

Identifying and managing emerging contaminants of concern



Strategic alignment

Regional Performance Objectives

RPO 23: The potential impacts of emerging contaminants of concern such as microplastics, pesticides and pharmaceuticals, and toxic chemicals are better understood and mechanisms to respond collaboratively developed.

Key Research Areas

Water quality: Understanding the environmental impacts of pollutants, including contaminants of concern, to inform risk-based management of waterways across the region.

Summary

Every year new chemicals appear in the market for a broad range of products ranging from pharmaceuticals, personal care products, disinfection by-products, pesticides, persistent organic chemicals, industrial chemicals and degradation products of all these substances. While many of these new products have little impact on the environment, there are emerging contaminants of concern that may impact on human or ecological health. There is a risk that new products emerge in the environment and there is inadequate information for waterway managers to determine whether they may pose a risk to human safety or the environment.

The aim of this research project is to identify new chemicals that are being used in Australia that may pose a risk to Melbourne Water's waterway values. It keeps a watching brief on national and international research regarding new chemicals of concern. Those chemicals that are most likely to impact wildlife are then screened in Melbourne's waterways to determine whether they are present. If they are present, then further work is conducted to determine whether they are present at concentrations that are likely to be harmful to environmental values (fish, platypus, frogs, macroinvertebrates, plants) and stream function (e.g., capacity for denitrification and breakdown of contaminants). A key component of this research is to also develop analytical methods that enable us to test for new chemicals of concern.

Recommendations

- It is recommended that a risk assessment framework is developed to include the information provided in the Aquatic Pollution Prevention Partnership (A3P) program to prioritise new chemicals of concern for management to better support the protection of environmental values.
- The annual use of passive samplers in routine monitoring programs is recommended as this can be used to gather information on a suite of priority pollutants of concern that are currently not screened as part of Melbourne Water water quality monitoring programs.
- It is recommended that an annual survey of sediment quality (heavy metals, pesticides, personal care products, petroleum hydrocarbons) is conducted at all Melbourne Water water quality monitoring sites.
- It is recommended that levels of pollutants in waters and sediments within estuaries and bays of the Port Phillip and Westernport region are surveyed to determine whether they may pose a threat to those ecosystems.
- Addressing Priority Chemicals of Concern.
- Use the list of priority chemicals from this research project to identify targeted management opportunities with relevant stakeholders.
- Developing passive sampling methods that quantify chemicals present.

What did we do?

Literature Review of potential impacts of contaminants of concern on environmental values

Initially a literature review was conducted incorporating both known chemicals of concern (CoC) and potential emerging chemicals of concern (ECoC) that could affect the environmental values identified in the Healthy Waterways Strategy (HWS). The assessment of potential impacts on environmental

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values was based on important ecological attributes of each value, such as their diet, life span, distribution and the type of habitat that they inhabit. In addition, the characteristics of the chemicals and where they are likely to occur in the environment (i.e. where they are used and discharged) were considered to determine likely chemical exposure of environmental values.

Ongoing surveillance of national and international research on emerging contaminants of concern

To identify potential new chemicals of concern based on the latest global research a systematic screening of the following journals was undertaken: Environmental Science & Technology, Environmental Pollution, Environmental Toxicology & Chemistry, Science of the Total Environment, Water Research, Chemosphere and Integrated Environmental Assessment & Management. Additional information was also synthesised from relevant national and international conferences.

Major pesticides in Melbourne

A survey of pesticides in urban wetlands across the Melbourne region was conducted using passive samplers that detect target chemicals present over an extended period (typically 2 to 4 weeks). 111 wetland sites were surveyed using POCIS and Chemcatcher SDB and C18 passive samplers – each targeting different types of chemicals.

