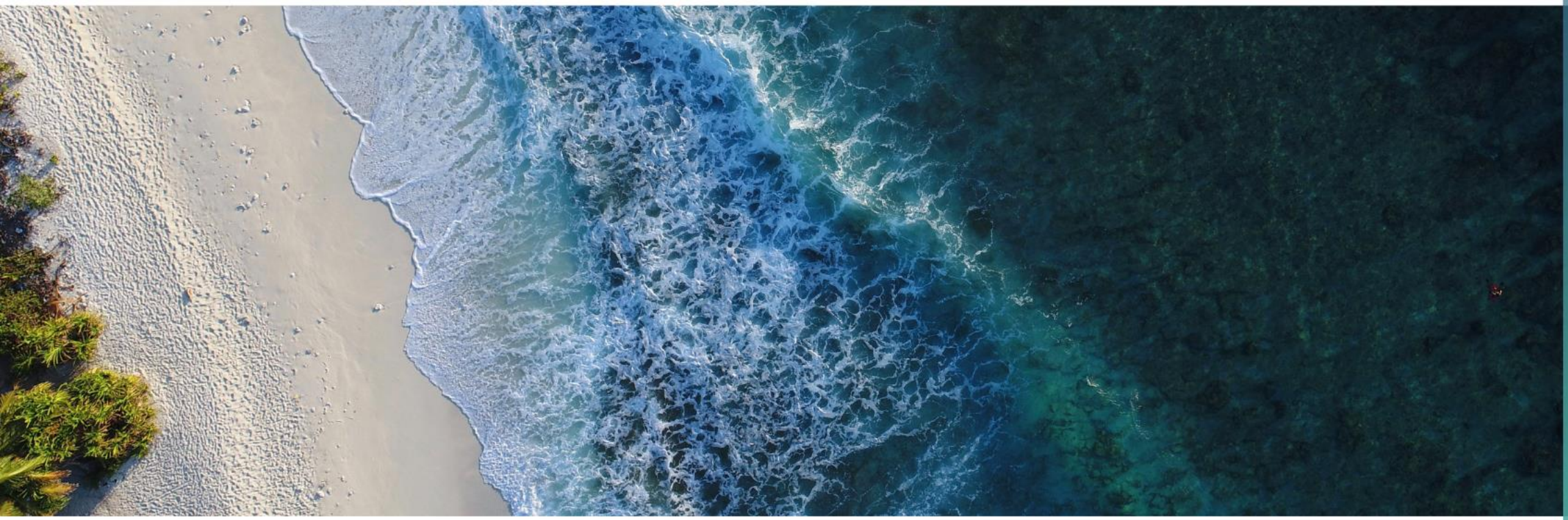
Introducing The StormFilter PFAS

Ocean Protect webinar by Blake Allingham, Michael Wicks & Brad Dalrymple

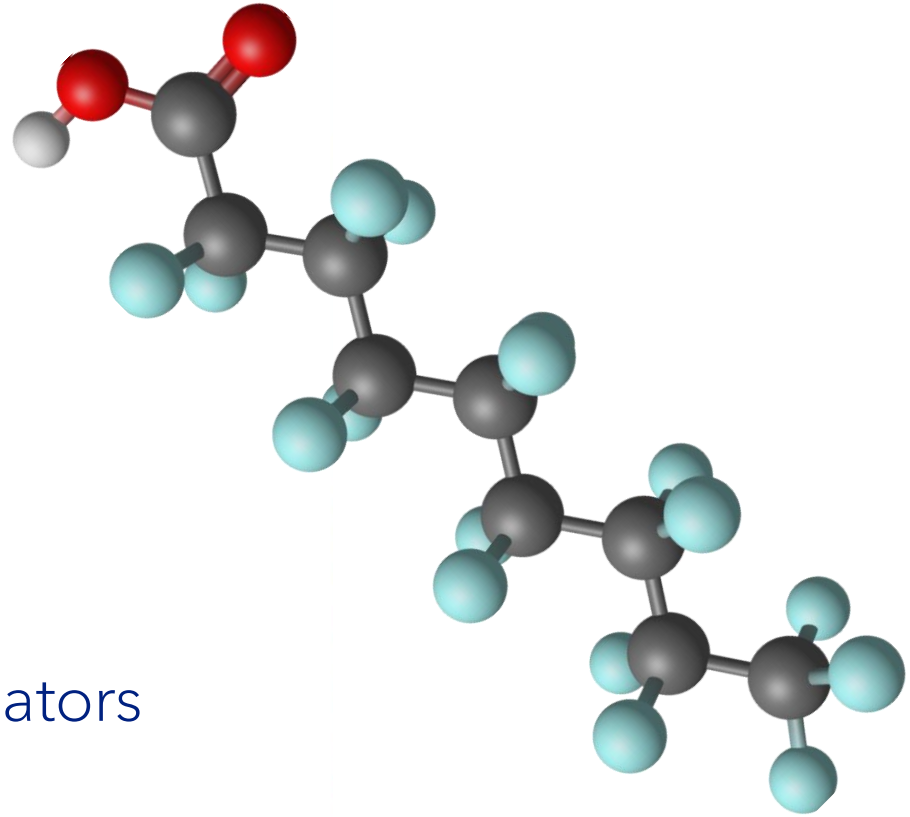
15th June 2023




The Problem

Per & poly-fluoroalkyl substances (PFAS)

- Manufactured ‘forever chemicals’
- Produced since 1940’s
- Used in various products
- Persistent
- Toxic
- Bio-accumulative
- Everywhere
- High priority for environmental regulators



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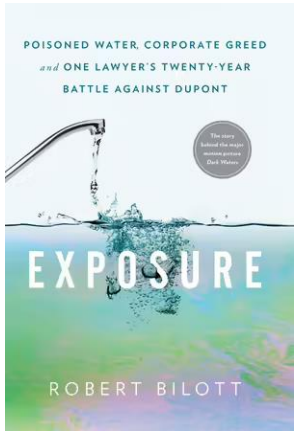
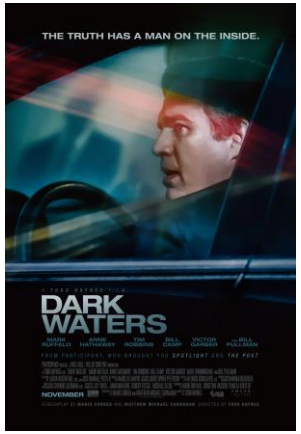
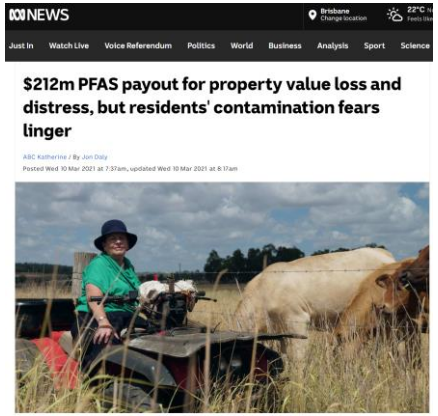
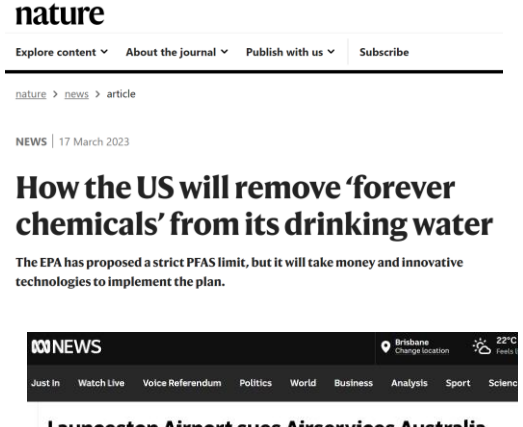
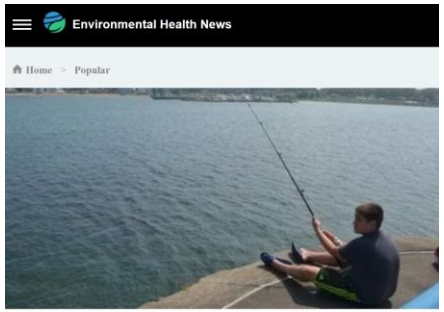
In the media (& courts)

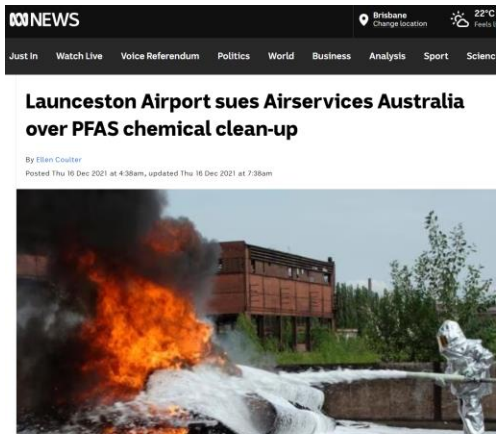


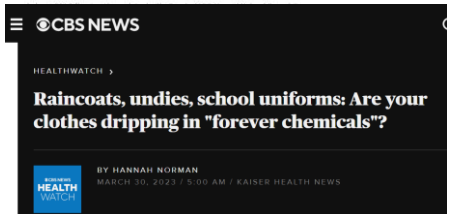












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Australian Government
Defence

PFAS INVESTIGATION AND MANAGEMENT PROGRAM

SERVICE
COURAGE
RESPECT
INTEGRITY
EXCELLENCE

PFAS INVESTIGATION AND MANAGEMENT PROGRAM SNAPSHOT - JULY 2022

Program financials (AUD)

