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National Outfall Database: Outfall ranking based on 2022/2023 nutrient load discharge

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Executive summary

This report provides an analysis of the Australian coastal outfalls and ranks them according to the total flow volume and nutrients (nitrogen and phosphorus) load to prioritise the potential degree of impact of each source to the environment and human health.

Wastewater quality data was collected from 42 out of 43 water authorities (WTAs) with 177 out of 192 outfall sites (93%) around Australia by either downloading the water quality data reports directly from WTA websites or by formally requesting the data through email.

The pollutant contribution index, based on nitrogen and phosphorus loads, was calculated for each outfall. Nitrogen and phosphorus loads were calculated according to the Load Calculation Protocol of New South Wales Department of Environment and Climate Change. Outfalls were ordered from lowest to highest index value to rank them according to their relative pollutant contribution to the coastal and marine environment. The index is based on a total nutrient load discharge using the variables of flow, nitrogen and phosphorus.

The results show that the outfalls released 1,552 gigalitres of effluent into the marine environment between July 2022 to June 2023. The total nutrient load from individual outfall sites around Australia ranged from 0 to 5,375,025 kg with a mean of 131,116 kg, and nutrient load per person ranged between 170 mg to 79 kg. The ranked loads throughout Australia were mapped by quartiles. The outfalls in the top 25% quartile were more prevalent in regional areas and discharge less nitrogen and phosphorus loads into the coastal and marine environment. The bottom 25% quartile, on the other hand, with higher nutrient loads, principally occur around the major cities. The phosphorus concentrations contribute less to the overall outfall nutrient load and vary less between outfall sites. Nitrogen, on the other hand has a higher median contribution and high variability across the sites.

In general, the outfalls contributing higher nitrogen and phosphorus loads varied more than those discharging lower loads. There may be many reasons for this, but it could be related to treatment plant capacity, population growth, and licensing requirements, resulting in increased discharge at metropolitan outfall sites. There are some exceptions to this pattern where rural/regional sites contributed higher nutrient loads than urban areas (e.g., Warrnambool, VIC). The reasons may vary; however, the main contributor is the level of technology employed to remove nutrients. This ranking of nutrient loads from Australian outfalls by site at a national scale can therefore be useful in prioritising treatment upgrade resources to manage biodiversity impacts and human health concerns.

1. Introduction

The discharge of treated wastewater has the potential to be a major contributor of marine environment pollution, which occurs globally. High concentrations of nutrients, pathogens, microplastics, organic and inorganic pollutants from wastewater discharge can threaten coastal ecology, biodiversity and affect the health of marine environment users, depending on the sensitivity of the receiving environment. (Wear et al., 2021, Boehm et al., 2017, Chahal et al., 2016, Ziajahromi et al., 2016). High loadings of nutrients may cause increased water eutrophication leading to hypoxic events that promote the mortality of marine organisms, including coral reefs (Altieri et al., 2017, Cheng et al., 2019, Whitehead et al., 2015). Harmful algal blooms (HABs) due to excess nutrient can be a major pose to human health by direct contact with water, consuming contaminated seafood and inhalation of the aerosolised algal toxins (Lim et al., 2023, Berdalet et al., 2023). In addition, eutrophication and HABs may also lead to economic losses for the local businesses that rely on the marine environment (Berdalet et al., 2023, Lemée et al., 2012).

To manage and safeguard aquatic and marine environments around Australia from the impacts of wastewater effluent, state/territory governments have each established Environment Protection Authorities (EPA). Each EPA acts as an independent environmental protection regulator to prevent and control pollutant impacts to human health and the environment. For example, in Victoria the EPA was established under section 5(1) of the Environment Protection Act of 1970. In New South Wales, the Protection of the Environment Administration Act (1991) (POEA Act) served as the mechanism to establish the environmental protection regulator. With regards to wastewater effluent each state or territory EPA has a role in regulating wastewater treatment plant (WWTP) discharges. For example, in New South Wales, the EPA regulates water pollution through the establishment of conditions in environmental protection licences. These licences take into account several factors, such as the community value of a waterway, the community's uses of a waterway and practical measures to prevent deterioration of waterway values and uses (EPA NSW, 2013). Any activity that may produce a discharge of waste that by reason of volume, location or composition adversely affects the quality of any segment of the environment will require a licence from the Authority (DECC NSW, 2009). The basic requirement of the licence consists of an explanation of the activity; pollutant loads and discharge limits. The actual load of a pollutant is the mass (in kilograms) of the pollutant (e.g., nitrogen, phosphorus, total suspended solids, oil and grease) released into the environment from the potential emission sources. Throughout each state and territory, emission sources are required to monitor their discharges and to comply with conditions set out in their licences. Each WWTP is required to conduct monitoring within the vicinity of their outfalls, analyse the samples and report the results to the EPA (DECC NSW, 2009, EPA VIC, 2009).

