Understanding contaminant risks at Victorian wastewater treatment plants in an era of General Environment Duty

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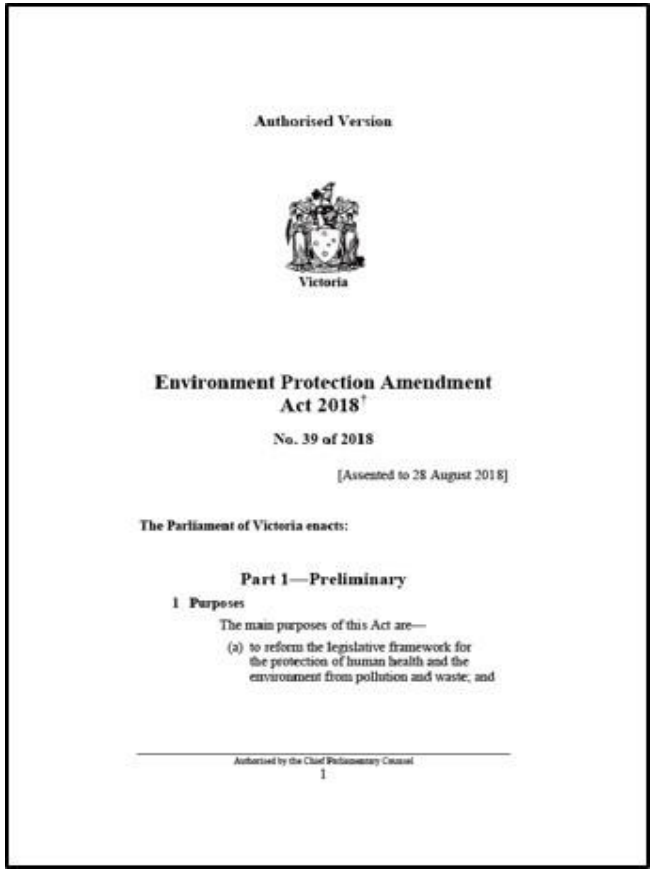
New environmental legislation



Authorised Version

Victoria

Environment Protection Amendment Act 2018[†]

No. 39 of 2018

[Assented to 28 August 2018]

The Parliament of Victoria enacts:

Part 1—Preliminary

1 Purposes

The main purposes of this Act are—

(a) to reform the legislative framework for the protection of human health and the environment from pollution and waste; and

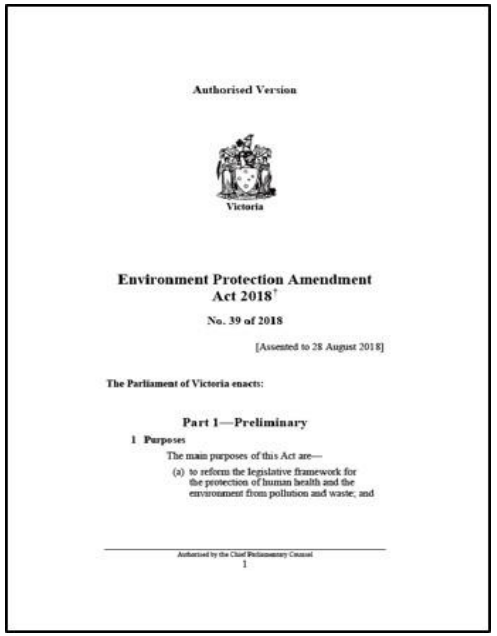
Authorised by the Chief Parliamentary Counsel

1

- In August 2018, the Victorian Parliament passed the *Environment Protection Amendment Act 2018* (the Act)

- The Act was scheduled to commence on 1 July 2020, but because of COVID-19, the commencement date was pushed back to 1 July 2021

New environmental legislation



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The main change that was brought about by the commencement of the Act is that:

- the regulatory focus has shifted from a ***consequences-based*** approach, which looked at managing pollution, to a ***prevention-based approach***, which focuses on managing systems and controls to minimise risks to human health and the environment, so far as reasonably practicable

- This change is encapsulated in the principle or concept of **General Environmental Duty (GED)**

General Environmental Duty (GED)

The **General Environmental Duty (GED)** creates a range of positive regulatory obligations on the duty holder, such as the:

- Duty to restore
- Duty to notify of an event
- Duty to manage contaminated land
- Duty to notify of contaminated land
- Duty to manage waste disposal
- Duties for priority waste

Discharging obligations under GED

Current advice from EPA is that they will consider that the GED has been discharged when all reasonably practicable steps have been taken, which include:

- Understanding the likelihood of a risk eventuating;
- The degree of harm that would result if the risk was to eventuate;
- What the person knew, or should have known, about appropriate risks and controls;
- The availability and suitability of ways to eliminate or reduce those risks; and
- The cost of eliminating or reducing those risks

GED and CEC

- The question then arises, under GED, what contaminants should a water corporation reasonably be trying to manage/understand, given the sheer volume of potential contaminants?

