Marine Biodiversity Hub

National Environmental Science Programme

Towards a national standard and guidelines for reporting wastewater treatment plant outfall data

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National Outfall Database

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Important Disclaimer

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EXECUTIVE SUMMARY

A need for readily accessible, reliable, national-scale data on Australia's domestic wastewater outfalls prompted the federal government in 2015 to commission Clean Ocean Foundation (COF) to develop the National Outfall Database (NOD). Working collaboratively with all stakeholders and under the auspices of the National Environmental Science Program (NESP), COF has successfully collected and analysed outfall data each (financial) year to produce the NOD for all of Australia's 186 coastal outfalls.

To ensure the NOD continues to meet the need and interests of stakeholders, this paper has been prepared by the NOD project group, with the assistance of those experienced in wastewater treatment plant design, outfall design, water recycling, environmental science, community organizations and economics. The paper aims to promote discussion and encourage feedback from stakeholders on national scale reporting procedures for outfall discharges from the nation's coastal wastewater treatment plants. It is intended to be used as a starting point in an ongoing process towards a uniform set of national standards on outfall reporting and provide an opportunity for expression of perspectives and ideas before advancing a formal proposal, which will also require further consultation.

As it currently stands, given the level of variability in reporting requirements and varying levels of data accessibility, it is difficult to comprehensively manage and assess effluent impacts on biodiversity, human health, water security and possibly the economic sector from a national perspective. The State of Environment 2016 has highlighted a deterioration in the quality of coastal waters around Australia (Clark and Johnston, 2017). A national approach to identify, assess and mitigate the impacts causing this deterioration will require accurate, standardized data from the wastewater sector. Decision makers at regional, state, and federal levels need greater clarity when allocating resources for water quality management and the opportunity to develop a clear set of standards will be essential. These standards can provide both a set of:

- Baseline national standards - minimum acceptable standards in reporting expected that most responsible agencies already supply to the NOD
- Aspirational standards – more comprehensive standards that agencies should strive for over a reasonable time period or required very quickly if additional national funding for infrastructure upgrades was to be made available.

Twenty-six of relevant water authorities (WTAs) were contacted in order to participate on the outfall data reporting standard survey. Of the 26, only 21 participants agreed to participate in the next discussion and 15 participants completed the survey (58% response rate). The WTAs support transparency and nationalised, centralised data collection and can manage the current twelve-month reporting cycle. There is, however, a strong preference to report on criteria as required by licensing authority and not necessarily expanding the scope of monitoring. Monitoring and reporting on other parameters and pollutants needs to be based on perceived benefits against additional costs and must have context in relation to evidence-based impacts on receiving waters. There were no concerns raised regarding reporting of

timelines to license variations, planned major process changes or capital works or representing mixing zones on maps. Collaborative development of a report card using this data has good support but needs to also provide measured context and avoid emotionally charged symbols in order to not misrepresent issues to general public. Emerging contaminants is a challenging area, where cost and some concerns relating to unproven impacts need to be considered. This may require some sensitivity in relation to the next stage of consideration of outfall standards where other stakeholders with different perspectives will also be approached for comment.

We recommend that the next step would be to use the information collected from responses to this survey to provide a basis for a consultation process with all stakeholders which would be conducted over the next phase of the NOD project. This would provide the opportunity to also establish an ongoing network with the ability to identify key parameters and evidence required for decision makers by engaging key stakeholders to contribute to the body of public knowledge related to the water sector and the development of a national reporting standard.

1. INTRODUCTION

A need for readily accessible, reliable, national-scale data on Australia's domestic wastewater outfalls prompted the federal government in 2015 to commission Clean Ocean Foundation (COF) to develop the National Outfall Database (NOD). Working collaboratively with all stakeholders and under the auspices of the National Environmental Science Program (NESP), COF has successfully collected and analyzed outfall data each (financial) year to produce the NOD for all of Australia's 186 coastal outfalls.

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Overall, the paper does five things.

1) Identifies the needs, benefits, and challenges of establishing national reporting standard.
2) Identifies the successes and lessons learned from a pilot reporting project, the National Outfall Database.
3) Identifies and considers the key elements of a proposed national approach to reporting, such as the process used to gather data, data storage arrangements, data access, reporting outputs and frequency and reporting costs.
4) This version lists the key research questions for stakeholders to address.
5) Lastly, the fifth section will propose a way forward.

2. NEEDS, BENEFITS AND CHALLENGES OF NATIONAL REPORTING STANDARDS

In general, standards are voluntary documents that:

- set out specifications, procedures and guidelines,
- facilitate interoperability, effectiveness and efficiency of any repeated interactions/operations,
- can contain technical specifications, rules, guidelines or definitions.
- perform an important part of operations in any industry as they save money and drive efficiency.

For wastewater treatment plants (WWTP), standards can:

- set criteria for the design, operation and disposal to minimise health and safety or environmental impacts,
- drive stakeholder engagement,
- provide a baseline level of acceptability,
- help facilitate communication and measurement, and
- provide a common baseline against which to assess health and environmental impacts and ensure accountability and transparency in order to attain outcomes that best reflect societies' evolving values and expectations (Rohmana et al., 2020).

Standards seek to establish a clear framework through which this transparency can be achieved. This will enable the identification, standardisation and delivery of important information that the community and stakeholders need to:

- understand outfall dynamics,
- assess and manage the negative impacts on the environment and human health,
- evaluate potential intrinsic and extrinsic benefits of alternatives for each individual outfall discharge using comparative data.

Wastewater Treatment Plant Monitoring

A key element of WWTP operations is the monitoring of effluent. With regards to wastewater effluent in Australia, each state or territory Environment Protection Agency (EPA) has a role in regulating WWTP discharge from outfalls (Table 1 and Table 2). Any activity that may produce a discharge of waste that adversely affects the quality of the environment requires a license. Each emission source is required to monitor discharges and to be in compliant with its licenses. To achieve compliance, WWTPs are required to conduct monitoring within the vicinity of their outfalls, analyse the samples and report the results to the relevant EPA.

Table 1. Responsible water authorities across states and a territory.