As of July 22

Spent to Date (Since 2016)
$580 million

FY22/23 budget allocation
$117.5 million

Site statistics

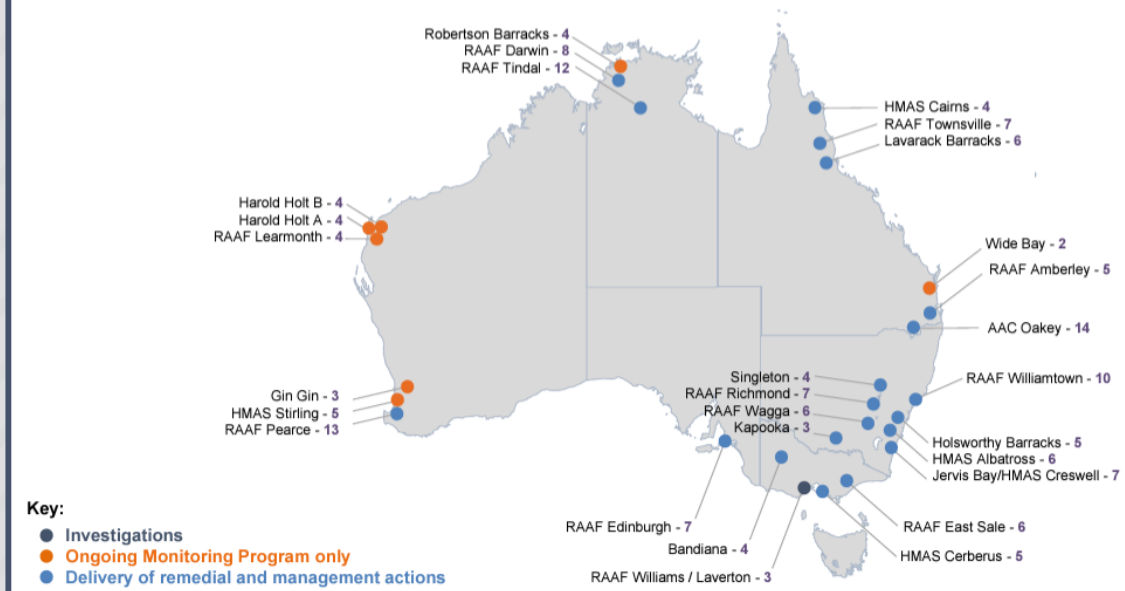
- PFAS environmental investigations are complete at 27 of 28 sites in Defence's PFAS investigation and management program.
- The 27 sites have now transitioned to remediation and/or management.
- The investigation at RAAF Williams (Laverton) is expected to conclude during the second half of 2022.

Program uncertainties

- Emerging science that may inform the risk profile of current levels of contamination.
- Emerging policy and regulatory frameworks and guidance.
- Rate of development of technology and options improving the efficiency and effectiveness of remedial actions.
- Unseasonal or extreme weather events may delay the conduct of remedial works or impact the effectiveness of works or technology trials underway.

Community & stakeholder concerns / risks

- Results from Defence's Ongoing Monitoring Program may demonstrate changes in PFAS contamination levels or locations, and leading to additional Defence responses.
- Remedial activities may not deliver timely changes to PFAS contamination profiles, or remediate to the extent desired.
- Uncertainty over the human health and ecological impacts of PFAS exposure.
- Delivery of town water infrastructure to the West Bullsbrook community.
- Concern over the impact of PFAS contamination on property values.



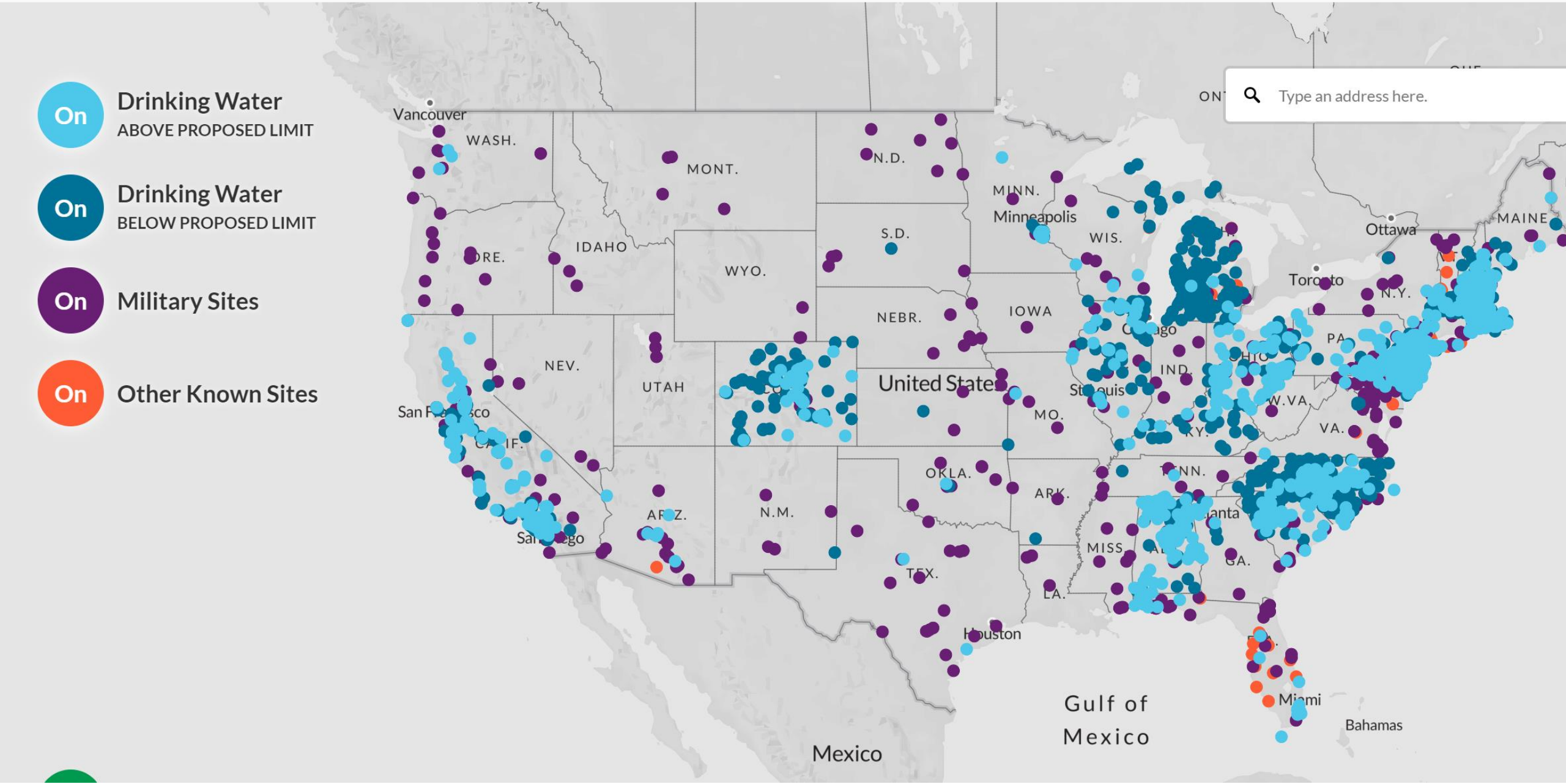
Remedial actions

- Treated over 8 billion litres of water.
- Treated and/or removed over 54,000 tonnes of contaminated soil.
- Provided 115 rainwater tanks to 80 properties in affected areas.
- Connected 378 properties to town water.
- Provided funding of approximately $24 million for 13 research activities in support of PFAS investigation and remediation activities.
- Remediation using water treatment plants are currently operating at Edinburgh (1), Tindal (2), Katherine (1), Williamtown (2), and Oakey (1). Resin media regeneration facilities are operating at both Williamtown and Tindal.
- Remediation works targeting soil and other materials have taken place or commenced at RAAF Base Williamtown, Army Aviation Centre Oakey, RAAF Base Edinburgh, HMAS Cerberus, RAAF Base Tindal, RAAF Base Pearce, and RAAF Base Townsville.
- Works are due to begin at RAAF Base Richmond, HMAS Creswell, and RAAF Base Darwin in the second half of 2022.

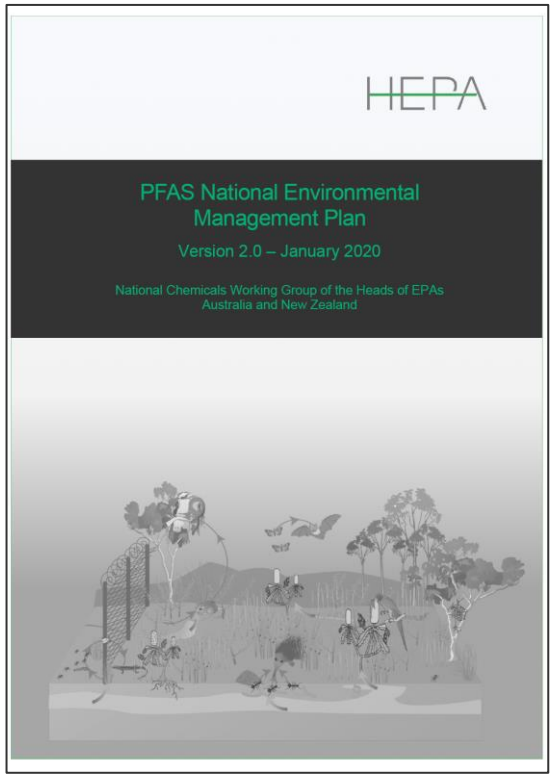
Our goal: To support affected communities and Defence capability by managing PFAS contamination on and around Defence bases, using the best science and practicable remedial approaches.

