

The impact of changing water quality on treatment of NOM laden water sources

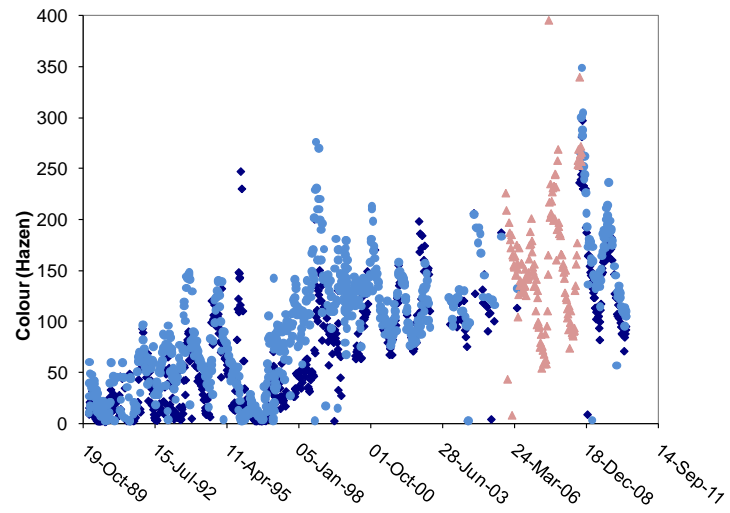
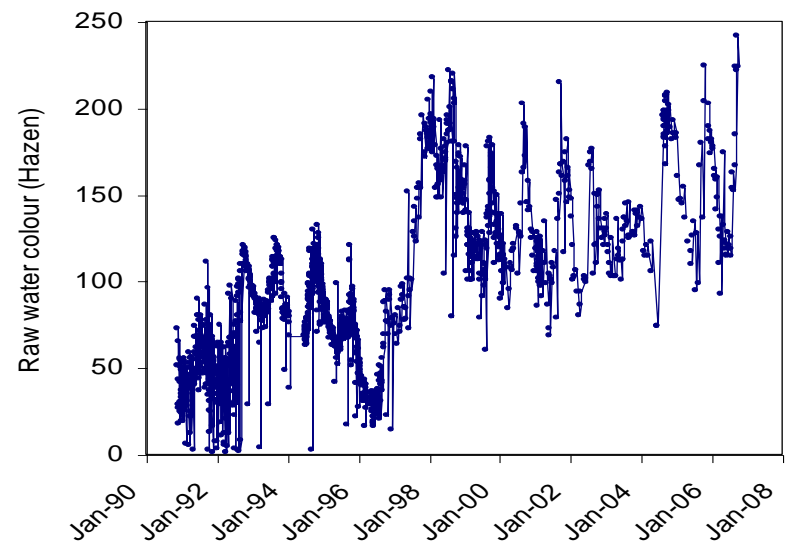
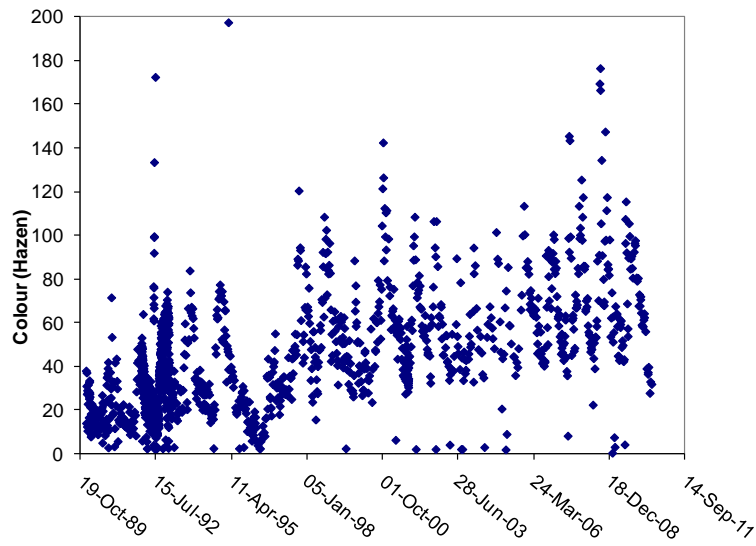


Peter Jarvis & Bruce Jefferson

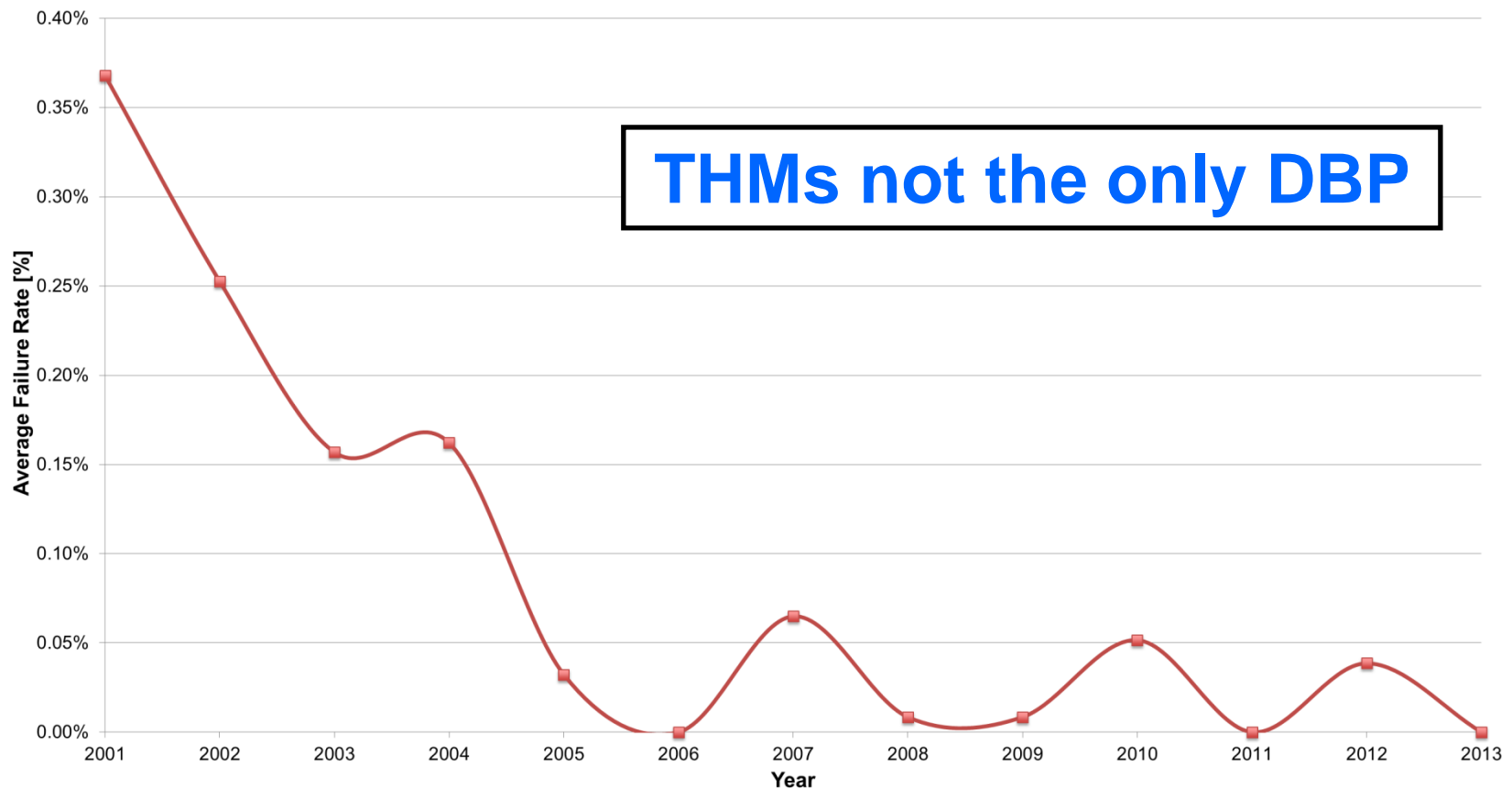
NOM load is increasing
and character is changing



