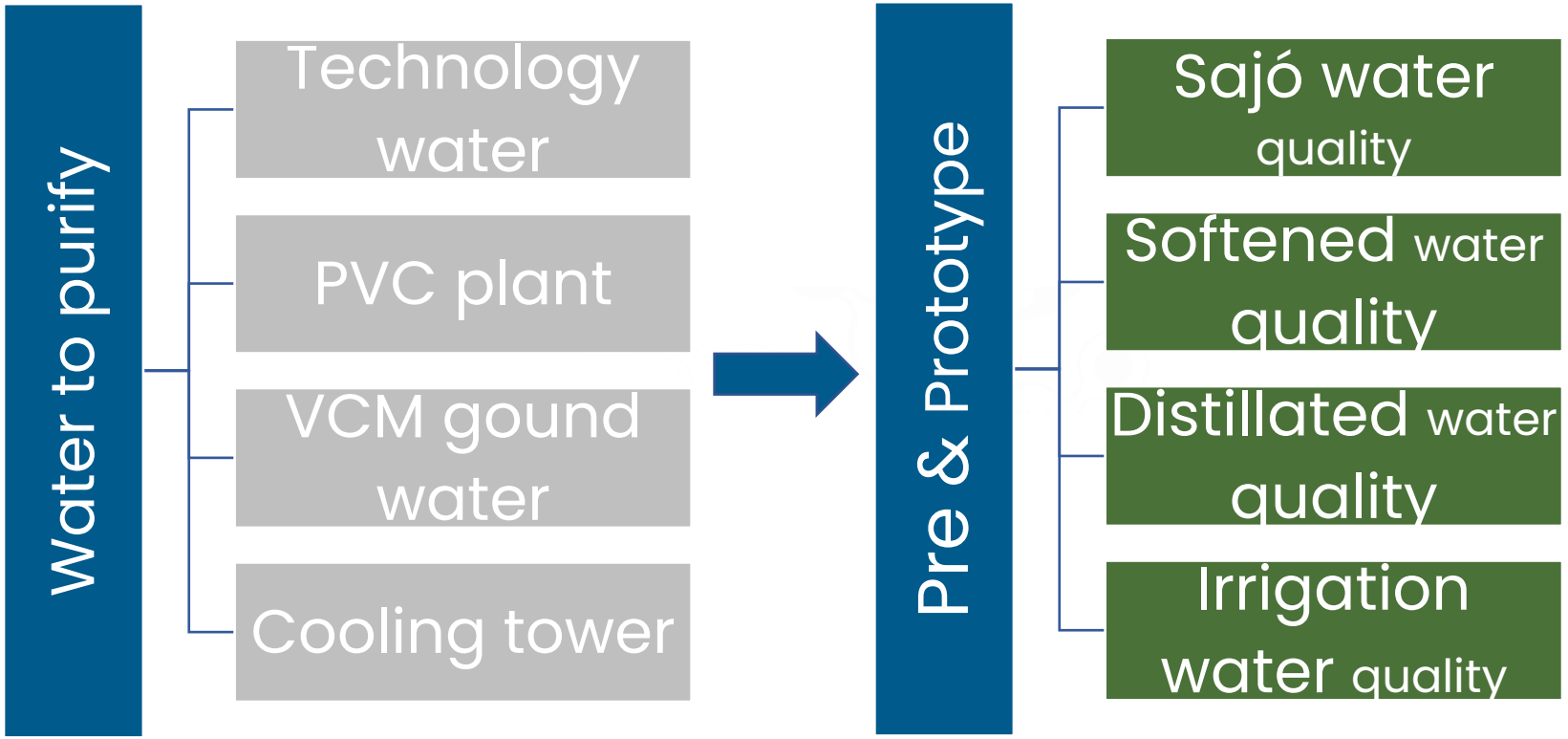
- Swelling
- Well systems
- Galleries
- Reservation

