Contaminants of Emerging Concern

echidna
Emerging Chemicals Database for National Awareness

Water Research AUSTRALIA

What are Contaminants of Emerging Concern (CEC)?

The widespread use of chemicals in food production, manufacturing and our everyday lives has resulted in diverse contaminants being identified in water, sediment, soil, and biota. Contaminants of Emerging Concern (CEC) are contaminants that have either recently been detected in the environment due to new sources or new detection methods, or which have recently been flagged as a potential hazard due to new toxicity data or exposure information (Diamond et al., 2011; Tang et al., 2020). CEC may be chemicals that have been present in the environment for a while but for which concerns have only recently been raised based on new toxicity information. This distinguishes CEC from so-called 'emerging contaminants', which are new chemicals that have only recently appeared due to new production or sources. By definition, CEC are contaminants for which there is limited occurrence data and/or evidence of effect (US EPA 2014). This uncertainty makes it particularly challenging to manage and regulate CEC.

CEC occur in a wide range of contaminant classes and are regularly detected in treated wastewater, surface waters, and drinking water. Chemical classes which contain large numbers of CEC include pharmaceuticals and personal care products, per- and poly-fluorinated compounds, industrial solvents and precursor chemicals, pesticides, flame retardants, and others. Transformation products may also represent unexpected CEC when the 'parent' chemical degrades, either via natural processes or during sewage or drinking water treatment.

Why are CEC a concern for the water industry in Australia (and globally)?

With increasing analytical detection limits, CEC are increasingly detected in water sources and product waters. The lack of reliable occurrence and/or toxicity data means that CEC are unregulated, and this lack of regulatory guidance makes it difficult to gauge the risk associated with those detections. In addition, lack of treatment and fate data means that it is difficult to know how to effectively manage the detected CEC. This "fog of uncertainty" can paralyse action on CEC for years, with a recent review suggesting up to 14 years between first detection and provision of a health-based guideline value for most CEC (Halden 2015). This highlights the need for proactive and consistent methodologies to help prioritise CEC in the absence of firm regulatory guidance.

While protecting the environment and human health is the ultimate motivation for robust prioritisation of CEC, practical outcomes relate to the social and economic costs associated with a lack of information. This is particularly true today since the spread of misinformation via social media outlets may demand action from industry despite limited concrete evidence for concern. For example, while some CEC indeed present significant risks, effects on the environment (*e.g.*, fish, invertebrates) or high dose impacts (*e.g.*, occupational exposure) may be taken as evidence of likely public health impacts from environmental exposure. However, such claims are not always supported by weight of the evidence. In these scenarios, transparent CEC prioritisation will enable utilities and regulators to respond to public concerns with the best available evidence base, and to avoid unnecessary or misinformed action.

How are CEC currently being managed in Australia?

There is intense interest in CEC but considerable disparity in how much is being done across Australia. Some stakeholders are heavily involved in research on toxicity and occurrence of CEC in water, others have comprehensive monitoring programs to screen for CEC, and some are simply maintaining a watching brief. Lack of suitable methods and/or excessive costs combined with limited regulatory guidance are major obstacles preventing water utilities from achieving a unified approach to managing CEC. In the absence of clear direction, surveyed representatives of various Australian water utilities, regulators, academia, and consultants identified three strategies to proactively manage CEC: 1) generate and compile high-quality data, 2) use this data for preliminary risk assessments, and 3) ensure ongoing communication between utilities and regulators. The ECHIDNA project specifically aims to support the first two strategies.

Prioritising CEC based on available data

With limited data on occurrence and toxicity, how then do we identify the toxic needle in the CEC haystack? How do we prioritise which contaminant to focus our research and monitoring efforts on? The ECHIDNA project applied a multi-tiered approach to prioritise CEC from a long-list of contaminants (Fig 1). In Tier 1, candidate CEC were categorised based on their known or predicted persistence, bioaccumulation, and toxicity (PBT), a common screening method in chemical risk assessment. Those that triggered two or more of the three PBT characteristics were short-listed as high priority CEC. In addition, suspected mutagens and estrogenic endocrine disrupting compounds were also identified and prioritised on the short-list. In Tier 2, short-listed chemicals were further prioritised by compiling (and, where unavailable, modelling) occurrence, toxicity, and removal data to calculate risk quotients (RQ). Missing occurrence values were generated using validated predictive models (*e.g.*, fugacity and removal via sewage treatment) and missing toxicity values generated from models of acute toxicity. By focusing risk assessment on available data and extrapolating from this using robust models, the multi-tiered approach applies the best available evidence to conduct a preliminary risk assessment and prioritisation of CEC despite knowledge gaps.

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Sharing Information – ECHIDNA

The Emerging Chemicals Database for National Awareness (ECHIDNA) was developed to make this information and risk prioritisation available to water professionals and assist them with management and decision-making surrounding CEC in various water matrices (ECHIDNA 2021).

