



Closed Circuit Reverse Osmosis contributes to drinking water robustness in Flanders coastal region

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De Watergroep
WATER. VANDAAG EN MORGEN.



Founded in 1913 as
 “**Nationale Maatschappij
 der Waterleiding**
 (NMDW)”

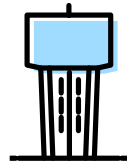
De Watergroep
 = largest water company in
 Flanders
 Autonomous public
 company



1913

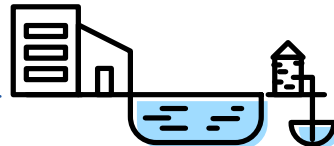


Today



127 million
 produced
 water (m³)

59
 reservoirs



86
 ground water
 abstractions

5
 surface water
 abstractions



1.5 million
 connections in
 service

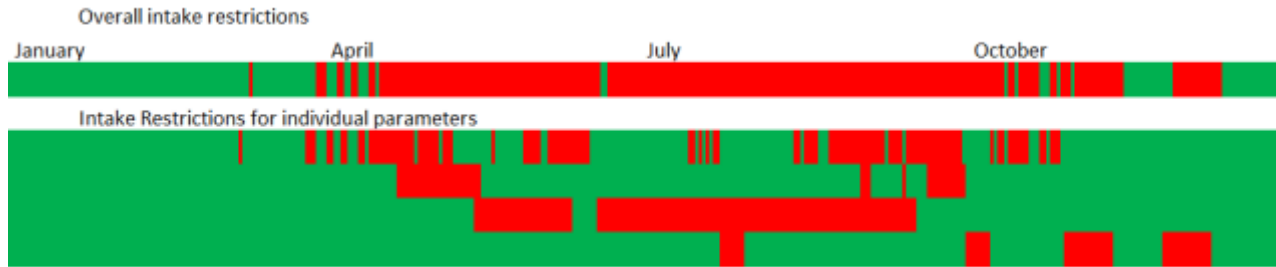
34,571
 km of pipeline

3.3 million
 customers in
 Flanders

Challenges in Water Production Center De Blankaart

- Production capacity 40.000 m³/day
- Main source surface water from River IJzer
- Large reservoir 3.000.000 m³

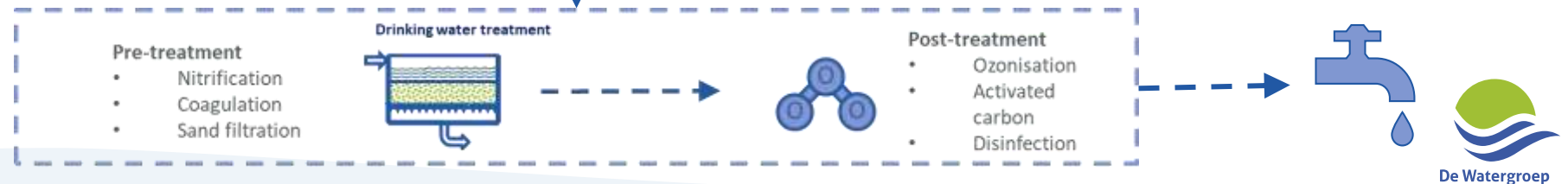
Summary of intake restrictions for one year



