CZECH-ISRAELI
WATER MANAGEMENT SEMINAR
Thursday, June 19, 2025

Quaternary treatment of wastewater in Israel

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Mekorot in figures

304,000 water samples analyzed per year	Over **1,000** active wells drilled	Supplies **70%** of the total water consumption in Israel
13,000 km of water pipelines	**85%** of potable water in Israel	**6** certified laboratories in Israel
Integrating **600** million m^3 of desalinated seawater per year	**10** command and control centers	**9** wastewater purification facilities and reclamation plants
3,000 production and supply installations	**23** desalination plants	**1.7** billion m^3 of water supplied per year (423 billion gallons)

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Topics for discussion

- **Wastewater reclamation in Israel**
- **Regulation -** Effluent Quality Standards and Quality-based effluent reuse
- **The SHAFDAN -** Mekorot's reclamation and distribution system
- **Future-proofing**

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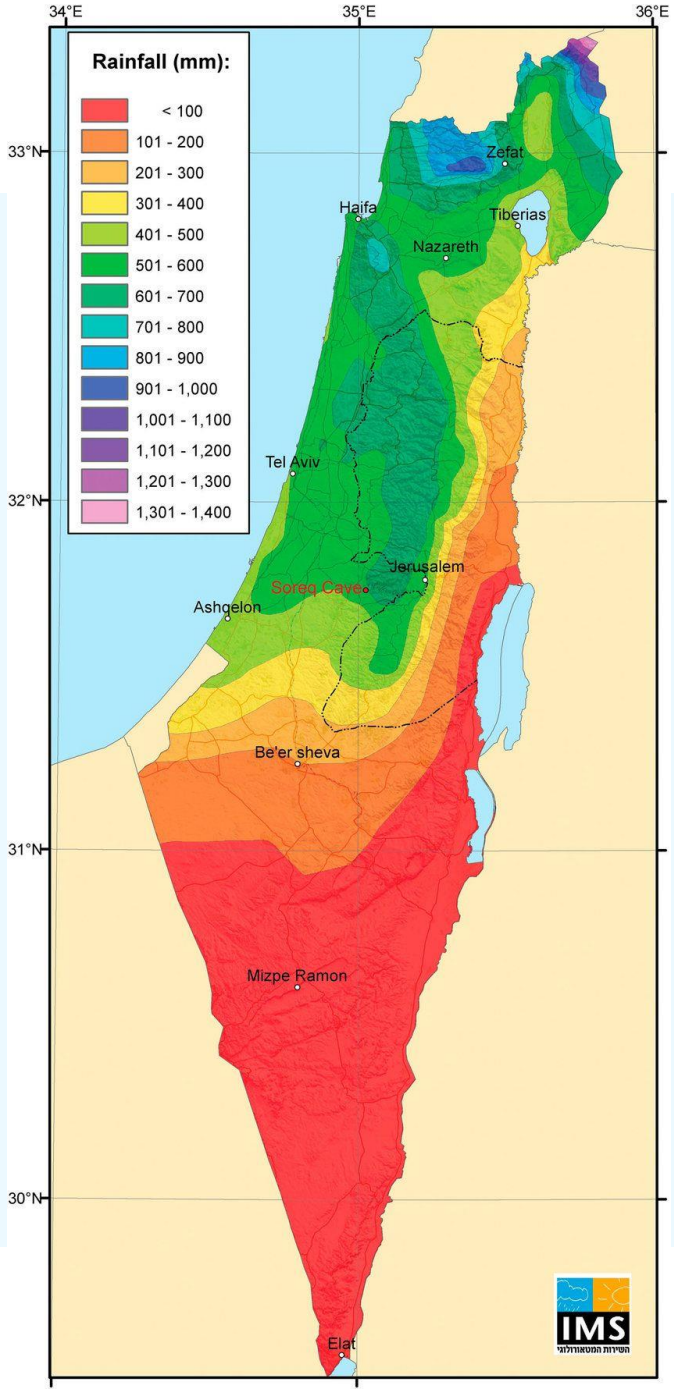

Israel – an overview

- A wide discrepancy in rainfall spread between districts and seasons
- A High probability of consecutive dry years
- Regional discrepancy in natural water resources
- Conveying water outside the borders of the watershed
- Continuous population growth
- Geopolitical aspects – Cross border, shared water sources

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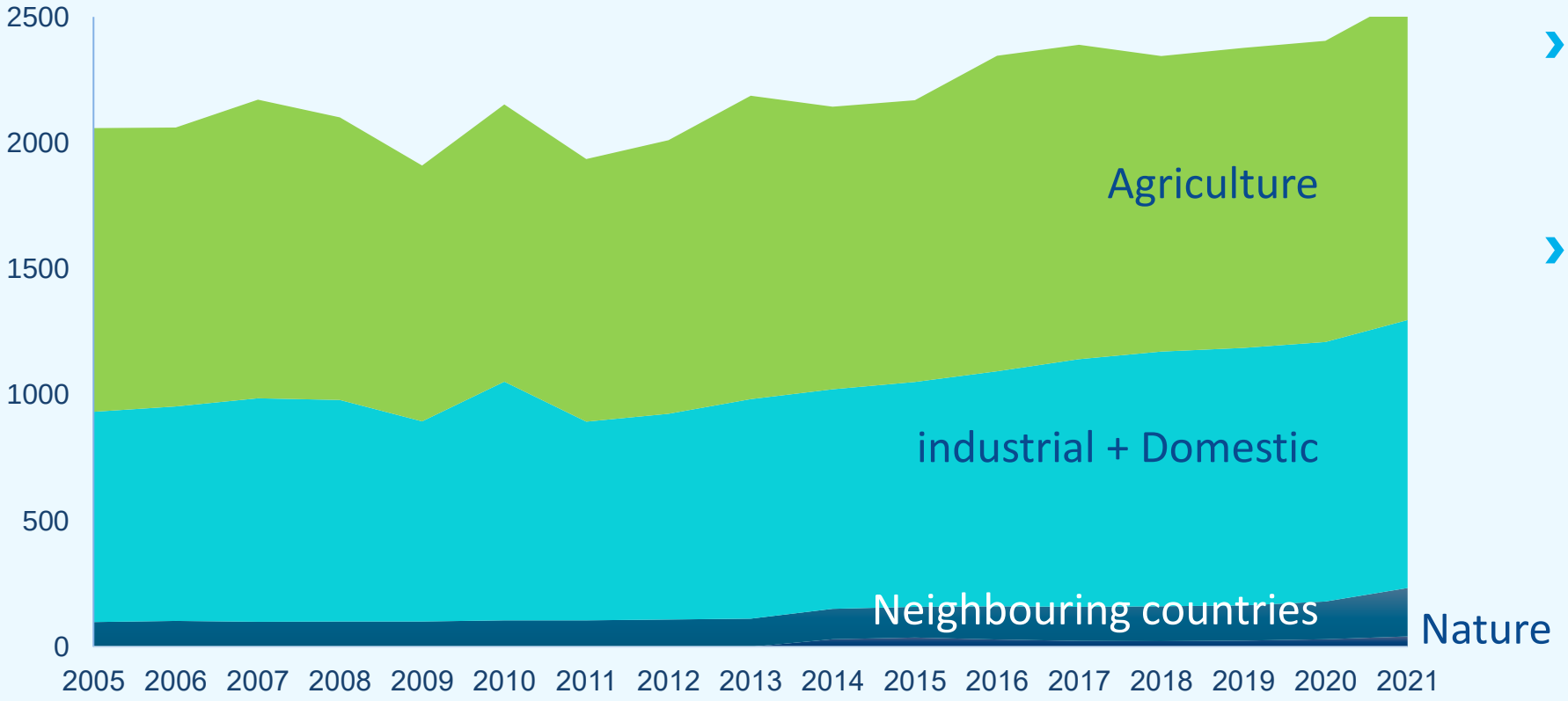
Annual water demand (MCM)



