



# Innovative Suspended Ion Exchange, In-Line Coagulation And Ceramic Microfiltration Process for Disinfection By-Product Removal

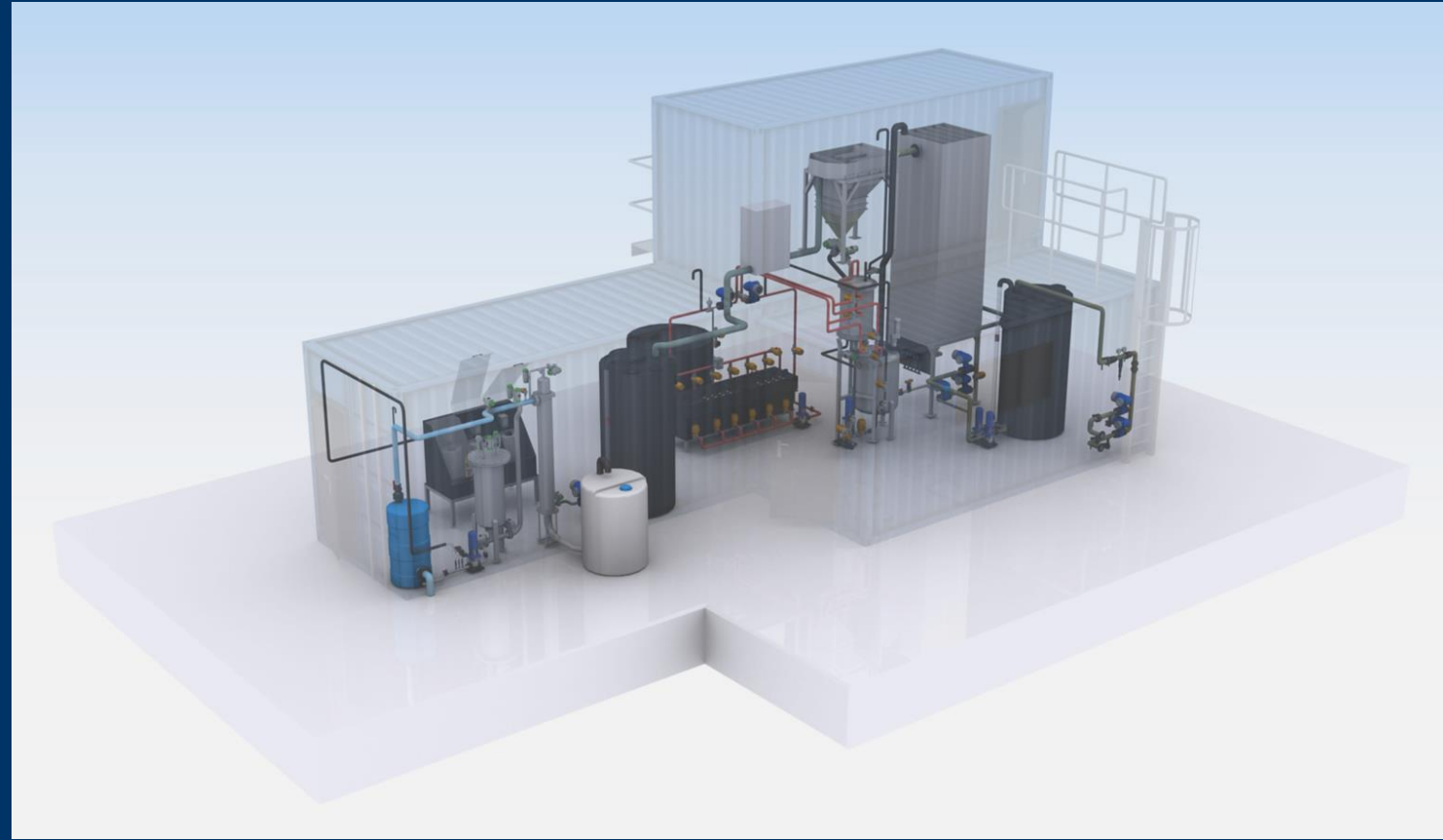
David Metcalfe, South West Water

21<sup>st</sup> September 2016

DOC2C's Project Workshop

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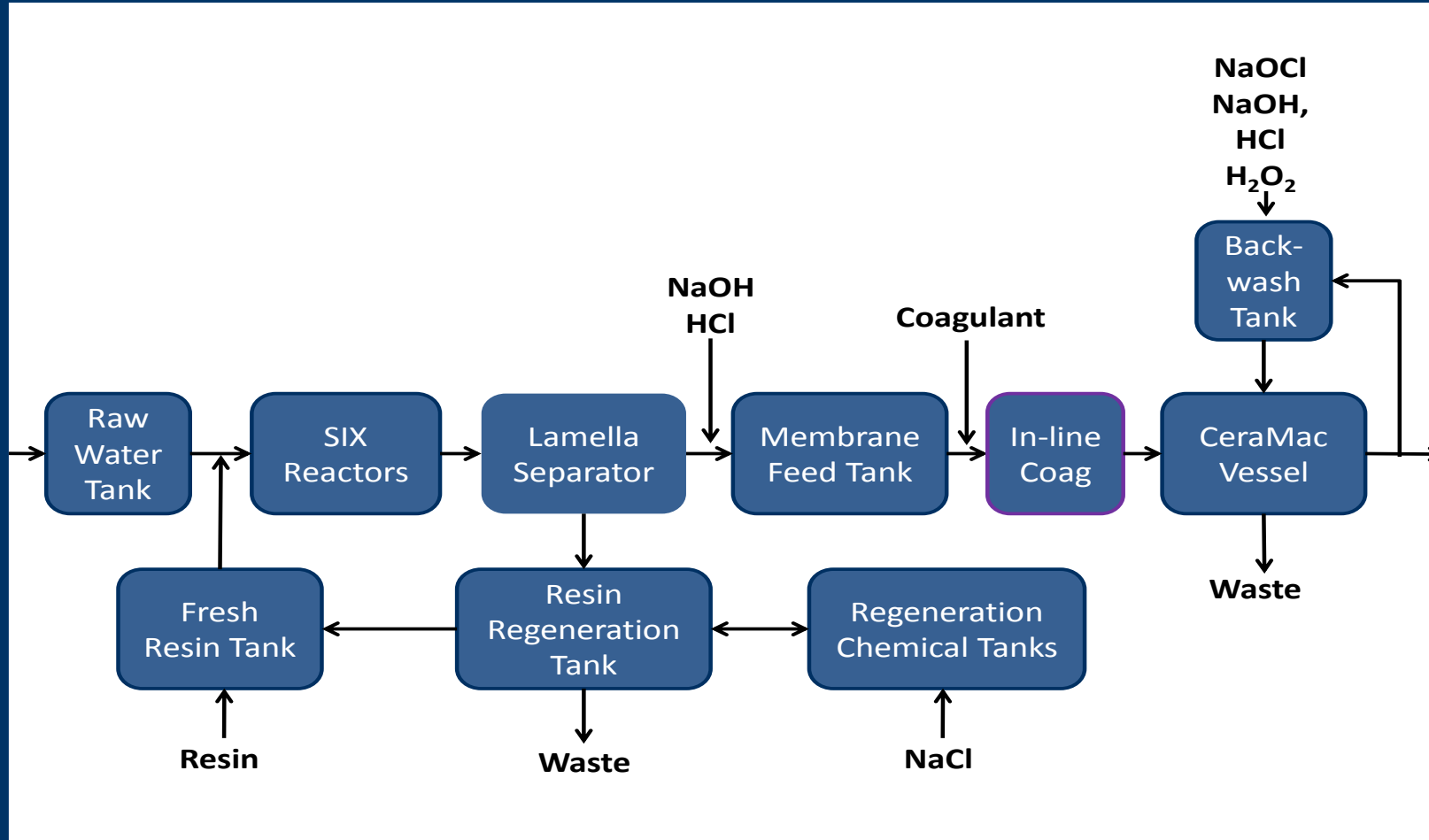
- **SIX / ILCA / CeraMac testing**
- **Organic fraction removal**
- **DBP formation potential**
- **College WTW Pilot Summary**



# SIX / ILCA / CeraMac possible advantages for SWW

- Replacement of Crownhill required
- Innovative Technology Identified
- Absolute Barrier to Cryptosporidium
- Organics / Disinfection by product reductions
- Very compact design
- Highly automatable
- Robust and efficient process
- Cost

