Recycled water use in irrigated crops 2023-2025

Technical report

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Executive Summary

EPA Victoria, in partnership with CSIRO, undertook a two-stage investigation into the use of recycled water (Class A and C) for crop irrigation and its potential to introduce emerging contaminants into agricultural systems. The study aimed to assess the occurrence, transport, and uptake of a broad suite of chemical and biological contaminants in water, soil, and crop tissues under real-world field conditions.

2023 Overview

The first stage, conducted in 2023, involved sampling at seven farms across Victoria, including five farms using recycled water and two reference farms using alternative irrigation sources. Crops studied included broccoli, lettuce, and pasture. Samples collected included irrigation water, adjacent soils, and plant tissues (roots, shoots, and edible portions). High-resolution mass spectrometry (HRMS) and targeted analytical techniques were used to screen for over 2,900 chemicals (with 666 targeted chemicals), including pharmaceuticals and personal care products (PPCPs), pesticides, endocrine disrupting chemicals (EDCs), phthalates, per- and polyfluoroalkyl substances (PFAS), polycyclic aromatic hydrocarbons (PAHs), and a range of industrial chemicals such as semi-volatile organic compounds (SVOCs).

There were 70 chemicals detected in water samples, most frequently at sites using recycled water. There were 34 pesticides detected in water samples along with, 5 PAHs, 8 PFAS, 17 PPCPs, 5 phthalates, and 1 SVOCs. There were 140 chemicals were detected in soil, including 2 EDCs, 28 PAHs, 2 PFAS, 4 PPCPs, 46 pesticides, 9 phthalates and 49 SVOCs. In plant samples, there were 93 chemicals detected, which included 1 EDC, 16 PAHs, 7 PFAS, 4 PPCPs, 36 pesticides, 5 phthalates, and 24 SVOCs.

2024 Study Overview

Building on the 2023 findings, the second stage in 2024 focused on two crops—broccoli (Class A water) and pasture (Class C water)—across six farms, including two reference farms. Sample collection was expanded for robustness, with 10 replicate samples of water, soil, and plant tissue per farm, alongside surface water sampling from nearby rivers to evaluate potential off-site transport.

Targeted chemical analysis focused on PPCPs, PFAS, pesticides, and selected industrial chemicals. Physicochemical parameters (pH, EC, nutrients, trace elements) were also measured, and plant health was evaluated using biomass and pigment (chlorophyll, carotenoids) content.

A total of 79 chemicals were detected in water samples, which included 1 EDC, 11 PAHs, 7 PFAS, 33 PPCPs, 12 pesticides, 3 phthalates, and 12 SVOCs. Only PFAS was analysed for in soil samples, with PFDA and PFOS being detected. Plant samples were analysed for PFAS and PPCPs, with 7 chemicals detected in plant tissues (carbamazepine, DEET, tramadol, tebuconazole, PFBA, PFBS, PFHxS).

Key Findings (2023 & 2024)

- Recycled water consistently contained a greater number and concentration of chemicals than reference water.
- Studies found limited evidence of emerging contaminants transferring into edible plant tissues.
- No impact of recycled water on crop health was observed. Differences in plant pigments and biomass appeared linked to crop maturity, not to irrigation source.
- Some pesticides were found in edible parts of the plants from the reference farms not using recycled water for irrigation, indicating on-farm sources (e.g. direct pesticide application).
- The reference farm irrigation water for broccoli contained PPCPs, suggesting other potential sources (e.g. river water).
- Concentrations of PFAS found in edible crops do not present an adverse risk to human health.
- Based on this study, recycled water can be used for crop irrigation, if the quality of the water is regularly monitored, and use managed appropriately.

- Ongoing monitoring and the inclusion of more crop types and locations are recommended to refine risk assessments and management strategies.

Project Background

Emerging contaminants include pharmaceuticals and personal care products (PPCPs), phthalates, pesticides, endocrine disrupting chemicals (EDCs) and per- and polyfluoroalkyl substances (PFAS). Using treated wastewater can discharge these contaminants into the environment.

It is important that recycled water scheme proponents and users take reasonable steps to manage the risk posed to human and environmental health from emerging contaminants. However, little is known about the impact to crops and soil from these chemicals in Victoria, nor in Australia more broadly.

The purpose of this project was to measure emerging contaminants in irrigation water, soil and crops in farms that rely on Class A and C water as a resource. Results from the farms were compared to those not using recycled water, as well as local ambient concentrations in nearby rivers.

The results presented here will help us to:

- Establish baseline concentrations of emerging contaminants in the agro-ecosystem (soil, plants, water) in Victoria.
- Understand whether emerging contaminants accumulate into edible crops irrigated with recycled water and present an adverse risk to human health.
- Improve state of knowledge and support the recycled water industry in meeting their GED requirements.

1.1 Aims

Here we present results from a field study conducted over 2023-2025 to better understand how recycled water impacts the chemical load of crops. Specifically, the study aimed to:

(1) Understand whether recycled water use on farms contains emerging contaminants that may end up in soil or crops used for human (broccoli, lettuce) and animal (ryegrass) consumption

(2) Compare farms using recycled water to those using other water sources, to understand the difference in emerging contaminants that may be present in recycled water.

(3) To help farmers, regulators and the public understand the potential for emerging contaminants in recycled water to accumulate in crops and pasture.

1.2 Intended audience

This report is intended for a broad audience. It provides valuable insights for water authorities, academics, industry stakeholders, recycled water users and members of the community who want to understand the potential impacts of recycled water on agricultural systems and the environment.

Methods

2.1 2023 Sampling

For the 2023 campaign, seven farms were included in the study. For broccoli and ryegrass, two farms using recycled water were compared to one reference farm that did not use recycled water. One farm that uses recycled water for lettuce was also included. Farms were selected primarily based on their recycled water class (A or C) and crop type.

Pasture farms growing ryegrass (*Lolium perenne*) for cattle and sheep grazing were in central-northern Victoria. In this region, flood (border check) irrigation is common due to the low topography and prevalence of sodic soils with poor water retention (Agriculture Victoria 2023). Border check irrigation is a type of irrigation that distributes water via open irrigation channels to irrigation bays that are enclosed by earthen banks.

Market garden farms growing broccoli (*Brassica oleracea var. italica*) and iceberg lettuce (*Lactuca sativa var. capitata*) were in south-western Victoria. Recycled water has been used for market garden crop irrigation in this region since 2005 (Barker et al. 2011). Fixed sprinkler irrigation is common, and recycled water is shandied with river water to reduce salinity, improving the suitability of recycled water for growing market garden crops. A summary of each farm sampled is provided in Table 1.

Table 1. Summary of the seven farms sampled in Victoria in 2023.

Site ID	Crop type	Recycled water class	Irrigation type	Notes
F01	Ryegrass pasture	Class C	Flood	Recycled water only; cattle and sheep grazing.
F02	Ryegrass pasture	Class C	Flood	Recycled water shandy with dairy runoff; dairy cattle grazing.
F03	Ryegrass pasture	-	Flood	River water only; dairy cattle grazing.
F04	Broccoli	Class A - diluted	Fixed sprinkler	Recycled water shandy with river water.
F05	Broccoli	Class A - diluted	Fixed sprinkler	Recycled water shandy with river water.
F06	Broccoli	-	Fixed sprinkler	River water only
F07	Lettuce	Class A - diluted	Fixed sprinkler	Recycled water shandy with river water.

In April 2023, the main sampling of crops, soil and water was undertaken. Timing coincided with a period where irrigation water was necessary for crop growth. Water samples (n = 6 per recycled water farm, n = 4 per reference farm) were collected, using a stainless-steel sampling pole for channels and lagoons, or by holding bottles directly under the fixed sprinkler. Irrigation systems were flushed for 5 minutes prior to sampling. Amber glass and HDPE bottles were used. Standard preservatives (H_2SO_4) were either pre-added or added using a micropipette once the bottle was filled to reduce the sample to pH 3 for analyte preservation.

For crops sampling, at harvest, loose soil was removed from around the crop to ease extraction. Roots were gently shaken to remove bulk soil particles and crop height measured. For each broccoli and lettuce sample, two adjacent plants were collected, one for chemicals analysis and one for AMR analysis. Whole

crop samples were stored in large LDPE bags. For ryegrass pasture, all grass plants within a 30 cm x 30 cm area were collected from two adjacent plots and stored in two large LDPE bags.

Soil samples were collected from the soil surrounding the excavated crop. Soil 0 – 10 cm deep was mixed thoroughly using a stainless-steel trowel and sampled to represent the depth that crop roots had most contact with. Samples were stored in amber glass or HDPE jars. All samples were immediately packed on ice in sealed boxes for overnight transport to CSIRO for analysis.

2.2 2024 Sampling

Following the 2023 campaign, sampling was undertaken again in 2024 to build on findings. The second stage focussed on two crops – broccoli (Class A water) and pasture (Class C water), utilising the same farm locations, as well as sampling the nearby rivers to assess background levels or offsite transport.

A summary of the farms and rivers sampled in 2024 is provided in **Table 2**.

Table 2. Farms and surface water locations sampled in 2024.

Site ID	Crop type	Recycled water class	Irrigation type	Notes
F01	Ryegrass pasture	Class C	Flood	Recycled water only; cattle and sheep grazing.
F02	Ryegrass pasture	Class C	Flood	Recycled water shandy with dairy runoff; dairy cattle grazing.
F03	Ryegrass pasture	-	Flood	River water only; dairy cattle grazing.
F04	Broccoli	Class A - diluted	Fixed sprinkler	Recycled water shandy with river water.
F05	Broccoli	Class A - diluted	Fixed sprinkler	Recycled water shandy with river water.
F06	Broccoli	-	Fixed sprinkler	River water only
Goulburn River	-	-	-	-
Werribee River	-	-	-	-

Sample collection involved the same methods as 2023, with expanded sample sizes. A total of 10 samples each of water, soil and plant tissue were collected per farm, allowed for improved replication and robustness in the data. Only surface water samples were collected from the river locations. Following the same procedures undertaken in 2023, all samples were immediately packed on ice in sealed boxes for overnight transport to CSIRO for analysis.

2.3 High resolution mass spectrometry (HRMS) analysis

High resolution mass spectrometry (HRMS) is a non-target analytical technique that is used to screen the molecular masses of compounds present in a sample, which can then be compared to a pre-existing database to identify the presence of chemicals. It is a useful initial screening tool, as a means of guiding targeted, quantitative analysis. Because HRMS is not able to measure the exact concentrations of specific chemicals that may be present in a sample, targeted analysis using certified standards is still

needed. Initial screens using tools like HRMS analyses can make further chemical analysis more efficient through identifying chemicals that are likely to be present for quantification.

In both sampling years, non-target HRMS was used as an initial screening step. See Appendix B for specific details on how HRMS was conducted in this study.

2.4 Targeted quantitative analysis of emerging contaminants

Targeted quantitative analysis is a highly sensitive means of measuring the concentrations of emerging contaminants that may be present in a sample, which is essential for characterising the risk of chemicals in the environment.

In both 2023 and 2024, broad suites of emerging contaminants were targeted. These included EDCs, PPCPs, polycyclic aromatic hydrocarbons (PAHs), PFAS, phthalates, a range of pesticides including herbicides, insecticides and fungicides, as well as a suite of semi-volatile organic compounds (SVOCs). A range of naturally occurring chemicals (associated with plant and soil processes) was also detected, these results are available in Appendix B.

- In 2023, a total of 666 emerging contaminants were targeted.
- In 2024, a total of 694 emerging contaminants were targeted.

Table 3 outlines the groups of emerging contaminants that were analysed for in each year.

Table 3. Emerging contaminant groups analysed for in each year, by sample type.

Year	Sample type	Analyte groups						
		EDCs	PAHs	PFAS	PPCPs	Pesticides	Phthalates	SVOCs
2023	Irrigation water	☑	☑	☑	☑	☑	☑	☑
	Soil	☑	☑	☑	☑	☑	☑	☑
	Plant	☑	☑	☑	☑	☑	☑	☑
2024	Irrigation water	☑	☑	☑	☑	☑	☑	☑
	River water	☑	☑	☑	☑	☑	☑	☑
	Soil	☒	☒	☑	☒	☒	☒	☒
	Plant	☒	☒	☑	☑	☒	☒	☒

Further explanation of methods for extraction and analysis are in the detailed CSIRO reports included in Appendix B.

Results

Results for each sampling year are summarised below, by emerging contaminant group. See Appendix A for overall summary statistics of emerging contaminant groups detected at each site in each sampling year. Summary results for SVOCs can be found in Appendix A.

3.1 HRMS analysis results

In 2023, the HRMS screen was only conducted on water samples, resulting in six chemicals found that were not detected using the targeted analysis. These were pesticides atrazine deisopropyl and haloxyfop, and PPCPs fexofenadine, gabapentin, ibuprofen, and tolazoline.

In 2024, HRMS analysis found 46 chemicals in pasture irrigation water, and 51 chemicals in broccoli irrigation water. These included 34 PPCPs, 26 pesticides and their metabolites, 12 SVOCs and 5

chemicals of natural origin. Of the emerging contaminants identified in recycled water that were not of a natural origin, 2 chemicals were identified in pasture shoots and 8 chemicals were identified in broccoli florets, with most of these chemicals being pesticides. Principal components analysis (PCA) found that there was a difference in the chemical composition of water between the recycled water sites and reference sites, indicating recycled water is a source of emerging contaminants.

For detailed HRMS analysis results, see CSIRO reports in Appendix B.

3.2 Targeted quantitative analysis results

3.2.1 EDCs

In 2023, EDCs were only detected in soil and broccoli samples, but not water samples. EDCs were detected in soil at all pasture sites and one broccoli site (Figure 1), and mean concentrations were highest at the pasture reference site F3 (mean ± SD = 0.29 ± 1.15 µg/kg). Progesterone and tert-octyl-phenol were the only two EDCs that were detected in soil, with the highest concentration detected for tert-octyl-phenol (6 µg/kg). For plant samples, EDCs were detected only at broccoli sites F4 and F5 (Figure 1), with the highest mean concentration detected in broccoli florets at site F4 (3.0 ± 26.83 µg/kg). tert-octyl-phenol was the only EDC detected in plant samples, with the highest concentration detected at 240 µg/kg.

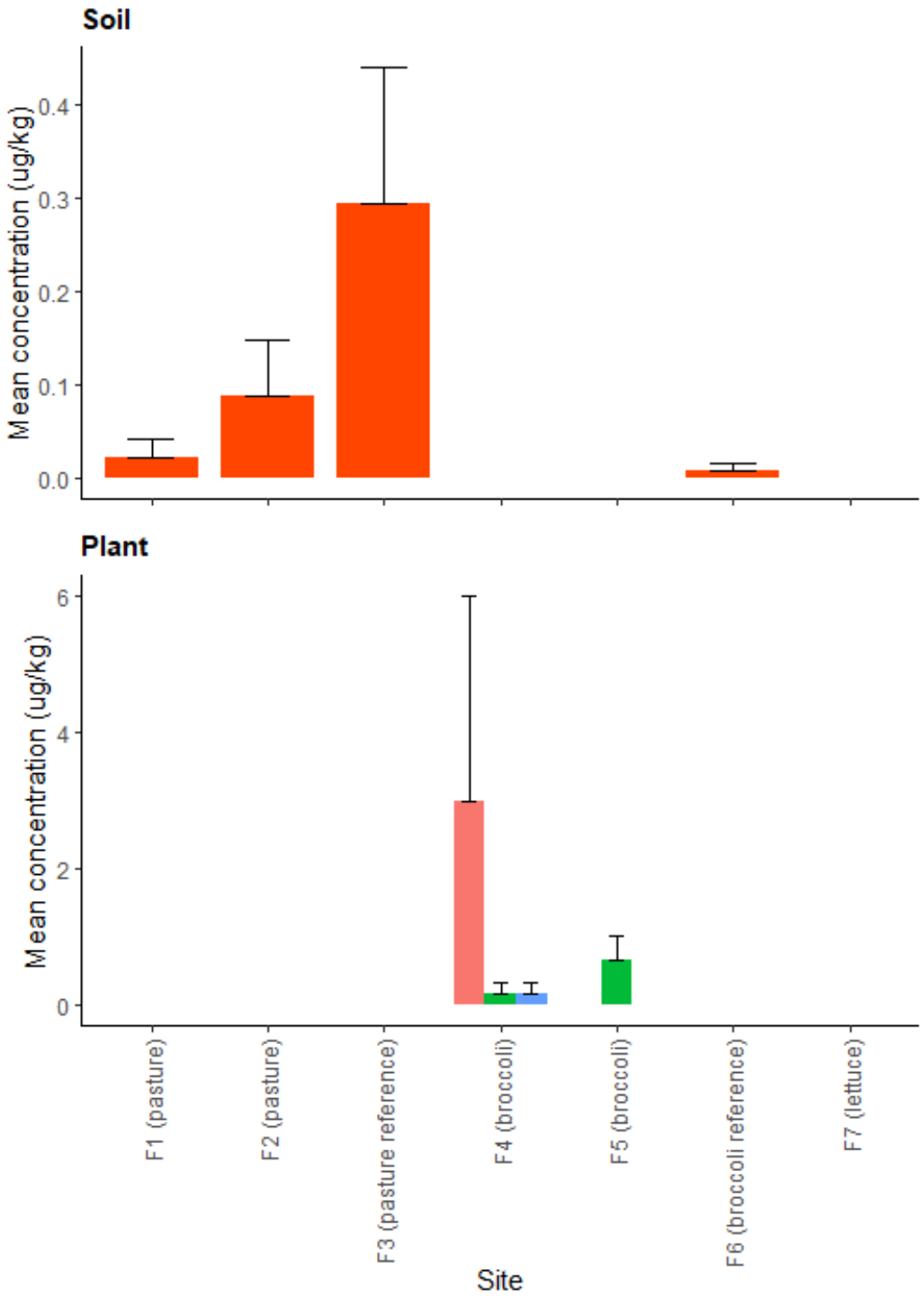

Figure 1. Mean concentrations of endocrine disrupting chemicals (EDCs) detected in soil and plant samples at each site in 2023, including standard error bars. n = 6 replicates for sites F1, F2, F4, F5, F7, and 4 replicates for reference sites F3 and F6.