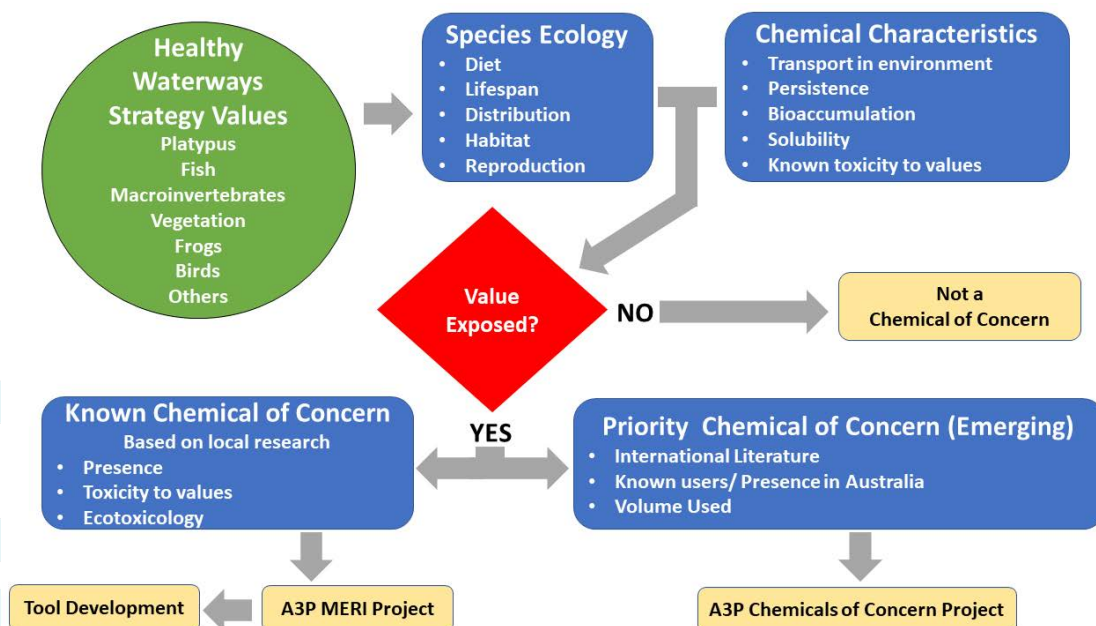
Methods for detection and investigate Emerging Contaminants of Concern

Two PhDs are developing new methods and analytical techniques for emerging chemicals of concern with the National Measurements Institute (NMI). This includes developing standard methods for the detection of synthetic fragrances, particularly musks and terpenes (e.g. used in cleaning products, personal care products and perfume) to determine whether they are present in the Melbourne Water region and to identify their major sources. This research project has also examined what are the background concentrations of perfluorinated compounds (PFAS) (e.g., used in fire retardants, waterproof garments and non-stick frypans) in industrial, residential and rural areas around Melbourne.

The second PhD has also developed a method to prioritise new pesticides that should be included in regional pesticide surveys. For example, 151 pesticides that are registered for use in the Greater Melbourne area are currently not screened by analytical laboratories but have the potential to impact aquatic ecosystems. Screening of these chemicals in waterways across Greater Melbourne is now occurring, within this PhD.

Previous A3P research has detected a new insecticide, chlorantraniliprole (used to protect sporting field turf from beetles), in many constructed urban wetlands. This chemical has now been included in ecotoxicological tests to determine the sensitivity of local aquatic species.

Figure 1. Flowchart identifying known chemicals of concern for the Healthy Waterways Strategy environmental values and links with the A3P Monitoring, Evaluation, Reporting and Improvement (MERI) research project (adapted from Pettigrove, 2019)



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What did we find?

Literature Review

Figure 1 provides a flow chart of the process for identifying chemicals of concern and emerging chemicals of concern. The Chemicals of Concern program looks for new chemicals that are not currently routinely monitored in the Greater Melbourne Area. International literature and knowledge of what chemicals are likely to be used locally help to focus on what broad types of chemicals should be considered in this program. Our current short list of priority Chemicals of Concern includes pesticides, PFAS, pharmaceuticals and personal care products and industrial fragrances. Based on research from the US and Europe, another group that could be considered in future are tyre compounds. Priority is given to those chemicals that are harmful to one or more Healthy Waterways Strategy values and are likely to be present in waterways where these values occur. Known chemicals of concern (zinc, copper, glyphosate, bifenthrin, petroleum hydrocarbons and simazine) are evaluated in other A3P research projects. New potential chemicals of concern (e.g. chlorantraniliprole) are evaluated further in the Monitoring, Evaluation, Reporting and Improvement (MERI) research project. Many other priority chemicals are not routinely tested for, primarily due to a lack of field collection and laboratory analytical methods. Analytical development occurs where the priority chemical is currently not routinely screened.

