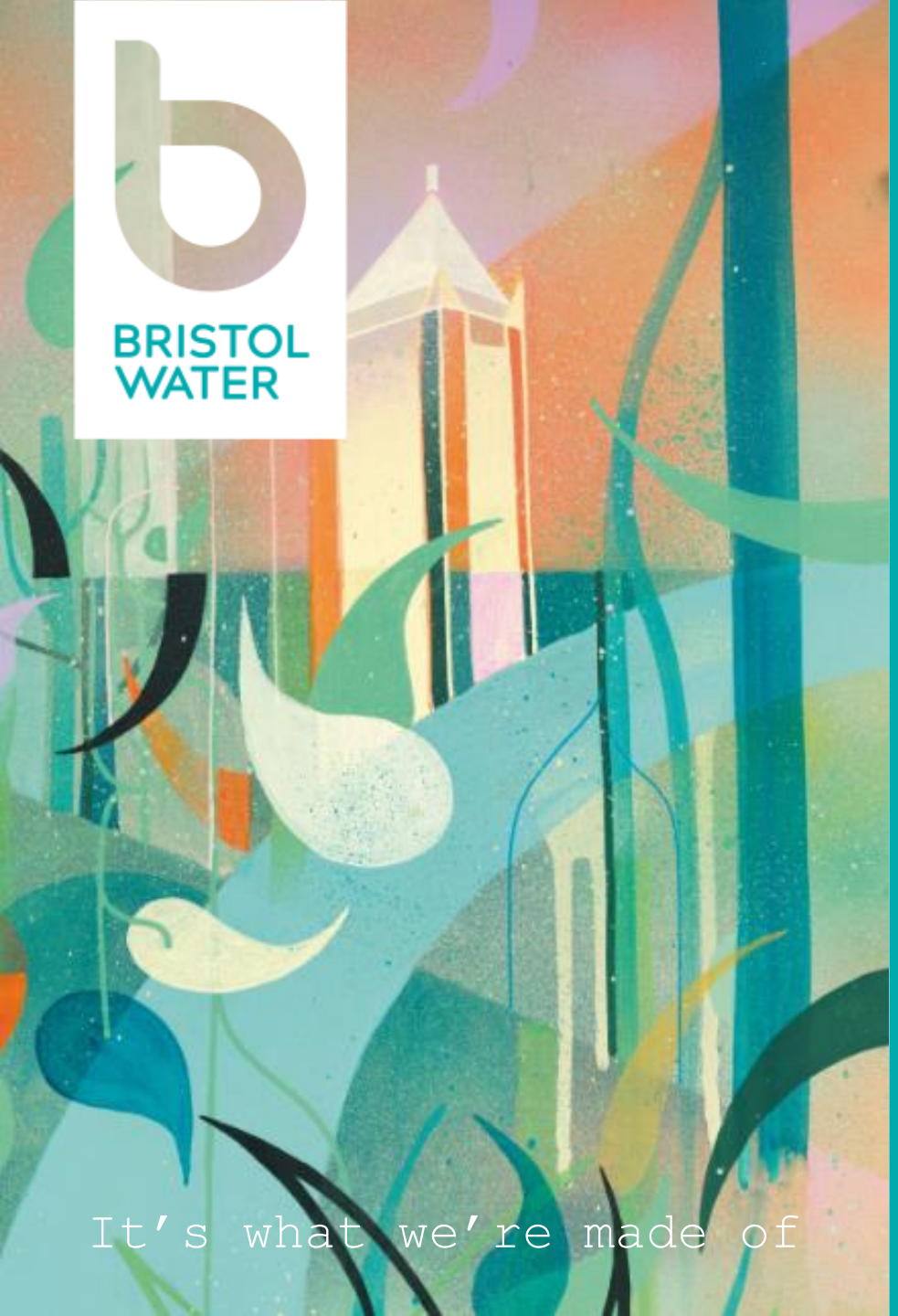


Challenges of Drinking Water Security in the West of England

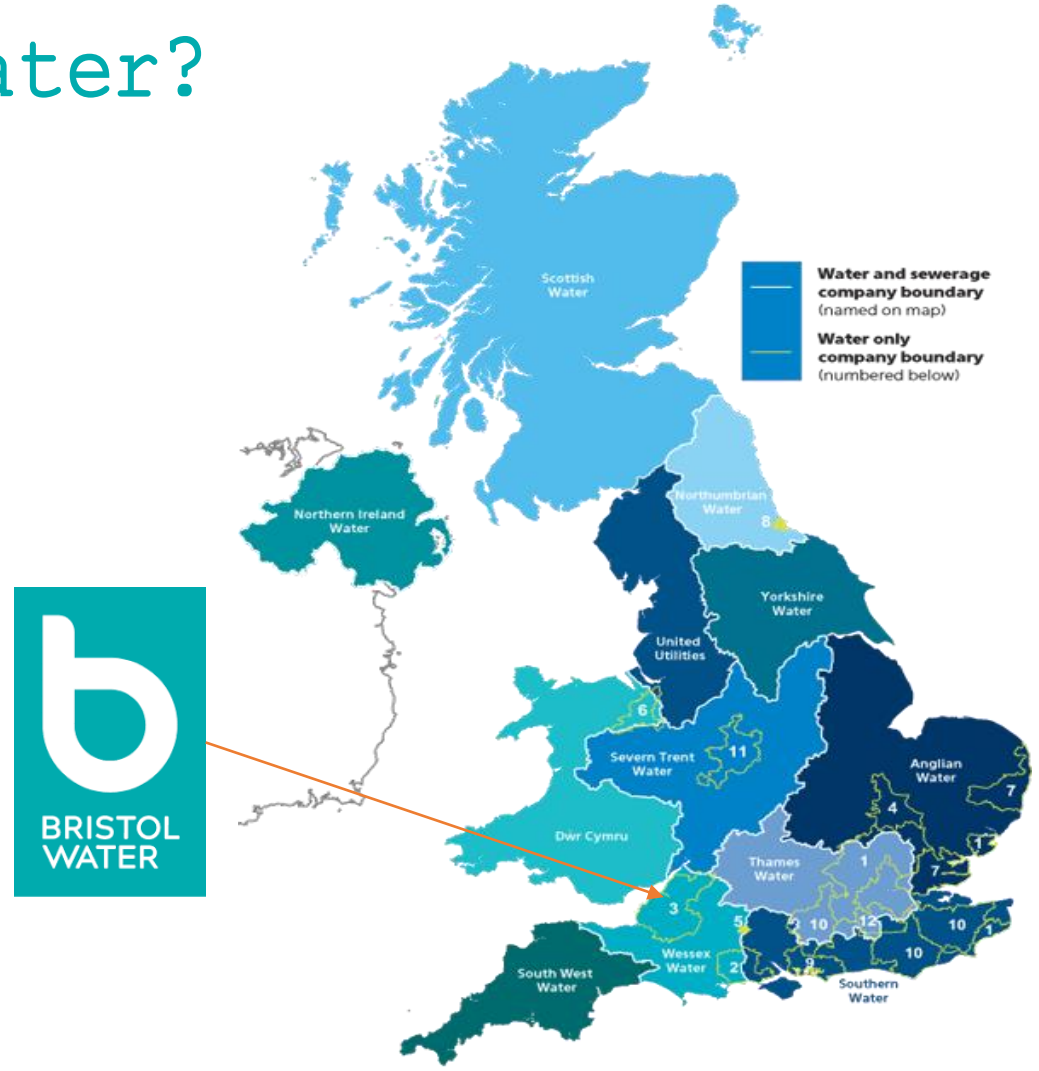
UWE Bristol | University of the West of England