In 2024, EDCs were only analysed for in water and not soil or plant samples. In water samples, mean concentrations were highest in the Goulburn River samples (mean ± SD = 0.0047 ± 0.020 µg/L), and at pasture reference site F3 (0.0044 ± 0.018 µg/L) (Figure 2). EDCs were not detected at any of the broccoli farm sites (Figure 2). The only EDC detected in all water samples was Bisphenol A with the highest concentration detected at 0.1 µg/L.

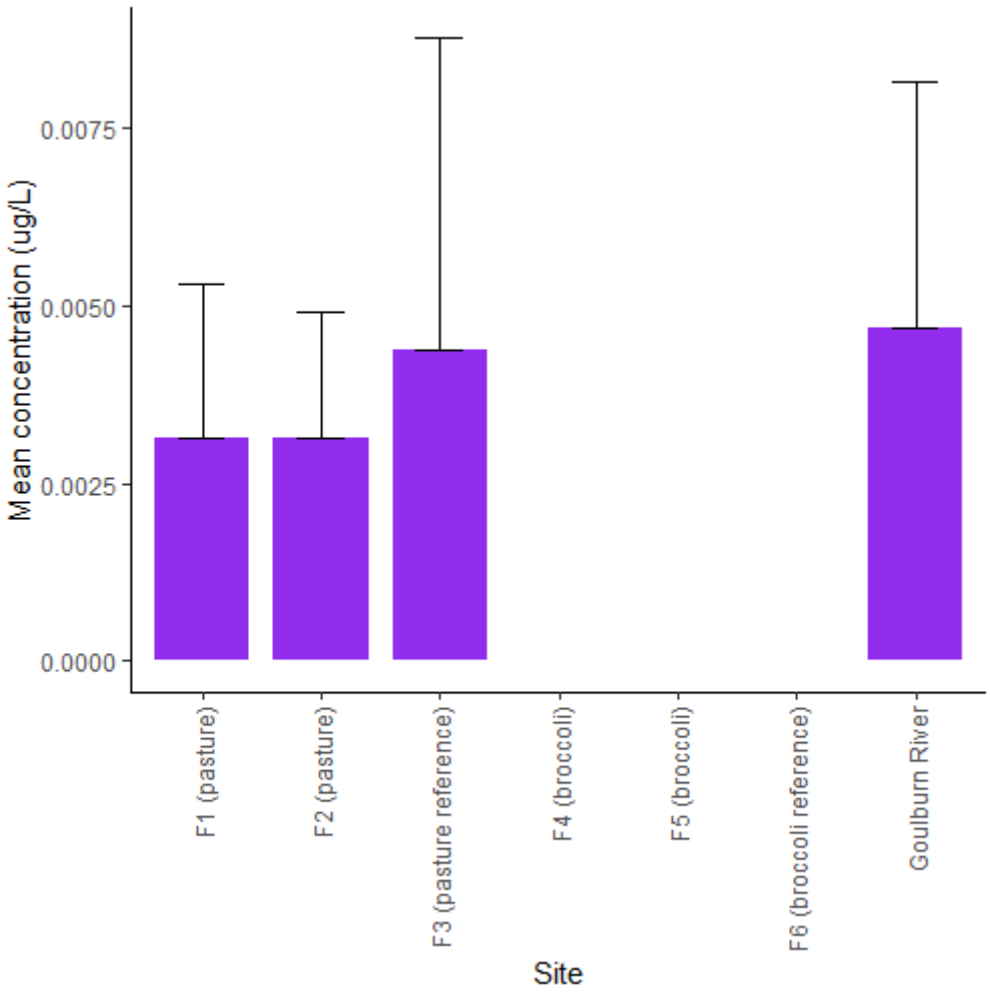

Figure 2. Mean concentrations of endocrine disrupting chemicals (EDCs) detected in irrigation and river water samples at each site in 2024, including standard error bars. n = 10 replicates for sites F1-F6 and 2 replicates for Goulburn River.

3.2.2 PAHs

In 2023, PAHs were detected in water, soil and broccoli samples. Mean PAH concentrations were highest at pasture site F1 (mean ± SD = 0.0047 ± 0.031 µg/L) for water samples, at pasture reference site F3 for soil samples (8.83 ± 16.73 µg/kg), and in the shoots of broccoli plants at site F5 for plant samples (21.32 ± 89.41 µg/kg) (Figure 3). Furthermore, where detected in broccoli plants, mean PAH concentrations were consistently highest in the shoots, followed by the florets, then the roots. The highest PAH concentrations were for C2 alkyl napthalenes (0.36 µg/L) in water, dibenz(a,h)anthracene (120 µg/kg) followed by naphthalene (110 µg/kg) in soil, and naphthalene (760 µg/kg) in the shoots of broccoli plants at site F5.

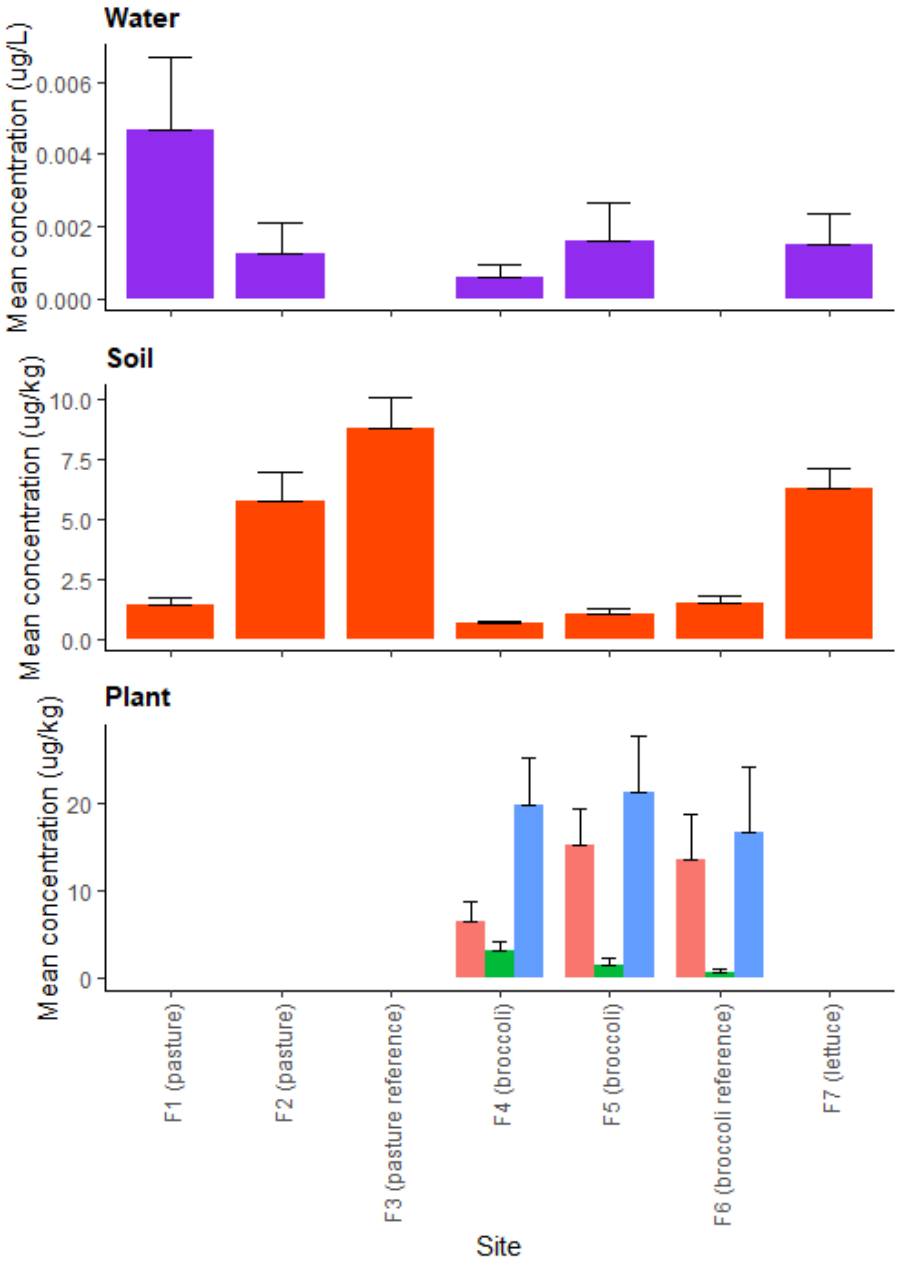

Figure 3. Mean concentrations of polycyclic aromatic hydrocarbons (PAHs) detected in irrigation water, soil and plant samples at each site in 2023, including standard error bars. n = 6 replicates per sample type for sites F1, F2, F4, F5, F7, and 4 replicates per sample type for reference sites F3 and F6. For plant samples: red = florets, green = roots, and blue = shoots.

In 2024, PAHs were only analysed in water, and not soil or plant samples. In water samples, PAHs were detected at all sites (Figure 4), and mean concentrations were highest at pasture site F2 (mean ± SD = 0.014 ± 0.042 µg/L). PAHs with the highest concentrations were C3- and C1 alkyl fluorenes (0.19 µg/L) followed by C2 alkyl fluorenes (0.17 µg/L).

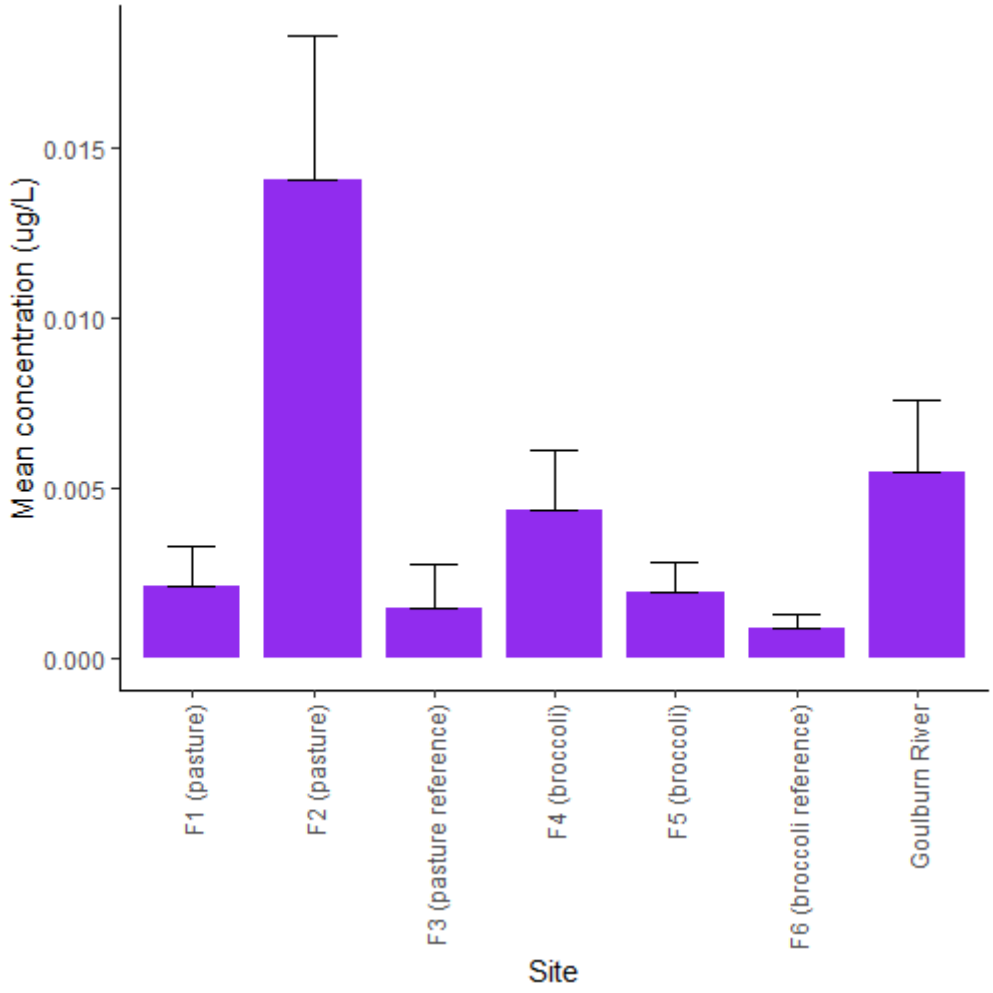

Figure 4. Mean concentrations of polycyclic aromatic hydrocarbons (PAHs) detected in irrigation and river water samples at each site in 2024, including standard error bars. n = 10 replicates for sites F1-F6 and 2 replicates for Goulburn River.

Interestingly, even though the highest PAH concentration detected in plants was in broccoli from site F5 in 2023, on average, PAH concentrations in broccoli were similar across all sites for that year, including the reference site. Additionally, although PAHs were detected in soil in 2023 at all pasture sites, no PAHs were detected in pasture plant samples. Overall, trends of PAHs in irrigation water did not appear to correlate with trends of PAHs in soil and plants.

3.2.3 PFAS

In 2023, PFAS were detected in water, soil, pasture, broccoli and lettuce samples. Mean PFAS concentrations were highest at pasture site F1 for water samples (mean ± SD = 0.0053 ± 0.011 µg/L) and for soil samples (0.41 ± 1.73 µg/kg) (Figure 5). However, for plant samples, mean PFAS concentrations were highest at site F5, in the shoots of broccoli plants (2.96 ± 16.74 µg/kg) (Figure 5). The highest PFAS concentrations were for PFHxA (0.041 µg/L) and PFOA (0.035 µg/L) in water, PFOA (10.6 µg/kg) and PFOS (8.46 µg/kg) in soil, and PFBS in the shoots of broccoli, lettuce, and pasture samples (154, 64, 41 µg/kg respectively).

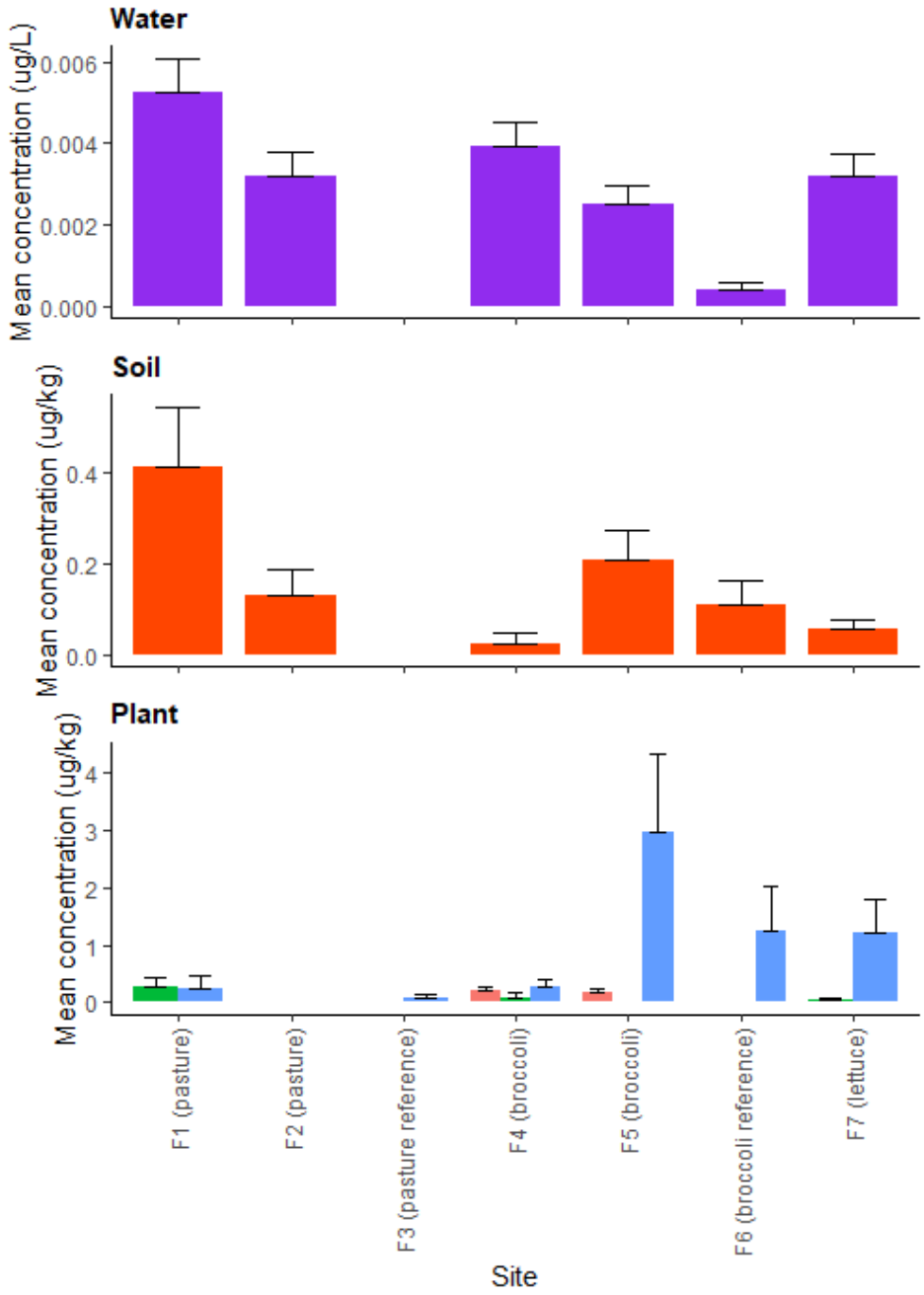

Figure 5. Mean concentrations of per- and polyfluoroalkyl substances (PFAS) detected in irrigation water, soil and plant samples at each site in 2023, including standard error bars. n = 6 replicates per sample type for sites F1, F2, F4, F5, F7, and 4 replicates per sample type for reference sites F3 and F6. For plant samples: red = florets, green = roots, and blue = shoots.

In 2024, PFAS were detected in water, soil and plant samples. In water samples, PFAS were detected at all sites except for pasture reference site F3 (Figure 6), and mean concentrations were highest at pasture site F2 (mean ± SD = 0.00086 ± 0.0023 µg/L). In soil samples, PFAS were also detected at all sites except for pasture reference site F3 (Figure 6), and mean concentrations were highest at pasture site F1 (0.28 ± 1.43 µg/kg). In plant samples, PFAS were detected at all sites except for pasture site F1 (Figure 6), and mean concentrations were highest in the root samples at pasture site F2 (0.25 ± 3.10 µg/kg).