- **Annual Water demand:** 2,600 MCM
- **Annual recharge (median):** 1,200 MCM

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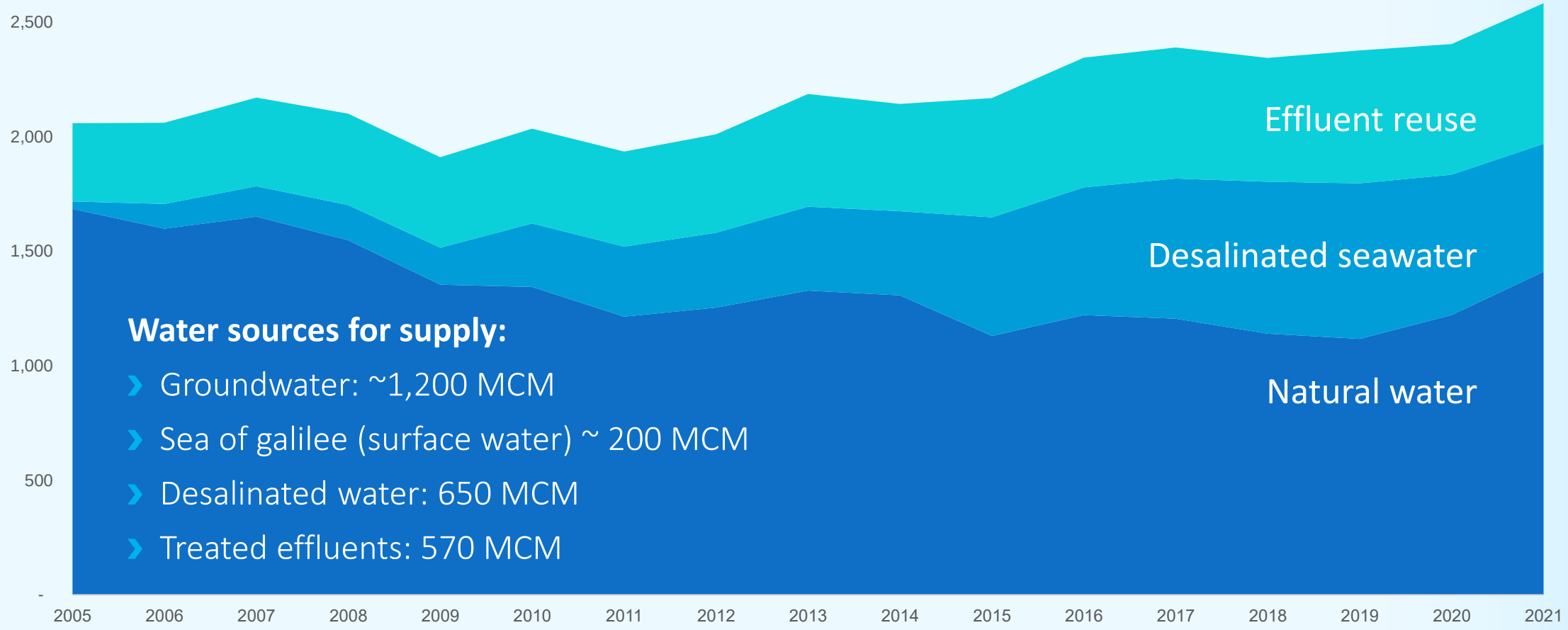
Annual demand of different water types



