CHALLENGES IN DEVELOPING A TREATMENT SOLUTION FOR PFAS - AN EMERGING CONTAMINANT

Nick Marquez

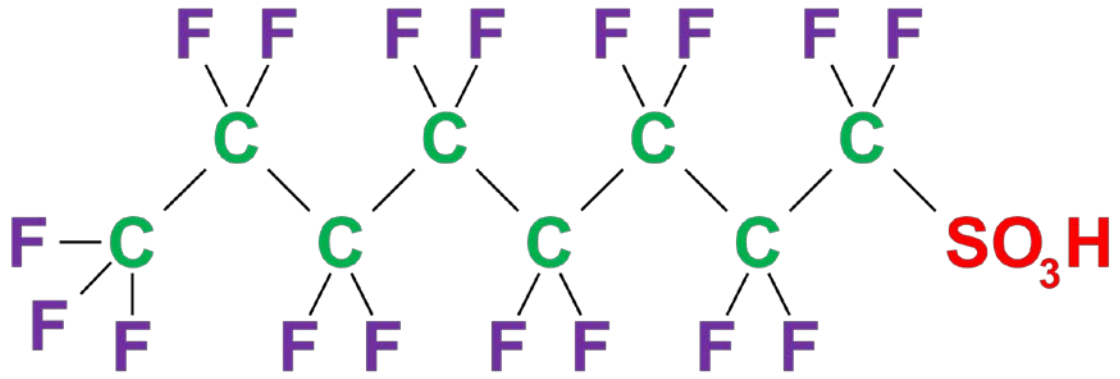
Beca. Creative people striving together to transform our world

Coming Up…

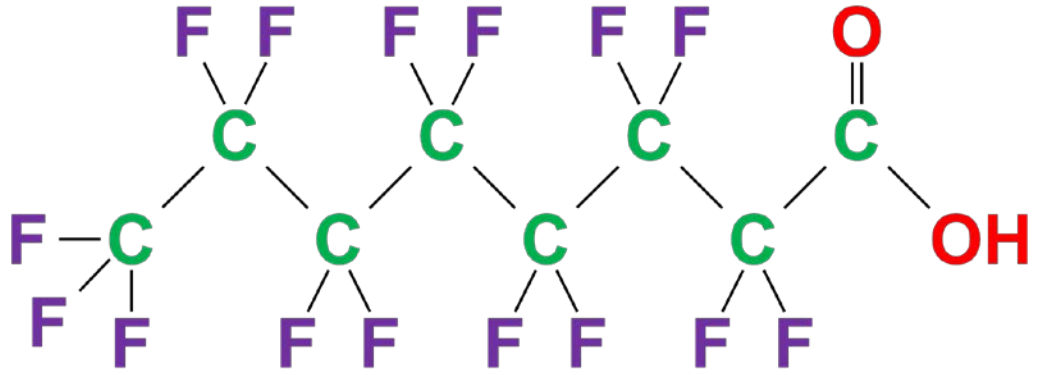
- An introduction to PFAS
- Specific context – wastewater produced by firefighting training
- Case study – treatment trials for an airport client
- Further opportunities

What are PFAS?

- Per- and poly-fluoroalkyl Substances
- Synthesized compounds for various uses
  - Non-stick cookware
  - Furniture & clothing stain & water proofing
  - Food packaging
  - Mist suppressant
  - Firefighting foams
- Problematic in the environment
  - Recalcitrant
  - Persistent
  - Bioaccumulating
  - Toxic (Humans?)



PFOS - perfluorooctanesulfonic acid



PFOA - perfluorooctanoic acid

So What?

So What?

- Water authorities treating PFAS as a contaminant of concern and beginning to monitor
- NZ Fire Service performed an assessment of environmental impacts of foams

Fiskville CFA training facility permanently closed after toxic chemicals found

By Alison Savage

Updated 26 Mar 2015, 5:15pm

The Country Fire Authority's Fiskville training centre, which was at the centre of a cancer cluster investigation, will be closed permanently after

at the site earlier

The centre near Ba
was temporarily clu
found the toxic che
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Authorities conduc

UPDATED JULY 11 2017 SAVE PRINT

Class action filed against Department of Defence following Oakey water contamination

Ruth McCosker Show comments

Rutherford refinery is without sewer services after discharging contaminants that feature at the centre of the Williamtown RAAF Base scandal