# Pilot process schematic

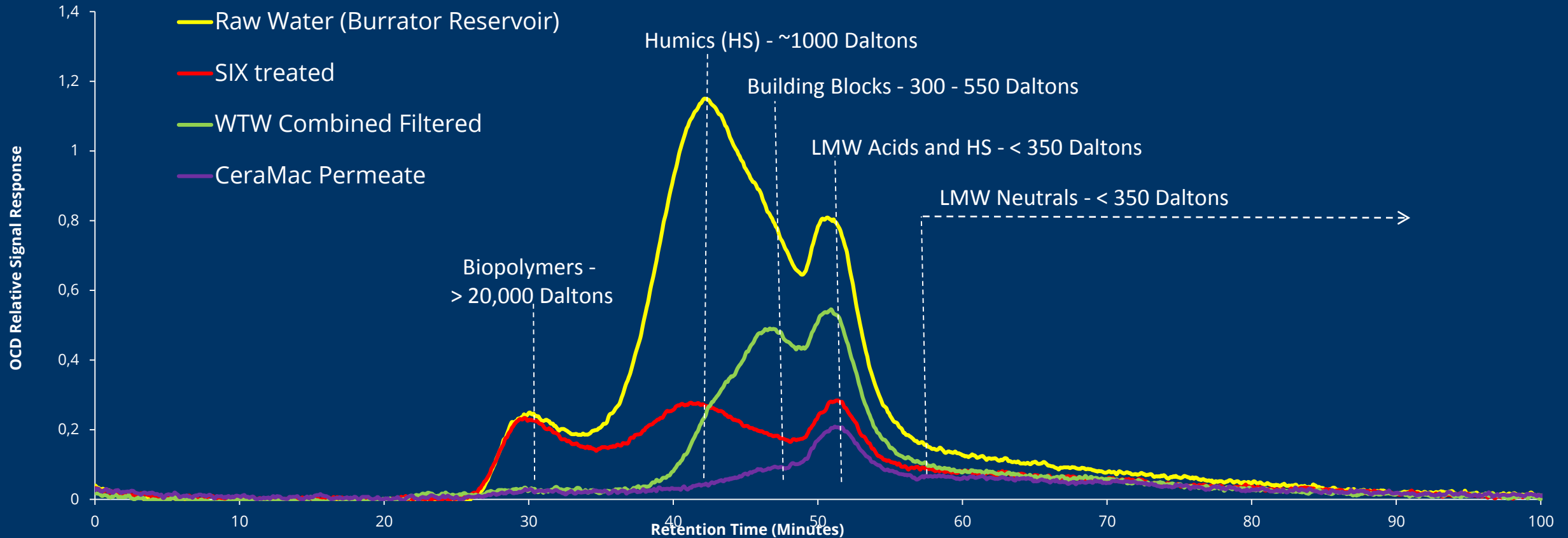


# DBP formation potential (DBPFP) testing

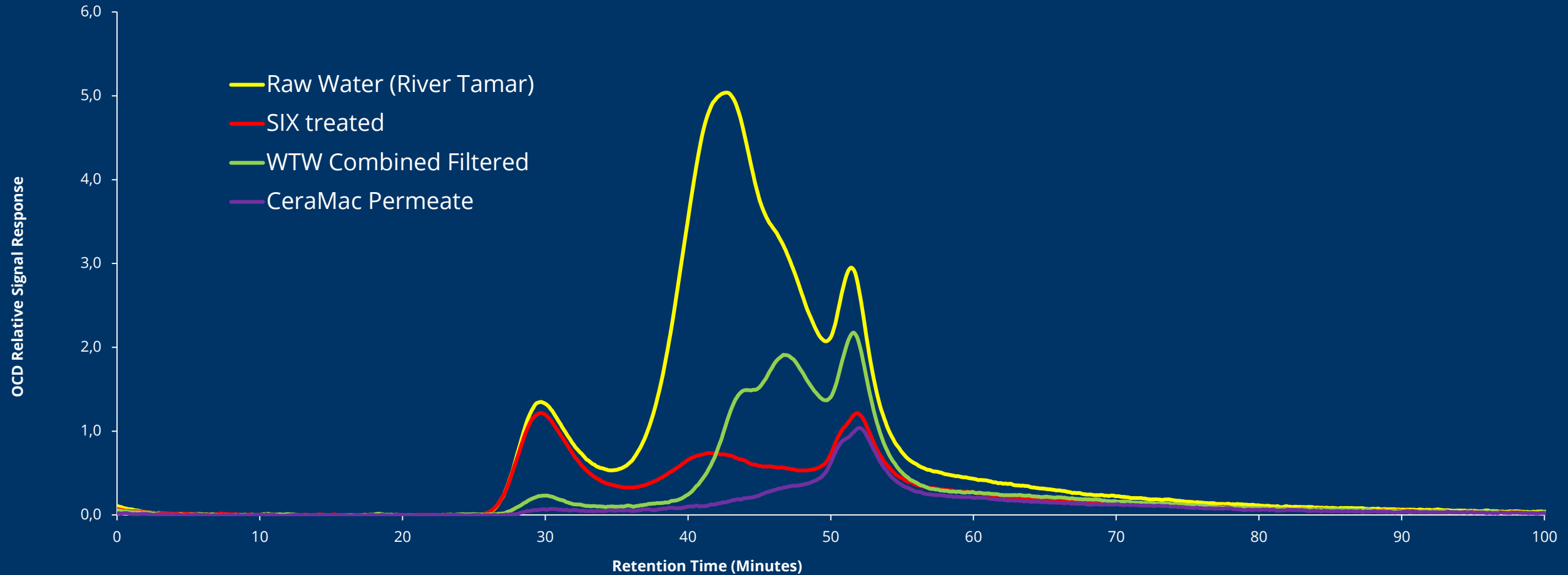
- DBPFP – 3-5mg/l Cl<sub>2</sub>, 7 days, pH 7, 20°C – drive by-product reactions to end point
