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MILESTONE REPORT 1
PROJECT 1166

Developing a Global Risk-based Tool for Prioritising Contaminants of Emerging Concern (CEC) for the Water Industry: Prioritisation Report



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Developing a Global Risk-based Tool for Prioritising Contaminants of Emerging Concern (CEC) for the Water Industry: Prioritisation Report

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Water Research Australia is the leading independent, member-driven hub that turns collaboration into impact—advancing research, translating insights, and building capability across Australia's water sector. Our purpose is simple: help our members solve the sector's most pressing challenges—together. We do this in ways that are simple, effective, and deliver great value research outcomes for our members and the communities they serve. Founded in the CRC for Water Quality & Treatment in 1995, we've maintained an unbroken focus on member-based research and measurable impact, turning collective intent into shared solutions for a resilient, safe, and sustainable water future.

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About ECHIDNA

ECHIDNA (Emerging Contaminants for International Decision Analysis) is a science-based decision support tool developed to help the water industry assess and manage risks associated with contaminants of emerging concern (CECs). With hundreds of thousands of chemicals in use globally, many detected in water sources, ECHIDNA provides a consistent, evidence-based framework for informed decision-making. Developed through a WaterRA-supported initiative led by Griffith University, ECHIDNA is widely used across Australia and internationally, with ongoing collaboration ensuring the tool continues to evolve and support the sector in responding to emerging risks and maintaining confidence in water quality and safety.
For more information visit www.waterra.com.au/echidna

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Abbreviations

AMOS	Analytical Method and Open Spectral
CCL	Contaminant Candidate List
CEC	contaminants of emerging concern
CHASM	Chemical Hazard Assessment of Stormwater Micropollutants
EBM	Effect-based methods
ETAP	EPA Transcriptomic Assessment Product
MS	mass spectrometry
NECRI	National Emerging Contaminant Research Initiative
NMR	nuclear magnetic resonance
NTA	non-target analysis
PFAS	per- and polyfluoroalkyl substances
PMT	persistent, mobile and toxic
QSAR	quantitative structure–activity relationship
RQ	risk quotient
vPvM	very persistent and very mobile

Milestone 1 Report

The primary objective of Project 1166 is to expand the current Australian version of ECHIDNA to become a user-friendly risk-based prioritization tool for contaminants of emerging concern (CEC) for the global water industry. As a first step, it was necessary to identify and prioritise industry needs. A Global Water Research Coalition (GWRC) workshop was held in July 2024, after which industry partners gave their feedback on six areas:

- addition of new matrices (e.g., biosolids, sediment, soils)
- addition of mass spectrometry (MS) fragmentation and spectral information
- expansion of data mining capacity
- expansion of regional regulatory information
- addition of new features (e.g., discussion forum or Community of Interest)
- addition of new data sets (e.g., production volumes, other exposure routes, toxicity updates, treatment modules)

The project team also followed up with industry partners in November 2024 for additional information regarding their feedback, as well as asking them to nominate the most important new functionality. In this report, we summarise the feedback received and identify priorities for new functionalities to be added in Stage 1 to the expanded global version of ECHIDNA (referred to as the "Global CEC Risk Ranking Tool" in this report, with a new name to be determined). Further, some of the feedback, such as the addition of new features, was more appropriate to Stage 2 of the project and could be included in the Stage 2 proposal. The priorities for Stage 2 will be discussed with the project partners and PAC towards the end of Stage 1.

1.1. Addition of new matrices

Many new matrices, including biosolids, wastewater sludge, recycled water and sediment, were suggested in the Miro Board. All responses, along with the contributing industry partner, are shown in Table 1 of the Appendix. Biosolids/wastewater sludge was most cited, with nominations from four of the industry partners, as well the GWRC board. The responses from the Miro Board also aligned with the Australian identified priorities from Water RA of expanding the Global CEC Risk Ranking Tool to a wider range of matrices, specifically sludge, soil and sediment. Some matrices, such as wastewater and reclaimed water, are already included in the current version of ECHIDNA, though there is only limited reclaimed water data, so including more reclaimed water data should also be considered in Stage 1.

Based on the feedback received, the addition of new matrices was prioritised for voting.