Major pesticides in Melbourne

Twenty-five of the 239 pesticides screened were detected in >5% of the 111 wetlands surveyed, with 10 pesticides present in >60% of wetlands. Six of these pesticides were associated with non-urban land uses (agriculture and forestry) and 19 pesticides were associated with urban areas. The major sources of pesticides are from residential areas and are likely to be from their use in wood preservatives, paints and weed/pest control. One new insecticide, chlorantraniliprole, was correlated with the presence of recreational ovals – consistent with its use to protect turf from beetles.

For the twenty-five pesticides and their associated catchment land use (where available) see Table 1. The passive samplers used in these surveys do not directly provide the concentration of these chemicals i.e., they just tell us if the chemical is present or not. Further method development by A3P will look into opportunities to quantify these chemicals with passive samplers.

Future direction and knowledge gaps

More informed risk management

This program and the A3P Synopsis project identify those chemicals that may pose a potential threat to HWS ecological values by understanding what chemicals are present, which chemicals are toxic to aquatic life, where these chemicals are used and what ecological values are potentially exposed to these chemicals. It is recommended that a risk assessment framework is developed to include the information provided in the A3P program to prioritise new chemicals of concern for management to better support the protection of environmental values.

Improved environmental monitoring including Sediment Quality Monitoring

Water and sediment quality monitoring is conducted to determine what chemicals are present, whether they are at concentrations that may impact aquatic life and to determine whether their concentrations are increasing or decreasing over time (especially in response to management actions).

The annual use of passive samplers in routine monitoring programs is recommended as this can be used to gather information on a suite of priority pollutants of concern that are currently not screened as part of Melbourne Water water quality monitoring programs.

It is recommended that an annual survey of sediment quality (heavy metals, pesticides, personal care products, petroleum hydrocarbons) is conducted at all Melbourne Water water quality monitoring sites. This would provide much more information on the many chemicals that accumulate in sediments that are infrequently detected in testing water quality.

Addressing Priority Chemicals of Concern

Use the list of priority chemicals from this research project to identify targeted management opportunities with relevant stakeholders.

Developing passive sampling methods that quantify chemicals present.

Table 1. The twenty five pesticides detected in wetlands and their associated catchment land use (where available)

Pesticide	Type	Associated land use
Simazine	Herbicide	% Hard surfaces, Residential
Diuron	Herbicide	Residential, Ovals, Roads
Metolachlor	Herbicide	% Hard surfaces, Roads
Bromacil	Herbicide	Ovals, Commercial
Atrazine	Herbicide	% Hard surfaces, Roads, Residential
Propyzamide	Herbicide	
Carbendazim	Fungicide	
Tebuconazole	Fungicide	% Hard surfaces Roads, Residential
Propiconazole	Fungicide	% Hard surfaces, Roads, Residential, Ovals, Commercial
Metalaxyl	Fungicide	
Azoxystrobin	Fungicide	
Trifloxystrobin	Fungicide	
Paclobutrazol	Fungicide	Ovals
Thiabendazole	Fungicide	Forests
Iprodione	Fungicide	
O-phenylphenyl	Fungicide	Forests
Imidacloprid	Insecticide	Quarry, Forest, Commercial
Chlorantraniliprole	Insecticide	Ovals
Thiamethoxam	Insecticide	
Clothiandin	Insecticide	Agriculture
Fenamiphos	Insecticide	
Fipronil	Insecticide	Residential, Roads
Propachlor	Insecticide	
Bifenthrin	Insecticide	Residential, Roads, % Hard surfaces, Ovals
Permethrin	Insecticide	

Research into Chemicals of Concern

This program makes a substantial contribution to the protection of aquatic waterway values. Currently, the focus has been on rivers and wetlands. There is limited information on the amount of pollution in the estuaries and bays. In particular, many pollutants such as heavy metals and pesticides such as bifenthrin may be present in fine sediments at concentrations harmful to aquatic life. It is recommended that levels of contaminants in waters and sediments within estuaries and bays of the Port Phillip and Westernport region are surveyed to determine whether they may pose a threat to those ecosystems.

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