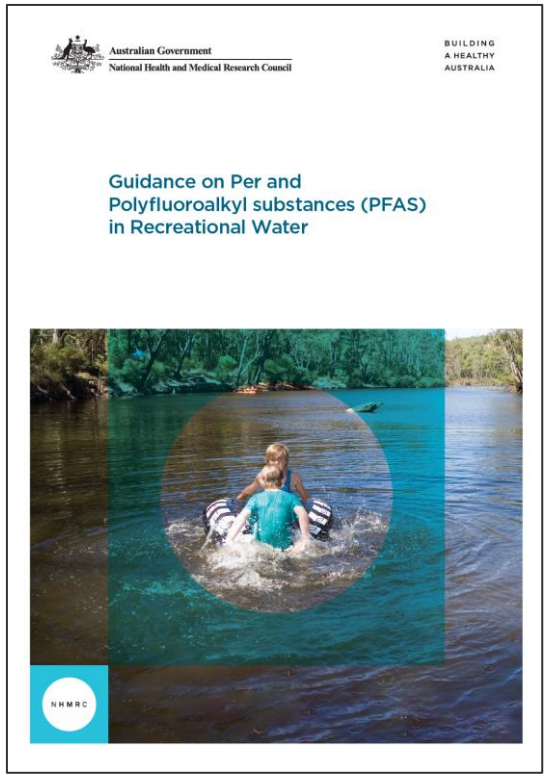
https://www.ewg.org/interactive-maps/pfas_contamination/map/

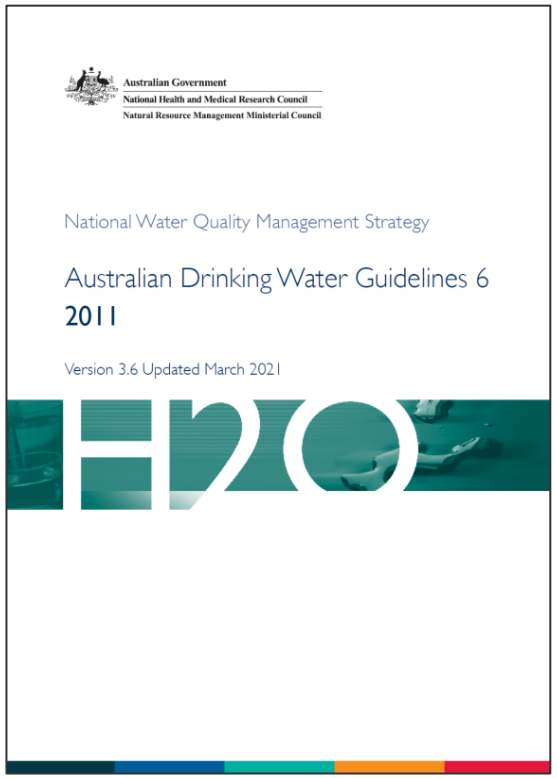
PFAS Contamination in the U.S. (June 8, 2022)

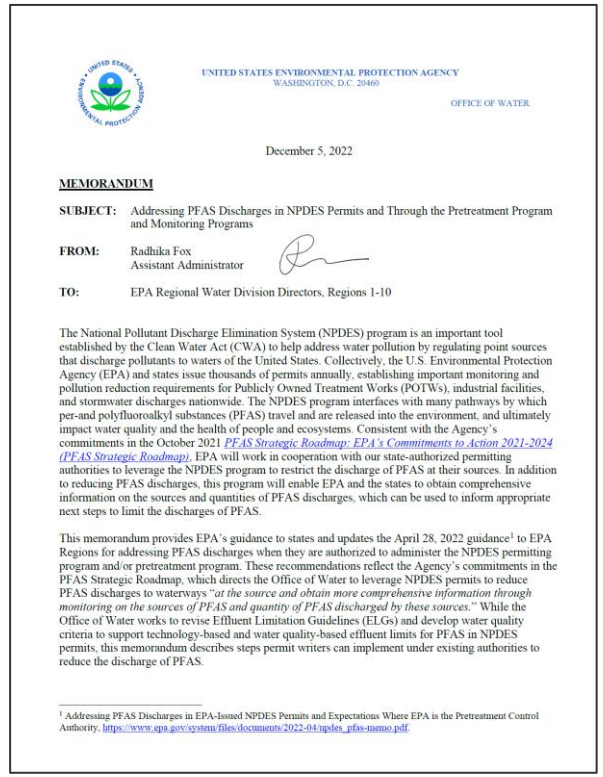


Guidelines & Regulations









OCEAN PROTECT


Solution
development &
testing

The StormFilter®

What is StormFilter ?

- Radial treatment technology
- Flexible configurations
- Multiple media options
- Self-cleaning functionality
- Accessible & rechargeable cartridges

OCEAN PROTECT

Application

- Commercial, industrial & residential areas
- Other projects (e.g. roads, airports)

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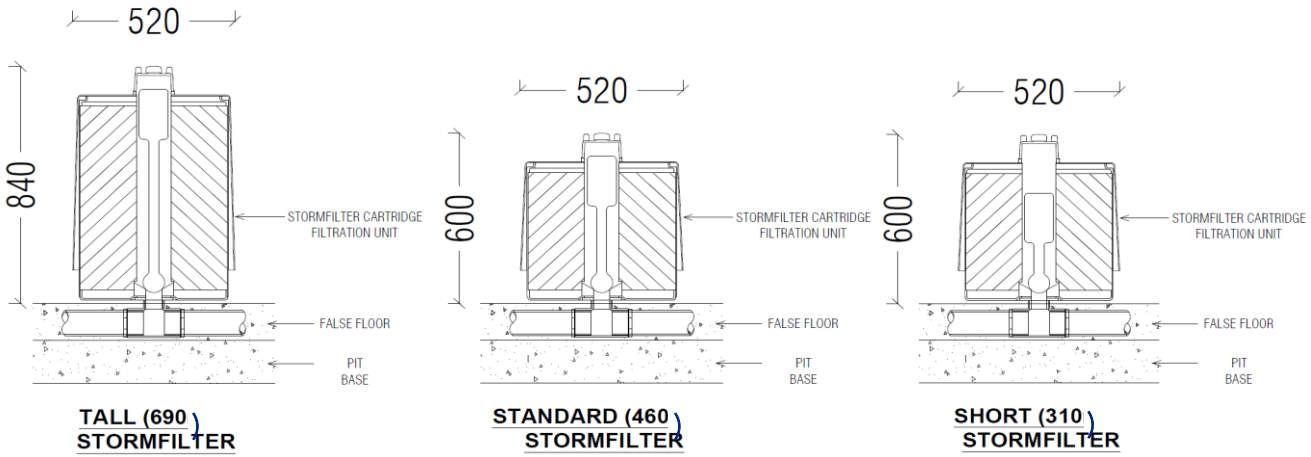
Configuration

- Precast concrete pits & tanks
- Custom above ground HDPE/aluminium tanks
- Integrated within on-site detention structures
- On-line or off-line
- 3 x cartridge heights



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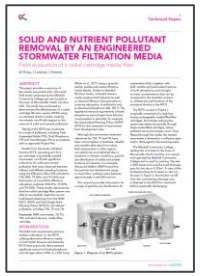
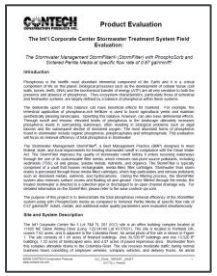
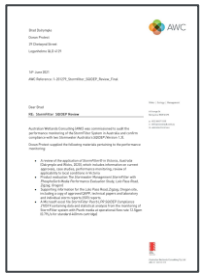
Performance

- 4 x ‘real world’, published studies
- 2 x peer review reports
- 1 x longevity study
- Council approved performance values