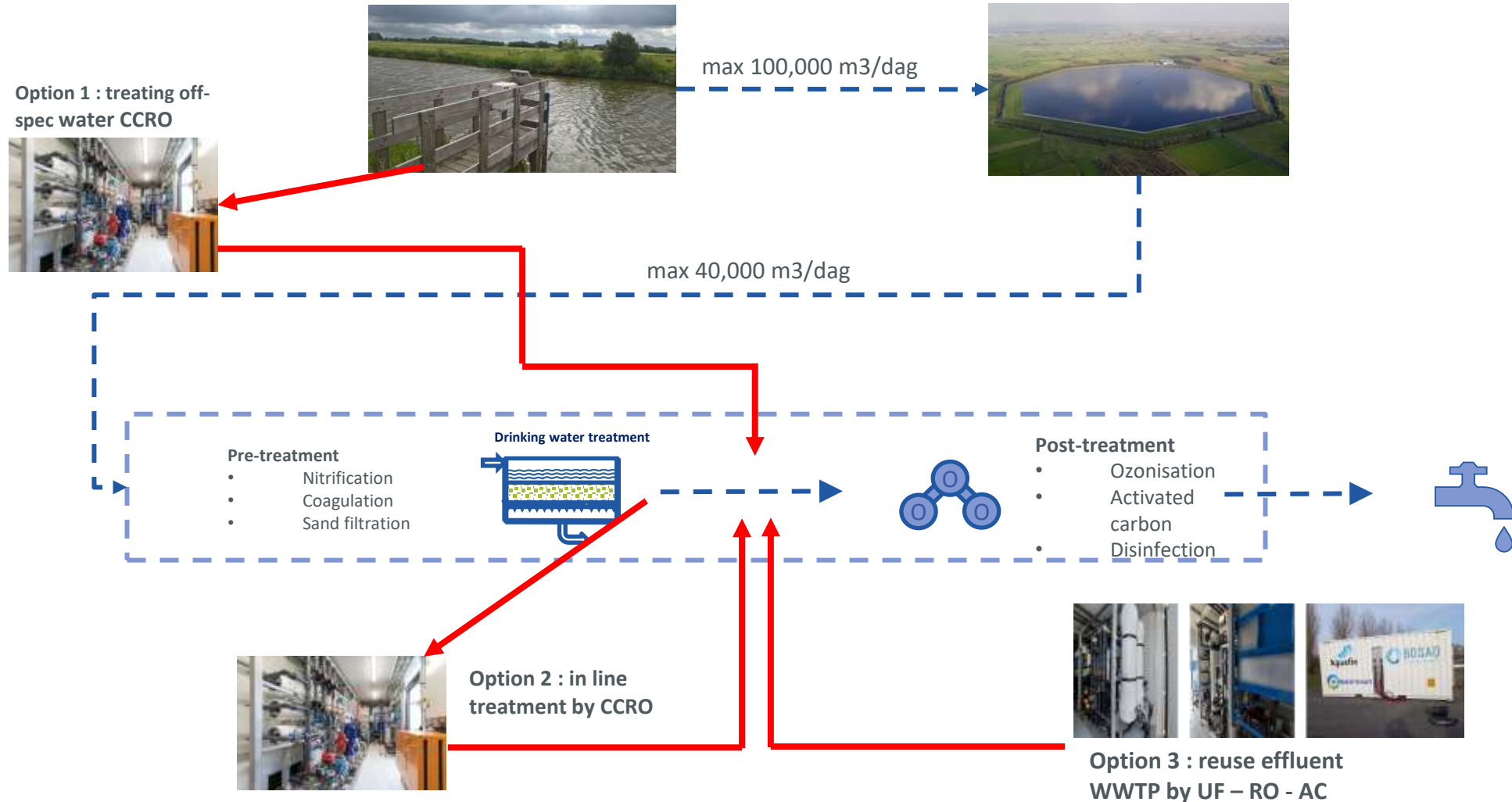
restrictions



- Chlorides
- Pesticides
- Nitrates
- Water quantity



Options considered to improve drinking water robustness



Project B-WaterSmart : Two pilots at WPC De Blankaart

Horizon 2020 project (grant agreement no 869171)

<https://b-watersmart.eu/>

Case 1: treating off-spec water



- Closed Circuit Reverse Osmosis (CCRO)
- Capacity 10 m³/h
- Lead partner : De Watergroep
- Supplier technology : Waterleau

