



Successful Site Trial of In-Situ Electrochemical Nanoremediation for PFAS Contaminated Groundwater

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12 July 2024



Photon Water

In the spirit of reconciliation,
Photon acknowledges the Traditional
Custodians throughout Australia and
their connections to land, waters
and community. We would like to pay
respect to the Gadigal People of
the Eora Nation who's land our
Sydney office operates on. We would
like to pay our respect to their
Elders past and present and extend
that respect to all Aboriginal and
Torres Strait Islander peoples
today.



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1. Aim & Trial Scope
2. Experimental Work
3. Deployment (Site Mobilisation & Operation)
4. Results
5. Conclusions
6. Learnings and Perspectives





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Australian Government

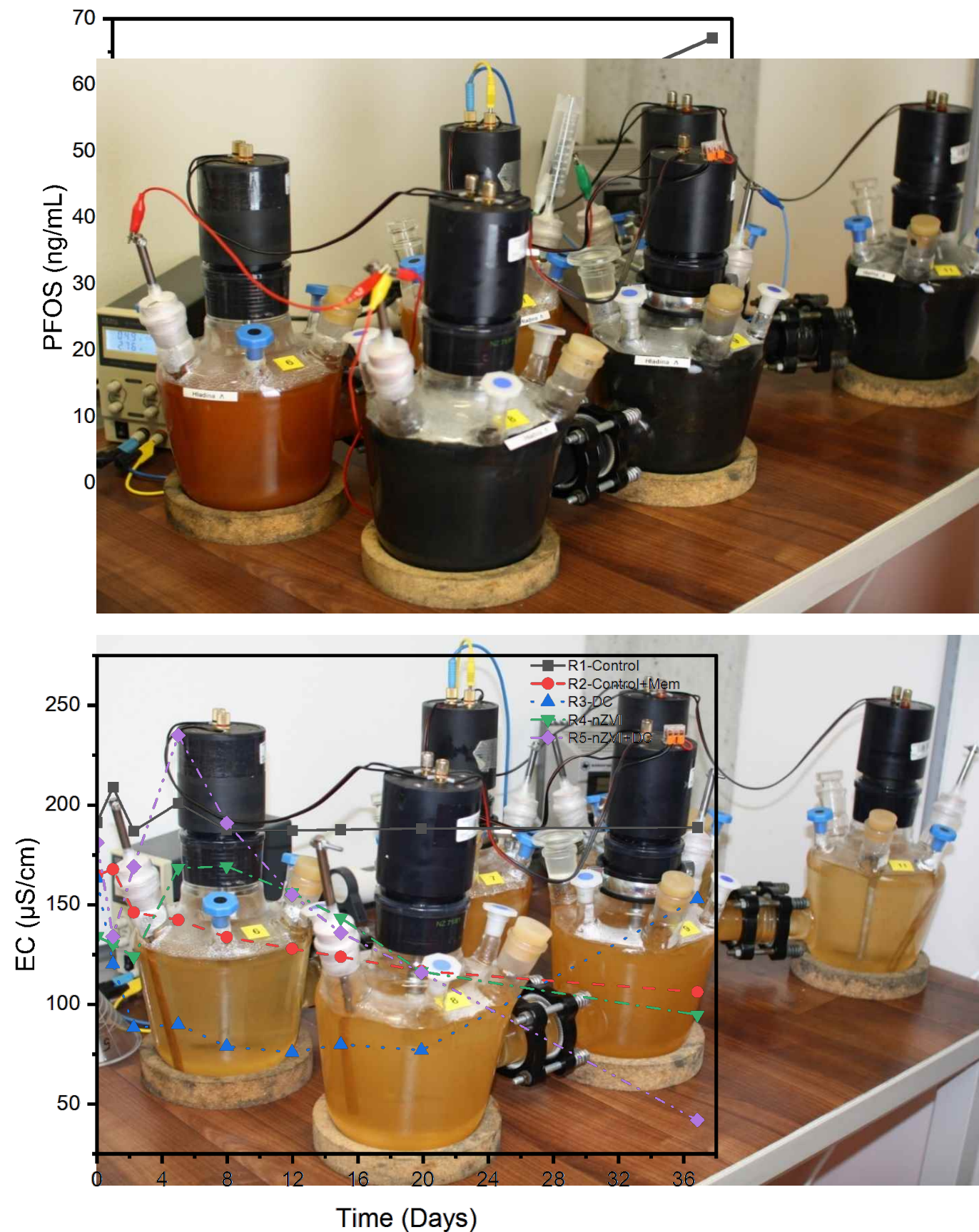
Department of Defence

The primary aim of the trial was to safely demonstrate the effectiveness of in-situ electrochemical nanoremediation (ECNR) as a solution to reduce the concentration and mass flux of PFAS contaminated groundwater.

EXPERIMENTAL WORK

Reactor Testing

- ▶ Average 94% concentration mass reduction
- ▶ Strong positive correlation of EC and PFOS (& PFAS site water) concentrations
- ▶ No incomplete mineralisation, absence of intermediate or short chain PFAS