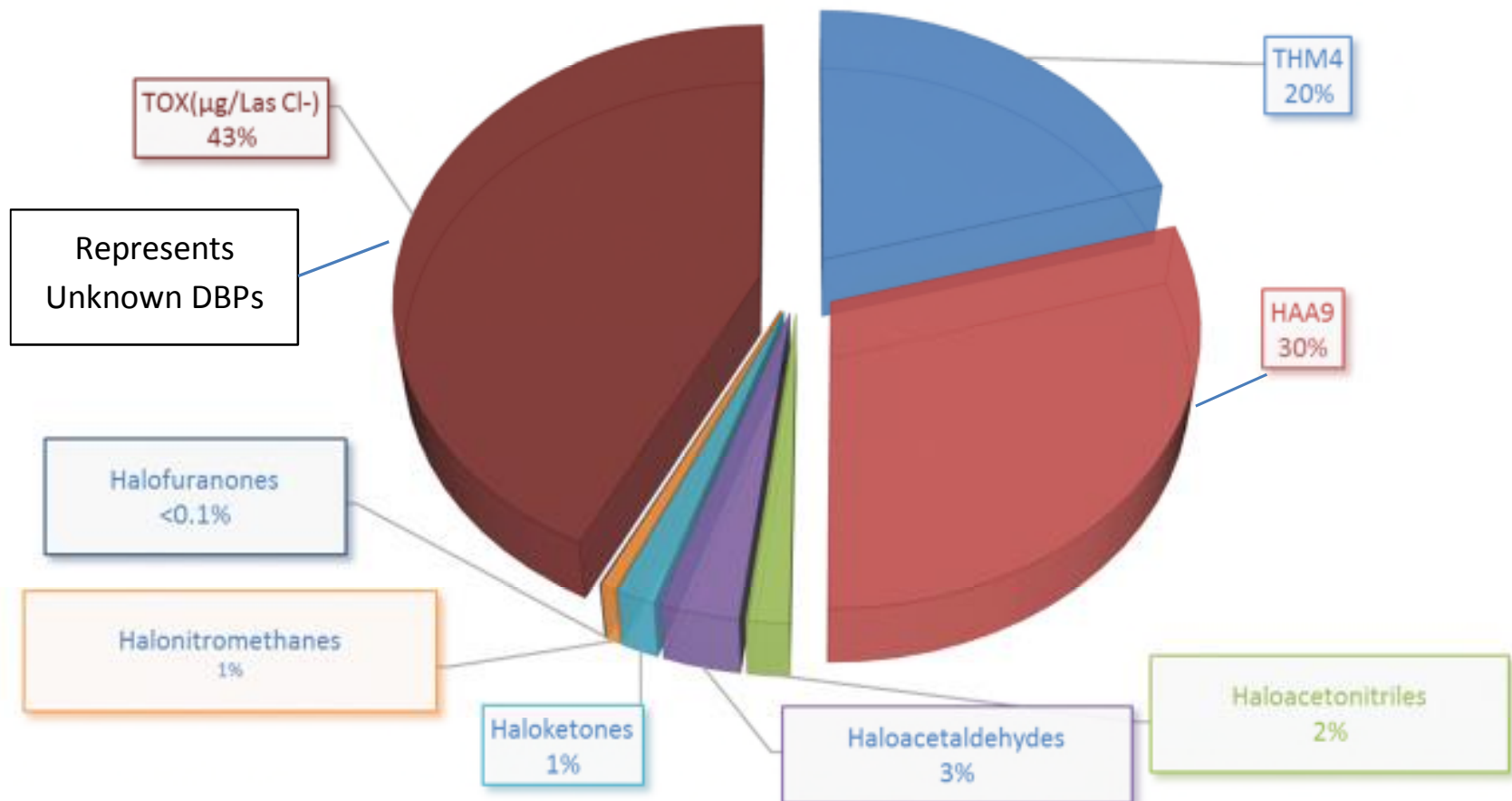
What impact has this had on water treatment?



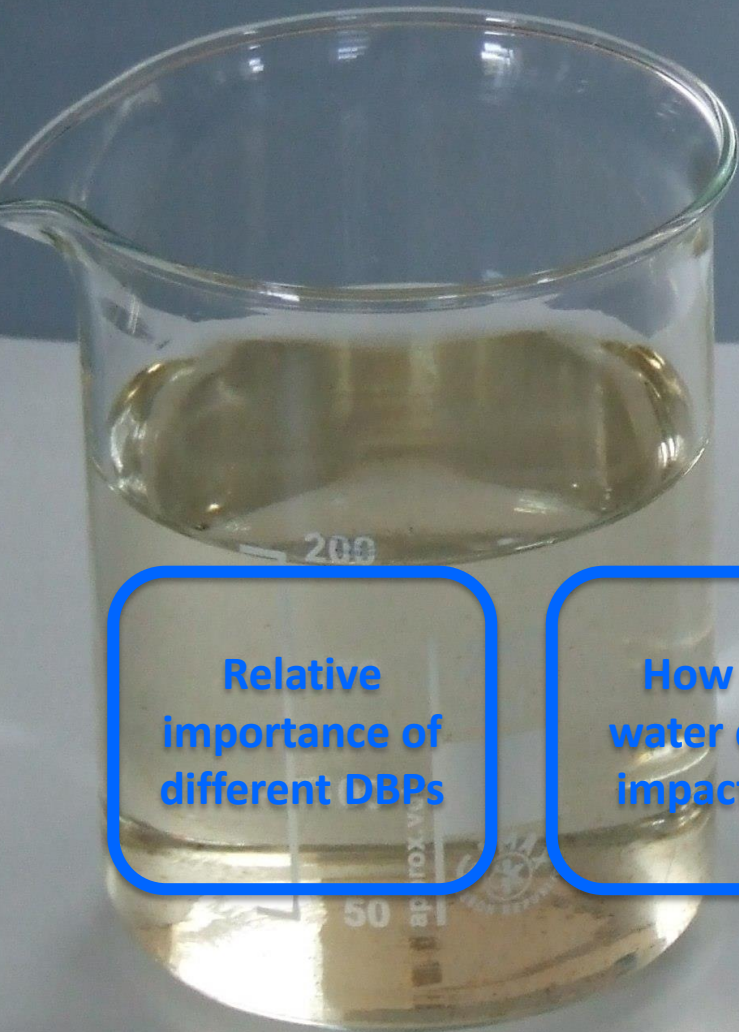
What impact has this had on water quality? THMs