BRISTOL WATER

A Model Drinking Water Treatment Train

- Raw water sources
- Water Intake
- Water Treatment
- Water into Distribution

Where is Bristol Water?



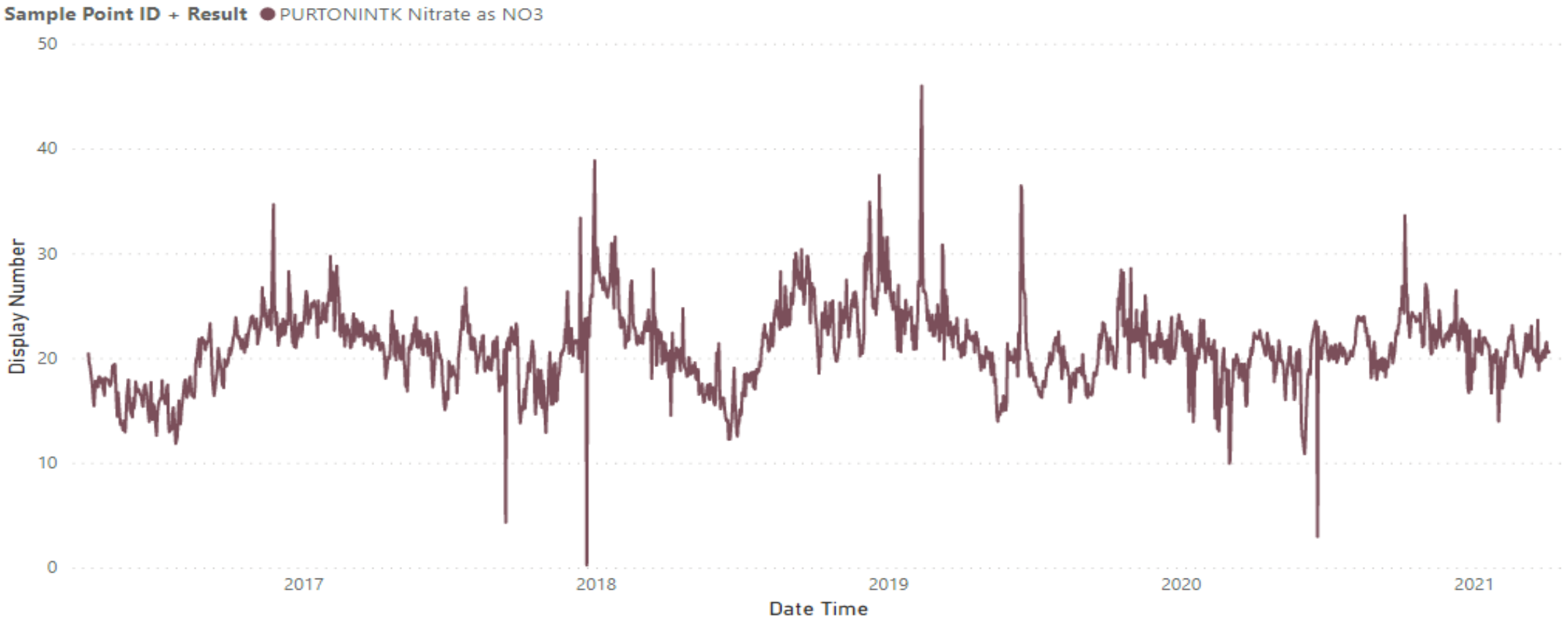
A Model Drinking Water Treatment Train

Gloucester and Sharpness Canal
Gloucester and Sharpness Canal
Gloucester and Sharpness Canal

1. Blending
2. Raw water chlorine
3. pH correction- acid
4. Pre Ozonation
5. Coagulation
6. Flocculation
7. Settlement
8. Filtration
9. Post Ozonation
10. Activated carbon adsorption
11. UV irradiation
12. pH correction- caustic
13. Chlorination
14. Phosphoric acid
Purton TW