DEPLOYMENT

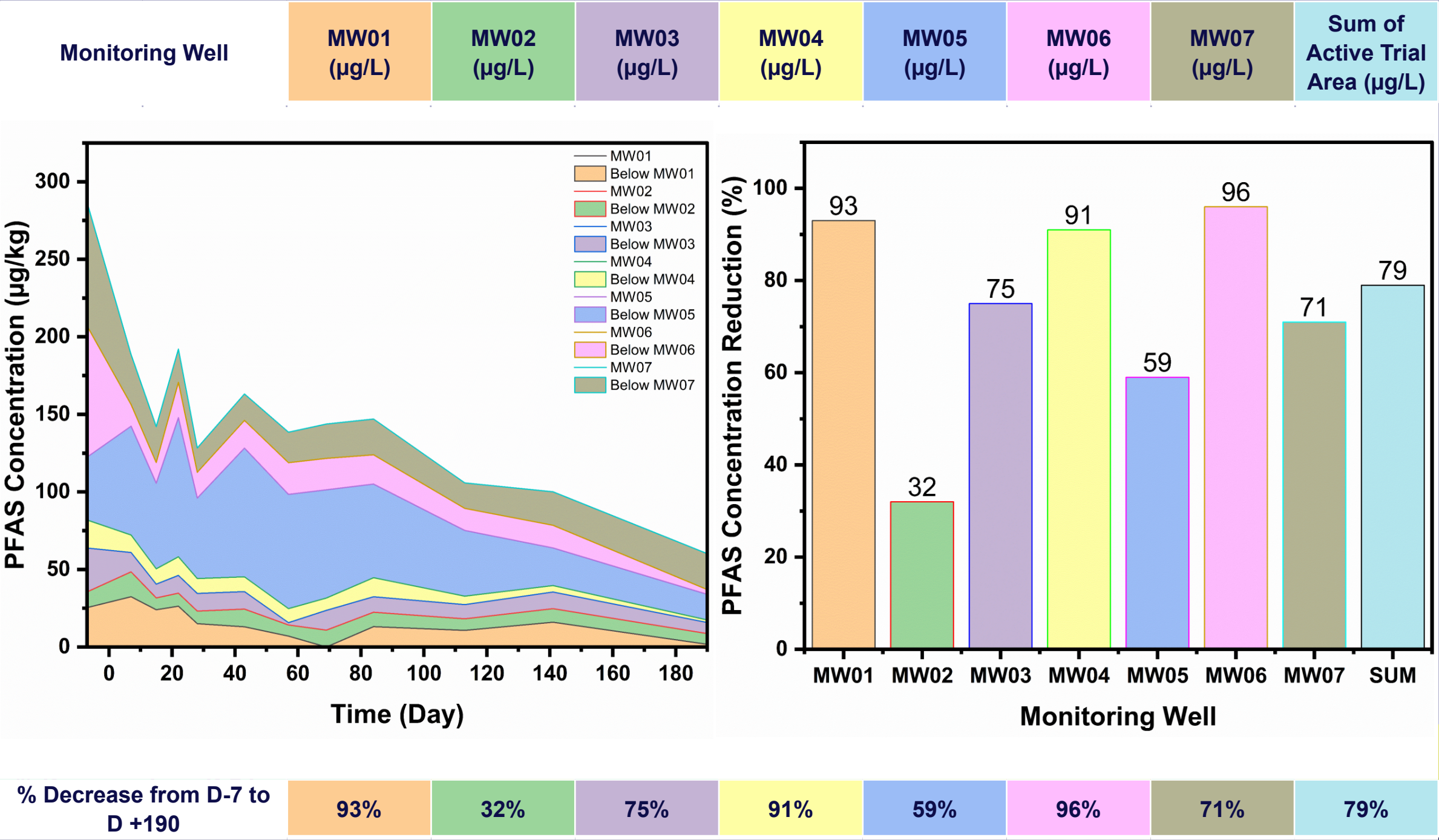
Site Mobilisation & Operation

- ▶ Site work Q1 2021 to Q2 2023
- ▶ ~ 100 m² site area with active trial site area ~ 50 m² with applied 50V
- ▶ Unconfined Pleistocene & Holocene upper aquifer with a hydraulic conductivity range 0.061m/day to 0.212m/day south-west offsite
- ▶ Low electrical energy order of removal 20W-h/Gal
- ▶ Eurofins Environmental Testing n = 30 (AUS standard) in addition to real-time physicochemical data