The National Outfall Database (NOD), developed by the Clean Ocean Foundation in collaboration with state and territory governments, provides policy makers with a guide to help prioritise outfall reform and identify public and private sector opportunities for wastewater recycling (Marine Biodiversity Hub, 2015). In collaboration with the National Environmental Science Program, the NOD also provides Australian water authorities and the public an accessible database to help identify pollutant loads and assess any potential health and environmental impact risks of wastewater outfalls on the marine environment and surrounding communities. The NOD provides an unprecedented national collection of water quality data, collected by water authorities and local governments according to guidelines set out in Environment Protection Authority (EPA) licences. Given the NOD's centralised collection of national scale water quality data, the opportunity to examine the comprehensive impacts of wastewater outfalls at regional scales becomes possible.

The aim of this report is to present a collection of discharge monitoring data between July 2022 and June 2023 from outfalls across Australian coastal regions. This report also ranks each outfall according to the total flow volume and nutrients load per capita to prioritise the potential degree of impact of each source to the environment. In general, the results of this analysis will provide stakeholders and the general community a better understanding of the relative pressures of outfalls to their coastal waterways and provide policy makers and managers one of evidence to prioritise outfall infrastructure reform and wastewater recycling initiatives.

2. Methods

2.1 Data collection

Wastewater quality data were collected from water treatment authorities (WTAs) around Australia (Figure 1) by either downloading the water quality data reports directly from WTA websites or by formally requesting the data through email. WTA monitoring requirements varied depending on EPA licence requirements. Therefore, the type of pollutant data monitored varied across all outfall locations. In this report, we assess only nitrogen, phosphorus and flow volume (Table 1), for nutrient loads calculation purposes. The population data of each outfall catchment were also gathered from the Australian Bureau of Statistics (2025) to calculate the amount of nutrient released per capita.

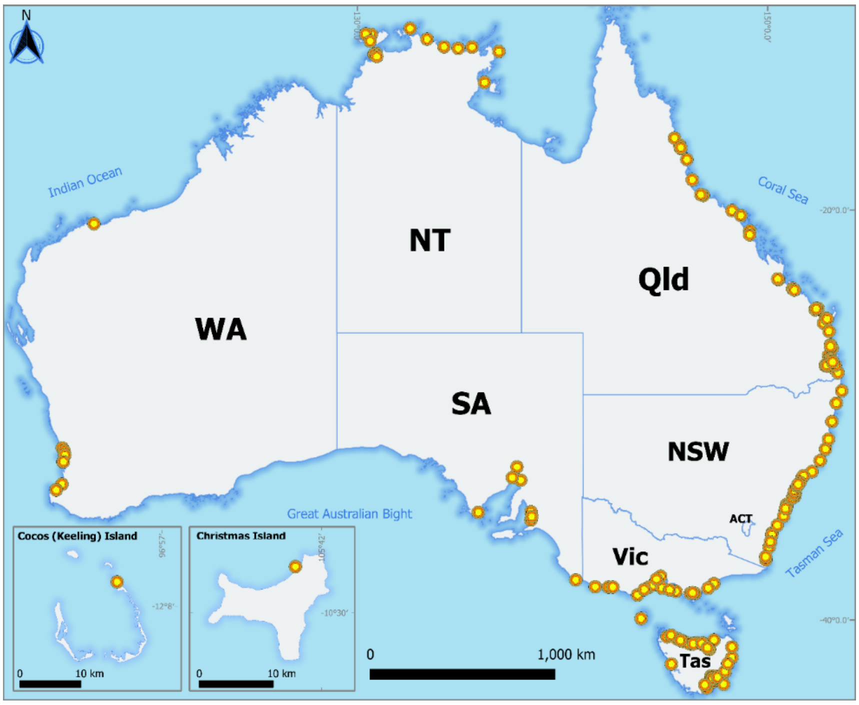

Figure 1. Australian outfall sites across six states and the Northern Territory over 43 water authorities. Cocos Keeling and Christmas islands are not in position.