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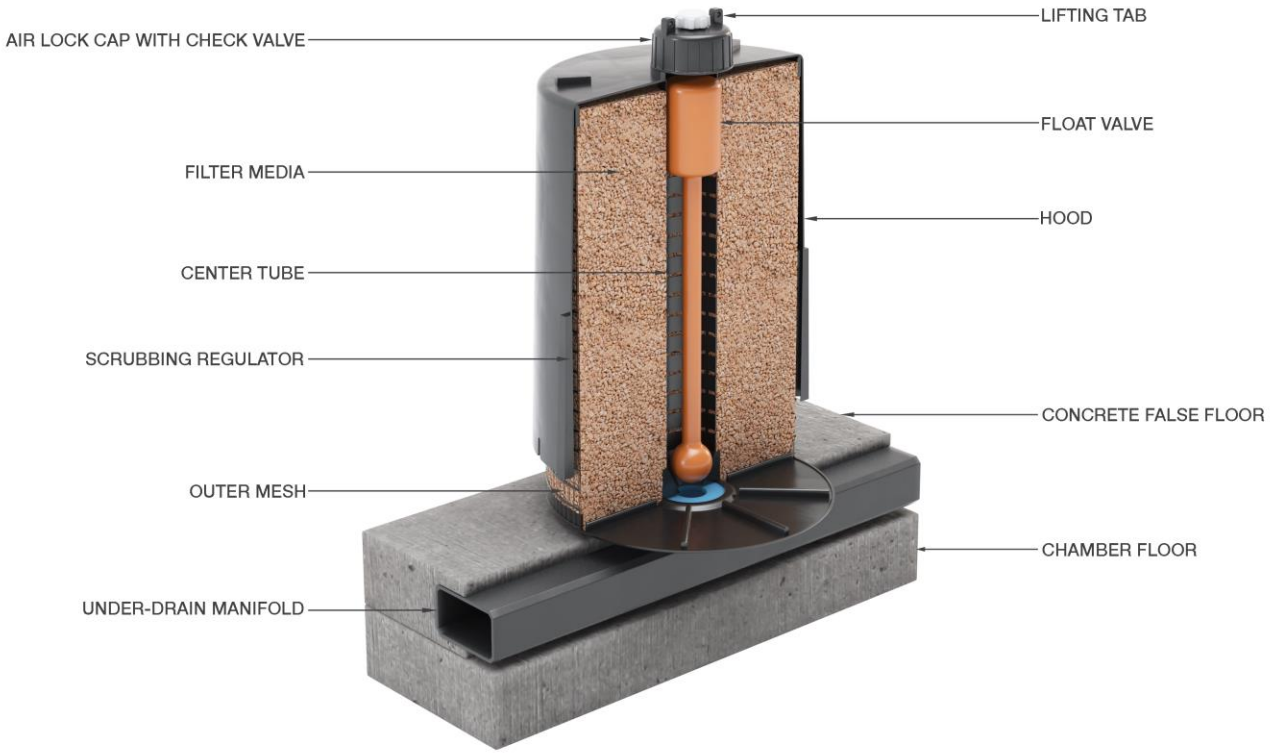
Case studies

- Over 27,000 installed in Australia
- Over 220,000 installed overseas

OCEAN PROTECT

StormFilter



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Solution development & testing

- Lab-scale testing of potential media options
- Field-scale testing

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Lab-scale testing

Lab-sale testing

UNSW
THE UNIVERSITY OF NEW SOUTH WALES

Per and Polyfluoroalkyl Substance Removal in Stormwater by Radial Flow Treatment Technology

Honours Research Thesis submitted as a requirement of Bachelor Degree in Civil Engineering

The School of Civil and Environmental Engineering
University of New South Wales

By
Blake Allingham

August 2021

15th International Conference on Urban Drainage, Melbourne, October, 2021

Per and Polyfluoroalkyl Substance Removal in Stormwater by Radial Flow Treatment Technology

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Abstract

The use of per and polyfluoroalkyl substances (PFAS) has been common in aqueous film forming foams for use in fire-fighting and associated training. The Australian government has had a ban on these substances since April 2021. However, due to their strong Carbon-Fluorine bond they are still found in high concentrations where historic use has occurred and low concentrations in surrounding areas (NSW Environment Protection Authority 2021a).

The suspension and transportation of PFAS occurs in stormwater runoff originating from contaminated areas. The focus of this study is the treatment of this runoff using existing radial flow treatment technology with selected granular activated carbons and an ion-exchange resin.

The first stage was to identify appropriate media that is capable of treating PFAS to meet the *Australian Drinking Water Guidelines* (Sum of PFOS and PFHxS to 0.07µg/litre and PFOA to 0.56µg/litre), (Australian Government 2011). This was completed using a bench scale radial flow horizontal column representing a 1/24th scale of the radial treatment technology. Two media identified as 'AC5' and 'IX1' were capable of reducing the sum of concentrations of perfluorohexanesulfonic acid and perfluorooctancesulfonate ranging 0.717 µg/litre - 0.830 µg/litre down to 0.001 µg/litre - 0.004 µg/litre.

The reduction in perfluorooctanoic acid in 'AC5' and' IX1' ranged from 0.018 µg/litre - 0.020 µg/litre down to below the limit of reporting (LOR) of the ultra-high-performance liquid chromatography combined with mass spectrometry method (0.002 µg/litre). During this initial testing, three flow rates were trialled at 11.43 litres/minute/m², 26.79 litres/minute/m² and 44.64 litres/minute/m² with no significant difference in performance.

A controlled field study of radial treatment technology using AC5 was commenced to determine the amount of volume of contaminated water that can be treated before the media needs to be replaced, which is defined as the 'breakthrough volume'. The controlled field study was conducted at a flow rate of 44.64 litres/minute/m². Results to date are up to 3600 bed volumes of treated water and show no signs of breakthrough volume being reached. Over the 3600 bed volumes of water treated, the total PFAS, sum of PFHxS and PFOS and PFOA influent concentrations ranged from 0.789 - 2.684 µg/litre, 0.396 - 2.065 µg/litre and 0.008 - 0.054 µg/litre respectively. The removal efficiency of total PFAS, sum of PFHxS and PFOS and PFOA ranged from 75.2% - 88.8%, 74.8% - 92.1% and 31.5% - 87.5% respectively. At this stage no definite breakthrough can be determined and continued bed volumes will be treated to provide an appropriate analysis on the longevity of the AC5 media.

Keywords

Per and Polyfluoroalkyl Substances (PFAS); Stormwater; Treatment.

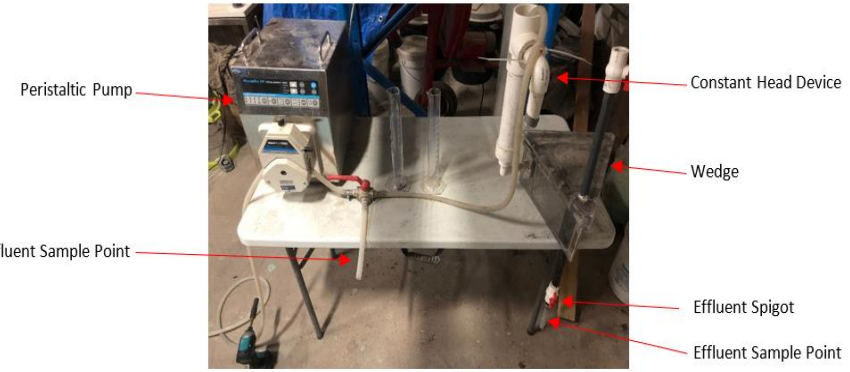


Table 1. Summary of removal efficiency for selected media and flow rate.

Media	Contaminant	Flow Rate (Litres/minute/m²)	Average Influent Conc. (µg/litre)	Average Effluent Conc. (µg/litre)	Removal Efficiency	Australian Drinking Water Guidelines (c/nc)*
AC5	Sum of PFHxS and PFOS	11.43	0.717	*0.001*	99.86%	c
	PFOA		0.019	*0.001*	94.64%	c
	Sum of PFHxS and PFOS	26.79	0.718	0.002	99.72%	c
	PFOA		0.019	*0.001*	94.83%	c
	Sum of PFHxS and PFOS	44.64	0.719	0.004	99.44%	c
	PFOA		0.019	*0.001*	94.74%	c
IX1	Sum of PFHxS and PFOS	11.43	0.810	*0.001*	99.88%	c
	PFOA		0.019	*0.001*	94.59%	c
	Sum of PFHxS and PFOS	26.79	0.769	*0.001*	99.87%	c
	PFOA		0.019	*0.001*	94.64%	c
	Sum of PFHxS and PFOS	44.64	0.830	*0.001*	99.88%	c
	PFOA		0.020	*0.001*	95.08%	c

*: c = Compliant;
nc = non-Compliant
Italicised vales are values recorded as below the laboratory level of reporting (LOR) and are presented as being equal to half of the Limit of Reporting.

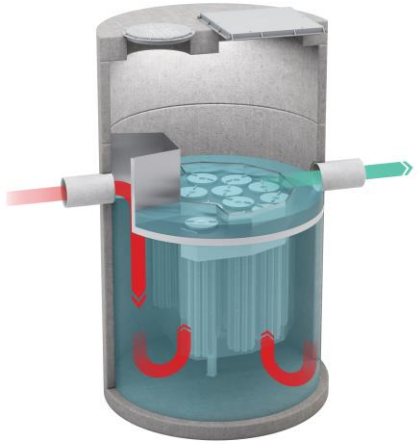
OCEAN PROTECT

The Jellyfish®

(for pre-treatment)

What is Jellyfish ?