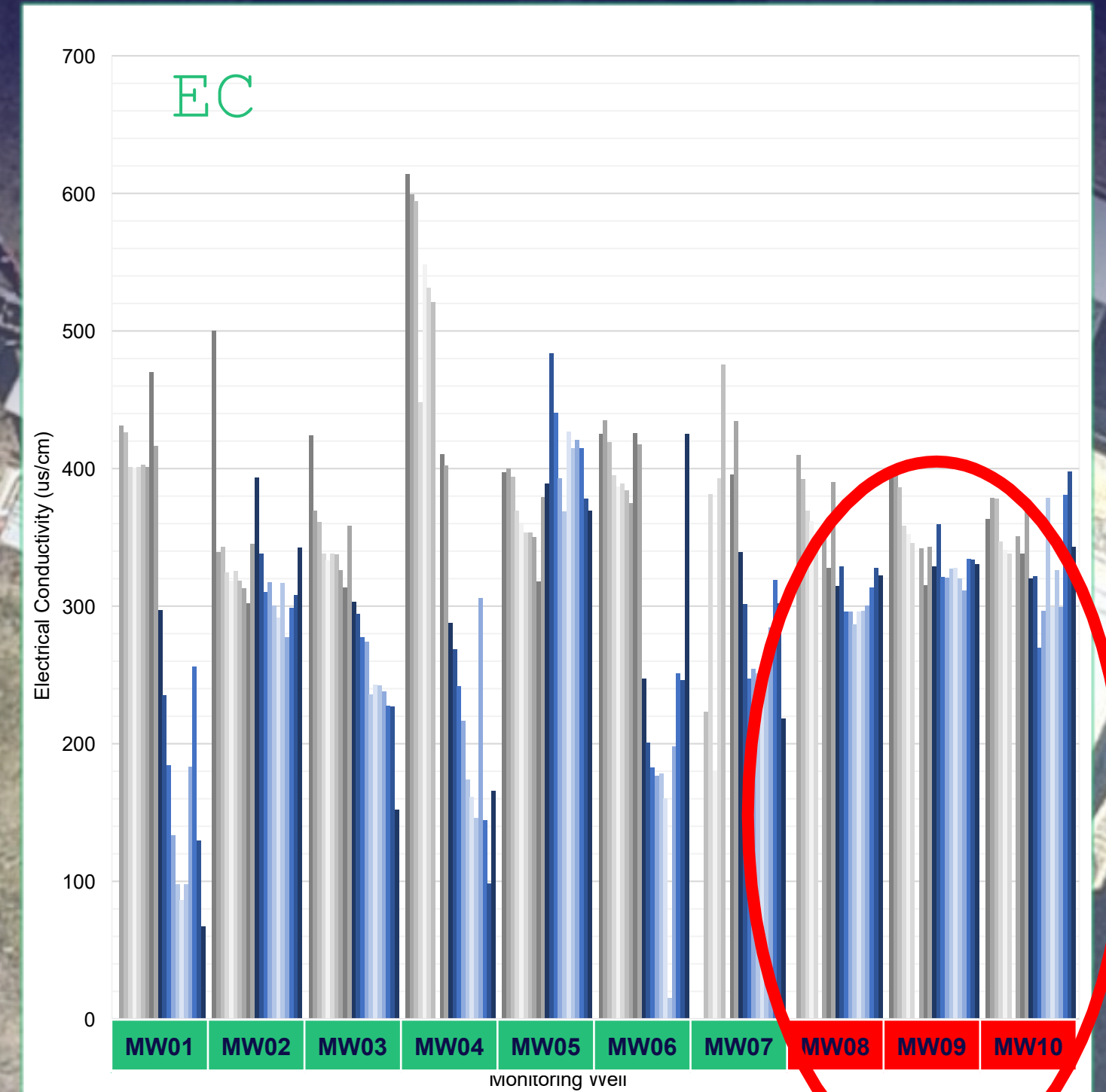
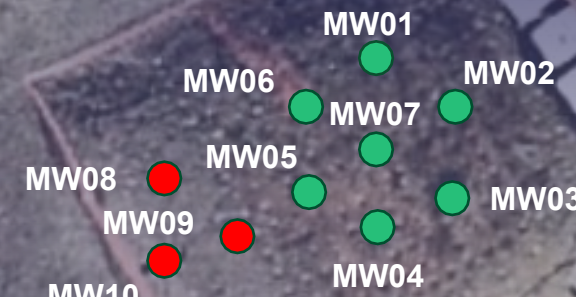
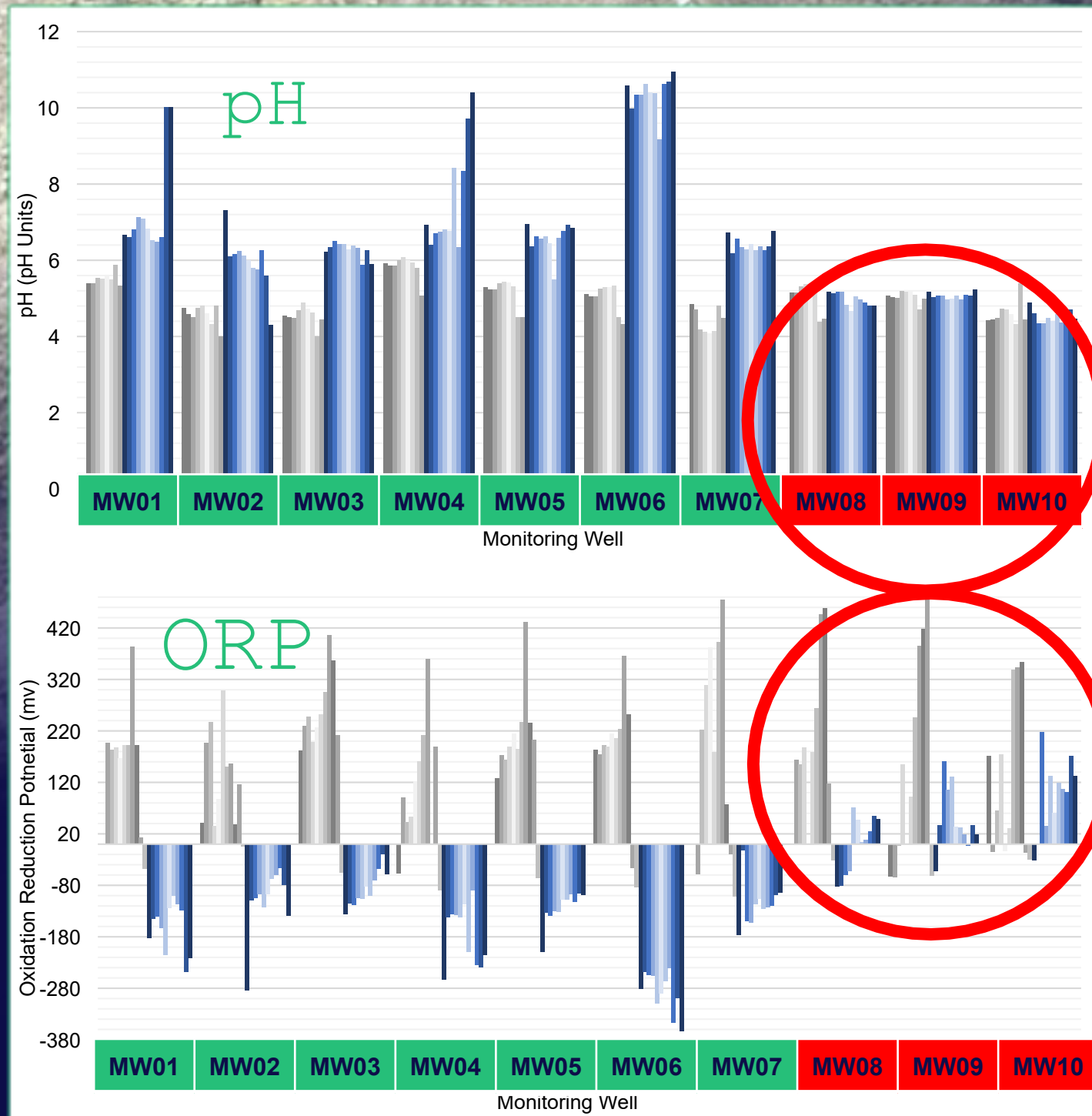
RESULTS