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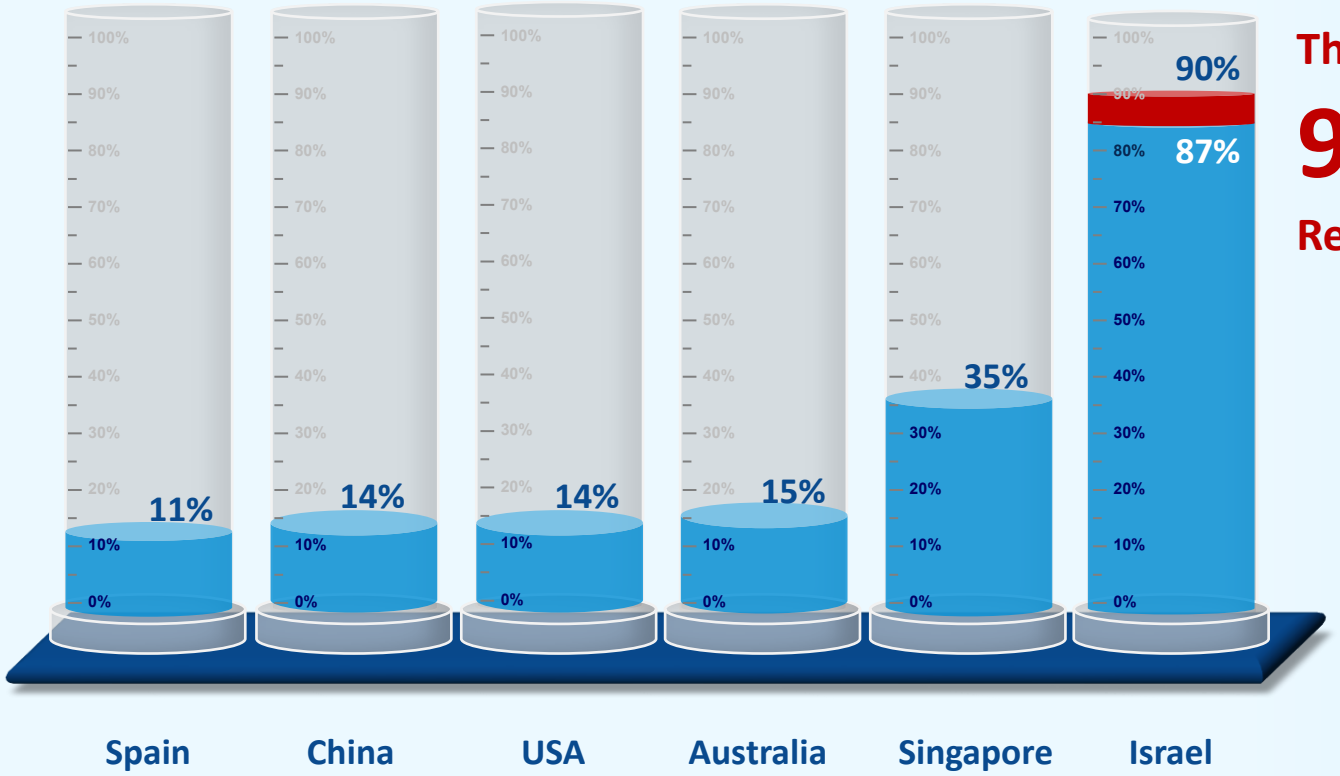
Effluent Reclamation

- Israel reuses 87% of the treated effluents – the highest rate in the world!
- Ability to supply all the agricultural needs
- Israel's strategic goal for the next decade is to increase the reuse to 90%



The Goal -

90%

Reclamation

*GWI Municipal Water Reuse Markets 2010

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Reclaimed Wastewater Policy Principles

- **Full use of Wastewater** - minimize disposal to the environment. Encouraging regional systems.
- **Economic efficiency** - Different qualities will be used appropriately, subject to agricultural, health & ecological limitations.
- **Fairness** - Sewage producers are responsible for treatment and purification. Reclaimed water users, for usage systems. The state participates for external costs.

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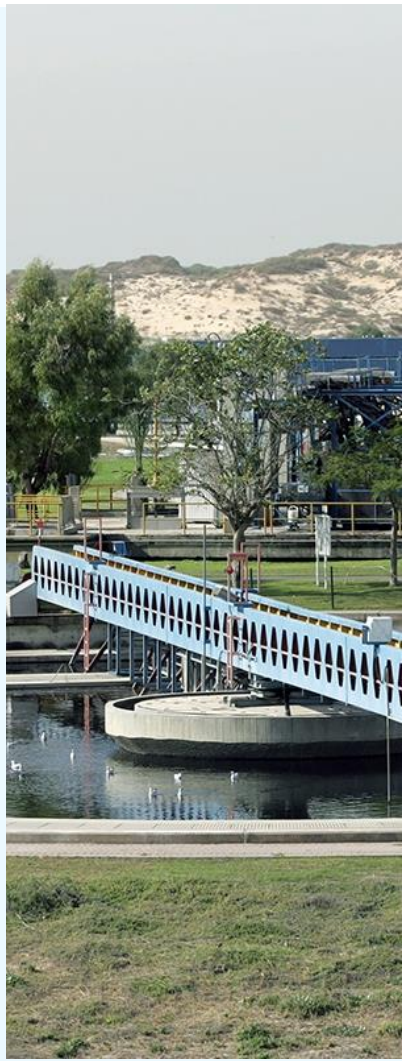
Effluent Quality Standards and Rules for Sewage Treatment, Regulations, 2010

- Determine maximum levels for 36 parameters for **irrigation** and **discharge to rivers.**
- Determine effluents quality for:
  - unrestricted agricultural irrigation
  - restricted irrigation (small WWTP or specific geographical areas)
  - Public gardening irrigation
- The chloride in the effluent should not exceed 80 mg/l above its concentration in the supply water. Limitation of Boron 0.4 mg/l
- **Monitoring and control** program on the quality and quantity. On line monitoring: flow, turbidity and chlorine.
- **Compulsory reporting** of monitoring, sampling and test results. Monthly to the regulators, annually to the public.



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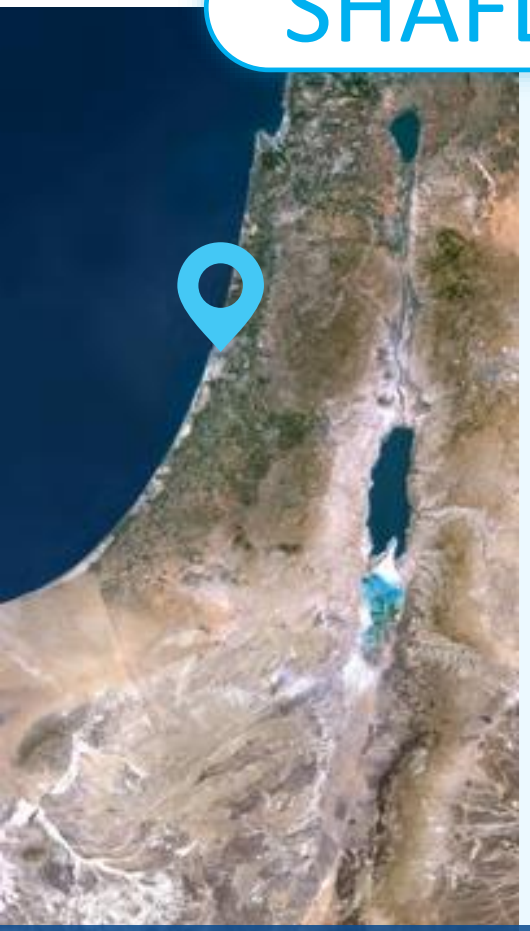
Use of effluent according to quality