- Membrane cartridge filtration
- Up-flow hydraulics
- Self cleaning functionality
- Flexible configurations
- Accessible & replaceable cartridges



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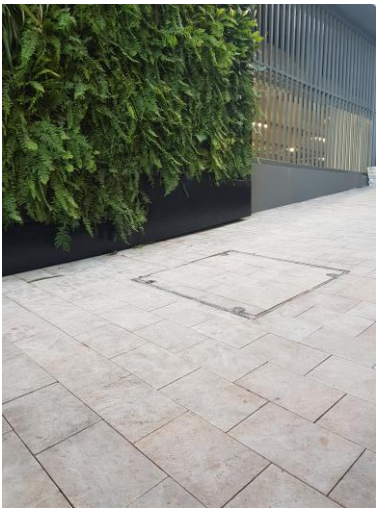
Application

- Commercial, industrial & residential areas
- Special projects (e.g. highways, airports)
- Popular for sites with low driving head



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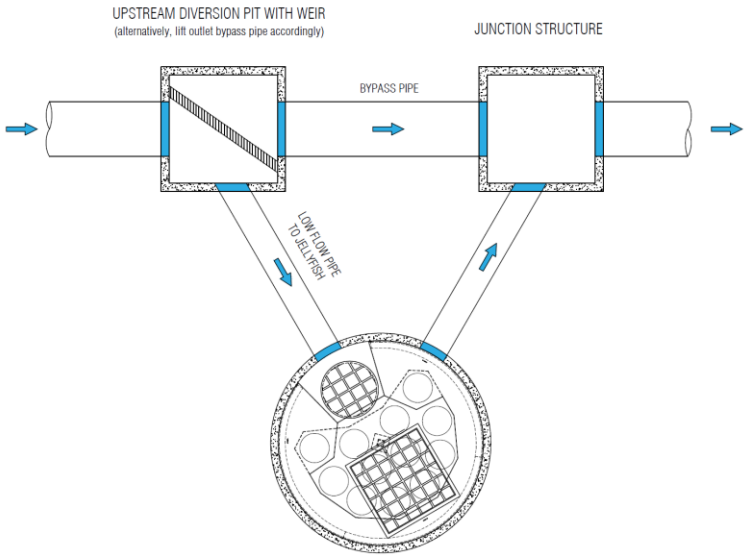
Configuration

- Precast concrete pits & tanks
- Custom chambers
- On-line or off-line



PLAN OF TYPICAL OFFLINE LAYOUT

Model	High-flow Cartridges	Drain-down Cartridges	Flow Rate (L/s)	Approximate unit Diameter (m)
JF1200-1-1	1	1	7.5	1.2
JF1200-2-1	2	1	12.5	
JF2250-3-1	3	1	17.5	2.25
JF2250-4-1	4	1	22.5	
JF2250-5-1	5	1	27.5	
JF2250-6-1	6	1	32.5	
JF2250-7-2	7	2	40	
JF2250-8-2	8	2	45	
JF2250-9-2	9	2	50	
JF2250-10-2	10	2	55	
JF3250-11-2	11	2	60	3.25
JF3250-12-2	12	2	65	
JF3250-13-3	13	3	72.5	
JF3250-14-3	14	3	77.5	
JF3250-15-3	15	3	82.5	
JF3250-16-3	16	3	87.5	
JF3250-17-3	17	3	92.5	
JF3250-18-3	18	3	97.5	
JF3250-19-4	19	4	105	
JF3250-20-4	20	4	110	
JF3250-21-4	21	4	115	
JF3250-22-4	22	4	120	
JF3250-23-4	23	4	125	
JF3250-24-4	24	4	130	
JF3250-25-5	25	5	137.5	
JF3250-26-5	26	5	142.5	
JF3250-27-5	27	5	147.5	
JF3250-28-5	28	5	152.5	

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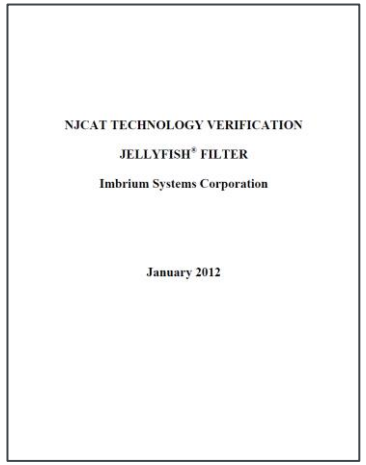
Performance

- 2 x ‘real world’, published studies
- 2 x peer review reports
- Council approved performance values

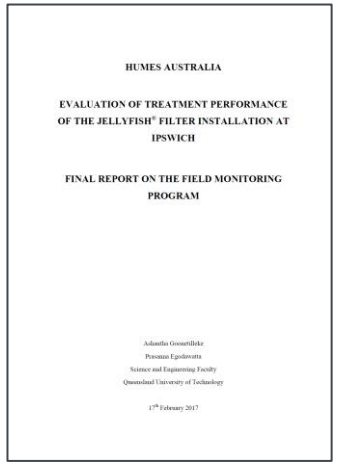


NJCAT TECHNOLOGY VERIFICATION

JELLYFISH® FILTER

Imbrium Systems Corporation

January 2012



HUMES AUSTRALIA

EVALUATION OF TREATMENT PERFORMANCE OF THE JELLYFISH® FILTER INSTALLATION AT IPSWICH

FINAL REPORT ON THE FIELD MONITORING PROGRAM

Ashantha Goonetilleke
Prasanna Egodawatta
Science and Engineering Faculty
Queensland University of Technology

17th February 2017

Evaluation of Treatment Performance of a Stormwater Treatment Membrane Filter under Australian Conditions

alluvium

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A review of the application of Jellyfish® in Australia

Date: September 2021

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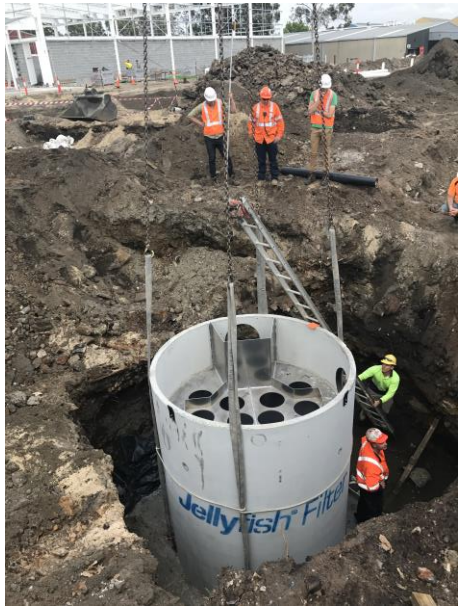
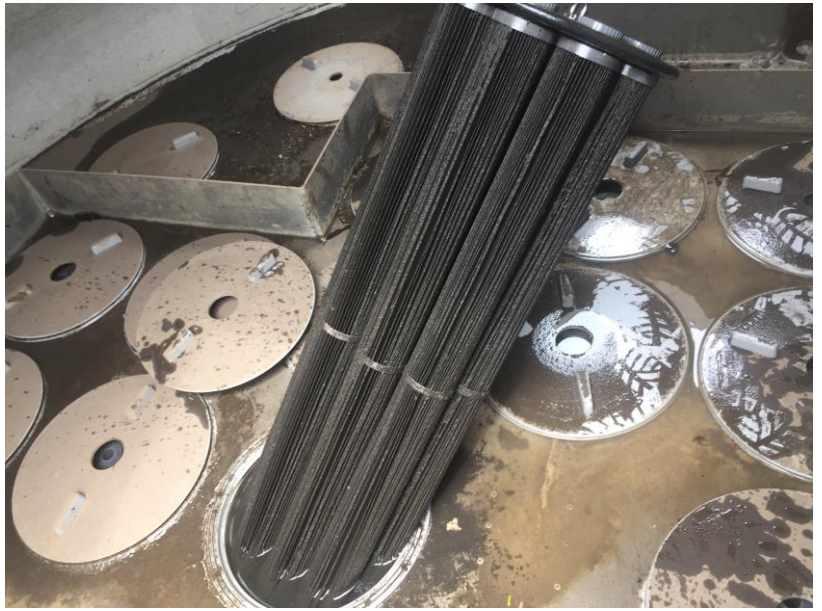
Case studies

- Over 1300 installed in Australia since 2017





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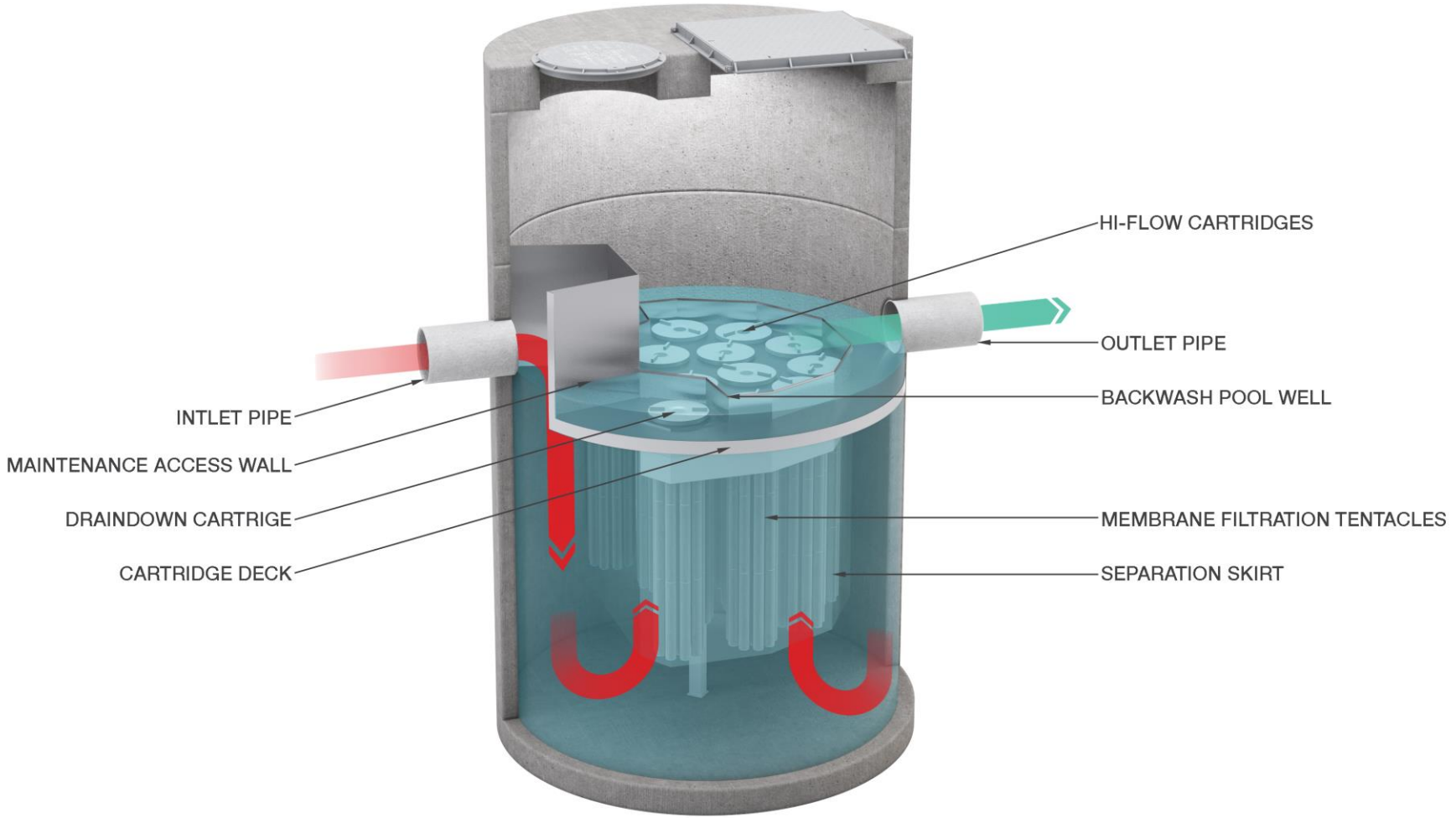
Jellyfish