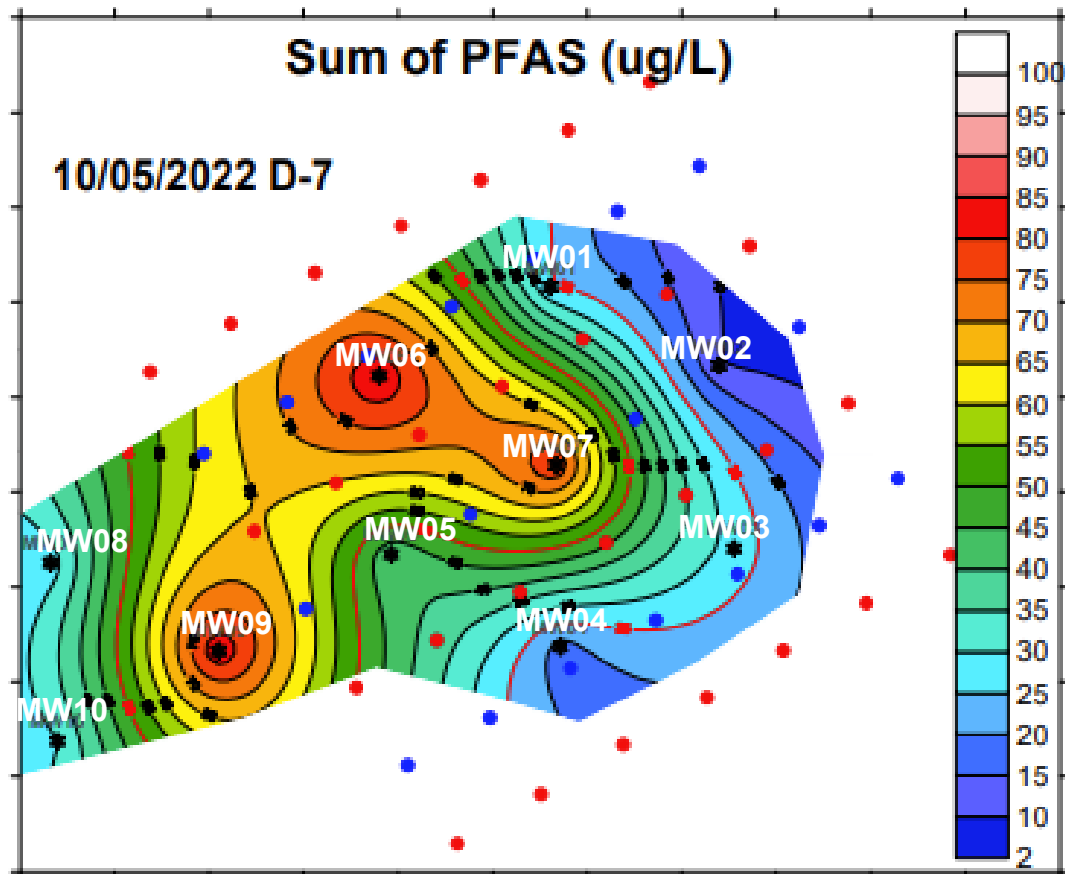
Active Trial Wells (MW01–MW07) Total Sum of PFAS