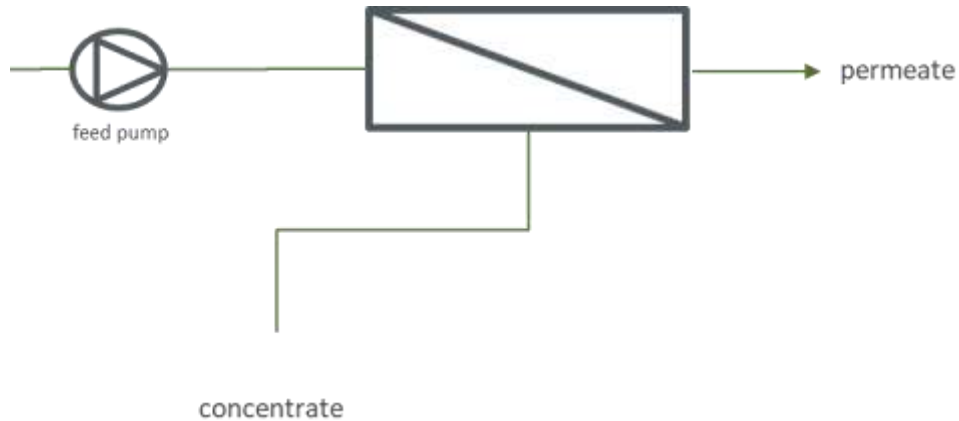


- Ultrafiltration – reverse osmosis – active carbon - UV
- Capacity 1 m³/h
- Lead partner Aquafin
- Supplier technology : Bosaq.