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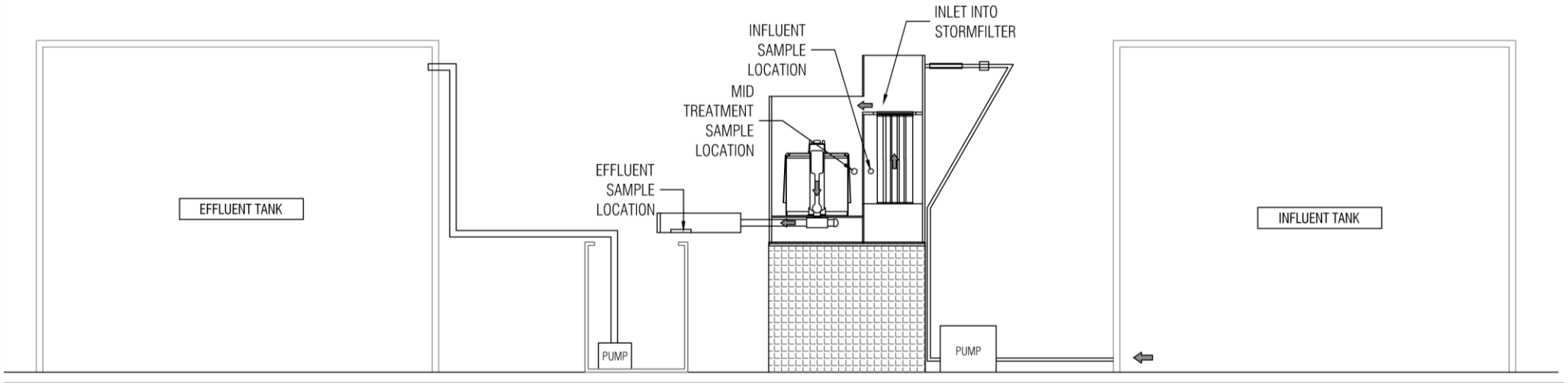
Field-scale testing

Overview of Field Scale Study



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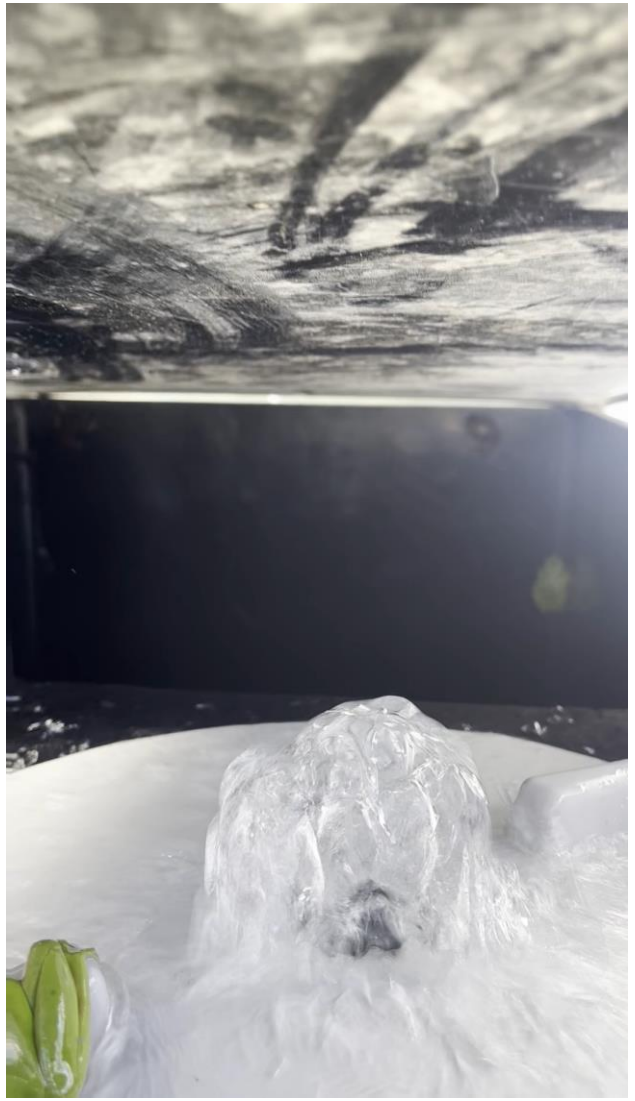
Field-scale testing

- ‘Bed volume’ defined by StormFilter (70L of media)
- 41790 litres of water (597 bed volumes) treated
- Operated & monitored in November & December 2022
- Auto-samplers sampled every 25 minutes
- 59 sampling events collected & preserved
- A total of 17 events analysed by ALS
- ‘Treatment train’ approach



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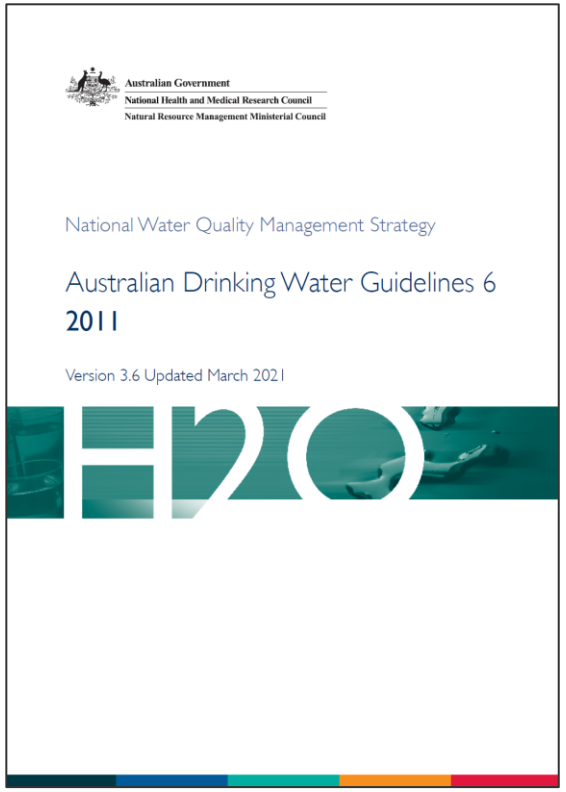
Drinking Water Guidelines