JOANNE MCCARTHY

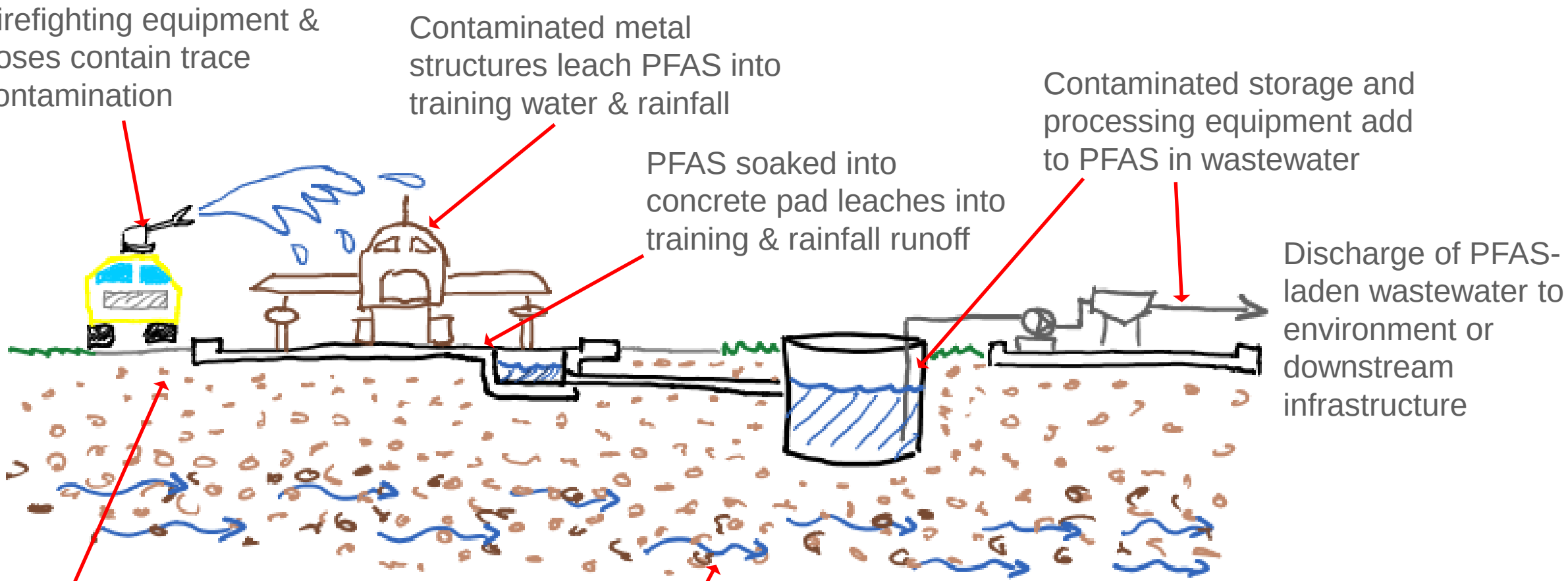
25 Feb 2016, 9:08 a.m.

Share Tweet Email

PFAS in Firefighting foams

- PFAS often key ingredients in Aqueous Film Forming Foams (AFFF)
- Phasing out began in early 2000s, switch to Fluorine Free Foams (F3)
- Trade off in risk between AFFF vs F3
- Main release pathway of AFFF is from firefighting training

Legacy Contamination at Firefighting Training Grounds



Why so difficult?

- Nature of the chemicals
  - Binds to various materials
  - Broad range of chemicals & behaviours
  - Ubiquitous background levels
  - Laboratory capability
- Technology limited
  - RO & filtration
  - Incineration
  - GAC & other adsorption
  - Waste disposal
- Regulatory environment
  - Gathering pace in AUS/NZ & globally
  - Discharge limits are very low
- Site/environment constraints
  - Variability (frequency & type)
  - Small volumes (no economies of scale)
  - Open environment
  - No technical personnel

Regulatory Levels

- Food Standards Australia & New Zealand

Toxicity Reference Value	PFOS/ PFHxS	PFOA
Tolerable daily intake, µg/kg bw/day	0.02	0.16
Drinking water quality value, µg/L	0.07	0.56
Recreational water quality value, µg/L	0.7	5.6

Department of Health (2017): Health Based Guidance Values for PFAS for use in Site Investigations in Australia, Australian Government

- DRAFT ANZECC trigger values

Exposure Scenario	PFOS, µg/L	PFOA, µg/L
99% species protection (Freshwater)	0.00023	19
95% species protection (Freshwater)	0.13	220
99% species protection (Marine water)	0.29	3,000
95% species protection (Marine water)	7.8	8,500

Department of the Environment and Energy (2016): Commonwealth Environmental Management Guidance on Perfluorooctane Sulfonic Acid (PFOS) and Perfluorooctanoic Acid (PFOA) [DRAFT], Australian Government

Case Study – Airport Firefighting Training Wastewater

Why?