Pre & Prototype

Process Flow Diagram

Starting points

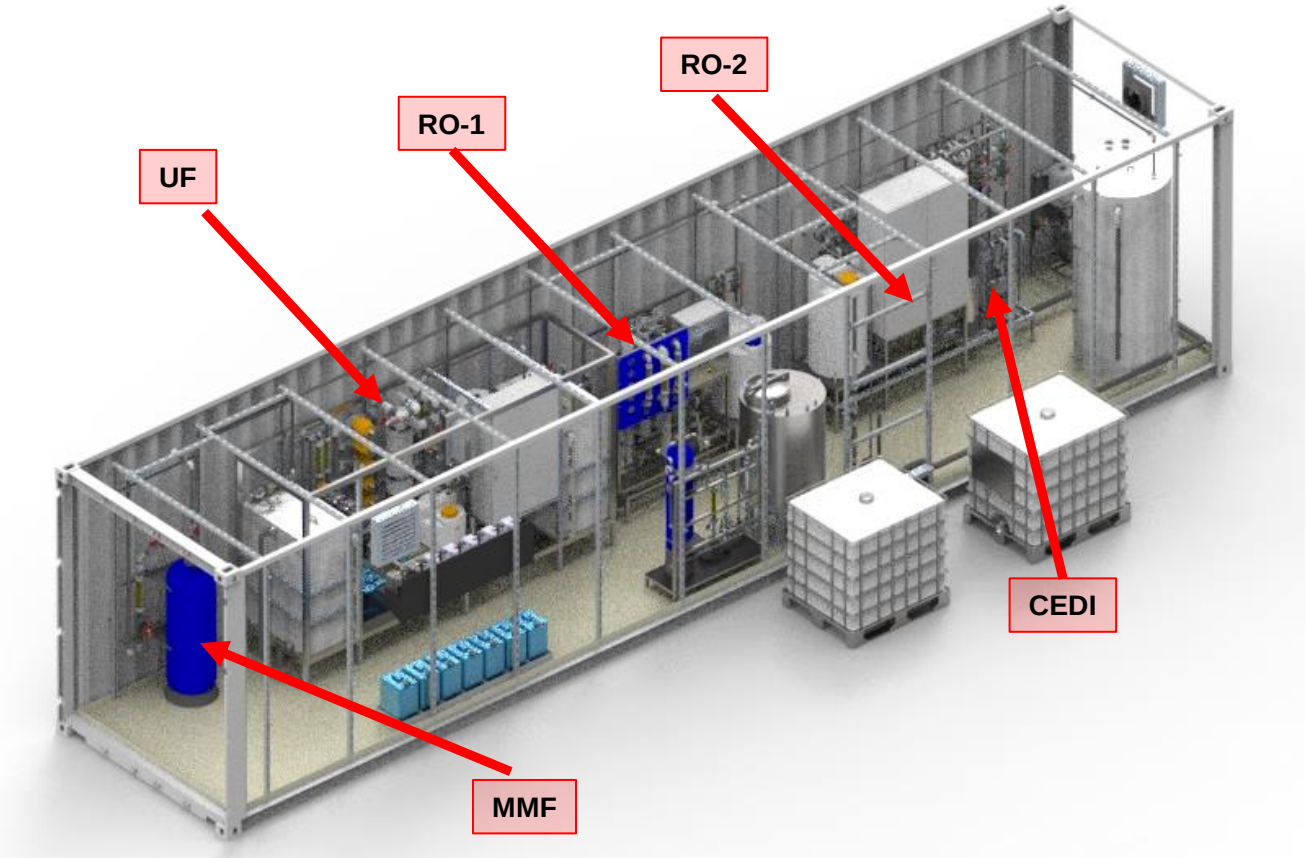
Goal



C 6 Results summary

HIDROFILT

Prototype – Implementation



- Prototype plan and implementation was finished
- Prototype is ready and working
- The reuse and recycling of treated wastewater can be a very effective alternative strategy with significant environmental and financial benefits.
- First tests – 4/14 purified organic wastewater sampling site – first evaluation was finished
- TDI,PVC,VCM,MNB,DNT and Aniline plants organic wastewater arrives here

C 6 Results summary

Prototype – Operation – 1st tests

Target

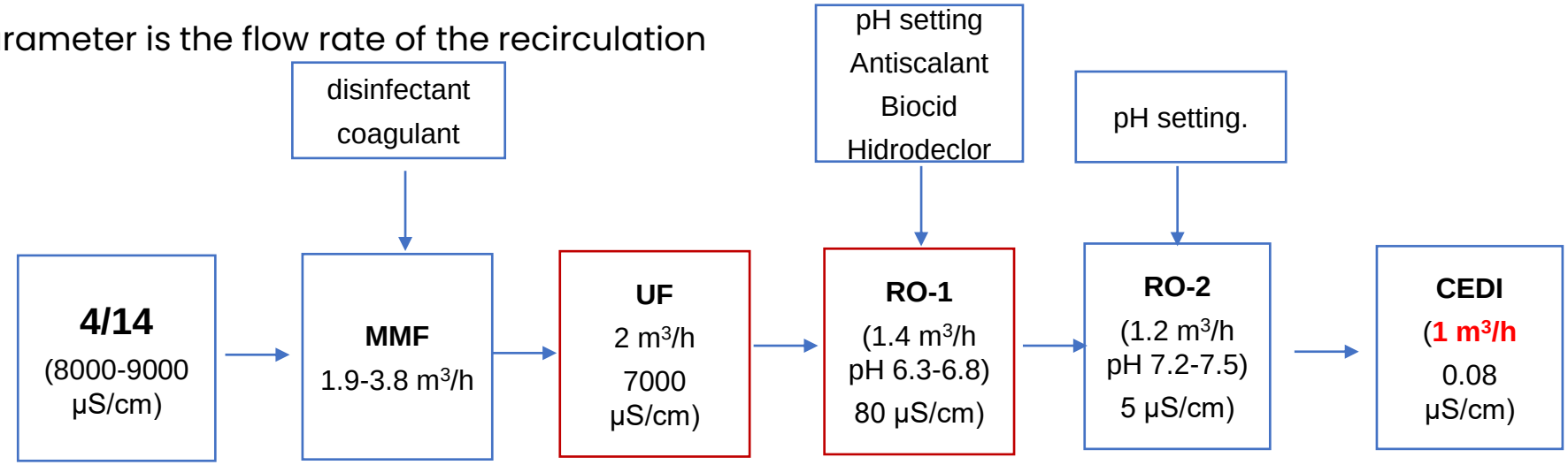
- Optimization the operating parameters of the prototype UF,RO-1, and RO-2 produced at the lowest possible cost
- Keep the limit value parameters specified by Hidrofilt

UF module

- The changed parameters are the flow rate of the retentate, the pressure and the flow rate of the recirculation

RO-1 and RO-2 modules

- The changed parameter is the flow rate of the recirculation



C 6 Results summary

- NEW sampling site from 8.9.2023. – 4/1 WW sampling site
- Mixed inorganic and organic wastewater
- Lower coductivity

Initial parameters	4/14	4/1
Amount [m^3/h]	290	730
Conductivity [µS/cm]	~8000	4650
pH	~7.4	8.79
TOC [ppm]	~16.3	12,2