State or Territory	Discharge Authority	Pollution Licensing Authority
Victoria	Water Authority	EPA Victoria
New South Wales	Water Authority or Council	EPA New South Wales
Queensland	Water Authority or Council	DOE Queensland
Northern Territory	Power and Water Corporation	EPA Northern Territory
Western Australia	Water Corporation	EPA Western Australia
South Australia	SA Water	EPA South Australia
Tasmania	TasWater	EPA Tasmania

Table 2. Number of relevant water authorities which interacted with the NOD.

State	No. of water authorities	No. of outfalls
New South Wales	12	34
Northern Territory	1	14*
Queensland	17	54
South Australia	1	10
Tasmania	2	43
Victoria	8	19
Western Australia	1	12

*Number of outfalls recorded according to Power and Water licenses are 14, data received by NOD is 4.

Monitoring requirements vary across states, ranging from Environmental Protection Authority (EPA), water treatment authority (WTA's), and in some cases individual outfalls. Individual monitoring arrangements are made in each case between EPAs and WTAs. Monitoring requirements ultimately depend on EPA requirements, WWTP treatment level, and the condition of the marine environment (EPA NSW, 2003; EPA VIC, 2017). A balance needs to be met between WWTP operators, largely interested in minimising expense and staying within their license conditions, and the EPA, which has an interest in regulating impacts on environmental quality. This system of WWTP effluent monitoring and reporting varies across states, jurisdictions, regions and ultimately individual outfalls.

Inconsistency in monitoring requirements and a lack of national-level standards for data collection, transmission and sharing results in a lack of transparency and a reduced ability to comprehensively assess regional and national scale water quality impacts and health risks. Existing monitoring arrangements make it difficult to get a clear picture of how individual wastewater treatment plants compare with others around the country. For example, it is difficult to compare technology, cost of disposal, recycling efficiencies, evaluating risk of emerging contaminants, quantities and qualities of effluent streams if the available data is sparse and lacks detail.

The current system for water quality management is guided by the National Water Quality Management Strategy (NWQMS). The NWQMS was designed to protect water resources by maintaining and improving water quality, while supporting dependent aquatic and terrestrial ecosystems, agricultural and urban communities, and industry (ANZECC, 1992; ANZECC and ARMCANZ, 2000). The NWQMS is guided by both the Water Quality Management Framework (WQMF) and the Australian and New Zealand Environment and Conservation Council (ANZECC) & Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ) water quality guidelines.

Both the WQMF and the ANZECC guidelines provide managers with steps and technical details for planning and managing water quality on an individual catchment/water body basis. The WQMF outlines 10 steps that logically encompass key requirements for long-term management strategies. The initial steps are to examine the current understanding of how a waterway system works, the issues they face and how to manage them. The second step suggests to "establish or refine community values and more specific management goals (including level of protection) for the relevant waterways at stakeholder involvement workshops." The first two steps of the WQMF are key elements with respect to national reporting standards. With regards to the National Outfall Reporting Standards, they can be viewed as the first steps toward achieving consistent reporting of outfall parameters to support community water quality monitoring efforts and the inclusion of community stakeholders in management process.

The ANZECC guidelines form the central technical reference of the NWQMS. The ANZECC guidelines provide detailed approaches and advice on identifying appropriate guideline values for water quality indicators. These guideline values were developed to help ensure that agreed community values and their management goals are protected. According to the ANZECC guidelines, for protection of aquatic ecosystems, locally derived guideline values are most appropriate. Consistently and effectively reported outfall monitoring data could be further integrated into the detailed approaches and for setting guideline values for water quality indicators as carried out in the ANZECC guidelines. Furthermore, standardised datasets could be integrated into risk-based management frameworks such as the New South Wales, "Risk-based Framework for Considering Waterway Health Outcomes in Strategic Land-use Planning Decisions," to assist with management of the impacts of land-use activities on the health of waterways.

3. THE NATIONAL OUTFALL DATABASE - LESSONS LEARNED

The Database

The Clean Ocean Foundation (COF), with the support of National Environmental Science Program (NESP), developed the National Outfall Database (NOD, 2020) (www.outfalls.info) (Gemmill et al.2019). This is a centralised spatial data management system for sharing and communicating comprehensive, national-scale pollutant data from outfalls (Gemmill et al., 2019). The NOD currently provides a national inventory of Australia's 186 coastal outfalls, including the volume of water and the quantity of pollutants and nutrients disposed of into coastal receiving waters. Water quality data, recorded in the NOD, were collected from 42 Water Treatment Authorities (WTAs) around Australia. Sampling conducted by the WTAs were taken from the sampling points within the WWTP premises as described in the licenses. Data describing water quality parameters (Table 3) and outfall characteristics were transcribed into a database. Outfall characteristics consist of outfall name, manager, license number, WWTP capacity, population serviced, treatment level, and location description.

Data collection and Datasets

The NOD began collecting data in 2015, and relevant WTAs were contacted in order to develop a collaborative approach to collecting and displaying data adopted. A key achievement involved in wastewater treatment was establishing lines of communication and effective protocols to collect and make publicly available data in a timely manner from WTAs (Table 4). This was made particularly challenging due to the variety of entities engaged in either the regulation or production of wastewater discharges from Australian outfalls (Rohmana et al., 2019a).

By successfully collecting and making this data available each financial year since 2015 to 2020, the NOD has in effect established a de facto "Baseline Standard" dataset for future data collection (see Table 3).

Table 3. Initial request of water quality data parameter for 2015 data. Common parameters collected by all WWTPs appear in bold.

Parameter	Unit
Flow volume	**ML**
pH	pH
Total dissolved solids	mg/L
Total suspended solids	mg/L
Total phosphorus	**mg/L**
Total nitrogen	**mg/L**
Oil and grease	mg/L
Surfactants (MBAS)	mg/L
E. coli	org/100mL
Enterococci	org/100mL
Faecal coliforms	org/100mL
Turbidity	NTU
Colour	Pt. Co. Units
Algal blooms	Frequency
Blue green algal bloom	Frequency

Table 4. Data collection progress from 2017 to 2018.