What about the others

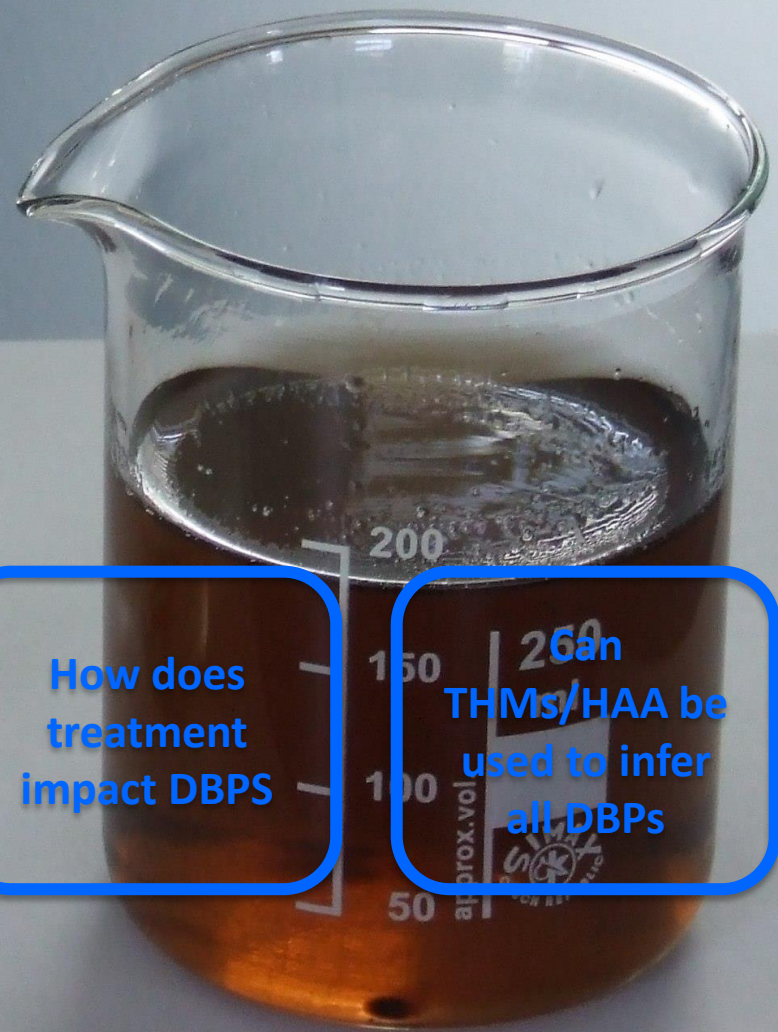


Now it is about risk assessments



Relative importance of different DBPs

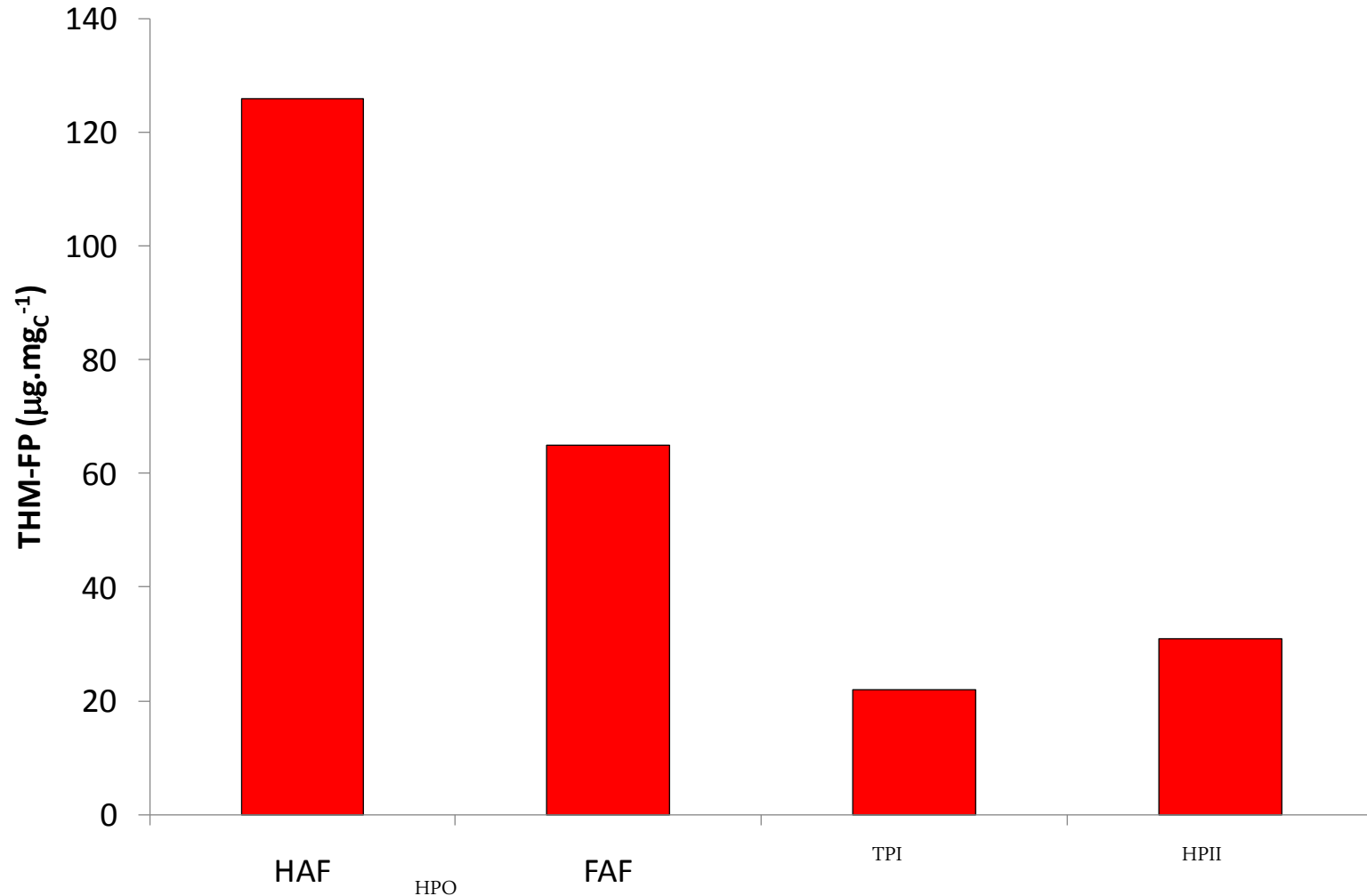
How does water quality impact DBPs



How does treatment impact DBPs

Can THMs/HAA be used to infer all DBPs

A strong link between hydrophobic organics and THMs

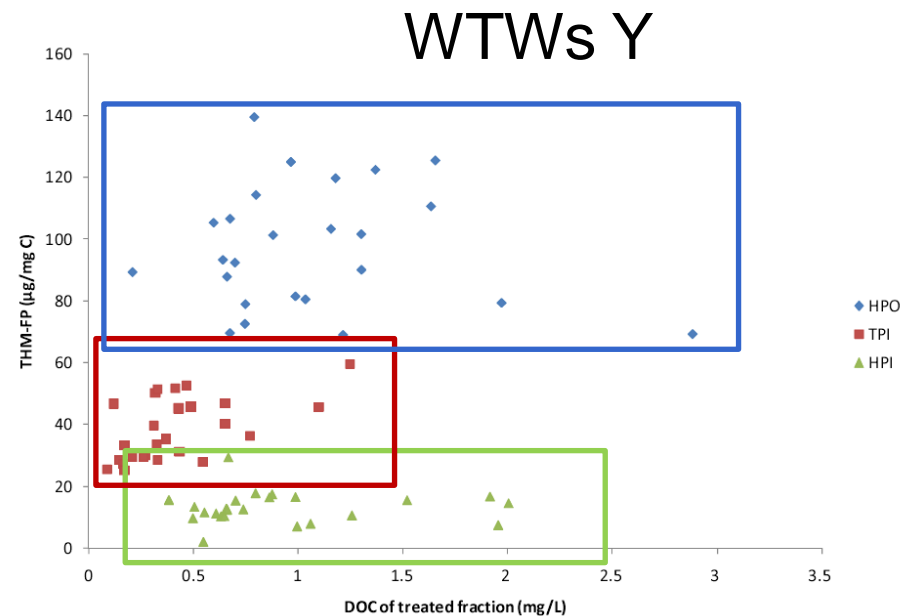
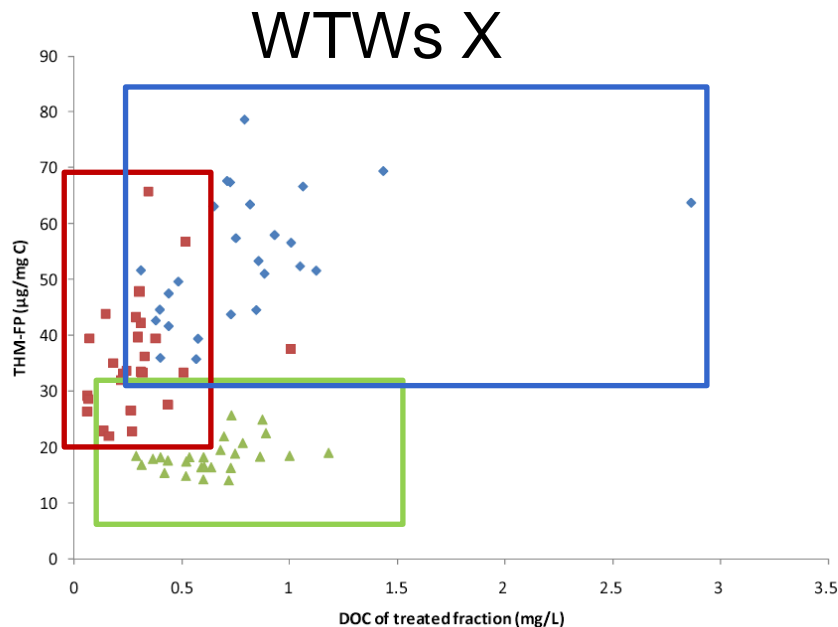