- Groundwater & soil are legacy issues. Treating wastewater and runoff prevents further discharge to the environment
- Client wanted an independently-run trial at one of their sites, dealing with their specific constraints

Objectives

- Assess to what extent two commercially available treatment technologies can remove PFAS
- Design and trial a process train that would comprise each technology
- Review the feasibility of these processes at full scale

Products tested

MyCelX™

- Polymer agent which binds to water soluble organics while repelling water

RemBind®

- Immobilising reagent, mainly powdered activated carbon, aluminium hydroxide & kaolin clay

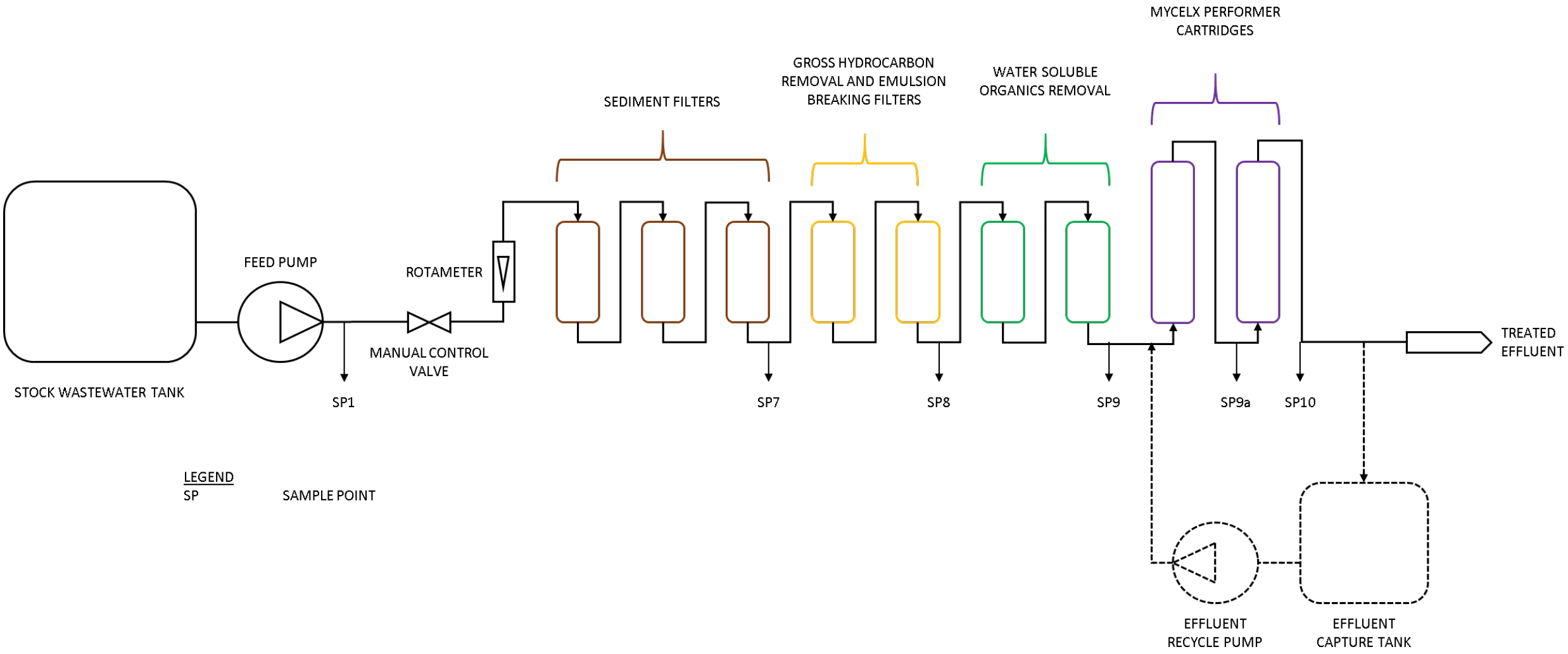
Approach

- Desktop design of pilot process & experiments
- Single wastewater feedstock collected from actual firefighting training
- Pilot trial rigs constructed & delivered to site
- Trial runs of 200L, modifying variables such as dose rates, contact time, bed depth
- Samples collected and tested throughout the process
- Some adjustments based on results