States/Territory	Number of outfalls	2017	2018
New South Wales	29	97%	98%
Northern Territory	14	30%	30%
Queensland	51	100%	100%
South Australia	10	100%	100%
Tasmania	41	100%	100%
Victoria	19	100%	100%
Western Australia	12	100%	100%

Data Usage

The NOD data has also been used internally by the NOD team:

- to develop a trial ranking system of nutrient discharge per capita to assist with analysing discharge impacts and to compare outfalls (Rohmana et al., 2019a; 2020).
- as a reference tool for the community relating to a survey on community perceptions on outfalls in their area (Rohmana et al., 2019b).

The NOD has also been used externally by other public users. These uses may have included:

- An economic analysis conducted by COF assessing the potential net benefit of upgrading all non-tertiary outfalls (Blackwell and Gemmill, 2019).
- By community groups concerned with impacts of outfalls e.g. Beach Patrol (2020).
- Researchers requiring reliable technical data relating to outfall design (Wright et al., 2019).
- Journalists researching outfall locations for news reports.
- Novel uses such as researchers interested in the possible transmission of covid-19 from outfalls, and a study related to correlations with shark attacks (Smith, 2017).

The NOD has established a “test” standard of national outfall data for Australian outfalls from WWTPs. It collected license conditions, location, monthly nitrogen and phosphorous volume discharges for each financial year and found that allowing for variances in data collection and delivery of that water quality data in March of the following year was an achievable deadline for public display of this information. WTAs support this initiative by supplying the data. The NOD has also been able to make comparisons between outfalls possible.

In relation to a future official standard, key findings are:

- WTAs face a complex mix of constraints (including resources), and each development in reporting needs be negotiated to correct for errors or misunderstanding.
- A standardized approach to data collection to provide a national perspective is possible for water treatment data.
- A collaborative and innovative approach underpinned by community involvement, scientific rigor and cross government support can produce an effective process for information gathering.
- The data made publicly available to date has stimulated interest in outfall discharge from researchers, community and decision makers alike.

4. TOWARDS A PROPOSED NATIONAL APPROACH TO REPORTING

As it currently stands, given the level of variability in reporting requirements and varying levels of data accessibility, it is difficult to comprehensively manage and assess effluent impacts on biodiversity, human health, water security and possibly the economic sector from a national perspective. The State of Environment 2016 has highlighted a deterioration in the quality of coastal waters around Australia (Clark and Johnston, 2017). A national approach to identify, assess and mitigate the impacts causing this deterioration will require accurate, standardised data from the wastewater sector.

Decision makers at regional, state and federal levels need greater clarity when allocating resources for water quality management, and the opportunity to develop a clear set of standards will be essential. These standards can provide both a set of:

- Baseline national standards - minimum acceptable standards in reporting expected that most responsible agencies already supply to the National Outfall Database (NOD).
- Aspirational standards – more comprehensive standards that agencies should strive for over a reasonable time period or required very quickly if additional national funding for infrastructure upgrades was to be made available.

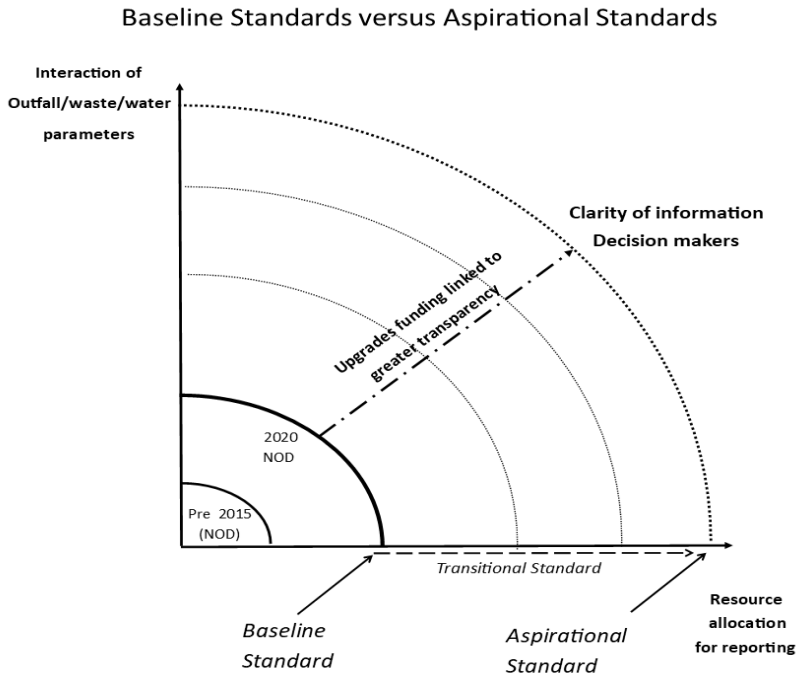


Figure 1. NOD Reporting Standards implementation towards the clarity of information for decision makers.

The goals of a process to develop a national standard would be to:

- outline a more efficient data collection process,
- further develop an accessible data storage platform accessible by all stakeholders,
- standardise reporting outputs and frequency,
- provide an efficient method to reduce reporting costs for WTA and WWTPs,
- consider how to address and how to extend reporting towards an aspirational standard as the need for information changes.

Since the "test" NOD already exists, Goals 1-4 above are relatively easy to achieve for data already collected on an annual basis. We have also listed survey questions R1 that when collected from stakeholders may provide further refinements to existing process.

Aspirational data can be critical to extend the value of the NOD process but also requires balancing the resource requirements for more comprehensive data reporting. A brief summary of key points follows with reference to the relevant appendix. The appendices contain themes relating to outfalls that drive the need for more aspirational standards.

Wastewater treatment technology

WWTPs have various levels of wastewater treatment (and pre-treatment) and technological approaches that impact on removal of various pollutants and quality of wastewater. For example, microplastics and their interaction with the environment and biosolids is becoming of increasing concern. Non-tertiary treatment will remove up to 66% of microplastics whilst tertiary treatment removes 98% (Conley et al., 2019; Cristaldi et al., 2020; Sol et al., 2020). Knowing the process technology operating at each WTP allows systematic research into mitigation measures to be explored and is currently being considered.