Different NOM, different formation potential

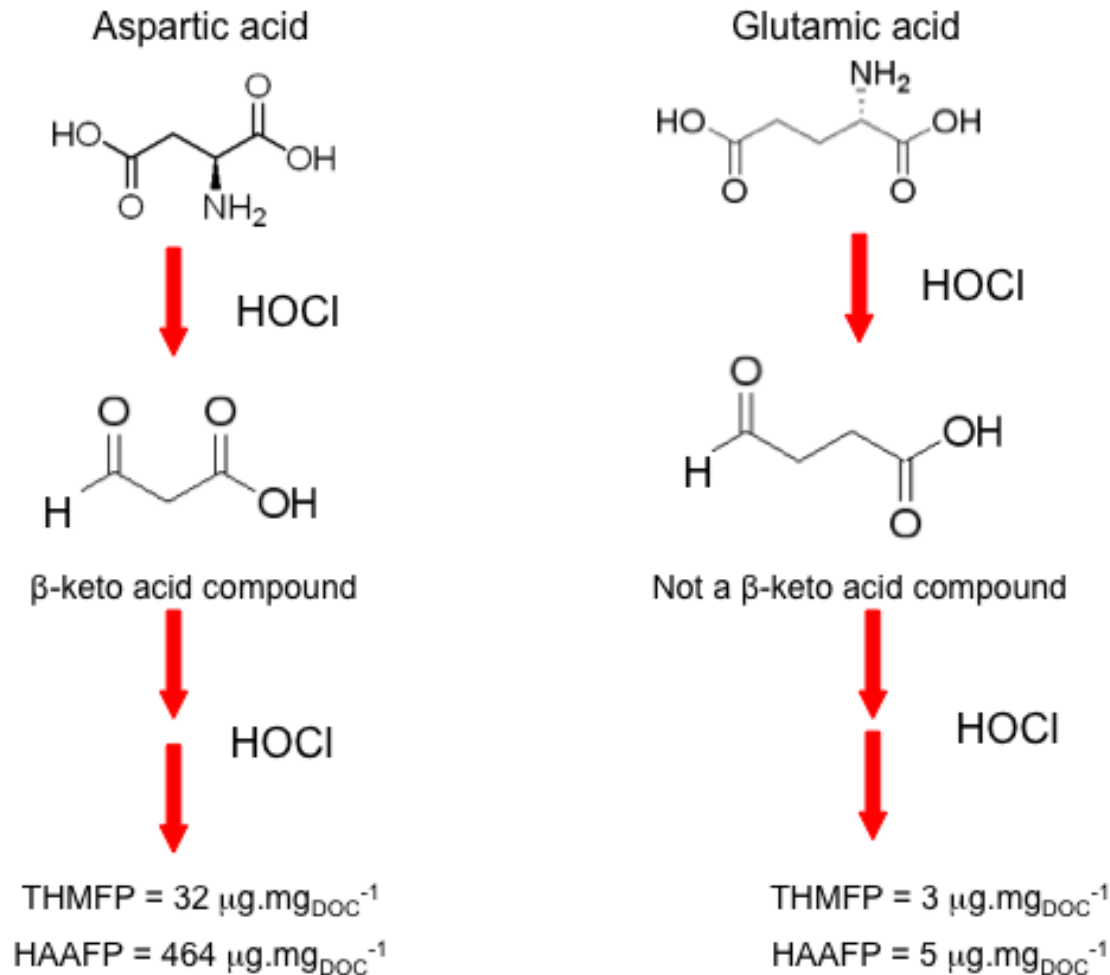
HPI - Stable at site and between WTWs

TPI - variable & different from site to site

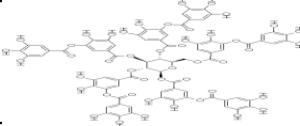
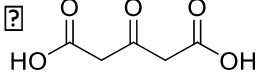
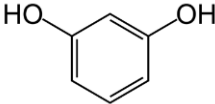
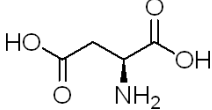
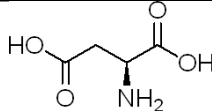
HPO - very reactive & variable