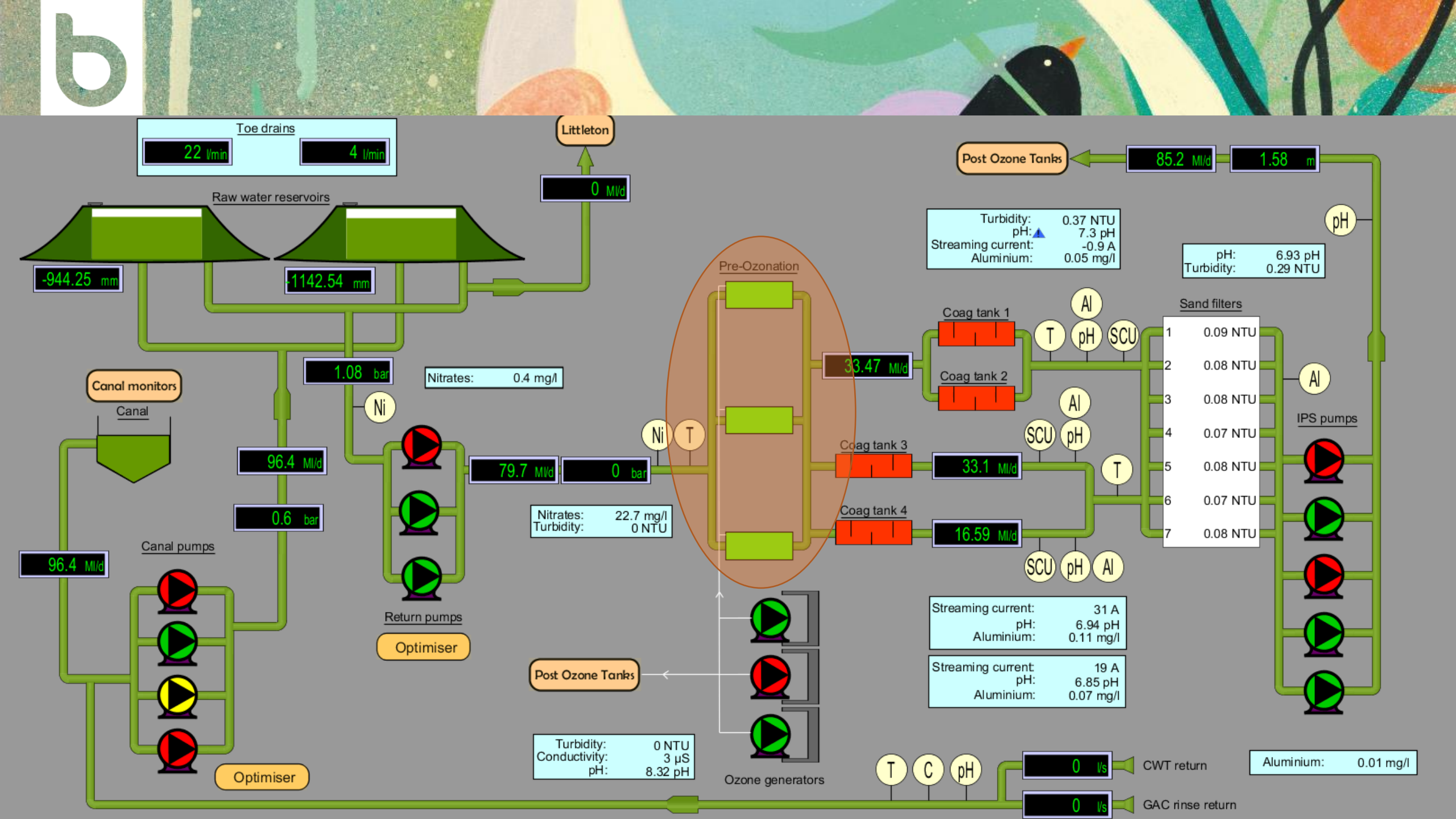
Raw Water Tanks and Blending

Raw Water Nitrate



Pre-ozone

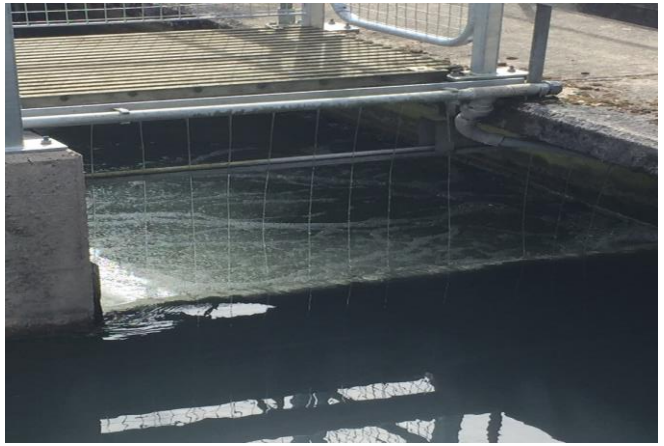
- Acid (pH control)
- Ozone generation
- Ozone diffusion
- Ozone destruction


Toe drains
22 l/min
4 l/min
Littleton
0 Ml/d
Raw water reservoirs
-944.25 mm
-1142.54 mm
1.08 bar
Nitrates: 0.4 mg/l
Ni
Canal monitors
Canal
96.4 Ml/d
0.6 bar
96.4 Ml/d
Canal pumps
Optimiser
Return pumps
Optimiser
79.7 Ml/d
0 bar
Nitrates: 22.7 mg/l
Turbidity: 0 NTU
Ni
T
Pre-Ozonation
Post Ozone Tanks
Turbidity: 0 NTU
Conductivity: 3 µS
pH: 8.32 pH
Ozone generators
33.47 Ml/d
Coag tank 1
Coag tank 2
Coag tank 3
Coag tank 4
33.1 Ml/d
16.59 Ml/d
T
Al
pH
SCU
Turbidity: 0.37 NTU
pH: 7.3 pH
Streaming current: -0.9 A
Aluminium: 0.05 mg/l
Streaming current: 31 A
pH: 6.94 pH
Aluminium: 0.11 mg/l
Streaming current: 19 A
pH: 6.85 pH
Aluminium: 0.07 mg/l
Sand filters
1 0.09 NTU
2 0.08 NTU
3 0.08 NTU
4 0.07 NTU
5 0.08 NTU
6 0.07 NTU
7 0.08 NTU
IPS pumps
pH: 6.93 pH
Turbidity: 0.29 NTU
Post Ozone Tanks
85.2 Ml/d
1.58 m
pH
Aluminium: 0.01 mg/l
T
C
pH
0 l/s
CWT return
0 l/s
GAC rinse return