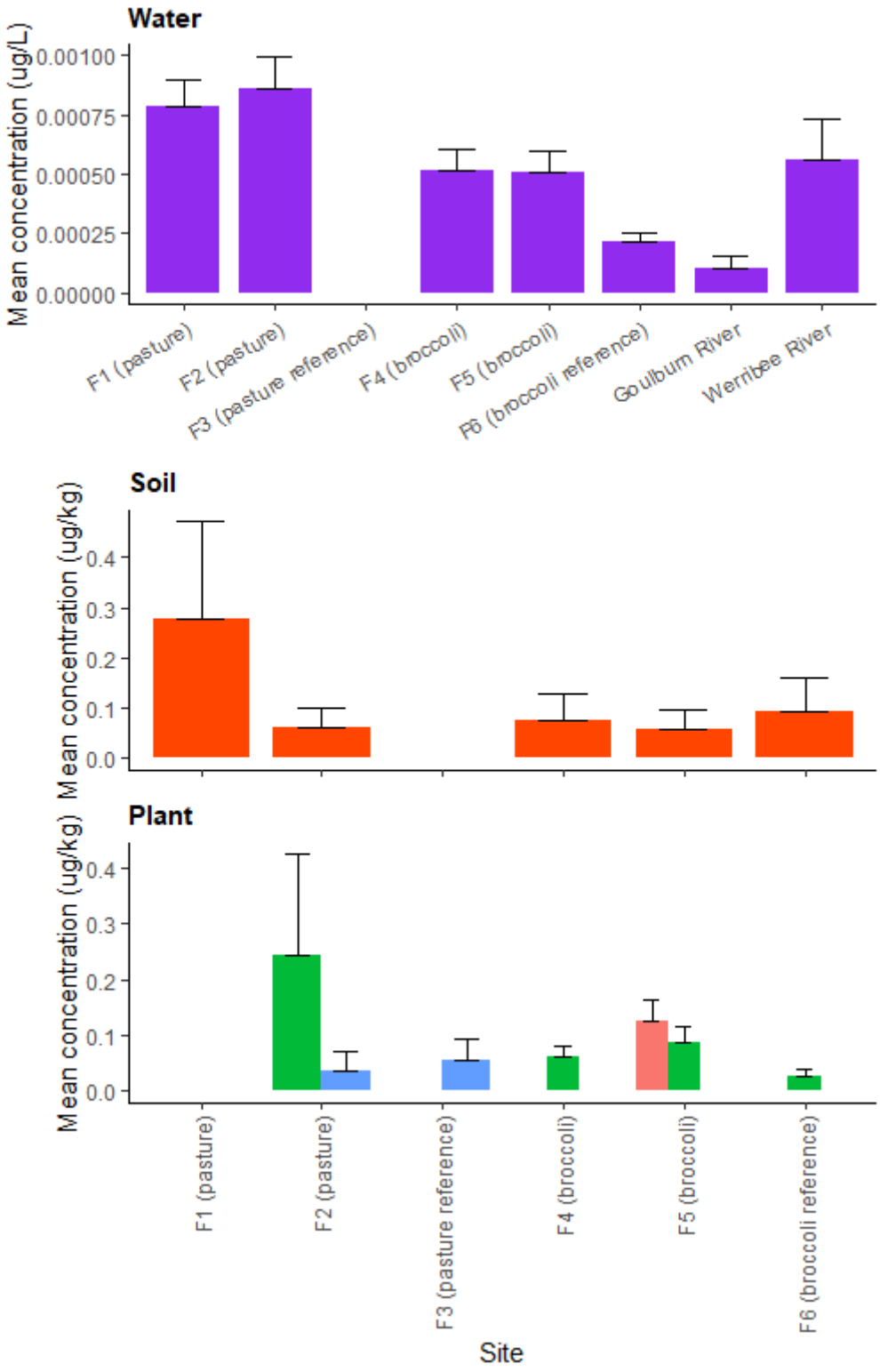

Figure 6. Mean concentrations of per- and polyfluoroalkyl substances (PFAS) detected in irrigation and river water, soil and plant samples at each site in 2024, including standard error bars. For water samples: n = 10 replicates for sites F1-F6, 2 replicates for Goulburn River, 4 replicates for Werribee River. For soil samples: n = 2 replicates for all sites. For plant samples: n = 10 replicates per sample type; red = florets, green = roots, and blue = shoots.

Distribution of PFAS at pasture farms

The 2023 sampling round identified that:

- PFDA (0.008 – 0.014 µg/L), PFHpA (0.008 – 0.014 µg/L), PFHxA (0.017 – 0.041 µg/L), PFNA (0.008 µg/L), and PFUdA (0.009 – 0.013 µg/L) were detected in water, but not in soil or pasture samples.
- PFHxS was detected in water (0.011 – 0.027 µg/L), and in roots (2.5 µg/kg), but not in soil or pasture shoots.
- PFOA was detected in water (0.014 – 0.0035 µg/L), soil (5.62 – 10.6 µg/kg), and roots (15.5 – 21.4 µg/kg), but not pasture shoots.
- PFOS was detected in water (0.013 – 0.026 µg/L), soil (1.76 – 8.46 µg/kg), and roots (4.57 – 5.37 µg/kg), but not pasture shoots.
- PFBA was detected in pasture shoots in one instance (9.6 µg/kg), and PFBS was detected in pasture shoots in one instance (41 µg/kg), but neither were detected in roots.

The 2024 sampling round identified that:

- PFOA (0.0048 – 0.0087 µg/L) and PFNA (0.0012 – 0.0033 µg/L) were detected in water but not detected in soil, root or shoots.
- PFDA was detected in water (0.0014 – 0.0038 µg/L) and in soil (0.56 – 0.57 µg/kg), but not in pasture roots or shoots.
- PFHxS was detected in water (0.0040 – 0.0072 µg/L) and in pasture shoots (5.83 – 10.58 µg/kg) and roots (2.85 – 51.69 µg/kg), but not in soil.
- PFOS was detected in water (0.0059 – 0.011 µg/L) and soil (1.18 – 9.28 µg/kg), but not in roots or shoots of pasture.

Distribution of PFAS at broccoli and lettuce farms

The 2023 sampling round identified that:

- PFDA (0.009 – 0.01 µg/L), PFHpA (0.006 – 0.019 µg/L), PFHxS (0.012 – 0.02 µg/L), and PFNA (0.008 – 0.009 µg/L) were detected in water, but not in soil, broccoli or lettuce samples.
- PFHxA was detected in water (0.013 – 0.025 µg/L) and in one instance in broccoli shoots (4.37 µg/kg), but not in soil or other plant samples.
- PFOS was detected in water (0.012 – 0.028 µg/L) and soil (1.76 – 4.24 µg/kg), but not in plant samples.
- PFOA was detected in water (0.01 – 0.028 µg/L), soil (3.89 – 5.25 µg/kg) and in one instance in broccoli roots (15.5 µg/kg).
- PFBA was detected in broccoli florets (3.79 – 6.7 µg/kg) and broccoli shoots (4.94 – 9.94 µg/kg), and in lettuce shoots (6.22 – 8.03 µg/kg) and lettuce roots (3.20 – 3.23 µg/kg), but not in water or soil.
- PFBS was detected only in broccoli shoots (41 – 154 µg/kg) and lettuce shoots (47 – 64 µg/kg), and PFPeA was detected only in broccoli shoots (14.4 – 19.4 µg/kg), and lettuce shoots (12.23 µg/kg).

The 2024 sampling round identified that:

- PFBA was detected in water (0.0079 – 0.0091 µg/L) at multiple sites, and in broccoli florets at one site (2.43 – 4.45 µg/kg).
- PFOA (0.0010 – 0.0030 µg/L) and PFHxS (0.0033 – 0.0047 µg/L) were detected in water, but not in soil or broccoli plants.

- PFOS was detected in water (0.0019 – 0.0060 µg/L) including at the reference site, and in soil (1.45 – 2.64 µg/kg) but not in broccoli plants.
- PFBS was detected in water only at the reference site (0.0017 – 0.0022 µg/L), and in broccoli roots at all sites (0.75 – 3.31 µg/kg).

3.2.4 PPCPs

In 2023, PPCPs were detected in water, soil, pasture, broccoli and lettuce samples. Mean PPCP concentrations were highest at broccoli site F4 for water samples (mean ± SD = 0.0036 ± 0.014 µg/L), at pasture site F2 for soil samples (0.25 ± 4.22 µg/kg), and in the shoots of broccoli plants at site F4 (0.081 ± 1.06 µg/kg) (Figure 7). The highest PPCP concentrations were for caffeine (0.61 µg/L) and benzotriazole (0.14 µg/L) in water, ketoprofen (84 µg/kg) and methyl paraben (40 µg/kg) in soil, and methyl paraben in the roots of broccoli (18 µg/kg) and telmisartan in the shoots of broccoli (15.8 µg/kg).

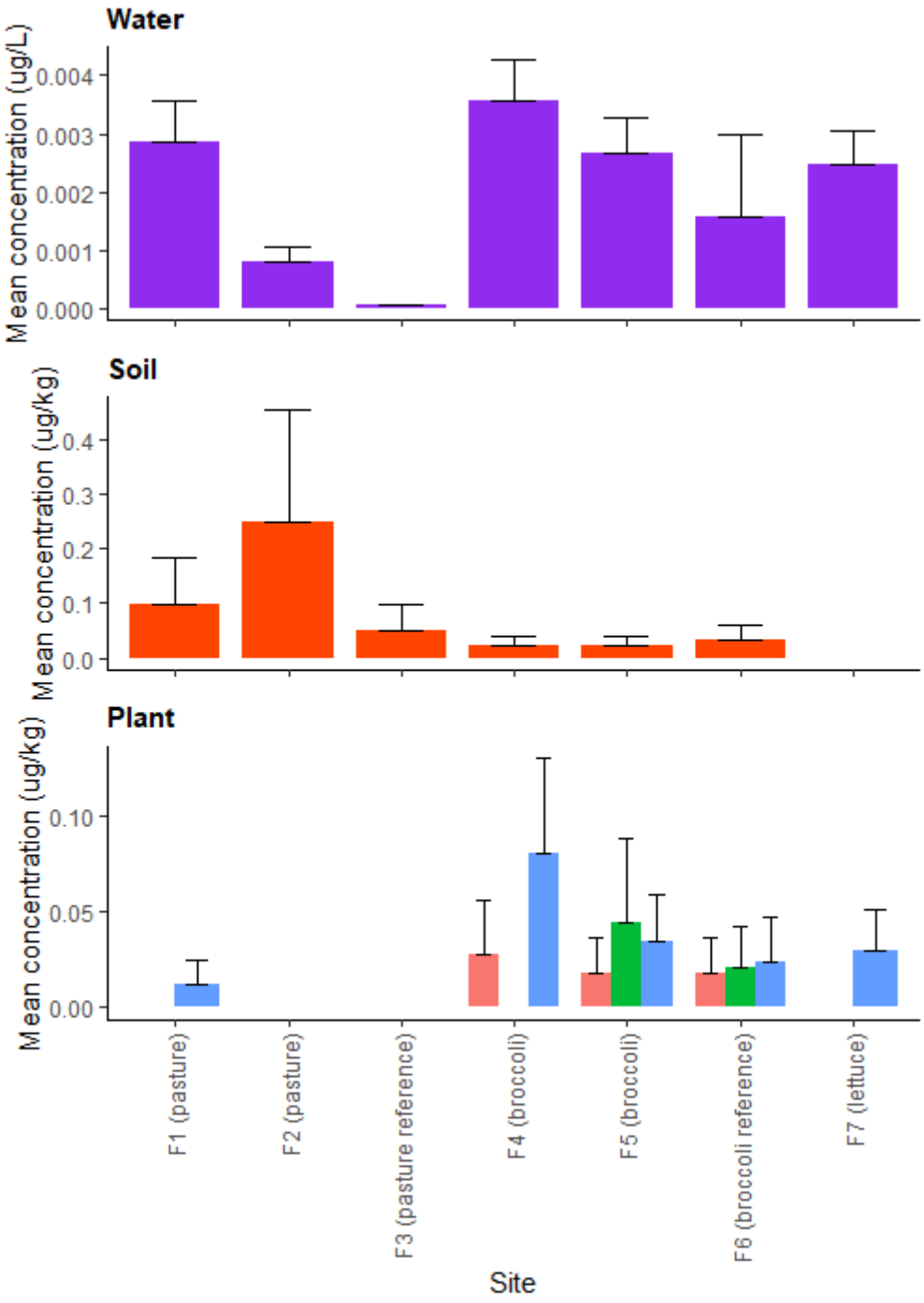

Figure 7. Mean concentrations of pharmaceuticals and personal care products (PPCPs) detected in irrigation water, soil and plant samples at each site in 2023, including standard error bars. n = 6 replicates per sample type for sites F1, F2, F4, F5, F7, and 4 replicates per sample type for reference sites F3 and F6. For plant samples: red = florets, green = roots, and blue = shoots.

In 2024, PPCPs were only analysed in water and plant samples. In water samples, PPCPs were detected at all sites (Figure 8), and mean concentrations were highest at pasture site F1 (mean ± SD = 0.055 ± 0.22 µg/L). In plant samples, PPCPs were detected at all pasture sites including the reference site, with the highest mean concentration detected in pasture shoots at site F1 (0.040 ± 0.18 µg/kg). PPCPs with the highest concentrations in water were benzotriazole (2.83 µg/L) followed by lamotrigine (2.7 µg/L), and

PPCPs with the highest concentrations in plants were carbamazepine (3.11 µg/kg) followed by DEET (1.21 µg/kg).

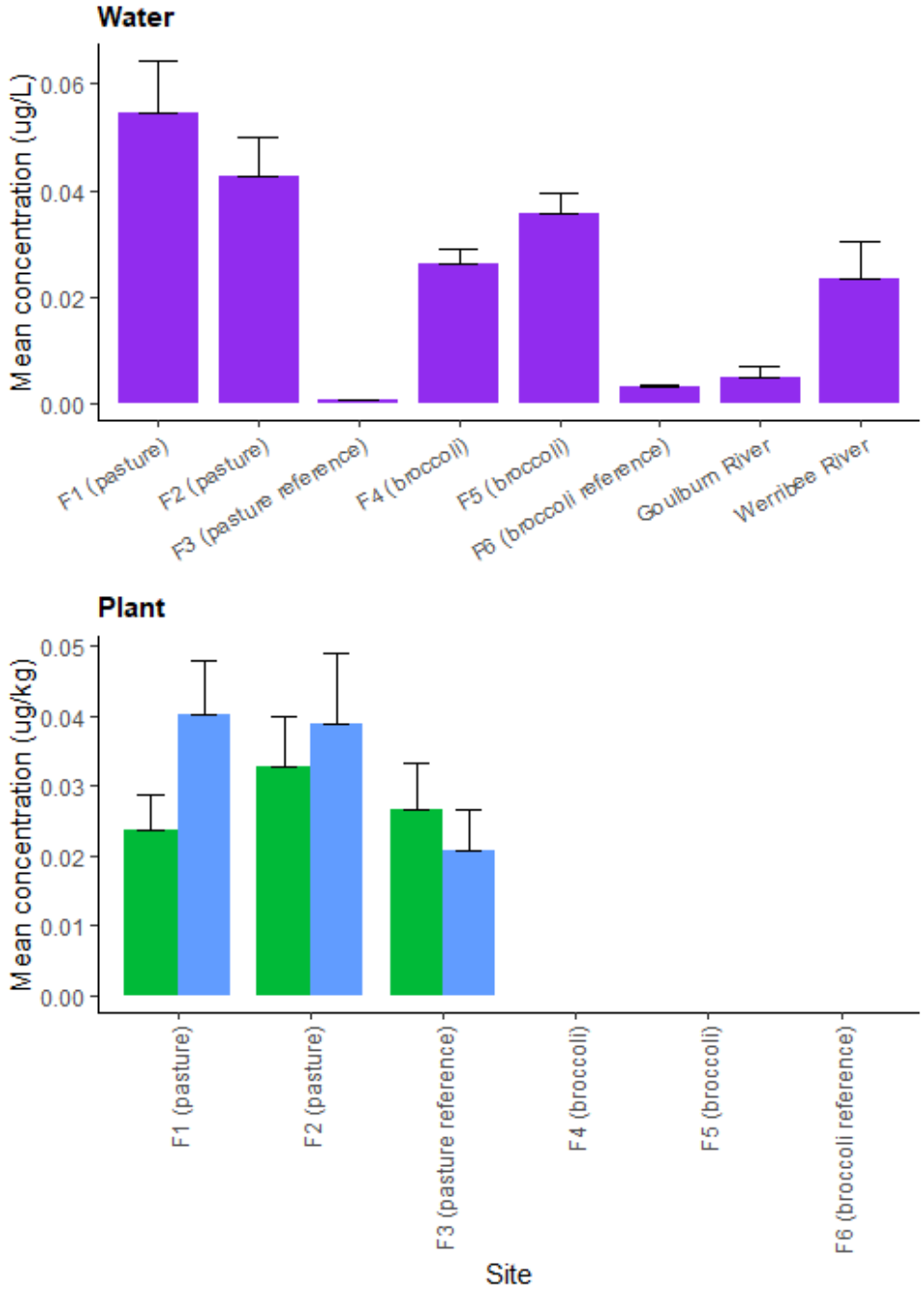

Figure 8. Mean concentrations of pharmaceuticals and personal care products (PPCPs) detected in irrigation and river water, and plant samples at each site in 2024, including standard error bars. For water samples: n = 10 replicates for sites F1-F6, 2 replicates for Goulburn River, 4 replicates for Werribee River. For plant samples: n = 10 replicates per sample type; red = florets, green = roots, and blue = shoots.

3.2.5 Pesticides

In 2023, pesticides were detected in water, soil, pasture, broccoli and lettuce samples. Mean pesticide concentrations were highest at pasture site F1 for water samples (mean ± SD = 0.0063 ± 0.11 µg/L), at broccoli site F5 for soil samples (2.92 ± 30.65 µg/kg), and in the shoots of broccoli plants at reference site F6 (41.07 ± 520.62 µg/kg) (Figure 9). The highest pesticide concentrations were for thiabendazole (2.5 µg/L) and sulfometuron methyl (1.9 µg/L) in water, prometryn (1100 µg/kg) and pendimethalin (740 µg/kg) in soil, and imidacloprid in the roots of lettuce plants (19000 µg/kg).