Defining Trial Success

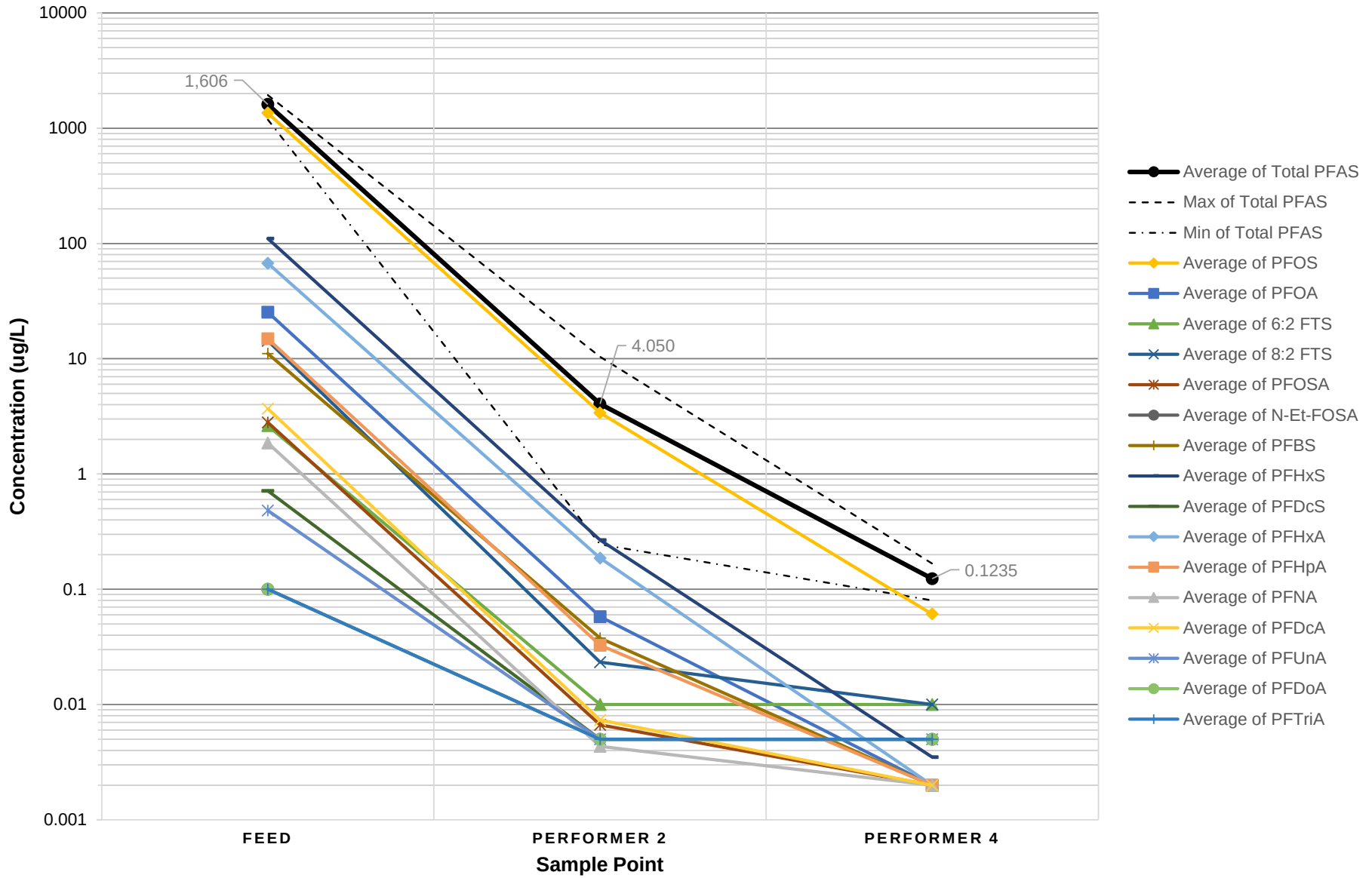
Ref	Benchmark	Threshold Levels[1]	Outcome
L1	Below the laboratory limit of reporting	PFOS = 0.002µg/L PFOA = 0.002µg/L 6:2 fts = 0.01µg/L Other PFASs = 0.002-0.1 µg/L	Process train is capable of removing PFAS and should be assessed against other feasibility criteria
L2	Below the US EPA Drinking Water Health Advisories limit for PFOS and PFOA	PFOS = 0.07µg/L PFOA = 0.07µg/L Or combined = 0.07µg/L	Process train is capable of removing PFAS and should be assessed against other feasibility criteria
L3	Below the Minnesota Administrative Rules (2009) drinking water limits	PFOS = 0.3µg/L PFOA = 0.3µg/L 6:2 fts = 0.3µg/L	Process train is capable of removing PFAS and should be assessed against other criteria or may have other applications
L4	Possibly acceptable discharge to sewer	PFOS and PFOA = 3µg/L	Process train might be of use, but in a limited context and the business case may only stack up on a site-by site basis.
L5	Greater than acceptable threshold	PFOS and PFOA > 3µg/L	Process train trial has been unsuccessful and should not be considered for pilot plant