Treatment	Quality	Use
Primary Treatment (Sedimentation)	Primary effluents	
Secondary Treatment	Secondary effluents	Restricted agricultural irrigation
Secondary Treatment + Nutrients removal		Discharge to rivers
Tertiary Treatment + disinfection	Tertiary effluents	Unrestricted agricultural irrigation
Tertiary Treatment+ Residual disinfection at the consumer		Public gardening irrigation
SAT, RO, Advance oxidation	Quaternary effluents	Reclaimed water

SHAFDAN



420,000 cubes meters per day in 2023

Waste water treatment plant

60,000 acres | 243 Km^2 | 2.5 Million People | Daily Flow rate 100M US Gallons

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Dan region Wastewater Treatment Plant

Six sub plants:

1. Pre-treatment
2. Activated Sludge - Bio-reactors
3. SAT - Soil Aquifer Treatment
4. Anaerobic Digestion
   - 4.1. Thickening & Dewatering
   - 4.2. Nutrient recovery and ammonia removal

SAT – Soil Aquifer Treatment

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SAT Advantages and Performance

Parameter	units	Secondary Effluent	SAT
Total Coliform	**cfu/100ml**	**10,850**	**1**
Fecal Coliform	**cfu/100ml**	**7,575**	**<0.01**
Streptococci Faecalis	cfu/100ml	3,094	<0.01
Total Bacteria	cfu/1 ml	229,955	246
Coliphage	PFU/L	960	0.05
EnteroVirus	PFU/L	65	<0.001
AdenoVirus	PFU/L	115	<0.001
NoroVirus	PFU/L	12.5	<0.001
DOC	mg/l	11	<1
COD	mg/l	35	2
NH4	mg/l	5.2	<0.05
NO3	mg/l	3.4	28
P/PO_4	mg/l	0.76	0.15
turbidity	mg/l	1.8	0.2

(Elkayam et al., 2018)

Reclaimed water quality is within the limits of the Israeli drinking water standard

- Consistent, stable and reliable SAT performance during over the 37 years of continuous operation
- Provides underground storage to manage seasonality of demand
- A naturally robust process
- Requires relatively low technical expertise

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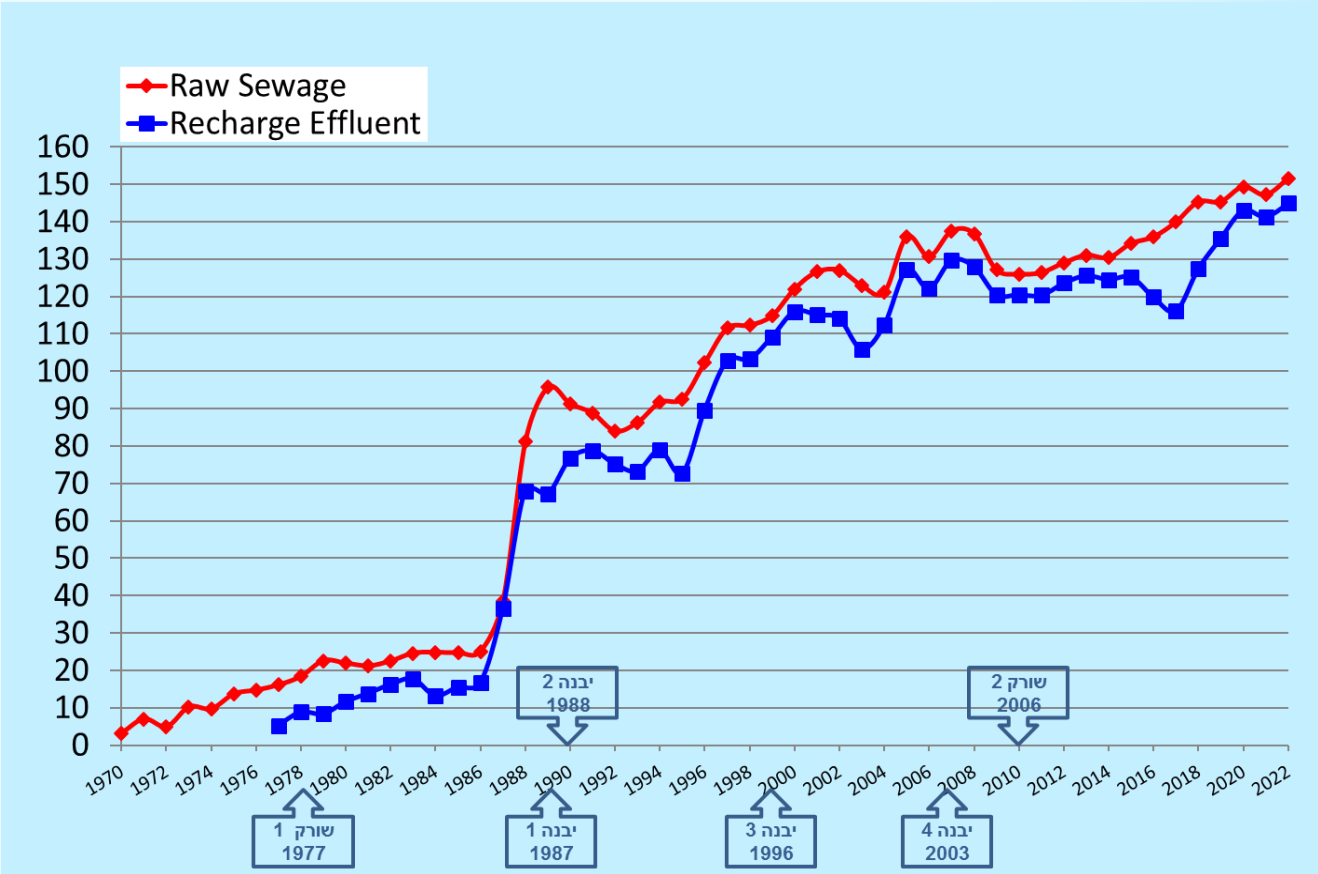
The challenge for the years to come