Ozonation

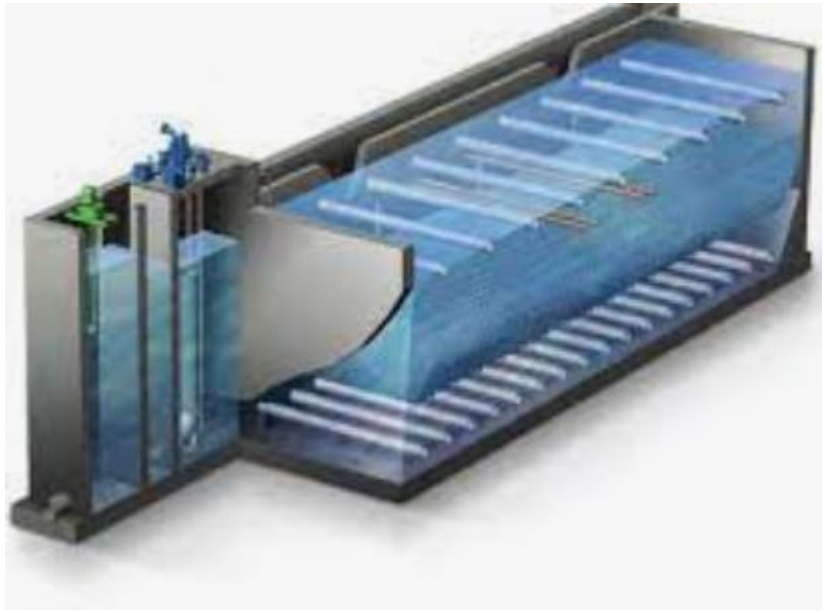
BRISTOL WATER

Coagulation and Flocculation



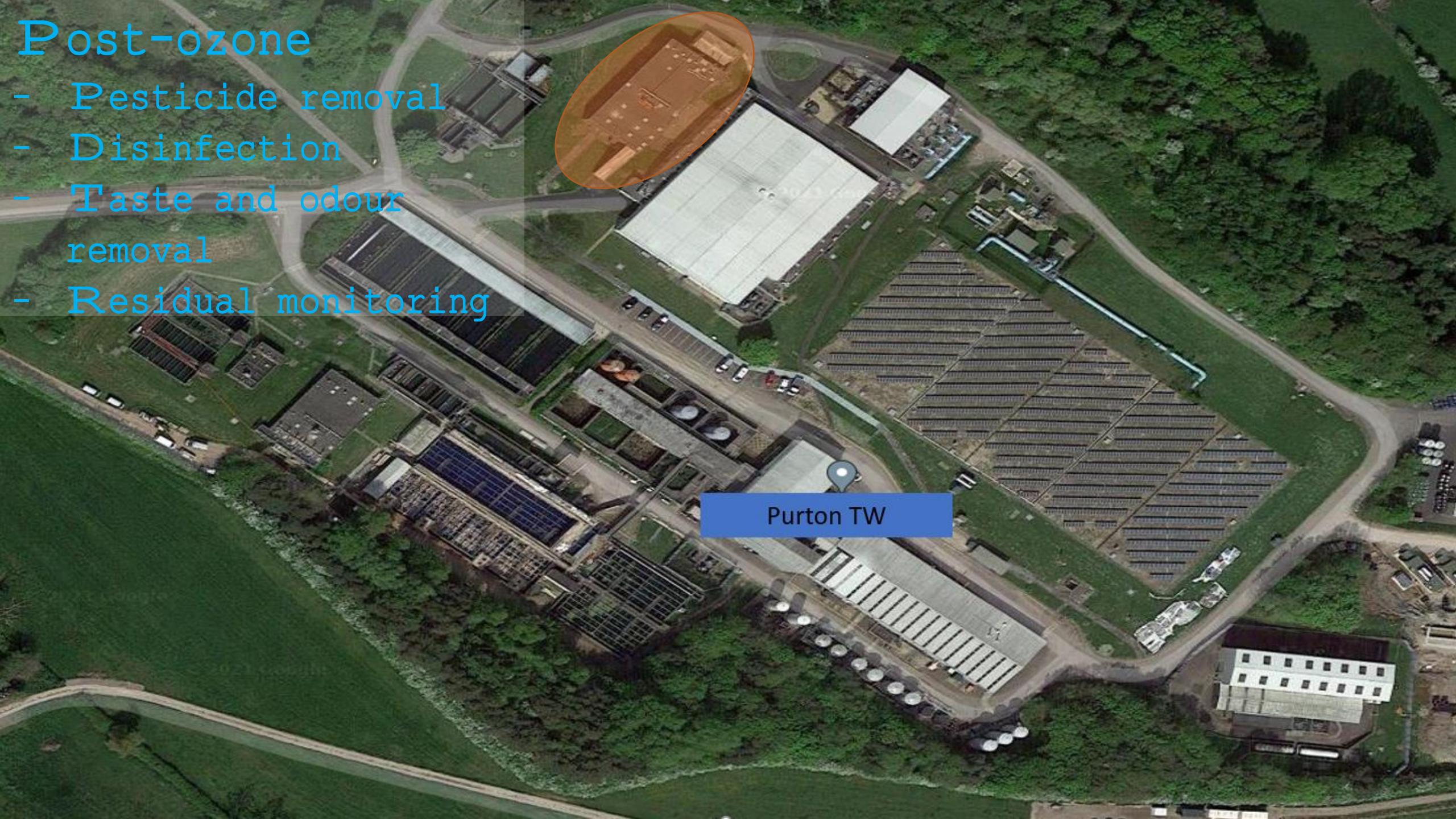
Clarification by settlement: Hopper-bottomed Clarifiers (x12)