- This is particularly of interest with respect to Contaminants of Emerging Concern (CEC)

EPA advice to water corporation

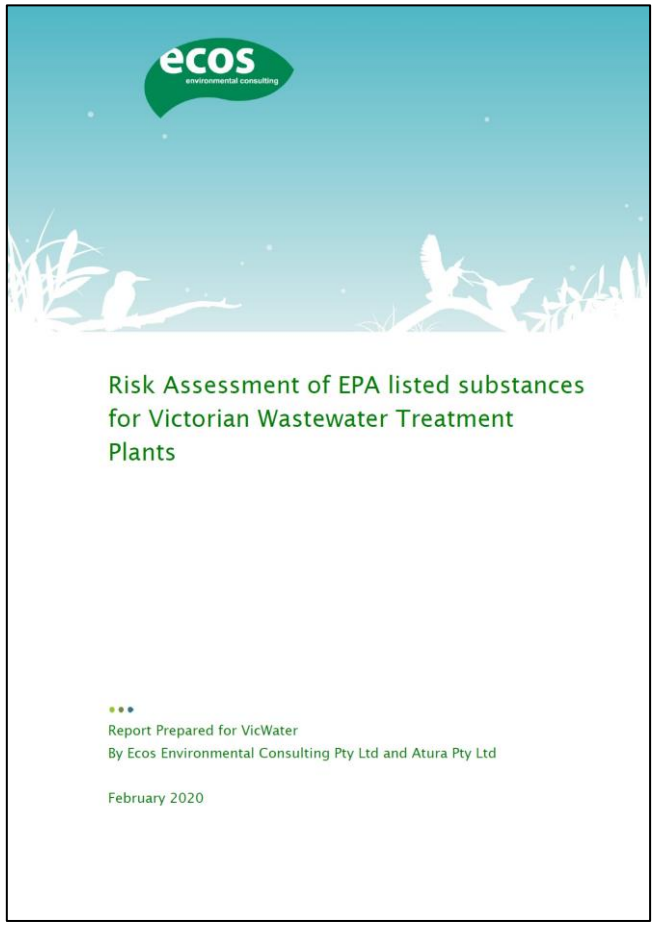
Appendix 1 – List of parameters

Whenever possible, compounds must be analysed at a reporting concentration below the standard value. If no standard is available for a compound, or the detection limit commercially available is above the standard value, the lowest commercially available measurable concentration should be used.