- Current SAT at capacity
- No available land for new SAT basins
- Effluent amount to keep increasing @~1.8% annually

Need for a supplemental solution to provide “SHAFDAN quality” water



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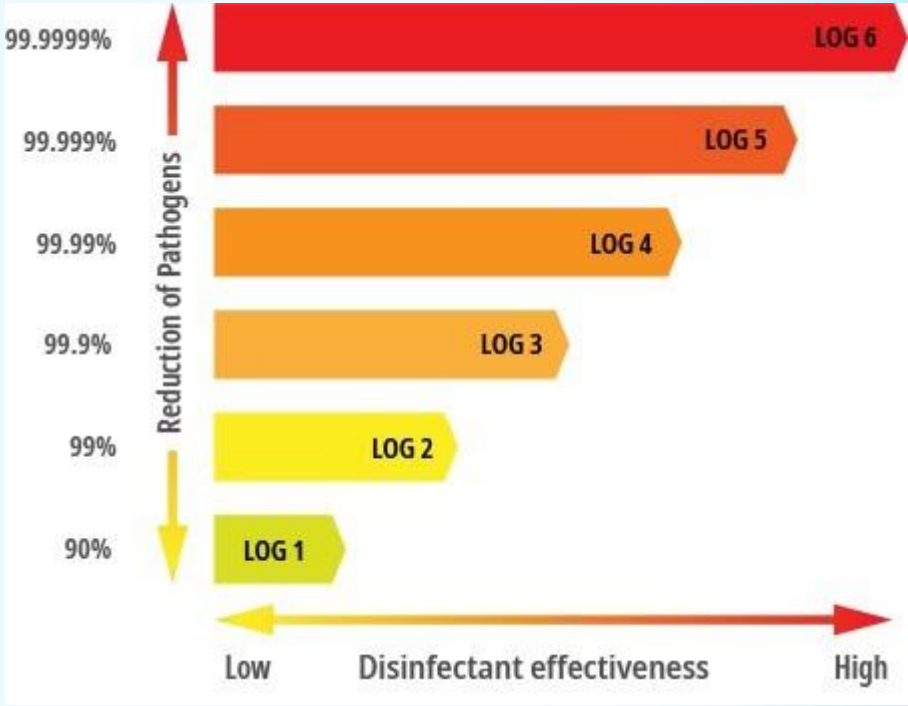
“SHAFDAN quality” definition

- 10 log removal for viruses
- 8 log removal for crypto. and giardia
- minimum 3 barriers of >1 LRV for viruses, cryptosporidium and giardia
- >80% removal of TrOCs from a pre-selected list
- Technology adapted as Tier 1
- Economically viable, protective of the environment



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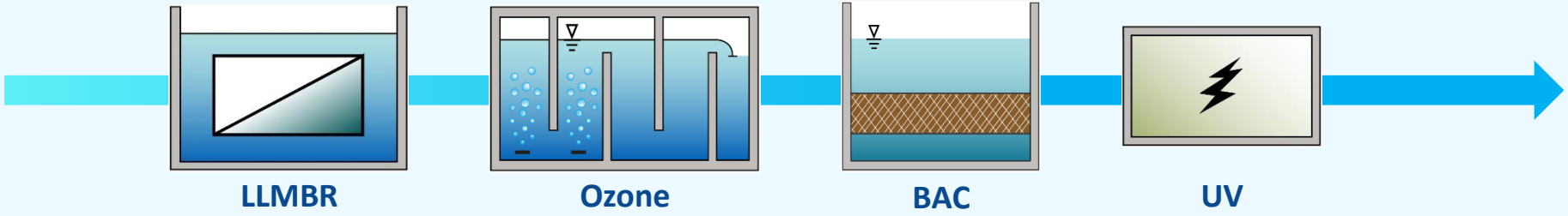
Technologies considered

Alternative Industrial Shafdan Treatment Train (following Shafdan WWTP)	Recovery[1]	Logic and Considerations	Relative Cost[2]
UF, RO, UV AOP	85%[3]	• RO based treatment is a technology very familiar to Mekorot. • RO can robustly handle the variable Shafdan WWTP effluent quality.	• Highest Cost for treatment only. • Additional brine treatment and disposal costs are substantial. • Substantial water lost due to brine from RO. Higher recovery RO systems increase cost.
Ozone, BAC, UF, UV	>99%[4]	• Use non-RO processes to maximize water recovery and reduce cost. • Rely upon the Shafdan WWTP to fully nitrify (with no detectable effluent nitrite) and produce consistent high-quality effluent (e.g., consistent and relatively low TOC) • Add in UF to provide an important protozoa barrier	• Lowest cost solution. • Not a viable solution, as the Shafdan WWTP is not operated to provide a nitrite free, fully nitrified, and stable and low TOC effluent.
Secondary MBR, ozone, BAC, UV	>95%[4]	• Provides for robust treatment of Shafdan WWTP effluent prior to ozone	• Anticipated to be a slightly higher cost compared to the ozone, BAC, UF, UV system above. Demonstration testing will confirm costs.

ETF – Enhanced Treatment Facility



Technology	Virus Reduction	Protozoa Reduction	Chemical Reduction
LLMBR	Minimum 90% removal, new data indicates 99.9% removal	Minimum 99.7% removal, new data indicates 99.99% removal	Good reduction of TOC and various chemicals
Ozone	99.999% reduction depending upon control set points	Limited reduction anticipated	Robust destruction of a broad range of constituents, depending upon control set points
BAC	Possible with coagulation/flocculation step	Possible with coagulation/flocculation step	Robust biodegradation for a broad range of constituents, depending upon control set points
UV	Depends upon control set point, but up to 99.9999%	Depends upon control set point, but up to 99.9999%	Photolysis of some constituents depending upon control set points