- LC-OCD organic fraction analysis
- Sampling representative of:
  - SIX only (pilot)
  - SIX/ILCA (pilot)
  - Enhanced coagulation (full scale)



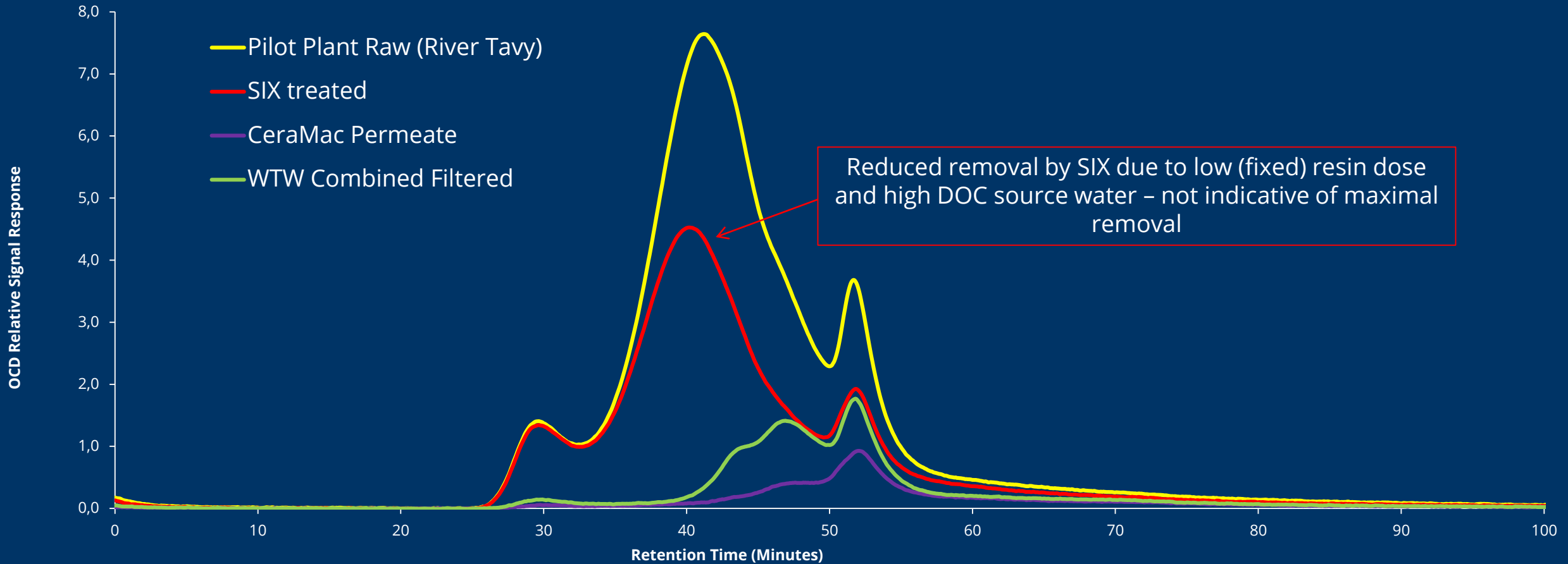
# Test 1. Low DOC upland reservoir organics removal