Prototype – next step
Moving of the prototype

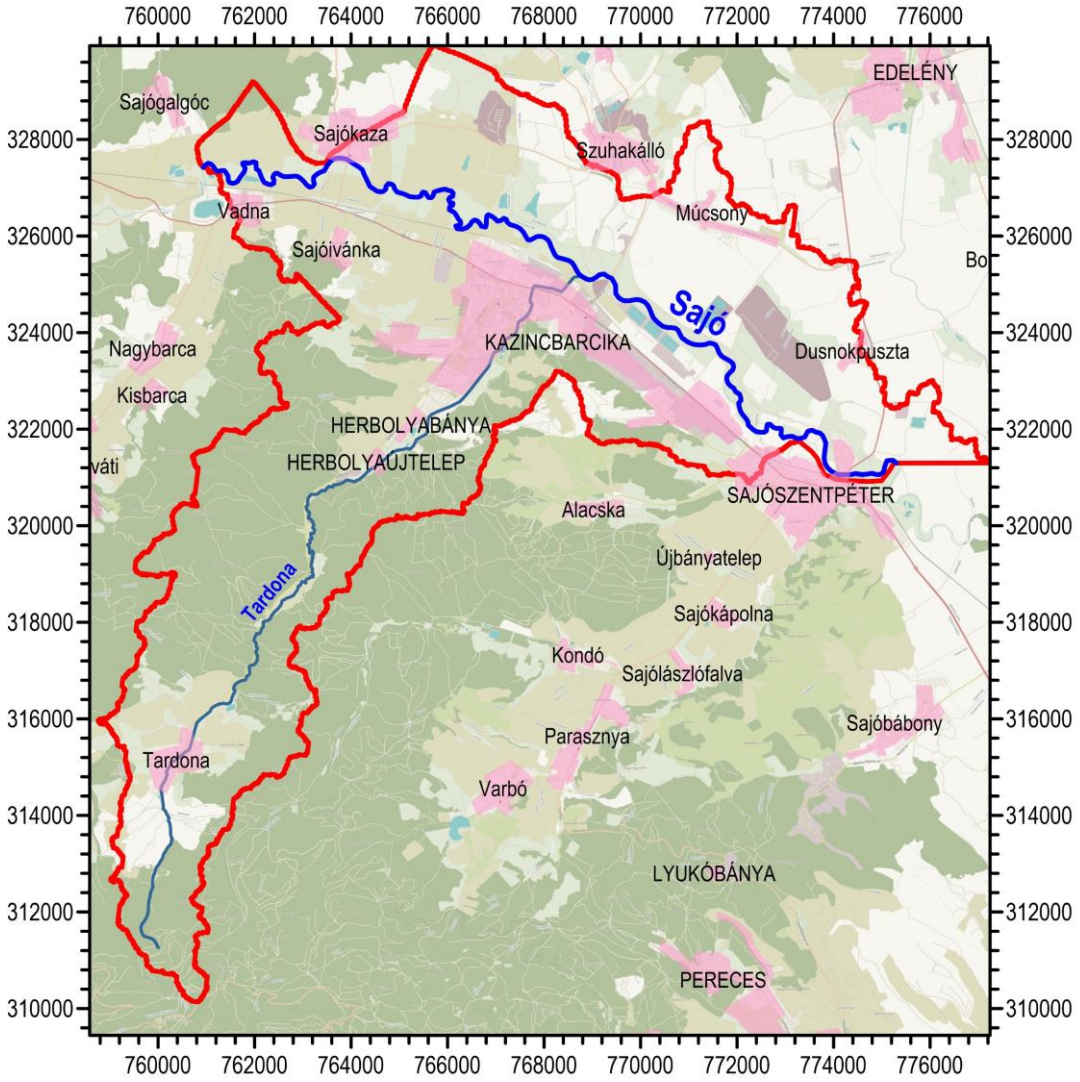
Hydrogeological modelling

Target:
Examination of Sajó's gravel terrace
Climate change and extreme weather conditions for groundwater
Managed Aquifer Recharge (MAR)