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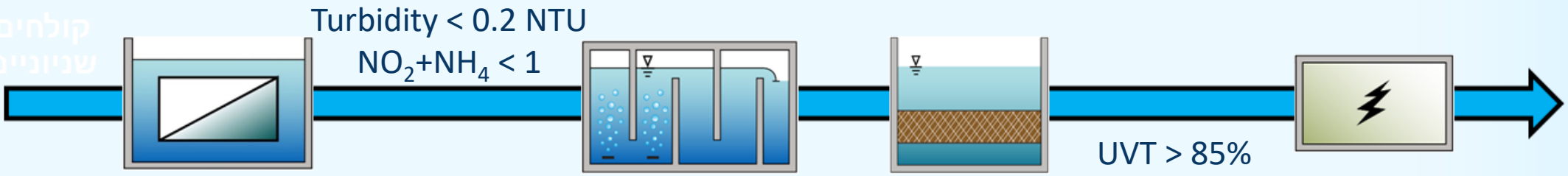
Piloting for technology validation

Pretreatment

Main process – disinfection and TrOCs removal

UV disinfection



CT=1

Buffer
Nitrification
Turbidity removal
Pathogen removal

TrOCs removal
Pathogen disinfection
ZLD

Pathogen disinfection

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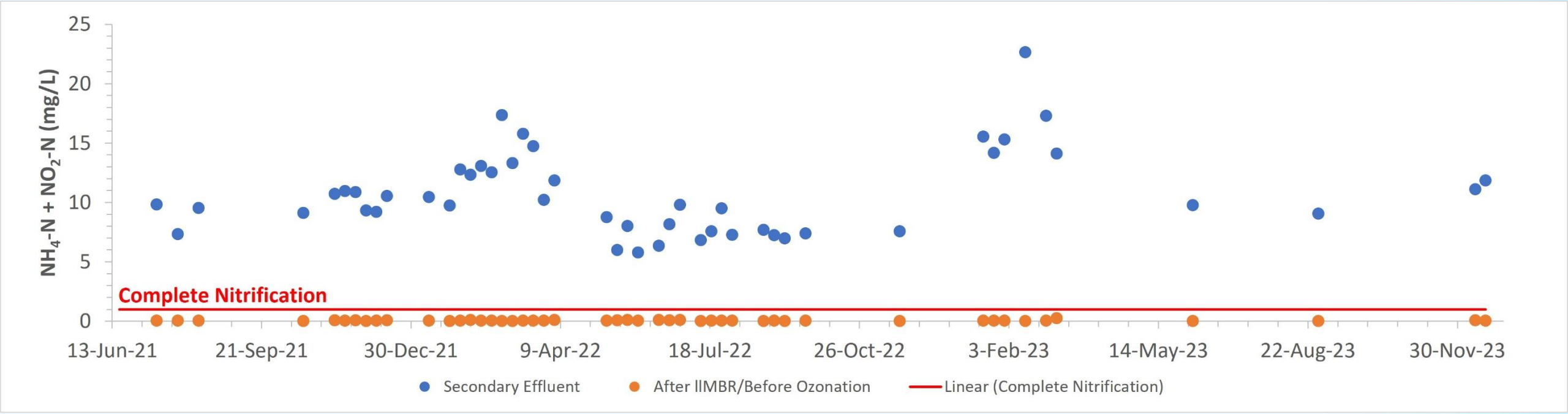
Consistently achieving complete nitrification



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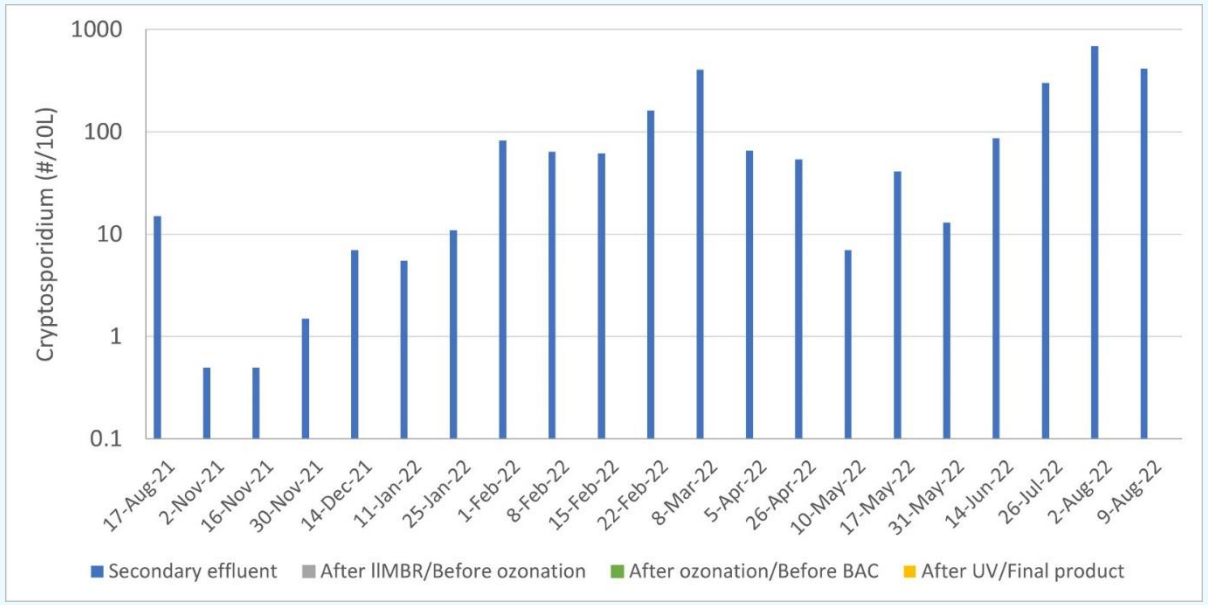
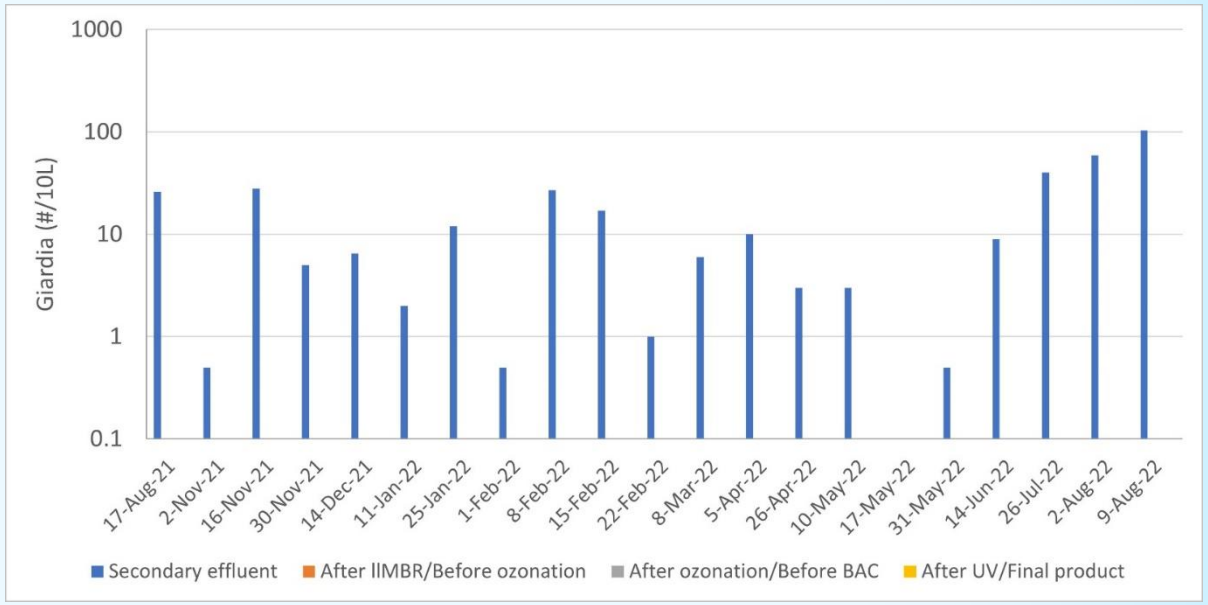
Pathogen removal