RESULTS

Control Wells
Total Sum of PFAS





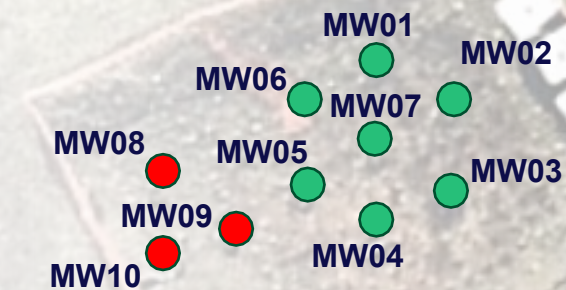
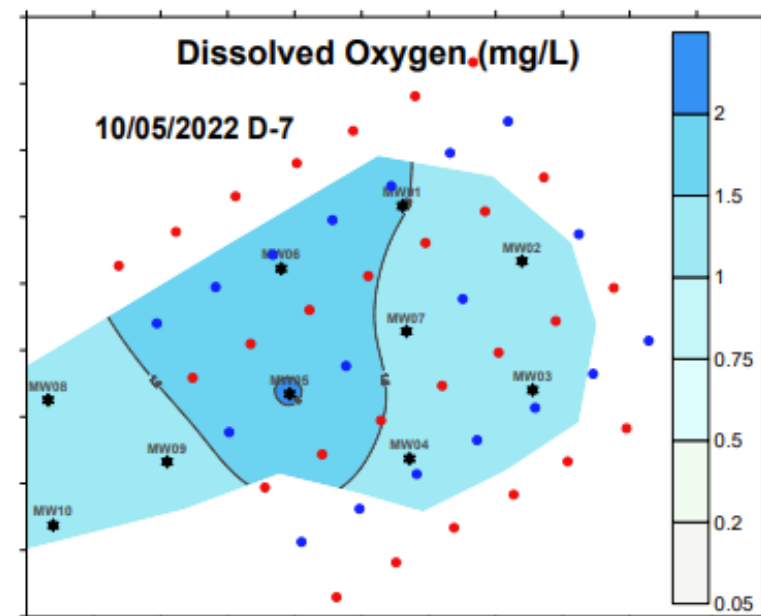
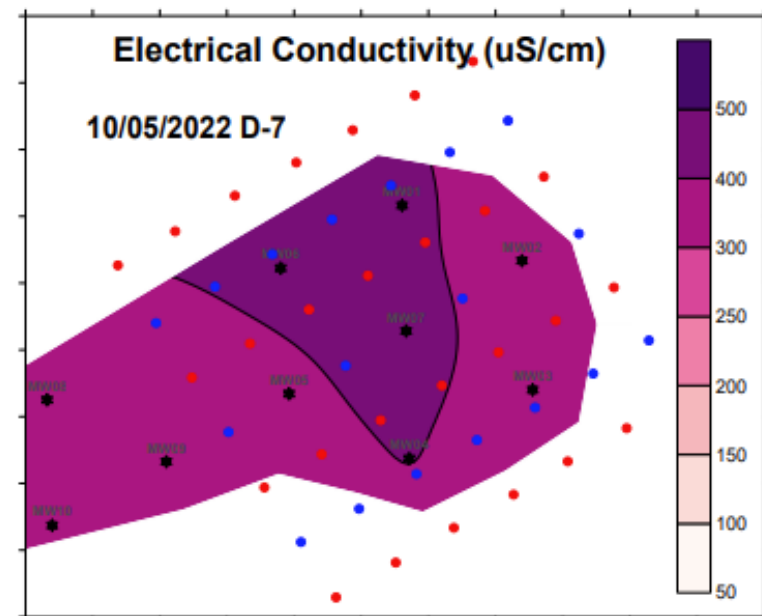
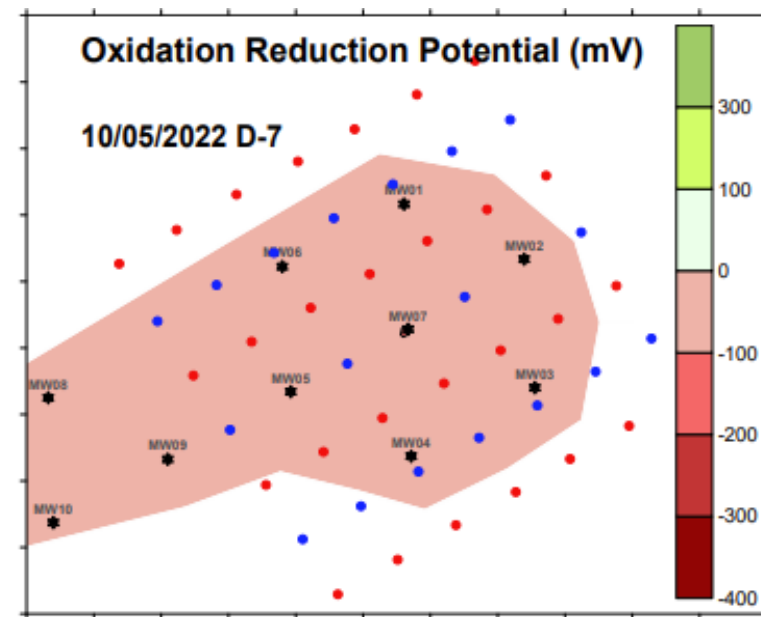
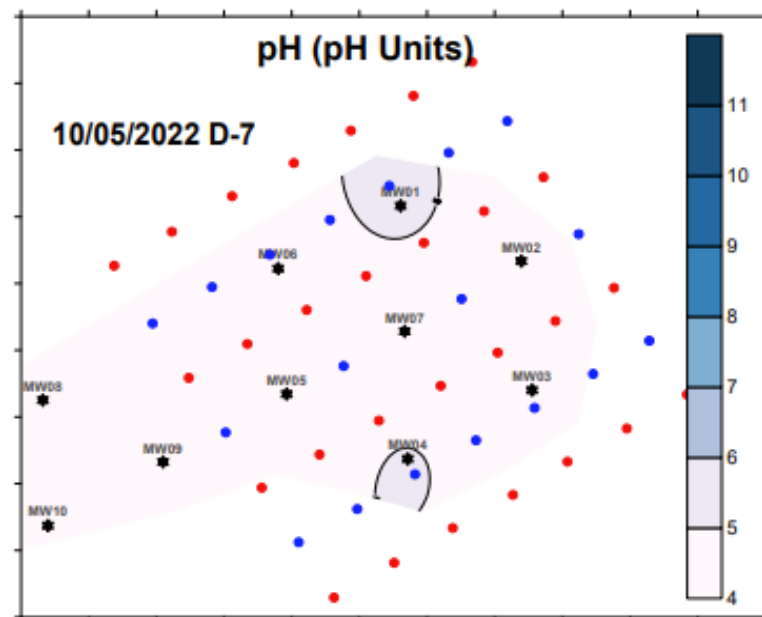
RESULTS