Model area: 117 km2

113 drilling and well data

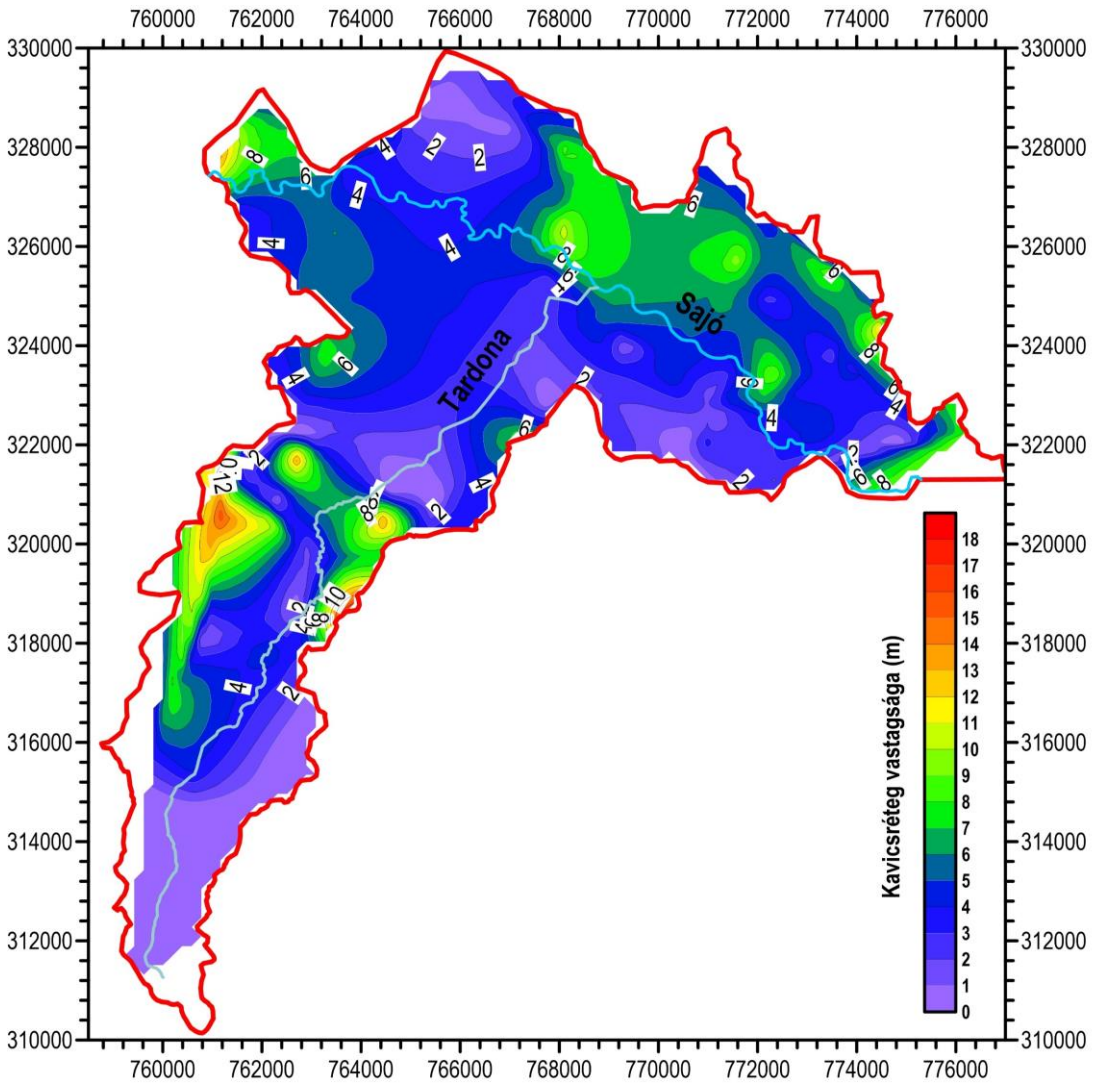
Geophysical measurement data
Topography, 6 model layers, geological formations, hydrostratigraphic units, Sajó water level data, precipitation data, calibration



A modellterület kiterjedése

Hydrogeological modelling

- Heterogeneous Sajó gravel terrace (4-10 m).
- Average thickness in the model area: 4.5 m.
- Extreme rainfall year (2009-2010): 1117 mm
- Extremely dry year (2010-2011): 470 mm
- The amount of water that can be stored in the gravel terrace is 8.7-16.9 million m3/year in the model area.



Sajó-kavicsterasz vastagsága a modellterületen

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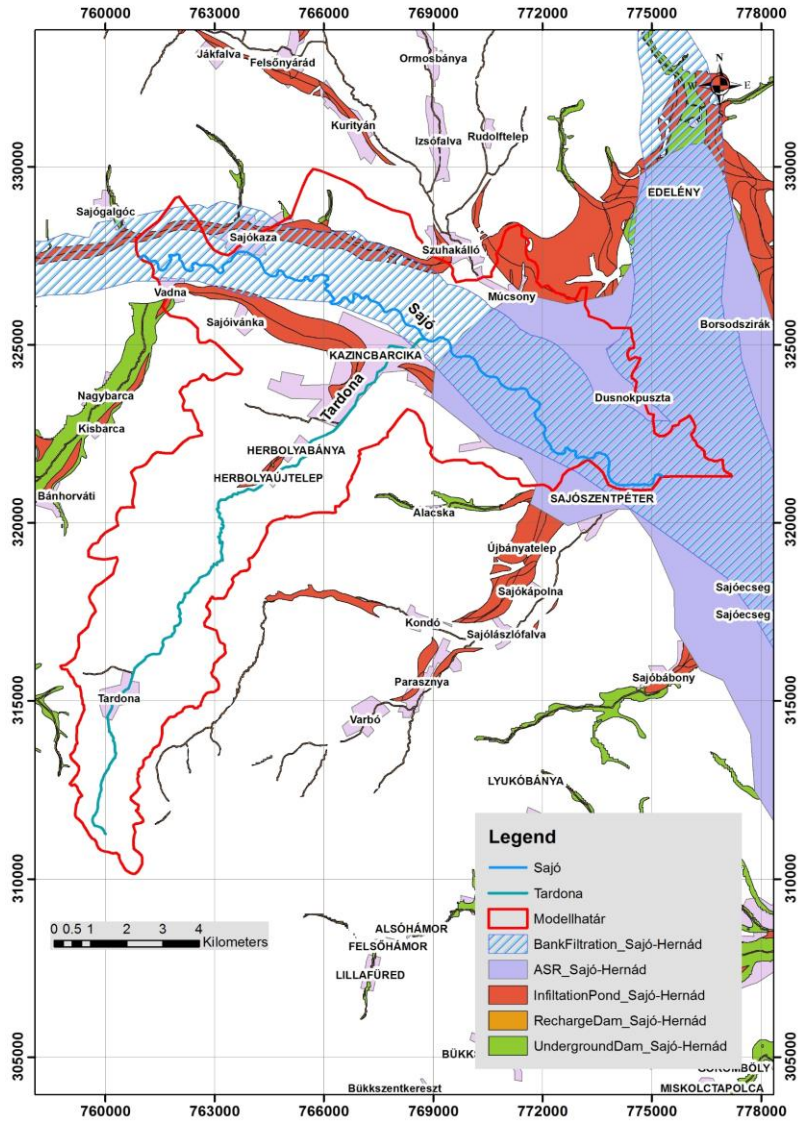
MAR opportunities (Groundwater storage)

We identified the MAR possibilities in the model area based on geological-hydrogeological studies:

- Coastal filtered water (Sajó gravel terrace)
- ASR – Injection through a well followed by water extraction
- Infiltration lakes and basins
- Subsurface barrier for supply

Geophysical-hydrogeological research can be replicated to other areas.