1.2. Addition of MS fragmentation and spectral information

We received limited feedback on this topic in the Miro Board, with only two industry partners responding (Table 2). As a result, we do not consider the addition of MS fragmentation and spectral information as a priority for Stage 1 of the project. In November, we received additional feedback from TZW that more general chemical analysis information may be more useful than MS fragmentation and spectral information. Specifically, this could include measurement method (e.g., liquid chromatography or gas chromatograph), separation column type or mechanism (e.g., reverse phase, hydrophilic interaction chromatography) and whether a labelled internal standard is available. US EPA indicated that much of this information is already included in the Analytical Method and Open Spectral (AMOS) database, which has a method information database and a searchable database for MS/MS and nuclear magnetic resonance (NMR) spectra. Further, WRF PIs working on the One Water CEC Framework(s) suggested Green Analytical Chemistry information may be useful to include (e.g., rapid and portable analysis, reproducible results, reduced environmental footprint, cost efficiency, enhanced worker and public safety). This could be considered in Stage 2 of the project.

1.3. Expansion of data mining capacity

We received twelve responses on this topic in the Miro Board (Table 3), with diverse responses ranging from the addition of new CEC classes, utilizing quantitative structure–activity relationship (QSAR) predictions and identifying likely sources of CEC. In addition to the Miro Board, an Australian identified priority from Water RA was harmonising or learning from, as far as practically possible, the Global CEC Risk Ranking Tool with other tools on the market.

Based on the feedback received, expansion of data mining capacity was prioritised for voting, with a request to indicate date sources that could be included. KWR suggested leveraging in-house KWR knowledge as a starting point, specifically focusing on the topic of data mining tailored to the water sector (Publicaties). The documents available in the KWR library can indicate potential data sources and provide insights for making progress in the area. KWR has offered to contact authors of relevant publications to assess the usability. WRF PIs also suggested data mining sources such as the US EPA's Treatability Database, utility-provided data and global surveillance programs (e.g., partnering with initiatives such as WHO's water safety plans or national groundwater surveillance programs). Further, mining OECD biodegradability data was suggested by WRF PIs as this information would be relevant for CEC fate in biosolids.

1.4. Expansion of regional regulatory information

We received five responses on this topic in the Miro Board (Table 4), with many focusing on the need for more international guidelines. The current version of ECHIDNA includes guideline values from Australia, New Zealand, United States, Canada, European Union and World Health Organisation. Based on the feedback received, expansion of regional regulatory information was prioritised for voting, with industry partners asked in November to indicate which guidelines they would like included.

Following on from this request, WRC provided a link to the South African Water Quality Guidelines and suggested expanding the scope of guideline values to include guidelines for other water uses, such as water for irrigation. WRF PIs also suggested that adding guidelines from China, India and Japan could provide broader applicability.

With the potential to influence regional regulations in the future, KWR referred to the recent European Union communication "Guiding criteria and principles for the essential use concept in EU legislation dealing with chemicals" (http://data.europa.eu/eli/C/2024/2894/oj). The concept aims to improve both human health and environment protection by accelerating the elimination of non-essential harmful substances. Consequently, this may have downstream environmental implications.

1.5. Addition of new features

We received an extensive list of new features to consider in the Global CEC Risk Ranking Tool in the Miro Board (Table 5). These ranged from risk communication guidelines, confidence and use caveats and allowing two-way communication for the inclusion of new information. In addition to the Miro Board, Australian identified priorities from Water RA included making the Global CEC Risk Ranking Tool more user friendly by adding expert assessment to give a simple summary for each individual CEC and facilitate communication, as well as integrating the online tool CHASM (Chemical Hazard Assessment of Stormwater Micropollutants) into the Global CEC Risk Ranking Tool platform.

We also received additional suggestions for new features from Water RA including:

- Expanding the treatment function further to calculate a risk quotient (RQ) for the residual risk after a new treatment process is included in the treatment train (also supported by Coliban Water). KRW also referred to a quantitative chemical risk assessment study (Cantoni et al. 2021) that quantifies the risk of bisphenol A in drinking water after different treatment scenarios.
- Ability to download data for a sewer catchment assessment to assess a purified recycled water scheme.

The suggestions for new features will be included in the Stage 2 proposal. Given the large number of suggested new features, it may be practical to vote to achieve a smaller list of high priority features for Stage 2.