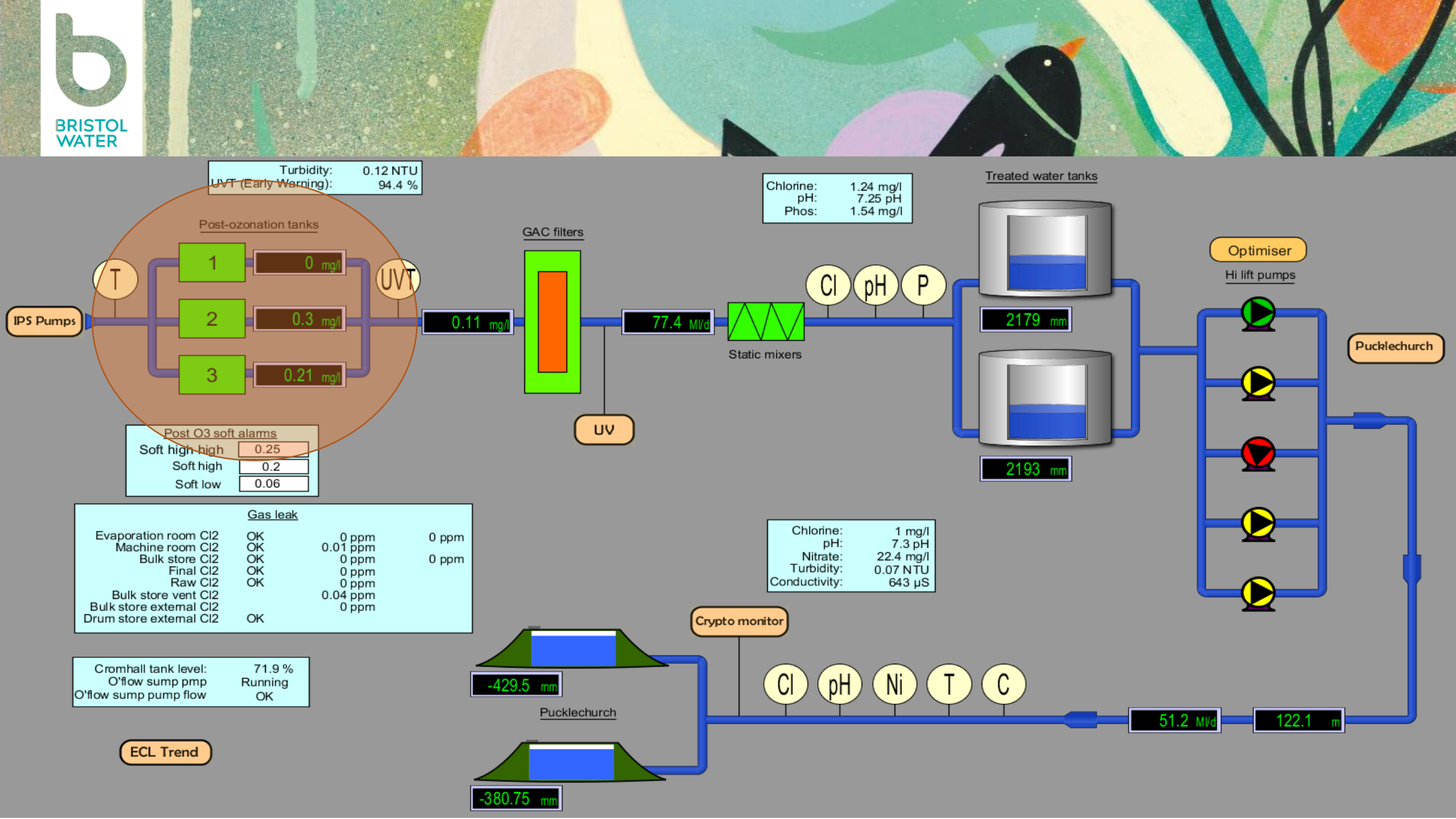
Clarification by settlement: Super-pulsators (x2)



Post-ozone

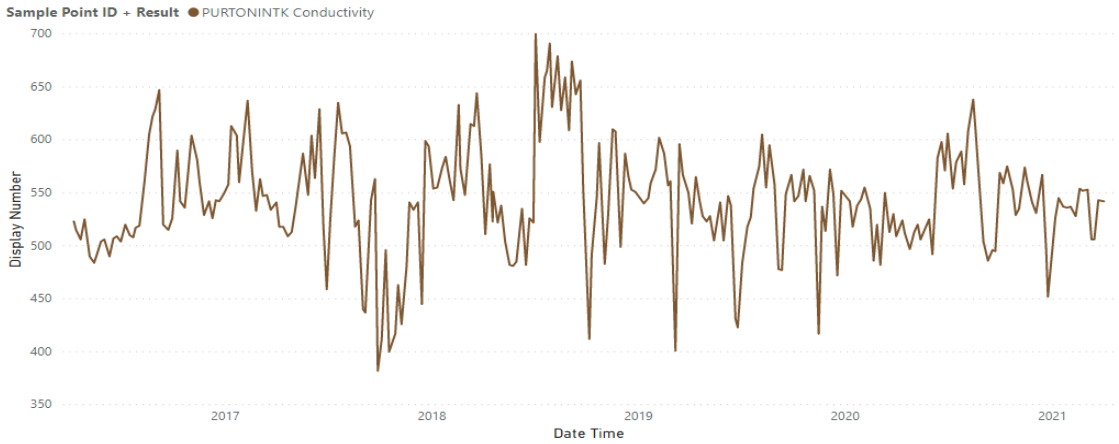
- Pesticide removal
- Disinfection
- Taste and odour removal
- Residual monitoring