Case 2: reuse effluent WWTP



Technology selected Closed Circuit Reverse Osmose

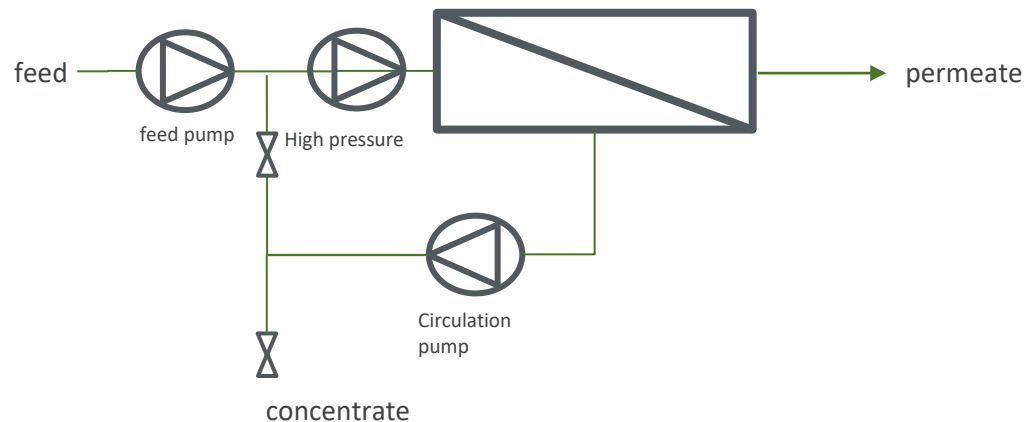


Technology based on conventional reverse osmose but cyclic operation

Main (claimed) advantages

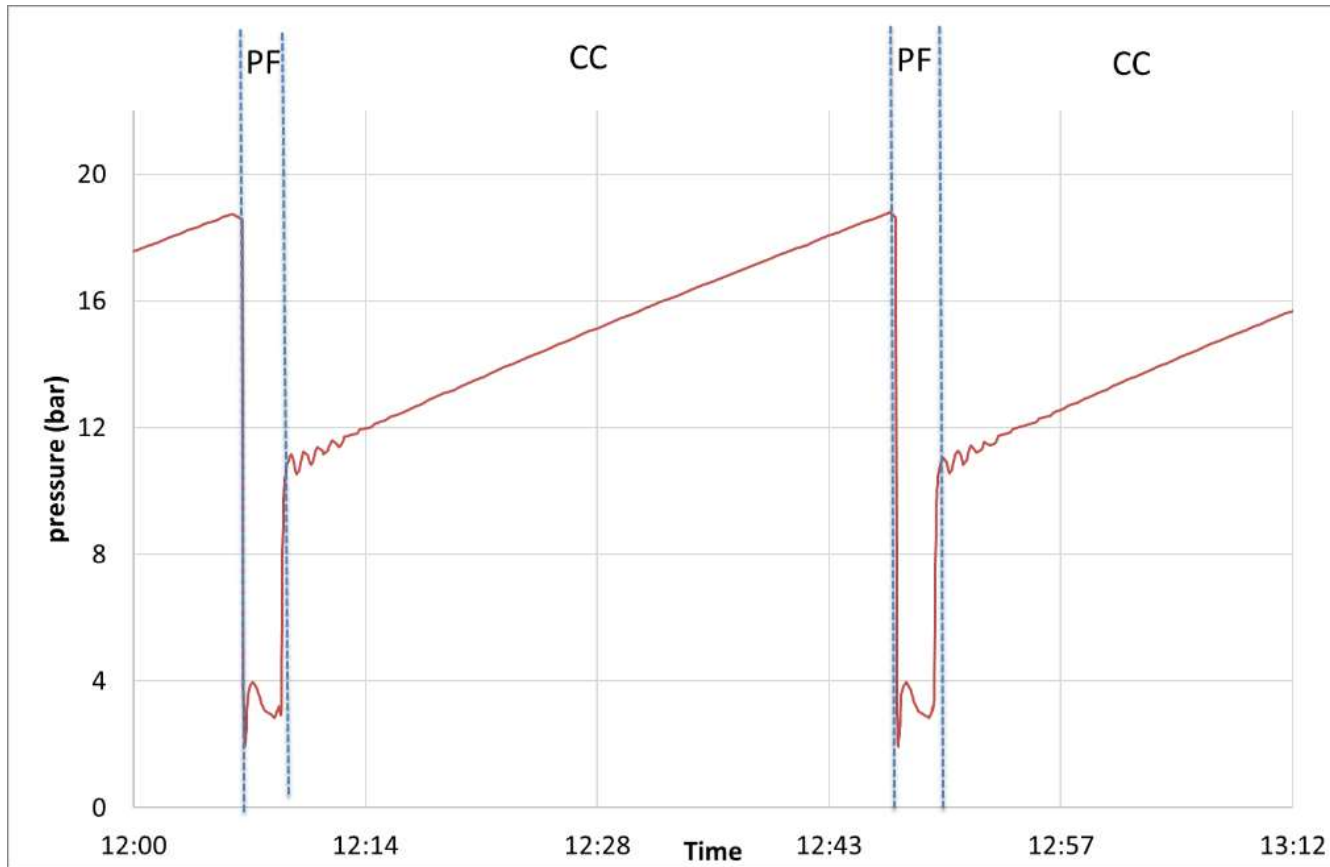
- Flexible operation for varying feed water quality (time setpoints of cycle)
- Less sensitive for fouling and scaling due to
 - Cross flow controlled by circulation pump – optimal for all membranes
 - Limited time operating at highest concentration factor – crystals are flushed out before strong binding with membrane
 - Lower energy usage (limited time at highest pressure)
- High water recovery possible

Conventional RO



CCRO

Typical CCRO cycle



- Discontinuous production of concentrate
- Varying pressure during cycle
→ energetical beneficial