MyCelX - Process

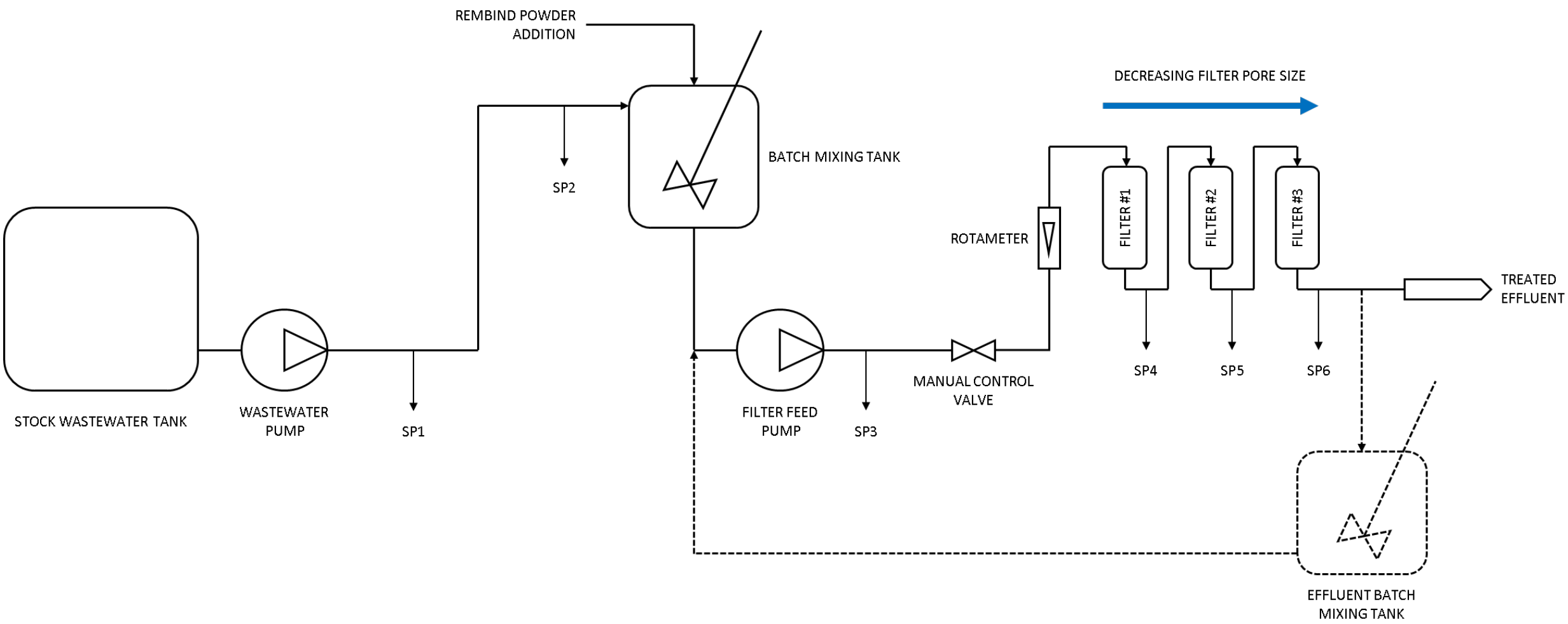


MyCelX - Results

- 99.99% of total PFAS removed
- L3 level of success achieved for total PFAS
- Individual PFAS components below L2 threshold