2.2 Data Analysis

The pollutant contribution index, based on nitrogen and phosphorus loads, was calculated for each outfall (Figure 1). Outfalls were ordered from lowest to highest index value to rank them according to their relative pollutant contribution to the coastal and marine environment.

The index is based on a total nutrient load discharge (see below) using the variables of flow, and nitrogen and phosphorus concentrations.

Nitrogen and phosphorus (nutrient) load was calculated based on the Load Calculation Protocol (DECC NSW, 2009) using

$$L_d(kg) = \sum(V_d * C_d) \tag{1}$$

$$C_{fw}(ML/kg) = \frac{L_d}{\Sigma(V_{d-i})} \tag{2}$$

$$N_l(kg) = C_{fw} \times VT \tag{3}$$

where, N_l is the total nutrient load in kilograms, calculated for the observed load (L_d) of nitrogen and phosphorus concentrations (C_d) and V_d, the day's total volume of discharge from each outfall in megalitres (ML) (1). Nitrogen and phosphorus observed loads were summed and divided by the total volume (V_{d-i}) for those days which resulted as flow-weighted concentration (C_{fw}) (2) and multiplied by total volume (VT) of the licence fee period (ML) (3).

Nutrient load values were sorted and ranked for each outfall location and grouped into four quartiles, top 25% quartile (least nutrient load released), 50% quartile, 75% quartile and bottom quartile (most nutrient load released). All outfalls were further calculated by population to examine the amount of nutrient load per person. Few couples of outfalls, which service the same areas and population, have the final nutrient load values combined. These include Sorell and Midway Point (Tasmania), Busselton North and South wetlands (Western Australia) and Christies Beach Northern and Southern (South Australia). Those sites with only nitrogen or only phosphorus monitored for 2022/2023 financial year were not considered in the final nutrient load ranking.

3. Results

NOD has been consistently collecting data from the WTAs since 2015. As for 2022/2023 financial year, wastewater quality data were collected from 42 out of 43 WTAs with 177 out of 191 outfall sites (93%). Despite the complexity having various individual WTAs in Victoria and New South Wales, the NOD has effectively collected wastewater quality data for the 2022/2023 financial year. Due to various circumstances, the Northern Territory experienced difficulties in providing the requested information.

Table 1. Outfalls wastewater quality data collected for 2022/2023 financial year.

States/Territory	Number of outfalls	Data collected (%)
New South Wales	34	100
Northern Territory	14	0
Queensland	55	100
South Australia	10	100
Tasmania	47	100
Victoria	19	100
Western Australia	12	100

There were 149 out of 192 outfall sites analysed in this report (Table 2). This is due to several combined outfalls (4), one fully recycled site (Beaconsfield, Tasmania), 14 missing sites and 25 sites with either phosphorus or nitrogen only data. The 2022/2023 financial year data shows that 1552 gigalitres effluent were released transporting a total nutrient load of 19,667 tonnes. Total nutrient load from individual outfall sites ranged from 0 to 5,375,025 kg with a mean of 131,116 kg, and nutrient load per person ranged between 0.00017 to 79 kg. Each quartile is represented by 37 outfall sites (Appendix A – Table X). Table 4 shows the bottom quartile was dominated by New South Wales outfall sites (15), followed by Queensland (13), Tasmania (4), Victoria (3) and Western Australia (2). The top quartile (highest nutrient load) was represented by 15 Tasmanian outfall sites. New South Wales and South Australia each had four sites. Victoria, Western Australia and Queensland each had 8, 5 and 2 outfall sites, respectively.

Table 2. Top 25% (green) and bottom 25% (red) quartiles of outfall ranking for 2022/2023 financial year data. BMS = Boneo, Mt Martha and Somers, ETP = Eastern Treatment Plant, WTP = Western Treatment Plant, and ROS = Regional Outfall System.