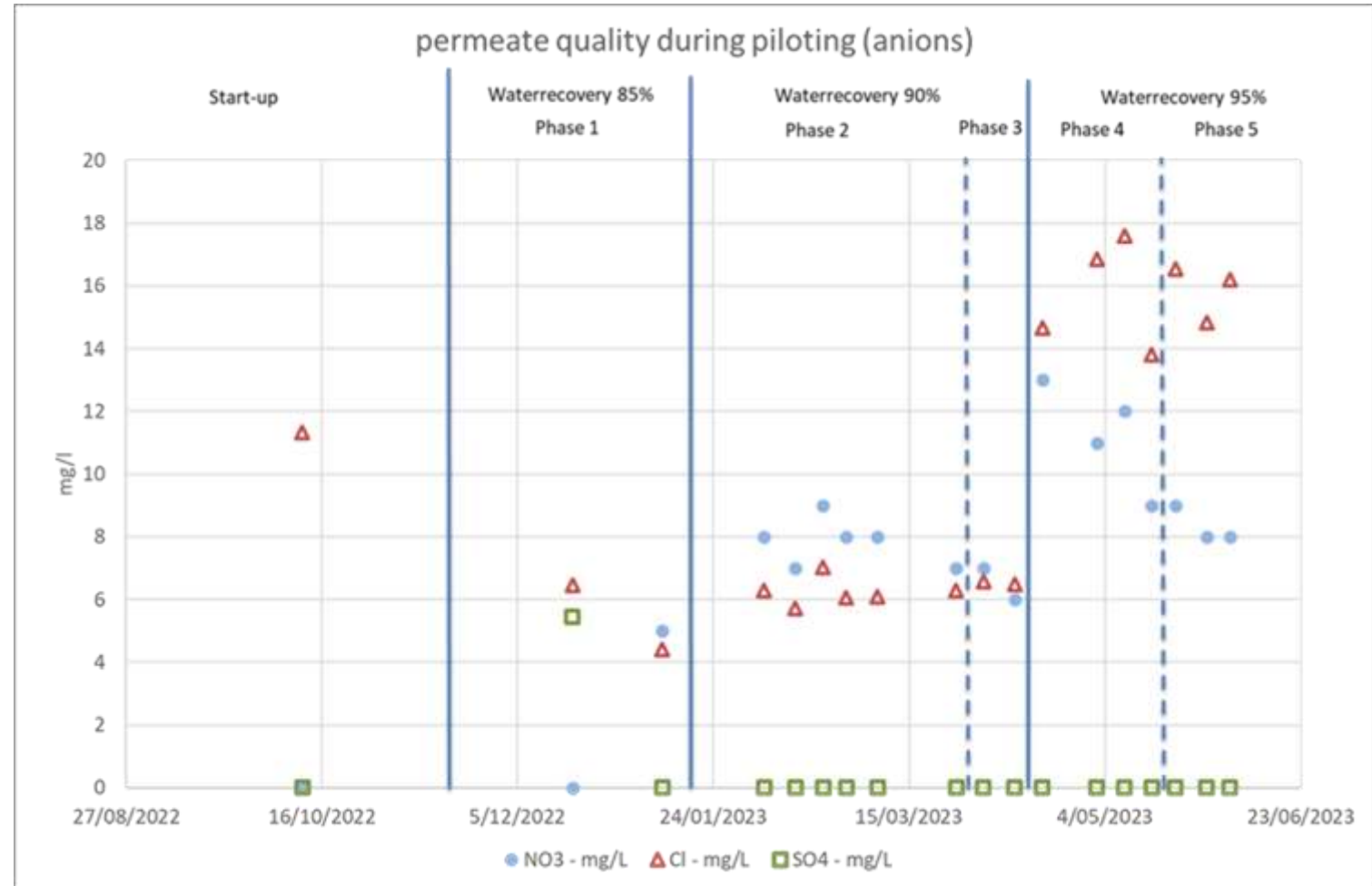
Phases :

- PF : Plug flow
- CC : Closed Circuit

Retention of salts by CCRO

Retention phase 5

SO4 - mg/L	100%
Ba - µg/L	100%
Ca - mg/L	100%
Mg - mg/L	100%
Fe - µg/L	100%
Mn - µg/L	100%
Sr - µg/L	100%
SiO2 - mg/L	100%
Cl - mg/L	90%
Na - mg/L	87%
K - mg/L	86%
NO3 - mg/L	53%