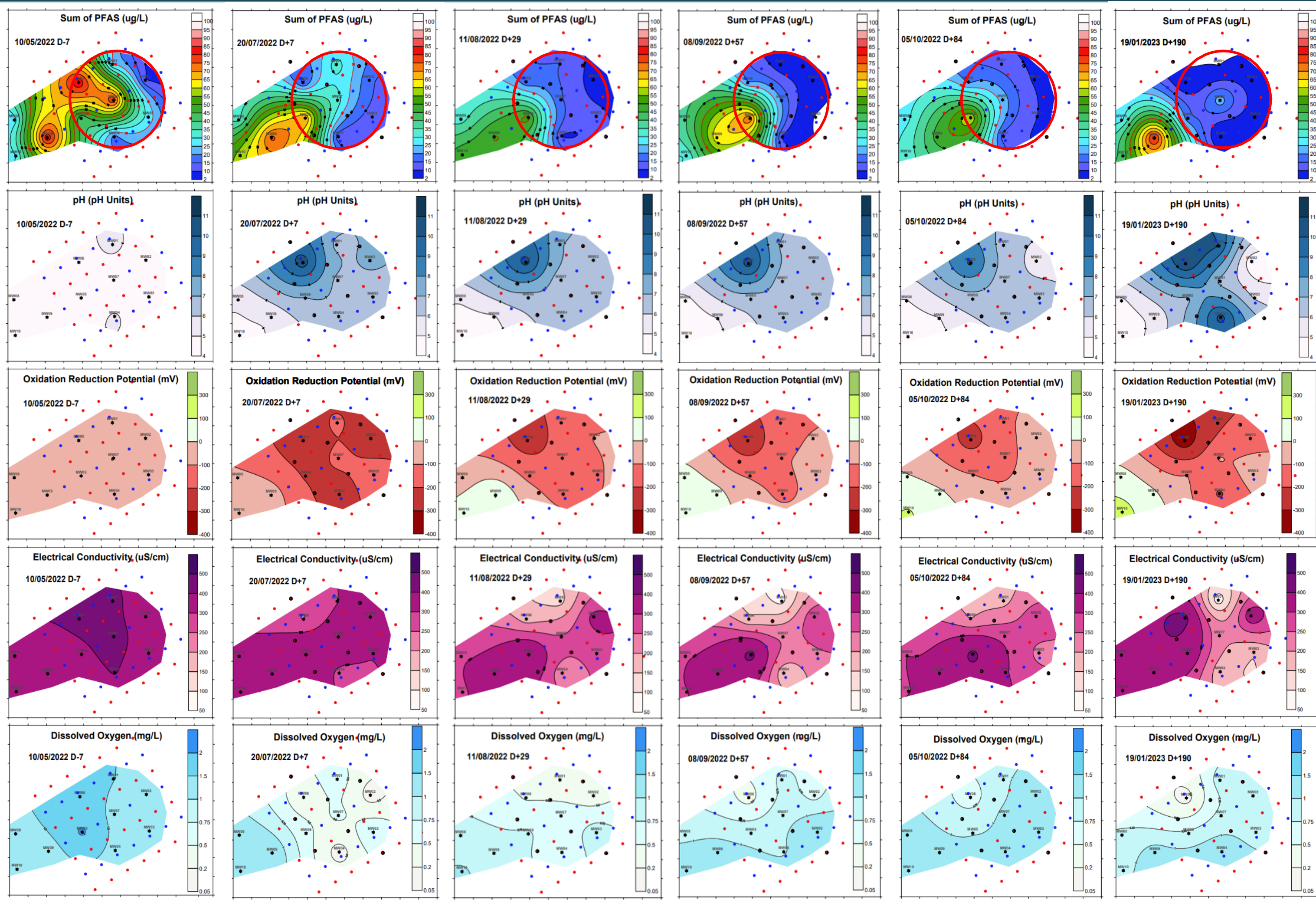
D-7

rior to injection

Sum of PFAS

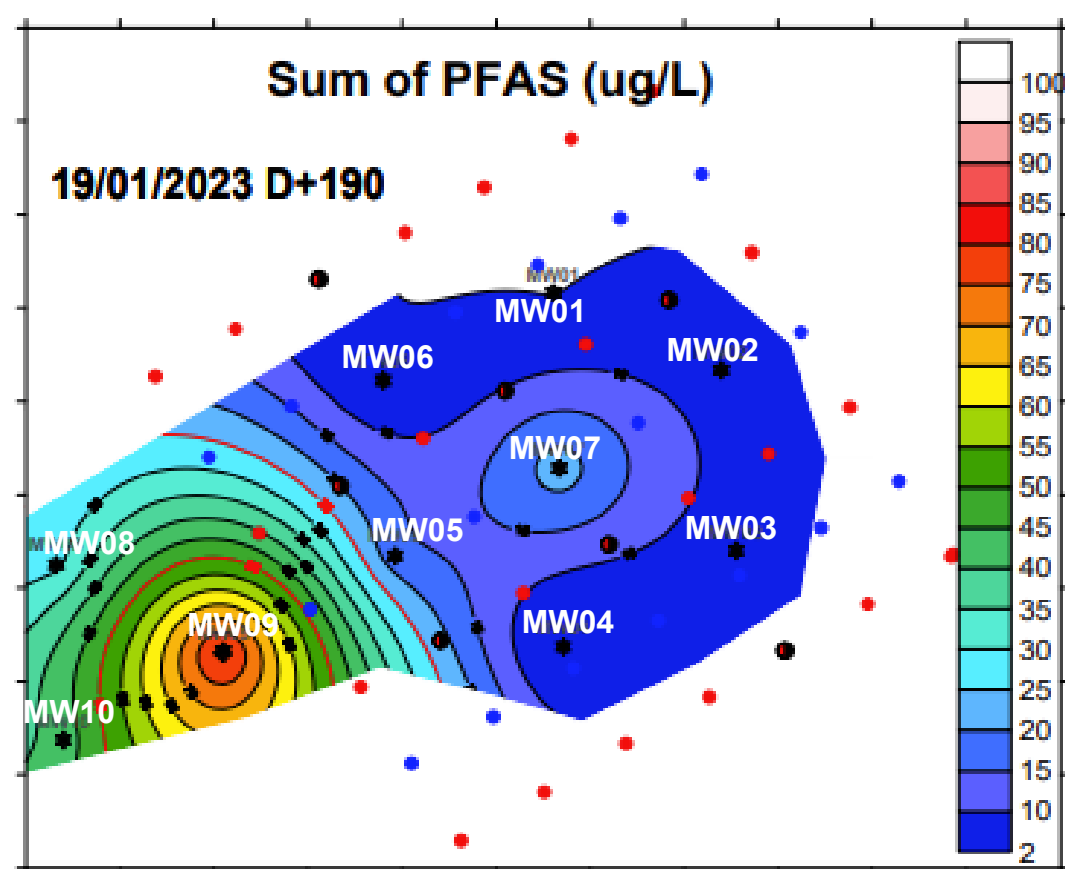
pH, ORP, EC & DO





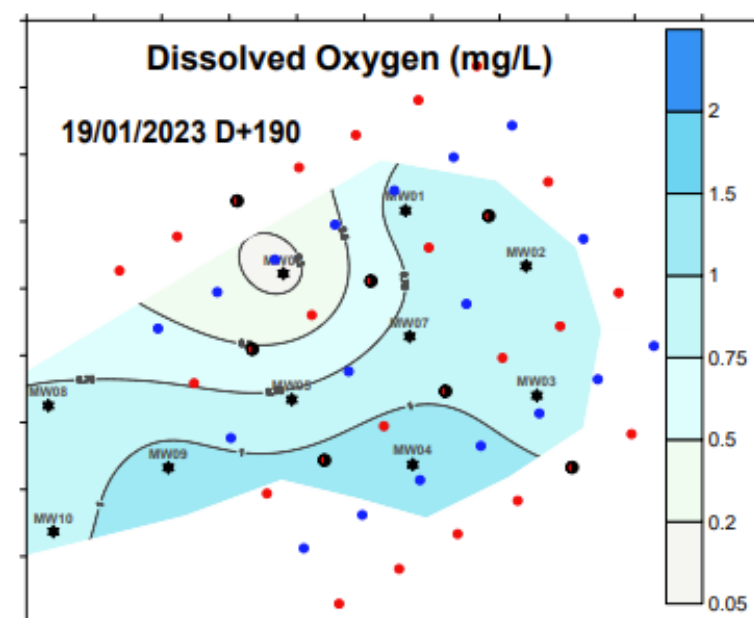