## Test 2. Moderate DOC lowland river organics removal

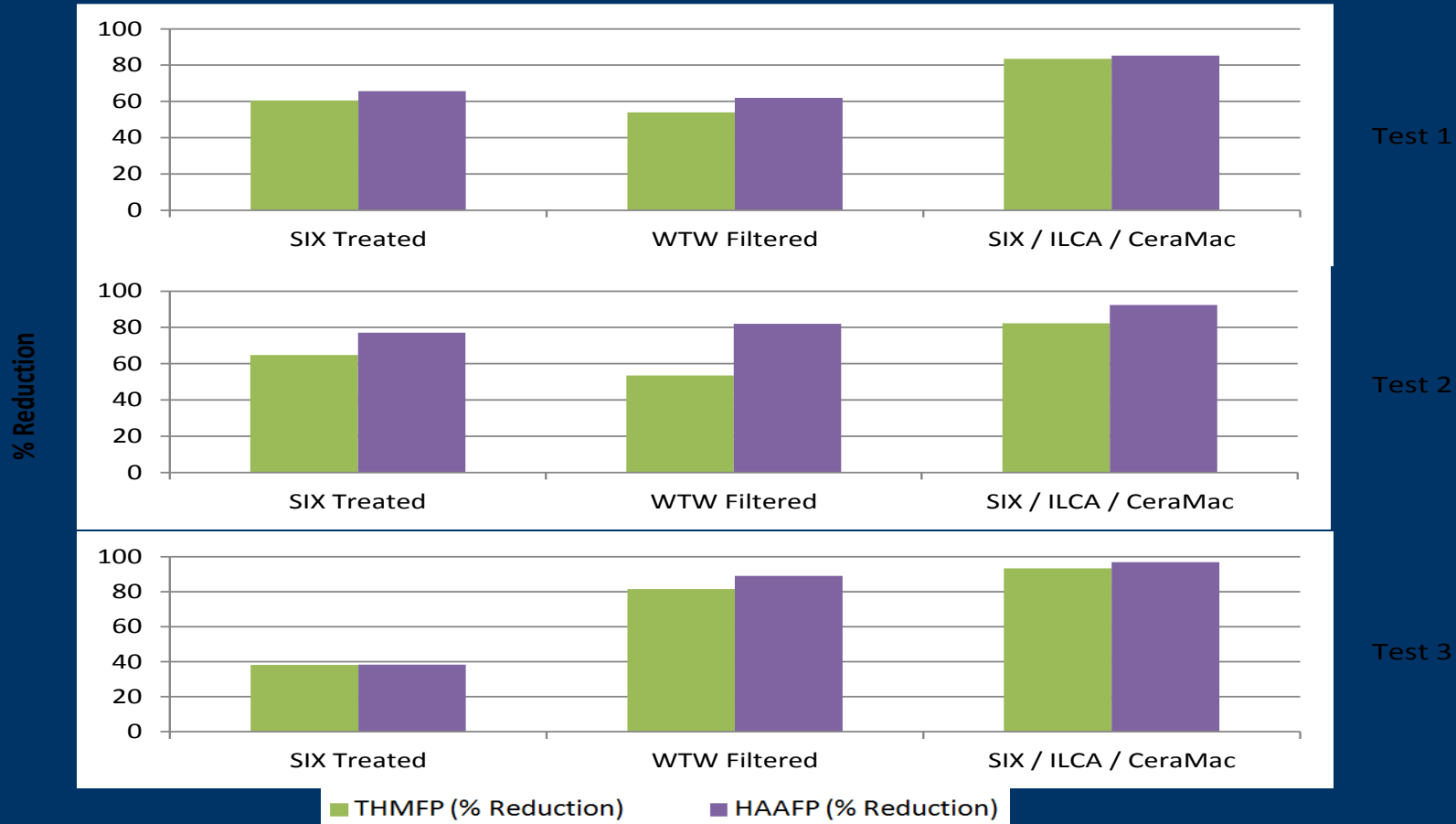


# Test 3. High DOC upland river organics removal

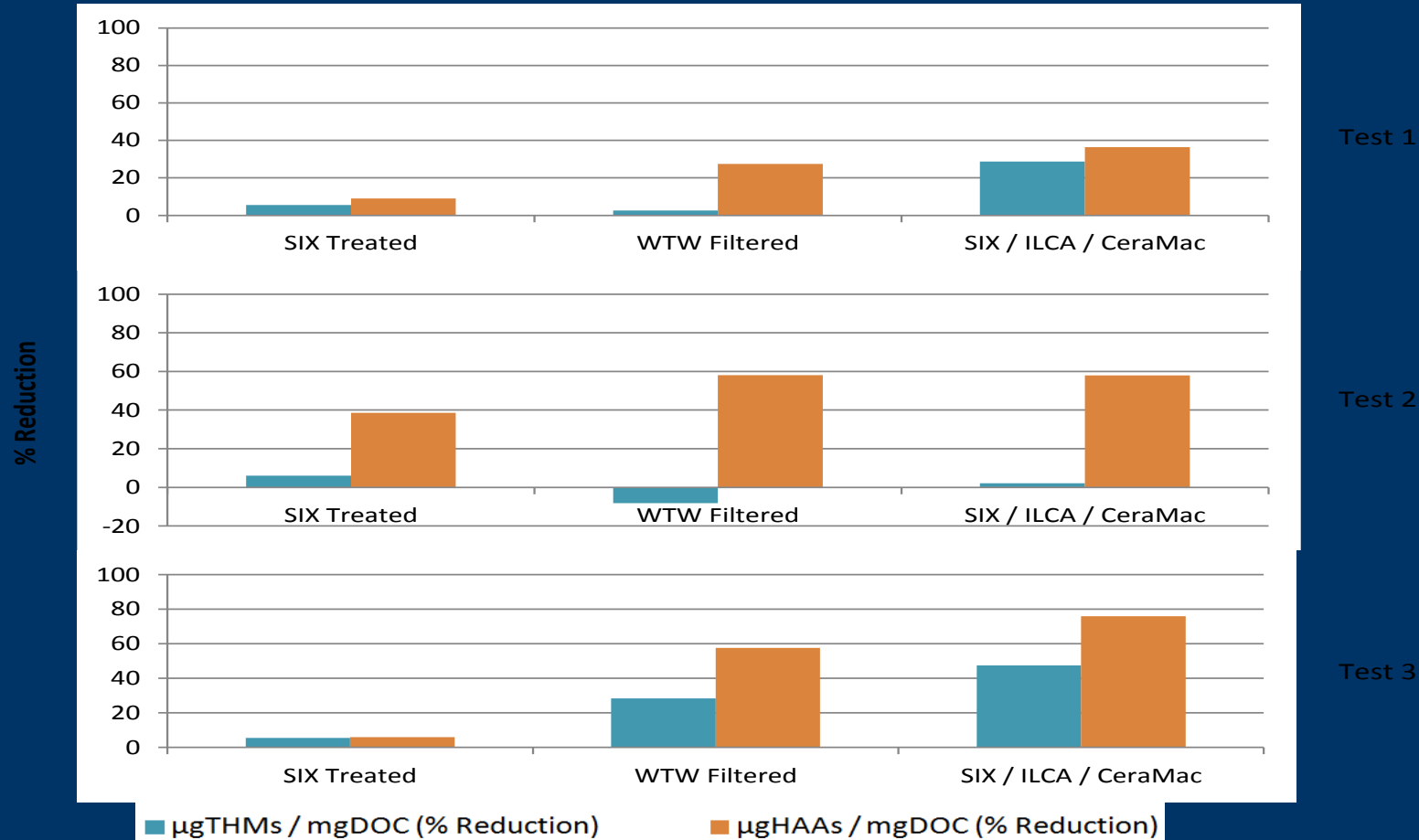




# THMFP and HAAFP reductions



# Specific reactivity $\mu\text{g-DBP}/\text{mgDOC}$ reduction



# Mean % removal SIX/ILCA vs. conventional

Parameter	SIX/ILCA/CeraMac additional removal relative to conventional treatment (%)
DOC (% Reduction)	50
UVA (% Reduction)	62
THMFP (% Reduction)	62
HAAFP (% Reduction)	62
THMFP Reactivity (% Reduction)	22
HAAFP Reactivity (% Reduction)	18
Brominated DBPFP (% Reduction)	47