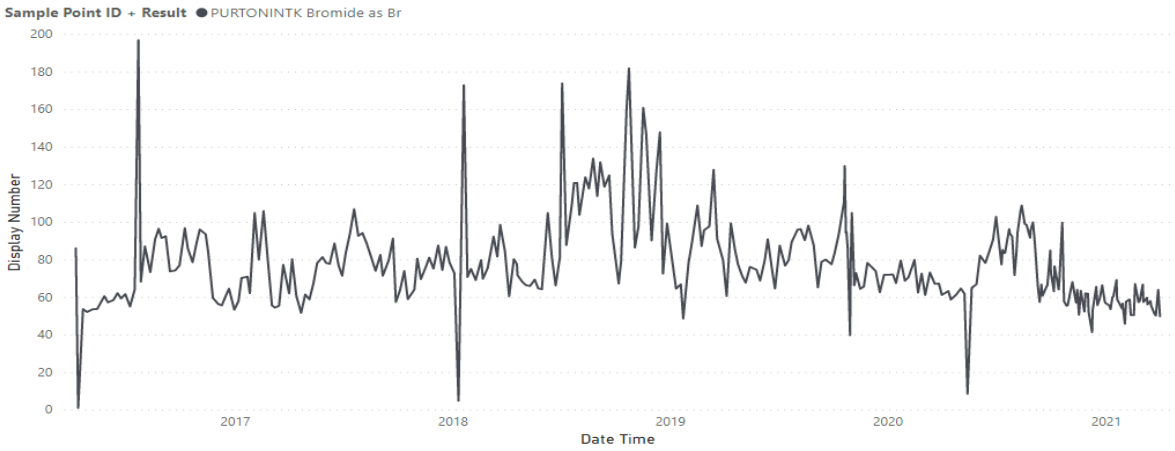


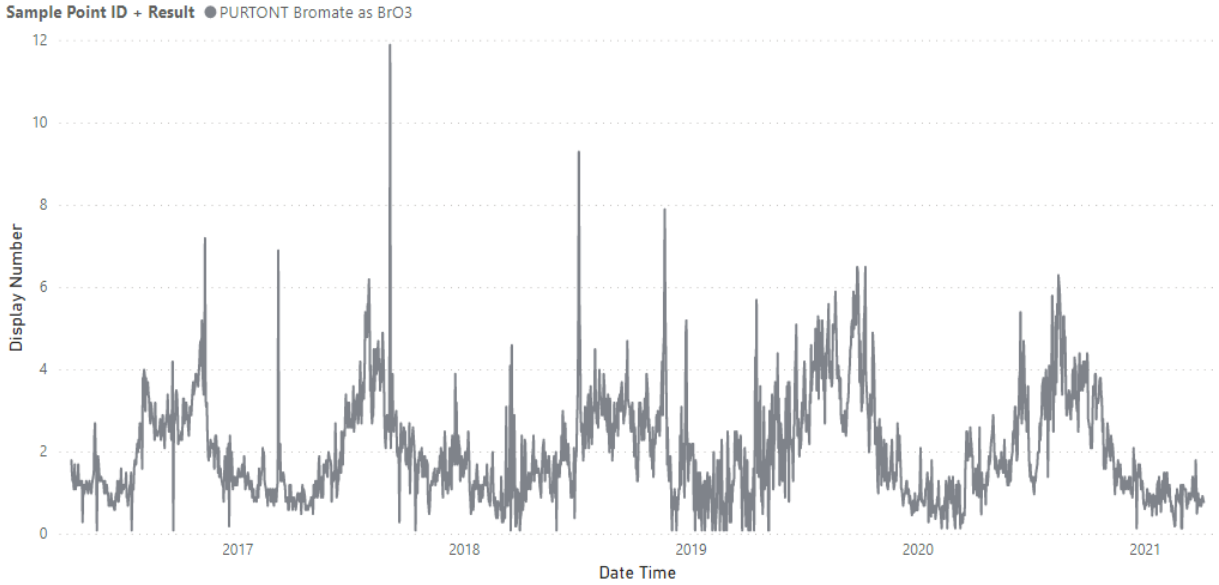

BRISTOL WATER
Turbidity: 0.12 NTU
UVT (Early Warning): 94.4 %
Post-ozonation tanks
T
UVT
1
2
3
0 mg/l
0.3 mg/l
0.21 mg/l
IPS Pumps
0.11 mg/l
GAC filters
UV
77.4 Ml/d
Static mixers
Cl
pH
P
Chlorine: 1.24 mg/l
pH: 7.25 pH
Phos: 1.54 mg/l
Treated water tanks
2179 mm
2193 mm
Optimiser
Hi lift pumps
Pucklechurch
Post O3 soft alarms
Soft high high 0.25
Soft high 0.2
Soft low 0.06
Gas leak
Evaporation room Cl2 OK 0 ppm 0 ppm
Machine room Cl2 OK 0.01 ppm
Bulk store Cl2 OK 0 ppm 0 ppm
Final Cl2 OK 0 ppm
Raw Cl2 OK 0 ppm
Bulk store vent Cl2 0.04 ppm
Bulk store external Cl2 0 ppm
Drum store external Cl2 OK
Chlorine: 1 mg/l
pH: 7.3 pH
Nitrate: 22.4 mg/l
Turbidity: 0.07 NTU
Conductivity: 643 µS
Crypto monitor
Cromhall tank level: 71.9 %
O'flow sump pmp Running
O'flow sump pump flow OK
-429.5 mm
Pucklechurch
-380.75 mm
Cl
pH
Ni
T
C
51.2 Ml/d
122.1 m
ECL Trend

Post Ozone

Bromate formation







BRISTOL WATER

Turbidity: 0.12 NTU
UVT (Early Warning): 94.4 %

Post-ozonation tanks

T

IPS Pumps

1 — 0 mg/l
2 — 0.3 mg/l
3 — 0.21 mg/l

UVT

GAC filters

0.11 mg/l

UV

77.4 MVd

Static mixers

Cl pH P

Chlorine: 1.24 mg/l
pH: 7.25 pH
Phos: 1.54 mg/l

Treated water tanks

2179 mm

2193 mm

Optimiser

Hi lift pumps

Pucklechurch

Post O3 soft alarms

Soft high high	0.25
Soft high	0.2
Soft low	0.06

Gas leak

Evaporation room Cl2	OK	0 ppm	0 ppm
Machine room Cl2	OK	0.01 ppm	
Bulk store Cl2	OK	0 ppm	0 ppm
Final Cl2	OK	0 ppm	
Raw Cl2	OK	0 ppm	
Bulk store vent Cl2		0.04 ppm	
Bulk store external Cl2		0 ppm	
Drum store external Cl2	OK		

Chlorine: 1 mg/l
pH: 7.3 pH
Nitrate: 22.4 mg/l
Turbidity: 0.07 NTU
Conductivity: 643 µS