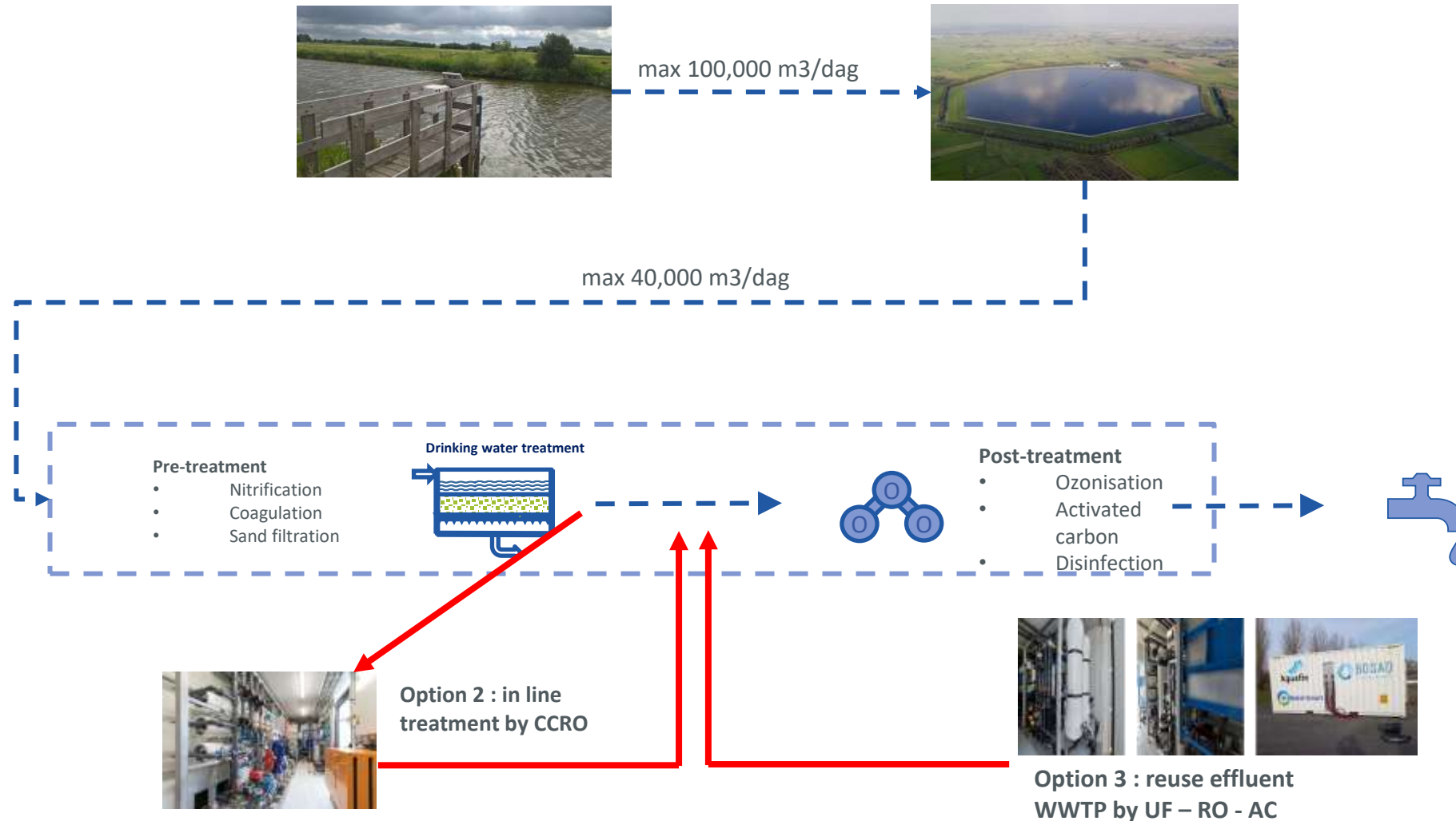
Retention of micropolluents

- 123 components analysed
- 46 components in concentrate
- 24 components detected in feed
- 5 components detected in permeate
- 0 components in permeate above drinking water limits