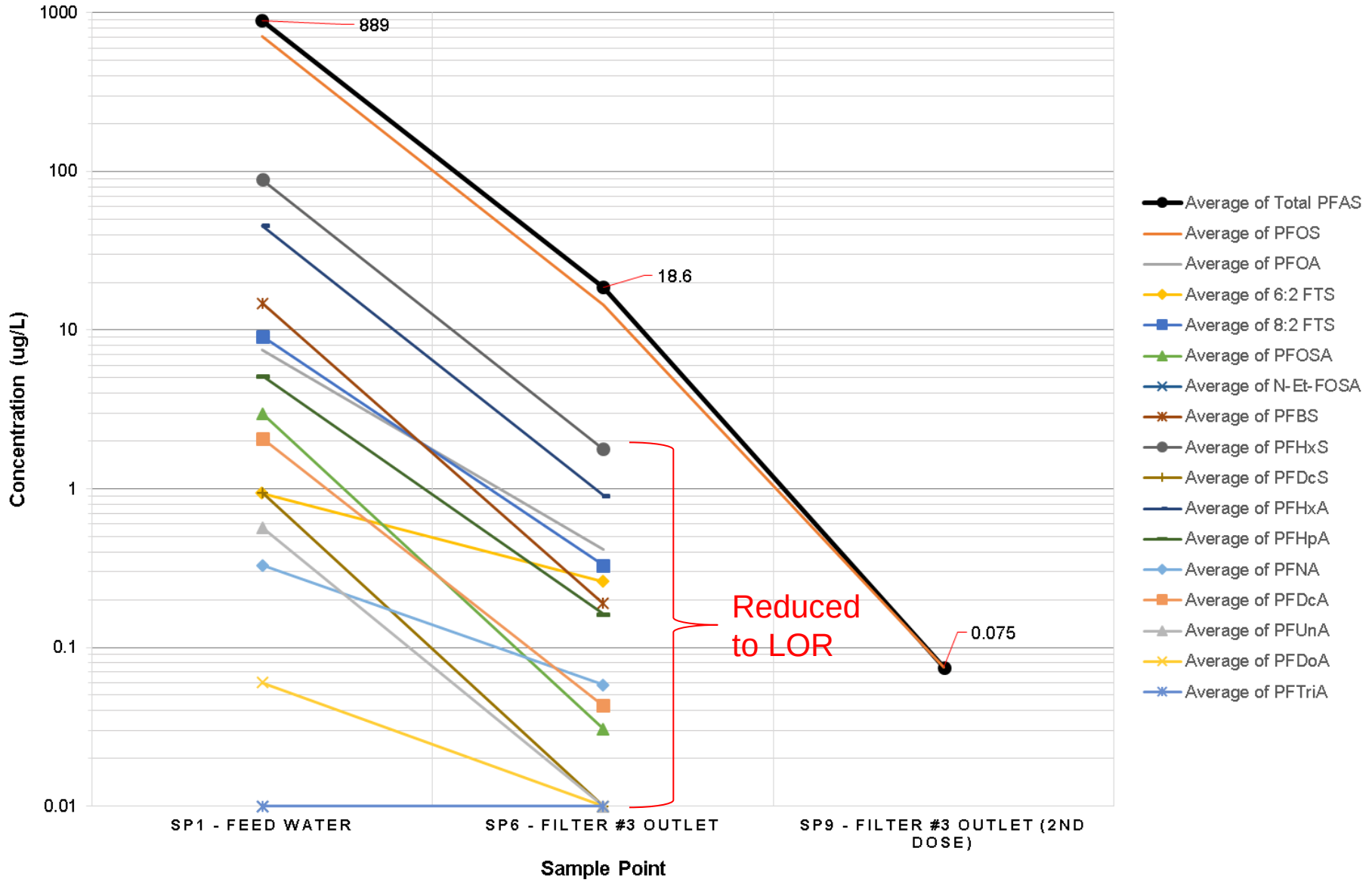


RemBind - Process



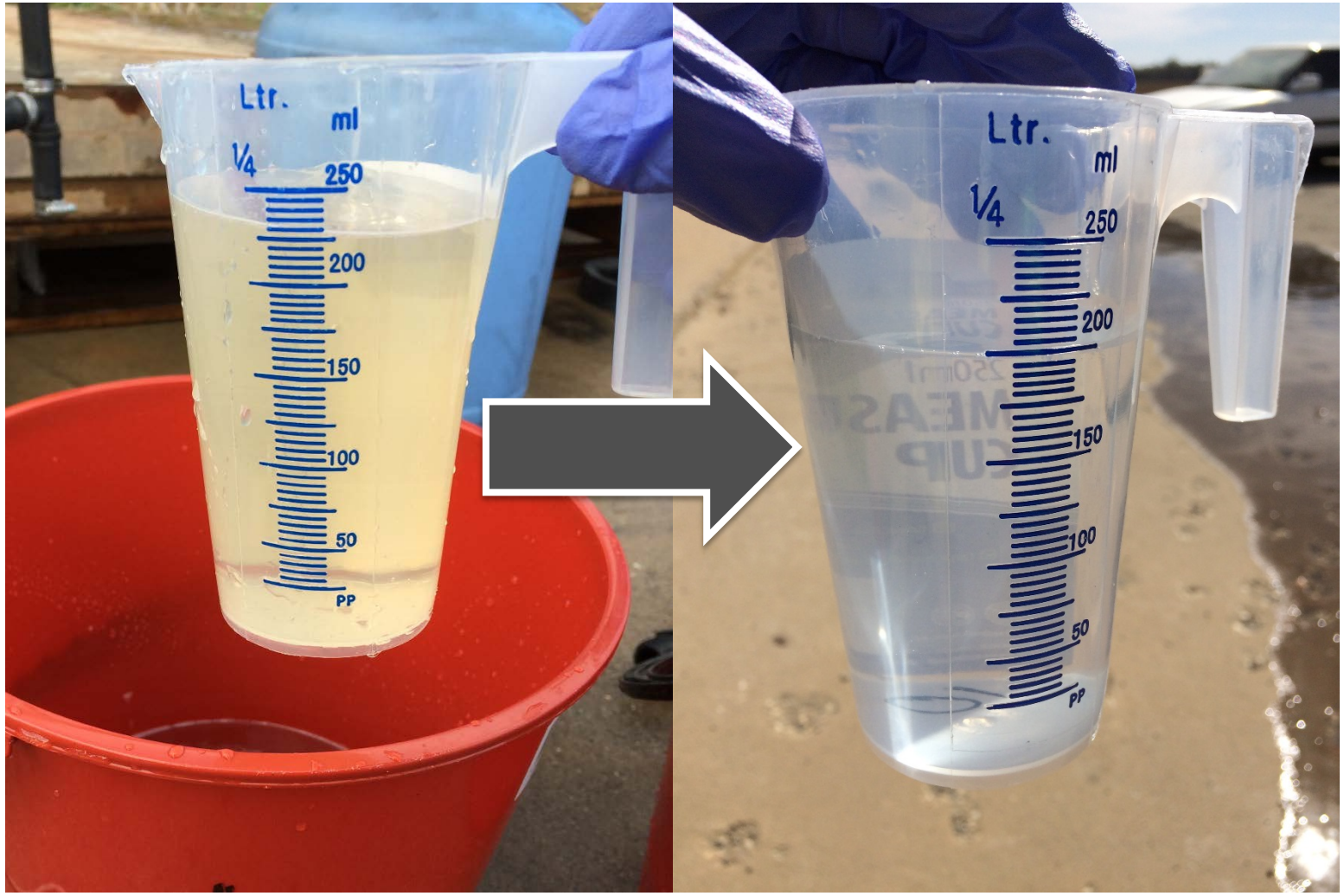
RemBind - Results

- 99.99% of total PFAS removed
- L3 level of success achieved



Conclusions

- Both processes removed a significant amount of PFAS (99.99%)
- Both demonstrated to achieve the freshwater 95% species protection guideline in the recent draft ANZECC update
- Neither could treat foamy wastewater as effectively



Was it so easy?

- Extended trial period – lots of waiting for test results
- Sampling interferences
- Laboratory issues
- Contingency costs for sample testing
- Red herrings – Rembind samples underreporting

Problem Solved?

- Economics
- Operations
- Waste generation & disposal
- Quality monitoring and control
- Developing regulatory environment
- Opportunity to apply this knowledge to other sources (groundwater, municipal sewer)

Questions

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