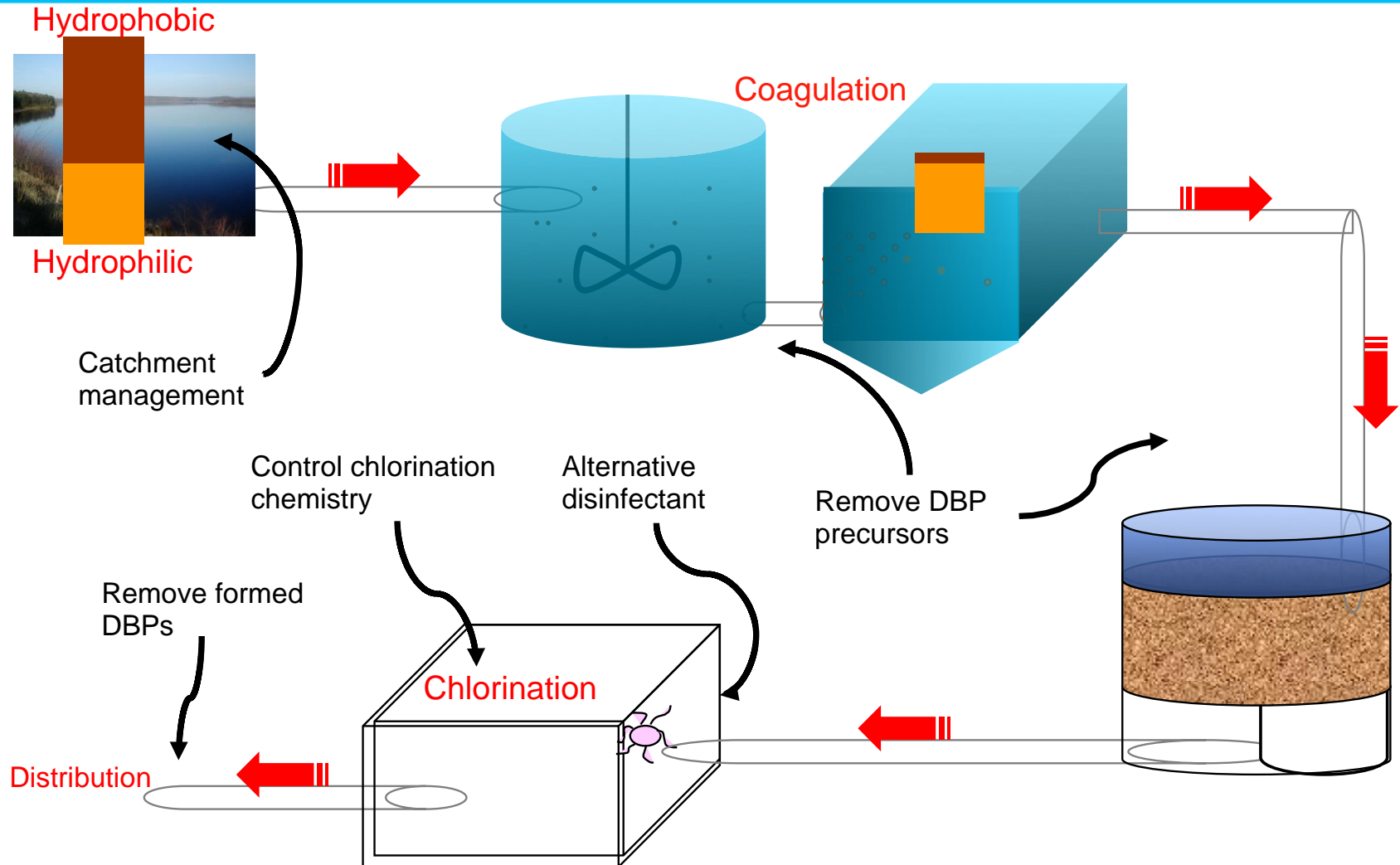
Removal is very similar yet DBP formation is very different



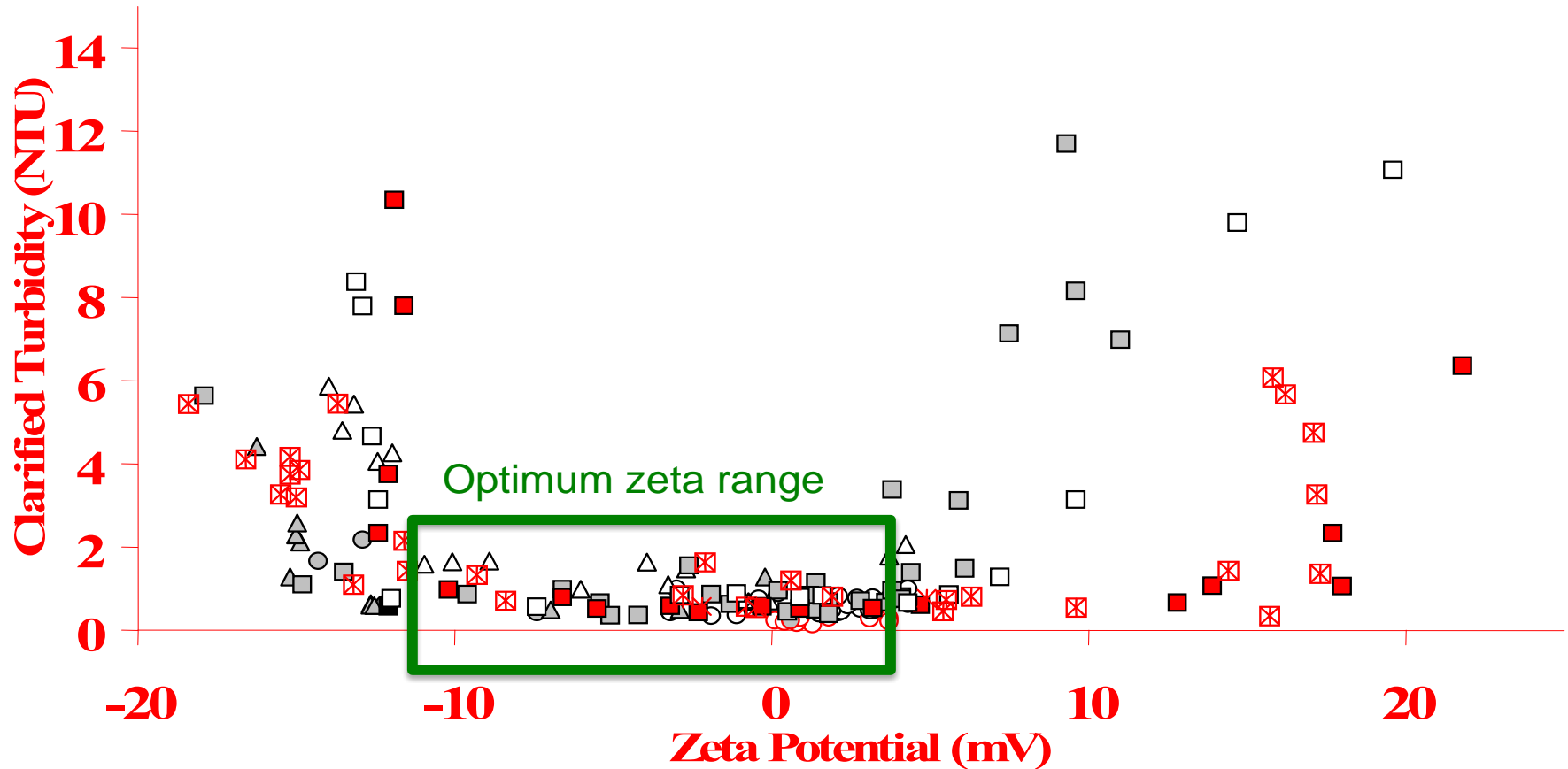
Treatability map: can we target pre cursors

Process	Selectivity	Good for	Example	Important factors
Coagulation	Charged species	Large, anionic precursors		Optimisation
MIEX	Highly and moderate charged species	b-dicarbonyl acids?		Effective for THMFP (maybe HAA)
GAC	Hydrophobic compounds	Neutral hydrophobics		Pore size and charge of carbon
Membrane	Size	Amino acid, carbs		Need NF (Cost)
AOP	Reactivity to free radicals	ALL		Can increase DBP
Biotreatment	Uptake by organisms	Amino acids		limited
Ozone	aromatics	Activated aromatics		Limited at typical doses