DBPFP reduction was not only due to enhanced DOC removal, but also to reduced concentrations of Br-DBPs and selective removal of reactive organic compounds

# See more in *Water Research*...

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## Removal of disinfection by-product precursors by coagulation and an innovative suspended ion exchange process



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### ABSTRACT

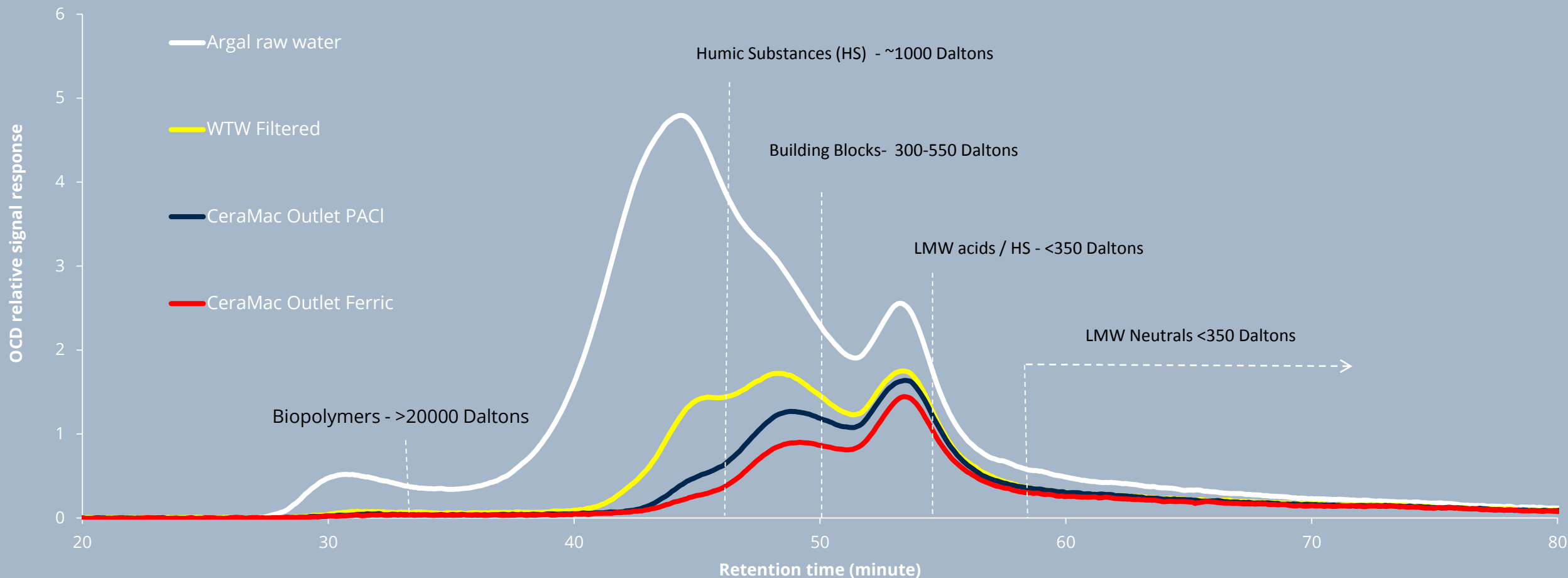
This investigation aimed to compare the disinfection by-product formation potentials (DBPFPs) of three UK surface waters (1 upland reservoir and 2 lowland rivers) with differing characteristics treated by (a) a full scale conventional process and (b) pilot scale processes using a novel suspended ion exchange (SIX) process and inline coagulation (ILCA) followed by ceramic membrane filtration (CMF). Liquid chromatography-organic carbon detection analysis highlighted clear differences between the organic fractions removed by coagulation and suspended ion exchange. Pretreatments which combined SIX and coagulation resulted in significant reductions in dissolved organic carbon (DOC), UV absorbance (UVA), trihalomethane and haloacetic acid formation potential (THMFP, HAAFP), in comparison with the SIX or coagulation process alone. Further experiments showed that in addition to greater overall DOC removal, the processes also reduced the concentration of brominated DBPs and selectively removed organic compounds with high DBPFP. The SIX/ILCA/CMF process resulted in additional removals of DOC, UVA, THMFP, HAAFP and brominated DBPs of 50, 62, 62, 62% and 47% respectively compared with conventional treatment.