Wastewater treatment plant performance data

Drivers of data collection can be benchmarks for industry, water recycling efficiencies, and comparison of pollutant removal rates. A table of parameters recommended for collection as part of the reporting standard appears in Appendix A. This table includes a list of parameters, the recommended frequency of recording, and a recommendation as to whether the data should be publicly available. There is also an assessment regarding the frequency of reporting (daily, monthly, yearly). It lists engineering data used to monitor plant performance. The data is likely to exist for each WWTP but may be difficult to collect without significant resource allocation.

Outfall Characteristics

NOD has classified outfalls into river/estuary, coastal and deep ocean outfalls and can broadly be seen to have a different set of impacts on receiving waters. A key concept in outfall design is that of the mixing zone – the zone in which some loss of beneficial use by regulating authority is considered acceptable. If the mixing zone specifications are met, the inference is that the outfall is operating within specification.

At present there is no agreed standard for recording or reporting when the mixing zone is or may likely be compromised, either transitory (perhaps due to a single event equipment failure, heavy rainfall event) or longer term (compromised capacity).

Public Access

Transparency in relation to outfalls is driven by many factors related to the environment and public health. The type of information and its format depends on the aims and perspective of the group wishing to use the information as well as objective parameters relating to the size and the magnitude of the outfall discharge and its potential impact. In providing timely and appropriate information the specific objective of the information must be considered. These can be:

- Human Health
  - Close contact recreational use – e.g., swimming, surfing, diving etc.
  - Seafood consumption.
- Environmental Health
- Social and Cultural Values

Elements of a proposed reporting format for the general public are provided in appendix B. This presents parameters in the form of yearly performance card for each outfall (loosely based on Queensland's Healthy Land and Water report card (https://reportcard.hlw.org.au/). There are also other standards that are made available in mainly metropolitan regions of states and territories. These include Beachwatch (NSW), Beach Report (Vic), Beach Alert (SA), Beach grades (WA).

Pollutants

Common pollutants monitored by the WTAs may include phosphorus, nitrogen, and occasionally oil and grease, and pathogens. EPA licenses normally restrict levels of these pollutants (or pollutant load) over a stipulated length of time. Variation between licenses is both significant and confusing. For example, with one major capital city authority, the NOD initially was not supplied with nitrogen data. The WTAs explained that this was because nitrogen levels at that time were not part of license conditions and therefore not required to be made public.

Licenses often stipulate pollutant levels (from an average from several samples) must be within tolerance over time (e.g., month), and that a peak value can be dismissed if further samples show a return to specification (i.e., by adjustments made by the WWTP). These individual peak values are not reported publicly. They may be of concern however to both recreational users and marine biota (e.g., exposure to pathogens). It can also provide an indication of how consistently a WWTP processes are operating. Currently, the WTAs neither provide this data to the NOD or the general public. This this could be an area worthy of further exploration.

Emerging Contaminants

Emerging contaminants is an area of concern where a framework to understand and manage risk posed to the environment requires further attention. The complexity of this area suggests a pilot approach to guidelines be developed cooperatively focusing on only a few selected emerging contaminants. If successful, this process could be extended to other contaminants.

Table 5. Detection methods for emerging contaminants measurement.

Emerging contaminant		Key points for WWTPs	Measurement
Plastics	Macro-plastics	Poor design or equipment failure	
	Micro-plastics	Micro – Tertiary Discharge < 98% Contamination Biosolids	FITR and MS
Fire Retardants	Brominated	Brom – Legacy	GC
	Organophosphate	Tertiary (?) < 80% Contamination Biosolids	GC
AgVet Chemicals Antibiotics, Pharmaceuticals and ARGs	Antibiotics	Ab reduced but significant	GC/LC
	Pharmaceuticals	Various levels, advanced	GC/LC
	Microbeads	Cosmetics etc Filtration	EM
	Antibiotic resistance genes (ARG)	Growing concern, advanced	PCR
Biocides and DBPs	Biocides	High Tertiary to improve removal	GC/LC
	Disinfection by products		GC
PFAs		Requires advanced treatment level to remove	GC/LC
Industrial chemicals	Varied	Control at source	Various

GS - Gas Chromatagraph, MS – Microscopy, LC – Liquid Chromotograhy, FITR – Fourier Infrared Spectroscopy, EM – Electron Microscopy, PCR – Polymerase Chain Reaction

5. RESULTS – SUMMARY OF STAKEHOLDER FEEDBACK

Twenty-six WTAs and outfall data providers were asked their willingness to complete the survey. Of the 26, only 21 participants agreed to participate in the next discussion and 15 participants completed the survey (a 58% response rate). Participant responses to the survey questions are summarized below.

Recommendation (R1):
To improve transparency and accountability within the community by continuing to build on the National Ocean Database which collates and publishes outfall data on a national scale from WTA, councils and WWTPs.

R1-Q2: What are the key benefits from a centralized database/data repository for WWTP pollutant information?

Participants were asked to choose the key benefits of a centralized database/data repository. They were allowed to choose more than one.