Conventional approach

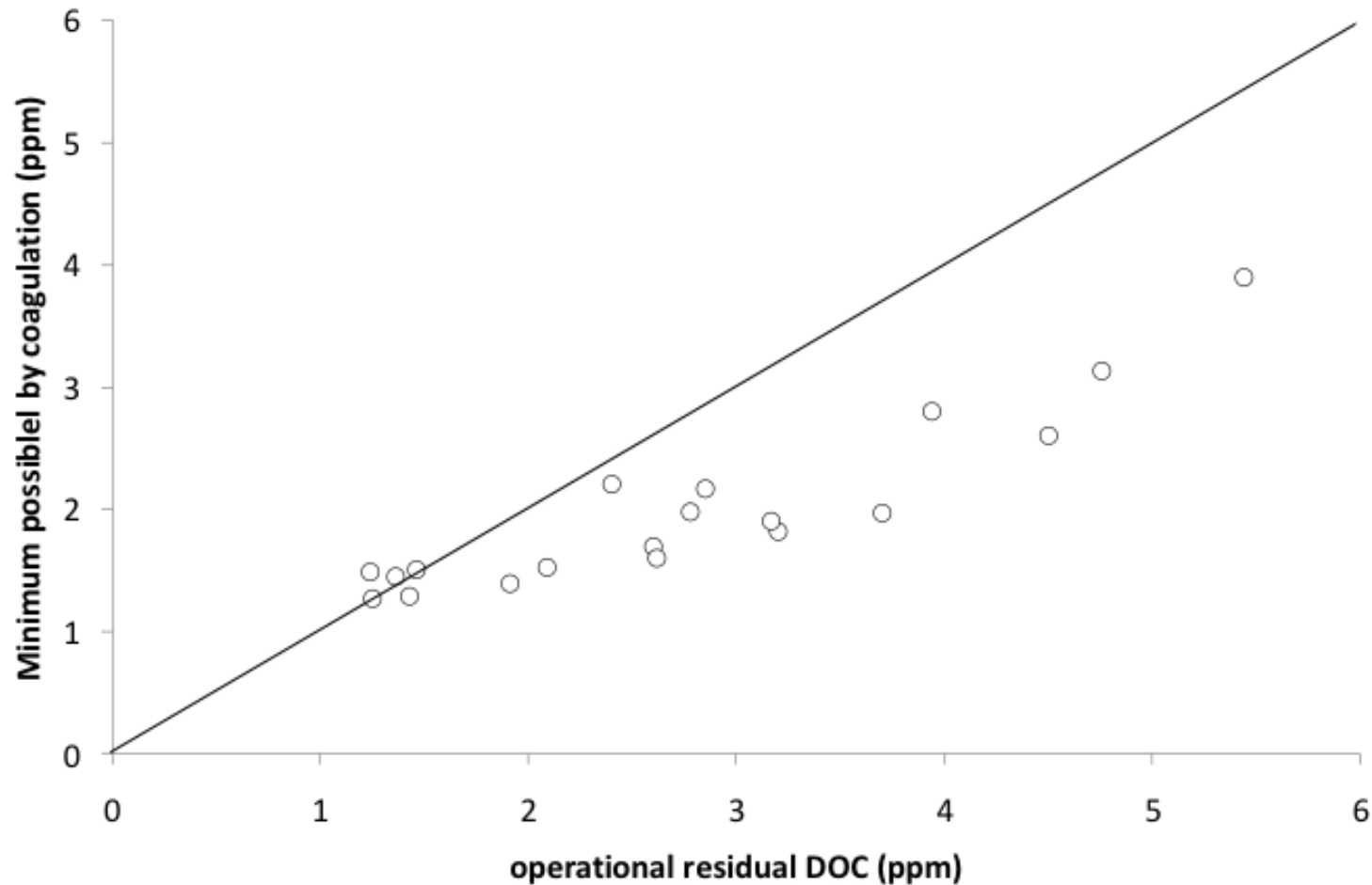


The efficacy of coagulation is controlled by charge

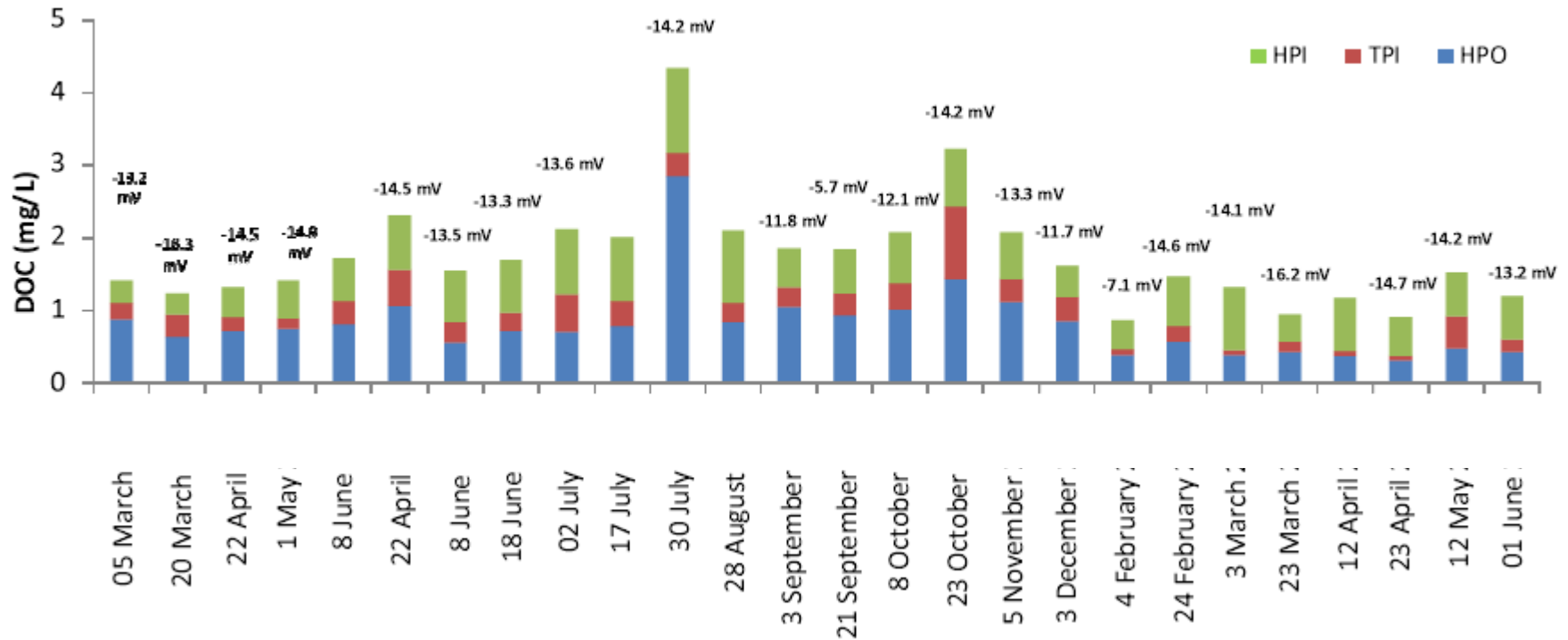


- Mountain (1) ● Moorland (2) △ Mountain (3) △ Moorland (4)
- Moorland (5) ■ River (6) □ River + HA (7) ⊠ Algae (8)