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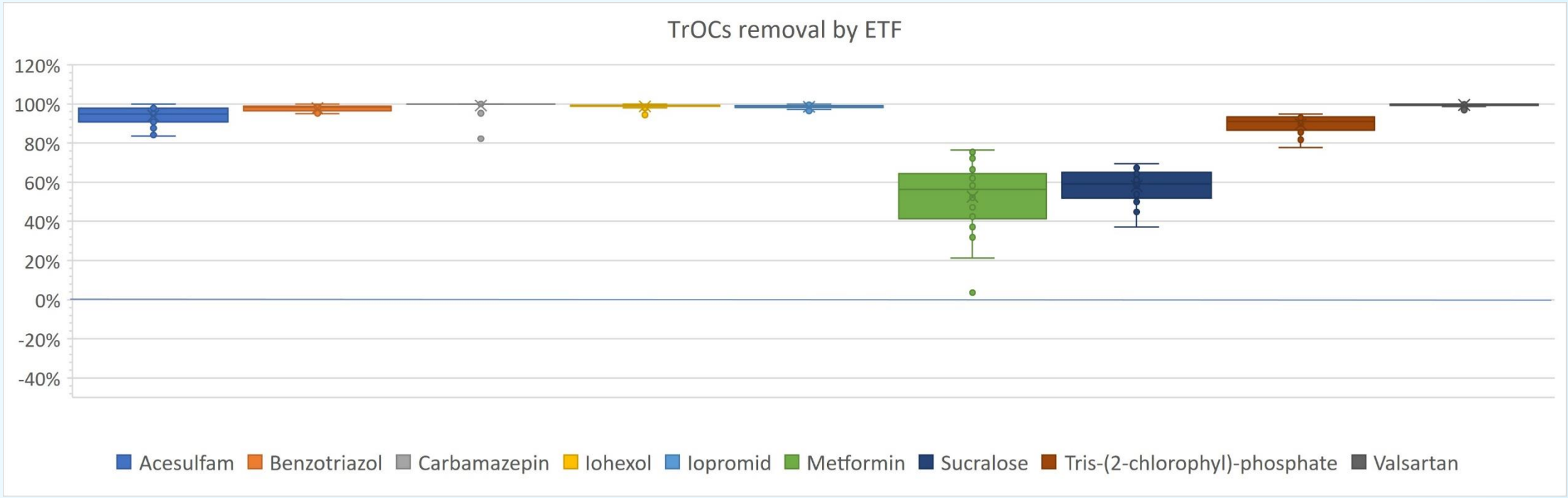
TrOCs removal