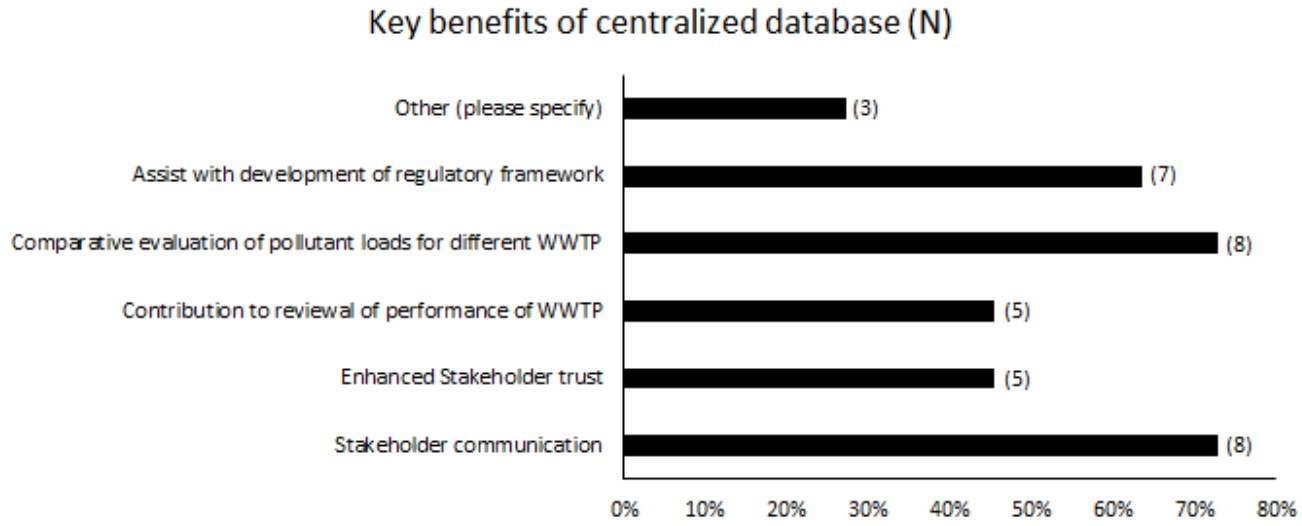


Figure 2. The percentages of centralized database key benefits. N is number of samples.

Figure 2 shows that the majority of WTAs believed that a centralised database will benefit the stakeholder communication with the general public (73%), allow them to compare pollutant loads between WWTPs (73%), and assist regulatory framework development (64%). Some WTAs also consider the centralised database to enhance the community's trust and may contribute the performance review and accountability of WWTPs.

R1-Q3: What elements of the current data collection process would you improve upon on order to make the data exchange/collection process more effective?

WTAs believed that data formatting (36%) for the NOD submission should be improved. Currently, COF has a uniform spreadsheet form which it collects only monthly data. Respondents indicated that this is insufficient. The authorities also stated that longer timeframe (18%) to collate the data will be needed.

Table 6. Elements which need improvements for data exchange process.

Element	N	Results
Communication (e.g., email)	2	18.18%
Timeframe	2	18.18%
Data formatting	4	36.36%
Spreadsheet form	1	9.09%
Other	6	54.55%

Under the "others" category, participants identified the following key themes:

- To improve data exchange process: Continuity of the NOD will provide WTA with justification to allocate resources for systematic data preparation.
- Data collected should:
  - Align with regulatory reporting requirements to ease administration burden.
  - Add value to the decision-making process rather than be collected for punitive purposes.
  - Provide context with respect to site specifics i.e., receiving dynamics, measurable impacts, or disturbance.

Recommendation (R2):
To expand the scope of monitoring to include a comprehensive list of required pollutants to be monitored across all WTPs and expand the list to include emerging pollutants.

R2-Q1a: Based on the list of pollutants in appendix A, can you indicate a percentage of those that are currently monitored at the recommended frequency?

Table 7. Indicated percentage or current monitored pollutant.

Percentage of monitored pollutants	N	Response
100%	0	0.0%
80%	6	66.67%
60%	2	22.22%
40%	1	11.11%
20% or less	0	0.0%

The majority of WTAs have monitored at least 80% of the pollutants in appendix A, while the rest monitored only 60% and 40%. There are no authorities which monitor all (100%) of the pollutants, or 20% or less.

R2-Q1b: Can you list those that would be most difficult to monitor?

Views largely reflected the lack of evidence related to the risk of emerging contaminants and a concurrent lack of resources to consistently provide data on high profile contaminants such as Per- and polyfluoroalkyl substances (PFAS)/perfluoro octane sulfonic acid (PFOS).

One large WTA indicated,

"*We currently sample for contaminants of emerging concern as part of discrete research projects with Universities, CSIRO, WaterRA or WSAA etc to understand the risk to the environment….. to understand if they pose a risk*"

whilst another indicated that

"All sewerage treatment plants are at the end of the waste hierarchy with their main focus to improve public health outcomes. Where does monitoring and regulation of microplastics add value for the community, environment and public health?"

Several respondents cited that many of the parameters (influent and effluent) are not monitored and not required to be reported to regulatory authorities. They also cited that the cost against perceived benefit was a key impediment to monitoring and reporting pollutants listed in the draft framework. Also noted was that smaller and remote WWTPs are unlikely to have resources to analyse and supply data. One larger WTA indicated that it most likely will have ability to collect this data.

R2-Q1c: Are there any other pollutants that could be added to the list?

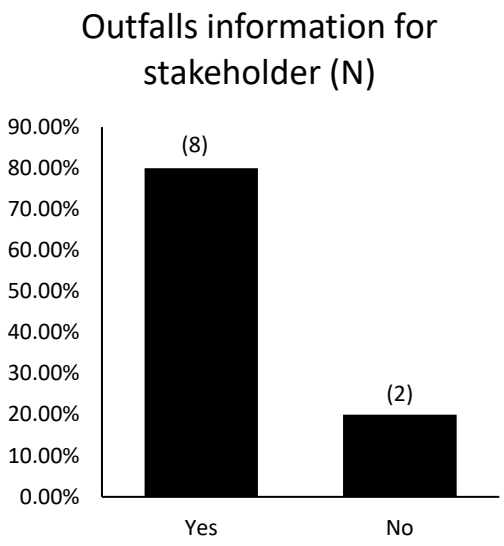
Answer choices	Response
No	80.0%
Yes (please specify)	20.0%

Those that responded, stated that other pollutants could be added but what is to be added should be based on site specific characteristics and legislation. One respondent indicated that toxic metals (e.g., copper, zinc, aluminium, cadmium, chromium, mercury, copper, lead, selenium), cyanide, nonyl phenol ethoxylates, pesticides are being measured by their organization, but these measurements were not required by the EPA.

Recommendation (R3):
To provide a more comprehensive data access and reporting format to address the needs of stakeholders.

R3-Q1a: Does the current outfalls information website currently met the needs of your stakeholder group in terms of data storage requirements and data access?

Figure 3. The needs of current outfalls information for stakeholders



Most WTA felt the data access and reporting provided by the NOD was appropriate, although it was suggested by one respondent that a reference to guideline values might add perspective.

R3-Q2a: Please review the proposed elements for the "report-card" reporting format presented in appendix B. Do you agree on the following statement?

"The proposed elements will provide valuable information and can be supplied relatively easily."