Rank	State	Location	Total Nutrient (Kg)
1	Victoria	Port Philip Bay (WTP)	5,375,025
2	Victoria	Boags Rock (ETP)	3,234,298
3	Western Australia	Woodman Point	1,228,639
4	Tasmania	Macquarie Point	839,592
5	Tasmania	Pardoe (Devonport and Latrobe)	830,537
6	New South Wales	Malabar	682,777
7	Western Australia	Beenyup	655,128
8	Tasmania	Ti Tree Bend	581,139
9	New South Wales	North Head	514,658
10	South Australia	Bolivar WWTP	495,659
11	Western Australia	Point Peron	457,152
12	Western Australia	Subiaco	392,426
13	Tasmania	Rosny	357,764
14	Tasmania	Smithton	307,297
15	South Australia	Glenelg	288,525
16	Tasmania	Cameron Bay	268,165
17	Tasmania	Ulverstone	244,359
18	Victoria	Warrnambool WRP	232,152
19	Tasmania	Newnham	229,508
20	South Australia	Christies Beach	203,649
21	New South Wales	Bondi	170,082
22	Victoria	Black Rock WRP	168,608
23	Victoria	Port Fairy WRP	164,298
24	Tasmania	Wynyard	162,311
25	Victoria	Boags Rock (BMS)	152,833
26	Tasmania	Prince of Wales Bay	117,441

Rank	State	Location	Total Nutrient (Kg)
27	Tasmania	Burnie	108,689
28	Tasmania	Selfs Point	107,675
29	Tasmania	Blackmans Bay	86,086
30	South Australia	Bolivar High Salinity	70,952
31	Queensland	Luggage Point	63,598
32	Queensland	Kawana	50,273
33	Western Australia	Bunbury	47,169
34	New South Wales	Potter Point (Cronulla)	46,952
35	Victoria	Altona	46,626
36	Tasmania	Bridgewater	39,708
37	Victoria	Baxter's Beach	37,927
112	Tasmania	Hoblers Bridge	32,447
113	Queensland	Nambour	831
114	New South Wales	Forster	752
115	New South Wales	Skennars Head (Lennox Head)	747
116	Queensland	Victoria Point	735
117	Queensland	Thorneside	716
118	Queensland	Capalaba	691
119	Tasmania	St Helens	687
120	Tasmania	Sisters Beach	643
121	Western Australia	Christmas Island	619
122	New South Wales	Ulladulla	613
123	Queensland	Landsborough	575
124	Tasmania	Dover	547
125	New South Wales	Batemans Bay	514
126	Victoria	Toora	476
127	Queensland	Marlin Coast	472
128	New South Wales	Vaucluse - untreated	*393*
129	Queensland	Edmonton	389

Rank	State	Location	Total Nutrient (Kg)
130	New South Wales	Yamba	372
131	Western Australia	Home Island	352
132	Tasmania	Boat Harbour	306
133	New South Wales	Camden Haven	274
134	Queensland	Cannonvale	264
135	Queensland	Millbank	254
136	Queensland	Port Douglas	226
137	New South Wales	Narooma	219
138	New South Wales	Diamond Bay South - untreated	*210*
139	New South Wales	Long Nose Tomakin	189
140	Queensland	Bowen	182
141	Victoria	Port Welshpool	170
142	New South Wales	Merimbula	160
143	Queensland	Bargara	151
144	New South Wales	Diamond Bay North - untreated	*123*
145	Queensland	Karana Downs	90
146	New South Wales	Bermagui	49
147	New South Wales	Crescent Head	39
148	Victoria	Delray Beach (ROS)	13
149	New South Wales	Iluka	7.8