Lokális MAR-lehetőségek a kazincbarcikai modellterületen

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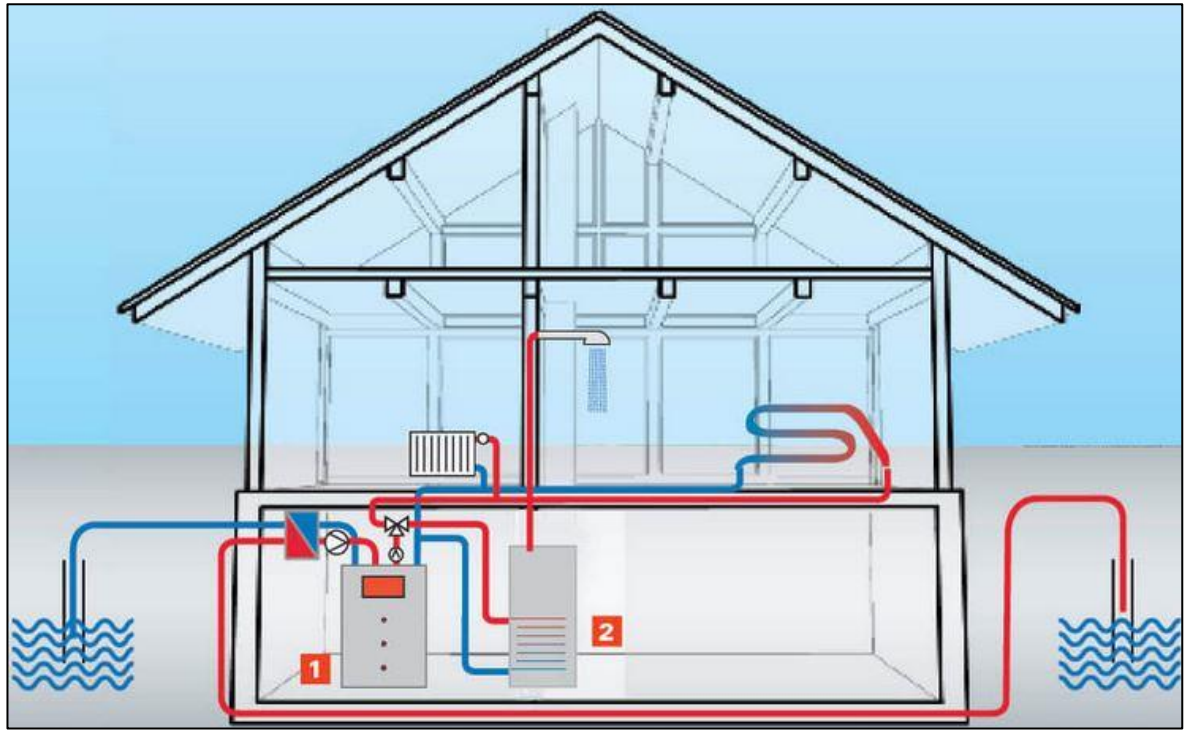
Drilled well water-to-water heat pump (production and sinking wells)

It is obtained from groundwater or coastal filtered water out the energy and heat needed for heating and cooling.

We return the water to the place of withdrawal, ensure circulation.

Advantage: COP (efficiency factor) is highest here. COP = can also be 5-7.

Disadvantage: area-specific due to high water demand.
Before installation, it is important to carry out geological-hydrogeological research, establish a test well and a test plant.



Termelő és nyelető kutas víz-víz hőszivattyú

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Water Research – Water supply for industrial cooling towers

- Design phase: Water exploration with geophysical studies, hydrogeological and heat transport modelling
- Industry planning taking into account water demand and geological conditions
- Providing cooling water for large-scale thermal equipment, designating optimal locations
- For cooling tower design

Financial and time losses associated with the construction of reactive or insufficiently yielding wells can be avoided.

Ipari hűtőtornyok (www.istockphoto.com)

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Summery

- Forms of cooperation
  - Easier together
- SMART solutions for adaptation
  - Modelling - log dams
- Risk reduction in industrial production
  - Water – wastewater – cost reduction
- Raising awareness
  - Residential and employee activity

Köszönöm a figyelmet

https://life-climcoop.hu/en/project/

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THANK YOU FOR YOUR AT10TION

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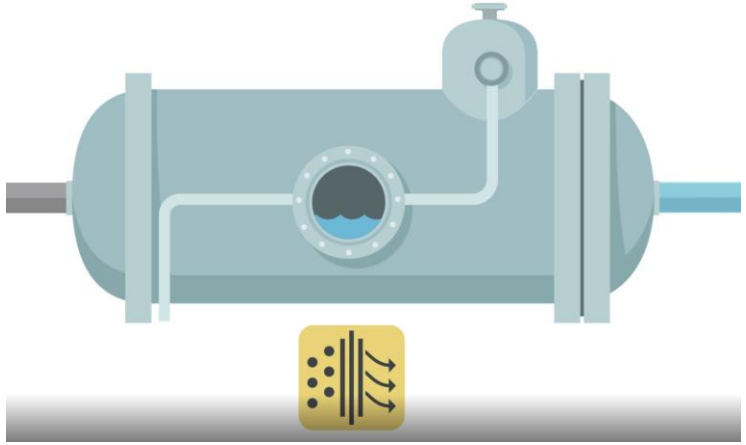
https://life-climcoop.hu/en/project/

C2.3 Climate Fund – Tender of IBC tanks

- 1st round [2021 October] – 27 IBC tanks
- 2nd round [2022 March] – 33 IBC tanks
- 3rd round [2023 March]– 30 IBC tanks + 8 IBC tanks donation to kindergartens and nurseries in Kazincbarcika
- Next plan – 2024. Spring

Prototípus

CÉL: a BorsodChem Zrt. és Kazincbarcika Város Önkormányzata vízfelhasználásának optimalizálása, a szürkevíz újrafelhasználása és a Sajó folyóból történő vízkivétel csökkentése az éghajlatváltozásra való felkészülés jegyében.