Parameters	Notes	Testing Matrix	Rationale	Standard
Hardness in freshwater	<2,500mg/L TDS	Water	Metal guideline adjustment	NA
Total organic carbon (TOC), Total suspended solids (TSS)		Water	To aid interpretation and for correction of organics concentrations (TOC)	SEPP Waters
In situs – pH, DO, EC, Temperature, NTU		Water	To aid interpretation	SEPP Waters
Nutrients – TP, TKN, Nitrate, Nitrite		Water	To aid interpretation	SEPP Waters, ANZECC 2000, updates in new ANZECC (**nitrate:** 1.1 mg/l (99%) and 2.1 mg/l (95%))
Metals and Metalloids	Al, Sb, As, Be, B, Cd, Cr, Co, Cu, Pb, Fe, Mn, Hg, Mo, Ni, Se, Ag, Sn, Zn	Water and sediment	High priority for testing unless prior data exists	ANZECC 2000, updates in new ANZECC (**boron:** 0.24 mg/l (99%) and 0.83 mg/l (95%), **chromium (III):** 0.00015 (99%) and 0.0036 mg/l (95%), **copper:** 0.00035 mg/l (99%) and 0.0012 mg/l (95%), **iron:** 0.43 mg/l (99%) and 0.7 mg/l (95%), **zinc:** 0.0006 mg/l (99%) and 0.003 mg/l (95%))
Nano silver		Water and sediment	No guidelines - to inform future guideline development	NA
Non-metallic inorganics	Ammonia, chlorine, hydrogen sulfide	Water	To aid interpretation and compliment licensed monitoring	ANZECC 2000, updates in new ANZECC (**ammonia:** 0.095 mg/l (99%) and 0.290 mg/l (95%)
Pesticide screen	Synthetic Pyrethroids	Sediment	Potential to pass through treatment plants	ANZECC 2000 (some low reliability), updates in new ANZECC (**alpha-cypermethrin:** 0.0000000098 mg/l (99%) and 0.00000065 mg/l (95%))
	Neonicotinoids	Water		NA
	Triazine herbicides	Sediment/water		ANZECC 2000 (some have low reliability)
PFAS screen	PFOA, PFOS and PFHxS plus 6:2 FTS, PFBS, PFOS, PFDS, PFPeA), PFHxA, PFHpA, PFNA, PFDA, PFUnA, PFDoA, PFTrDA, PFTeDA, PFOSA, NEtFOSSA, (NetFOSAA), NMEFOSAA, 4:2, 6:2 FTS, 8:2 FTS	Water/passive samplers	High priority for testing	Publication 1633.2. (Note in the publication: "As both PFOS and PFOA have been shown to bioaccumulate and biomagnify in wildlife, the draft national standards recommend that the 99 per cent level of protection be used for 'slightly to moderately disturbed systems'. This approach is generally adopted for chemicals that bioaccumulate and biomagnify in wildlife. Current Australian laboratory analytical procedures are only able to reliably detect PFOS at a concentration of 0.001 µg/L, which is well above that required to assess the 99 per cent standard for species protection. EPA expects that analytical procedures will continue to improve making an accurate measurement against this standard possible. Until then, EPA will use the current limit of detection (0.001 µg/L) as the practical standard for 'slightly to moderately disturbed' and 'high conservation value systems' until laboratory procedures are able to report on lower concentrations. The 95 per cent protection standard will apply for highly disturbed systems, as recommended by Warne et al. (2015).
Pharmaceutical broad screen	Including carbamazepine, diclofenac, metoprolol, atenolol, valsartan, sertraline, propranolol, desmethylsertraline, lisinopril, hydrochlorothiazide	Water	High priority for testing.	NA
			Based on local testing and US EPA https://www.epa.gov/water-research/concentrations-prioritized-pharmaceuticals-effluents-50-large-wastewater-treatment	
			No guidelines - to inform future guideline	

- To try and assist Victorian water corporations navigate the CEC issue, EPA issued draft advice on the Pollutants of Concern (POC) that water corporations should take into consideration when doing environmental risk assessments
- The draft advice listed 233 POC
- The challenge was making sense of this list, and putting in place a sound and defensible prioritisation process

Risk assessment project



- To assist in the prioritisation process, VicWater coordinated a project to risk assess the listed POC
- Sixteen Victoria water corporations participated in the study, which covered 89 wastewater treatment plants (WWTPs)

Risk assessment inputs

The risk assessment process considered the following data:

- Water quality monitoring data for monitoring stations that included the discharged water, sites upstream and downstream of mixing zones for stream-based discharges and other relevant sites for wetland-based and marine-based discharges
- Information on sewage catchment attributes including the proportion of trade waste and information on significant trade waste customers
- Information on each WWTP's treatment train

Source assessment

Table 2-1. High risk tradewaste streams. The presence of one or more such industries in the sewage catchment of WWTPs was used to adjust their risk profile.

High risk waste stream	Associated contaminants
Hospitals	Radionuclides, radio-contrast compounds (persistent), pharmaceuticals
Tanneries	Chromium, other trace metals, aldehydes, other compounds
Paint manufacturers, Powder coating industries, Printers (including screen printers) (inks)	Heavy metals, pigments, solvents
Steel manufacturer, Landfill leachate	Heavy metals
Electrical manufacturer	Heavy metals, solvents
Wool scouring	Solvents, surfactants
Textiles processing	Surfactants, insecticides, other biocides, preservatives
Pharmaceutical manufacturer or processor	Pharmaceuticals
Chemical batching facility, Pesticide management facility (e.g. batching etc.), Pesticide manufacturer	Solvents, pesticides, other compounds
Infiltration* of contaminated groundwater	PFAS, heavy metals, other petroleum hydrocarbons

** not a trade waste source*

No great surprise that a major influence on the risk profile of a WWTP are the trade waste inputs

Treatment trains

Table 2-3. Major treatment processes in the removal of POCs from recycled water during wastewater treatment.