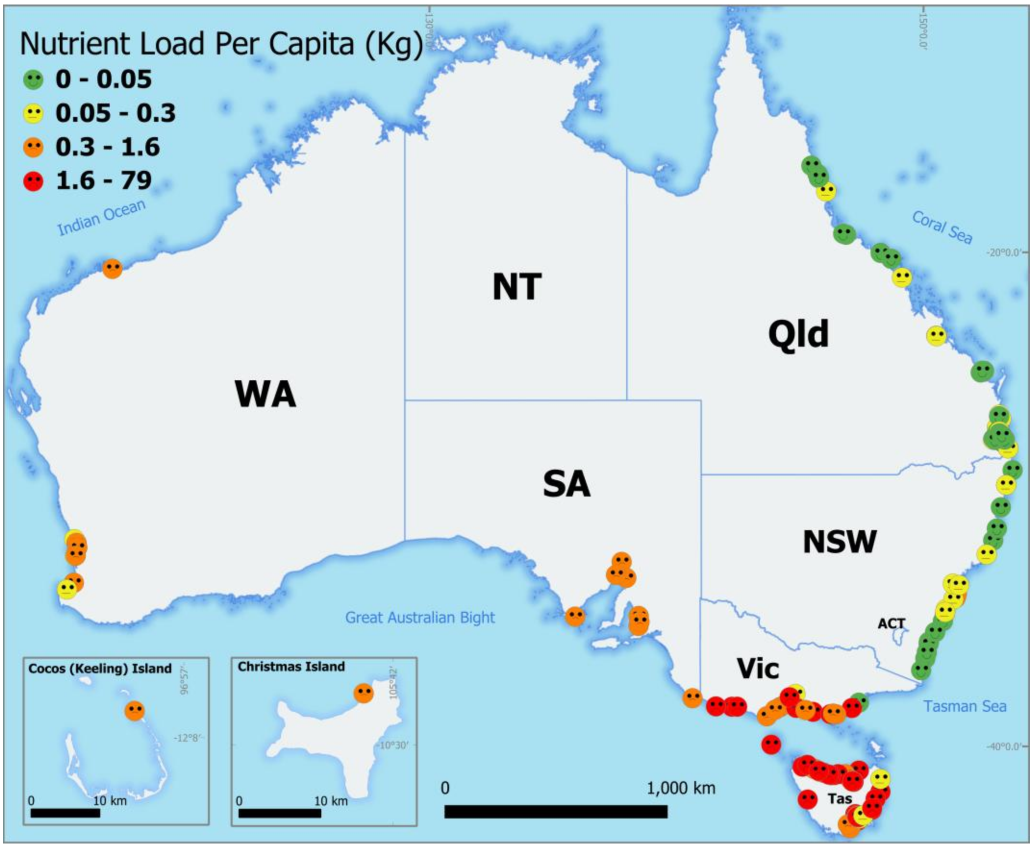

Figure 2. Nutrient load per capita for 2022/2023 financial year. Cocos (Keeling) Island and Christmas Island not in position.

Table 3. Bottom ten outfalls with highest total nutrient in 2022/2023 FY.

Rank	State	Outfall	Total Nutrient (Kg)	Nutrient/Capita (Kg)
1	Victoria	Port Phillip Bay (WTP)	5,375,025	2.15
2	Victoria	Boags Rock (ETP)	3,234,298	1.70
3	Western Australia	Woodman Point	1,228,639	1.56
4	Tasmania	Macquarie Point	839,592	24
5	Tasmania	Pardoe (Devonport and Latrobe)	830,537	22
6	New South Wales	Malabar	682,777	0.40
7	Western Australia	Beenyup	655,128	0.89
8	Tasmania	Ti Tree Bend	581,139	26
9	New South Wales	North Head	514,658	0.38
10	South Australia	Bolivar WWTP	495,659	0.55

4. Discussion

Nitrogen, phosphorus, and flow volume data were collected from 177 (93%) coastal outfall sites across six states, Queensland, New South Wales, Western Australia, South Australia, Victoria and Tasmania. These outfalls were ranked according to their total nutrient load (nitrogen and phosphorus). General patterns show that the highest nutrient loads tend to occur through those outfalls serving metropolitan and surrounding areas. Lower nutrient loads outfalls seem to occur in regional areas, however, the loads varied across individual outfalls. Sites with higher discharge load of nitrogen exhibited greater variability in discharge, compared to sites with lower discharge. This trend is most likely due to high population levels in urban areas which cause increasing in general discharge at metropolitan outfall sites. However, it seems that in metropolitan areas, people tend to release higher nutrient load compared to small population areas. In addition, higher nutrient loading could be related to high levels of industrial influent to WWTPs within service areas, such as in Smithton, Tasmania; Warrnambool, Victoria; and Point Peron, Western Australia.