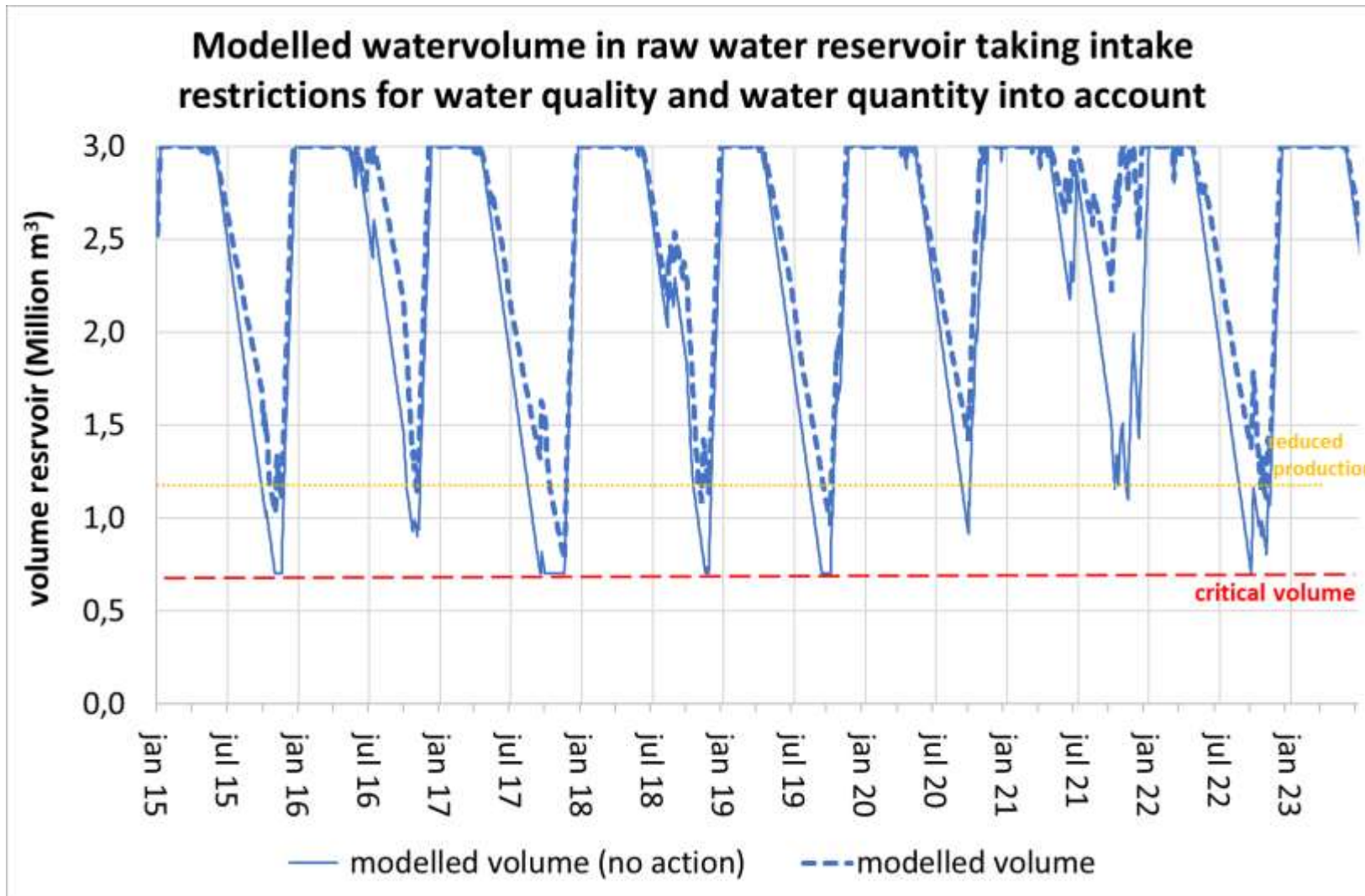


Type	component	#	PERMEATE		Feed		Quality standard
			Mean	Max	Mean	Max	
Herbicides	CLOPYRALID	3			0,069	0,079	0,1
	TRICLOPYR	3	0,028	0,083			0,1
	24D	3			0,024	0,037	0,1
	Bentazon	3			0,108	0,111	0,1
	MCPA	3			0,080	0,104	0,1
	TERBUTYLAZINE	3			0,009	0,027	0,1
	_DESETH						
	METALDEHYDE	3			0,022	0,066	0,1
	CHLORTOLU	3	0,007	0,020	0,052	0,073	0,1
	METOLACHL	3	0,009	0,026	0,050	0,072	0,1
Medicals	BAM	3	0,037	0,111	0,257	0,293	0,4
	TRAMADOL	3			0,018	0,054	0,1
	CARBAMAZEPINE	3			0,021	0,062	0,1
	IBUPROFEN	2			0,042	0,083	0,1
	METFORMINE	2	0,033	0,033	0,717	0,924	0,1
PFAS	FOSA	7			0,000	0,001	
	PFPeS	7			0,000	0,001	
	6:2 FTS	7			0,001	0,004	
	PFHxS	7			0,001	0,002	
	PFHpA	7			0,002	0,003	
	PFOA	7			0,003	0,003	
	PFBS	7			0,005	0,009	
	PFOS	7			0,003	0,005	
	PFPeA	7			0,005	0,007	
	PFBA	7			0,007	0,009	
	PFHxA	7			0,008	0,010	
	som EFSA-4	7			0,007	0,010	0,004
	som PFAS	7			0,033	0,042	0,1
som PFAS_TOT	7			0,035	0,047	0,1	