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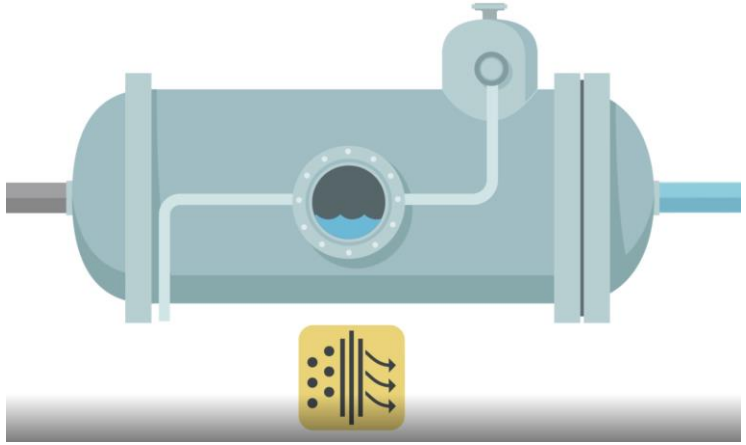

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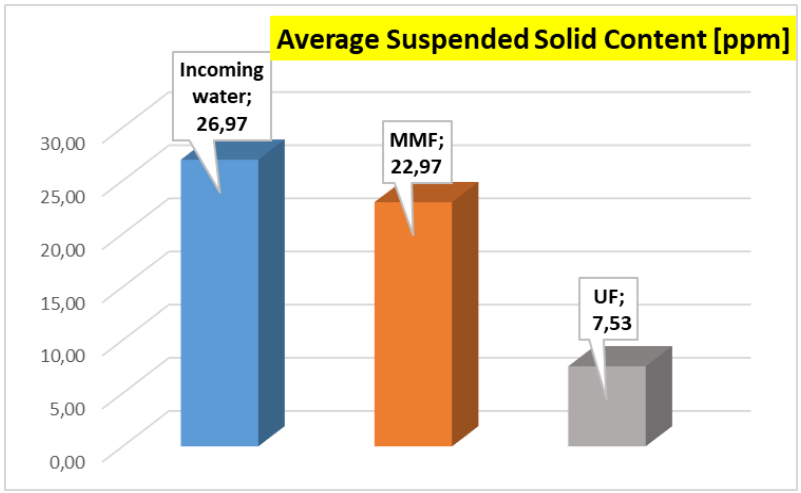
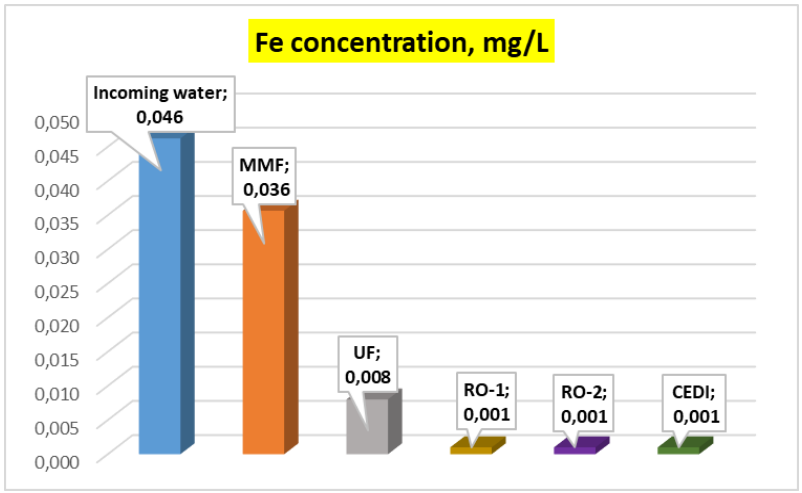
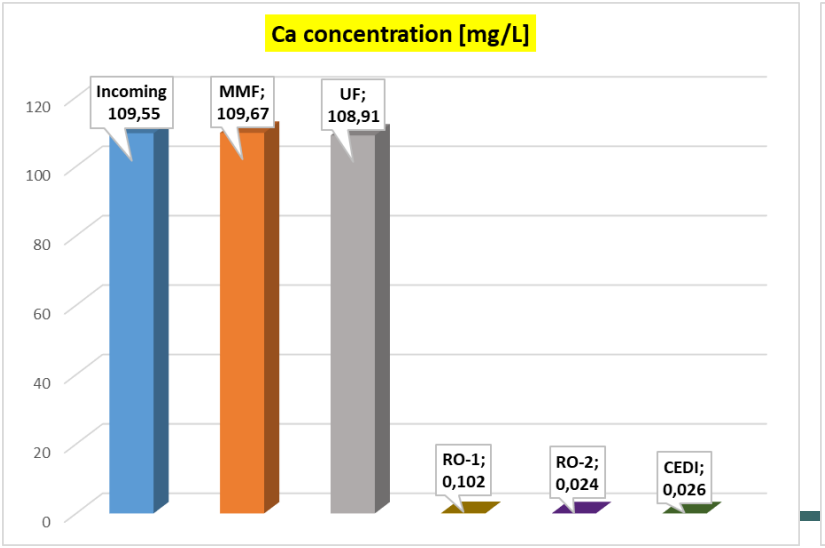
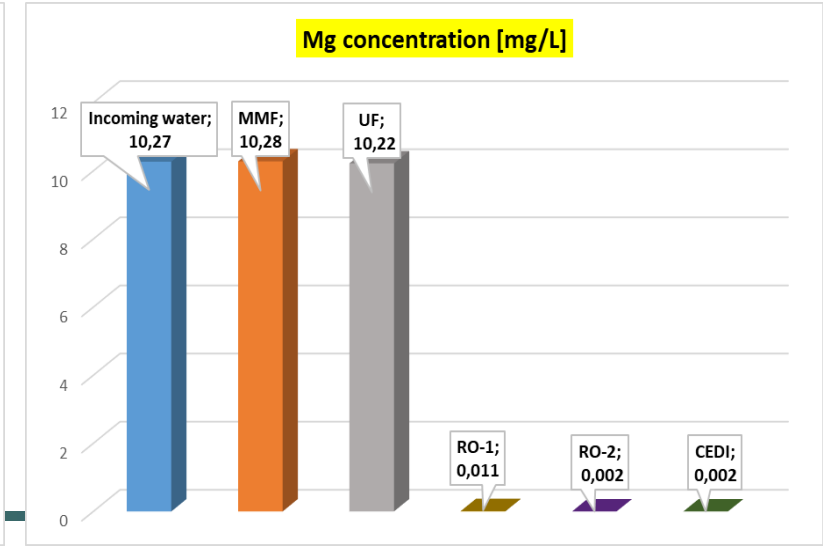
C 6 Results summary