- Maximum Sum of PFOS and PFHxS conc. = 0.07µg/L
- Maximum PFOA conc. = 0.56µg/L

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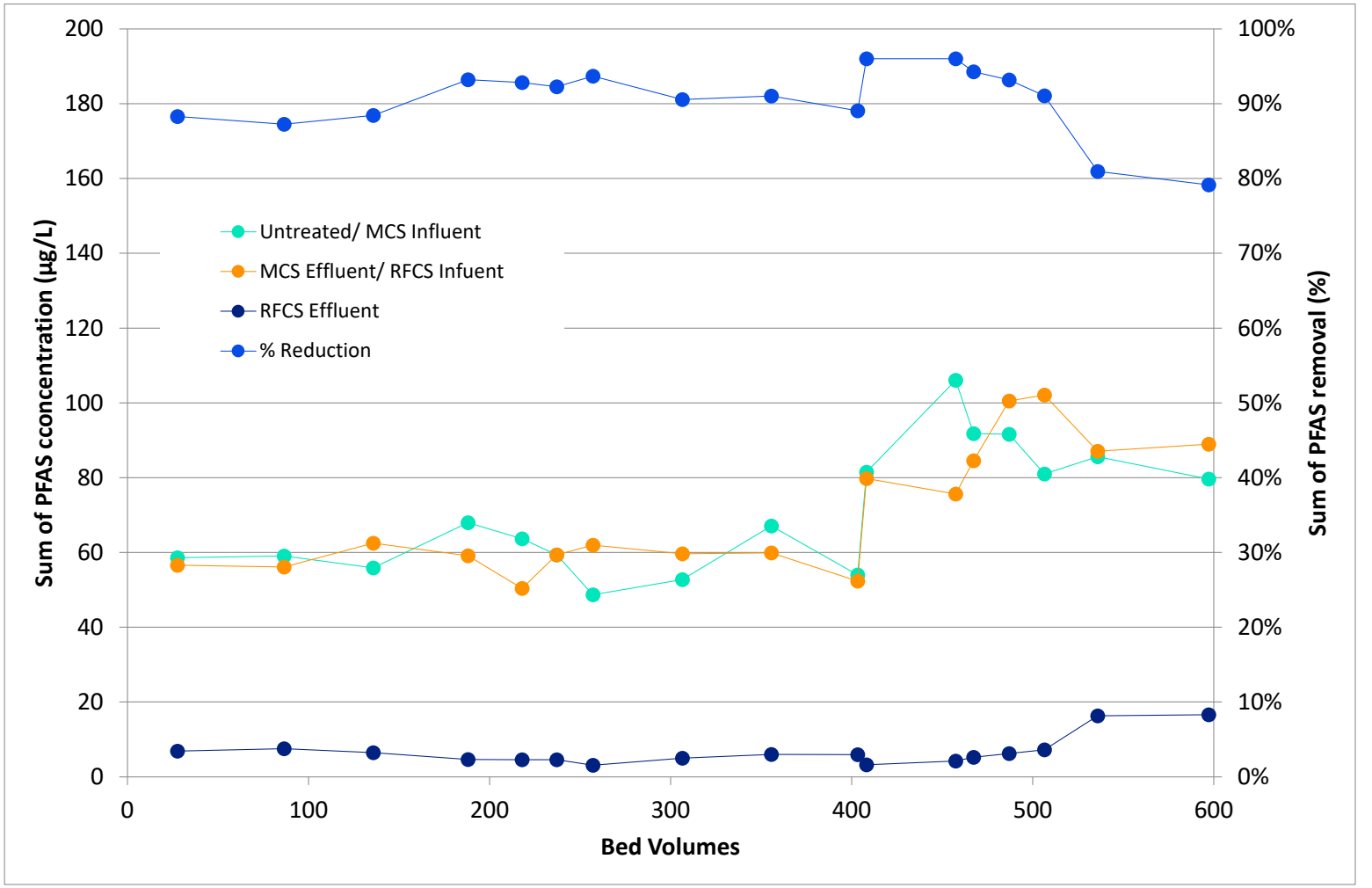
Results

Results – Sum of PFAS



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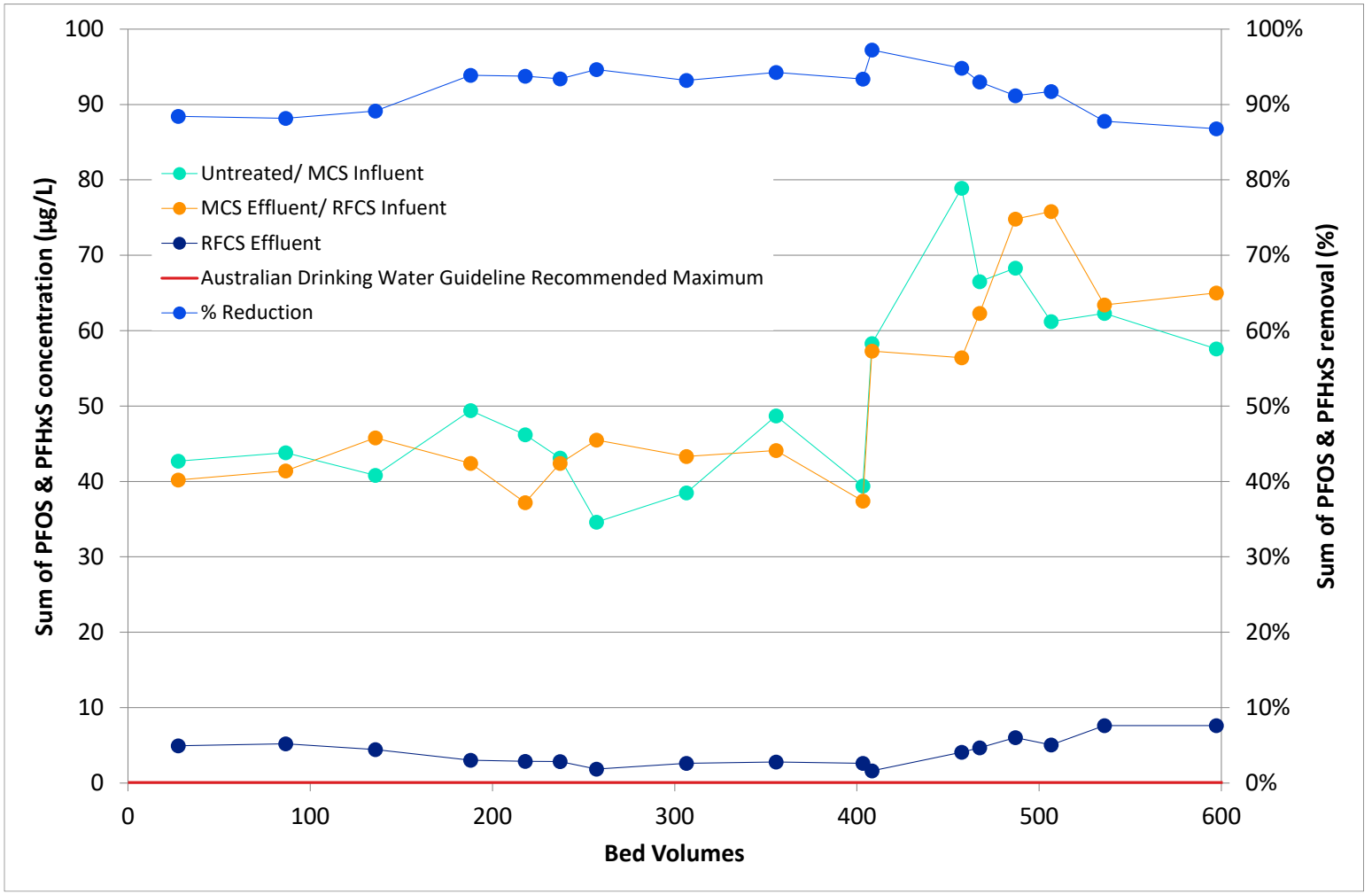
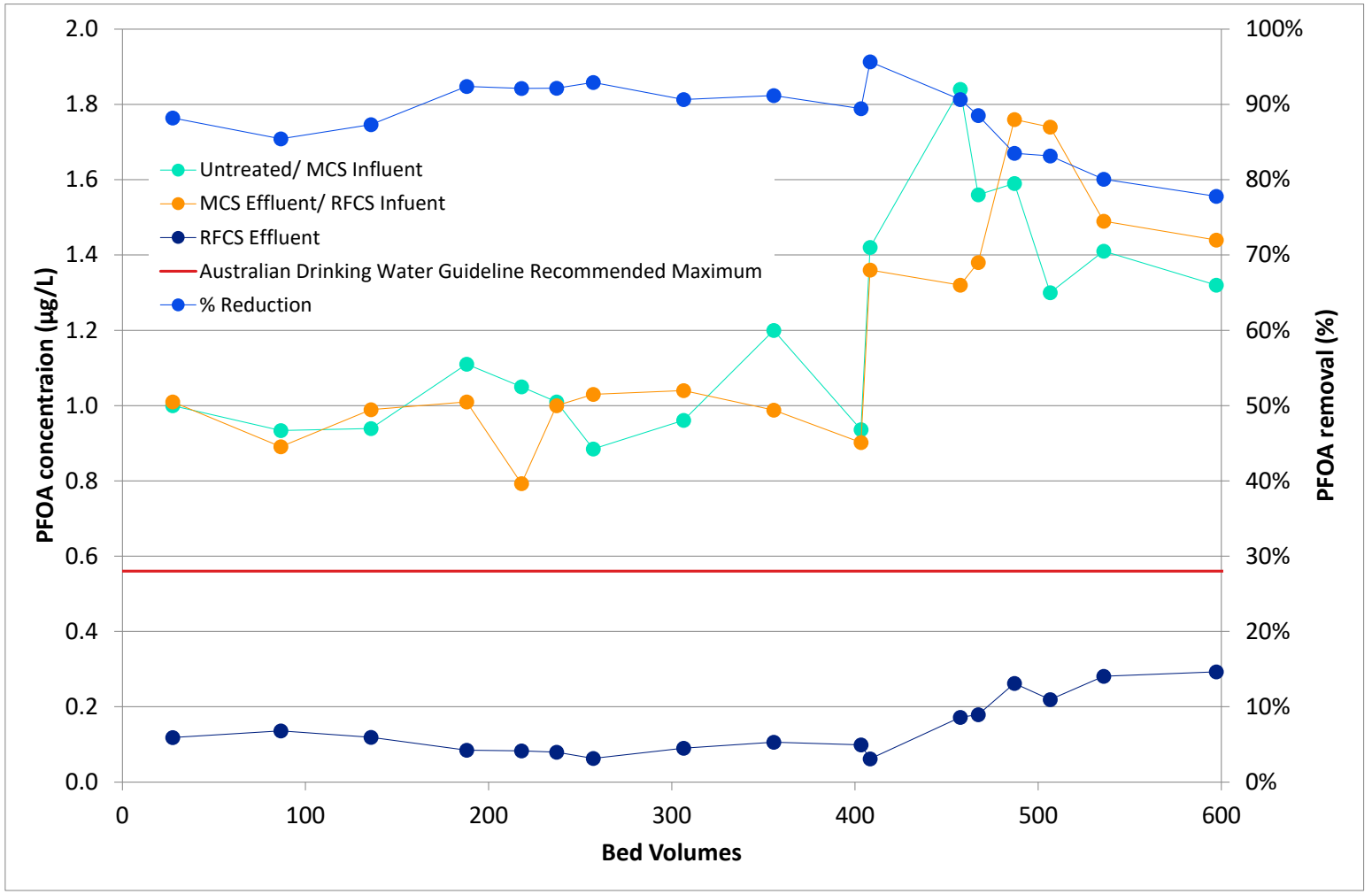
Results – Sum of PFOS & PFHxS