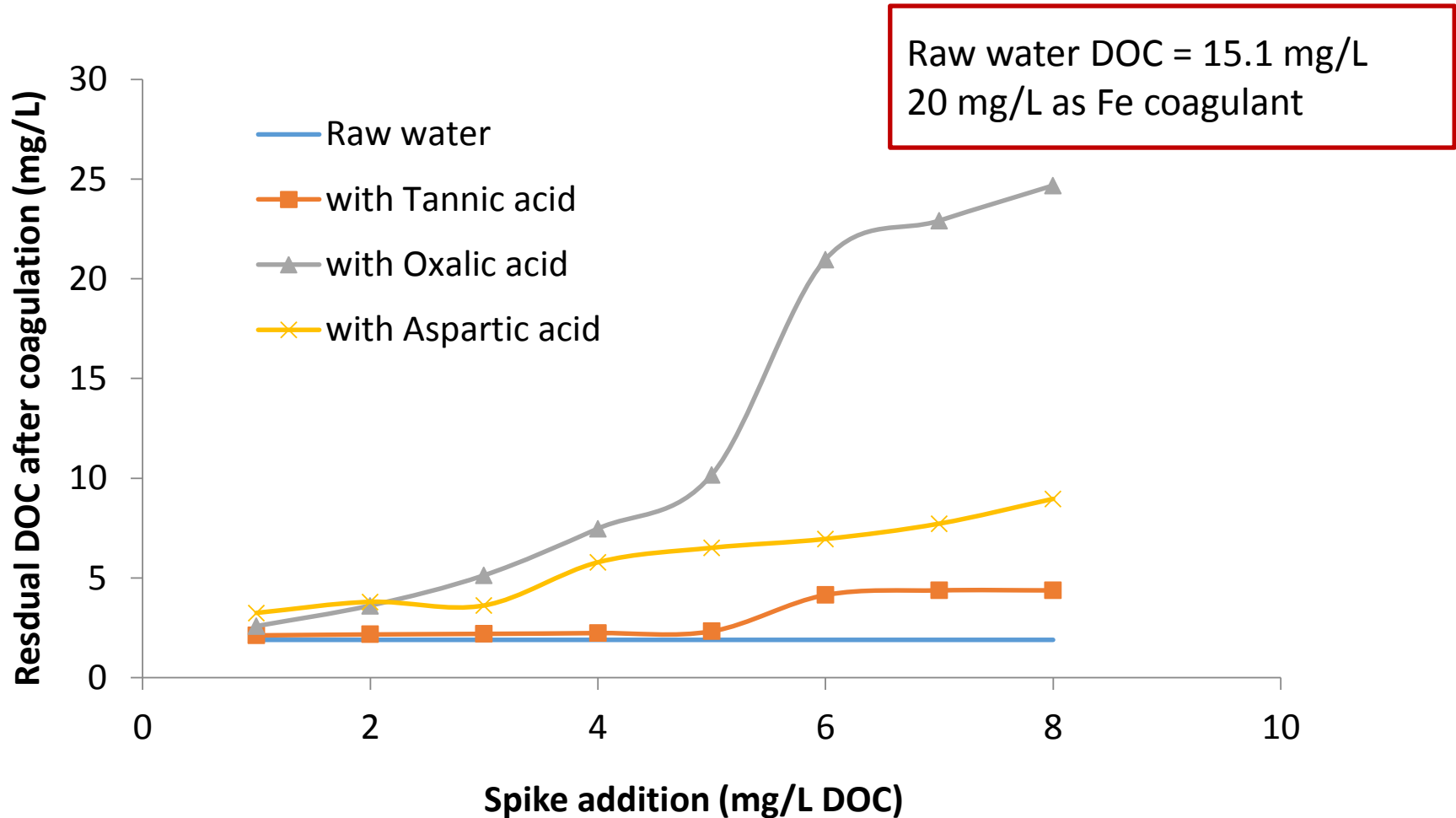
Difficult to deliver optimum at all works



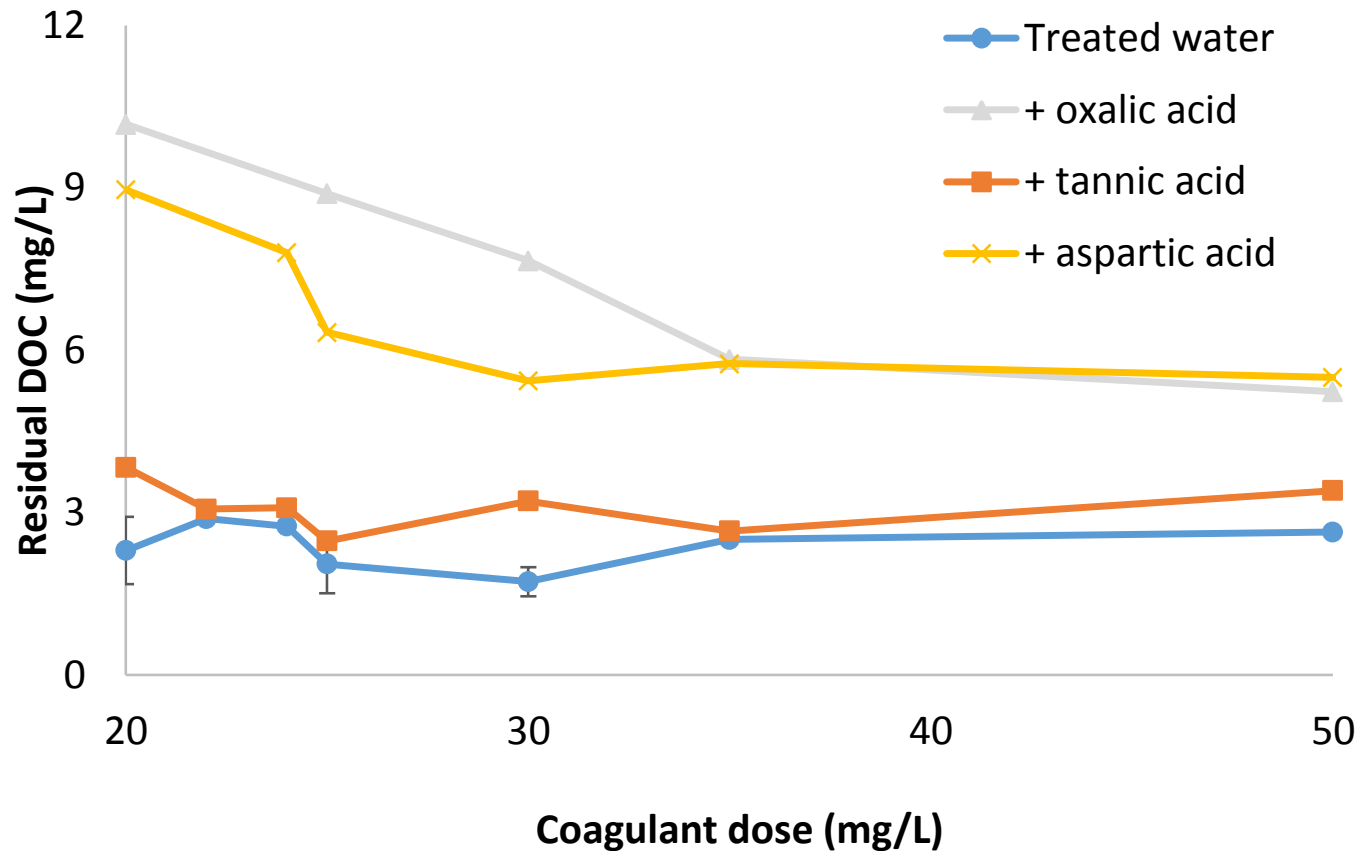
Despite our best efforts.... Hydrophobic bleed



Removal of organic compounds



Removal of organic compounds.... How do you respond with coagulation



Good coagulation practice

How much coagulant do I need?

- Hydrophobic content
- Charge load

How do I optimise the process?

- Zeta potential

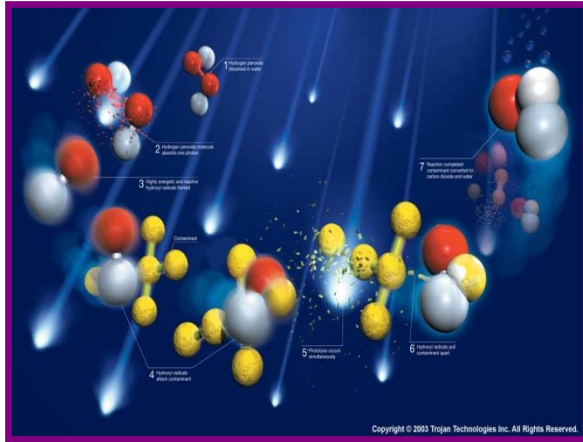
How much DOC will remain?