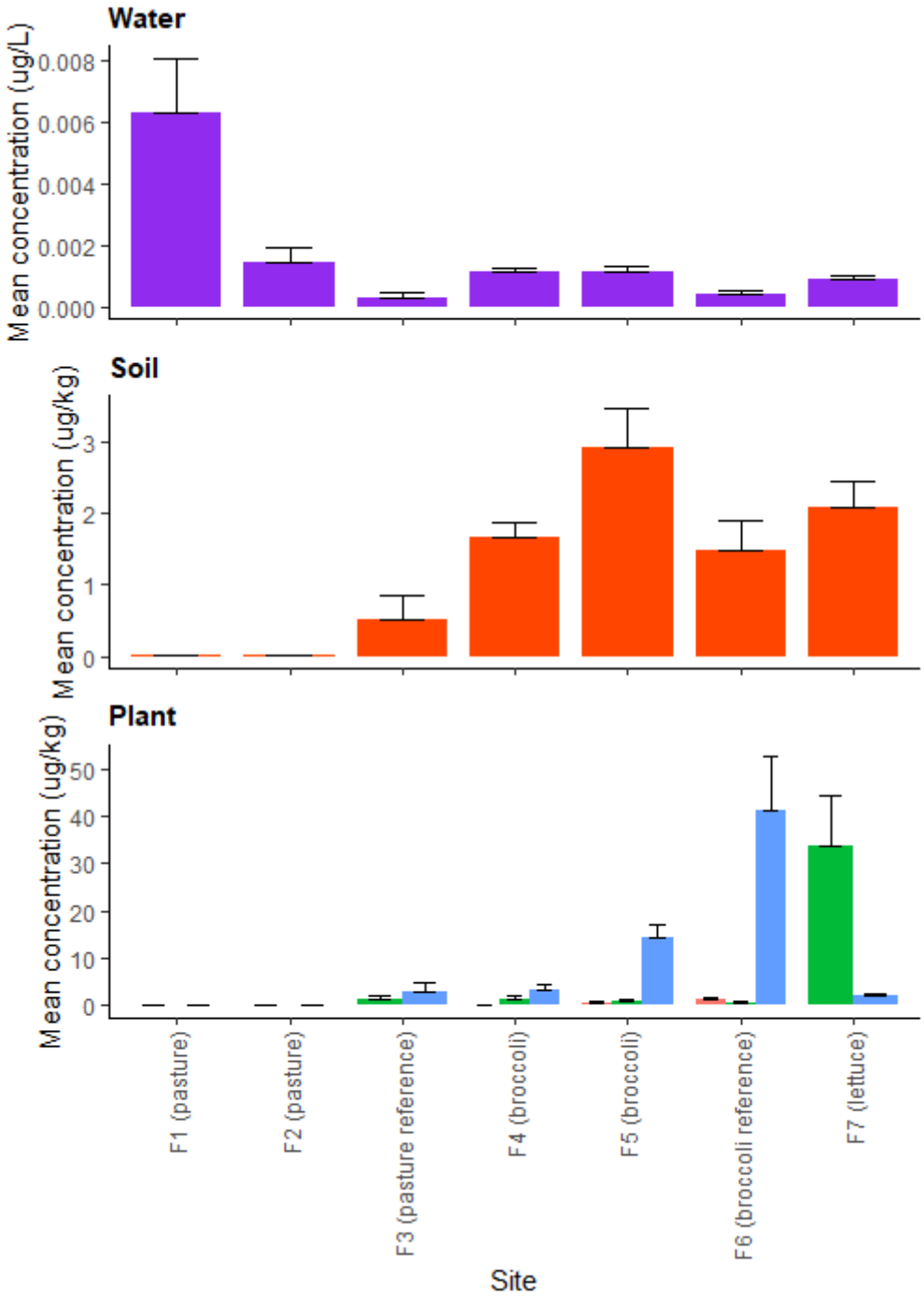

Figure 9. Mean concentrations of pesticides detected in irrigation water, soil and plant samples at each site in 2023, including standard error bars. n = 6 replicates per sample type for sites F1, F2, F4, F5, F7, and 4 replicates per sample type for reference sites F3 and F6. For plant samples: red = florets, green = roots, and blue = shoots.

In 2024, pesticides were only analysed for in water samples. In water samples, pesticides were detected at all sites (Figure 10), with the highest mean concentration detected at broccoli site F5 (mean ± SD = 0.0023 ± 0.020 µg/L), followed by broccoli site F4 (0.0017 ± 0.015 µg/L). The highest concentrations of pesticides detected were for propyzamide (0.28 µg/L) and simazine (0.18 µg/L).

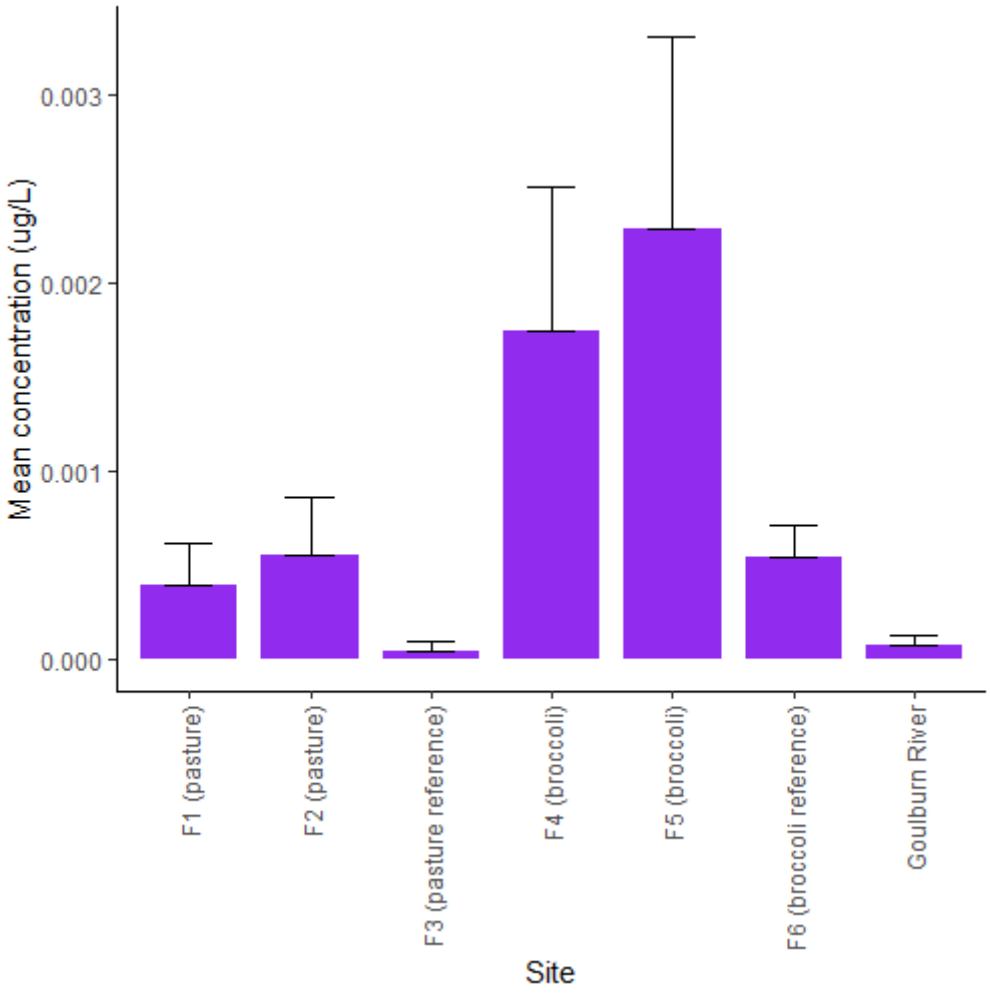

Figure 10. Mean concentrations of pesticides detected in irrigation and river water samples at each site in 2024, including standard error bars. n = 10 replicates for sites F1-F6 and 2 replicates for Goulburn River.

3.2.6 Phthalates

In 2023, phthalates were detected in water, soil, pasture, broccoli and lettuce samples. Mean phthalate concentrations were highest at pasture site F2 for both water samples (mean ± SD = 0.022 ± 0.098 µg/L) and soil samples (12.17 ± 25.99 µg/kg), and in the roots of lettuce plants at site F7 (232.47 ± 881.90 µg/kg) (Figure 11). The highest phthalate concentrations were for di-n-pentyl phthalate (DnPP; 0.55 µg/L) and dibutyl phthalate (DBP; 0.2 µg/L) in water, di-(2-ethylbutyl) phthalate (170 µg/kg) and di-ethylhexyl phthalate (DEHP; 71 µg/kg) in soil, and DBP in the roots of lettuce plants (6100 µg/kg) and DEHP in the shoots of broccoli plants (6000 µg/kg).

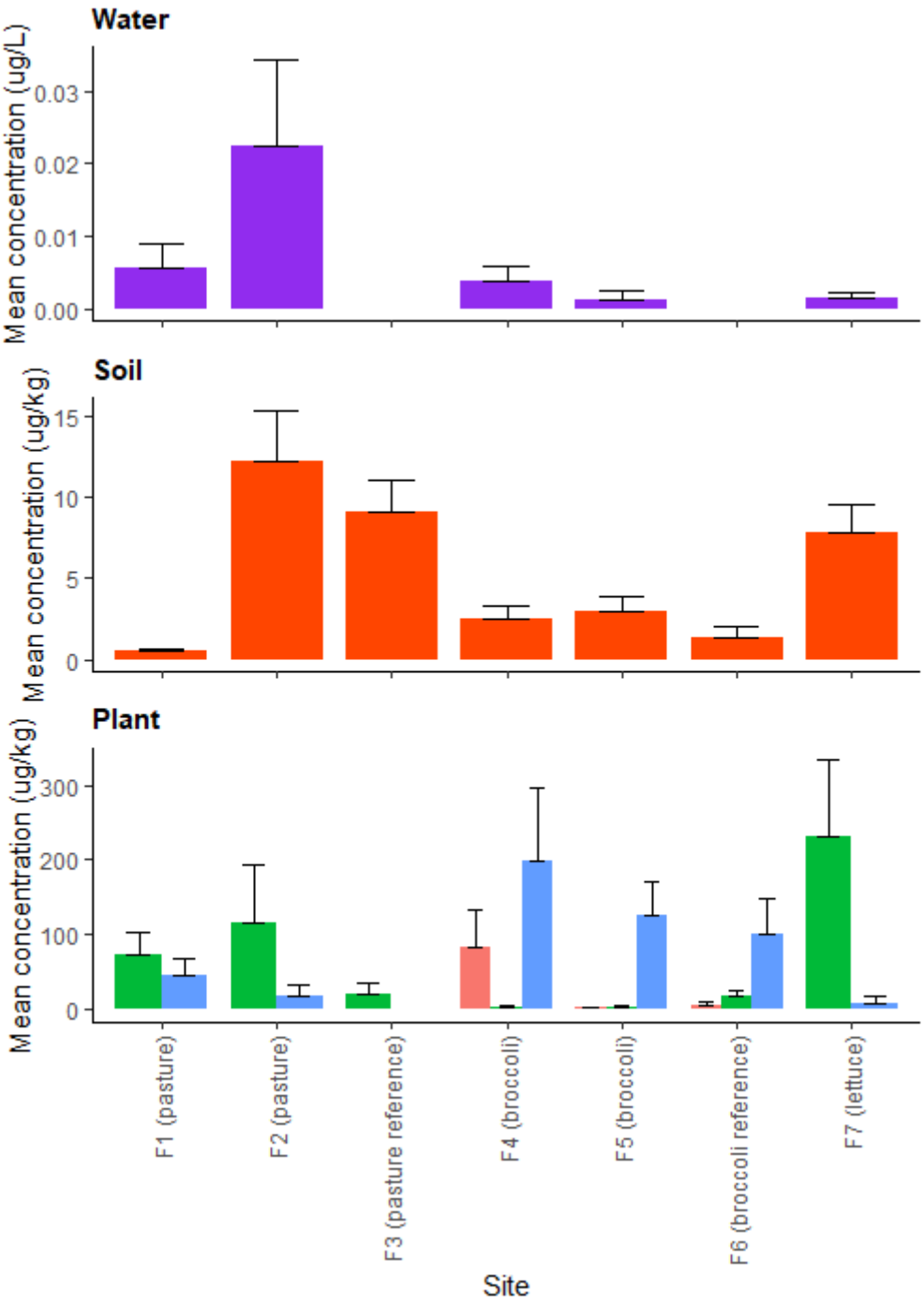

Figure 11. Mean concentrations of phthalates detected in irrigation water, soil and plant samples at each site in 2023, including standard error bars. n = 6 replicates per sample type for sites F1, F2, F4, F5, F7, and 4 replicates per sample type for reference sites F3 and F6. For plant samples: red = florets, green = roots, and blue = shoots.

In 2024, phthalates were only analysed for in water samples. Phthalates were detected at all sites in water samples (Figure 12), with the highest mean concentration detected in the Goulburn River sample (mean ± SD = 0.030 ± 0.067 µg/L), followed by pasture site F2 (0.020 ± 0.046 µg/L). The highest concentrations of phthalates detected were for DEHP (0.26 µg/L) and DBP (0.19 µg/L).

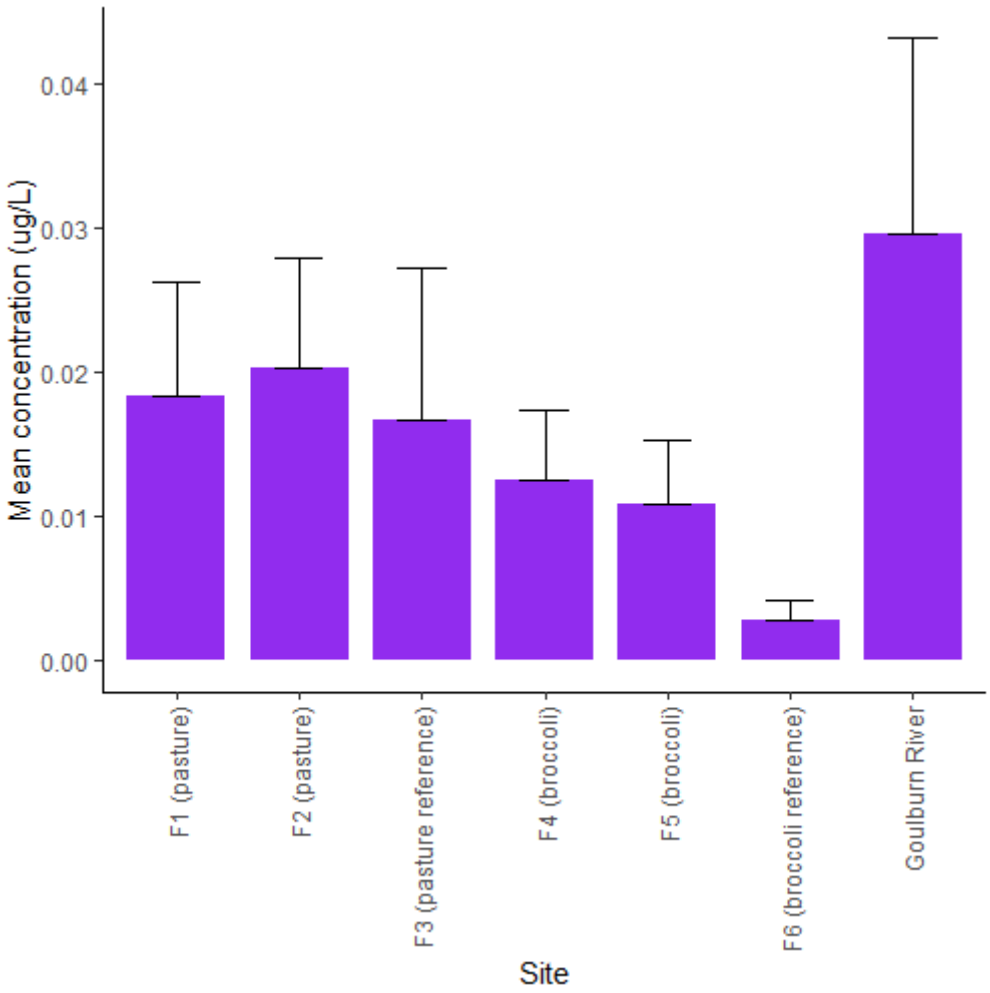

Figure 12. Mean concentrations of phthalates detected in irrigation and river water samples at each site in 2024, including standard error bars. n = 10 replicates for sites F1-F6 and 2 replicates for Goulburn River.

Conclusions and key findings

This study found that the chemical composition of recycled water used for crop irrigation was distinct from water used on the reference sites (i.e., non-recycled water sources). Consistently, across the different chemical groups, concentrations were higher in irrigation water at recycled water sites compared to reference sites. However, this trend seen in irrigation water was not as apparent in the chemical composition of soil and crops between recycled water and reference sites, indicating that there may be other site-specific sources of chemicals, such as on-farm practices. Additionally, there was limited transfer from water and soil to plant tissues for the chemicals detected.

Some variability in trends were seen between the 2023 and 2024 sampling rounds, with some chemicals being detected in one year but not the other. This could be due to the concentrations of many chemicals being close to the detection limit, differences in the limits of reporting between years, and the inherent variability in chemical concentrations in water, soil and crops across time. Several factors and uncertainties that may have also contributed to the variability of chemical concentrations between years and across sites include, the level of dilution of recycled water with other sources of water before irrigation (shandying), and the on-site application of chemicals.

Based on human health risk assessment, concentrations of PFBS detected in lettuce and broccoli samples do not present an adverse risk to human health, even for people consuming large amounts of leafy vegetables (P90 consumers). The limit of reporting used in this study (3 µg/kg) is protective of human health for PFOA, PFHxS and PFBS, and likely to be protective of human health for PFOS. Concentrations of PFAS found in crops in this study do not present an adverse risk to human health.

Overall, our key findings for this study were:

- Recycled water consistently contained a greater number and concentration of contaminants than reference water.
- Studies found limited evidence of emerging contaminants transferring into edible plant tissues.
- No impact of recycled water on crop health was observed. Differences in plant pigments and biomass appeared linked to crop maturity, not to irrigation source.
- Some pesticides were found in edible parts of the plants from the reference farms not using recycled water for irrigation, indicating on-farm sources (e.g. direct pesticide application).
- The reference farm irrigation water for broccoli contained PPCPs, suggesting other potential sources (e.g. river water).
- Concentrations of PFAS found in edible crops do not present an adverse risk to human health.
- Based on this study, recycled water can be used for crop irrigation, if the quality of the water is regularly monitored, and use managed appropriately.
- Ongoing monitoring and the inclusion of more crop types and locations are recommended to refine risk assessments and management strategies.