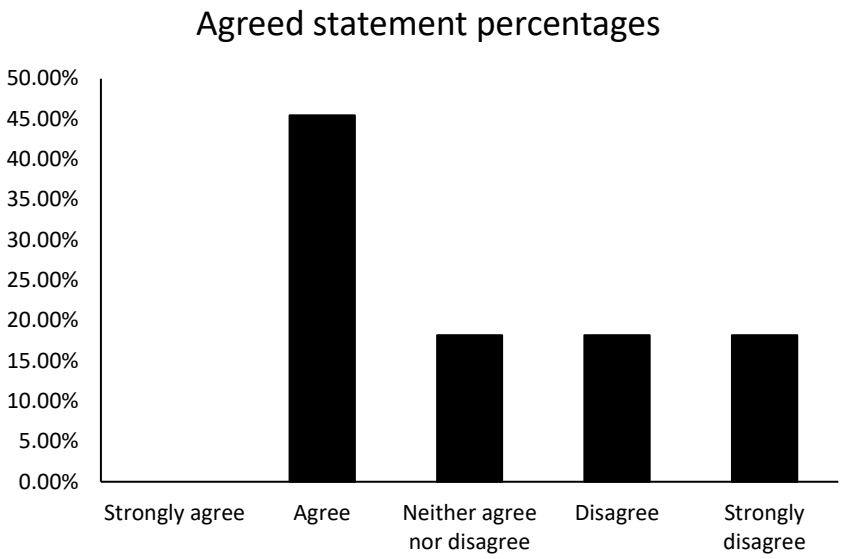


Figure 4. The percentages of the report card reporting format statement.

A key concern was that report card that included representations of "olympic swimming pools or toxic containers" might give the wrong impression about the impact of effluent discharges on the receiving environment. Another respondent recommended keeping to simple pictorial representation of the types, location, and sizes of WWTPs to avoid "people trying to read more into it than they should be." They also expressed concern that some pictorial representations such as toxic containers can be misleading, especially when there is "no avenue for observed location and/or ecological disturbance in what has been put forward." The same respondent also was critical of including "contaminants of emerging concern" as there is "still scientific uncertainty about them and they don't have guidelines" and that the concept of a general "load" category was vague. Another respondent urged a collaborative approach during a report card development process.

R3-Q2b: Are there additional components you feel should be added to make the report-card format more useful?

One WTA thought an emerging pollutant list might also need to consider "toxicity, metals (e.g., copper, zinc, aluminium, cadmium, chromium, mercury, copper, lead, selenium), cyanide, nonyl phenol ethoxylates, pesticides."

Recommendation (R4):
To modify reporting frequency to address needs of environmental protection and human health outcomes.

R4-Q1: Based on the reporting frequencies recommended in the table in appendix A, what frequency of information is possible.

Table 8. Possibility of monitoring frequency.

Monitoring frequency	Response
Daily	9.09%
Weekly	9.09%
Fortnightly	0.0%
Monthly	18.18%
Other (please specify)	63.64%

Most of the respondents suggested annual reporting was sufficient. More frequent reporting was not possible due to the remoteness of some of the sites where there are "legacy designs and inadequate infrastructure and services."

R4-Q2: What sort of resources/infrastructure are needed to for you to comply to the desired reporting frequencies in appendix A?

Key themes
Only a small minority of WTAs (10%) would find it possible to deliver parameters daily assuming extra resources were made available for this to happen. For all other WTA's, cost of integration, especially with older legacy projects, was a major impediment. Once again, a common thread included demonstrating benefit to stakeholders to justify an increased frequency of reporting to that level. The majority (63%) of respondents indicated a twelve-month reporting period was suitable.

6. CONCLUSION

Overall, WTAs support transparency and nationalised, centralised data collection and can manage the current twelve-month reporting cycle. There is, however, a strong preference to report on criteria as required by licensing authority and not necessarily expanding the scope of monitoring. Monitoring and reporting on other parameters and pollutants needs to be based on perceived benefits against additional costs and must have context in relation to evidence-based impacts on receiving waters. No concerns were raised regarding reporting of timelines to license variations, planned major process changes or capital works or representing mixing zones on maps. Collaborative development of a report card using this data has good support but needs to also provide measured context and avoid emotionally charged symbols in order to not misrepresent issues to general public. Emerging contaminants is a challenging area, where cost and some concerns relating to unproven impacts need to be considered. This may require some sensitivity in relation to the next stage of consideration of outfall standards where other stakeholders with different perspectives will also be approached for comment.

7. DISCUSSION AND NEXT STEPS

National standards can provide further legal directive to reduce WWTP effluent impacts to the marine environment and improve health outcomes for recreational users and enhance business output (European Commission, 2017; World Bank, 2018; European Commission, 2019). National standard can redefine parameters, monitoring methods and reporting requirements in an effort to expand Australia's efforts in enhancing biodiversity protection and achieving Sustainable Development Goal 14.

Many countries have already implemented national wastewater standards in order to protect their aquatic and marine environments. The European Commission (EC) has developed the Urban Wastewater Treatment Directive (UWWTD) 91/271/EEC in 1991 (European Commission, 1991; 2019). The Directive is related to Marine Strategy Framework Directive (MSFD) 2008/56/EC, Water Framework Directive (WFD) 2000/60/EC and Environmental Quality Standards Directive (EQSD) 2013/39/EU, for setting up the water quality parameter concentration limits. It lays down four main obligations, planning, regulation, monitoring and information and reporting. The UWWTD plays a main role to deal with wastewater collection, treatment level and designated discharge location, which includes estuaries and coastal waters. The EC invested approximately EUR 25 million each year for the UWWTD framework development, implementation, wastewater infrastructures, drinking water supply and water conservation (European Commission, 2017).

In order to fulfill the UWWTD obligations, specifically monitoring, information and reporting, the EC has created Water Information System for Europe (WISE) which is divided into two areas, freshwater and marine (European Environment Agency, 2017). Under the MSFD, WISE Marine provides access to information and data on the state of European seas, including the pressures and actions being taken to protect and conserve the marine environment. The WISE Marine also prepares built-in visualisation tools for its users, such as the urban wastewater treatment viewer map. All data reported in the WISE Marine database must be in accordance with the approved formatting before it finally can be published for general usage (European Environment Agency, 2017). This website has successfully improved quality and consistency of assessment within European national level. It also harmonises the technical and organisational processes which create a streamlined high quality data reporting.