1.6. Addition of new data sets

We received twenty responses regarding the addition of new data sets in the Miro Board (

Table 6). Some of the suggestions, such as addition of bioassay monitoring data and catchment categorisation linked to the detection of CEC, would require a new feature that could potentially be implemented in Stage 2 of the project. Other suggested data sets, like emission permits or new occurrence data, could possibly be included in Stage 1.

For some of the suggestions, we sought further clarification from project partners about how we could obtain this data. These included:

- Emission permits: KWR's understanding is that there is little accessible and public information about emission permits, with accessible permits often containing limited relevant information. Some options to obtained data include the European Industrial Emissions Portal (https://industry.eea.europa.eu/), as well as a Dutch source, Schone

Maaswaterketen (https://www.schonemaaswaterketen.nl/). WRF PIs also indicated that it is not straightforward to retrieve emission permits, with information usually found in regional Department of Environment webpages.

- Literature input of tools that can identify CEC: KWR has identified text mining as a potential approach to identify CEC (https://library.kwrwater.nl/publication/68239769/textmining-voor-de-watersector/), as well as recent reviews by Julia Hartman et al. (e.g., https://doi.org/10.1186/s12302-023-00749-w, https://doi.org/10.1186/s13750-019-0177-z). KWR is also conducting a project called ChemRadar, with the potential to gradually support the Global CEC Risk Ranking Tool with additional information and foster discussions.
- EBM and NTA monitoring; CCL lists; NECRI: Effect-based methods (EBM) and non-target analysis (NTA) would be a new feature (potential for Stage 2). The publicly available Contaminant Candidate List (CCL) is already included in the current version of ECHIDNA. US EPA indicated that NECRI or National Emerging Contaminant Research Initiative (https://www.whitehouse.gov/wp-content/uploads/2022/08/08-2022-National-Emerging-Contaminants-Research-Initiative.pdf) is a US inter-agency activity to better coordinate CEC research efforts, but to date, there are no NECRI related lists.
- "ETAP"; focus on CEC toxicology info: Currently there is only one approved EPA Transcriptomic Assessment Product (ETAP) assessment online (https://www.epa.gov/etap/etap-assessments), with more planned for 2025.
- Treatability database: The treatability database is available at https://www.epa.gov/water-research/drinking-water-treatability-database-tdb. US EPA has generated PDF forms of each of the pages mapped to the chemicals for the AMOS database and have offered to provide copies of the documents.
- PFAS thermal treatment database: The database, available at https://www.epa.gov/chemical-research/pfas-thermal-treatment-database-pfastt, provides information about the thermal treatment of 58 different per- and polyfluoroalkyl substances (PFAS). It is possible to search by PFAS name or abbreviation, CAS registry number, treatment process and other test parameters and download the data in either a CSV or HTML format.
- Link to national CEC initiative: WRC indicates that this is related to expanding regional regulatory information, with a series of South African Water Quality Guidelines that "specify" the limit for different water uses.

US EPA also mentioned the "Prioritised PMT/vPvM substances in the REACH registration database" report (https://www.umweltbundesamt.de/en/publikationen/prioritised-pmtvpvm-substances-in-the-reach), which contains a list of 343 persistent, mobile and toxic (PMT)/very persistent and very mobile (vPvM) substances. These substances could be added to Global CEC Risk Ranking Tool, if not already included.

While the addition of new occurrence data was mentioned by several industry partners in the Miro Board and could provide valuable real-world information for risk ranking, many raised the issue of data confidentially. A potential solution would be for users to enter their own data for a particular CEC in an updated interface of the Global CEC Risk Ranking Tool to calculate a RQ for their water. This was also suggested by the GWRC board and WRC in the Miro Board under new

data sets and new features, respectively. In cases where information is confidential, such a feature could rank local CEC risks in the context of the full Global CEC Risk Ranking Tool RQ ranking system without saving the data. In cases where confidentially is not an issue (e.g., published report), we would appreciate it if industry partners can share resources with us so we can include the data in the Global CEC Risk Ranking Tool, particularly for prioritised matrices, such as biosolids/wastewater sludge and recycled water. To facilitate this, the project team will consider developing a template with the key information required (e.g., CEC name, CAS number, concentration units, matrix etc).