References

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Barker F., Faggian R., Hamilton AJ. (2011). A history of wastewater irrigation in Melbourne, Australia. *Journal of Water Sustainability* 1, 183-202.

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Appendix A – Data summary tables

Table S1. Summary statistics for groups of emerging contaminants detected in water samples at each site. Min = minimum; SD = standard deviation; Max = Maximum. LOR = Limit of reporting.

Water samples								
Year	**Analyte group**	**Site**	**Min (µg/L)**	**Mean (µg/L)**	**SD (µg/L)**	**Max (µg/L)**	**Total sample size**	**Detections sample size**
2023	EDCs	F1 (pasture)	<LOR	0	0	<LOR	63	0
		F2 (pasture)	<LOR	0	0	<LOR	54	0
		F3 (pasture reference)	<LOR	0	0	<LOR	45	0
		F4 (broccoli)	<LOR	0	0	<LOR	63	0
		F5 (broccoli)	<LOR	0	0	<LOR	54	0
		F6 (broccoli reference)	<LOR	0	0	<LOR	81	0
		F7 (lettuce)	<LOR	0	0	<LOR	63	0
	PAHs	F1 (pasture)	<LOR	0.0047	0.031	0.36	231	9
		F2 (pasture)	<LOR	0.0013	0.012	0.12	198	3
		F3 (pasture reference)	<LOR	0	0	<LOR	165	0
		F4 (broccoli)	<LOR	0.00061	0.0048	0.05	231	4
		F5 (broccoli)	<LOR	0.0016	0.015	0.19	198	4
		F6 (broccoli reference)	<LOR	0	0	<LOR	231	0
		F7 (lettuce)	<LOR	0.0015	0.013	0.13	231	5
	Pesticides	F1 (pasture)	<LOR	0.0063	0.11	2.5	3584	47
		F2 (pasture)	<LOR	0.0014	0.027	0.83	3072	36
		F3 (pasture reference)	<LOR	0.00030	0.0073	0.27	2560	5
		F4 (broccoli)	<LOR	0.0011	0.0093	0.19	3584	102
		F5 (broccoli)	<LOR	0.0011	0.011	0.24	3072	90
		F6 (broccoli reference)	<LOR	0.00038	0.0075	0.25	3624	26
		F7 (lettuce)	<LOR	0.00087	0.010	0.28	3584	48
	PFAS	F1 (pasture)	<LOR	0.0053	0.011	0.037	175	38
		F2 (pasture)	<LOR	0.0032	0.0076	0.041	150	27
		F3 (pasture reference)	<LOR	0	0	<LOR	125	0
		F4 (broccoli)	<LOR	0.0039	0.0076	0.028	175	43
		F5 (broccoli)	<LOR	0.0025	0.0053	0.016	150	29
		F6 (broccoli reference)	<LOR	0.00038	0.0021	0.014	125	4
		F7 (lettuce)	<LOR	0.0032	0.0068	0.028	175	36
	Phthalates	F1 (pasture)	<LOR	0.0056	0.030	0.2	77	3
		F2 (pasture)	<LOR	0.022	0.098	0.55	66	6
		F3 (pasture reference)	<LOR	0	0	<LOR	55	0
		F4 (broccoli)	<LOR	0.0039	0.018	0.1	77	4

		F5 (broccoli)	<LOR	0.0012	0.0098	0.08	66	1
		F6 (broccoli reference)	<LOR	0	0	<LOR	77	0
		F7 (lettuce)	<LOR	0.0014	0.0064	0.04	77	4
	PPCPs	F1 (pasture)	<LOR	0.0029	0.014	0.142	385	33
		F2 (pasture)	<LOR	0.00080	0.0044	0.044	330	15
		F3 (pasture reference)	<LOR	0.000040	0.00047	0.006	275	2
		F4 (broccoli)	<LOR	0.0036	0.014	0.129	385	44
		F5 (broccoli)	<LOR	0.0026	0.012	0.124	330	36
		F6 (broccoli reference)	<LOR	0.0016	0.029	0.61	433	6
		F7 (lettuce)	<LOR	0.0025	0.012	0.118	385	38
	SVOCs	F1 (pasture)	<LOR	0.000045	0.0015	0.06	1785	2
		F2 (pasture)	<LOR	0.000013	0.00051	0.02	1530	1
		F3 (pasture reference)	<LOR	0	0	<LOR	1275	0
		F4 (broccoli)	<LOR	0.000022	0.00067	0.02	1785	2
		F5 (broccoli)	<LOR	0	0	<LOR	1530	0
		F6 (broccoli reference)	<LOR	0	0	<LOR	1785	0
		F7 (lettuce)	<LOR	0	0	<LOR	1785	0
2024	EDCs	F1 (pasture)	<LOR	0.0031	0.012	0.05	32	2
		F2 (pasture)	<LOR	0.0031	0.012	0.06	48	3
		F3 (pasture reference)	<LOR	0.0044	0.018	0.07	16	1
		F4 (broccoli)	<LOR	0	0	<LOR	32	0
		F5 (broccoli)	<LOR	0	0	<LOR	32	0
		F6 (broccoli reference)	<LOR	0	0	<LOR	48	0
		Goulburn River	<LOR	0.0047	0.020	0.1	32	2
		Werribee River	-	-	-	-	0	-
	PAHs	F1 (pasture)	<LOR	0.0021	0.0098	0.06	66	4
		F2 (pasture)	<LOR	0.014	0.042	0.19	99	19
		F3 (pasture reference)	<LOR	0.0015	0.0071	0.04	33	2
		F4 (broccoli)	<LOR	0.0044	0.014	0.09	66	11
		F5 (broccoli)	<LOR	0.0020	0.0071	0.04	66	6
		F6 (broccoli reference)	<LOR	0.00091	0.0038	0.02	99	6
		Goulburn River	<LOR	0.0055	0.017	0.11	66	9
		Werribee River	-	-	-	-	0	-
	Pesticides	F1 (pasture)	<LOR	0.00039	0.0046	0.07	406	5
		F2 (pasture)	<LOR	0.00056	0.0075	0.13	609	9
		F3 (pasture reference)	<LOR	0.000049	0.00070	0.01	203	1
		F4 (broccoli)	<LOR	0.0017	0.015	0.18	406	10

	F5 (broccoli)	<LOR	0.0023	0.020	0.28	406	12
	F6 (broccoli reference)	<LOR	0.00054	0.0043	0.08	609	15
	Goulburn River	<LOR	0.000074	0.0011	0.02	406	2
	Werribee River	-	-	-	-	0	-
PFAS	F1 (pasture)	<LOR	0.00078	0.0019	0.0075	270	50
	F2 (pasture)	<LOR	0.00086	0.0023	0.011	270	41
	F3 (pasture reference)	<LOR	0	0	<LOR	270	0
	F4 (broccoli)	<LOR	0.00051	0.0015	0.0091	270	33
	F5 (broccoli)	<LOR	0.00050	0.0015	0.0090	270	32
	F6 (broccoli reference)	<LOR	0.00021	0.00066	0.0033	270	29
	Goulburn River	<LOR	0.00010	0.00038	0.0020	54	4
	Werribee River	<LOR	0.00056	0.0015	0.0071	82	12
Phthalates	F1 (pasture)	<LOR	0.018	0.039	0.11	24	6
	F2 (pasture)	<LOR	0.020	0.046	0.16	36	9
	F3 (pasture reference)	<LOR	0.017	0.037	0.1	12	3
	F4 (broccoli)	<LOR	0.013	0.024	0.08	24	6
	F5 (broccoli)	<LOR	0.011	0.022	0.07	24	6
	F6 (broccoli reference)	<LOR	0.0028	0.0085	0.03	36	4
	Goulburn River	<LOR	0.030	0.067	0.26	24	6
	Werribee River	-	-	-	-	0	-
PPCPs	F1 (pasture)	<LOR	0.055	0.22	2.83	544	115
	F2 (pasture)	<LOR	0.043	0.20	2.7	685	124
	F3 (pasture reference)	<LOR	0.00070	0.0037	0.034	506	25
	F4 (broccoli)	<LOR	0.026	0.071	0.38	700	148
	F5 (broccoli)	<LOR	0.036	0.10	0.90	700	151
	F6 (broccoli reference)	<LOR	0.0030	0.013	0.18	790	92
	Goulburn River	<LOR	0.0051	0.033	0.36	284	16
	Werribee River	<LOR	0.023	0.10	1.15	208	46
SVOCs	F1 (pasture)	<LOR	0.083	1.33	23	522	9
	F2 (pasture)	<LOR	0.32	5.69	150	783	19
	F3 (pasture reference)	<LOR	0.11	1.80	29	261	4
	F4 (broccoli)	<LOR	0.099	1.58	27	522	11
	F5 (broccoli)	<LOR	0.060	0.96	16	522	10
	F6 (broccoli reference)	<LOR	0.018	0.30	6.6	783	8
	Goulburn River	<LOR	0.11	1.90	40	522	9

		Werribee River	-	-	-	-	0	-

Table S2. Summary statistics for groups of emerging contaminants detected in soil samples at each site. Min = minimum; SD = standard deviation; Max = Maximum. LOR = Limit of reporting.

Soil samples								
Year	**Analyte group**	**Site**	**Min (µg/kg)**	**Mean (µg/kg)**	**SD (µg/kg)**	**Max (µg/kg)**	**Total sample size**	**Detections sample size**
2023	EDCs	F1 (pasture)	<LOR	0.021	0.19	1.7	80	1
		F2 (pasture)	<LOR	0.087	0.52	3.1	71	2
		F3 (pasture reference)	<LOR	0.29	1.15	6	62	5
		F4 (broccoli)	<LOR	0	0	<LOR	80	0
		F5 (broccoli)	<LOR	0	0	<LOR	71	0
		F6 (broccoli reference)	<LOR	0.0075	0.055	0.4	53	1
		F7 (lettuce)	<LOR	0	0	<LOR	63	0
	PAHs	F1 (pasture)	<LOR	1.45	4.10	24	231	70
		F2 (pasture)	<LOR	5.75	17.15	120	198	59
		F3 (pasture reference)	<LOR	8.83	16.73	100	165	64
		F4 (broccoli)	<LOR	0.65	1.46	10	231	88
		F5 (broccoli)	<LOR	1.06	2.58	17	198	77
		F6 (broccoli reference)	<LOR	1.50	2.95	16	132	53
		F7 (lettuce)	<LOR	6.31	12.41	74	231	101
	Pesticides	F1 (pasture)	<LOR	0.013	0.32	14	3584	32
		F2 (pasture)	<LOR	0.0055	0.11	4.6	3072	16
		F3 (pasture reference)	<LOR	0.52	17.25	650	2560	12
		F4 (broccoli)	<LOR	1.65	13.21	300	3584	156
		F5 (broccoli)	<LOR	2.92	30.65	1100	3072	138
		F6 (broccoli reference)	<LOR	1.49	18.65	480	2048	55
		F7 (lettuce)	<LOR	2.07	22.36	740	3584	172
	PFAS	F1 (pasture)	<LOR	0.41	1.73	10.6	175	10
		F2 (pasture)	<LOR	0.13	0.69	6.53	150	7
		F3 (pasture reference)	<LOR	0	0	<LOR	125	0
		F4 (broccoli)	<LOR	0.024	0.32	4.24	175	1
		F5 (broccoli)	<LOR	0.21	0.82	5.25	150	10
		F6 (broccoli reference)	<LOR	0.11	0.54	3.05	100	4
		F7 (lettuce)	<LOR	0.053	0.31	2.01	175	5
	Phthalates	F1 (pasture)	<LOR	0.52	1.46	7.6	77	12
		F2 (pasture)	<LOR	12.17	25.99	170	66	29
		F3 (pasture reference)	<LOR	9.12	14.62	46	55	22
		F4 (broccoli)	<LOR	2.43	7.12	55	77	19

		F5 (broccoli)	<LOR	2.94	8.04	50	66	15
		F6 (broccoli reference)	<LOR	1.38	4.39	21	44	11
		F7 (lettuce)	<LOR	7.81	14.86	71	77	30
	PPCPs	F1 (pasture)	<LOR	0.097	1.87	40	463	3
		F2 (pasture)	<LOR	0.25	4.22	84	408	4
		F3 (pasture reference)	<LOR	0.048	0.90	17	353	1
		F4 (broccoli)	<LOR	0.023	0.40	8.2	463	2
		F5 (broccoli)	<LOR	0.021	0.35	6.9	408	2
		F6 (broccoli reference)	<LOR	0.033	0.48	8.2	298	2
		F7 (lettuce)	<LOR	0	0	<LOR	385	0
	SVOCs	F1 (pasture)	<LOR	1.30	20.37	600	1785	69
		F2 (pasture)	<LOR	6.47	60.47	1100	1530	79
		F3 (pasture reference)	<LOR	7.05	58.35	980	1275	81
		F4 (broccoli)	<LOR	2.84	28.25	650	1785	108
		F5 (broccoli)	<LOR	3.24	44.47	970	1530	93
		F6 (broccoli reference)	<LOR	1.29	25.75	800	1020	54
		F7 (lettuce)	<LOR	3.48	34.15	880	1785	114
2024	PFAS	F1 (pasture)	<LOR	0.28	1.43	9.28	54	3
		F2 (pasture)	<LOR	0.062	0.28	1.64	54	3
		F3 (pasture reference)	<LOR	0	0	<LOR	54	0
		F4 (broccoli)	<LOR	0.075	0.39	2.10	54	2
		F5 (broccoli)	<LOR	0.058	0.30	1.65	54	2
		F6 (broccoli reference)	<LOR	0.095	0.49	2.64	54	2

Table S3. Summary statistics for groups of emerging contaminants detected in plant samples at each site. Min = minimum; SD = standard deviation; Max = Maximum. LOR = Limit of reporting.

Plant samples									
Year	**Analyte group**	**Site**	**Sample type**	**Min (µg/kg)**	**Mean (µg/kg)**	**SD (µg/kg)**	**Max (µg/kg)**	**Total sample size**	**Detections sample size**
2023	EDCs	F1 (pasture)	Root	<LOR	0	0	<LOR	80	0
			Shoot	<LOR	0	0	<LOR	80	0
		F2 (pasture)	Root	<LOR	0	0	<LOR	71	0
			Shoot	<LOR	0	0	<LOR	71	0
		F3 (pasture reference)	Root	<LOR	0	0	<LOR	62	0
			Shoot	<LOR	0	0	<LOR	62	0
		F4 (broccoli)	Floret	<LOR	3	26.83	240	80	1
			Root	<LOR	0.16	1.45	13	80	1
			Shoot	<LOR	0.16	1.45	13	80	1
		F5 (broccoli)	Floret	<LOR	0	0	<LOR	71	0
			Root	<LOR	0.68	2.98	17	71	4
			Shoot	<LOR	0	0	<LOR	71	0
		F6 (broccoli reference)	Floret	<LOR	0	0	<LOR	53	0
			Root	<LOR	0	0	<LOR	53	0
			Shoot	<LOR	0	0	<LOR	53	0
		F7 (lettuce)	Root	<LOR	0	0	<LOR	80	0
			Shoot	<LOR	0	0	<LOR	80	0
	PAHs	F1 (pasture)	Root	<LOR	0	0	<LOR	231	0
			Shoot	<LOR	0	0	<LOR	231	0
		F2 (pasture)	Root	<LOR	0	0	<LOR	198	0
			Shoot	<LOR	0	0	<LOR	198	0
		F3 (pasture reference)	Root	<LOR	0	0	<LOR	165	0
			Shoot	<LOR	0	0	<LOR	165	0
		F4 (broccoli)	Floret	<LOR	6.49	33.73	240	231	11
			Root	<LOR	3.11	15.78	135	231	16
			Shoot	<LOR	19.83	83.34	580	231	25
		F5 (broccoli)	Floret	<LOR	15.28	58.84	350	198	25
			Root	<LOR	1.60	10.81	90	198	6
			Shoot	<LOR	21.32	89.41	760	198	27
		F6 (broccoli reference)	Floret	<LOR	13.61	59.18	330	132	8
			Root	<LOR	0.62	6.32	72	132	2
			Shoot	<LOR	16.64	87.25	680	132	8
		F7 (lettuce)	Root	<LOR	0	0	<LOR	231	0
			Shoot	<LOR	0	0	<LOR	231	0
	Pesticides	F1 (pasture)	Root	<LOR	0.019	0.46	21	3584	10
			Shoot	<LOR	0.020	0.64	35	3584	9
		F2 (pasture)	Root	<LOR	0.040	1.41	74	3072	5
			Shoot	<LOR	0.0086	0.29	13	3072	3

	F3 (pasture reference)	Root	<LOR	1.17	37.64	1600	2555	7
		Shoot	<LOR	2.93	106.29	4700	2555	5
	F4 (broccoli)	Floret	<LOR	0.010	0.46	25	3584	2
		Root	<LOR	1.48	38.19	1700	3584	26
		Shoot	<LOR	3.43	63.39	2300	3584	58
	F5 (broccoli)	Floret	<LOR	0.58	11.09	480	3072	24
		Root	<LOR	0.93	19.23	790	3072	29
		Shoot	<LOR	14.19	161.91	4700	3072	72
	F6 (broccoli reference)	Floret	<LOR	1.33	25.68	990	2042	14
		Root	<LOR	0.67	13.63	395	2048	8
		Shoot	<LOR	41.07	520.62	11000	2048	40
	F7 (lettuce)	Root	<LOR	33.61	642.99	19000	3584	131
		Shoot	<LOR	2.11	25.07	860	3584	98
PFAS	F1 (pasture)	Root	<LOR	0.28	2.06	21.4	175	5
		Shoot	<LOR	0.23	3.10	41	175	1
	F2 (pasture)	Root	<LOR	0	0	<LOR	150	0
		Shoot	<LOR	0	0	<LOR	150	0
	F3 (pasture reference)	Root	<LOR	0	0	<LOR	125	0
		Shoot	<LOR	0.077	0.86	9.6	125	1
	F4 (broccoli)	Floret	<LOR	0.20	1.01	6.7	175	7
		Root	<LOR	0.089	1.17	15.5	175	1
		Shoot	<LOR	0.28	1.42	9.94	175	7
	F5 (broccoli)	Floret	<LOR	0.173	0.95	6.61	150	5
		Root	<LOR	0	0	<LOR	150	0
		Shoot	<LOR	2.96	16.74	154	150	13
	F6 (broccoli reference)	Floret	<LOR	0	0	<LOR	100	0
		Root	<LOR	0	0	<LOR	100	0
		Shoot	<LOR	1.24	7.77	66	100	5
	F7 (lettuce)	Root	<LOR	0.037	0.34	3.23	175	2
		Shoot	<LOR	1.23	7.46	64	175	9
Phthalates	F1 (pasture)	Root	<LOR	74.29	263.70	1300	77	7
		Shoot	<LOR	45.19	212.79	1200	77	4
	F2 (pasture)	Root	<LOR	116.97	630.55	4800	66	4
		Shoot	<LOR	19.24	111.86	760	66	2
	F3 (pasture reference)	Root	<LOR	21.09	109.84	620	55	2
		Shoot	<LOR	0	0	<LOR	55	0
	F4 (broccoli)	Floret	<LOR	83.77	437.84	2900	77	7
		Root	<LOR	4.45	16.94	100	77	7
		Shoot	<LOR	198.44	851.42	6000	77	12
	F5 (broccoli)	Floret	<LOR	2.38	9.34	58	66	5
		Root	<LOR	3.61	12.85	70	66	6
		Shoot	<LOR	125.47	372.54	1850	66	13
	F6 (broccoli reference)	Floret	<LOR	6.36	28.50	180	44	4
		Root	<LOR	17.43	56.95	320	44	7