The United States have developed a water portal as a single window for reporting standard purposes (NWQMC, 2016; Read et al., 2017). The main objectives of the water portal development between these countries were similar, reducing administrative cost and paperwork of regulatory compliance. The portal also helps to streamline and simplify environmental reporting requirements. This portal provides a centralised data repository for WTP monitoring data allowing for the centralised analysis, reporting and display of water quality data across the United States. Similar to the NOD, the portal has a standardised format data upload, presentation, analysis and mapping.

Similar to the USA and European Union, having a standard reporting in Australia may help the relevant stakeholders, including citizen science, to promote healthy marine environment initiatives and play an active governance role in developing national reporting standards. Currently, the WTAs have been following the monitoring and reporting process according to the WQMF. It applies to the development of water quality management plans as well as water quality guideline values. WTAs would be able to commit to fulfil their obligations of accountability to the general public for improved management of the environment if perceived benefits against additional costs were evident and if evidence-based impacts on receiving waters were clear.

We recommend that the next step would be to use the information collected from responses to this survey to provide a basis for a consultation process with all stakeholders which would be conducted over the next phase of the NOD project. This would provide the opportunity to also establish an ongoing network with the ability to identify key parameters and evidence required for decision makers by engaging key stakeholders to contribute to the body of public knowledge related to the water sector and the development of a national reporting standard.

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APPENDIX A – COMPREHENSIVE LIST OF PROPOSED INFLUENT/EFFLUENT PARAMETER TO BE REPORTED ANNUALLY.

Wastewater source *Monitoring*		Parameter				Data Availability			Proposed Reporting Standard	
		Variable	Description	Units		Recorded (C = Continuously, D = Daily, W = Weekly, Y = Yearly)	Public Availability (Y = Yes, N = No, S = Sometimes)		Proposed Frequency Required (Desirable)	Comments from WTA (Survey) if any
Influent wastewater										
Volumetric flow received at plant		Flow	Average Dry Weather Flow (ADWF)	kL/d		D	N		Daily and Peak	
			Average Flow	kL/d		D	N		Daily and Peak	
			Peak Daily Influent Flow	kL/d		D	N		Daily and Peak	
			Peak Instantaneous Influent Flow	L/s		D	N		Daily and Peak	
Sewage overflows in catchment		Flow	Number in period			D	N		Monthly and Peak	
			Estimated Volume	kL		D	N		Monthly and Peak	
Pollutant received at plant		Suspended Solids	Total Suspended Solids (TSS or NFR)	mg/L		W	No		Monthly and Peak	
		Organic matter	5-Day Biological Oxygen Demand (Total BOD_5 (uninhibited))	mg/L		W	No		Monthly and Peak	
			5-Day Biological Oxygen Demand (Carbonaceous BOD_5, inhibited))	mg/L		W	No		Monthly and Peak	
			Chemical Oxygen Demand (COD)	mg/L		W	No		Monthly and Peak	
		Nitrogen Species	Ammonia (NH_3 as N)	mg/L		W	No		Monthly and Peak	
			Total Kjeldahl Nitrogen (TKN)	mg/L		W	No		Monthly and Peak	

Wastewater source *Monitoring*	Parameter			Data Availability		Proposed Reporting Standard	
	Variable	Description	Units	Recorded (C = Continuously, D = Daily, W = Weekly, Y = Yearly)	Public Availability (Y = Yes, N = No, S = Sometimes)	Proposed Frequency Required (Desirable)	Comments from WTA (Survey) if any
		Total Nitrogen (TN)	mg/L	W	No	Monthly and Peak	
	Phosphorus Species	Orthophosphate (PO_4 as P) or Reactive Phosphorus (FRP)	mg/L	W	No	Monthly and Peak	
		Total Phosphorus (TP)	mg/L	W	No	Monthly and Peak	
Effluent wastewater							
Volumetric flow to environment	Flow	Average Dry Weather Flow	kL/d	Y	No	Daily and Peak	
		Average Flow	kL/d	Y	Y	Daily and Peak	
		Peak Daily Discharge	kL/d	Y	N	Daily and Peak	
		Peak Instantaneous Discharge Flow	L/s	Y	N	Each Incident	
		Number of Process Bypass Events		Y	N	Each Incident	
		Volume of Effluent that Bypassed Process in Period	kL	Y	N	Each Incident	
		Volume of Effluent discharged to alternative location or emergency discharge		Y	N	Each Incident	
Volumetric flow to water reuse	Location	Reuse applications (list)	(list)	Y	S	List	
	Flow	Volume of Flow Reused in Period	kL	Y	S	Annually	

Wastewater source *Monitoring*		Parameter				Data Availability			Proposed Reporting Standard	
		Variable	Description	Units		Recorded (C = Continuously, D = Daily, W = Weekly, Y = Yearly)	Public Availability (Y = Yes, N = No, S = Sometimes)		Proposed Frequency Required (Desirable)	Comments from WTA (Survey) if any
Pollutant to environment / reuse		Suspended Solids	Total Suspended Solids (TSS or NFR)	mg/L		W	S		Monthly and Peak	
		Organic matter	5-Day Biological Oxygen Demand (Total BOD_5 (uninhibited))	mg/L		W	S		Monthly and Peak	
			5-Day Biological Oxygen Demand (Carbonaceous BOD_5, inhibited))	mg/L		W	S		Monthly and Peak	
			Chemical Oxygen Demand	mg/L		W	S		Monthly and Peak	
		Nitrogen Species	Ammonia (NH_3 as N)	mg/L		W	S		Monthly and Peak	
			Total Kjeldahl Nitrogen (TKN)	mg/L		W	S		Monthly and Peak	
			Total Nitrogen (TN)	mg/L		W	Y		Monthly and Peak	
		Phosphorus Species	Orthophosphate (PO_4 as P) or Reactive Phosphorus (FRP)	mg/L		W	N		Monthly and Peak	
			Total Phosphorus (TP)	mg/L		W	Y		Monthly and Peak	
		Oxygenation	Dissolved Oxygen	mg/L		W	N		Monthly and Peak	
		Acidity	pH	pH		D	N		Monthly and Peak	
		Bacteria and Viruses	*Escherichia coli*	cfu/100mL or MPN/100 mL		W	N		Monthly and Peak	