ECHIDNA is a web-accessible data repository with integrated CEC risk prioritisation framework. It helps identify potentially important CEC that may pose a risk to humans and the environment. The database and its ability to inform risk will continue to grow as new information is generated and incorporated, meaning its growth and ability to support water utilities, regulators, academics, and consultants will evolve to reflect user engagement with the system. In instances where information remains limited for specific chemicals, ECHIDNA can further serve the scientific community by helping to direct the data needs of the water industry with regards to high-profile or suspected CEC.

The assessment from ECHIDNA can help ensure that CEC management is evidence-based, and that investment in managing the risk posed by CEC is focused where it is most needed.

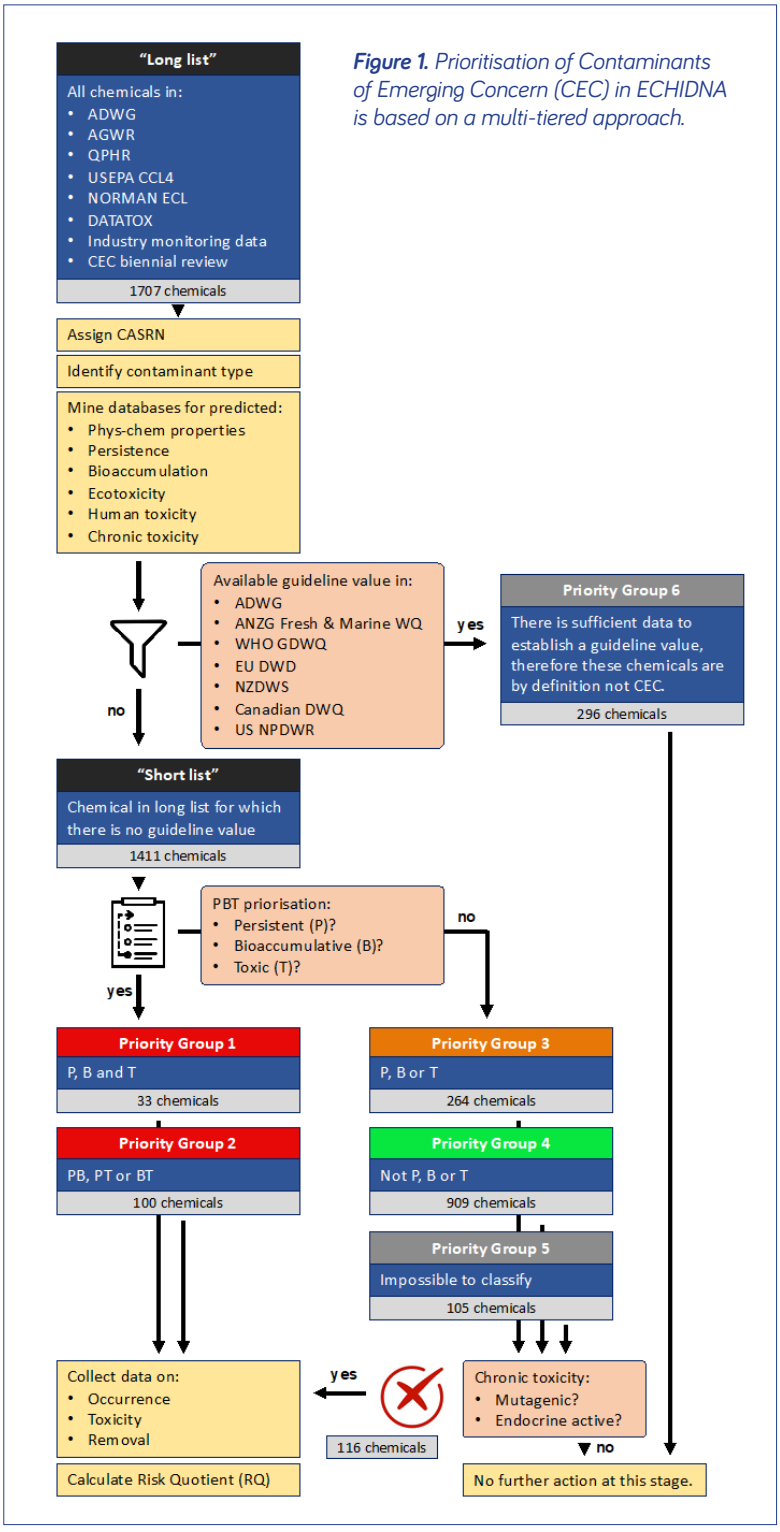

Figure 1. *Prioritisation of Contaminants of Emerging Concern (CEC) in ECHIDNA is based on a multi-tiered approach.*

References

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