			Shoot	<LOR	100.59	312.35	1970	44	12
		F7 (lettuce)	Root	<LOR	232.47	881.90	6100	77	7
			Shoot	<LOR	8.83	77.49	680	77	1
	PPCPs	F1 (pasture)	Root	<LOR	0	0	<LOR	463	0
			Shoot	<LOR	0.012	0.27	5.76	463	1
		F2 (pasture)	Root	<LOR	0	0	<LOR	408	0
			Shoot	<LOR	0	0	<LOR	408	0
		F3 (pasture reference)	Root	<LOR	0	0	<LOR	353	0
			Shoot	<LOR	0	0	<LOR	353	0
		F4 (broccoli)	Floret	<LOR	0.028	0.60	13	463	1
			Root	<LOR	0	0	<LOR	463	0
			Shoot	<LOR	0.081	1.06	15.8	463	3
		F5 (broccoli)	Floret	<LOR	0.018	0.37	7.4	408	1
			Root	<LOR	0.044	0.89	18	408	1
			Shoot	<LOR	0.034	0.49	7.95	408	2
		F6 (broccoli reference)	Floret	<LOR	0.018	0.31	5.4	298	1
			Root	<LOR	0.021	0.36	6.3	298	1
			Shoot	<LOR	0.023	0.41	7	298	1
		F7 (lettuce)	Root	<LOR	0	0	<LOR	463	0
			Shoot	<LOR	0.030	0.46	8.03	463	2
	SVOCs	F1 (pasture)	Root	<LOR	9.19	166.78	5100	1785	10
			Shoot	<LOR	8.57	177.41	6800	1785	10
		F2 (pasture)	Root	<LOR	0	0	<LOR	1530	0
			Shoot	<LOR	0	0	<LOR	1530	0
		F3 (pasture reference)	Root	<LOR	0.016	0.59	21	1275	1
			Shoot	<LOR	2.51	59.51	1500	1275	4
		F4 (broccoli)	Floret	<LOR	28.65	525.26	18044	1785	35
			Root	<LOR	5.62	73.37	1500	1785	30
			Shoot	<LOR	24.07	193.26	3610	1785	54
		F5 (broccoli)	Floret	<LOR	42.69	478.25	12820	1530	54
			Root	<LOR	10.35	107.91	2000	1530	41
			Shoot	<LOR	53.22	344.72	5320	1530	66
		F6 (broccoli reference)	Floret	<LOR	78.96	949.31	18009	1020	36
			Root	<LOR	4.06	39.52	650	1020	30
			Shoot	<LOR	45.41	288.57	3700	1020	42
		F7 (lettuce)	Root	<LOR	4.43	87.61	2300	1785	11
			Shoot	<LOR	4.75	82.84	2300	1785	13
2024	PFAS	F1 (pasture)	Root	<LOR	0	0	<LOR	297	0
			Shoot	<LOR	0	0	<LOR	297	0
		F2 (pasture)	Root	<LOR	0.25	3.10	51.69	297	4
			Shoot	<LOR	0.036	0.61	10.58	297	1
		F3 (pasture reference)	Root	<LOR	0	0	<LOR	297	0
			Shoot	<LOR	0.054	0.68	10.27	297	2
		F4 (broccoli)	Floret	<LOR	0	0	<LOR	270	0

		Root	<LOR	0.062	0.33	2.39	270	10
		Shoot	<LOR	0	0	<LOR	270	0
	F5 (broccoli)	Floret	<LOR	0.13	0.65	4.45	270	10
		Root	<LOR	0.087	0.47	3.31	270	10
		Shoot	<LOR	0	0	<LOR	270	0
	F6 (broccoli reference)	Floret	<LOR	0	0	<LOR	270	0
		Root	<LOR	0.028	0.20	1.89	270	6
		Shoot	<LOR	0	0	<LOR	270	0
PPCPs	F1 (pasture)	Root	<LOR	0.024	0.12	0.81	572	20
		Shoot	<LOR	0.040	0.18	1.21	572	27
	F2 (pasture)	Root	<LOR	0.033	0.17	1.73	572	23
		Shoot	<LOR	0.039	0.24	3.11	572	19
	F3 (pasture reference)	Root	<LOR	0.027	0.16	1.47	572	17
		Shoot	<LOR	0.021	0.14	1.26	568	13
	F4 (broccoli)	Floret	<LOR	0	0	<LOR	520	0
		Root	<LOR	0	0	<LOR	520	0
		Shoot	<LOR	0	0	<LOR	520	0
	F5 (broccoli)	Floret	<LOR	0	0	<LOR	520	0
		Root	<LOR	0	0	<LOR	520	0
		Shoot	<LOR	0	0	<LOR	520	0
	F6 (broccoli reference)	Floret	<LOR	0	0	<LOR	520	0
		Root	<LOR	0	0	<LOR	520	0
		Shoot	<LOR	0	0	<LOR	520	0

Table S4. Summary statistics for individual emerging contaminants detected in water samples for each sampling year and at each type of site (i.e., recycled water irrigated site, reference site, or river water samples). Where a chemical was not detected in any samples at a sampling point, it was excluded from this table. Min = minimum; SD = standard deviation; Max = Maximum. LOR = Limit of reporting.

Water samples									
Year	**Analyte group**	**Analyte**	**Site type**	**Min (µg/L)**	**Mean (µg/L)**	**SD (µg/L)**	**Max (µg/L)**	**Total sample size**	**Detections sample size**
2023	PAHs	C2 alkyl napthalenes	Recycled water	<LOR	0.027	0.071	0.36	33	6
		C3 alkyl napthalenes	Recycled water	<LOR	0.0096	0.033	0.15	33	5
		Naphthalene	Recycled water	<LOR	0.0078	0.019	0.09	33	6
		1-Methyl naphthalene	Recycled water	<LOR	0.010	0.035	0.19	33	5
		2-Methyl naphthalene	Recycled water	<LOR	0.0093	0.038	0.21	33	3
	Pesticides	Clopyralid	Reference	0.054	0.057	0.0042	0.06	2	2
		Dichloroprop	Reference	0.008	0.0085	0.00070	0.009	2	2
		Diuron	Recycled water	0.01	0.030	0.019	0.09	33	33
		Epoxiconazole	Recycled water	<LOR	0.0075	0.010	0.03	33	14
		Fipronil	Recycled water	<LOR	0.0054	0.0075	0.02	33	13
		Flutriafol	Recycled water	<LOR	0.056	0.052	0.25	33	32
			Reference	<LOR	0.005	0.0067	0.02	12	5
		Imidacloprid	Recycled water	<LOR	0.018	0.016	0.04	33	20
		MCPA	Reference	0.006	0.006	0	0.006	2	2
		Mesosulfuron methyl	Recycled water	<LOR	0.012	0.019	0.06	33	10
		Metalaxyl	Recycled water	<LOR	0.0072	0.010	0.04	33	15
		Metolachlor	Recycled water	<LOR	0.0063	0.0082	0.03	33	15
		Metsulfuron methyl	Recycled water	<LOR	0.010	0.019	0.06	33	9
		Propargite	Reference	<LOR	0.0058	0.015	0.05	12	2
		Propiconazole	Recycled water	<LOR	0.00027	0.0022	0.018	66	1
		Propyzamide	Recycled water	<LOR	0.073	0.087	0.28	33	20
			Reference	<LOR	0.0041	0.0099	0.03	12	2
		Pyrimethanil	Recycled water	<LOR	0.0027	0.0057	0.02	33	7
		Sebuthylazin	Recycled water	<LOR	0.0039	0.0049	0.01	33	13
		Simazine	Recycled water	<LOR	0.022	0.016	0.08	33	32
		Spirotetramat	Recycled water	<LOR	0.0036	0.0048	0.01	33	12
		Spirotetramat.enol	Recycled water	<LOR	0.0039	0.0049	0.01	33	13
		Sulfentrazone	Recycled water	<LOR	0.15	0.39	1.7	33	5
		Sulfometuron methyl	Recycled water	<LOR	0.24	0.47	1.9	33	20
			Reference	<LOR	0.14	0.086	0.27	12	10
		Tebuthiuron	Recycled water	<LOR	0.049	0.049	0.17	33	20
		Terbuthylazine	Recycled water	<LOR	0.0057	0.0083	0.03	33	13
		Thiabendazole	Recycled water	<LOR	0.41	0.82	2.5	33	7
		Trichlopyr	Reference	0.016	0.019	0.0049	0.023	2	2
		2,4 D	Reference	0.01	0.015	0.0070	0.02	2	2
		2,6 D	Reference	0.02	0.02	0	0.02	2	2
	PFAS	PFDA	Recycled water	<LOR	0.0029	0.0046	0.014	33	10
		PFHpA	Recycled water	<LOR	0.0094	0.0038	0.019	33	31
			Reference	<LOR	0.0009	0.0028	0.009	10	1
		PFHxA	Recycled water	0.013	0.024	0.0081	0.041	33	33

		PFHxS	Recycled water	<LOR	0.014	0.0074	0.027	33	28
			Reference	<LOR	0.0014	0.0044	0.014	10	1
		PFNA	Recycled water	<LOR	0.0012	0.0029	0.009	33	5
		PFOA	Recycled water	<LOR	0.018	0.0084	0.035	33	32
			Reference	<LOR	0.0012	0.0037	0.012	10	1
		PFOS	Recycled water	<LOR	0.019	0.0053	0.028	33	32
			Reference	<LOR	0.0012	0.0037	0.012	10	1
		PFUdA	Recycled water	<LOR	0.00066	0.0027	0.013	33	2
	Phthalates	DnPP	Recycled water	<LOR	0.038	0.13	0.55	33	3
		DBP	Recycled water	<LOR	0.011	0.036	0.2	33	6
		DCHP	Recycled water	<LOR	0.0024	0.013	0.08	33	1
		DEP	Recycled water	<LOR	0.0090	0.025	0.1	33	4
		DIBP	Recycled water	<LOR	0.011	0.035	0.17	33	4
	PPCPs	Benzotriazole	Recycled water	<LOR	0.049	0.046	0.142	33	24
			Reference	<LOR	0.0027	0.0043	0.01	10	3
		Benzotriazole 4,5methyl	Recycled water	<LOR	0.0023	0.0050	0.019	33	8
		Caffeine	Recycled water	<LOR	0.0068	0.012	0.051	33	11
			Reference	<LOR	0.050	0.17	0.61	12	1
		Carbamazepine	Recycled water	<LOR	0.00097	0.0038	0.021	33	3
		DEET	Recycled water	<LOR	0.0022	0.0078	0.06	66	14
		Fluconazole	Recycled water	<LOR	0.022	0.017	0.055	33	28
		Galaxolide	Recycled water	<LOR	0.0056	0.012	0.0416	33	6
		Lamotrigine	Recycled water	<LOR	0.0084	0.021	0.107	33	10
		Metoprolol	Recycled water	<LOR	0.0017	0.0041	0.0176	33	6
		Paraben Propyl	Recycled water	<LOR	0.0052	0.017	0.073	33	4
		Tebuconazole	Recycled water	<LOR	0.0083	0.015	0.06	66	20
		Tebuconazole	Reference	<LOR	0.0019	0.0065	0.028	22	2
		Telmisartan	Recycled water	<LOR	0.010	0.021	0.12	33	18
		Triclosan	Recycled water	<LOR	0.0026	0.0035	0.009	33	13
			Reference	<LOR	0.00091	0.0021	0.006	12	2
	SVOCs	Biphenyl	Recycled water	<LOR	0.0042	0.011	0.06	33	5
2024	EDCs	Bisphenol A	Recycled water	<LOR	0.027	0.026	0.06	9	5
			Reference	<LOR	0.017	0.035	0.07	4	1
			River water samples	0.05	0.075	0.035	0.1	2	2
	PAHs	Acenaphthene	Recycled water	<LOR	0.0066	0.0086	0.02	9	4
			Reference	<LOR	0.0025	0.005	0.01	4	1
			River water samples	0.01	0.02	0.014	0.03	2	2
		Acenaphthylene	Recycled water	<LOR	0.012	0.015	0.04	9	4
			Reference	<LOR	0.01	0.0081	0.02	4	3
		C1 alkyl fluorenes	Recycled water	<LOR	0.052	0.076	0.19	9	5
		C2 alkyl fluorenes	Recycled water	<LOR	0.028	0.056	0.17	9	4
		C2 alkyl napthalenes	Recycled water	<LOR	0.0066	0.016	0.05	9	2
			River water samples	<LOR	0.03	0.042	0.06	2	1
		C3 alkyl fluorenes	Recycled water	0.03	0.087	0.061	0.19	9	9
			Reference	0.01	0.022	0.012	0.04	4	4
			River water samples	0.02	0.065	0.063	0.11	2	2

	C3 alkyl napthalenes	Recycled water	<LOR	0.0011	0.0033	0.01	9	1
		River water samples	<LOR	0.015	0.021	0.03	2	1
	C3 alkyl phenanthrenes	Recycled water	<LOR	0.0033	0.01	0.03	9	1
	Naphthalene	River water samples	<LOR	0.01	0.014	0.02	2	1
	1-Methyl naphthalene	Recycled water	<LOR	0.0061	0.0091	0.03	18	7
		River water samples	<LOR	0.01	0.02	0.04	4	1
	2-Methylnaphthalene	Recycled water	<LOR	0.0027	0.0066	0.02	18	3
		River water samples	<LOR	0.01	0.02	0.04	4	1
Pesticides	Atrazine	Recycled water	<LOR	0.0022	0.0044	0.01	9	2
	Azoxystrobin	Recycled water	<LOR	0.0088	0.010	0.03	9	5
	Boscalid	Recycled water	<LOR	0.011	0.014	0.04	9	4
		Reference	<LOR	0.017	0.012	0.03	4	3
	Chlorantraniliprole	Recycled water	<LOR	0.0055	0.0072	0.02	9	4
		Reference	<LOR	0.0025	0.005	0.01	4	1
	DCPA	Reference	<LOR	0.0075	0.005	0.01	4	3
	DDD.p.p	Reference	<LOR	0.005	0.01	0.02	4	1
	DDT.p.p	Reference	<LOR	0.02	0.04	0.08	4	1
	Propiconazole	Recycled water	<LOR	0.26	0.24	0.89	35	27
		Reference	0.0022	0.0039	0.00098	0.0072	18	18
		River water samples	<LOR	0.045	0.028	0.069	6	5
	Propyzamide	Recycled water	<LOR	0.087	0.11	0.28	9	4
		Reference	<LOR	0.015	0.01	0.02	4	3
	Pyrimethanil	Recycled water	<LOR	0.0011	0.0033	0.01	9	1
	Simazine	Recycled water	<LOR	0.11	0.057	0.18	9	8
		Reference	0.01	0.017	0.005	0.02	4	4
		River water samples	0.01	0.015	0.0070	0.02	2	2
	Simetryn	Recycled water	<LOR	0.0044	0.0052	0.01	9	4
	Terbuthylazine	Recycled water	<LOR	0.0044	0.0052	0.01	9	4
	Thiabendazole	Recycled water	<LOR	0.12	0.25	0.64	9	5
		River water samples	<LOR	0.023	0.033	0.047	2	1
PFAS	PFBA	Recycled water	<LOR	0.0010	0.0028	0.0091	40	5
	PFBS	Reference	<LOR	0.00099	0.0010	0.0021	20	10
		River water samples	<LOR	0.00093	0.00085	0.0016	5	3
	PFDA	Recycled water	<LOR	0.0010	0.0011	0.0037	40	19
		River water samples	<LOR	0.00017	0.00039	0.00089	5	1
	PFHxS	Recycled water	<LOR	0.0046	0.0015	0.0071	40	38
		River water samples	<LOR	0.0033	0.0025	0.0053	5	4
	PFNA	Recycled water	<LOR	0.00087	0.0010	0.0032	40	18
	PFOA	Recycled water	<LOR	0.0042	0.0024	0.0086	40	38
		Reference	<LOR	0.00051	0.00058	0.0013	20	9
		River water samples	<LOR	0.0017	0.0010	0.0026	5	4
	PFOS	Recycled water	<LOR	0.0060	0.0021	0.010	40	38