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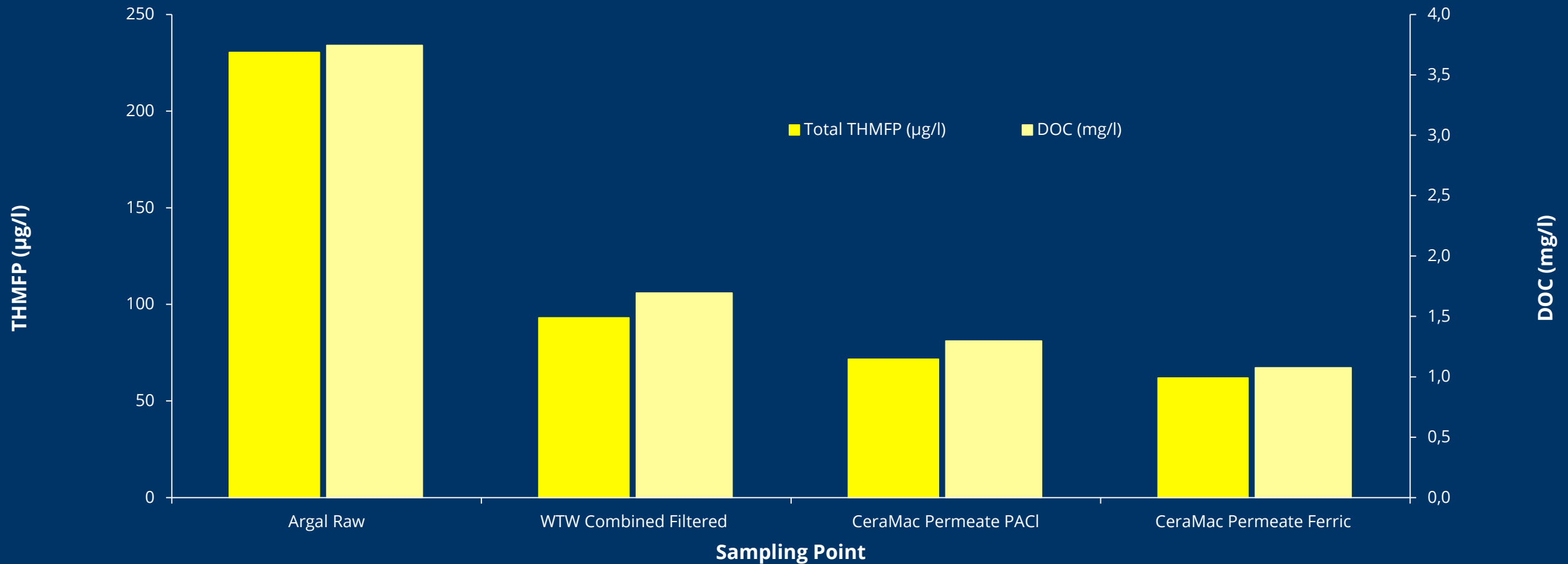
# College WTW Pilot Summary

- Operation at very high flux possible with typically low fouling
- Membrane performance not impeded during algal blooms..... Typically improves.....!
- ILCA / CeraMac (no SIX) better than conventional **PAC**-coagulation-DAF-RGF for DOC and DBPFP removal
- Potential to use ferric or PACl coagulants - Significantly enhanced DOC / DBP precursor removal with low pH ferric coagulation is possible.....
- Ozone cleaning for the membranes looks promising – fast acting, greater permeability recovery and much lower residuals required than for other organic cleaning chemicals e.g. Chlorine.
- Throughout 23 tests we have always been able to recover the membrane to “as new”. Even following a significant fouling event....

# LC-OCD conventional vs. membrane with PACl or Ferric Sulphate



# DOC / DBPFP - conventional vs. membrane with PACl or Ferric Sulphate



# Any Questions??