In addition to the Miro Board, we also received other suggestions for new data sets. TZW suggested adding information about whether a CEC can be removed by a particular drinking water treatment process (e.g., activated carbon, chlorine), whether the CEC undergoes transformation and whether critical transformation products are known. Given the potential complexity, a general text field on "Behaviour of the substance in drinking water treatment" was suggested. PUB also suggested including further information about treatment options and detection technologies, such as conducting literature reviews to determine which technologies have been reported and shown to be effective (e.g., ion exchange and thermal destruction technologies for PFAS).

1.7. Nominated functionalities

In November 2024, we asked all project partners to nominate what they see as most important new functionality: addition of new matrices, expansion of data mining capacity or expansion of regional regulatory information. We received responses from 12 industry partners, with most partners nominating addition new matrices as the preferred functionality (Figure 1). As discussed above, biosolids and wastewater sludge were the matrices most mentioned in the Miro Board. As noted by the WRF PIs, biosolids and wastewater sludge are important matrices for understanding CEC fate in agricultural reuse and environmental transfer scenarios and including these in the Global CEC Risk Ranking Tool would enhance its applicability for risk assessment. Several partners also confirmed in their responses in November that biosolids would be the preferred matrix to add, along with purified recycled water. There is some reclaimed water data in the current version of ECHIDNA, but this is limited to only 13 chemicals, compared to 274 chemicals with treated wastewater data. WRC has also offered to share groundwater occurrence data, so we can also include this in the Global CEC Risk Ranking Tool, given that groundwater can be a source for drinking water production.

The expansion of regional regulatory information was often mentioned as the second priority, with partners expressing that this information would be useful for understanding current developments.

Therefore, we have identified expansion of matrices, specifically biosolids/wastewater sludge and purified recycled water, as the main priority for Stage 1 of the Global CEC Risk Ranking Tool, followed by expansion of regional regulatory information. If possible, we would appreciate if project partners could share any freely available occurrence data (e.g., grey literature), with the project team to contact project partners prior to Milestone 3 to request any available data. We have included the maximum detected concentration in wastewater influent, wastewater effluent, surface water, drinking water and recycled water in the current version of ECHIDNA, but it would also be useful to provide a range. Any new data would be de-identified as necessary.

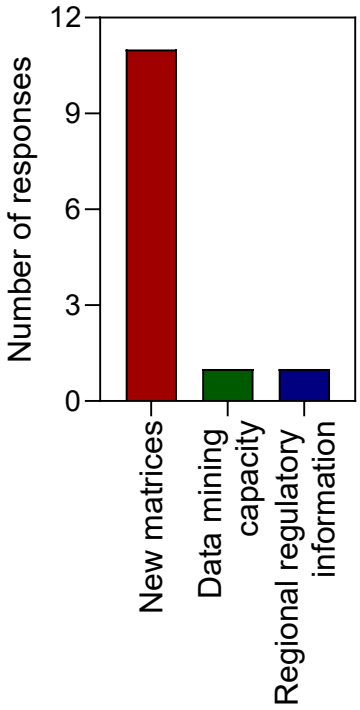

Figure 1 Overview of industry partner responses in November 2024

Appendix

Table 1 Additional matrices responses from Miro Board. Additional clarifying comments are provided in italics

Contributor	Comment
PUB	Expanding the types of matrices covered beyond drinking water - include WW, recycled water, source waters, seawater (desal)...
PUB	Consider and assess the release of pollutants from sediments (reservoir beds etc.)
PUB	Singapore does not practice land application of biosolids at the moment, but it might be of interest to other jurisdictions
GWRC Board	Other media 'module': identifying priority list of those to be considered in ECHIDNA (eg, biosolids, sludges,...)
WRC	Wastewater / drinking water / faecal sludge to update guidelines for sludge use
US EPA	Biosolids
WSAA	Drinking water treatment sludges/filter cakes; and biosolids
WSAA	Soils and sediments carried into water sources from bushfire events and flood prone land (erosion/land slips)
TZW	Concentrates from RO membrane filtration (residual treatment streams)
WSAA	Waste water as a useful tool to determine the potential risk from sewer overflows and discharge to environment
WRC	Plant material to determine transfer of CECs from irrigation water into food/plants/
WSAA	Links to trade waste criteria and downstream input into wastewater, sludge and biosolids
KWR	Reclaimed water *(as alternative source for drinking water production)*

Table 2 Addition of MS fragmentation and spectral information response from Miro Board. Additional clarifying comments are provided in italics