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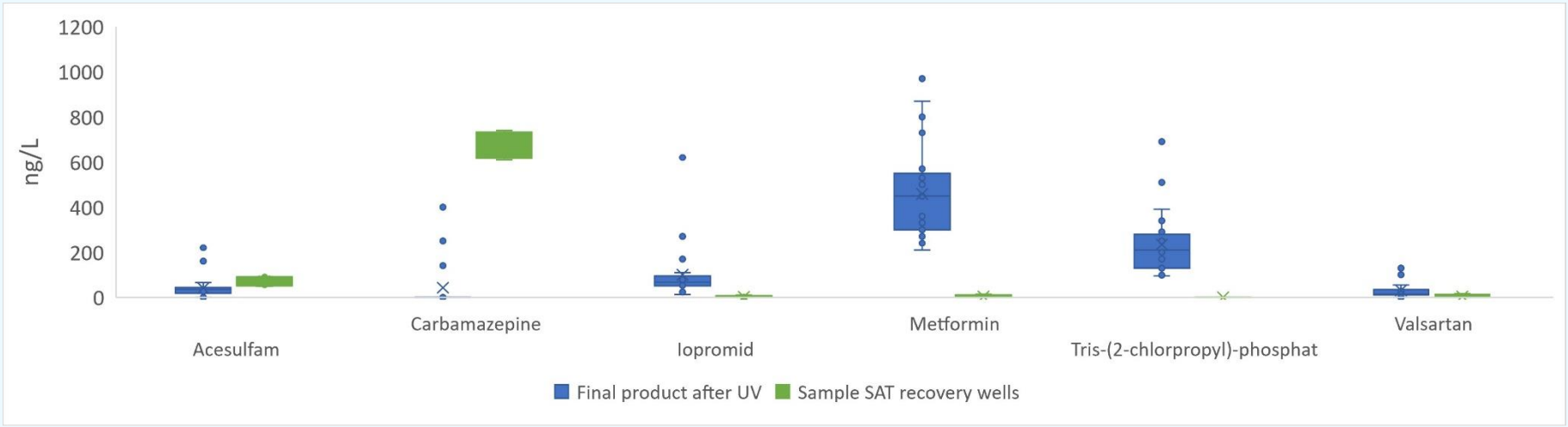
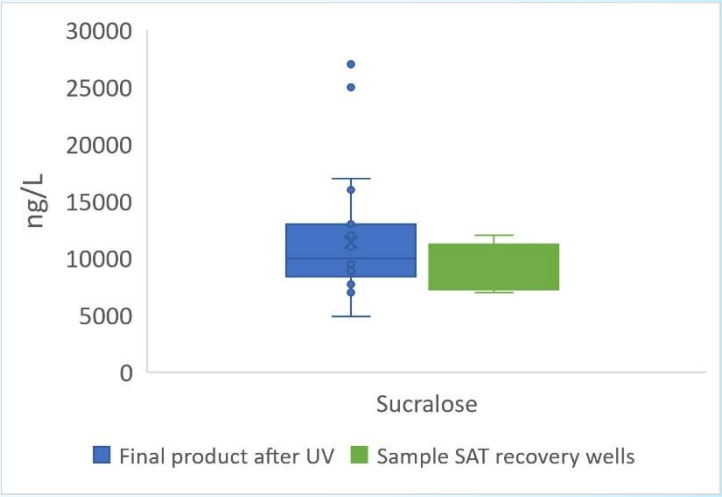
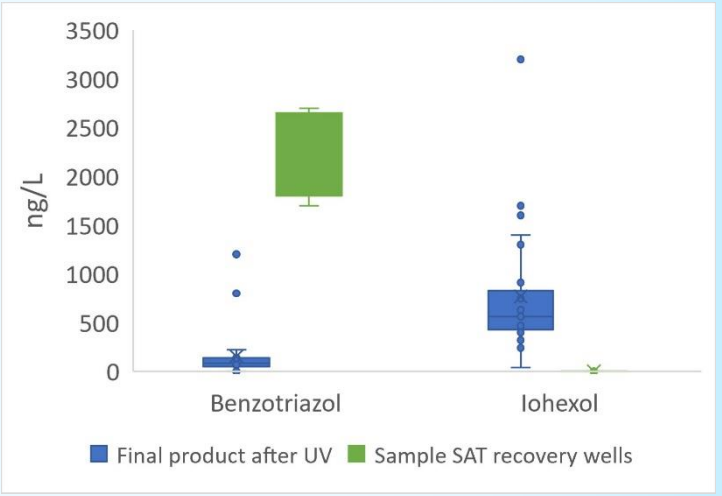
TrOCs removal compared to SAT







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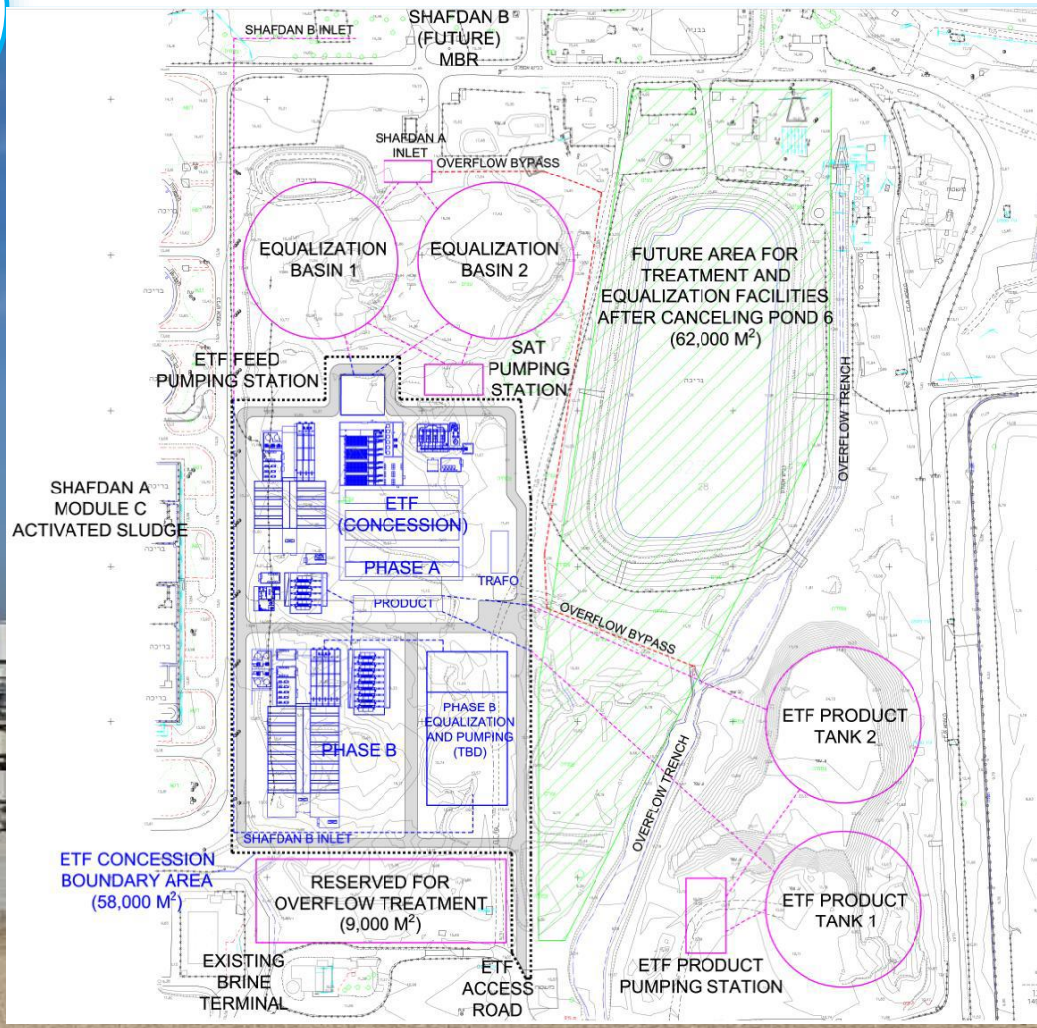
Current status: full scale design, 170,000 m^3/day for current plant



* Future ETF indicative design by Yoan Yinon and Carollo Engineers

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Interested in promoting effluent reuse?
Developing a new breakthrough technology?!
Seeking a research partner/ beta-site?

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Thanks for your time and attention

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