		Reference	<LOR	0.0013	0.0014	0.0033	20	10
		River water samples	<LOR	0.0040	0.0029	0.0071	5	4
Phthalates	DEHP	Recycled water	0.06	0.093	0.035	0.16	9	9
		Reference	0.03	0.047	0.035	0.1	4	4
		River water samples	0.08	0.17	0.12	0.26	2	2
	DBP	Recycled water	0.04	0.082	0.036	0.14	9	9
		Reference	<LOR	0.025	0.043	0.09	4	2
		River water samples	0.09	0.14	0.070	0.19	2	2
	DEP	Recycled water	<LOR	0.0083	0.010	0.04	18	9
		Reference	<LOR	0.0012	0.0035	0.01	8	1
		River water samples	<LOR	0.022	0.033	0.07	4	2
PPCPs	Acetaminophen	Recycled water	<LOR	0.12	0.36	1.1	9	1
	Amoxicillin	Recycled water	<LOR	0.05	0.1	0.25	9	2
	Amphetamine	Recycled water	<LOR	0.013	0.021	0.054	9	3
	Atenolol	Recycled water	<LOR	0.0021	0.0075	0.037	44	4
	Benzotriazole	Recycled water	<LOR	0.57	0.55	2.83	35	33
		Reference	<LOR	0.010	0.010	0.023	18	10
		River water samples	<LOR	0.14	0.11	0.35	6	5
	Benzotriazole 4,5methyl	Recycled water	<LOR	0.21	0.11	0.46	35	33
		Reference	<LOR	0.010	0.0098	0.021	18	10
		River water samples	<LOR	0.052	0.028	0.086	6	5
	Benzoylecgonine	Recycled water	<LOR	0.012	0.014	0.038	9	6
	Caffeine	Recycled water	<LOR	0.13	0.12	0.38	44	27
		Reference	<LOR	0.017	0.018	0.052	22	11
		River water samples	<LOR	0.33	0.42	1.14	8	4
	Carbamazepine	Recycled water	0.01	0.25	0.25	0.85	44	44
		Reference	<LOR	0.0043	0.0048	0.010	22	10
		River water samples	<LOR	0.013	0.019	0.051	8	4
	Cetrazine	Recycled water	<LOR	0.007	0.019	0.058	9	2
	Clindamycin	Recycled water	<LOR	0.011	0.016	0.04	9	4
	DEET	Recycled water	0.018	0.12	0.068	0.25	35	35
		Reference	0.013	0.030	0.013	0.046	18	18
		River water samples	0.018	0.038	0.019	0.076	6	6
	Desmethlycitalopram	Recycled water	<LOR	0.015	0.011	0.029	9	6
	Diatrizoate	Recycled water	<LOR	0.025	0.070	0.3	44	6
		Reference	<LOR	0.0030	0.0080	0.028	22	3
		River water samples	<LOR	0.018	0.053	0.15	8	1
	Diltiazem	Recycled water	<LOR	0.00019	0.00069	0.0036	35	3
	Doxylamine	Recycled water	<LOR	0.016	0.033	0.082	9	2
	Fluconazole	Recycled water	0.0028	0.043	0.026	0.10	35	35
		River water samples	<LOR	0.0070	0.0038	0.011	6	5
	Gabapentin	Recycled water	<LOR	0.066	0.17	0.8	44	21

		Reference	<LOR	0.0045	0.012	0.045	22	3
		River water samples	<LOR	0.02	0.056	0.16	8	1
	Lamotrigine	Recycled water	<LOR	0.49	0.59	2.7	44	40
		River water samples	<LOR	0.12	0.10	0.33	8	6
	Lidocaine	Recycled water	0.0028	0.013	0.018	0.10	35	35
		River water samples	<LOR	0.017	0.013	0.027	6	5
	Methamphetamine	Recycled water	<LOR	0.0041	0.0052	0.013	9	4
	Metoprolol	Recycled water	<LOR	0.082	0.070	0.26	44	35
		River water samples	<LOR	0.0054	0.0088	0.021	8	3
	Octocrylene	Recycled water	<LOR	0.17	0.08	0.31	9	8
		Reference	<LOR	0.11	0.080	0.18	4	3
	Oxazepam	Recycled water	<LOR	0.015	0.021	0.05	9	4
	Paraben Propyl	Recycled water	<LOR	0.077	0.18	0.88	35	17
		Reference	<LOR	0.028	0.0097	0.044	18	17
		River water samples	<LOR	0.00092	0.0022	0.0055	6	1
	Phenytoin	Recycled water	<LOR	0.0081	0.010	0.026	9	4
	Tebuconazole	Recycled water	<LOR	0.062	0.056	0.16	44	37
		Reference	<LOR	0.0060	0.0049	0.014	22	14
		River water samples	<LOR	0.028	0.029	0.062	8	5
	Temazepam	Recycled water	<LOR	0.051	0.047	0.13	9	7
	Tramadol	Recycled water	<LOR	0.018	0.0089	0.043	44	40
		River water samples	<LOR	0.012	0.012	0.026	8	5
	Valsartan	Recycled water	<LOR	0.053	0.042	0.11	9	7
	Venlafaxine	Recycled water	<LOR	0.00013	0.00090	0.006	44	1
SVOCs	Benzaldehyde	Recycled water	0.01	0.16	0.23	0.61	9	9
		Reference	<LOR	0.01	0.011	0.02	4	2
		River water samples	0.01	0.085	0.10	0.16	2	2
	C1 alkyl biphenyls	Recycled water	<LOR	0.001	0.0033	0.01	9	1
		River water samples	<LOR	0.01	0.014	0.02	2	1
	C1 alkyl dibenzothiophenes	Recycled water	<LOR	0.0011	0.0033	0.01	9	1
	C2 alkyl biphenyls	Recycled water	<LOR	0.014	0.026	0.08	9	4
	C3 alkyl biphenyls	Recycled water	<LOR	0.0088	0.026	0.08	9	1
	Mestranol	Recycled water	<LOR	2.55	10.84	46	18	1
	Phenol	Recycled water	<LOR	0.22	0.66	2	9	3
		Reference	<LOR	0.0025	0.005	0.01	4	1
	2,4.Di.tert.butyl.phenol	Recycled water	15	19.11	4.53	27	9	9
		Reference	2.5	10.7	12.31	29	4	4
		River water samples	17	28.5	16.26	40	2	2
	2,6.Dichlorophenol	Recycled water	<LOR	0.0011	0.0032	0.01	18	2
	3.Ethyl.phenol	Recycled water	<LOR	16.68	49.99	150	9	5
		Reference	<LOR	0.01	0.02	0.04	4	1
		River water samples	0.01	0.015	0.0070	0.02	2	2

	7,9.Di.tert.butyl.1.oxaspiro .4.5.deca.6.9.diene.2.8.dione	Recycled water	<LOR	0.091	0.11	0.29	9	4
		Reference	<LOR	0.042	0.034	0.07	4	3

Table S5. Summary statistics for individual emerging contaminants detected in soil samples for each sampling year and at each type of site (i.e., recycled water irrigated site or reference site). Where a chemical was not detected in any samples at a sampling point, it was excluded from this table. Min = minimum; SD = standard deviation; Max = Maximum. LOR = Limit of reporting.

Soil samples

Year	Analyte group	Analyte	Site type	Min (µg/kg)	Mean (µg/kg)	SD (µg/kg)	Max (µg/kg)	Total sample size	Detections sample size
2023	EDCs	Progesterone	Recycled water	<LOR	0.045	0.27	1.7	37	1
			Reference	<LOR	0.10	0.36	1.2	11	1
		tert-octyl phenol	Recycled water	<LOR	0.16	0.71	3.1	37	2
			Reference	<LOR	1.58	2.38	6	11	5
	PAHs	Acenaphthene	Recycled water	<LOR	0.17	0.54	2.2	33	4
		Acenaphthylene	Recycled water	<LOR	0.024	0.083	0.4	33	3
		Anthracene	Recycled water	<LOR	0.52	0.81	2.5	33	12
			Reference	<LOR	0.38	0.90	2.7	9	2
		Benz(a)anthracene	Recycled water	<LOR	3.43	8.83	49	33	19
			Reference	<LOR	4.85	5.70	14	9	6
		Benzo(a)pyrene	Recycled water	<LOR	4.25	11.57	65	33	21
			Reference	<LOR	6.6	7.74	21	9	6
		Benzo(b,J)fluoranthene	Recycled water	<LOR	3.85	10.57	59	33	22
			Reference	<LOR	6.2	6.74	16	9	6
		Benzo(c)phenanthrene	Recycled water	<LOR	0.060	0.24	1.1	33	2
			Reference	<LOR	0.044	0.13	0.4	9	1
		Benzo(e)pyrene	Recycled water	<LOR	2.76	7.24	40	33	21
			Reference	<LOR	4.03	4.34	12	9	6
		Benzo(ghi)perylene	Recycled water	<LOR	4.55	10.26	40	33	20
			Reference	<LOR	16.72	19.50	50	9	7
		Benzo(k)fluoranthene	Recycled water	<LOR	0.95	4.05	23	33	8
			Reference	<LOR	0.26	0.8	2.4	9	1
		C1 alkyl phenanthrenes	Recycled water	<LOR	0.78	2.90	16	33	4
			Reference	<LOR	0.68	1.39	3.7	9	2
		C2 alkyl napthalenes	Recycled water	<LOR	9.04	10.09	31	33	26
			Reference	<LOR	9.66	9.94	25	9	8
		C2 alkyl phenanthrenes	Reference	<LOR	0.2	0.6	1.8	9	1
			Reference	<LOR	0.13	0.4	1.2	9	1
		Chrysene	Recycled water	<LOR	4.97	12.98	74	33	28
			Reference	<LOR	7.85	6.41	19	9	8
		Dibenz(ah)anthracene	Recycled water	<LOR	3.63	20.88	120	33	1
			Reference	<LOR	28.11	40.39	100	9	4
		Dibenzo(a.e)pyrene	Recycled water	<LOR	0.5	2.8	18	66	2
			Reference	<LOR	0.23	0.73	2.9	18	2
		Dibenzo(a.i)pyrene	Reference	<LOR	0.61	1.25	3.4	9	2

	Fluoranthene	Recycled water	<LOR	6.40	11.67	66	33	29
		Reference	<LOR	13.86	11.55	33	9	8
	Fluorene	Recycled water	<LOR	0.75	1.52	6	33	10
		Reference	<LOR	0.033	0.1	0.3	9	1
	Indeno(1.2.3.c.d)pyrene	Recycled water	<LOR	2.54	6.23	35	33	19
		Reference	<LOR	5.75	5.28	14	9	7
	Naphthalene	Recycled water	<LOR	20.05	29.47	110	33	31
		Reference	<LOR	33.68	31.75	75	9	8
	Perylene	Recycled water	<LOR	0.5	2.09	12	33	6
		Reference	<LOR	0.36	0.59	1.6	9	3
	Phenanthrene	Recycled water	<LOR	2.60	3.87	19	33	26
		Reference	<LOR	6.55	5.77	16	9	7
	Pyrene	Recycled water	<LOR	12.63	15.44	74	33	30
		Reference	<LOR	18.3	11.05	36	9	8
	1-Methyl naphthalene	Recycled water	<LOR	3.9	4.29	12	33	24
		Reference	<LOR	5.7	6.18	16	9	5
	2-Methyl naphthalene	Recycled water	<LOR	9.76	9.97	30	33	26
		Reference	<LOR	12.56	12.47	32	9	7
	5-Nitroacenaphthene	Recycled water	<LOR	0.42	2.43	14	33	1
Pesticides	Azoxystrobin	Recycled water	<LOR	51.21	62.64	200	33	27
		Reference	<LOR	12.08	34.10	103	9	4
	Boscalid	Recycled water	<LOR	56.39	50.0	130	33	20
		Reference	<LOR	7.3	21.62	65	9	3
	Carbaryl	Recycled water	<LOR	0.018	0.10	0.6	33	1
		Reference	<LOR	0.055	0.16	0.5	9	1
	Chlorantraniliprole	Recycled water	<LOR	9.41	8.30	23	33	21
		Reference	<LOR	1.94	5.64	17	9	2
	Chlorpyriphos	Recycled water	<LOR	0.49	1.11	5.6	33	11
		Reference	<LOR	0.6	1.04	2.5	9	3
	Cyazofamid	Recycled water	<LOR	3.88	10.24	51	33	12
		Reference	<LOR	1.7	4.97	15	9	2
	Cyprodinil	Recycled water	<LOR	18.77	37.97	200	33	20
		Reference	<LOR	0.48	1.46	4.4	9	1
	DDD.p.p	Recycled water	<LOR	0.86	1.77	5.9	33	7
	DDE.p.p	Recycled water	<LOR	24.24	49.93	150	33	11
	DDT.p.p	Recycled water	<LOR	0.039	0.12	0.5	33	3
	Deltamethrin	Recycled water	<LOR	0.27	0.94	4.6	33	3
	Diflufenican	Recycled water	<LOR	0.93	3.14	14	33	7
	Epoxiconazole	Reference	<LOR	0.077	0.23	0.7	9	1
	Ethofumesate	Recycled water	<LOR	0.086	0.25	1.2	33	4
		Reference	<LOR	146.33	266.78	650	9	5
	Fipronil	Recycled water	<LOR	0.51	0.92	4.1	33	13
		Reference	<LOR	10.33	21.16	57	9	2
	Floupicolide	Recycled water	<LOR	70.06	90.42	300	33	20
		Reference	<LOR	112.22	184.37	480	9	3
	Flubendiamide	Recycled water	<LOR	39.66	37.46	120	33	20
		Reference	<LOR	7	21	63	9	1
	Fludioxonil	Recycled water	<LOR	53.6	58.72	270	33	20

		Reference	<LOR	4.77	14.33	43	9	1
	Flutriafol	Recycled water	<LOR	0.28	0.36	1.3	33	15
		Reference	<LOR	0.36	0.30	1	9	7
	Imidacloprid	Recycled water	<LOR	54.86	74.19	270	33	26
		Reference	<LOR	22.43	43.40	116	9	3
	Indoxacarb	Recycled water	<LOR	26.33	28.55	92	33	20
		Reference	<LOR	5	15	45	9	1
	Metalaxyl	Recycled water	<LOR	0.20	0.44	1.6	33	7
		Reference	<LOR	0.76	1.6	4.5	9	2
	Methomyl	Recycled water	<LOR	0.03	0.10	0.4	33	3
	Metolachlor	Recycled water	<LOR	7.46	11.98	60	33	20
		Reference	<LOR	4.76	7.43	18	9	3
	Novaluron	Recycled water	<LOR	6.9	7.1	24	33	20
		Reference	<LOR	1.22	3.66	11	9	1
	Oxadixyl	Recycled water	<LOR	0.18	0.3	1.2	33	8
	Pendimethalin	Recycled water	<LOR	129.393	184.80	740	33	20
		Reference	<LOR	57.77	88.70	200	9	3
	Pentachlorophenol	Recycled water	<LOR	0.33	1.47	8.3	33	3
	Prochloraz	Recycled water	<LOR	4.19	4.49	13	33	20
		Reference	<LOR	0.64	1.93	5.8	9	1
	Procymidone	Recycled water	<LOR	0.12	0.27	1	33	6
	Prometryn	Recycled water	<LOR	96.24	233.75	1100	33	13
		Reference	<LOR	34.44	103.33	310	9	1
	Propamocarb	Reference	<LOR	0.033	0.1	0.3	9	1
	Propiconazole	Recycled water	<LOR	0.23	0.44	1.9	66	19
		Reference	<LOR	0.077	0.22	0.8	18	2
	Propyzamide	Recycled water	<LOR	2.34	3.00	14	33	20
		Reference	<LOR	0.6	1.96	5.9	9	1
	Pymetrozine	Recycled water	<LOR	0.024	0.10	0.5	33	2
		Reference	<LOR	0.066	0.2	0.6	9	1
	Pyraclostrobin	Recycled water	<LOR	17.44	23.84	82	33	20
		Reference	<LOR	51.44	93.38	220	9	3
	Spinosad A	Recycled water	<LOR	0.018	0.072	0.3	33	2
	Spinosad D	Recycled water	<LOR	0.087	0.1	0.6	33	7
		Reference	<LOR	0.41	0.73	1.8	9	3
	Spirotetramat	Recycled water	<LOR	0.030	0.12	0.6	33	2
	Spirotetramat.enol	Recycled water	<LOR	0.1	0.21	0.8	33	7
	Tebuthiuron	Recycled water	<LOR	0.23	0.3	1.1	33	13
		Reference	<LOR	0.033	0.1	0.3	9	1
	Thiabendazole	Recycled water	<LOR	0.0090	0.052	0.3	33	1
	Triadimenol	Reference	<LOR	0.022	0.094	0.4	18	1
	Trifloxystrobin	Recycled water	<LOR	0.22	0.33	1.1	33	12
		Reference	<LOR	0.066	0.2	0.6	9	1
	Triflumuron	Reference	<LOR	0.077	0.1	0.4	9	2
	Trifluralin	Recycled water	<LOR	0.17	0.32	0.8	33	8
PFAS	PFOA	Recycled water	<LOR	1.42	2.76	10.6	33	8
	PFOS	Recycled water	<LOR	2.70	2.57	8.46	33	25
		Reference	<LOR	1.21	1.45	3.05	9	4