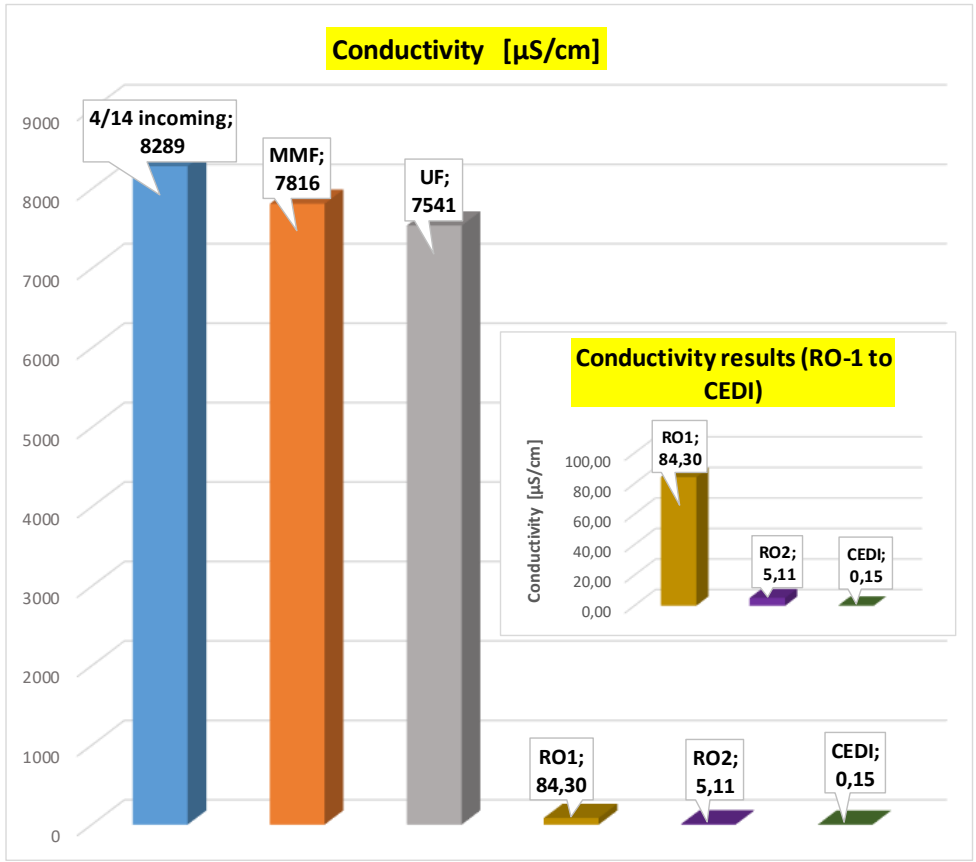


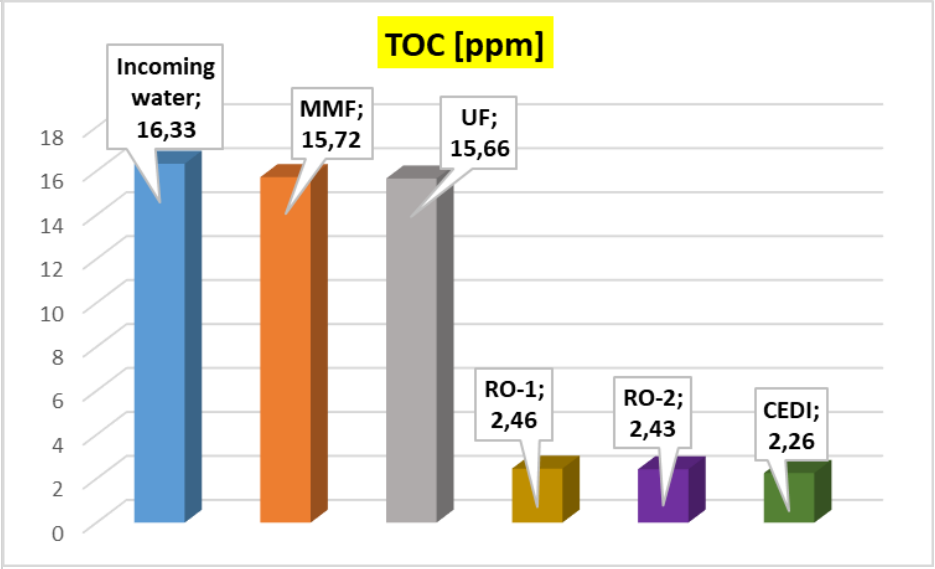
Prototype – Chemical Water Analysis

- The suspended solid content was significantly reduced by the UF equipment
- The RO-1 equipment removed the metal content of the water and the salts which cause water hardness