What DBPs will form?

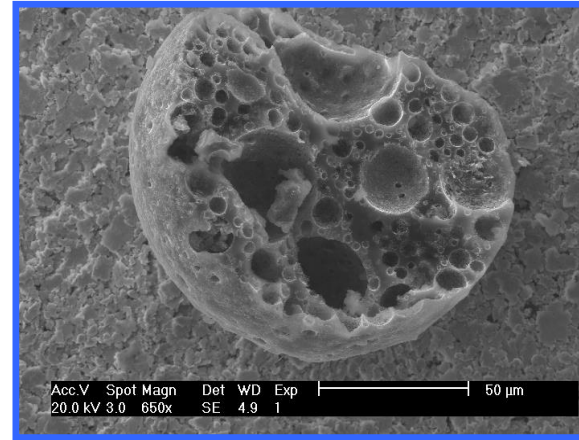
- Hydrophilic content
- No idea!

PLUMBOSOLVEM
RESERVOIR SAMPLING
CAPITAL CODE 1
TEST RIG A 05
UVS - DE-SLUDGING

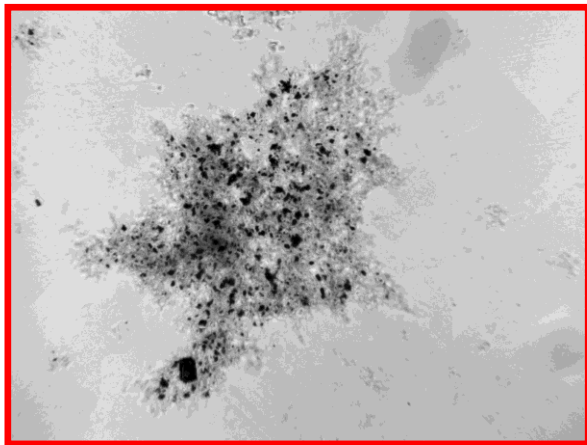
A number of alternative treatments are being trialled



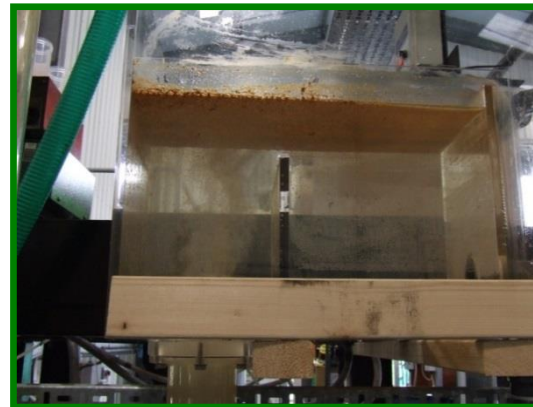
AOPs



IEX & coagulation

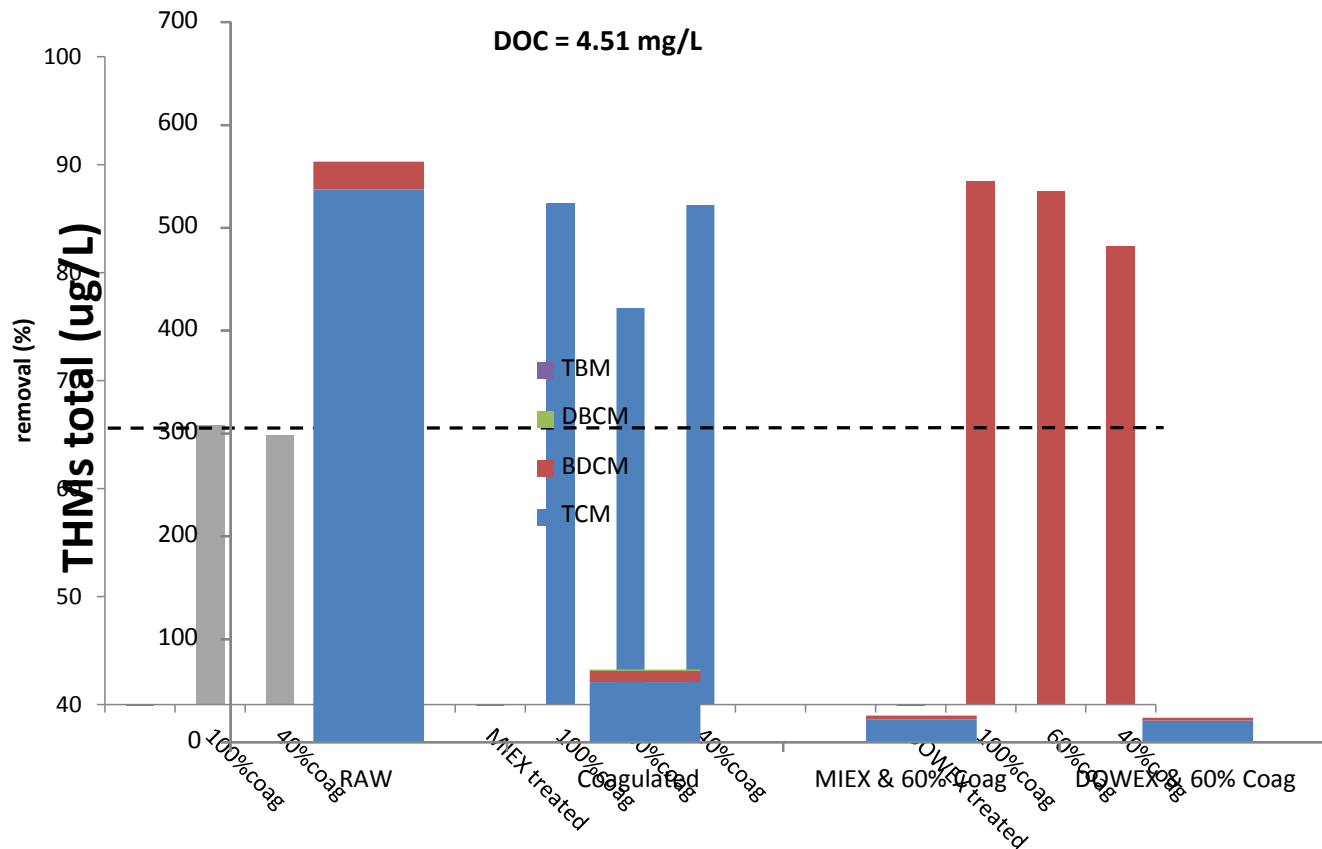


PAC & coagulation



**Zr Coag –
New coagulants**

New Processes - IEX



New Processes



Implications of findings

NOM

- **Complex mixture & spikes are not consistent**
- **Routine organic characterisation (SUVA, fractionation, HPSEC etc) not sensitive enough**
- **Surrogates can help inform on likely changes to treatment**
 - **Residuals & flocs**
- **More of a data base needed**

IMPACT ON COAGULATION

- **Easy to coagulate organics don't need more coagulant until very high spike**
- **Some organics interfere with others and reduce overall removal**
- **Large increases in coagulant needed – very impractical**
- **Flocs can be affected**
 - **Aspartic acid (no floc formed on its own)**

THE FUTURE

- **Characterisation of organics into chemical groups**
- **IEX, adsorption, biological needed for difficult organics**

Acknowledgements

- TRUST, EU project
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 - Elodie Loubineaud
 - Charlotte Sable
 - Anais Salmon
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