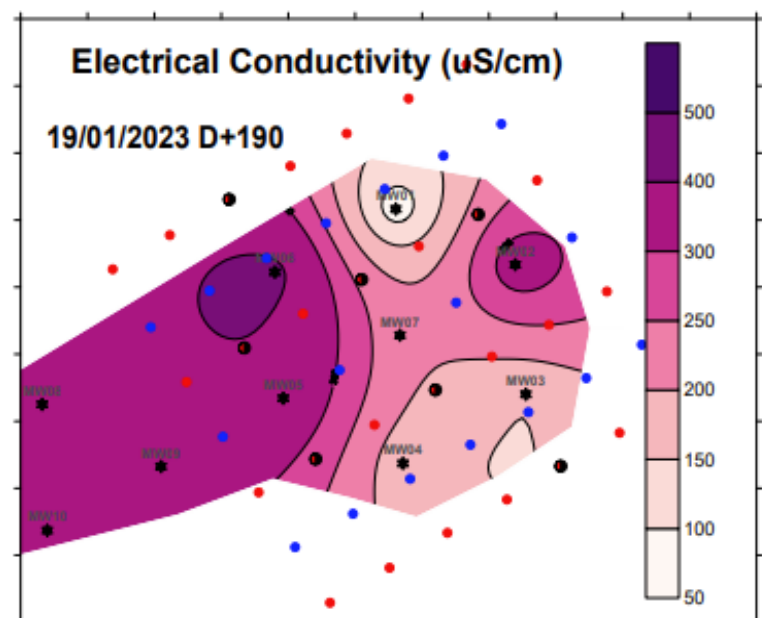
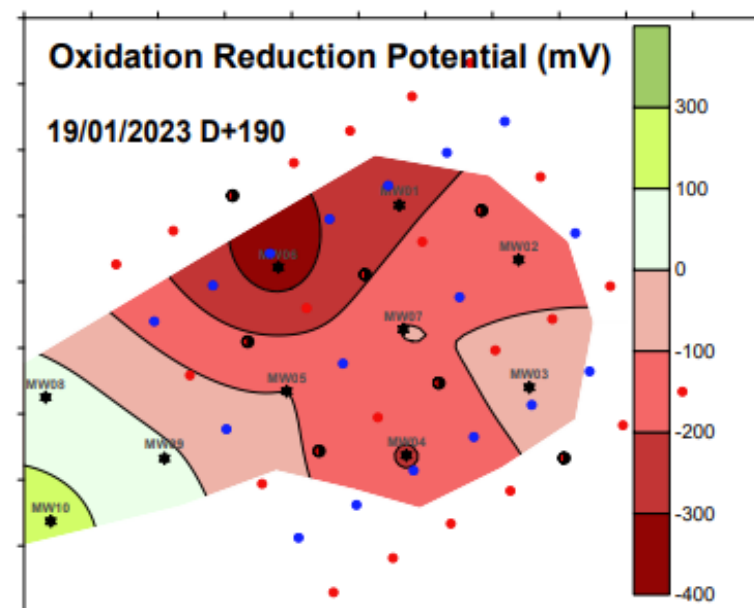
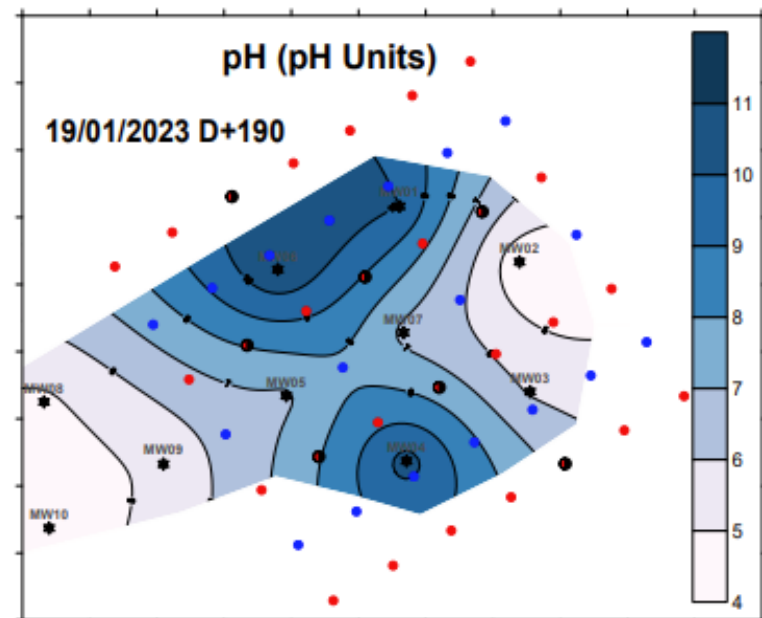
LEGEND	
Symbol	Definition
★	Monitoring Well
●	Cathode
●	Anode
●	Decommissioned Anode