C 6 Results summary

Prototype – Chemical Water Analysis





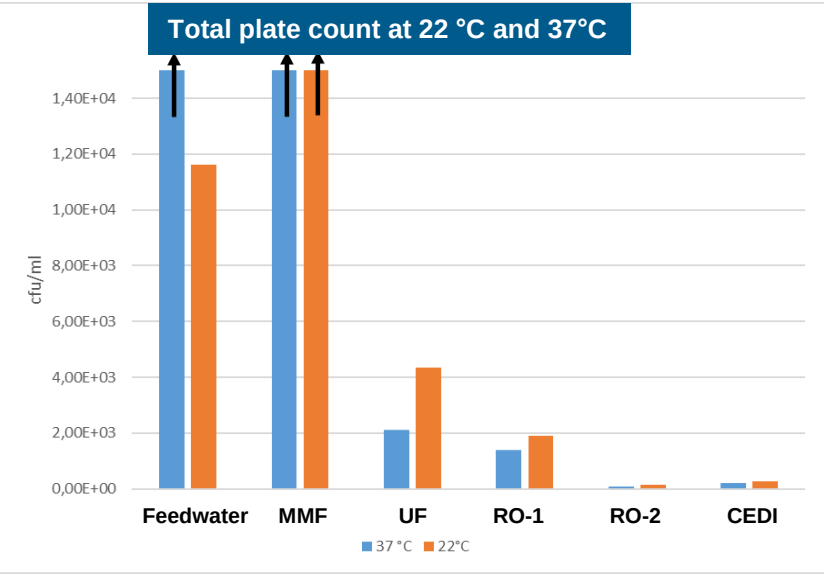
- **The TOC content and the conductivity were significantly reduced by water treatment with RO membranes**
- **RO-1 module produced soft (+irrigation) water quality, while the purified water after CEDI corresponded to demineralized water qulity**

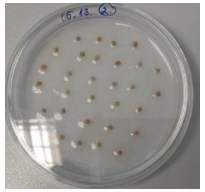
C 6 Results summary

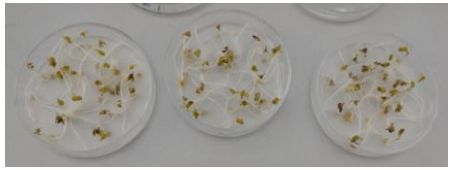
Prototype – Biological tests

Total plate count and toxicity tests

- From the inhibitory/weakly inhibitory water - not influencing category and after the CEDI step, the seeds germinated very well, there was 90% of control root length
- The high colony count values of feed water and MMF filtered water was totally disappeared at the end of purification process.



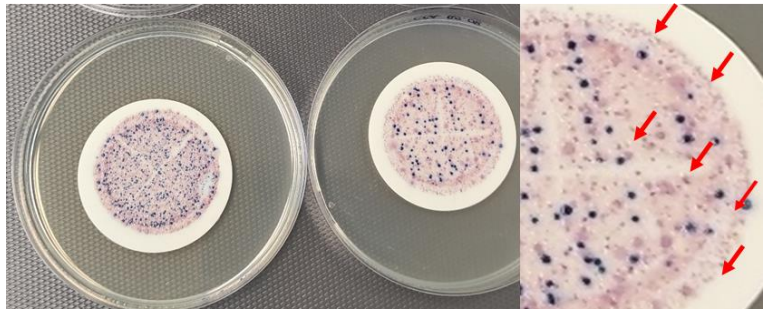




Sample	Root length [mm]	Root germination inhibitor [%]	$\frac{Root\ length\ of\ sample}{Root\ length\ of\ control}$ ×100 [%]	Inhibition category
Feed water	41	35,59	64	weakly inhibitory
	36	37,10	62	weakly inhibitory
	35	37,02	62	weakly inhibitory
	36	36,31	63	weakly inhibitory
	36	31,87	68	weakly inhibitory
	18	48,23	51	inhibitory
	21	44,72	55	inhibitory
	28	25,01	74	weakly inhibitory
After MMF	50	20,28	79	weakly inhibitory
	43	35,77	64	weakly inhibitory
	41	25,74	74	weakly inhibitory
	43	22,56	77	weakly inhibitory
After UF	52	16,78	83	weakly inhibitory
	43	26,36	73	weakly inhibitory
	41	25,89	74	weakly inhibitory
	47	16,54	83	weakly inhibitory
	36	3,78	96	non-influencing
After RO-1	42	17,06	82	weakly inhibitory
After RO-2	32	9,52	90	non-influencing
	34	10,23	89	non-influencing
After CEDI	47	10,72	89	non-influencing
	27	23,27	76	weakly inhibitory
	33	11,57	87	non-influencing
	38	-1,54	102	non-influencing

C 6 Results summary

Prototype – Biological test



Escherichia coli and coliform bacteria content

- The very high E. coli and coliform content of the feedwater was completely eliminated by the end of the purifying process

- The water purification prototype can produce the best quality irrigation water