Treatment process supporting POC removal and abbreviation	Type of POC removal processes present	Source of information
ASP Normal Aeration (ASP)	• Biodegradation in primary, aerated and settling tanks or ponds; different rates apply for each type of tank/pond; • Volatilisation; • Partitioning to solids; Each POC has a unique rate for each of the above processes derived from QSAR-based software tools.	US EPA EPI Suite (US EPA, 2012)
ASP Extended Aeration (ASPe)	• As above, but with extended HRT in the aeration tank which permits more time for removal of certain POCs with intermediate biodegradation rates;	US EPA EPI Suite (US EPA, 2012)
Lagoon (LAGbp) (where b=biodegradation, p = photolysis oxidation)	• Biodegradation at the lagoon rate. • Oxidation via photolysis (due to UV light absorption by POCs in the lagoon surface layers). • POC removal rates via oxidation due to photolysis were estimated from POC chemical structure via use of the PyRate software program. These removal rates were applied wherever lagoon treatment was listed amongst the WWTP treatment processes.	US EPA EPI Suite (US EPA, 2012), PyRate (Svoboda and O'Connor, 2019)
Aerated Lagoon (LAGa) (where a = aerated)	• As above but with higher POC removal rate via biodegradation	US EPA EPI Suite (US EPA, 2012) Seth et al. (2008)
Oxidation: chlorination (CL_2)	• POC removal rates via oxidation due to chlorination were estimated from POC chemical structure via use of the PyRate software program. These removal rates were applied wherever chlorination was listed amongst the WWTP treatment processes.	PyRate (Svoboda and O'Connor, 2019)
Membrane filtration (RO) (reverse osmosis was the only type of membrane filtration listed)	• A molecular weight cut off (MWCO) of 100. Thus, POCs with a molecular weight ≥ 100 are removed to the reject brine stream and those < 100 remain in the recycled water	Kiso et al. (2011),(Wikipedia, 2019)

- The available treatment trains at the 89 WWTPs included in the study were obtained
- The ability of each treatment unit to remove POC was assessed
- The risk assessment framework identified 11 unique treatment trains, with respect to their ability to remove POC, and 3 tiers of sewage catchment risk, based on the proportion of trade waste flows and the presence of high risk trade waste customers

WERT (Weight of Evidence Ranking Tool)

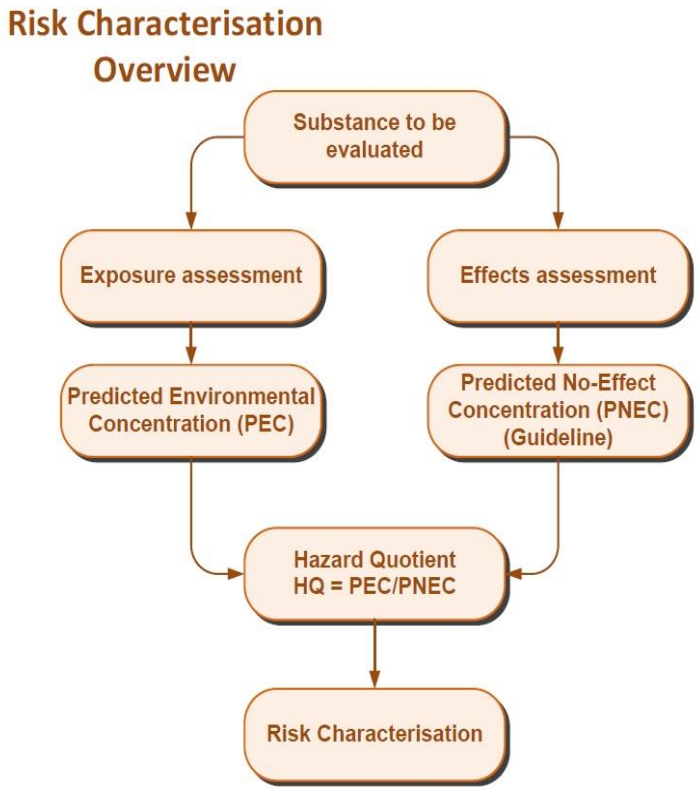


Figure 2-1. Overview of assessment methodology used this study (modified from van Leeuwen and Vermeire 2007).