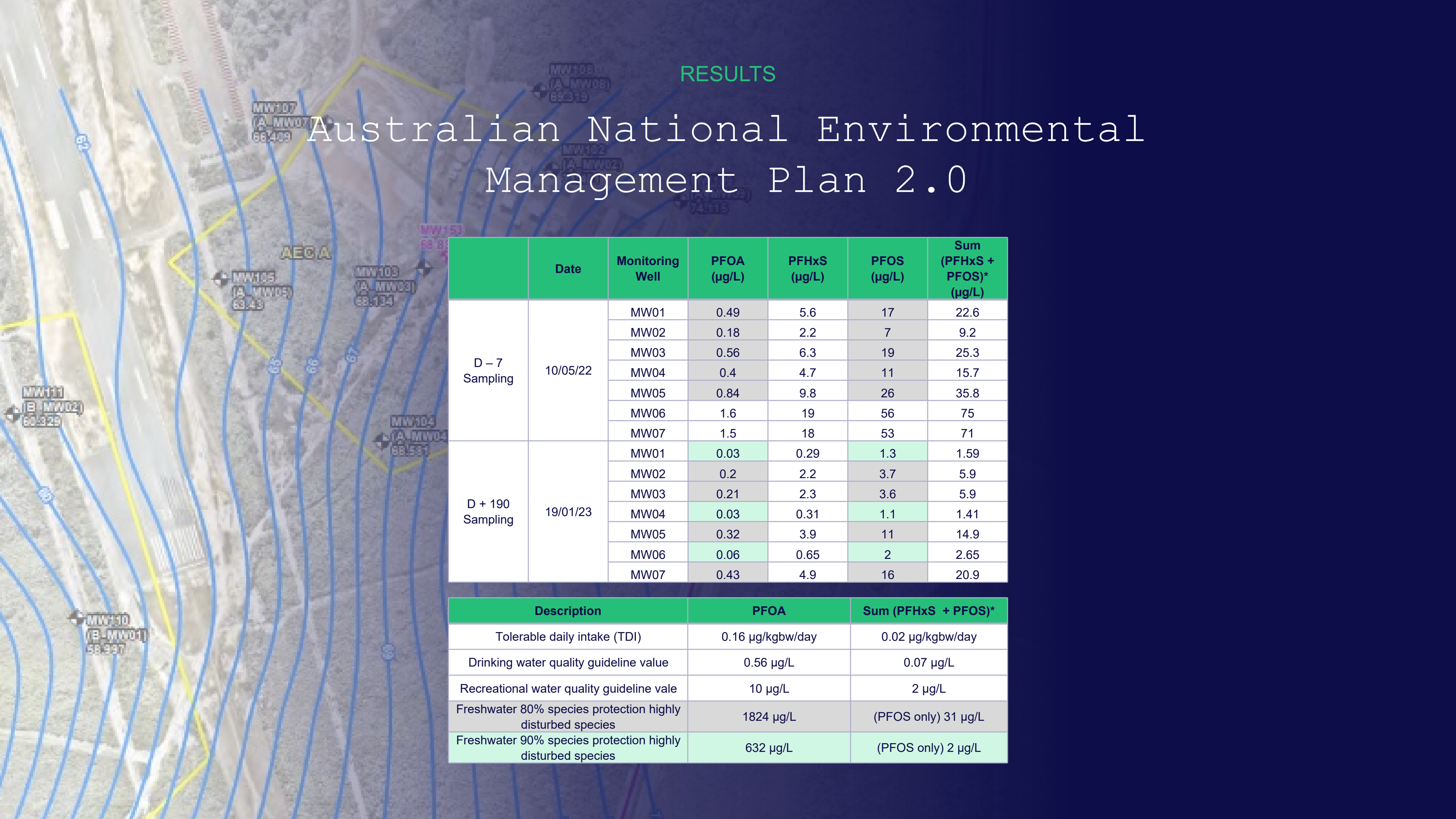




RESULTS

D+190
Post Injection
Sum of PFAS
pH, ORP, EC & DO





RESULTS

Australian National Environmental Management Plan 2.0

	Date	Monitoring Well	PFOA (µg/L)	PFHxS (µg/L)	PFOS (µg/L)	Sum (PFHxS + PFOS)* (µg/L)
D – 7 Sampling	10/05/22	MW01	0.49	5.6	17	22.6
		MW02	0.18	2.2	7	9.2
		MW03	0.56	6.3	19	25.3
		MW04	0.4	4.7	11	15.7
		MW05	0.84	9.8	26	35.8
		MW06	1.6	19	56	75
		MW07	1.5	18	53	71
D + 190 Sampling	19/01/23	MW01	0.03	0.29	1.3	1.59
		MW02	0.2	2.2	3.7	5.9
		MW03	0.21	2.3	3.6	5.9
		MW04	0.03	0.31	1.1	1.41
		MW05	0.32	3.9	11	14.9
		MW06	0.06	0.65	2	2.65
		MW07	0.43	4.9	16	20.9

Description	PFOA	Sum (PFHxS + PFOS)*
Tolerable daily intake (TDI)	0.16 µg/kgbw/day	0.02 µg/kgbw/day
Drinking water quality guideline value	0.56 µg/L	0.07 µg/L
Recreational water quality guideline vale	10 µg/L	2 µg/L
Freshwater 80% species protection highly disturbed species	1824 µg/L	(PFOS only) 31 µg/L
Freshwater 90% species protection highly disturbed species	632 µg/L	(PFOS only) 2 µg/L

CONCLUSIONS

Key Findings

- ▶ Discrete results of 100% with average of 79% MW01- MW07
- ▶ Optimal conditions (electrification and water physiochemistry) delivered avg of 93% reduction from an avg of 42.65 µg/L to 2.15 µg/L.
- ▶ 74% reduction in concentration observed in downstream well
- ▶ Quantified improvement for freshwater species protection delivering a reduced environmental risk
- ▶ Alignment with laboratory 94% mass concentration reduction with no evidence of incomplete mineralisation
- ▶ No phase transfer. Combination of mechanisms complexation, adsorption with a small amount of destruction





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Learning and Perspectives



- ▶ Australian Government, Department of Defence
- ▶ Jacobs and Consultants
- ▶ Technical University of Liberec, Dr Jaroslav Nosek, Tomáš Pluhař
- ▶ Czech Academy of Science, Dr Tomáš Cajthaml & Dr Jaroslav Semerad
- ▶ University of Technology Sydney, Dr Namuun Ganbat & Dr Ali Altaee

Thank you



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