Results – PFOA



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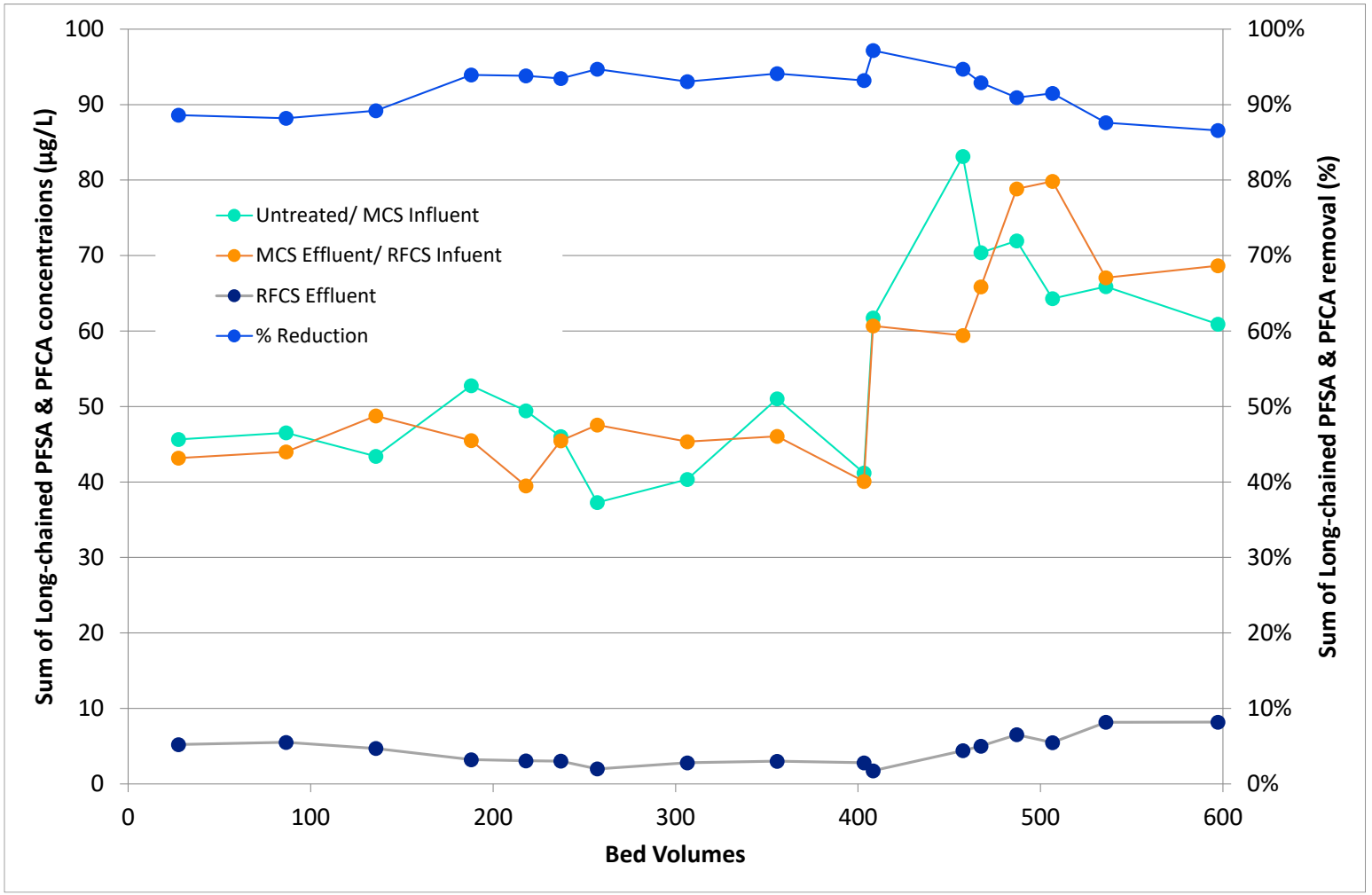
Results – Long-chained PFSAs & PFCAs



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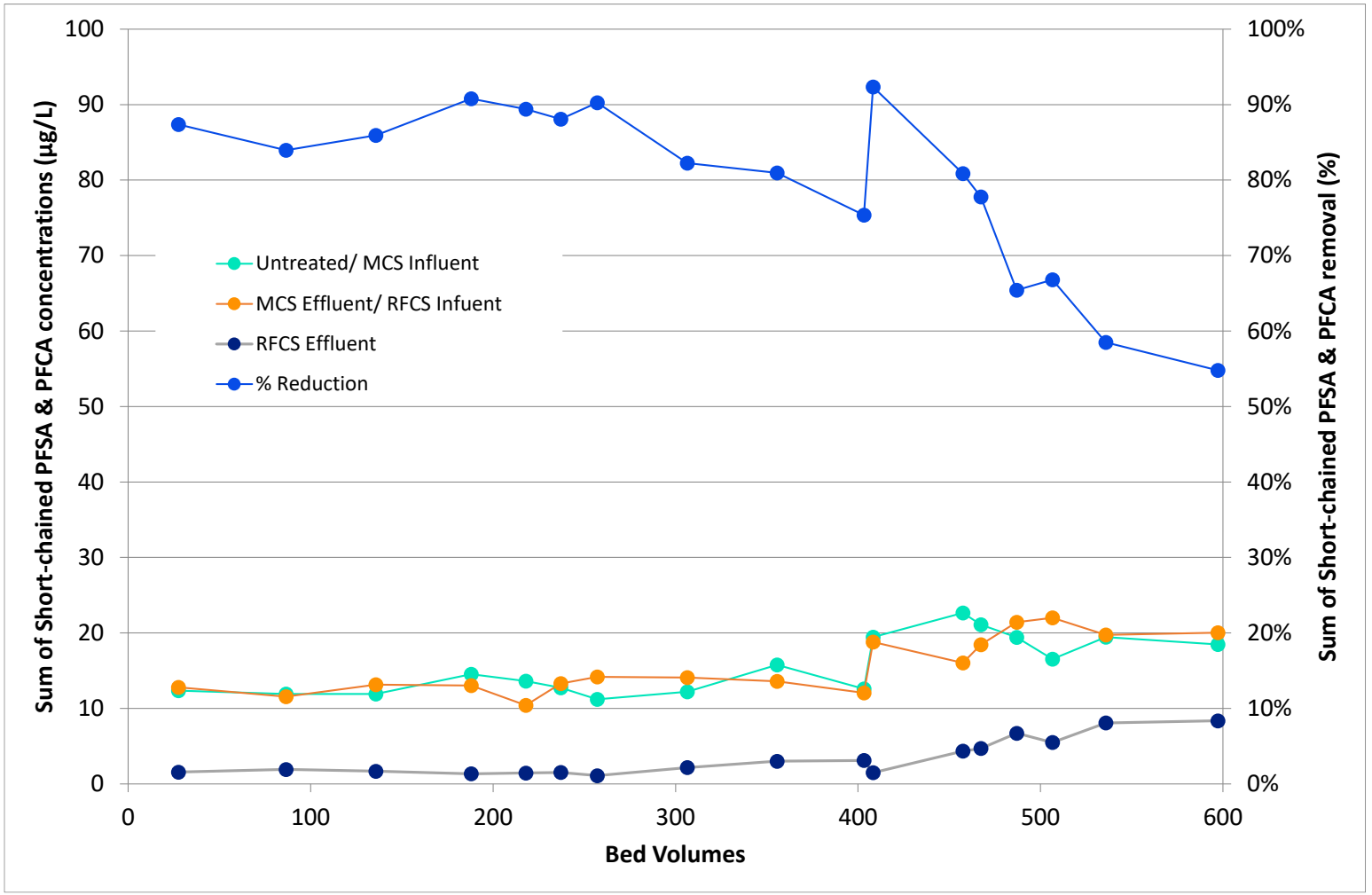
Results – Short-chained PFSAs & PFCAs



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Results – Summary (for 'peak performance period', 467 bed volumes)

PFASs	Mean concentration in untreated water (µg/L)	Mean concentration in RCFS effluent (µg/L)	Total load removal (µg)	% removal
Sum of PFAS	66.64	5.18	2010375	93%
Sum of PFHxS and PFOS	48.53	3.35	1477938	94%
Sum of PFOA	1.14	0.11	33857	91%
Sum of long-chained PFSAs & PFCAs	51.46	3.57	1566485	94%
Sum of short-chained PFSAs & PFCAs	14.77	2.26	409352	83%

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Likely applications

Likely applications

- Treatment of PFAS-contaminated surface waters
  - Military bases
  - Airports
  - Fire-training facilities

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Key considerations

Key considerations

- Incoming flow characteristics
  - PFAS concentrations/ loads & types
  - Solids concentrations/ loads
  - pH, fluoride, organic carbon, nitrogen
  - Flow rates, volumes
- Site hydraulics
- Water quality objectives
- Operation & maintenance

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Key advantages

Key advantages

- Turn-key solution
- Passive
- Underground
- Multiple ‘pass’ possible
- Remote monitoring
- Independently authored O&M guidance & SWMS’s
- Easy integration
- Lower costs

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THANK YOU

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