- To assist the prioritisation process a Weight of Evidence Ranking Tool (WERT) was used
- This tool was developed by Atura Pty Ltd for Melbourne Water
- The process is summarised in the accompanying the flow chart

Outputs

- WWTP process classification
- Log Removal Value (LRV) summary for the POC on the EPA list
- Overall WWTP classification
- Screening of POC on the EPA list
- For those water corporations that wanted it, there was also the opportunity to have a more tailored assessment of their WWTPs included in the study

Piece of parallel work on CEC

echidna

Emerging Chemicals Database
for National Awareness

Developing a risk assessment and management framework for the prioritisation of contaminants of emerging concern (CEC)

WaterRA Project 1127

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Project Partners

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SA Water

QUEENSLAND Urban Utilities

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Coliban WATER

Barwon Water

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State Government Victoria

Project 1127 Emerging Contaminants Management System

- Project Objectives
  - » Develop an emerging contaminant database.
  - » Develop a classification system based on source, treatment and effects to facilitate management of emerging contaminants by the water industry.
  - » Develop risk assessment approaches.
  - » Provide guidance on including emerging contaminants into current water quality risk management plans/frameworks.

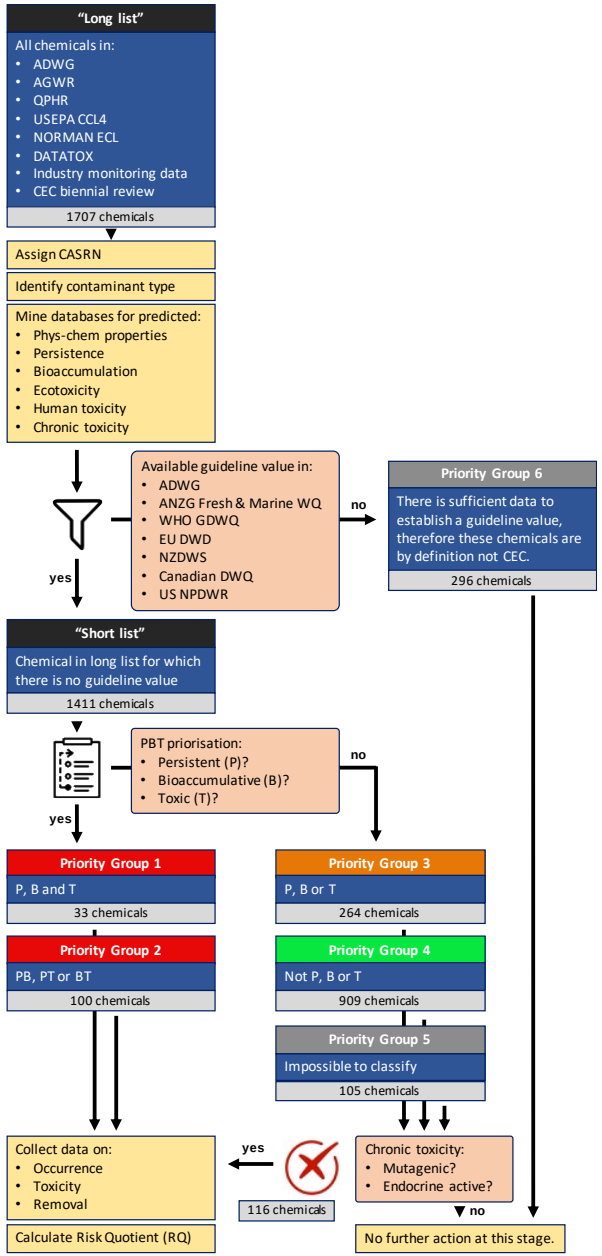
Contaminants of Emerging Concern (CEC)

- Several water utilities in Australia have identified the need to better manage CEC in a more holistic way
- WaterRA Project 1127 - Emerging Contaminants Risk Framework
  - » Develop a CEC management approach and prioritisation tool

Step 1 | The CEC long-list

- **1707 CECs** from academic, industry and government resources
  - Australian Drinking Water Guidelines (ADWG)
  - Australian Guidelines for Water Recycling (AGWR)
  - Queensland Government Public Health Regulation 2018
  - European Chemicals Agency (ECHA) REACH program
  - NORMAN Network emerging substances list
  - US EPA Contaminant Candidate List (CCL)
  - Seqwater DATATOX database and key monitoring programs
  - Authoritative academic CEC reviews[1,2]

[1]Richardson and Ternes 2018; [2]Richardson and Kimura 2020



Emerging Chemicals Database for National Awareness

Searchable online database designed to equip the water industry with relevant information and help guide the management of CEC

VicWater

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