Crypto monitor

Cl pH Ni T C

51.2 MVd

122.1 m

Cromhall tank level: 71.9 %
O'flow sump pmp Running
O'flow sump pump flow OK

-429.5 mm

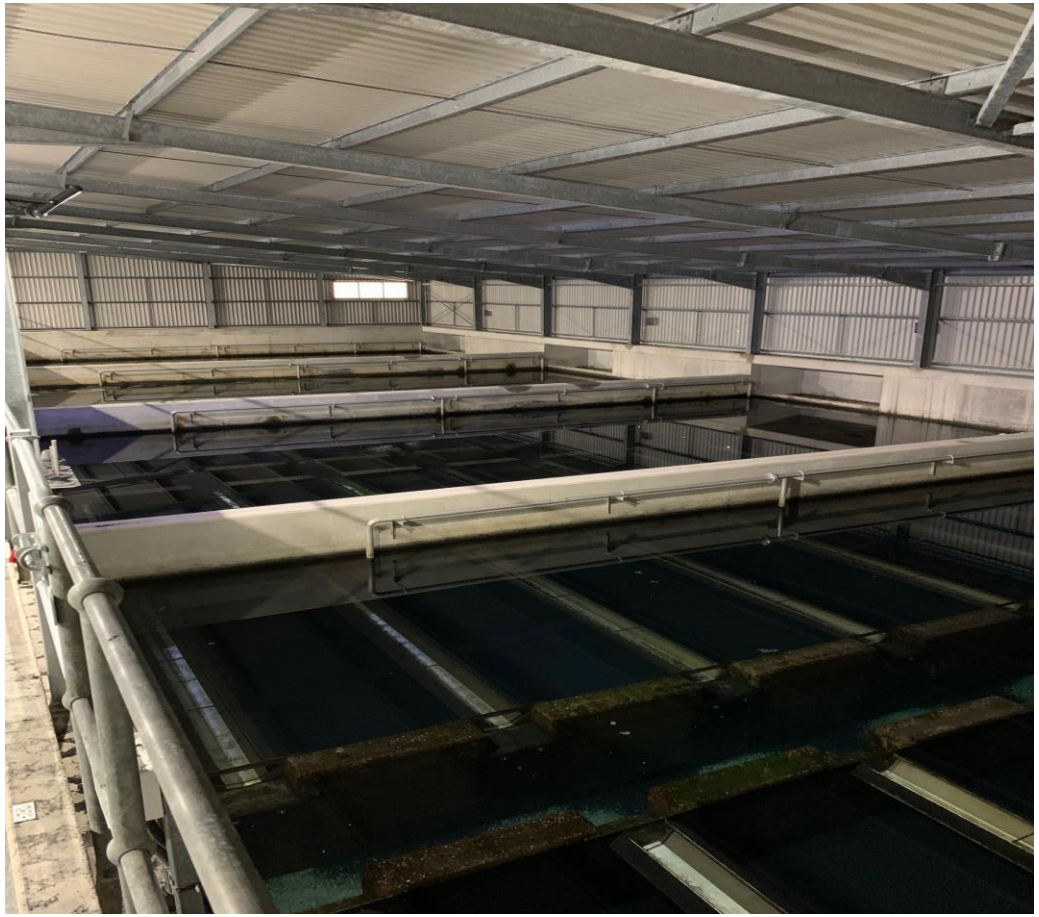
Pucklechurch

-380.75 mm

ECL Trend

BRISTOL WATER

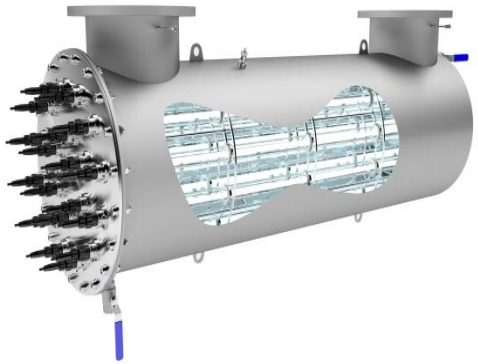
Granular Activated Carbon (GAC) Filtration



UV irradiation

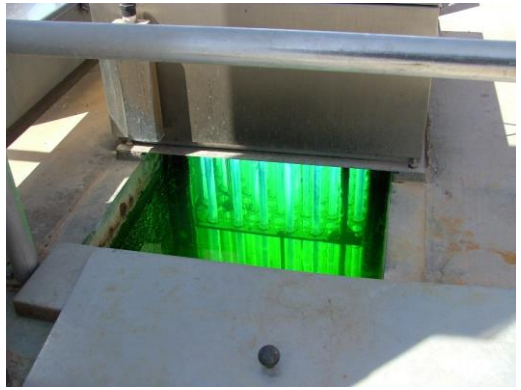
- Three reactors
- Cryptosporidium inactivation
- Disinfection