Phthalates	BBP	Reference	<LOR	0.12	0.36	1.1	9	1
	BEBP	Recycled water	<LOR	5.15	29.59	170	33	1
	DMEP	Recycled water	<LOR	0.66	3.82	22	33	1
	DEHP	Recycled water	<LOR	21.78	22.92	71	33	26
		Reference	<LOR	28.711	16.97	46	9	8
	DnOP	Recycled water	<LOR	7.18	12.17	38	33	13
		Reference	<LOR	15.88	15.31	33	9	5
	DBP	Recycled water	<LOR	14.58	14.44	50	33	27
		Reference	<LOR	10.31	12.46	40	9	8
	DEP	Recycled water	<LOR	0.61	1.31	5.4	33	9
		Reference	<LOR	0.54	0.95	2.4	9	3
	DIBP	Recycled water	<LOR	4.97	6.8	26	33	23
		Reference	<LOR	6.75	8.1	20	9	7
	DMP	Recycled water	<LOR	0.34	0.95	4.4	33	5
		Reference	<LOR	0.1	0.3	0.9	9	1
PPCPs	Carbamazepine	Recycled water	<LOR	0.21	0.6	2.3	37	4
		Reference	<LOR	0.1	0.48	1.6	11	1
	Ketoprofen	Recycled water	<LOR	2.27	13.80	84	37	1
	Lamotrigine	Recycled water	<LOR	0.11	0.52	3	37	2
	Paraben methyl	Recycled water	6.9	17.27	15.46	40	4	4
		Reference	8.2	12.6	6.22	17	2	2
SVOCs	a.Naphthylamine	Recycled water	<LOR	0.11	0.66	3.8	33	1
	a.Terpineol	Recycled water	<LOR	2.62	9.85	45	33	4
	Acetophenone	Recycled water	<LOR	3.21	5.84	20	33	10
		Reference	<LOR	9.88	9.79	23	9	5
	Benzothiazole	Recycled water	97	418.63	289.30	1100	33	33
		Reference	<LOR	493.88	378.30	980	9	8
	Biphenyl	Recycled water	<LOR	2.72	4.04	14	33	12
		Reference	<LOR	2.88	2.84	7	9	5
	Bis.2.chloroethoxy.methane	Reference	<LOR	0.17	0.53	1.6	9	1
	Bis.2.chloroethyl.ether	Reference	<LOR	0.15	0.32	0.9	9	2
	Bis.ethylhexyl.sebacate	Recycled water	<LOR	83.63	123.44	420	33	20
		Reference	<LOR	181.05	174.17	400	9	7
	Bumetrizole	Recycled water	<LOR	3.84	9.11	38	33	12
		Reference	<LOR	0.88	2.66	8	9	1
	Butylhydroxyanisole (BHA)	Recycled water	<LOR	5.60	26.62	150	33	2
	Butylhydroxytoluene (BHT)	Recycled water	<LOR	0.015	0.061	0.3	33	2
		Reference	<LOR	0.044	0.13	0.4	9	1
	C1 alkyl biphenyls	Recycled water	<LOR	0.27	1.58	9.1	33	1
		Reference	<LOR	0.24	0.73	2.2	9	1
	C2 alkyl biphenyls	Reference	<LOR	0.23	0.7	2.1	9	1
	C3 alkyl naphthalenes	Recycled water	<LOR	2.86	6.84	38	33	20
		Reference	<LOR	2.1	1.66	4	9	8
	Carbazole	Recycled water	<LOR	0.042	0.24	1.4	33	1
		Reference	<LOR	0.16	0.33	0.9	9	2
	Cumene	Recycled water	<LOR	0.47	0.66	1.8	33	12
		Reference	<LOR	0.13	0.26	0.7	9	2
	Decamethyl-	Recycled water	<LOR	1.66	5.83	28	33	4

cyclopentasiloxane							
Dibenzofuran	Recycled water	<LOR	0.55	1.50	6.7	33	9
	Reference	<LOR	0.14	0.30	0.8	9	2
Dioctyl.adipate (DOA)	Recycled water	<LOR	51.75	57.75	180	33	21
	Reference	<LOR	45.66	40.23	100	9	7
Diphenyl.amine	Recycled water	<LOR	0.17	1.02	5.9	33	1
E.Caprolactam	Recycled water	<LOR	153.54	232.11	710	33	22
	Reference	<LOR	215.77	263.99	700	9	6
Isophorone	Recycled water	<LOR	1.24	4.47	25	33	7
	Reference	<LOR	1.1	2.20	5.6	9	2
m.p.Cresol	Recycled water	<LOR	2.3	3.82	14	33	24
	Reference	<LOR	4.94	5.61	14	9	7
Methyl.caprolactam	Recycled water	<LOR	0.12	0.73	4.2	33	1
	Reference	<LOR	0.36	1.1	3.3	9	1
N.Nitrosodi.N.butylamine	Recycled water	<LOR	5.54	13.38	65	33	9
	Reference	<LOR	7.55	15.12	38	9	2
Octamethyltetrasiloxane	Recycled water	<LOR	0.03	0.13	0.7	33	3
Phenol	Recycled water	<LOR	3.18	3.68	14	33	30
	Reference	<LOR	6.75	6.38	15	9	7
Stearamide	Recycled water	<LOR	22.81	21.55	70	33	32
	Reference	<LOR	29.06	27.04	71	9	8
Styrene	Recycled water	<LOR	26.27	31.20	140	33	30
	Reference	<LOR	44.77	40.71	110	9	8
tert.Butyl.Benzene	Recycled water	<LOR	0.027	0.11	0.6	33	2
Tetramethyl.phenol.isomers	Recycled water	<LOR	0.28	1.61	9.3	33	1
	Reference	<LOR	3.11	9.33	28	9	1
Tris.2.4.di.tert. butylphenyl.phosphate	Recycled water	<LOR	24.45	70.99	400	33	13
	Reference	<LOR	25.77	35.52	110	9	5
Tris.2.4.dimethylphenyl. phosphate	Recycled water	<LOR	29.15	152.9	880	33	5
	Reference	<LOR	54.444	109.44	280	9	2
1.2.4.Trimethyl.benzene	Recycled water	<LOR	0.99	1.54	4.6	33	12
	Reference	<LOR	0.33	0.69	1.9	9	2
1.2.Dichlorobenzene	Recycled water	<LOR	0.56	0.75	2.4	33	20
	Reference	<LOR	0.93	1.21	3	9	7
1.3.Di.tert.butylbenzene	Recycled water	<LOR	0.28	0.80	3	33	5
1.3.Dichlorobenzene	Recycled water	<LOR	0.94	2.48	10	33	6
	Reference	<LOR	0.73	1.45	3.5	9	2
1.4.Dichlorobenzene	Recycled water	<LOR	0.96	1.33	6	33	21
	Reference	<LOR	0.25	0.42	1.2	9	3
1.4.Dinitrobenzene	Reference	<LOR	2.16	3.75	10	9	3
1H.Benzotriazole	Recycled water	<LOR	0.090	0.40	2.2	33	2
	Reference	<LOR	2.88	6.16	19	9	4
2.4.6.Trichlorophenol	Recycled water	<LOR	6.37	13.53	60	33	16
	Reference	<LOR	0.81	2.21	6.7	9	2
2.4.Di.tert.butyl.phenol	Recycled water	<LOR	0.19	0.46	2	33	6
	Reference	<LOR	1.08	2.97	9	9	2
2.4.Dichlorophenol	Recycled water	<LOR	0.50	1.56	8.1	33	9

			Reference	<LOR	0.033	0.1	0.3	9	1
		2.4.Dimethyl.phenol	Recycled water	<LOR	0.29	1.14	6.2	33	3
		2.Chlorophenol	Recycled water	<LOR	0.24	1.00	5	33	2
		2.Cresol	Recycled water	<LOR	3.41	12.71	65	33	10
			Reference	<LOR	1.01	2.33	7.1	9	3
		2.tert.Butyl.phenol	Recycled water	<LOR	0.36	2.08	12	33	1
			Reference	<LOR	3.88	11.66	35	9	1
		2.Toluidine	Recycled water	<LOR	0.030	0.12	0.6	33	2
		2.Toluidine	Reference	<LOR	0.088	0.17	0.4	9	2
		4.Chloro.3.cresol	Recycled water	<LOR	0.42	1.37	7.1	33	4
			Reference	<LOR	0.12	0.36	1.1	9	1
2024	PFAS	PFDA	Recycled water	<LOR	0.14	0.26	0.57	8	2
		PFOS	Recycled water	1.18	3.03	2.7	9.27	8	8
			Reference	<LOR	1.28	1.47	2.64	4	2

Table S6. Summary statistics for individual emerging contaminants detected in plant samples for each sampling year and at each type of site (i.e., recycled water irrigated site or reference site). Where a chemical was not detected in any samples at a sampling point, it was excluded from this table. Min = minimum; SD = standard deviation; Max = Maximum. LOR = Limit of reporting.

Plant samples

Year	Analyte group	Analyte	Site type	Min (µg/kg)	Mean (µg/kg)	SD (µg/kg)	Max (µg/kg)	Total sample size	Detections sample size
2023	EDCs	tert-octyl phenol	Recycled water	<LOR	3.45	25.27	240	91	7
	PAHs	Acenaphthene	Recycled water	<LOR	10.16	21.49	78	79	17
			Reference	<LOR	5.136	16.68	61	22	2
		Acenaphthylene	Recycled water	<LOR	1.32	7.20	51	79	3
		Benz(a)anthracene	Recycled water	<LOR	0.93	8.32	74	79	1
		Benzo(a)pyrene	Recycled water	<LOR	0.17	1.57	14	79	1
		Benzo(b,J)fluoranthene	Recycled water	<LOR	0.63	5.62	50	79	1
		Benzo(e)pyrene	Recycled water	<LOR	0.50	4.50	40	79	1
		Benzo(k)fluoranthene	Recycled water	<LOR	0.98	8.77	78	79	1
			Reference	<LOR	3.27	15.35	72	22	1
		C2 alkyl napthalenes	Recycled water	<LOR	0.65	5.85	52	79	1
		Chrysene	Recycled water	<LOR	1.70	15.18	135	79	1
		Fluoranthene	Recycled water	<LOR	0.21	1.45	12	79	2
		Fluorene	Recycled water	<LOR	40.37	116.79	580	79	10
			Reference	<LOR	23.63	76.75	280	22	2
		Naphthalene	Recycled water	<LOR	100.82	169.25	760	79	31
			Reference	<LOR	142.27	208.64	680	22	9
		Phenanthrene	Recycled water	<LOR	15.93	30.51	120	79	21
			Reference	<LOR	10.95	24.48	75	22	4
		Pyrene	Recycled water	<LOR	0.10	0.90	8	79	1
		1-Methyl naphthalene	Recycled water	<LOR	3.24	13.43	77	79	7
		2-Methyl naphthalene	Recycled water	<LOR	3.97	11.88	64	79	11
	Pesticides	Acetamiprid	Recycled water	<LOR	0.13	0.85	5.6	79	2
		Azoxystrobin	Recycled water	<LOR	152.64	548.30	3200	79	14

	Boscalid	Recycled water	<LOR	50.38	164.88	870	79	25
	Buprofezin	Recycled water	<LOR	0.044	0.39	3.5	79	1
	Chlorantraniliprole	Recycled water	<LOR	0.98	2.42	9.2	79	12
	Chlorpyriphos	Recycled water	<LOR	3.46	17.43	140	79	11
	Cyazofamid	Recycled water	<LOR	113.07	513.48	4100	79	10
	Cyprodinil	Recycled water	<LOR	15.89	46.80	210	79	14
	DCPA	Recycled water	<LOR	16.95	63.56	400	79	16
		Reference	<LOR	2.18	5.01	18	22	4
	DDE.p.p	Recycled water	<LOR	24.92	55.60	340	79	33
		Reference	<LOR	2.04	4.59	14	22	4
	Diflufenican	Recycled water	<LOR	0.2	1.48	12	79	3
	Dimethoate	Recycled water	<LOR	0.48	3.94	35	79	2
	Epoxiconazole	Reference	<LOR	0.26	1.25	5.9	22	1
	Ethiofencarb sulfoxide	Recycled water	<LOR	2.88	12.27	77	79	5
	Ethofumesate	Recycled water	<LOR	2.94	9.14	74	79	22
		Reference	<LOR	476.04	1144.53	4700	22	10
	Fipronil	Recycled water	<LOR	14.77	37.16	180	79	16
		Reference	<LOR	22.36	50.17	170	22	4
	Floupicolide	Recycled water	<LOR	112.27	280.29	1300	79	38
		Reference	<LOR	1514.27	3434.74	11000	22	12
	Flubendiamide	Recycled water	<LOR	68.27	193.45	1300	79	23
	Fludioxonil	Recycled water	<LOR	21.037	59.43	400	79	21
	Imidacloprid	Recycled water	<LOR	1369.94	4107.96	19000	79	28
		Reference	<LOR	14.81	38.35	120	22	3
	Indoxacarb	Recycled water	<LOR	119.52	329.97	2100	79	30
	Metalaxyl	Recycled water	<LOR	5.82	15.37	86	79	14
		Reference	<LOR	79.54	184.60	660	22	4
	Methomyl	Recycled water	<LOR	1.30	6.10	39	79	6
	Metolachlor	Recycled water	<LOR	1.40	5.09	31	79	7
	Novaluron	Recycled water	<LOR	56.32	197.37	1500	79	21
	Pendimethalin	Recycled water	<LOR	7.489	27.33	180	79	12
	Pentachlorophenol	Recycled water	<LOR	3.49	10.59	50	79	9
		Reference	<LOR	1.45	6.82	32	22	1
	Permethrin 1R-cis	Reference	<LOR	325	718.7	2600	22	5
	Permethrin 1R-trans	Reference	<LOR	188.63	416.83	1500	22	5
	Prometryn	Recycled water	<LOR	16.47	60.82	380	79	13
		Reference	<LOR	0.13	0.63	3	22	1
	Propamocarb	Recycled water	<LOR	246.10	767.80	4700	79	14
		Reference	<LOR	1274.18	2855.38	9000	22	8
	Propyzamide	Recycled water	<LOR	2.32	7.96	37	79	7
	Pyraclostrobin	Recycled water	<LOR	5.53	17.1	100	79	14
		Reference	<LOR	583.72	1171.75	4000	22	12
	Spirotetramat	Recycled water	<LOR	0.75	4.34	36	79	4
	Spirotetramat.enol	Recycled water	<LOR	19.55	69.37	460	79	14
	Spirotetramat.enol.glucoside	Recycled water	<LOR	0.56	2.27	16	79	6
PFAS	PFBA	Recycled water	<LOR	2.48	3.20	9.94	79	32
		Reference	<LOR	1.20	2.72	9.6	22	4
	PFBS	Recycled water	<LOR	7	25.12	154	79	7

		Reference	<LOR	4.86	16.20	66	22	2
	PFHxA	Recycled water	<LOR	0.055	0.49	4.37	79	1
	PFHxS	Recycled water	<LOR	0.031	0.28	2.5	79	1
	PFOA	Recycled water	<LOR	0.66	3.40	21.4	79	3
	PFOS	Recycled water	<LOR	0.12	0.7	5.37	79	2
	PFPeA	Recycled water	<LOR	0.78	3.47	19.4	79	4
Phthalates	DEHP	Recycled water	<LOR	350.18	951.48	6000	79	24
		Reference	<LOR	148.86	421.34	1970	22	8
	DnOP	Recycled water	<LOR	1.26	11.25	100	79	1
	DBP	Recycled water	<LOR	380.34	924.81	6100	79	30
		Reference	<LOR	140.90	199.35	620	22	12
	DEP	Recycled water	<LOR	62.11	166.51	800	79	19
		Reference	<LOR	11.36	27.55	95	22	4
	DMP	Recycled water	<LOR	60.75	540.04	4800	79	1
		Reference	<LOR	0.36	1.70	8	22	1
PPCPs	Azithromycin	Recycled water	<LOR	0.087	0.83	7.95	91	1
	DEET	Recycled water	<LOR	0.12	0.9	8.033	158	3
	Paraben methyl	Recycled water	<LOR	4.26	6.11	18	12	5
		Reference	<LOR	3.74	3.4	7	5	3
	Telmisartan	Recycled water	<LOR	0.38	2.42	15.8	79	2
SVOCs	Acetophenone	Recycled water	<LOR	177.21	455.01	2130	79	17
		Reference	<LOR	225.5	491.83	1401	22	5
	Benzaldehyde	Recycled water	<LOR	36.32	176.64	1300	79	5
	Benzothiazole	Recycled water	<LOR	40.68	98.70	710	79	19
		Reference	<LOR	90.36	114.13	430	22	11
	Biphenyl	Recycled water	<LOR	202.17	394.35	1800	79	21
		Reference	<LOR	292.72	418.44	1160	22	8
	Dibenzofuran	Recycled water	<LOR	0.077	0.68	6.1	79	1
	Dioctyl.adipate (DOA)	Recycled water	<LOR	612.15	2317.76	12820	79	11
		Reference	<LOR	2983.13	5812.46	18009	22	8
	E.Caprolactam	Recycled water	<LOR	149.36	675.93	5100	79	5
		Reference	<LOR	25	117.26	550	22	1
	Irganox 1076	Reference	<LOR	168.63	547.18	1980	22	2
	Isophorone	Recycled water	<LOR	535.69	1065.77	5320	79	22
		Reference	<LOR	544.45	991.57	3190	22	7
	m.p.Cresol	Recycled water	<LOR	189.10	274.21	1280	79	47
		Reference	<LOR	127	189.92	690	22	11
	Phenol	Recycled water	<LOR	316.20	590.28	2900	79	34
		Reference	<LOR	187.72	306.48	1090	22	8
	Stearamide	Recycled water	<LOR	116.59	231.40	1100	79	26
		Reference	<LOR	146.22	228.65	660	22	11
	Styrene	Recycled water	<LOR	105.27	201.42	640	79	22
		Reference	<LOR	140.86	215.62	670	22	12
	Tris.2.4.di.tert. butylphenyl.phosphate	Recycled water	<LOR	224.05	571.59	2300	79	12
		Reference	<LOR	139.54	440.52	1500	22	4
	Tris.2.4.dimethylphenyl. phosphate	Recycled water	<LOR	2.15	18.02	160	79	2
	1.2.Dichlorobenzene	Recycled water	<LOR	1.45	5.42	30	79	6

			Reference	<LOR	2.86	6.2	18	22	4
		1.3.Di.tert.butylbenzene	Recycled water	<LOR	0.55	4.95	44	79	1
			Reference	<LOR	2.09	9.8	46	22	1
		1.4.Dichlorobenzene	Recycled water	<LOR	3.16	9.24	44	79	9
			Reference	<LOR	2.22	7.40	30	22	2
		1.4.Dinitrobenzene	Recycled water	<LOR	0.45	4.05	36	79	1
			Reference	<LOR	2.5	8.10	29	22	2
		2.4.Di.tert.butyl.phenol	Recycled water	<LOR	359.92	2034.68	18044	79	19
			Reference	<LOR	72.72	167.42	550	22	4
		2.4.Dichlorophenol	Recycled water	<LOR	150	797.03	6800	79	7
		2.6.Di.tert.butyl.phenol	Reference	<LOR	20	93.80	440	22	1
		2.Chlorophenol	Recycled water	<LOR	5.93	21.61	150	79	9
			Reference	<LOR	7.72	24.50	109	22	3
		2.Cresol	Recycled water	<LOR	756.45	1201.39	4210	79	28
			Reference	<LOR	920	1291.45	3700	22	8
2024	PFAS	PFBA	Recycled water	<LOR	0.32	1.019	4.45	104	10
		PFBS	Recycled water	<LOR	0.38	0.85	3.30	104	20
			Reference	<LOR	0.14	0.42	1.89	52	6
		PFHxS	Recycled water	<LOR	0.80	5.30	51.69	104	5
			Reference	<LOR	0.30	1.62	10.26	52	2
	PPCPs	Carbamazepine	Recycled water	<LOR	0.41	0.59	3.11	104	42
			Reference	<LOR	0.24	0.50	1.47	52	10
		DEET	Recycled water	<LOR	0.15	0.32	1.20	104	21
			Reference	<LOR	0.17	0.32	1.04	52	12
		Tebuconazole	Recycled water	<LOR	0.0067	0.068	0.70	104	1
			Reference	<LOR	0.10	0.24	0.72	52	8
		Tramadol	Recycled water	<LOR	0.16	0.29	0.89	104	25

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