Wastewater source *Monitoring*		Parameter				Data Availability			Proposed Reporting Standard	
		Variable	Description	Units		Recorded (C = Continuously, D = Daily, W = Weekly, Y = Yearly)	Public Availability (Y = Yes, N = No, S = Sometimes)		Proposed Frequency Required (Desirable)	Comments from WTA (Survey) if any
			Thermotolerant coliforms (Faecal Coliforms)	cfu/100mL		W	N		Monthly and Peak	
			Total Coliforms	cfu/100mL		W	N		Monthly and Peak	
			Enterococci	cfu/100mL		W	N		Monthly and Peak	
			Clostridium Perfringens	org/100mL		W	N		Monthly and Peak	
			fRNA phage	pfu/100mL		W	N		Monthly and Peak	
			Somatic Coliphage	pfu/100mL		W	N		Monthly and Peak	
			Other			W	N		Monthly and Peak	
		Oil and Grease		mg/L		W	N		Monthly and Peak	
		Chlorine	Free Chlorine (as Cl)	mg/L		W	N		Monthly and Peak	
			Total Chlorine (as Cl)	mg/L		W	N		Monthly and Peak	
		Conductivity		mS/cm		D	N		Monthly and Peak	
		Total Dissolved Salts		mg/L		W	Y		Monthly and Peak	

APPENDIX B – PROPOSED ELEMENTS OF "REPORT-CARD" REPORTING FORMAT

Feature to Display	Information Listed	Pictorial Representation
Outfall location		Coordinate point
Treatment level/process	Primary, Secondary, Tertiary, Advanced Tertiary	
Water quality compared to class A+ recyclable		4 Shaded drops
Outfall type	Deep ocean	Symbol
	Coastal/estuary	Symbol
	River	Symbol
Treatment plant capacity	% Influent capacity (influent volume/capacity)	
Influent received	Actual flow received per day	Olympic swimming pools
Population serviced		People
Effluent discharged		Olympic swimming pools
Nutrient load		Container
Pollutant monitoring	Frequency and availability	
Emerging contaminant load	Are these being addressed or monitored or reduced. If so how and list access to data.	Toxic container
Key pollutants issues related to specific to outfall	e.g., Warriewood heavy rain events, Warrnambool: cotton buds etc.	Toxic container
Size of mixing zone (Compromised Beneficial Use)	Description	Shaded area of mixing zone on map
Future changes or proposals that may affect discharge e.g., Capital works, License changes or anything else that might change pollutant load	Key dates and description of change and regulatory requirements	A suitable symbol for change

APPENDIX C – SURVEY QUESTION FOR THE WATER AUTHORITIES AND DATA PROVIDER

Survey questions - Recommendations (and high-level questions posed to stakeholders)

Toward that end, the following recommendations and related questions have been posed to stakeholders to further develop national standard and guidelines for reporting wastewater treatment plant outfall data. Each of the questions are related to a recommendation that has been developed to improve outfall monitoring and ultimately marine environmental protection. https://www.surveymonkey.com/r/outfall-standard

Recommendation (R1): To improve transparency and accountability within the community by continuing to build on the National Ocean Database which collates and publishes outfall data on a national scale from WTA, councils and WWTPs.	
Questions	**Answers**
	Yes or No
R1-Q1: Do you support a centralized and standardized data repository for WWTP pollutant information?	
	Select relevant benefits
R1-Q2: What are the key benefits from a centralized database data repository for WWTP pollutant information?	☐ Stakeholder communication ☐ Enhanced Stakeholder trust ☐ Contribution to reviewal of performance of WWTP ☐ Comparative evaluation of pollutant loads for different WWTP ☐ Assist with development of regulatory framework ☐ Other? _____
	Select relevant elements
R1-Q3: What elements of the current data collection process would you improve upon on order to make the data exchange/collection process more effective?	☐ Communication (e.g., email) ☐ Timeframe ☐ Data formatting ☐ Spreadsheet form
Recommendation (R2): To expand the scope of monitoring to include a comprehensive list of required pollutants to be monitored across all WTPs and expand the list to include emerging pollutants	
You can download a spreadsheet version of Appendix A to add more specific comments[1]	
	List those from Appendix A
R2-Q1a: Based on the list of pollutants in appendix A, can you indicate a percentage of those that are currently monitored at the recommended frequency?	☐ 100% ☐ 80% ☐ 60% ☐ 40% ☐ 20% or less
R2-Q1b: Can you list those that would be most difficult to monitor?	

[1] Accessible when completing the online survey containing these research questions.

R2-Q1c: Are there any other pollutants that could be added to the list?	☐ No ☐ Yes (please specify…)
R2-Q2: What is the current capacity and resource requirements to monitor microplastics and emerging pollutants?	
Recommendation (R3): To provide a more comprehensive data access and reporting format to address the needs of stakeholders.	
	Yes or No (including additional elements)
R3-Q1a: Does the current outfalls information website currently met the needs of your stakeholder group in terms of data storage requirements and data access?	
R3-Q1b: If no, what additional elements would you like to see?	
	Identify additional components
R3-Q2a: Please review the proposed elements for the "report-card" reporting format presented in appendix B. Do you agree on the following statement? "The proposed elements will provide valuable information and can be supplied relatively easily."	☐ Strongly agree ☐ Agree ☐ Neither agree nor disagree ☐ Disagree ☐ Strongly disagree
R3-Q2b: Are there additional components you feel should be added to make the report-card format more useful?	
Recommendation (R4): To modify reporting frequency to address needs of environmental protection and human health outcomes.	
	Select reporting frequency
R4-Q1: Based on the reporting frequencies recommended in the table in appendix A, what frequency of information is possible.	☐ Daily ☐ Weekly ☐ Fortnightly ☐ Monthly ☐ Other
	Identify resources
R4-Q2: What sort of resources/infrastructure are needed to for you to comply to the desired reporting frequencies in appendix A?	

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