Contributor	Comment
KWR	Advanced data analysis of HRMS data to find new CECs *(inclusion in databases such as Home - Digital Sample Freezing Platform may allow derivation of (historical) time trends)*
US EPA	Confidence in data - BP4NTA and other NTA webtool

Table 3 Expansion of data mining capacity response from Miro Board

Contributor	Comment
PUB	PFAS
PUB	micro plastic
GWRC Board	Treatment 'module': Log removal by treatment process – where available
GWRC Board	Assessment 'module': consideration of indicator compounds for (new) CECs and classes of compounds, as they behave similar to existing chemicals or chemical groups
WRC	Add a functionality on the platform to mine data on that specific CEC
KWR	qsar prediction of toxicity
KWR	qsar prediction of transformation product formation
KWR	Text mining to find emerging contaminants (incl. replacement/substitution/societal developments)
WSAA	Likely sources of CEC, applications and uses of compounds that breakdown or lead to formation of CECs
WRC	Evidence that will support the one health approach to dealing with contaminants
WaterRA	Extract data in more efficient and different ways (e.g groups)
WSAA	I like the existing "google search" history data - can this be expanded using AI to really know what CECs are keeping people awake at night?

Table 4 Expansion of regional regulatory information response from Miro Board

Contributor	Comment
PUB	We would appreciate a more international perspective: PBT etc. in Oz has been useful; used by everyone
Unknown*	Inclusion of a range of guidelines. There is already a range of GV documents used in the current tool.
WSAA	Would it be worth expanding the thresholds for different chemicals (where these apply) from around the world e.g. USEPA vs NHMRC (ADWG) for PFAS etc.
KWR	Global overview legal standards and health-based guidelines
KWR	Global overview concentrations of CECs in different (environmental) matrices

*No contributor name provided in Miro Board

Table 5 Addition of new features response from Miro Board

Contributor	Comment
PUB	Allow 2-way comms to allow new data and new info
PUB	Sharing and standardisation of methodologies for sample extraction, processing and enumeration
WRC	Addition of a tab resources / publications /reports / ongoing projects
WRC	Functionality for GIS enabled data
WRC	Functionality to compute site specific risks for different water uses
WRC	Information on recommended technology for removal in water
KWR	Weight of evidence-balancing for prioritization
KWR	Risk communication guidelines
KWR	Global overview legal standards and health-based guidelines
KWR	Link to comparable guideline values internationally and associated source/reference material
KWR	Grouping of substances (structure, hazard)
US EPA	Context for ranking
KWR	Bioassay monitoring sets
KWR	Global overview concentrations of CECs in different (environmental) matrices
PUB	News /media articles, possible public comms lines for groups of chemicals
KWR	Extract the underlying evidence of a risk prioritization (including data gaps)
KWR	Highlight urgent data/knowledge gaps
US EPA	Confidence and use caveats

Table 6 Addition of new data sets response from Miro Board

Contributor	Comment
PUB	We can contribute our bioassay monitoring data on different water matrices that we are starting to collect
GWRC Board	Value add to risk ranking using actual utility data, where it can be provided
Unknown*	May need some controls to ensure data is reliable/credible
KWR	Emission permits
WSAA	Concentration of chemicals in matrixes
KWR	Subpopulations sensitivity (e.g., development, preconditions)
Unknown*	Wastewater / Source water catchment categorisation linked to detection / testing of CEC
PUB	Inclusion of other routes of exposure (e.g. food, inhalation) to enhance risk assessment
Unknown*	Sources of chemicals in products eg what is the source of the CEC. This will help with catchment assessment and risk assessments
WSAA	Recycled Water
PUB	Possible mixtures e.g. PFAS mixtures
WSAA	Linkage to WSAA WQH network (source and other 'grey literature' WQ data)
KWR	Literature inputs of tools that can identify CECs
US EPA	EBM and NTA monitoring; CCL lists; NECRI
US EPA	"ETAP"; focus on CECs' toxicology info
US EPA	Treatability database
US EPA	PFAS thermal treatment data base
WRC	Link to national CEC initiative (eg spreadsheet based, to include CECs in the future: 'fitness for use' and WQ potable and non-potable use
WRC	Surveillance data, incl. GW
TZW	Focus on German gw and soil data

*No contributor name provided in Miro Board