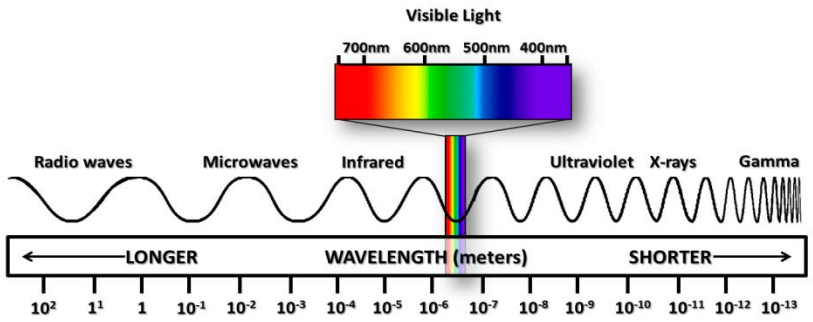
Ultraviolet irradiation

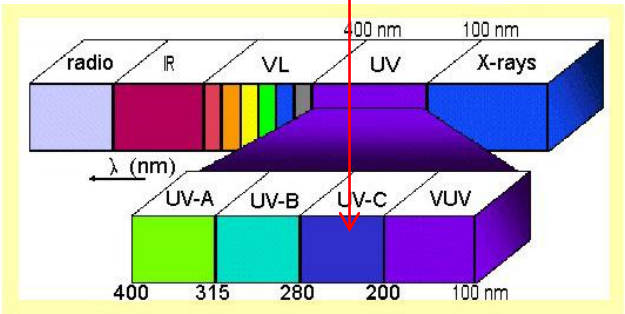


Inactivates crypto at 40mJ/cm^2

UV-C rays







Cryptosporidium

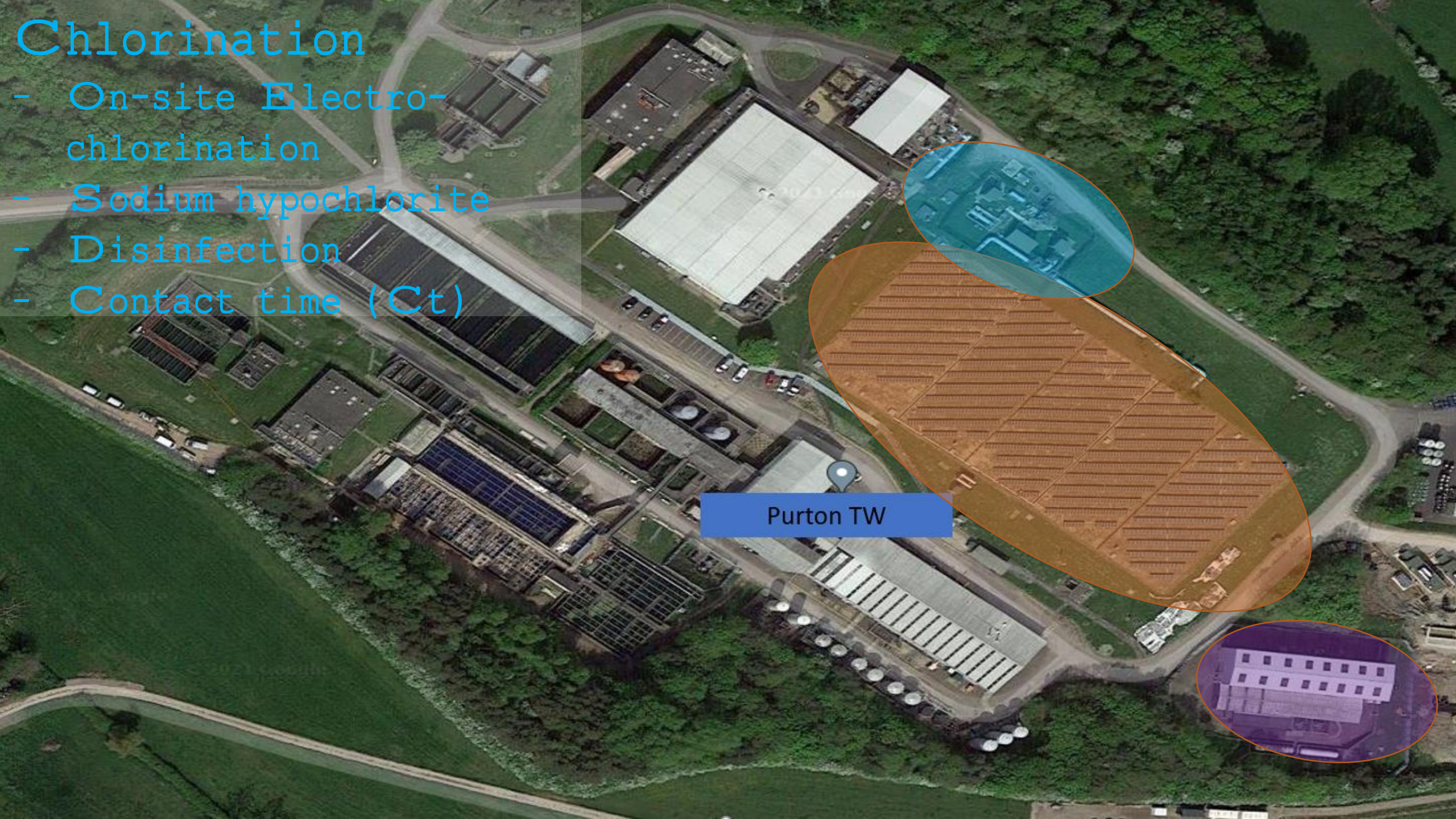
Nemesis of the water industry!

6 – 8 µm (micron) in diameter = 0.006 to 0.008 mm

Resistant to chlorine

Chlorination

- On-site Electro-chlorination
- Sodium hypochlorite
- Disinfection
- Contact time (Ct)



Chlorination and Pumping

Compliance

Compliance with water quality standards

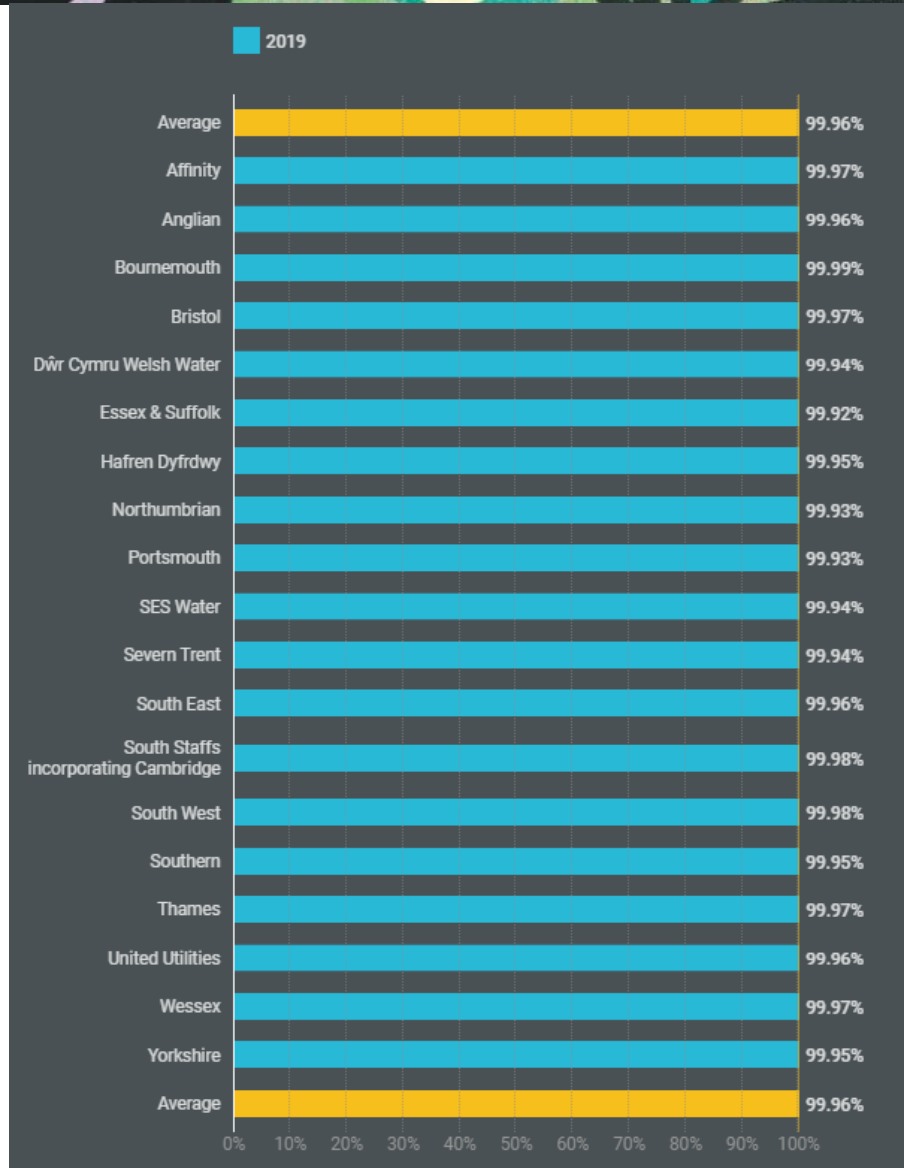
Also Known As:

Mean zonal compliance (MZC)

Actual:	99.97%
Target:	100%

Definition

Drinking water must meet strict standards that ensure it is safe to drink and the quality is acceptable to consumers. This is a water quality compliance measure based on a series of 35 parameters (e.g. levels of lead, nitrate levels etc.) determined by the Drinking Water Inspectorate. It is calculated based on sampling each parameter at supply points and customer taps in a number of specified zones.



End