Modelling impact of options

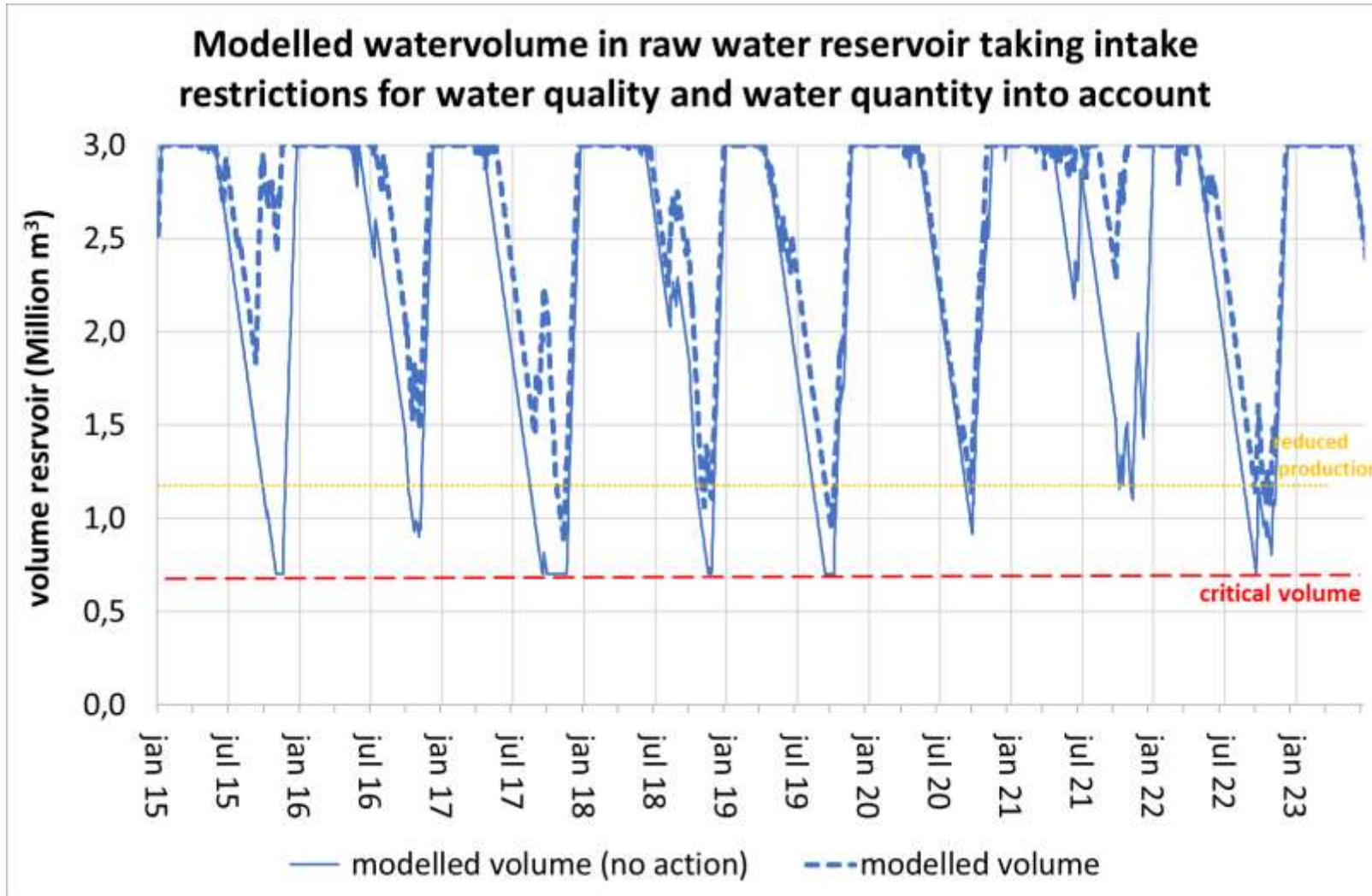


Impact of RWZI effluent reuse



Scenario
UF-RO-AC or CCRO on
RWZI effluent
Capacity 5.000 m³/day

Impact of in-line treatment step



Scenario
Inline treatment step CCRO
Capacity 20.000 m³/day

Conclusions

- Technical evaluation of CCRO
 - High water recovery
 - No scaling indication
- Impact of CCRO/RO concepts on water production capacity in WPC De Blankaart
 - Both scenario's contribute to robust water supply
 - Design capacity RWZI effluent reuse smaller
- Next steps : further explore options for concentrate



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[H2020 B-WaterSmart | De Watergroep](#)

Video CCRO

[B-Watersmart - De Watergroep en Waterleau – YouTube](#)



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 869171. The publication reflects only the authors' views and the European Union is not liable for any use that may be made of the information contained therein.