Licence conditions are determined by a variety of factors, including the conditions of the waterway being discharged to, and the community uses of the waterway (EPA NSW, 2013, EPA VIC, 2017). For instance, although it is required to monitor, Pardoe does not have a concentration limit condition for nitrogen and phosphorus, compared to Macquarie Point, TAS that has the concentration limit of 38 mg/L and 8 mg/L for nitrogen and phosphorus, respectively (EPA Tasmania, 1998, EPA Tasmania, 2013). In addition to existing conditions and the uses of waterways, available resources for treatment plant upgrades and community pressure may also contribute to WWTP loading. For example, Boags Rock outfall, serving ETP and BMS, were under significant community pressure in the past and upgraded to tertiary treatment in 2012 (Melbourne Water, 2022). Another example related to the community pressure is the VCAT order for Warrnambool WWTP to upgrade the current wastewater treatment by 31 December 2025 (VCAT, 2021).

Several outfall sites that ranked in the top quartile do not have concentration limits for nitrogen and phosphorus in their licence conditions. Despite having no concentration limits, these sites are not considered to be breaching their licences regardless the amount of nitrogen and phosphorus loading into the marine and coastal environments. For example, the Eastern Treatment Plant in Victoria has no nitrogen concentration limit restriction listed in its license (EPA VIC, 2023). This, however, is a tertiary treatment plant which tends to be more efficient at the removal of bacteria and the further reduction of organics, turbidity, nitrogen and phosphorus (Roberts et al., 2010, EPA VIC, 2002, ANZECC and ARMCANZ, 1997). In addition, this plant has been consistently listed in the bottom quartile in the last five years, including current 2022/2023 financial year data, due to high flow volume (Rohmana et al., 2019, Rohmana et al., 2020a, Rohmana et al., 2021, Rohmana et al. 2023).

This ranking and the identification of nutrient loads by site can therefore be useful in prioritising treatment upgrade resources. In addition, the discrepancies in treatment level and license conditions, as well as wastewater reuse policies, warrant further examination at a national scale. This may indicate that bottom quartile outfalls should be the primary target for an upgrade in order to achieve the greatest benefit of water investment (Blackwell and Gemmill, 2019, Blackwell and Gemmill, 2020, Rohmana et al., 2020b). In addition, some sites (e.g., Beaconsfield in Tasmania and Lucinda in Queensland) reported almost zero discharge (NOD, 2023, Fitzgibbon, 2022). These sites are already fully recycling and diverting their wastewater to agricultural use, highlighting the success of a program that could be implemented in other areas.

In 2016 NSW EPA, issued a Pollution Reduction Program to Sydney Water regarding three discharge locations at Vaucluse and Diamond Bay. Previously these outfalls discharged raw wastewater into the ocean but the new proposed initiative “Refresh Vaucluse Diamond Bay” would reroute these outfalls during dry weather to the Bondi Wastewater Treatment Plant (Sydney Water 2020). The project was initially anticipated to be completed in 2022, however as of April 2025 construction is still ongoing. The outcome of the project is to reduce the discharge of raw wastewater from these outfalls but 93% with the other 7% coming from wet weather overflow. As it stands, the nutrient input from these three discharge points rank in the top 25% of all outfalls, with Diamond Bay (north) ranking 6th contributing a total of 123kg of total nutrients in the current financial year (2022/23). Diamond Bay (South) ranking 12th with 230kg and Vaucluse ranking 22nd with a total nutrient input of 393kg.

5. References

ALTIERI, A. H., HARRISON, S. B., SEEMANN, J., COLLIN, R., DIAZ, R. J. & KNOWLTON, N. 2017. Tropical dead zones and mass mortalities on coral reefs. *The Proceedings of the National Academy of Sciences,* 114**,** 3660-3665.

ANZECC & ARMCANZ 1997. Australian guidelines for sewerage systems: effluent management. *National Water Quality Management Strategy.* Canberra, ACT: Australian and New Zealand Environment and Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand.

AUSTRALIAN BUREAU OF STATISTICS. 2021. *Data by region* [Online]. Canberra, Australia: Australian Bureau of Statistics. Available: https://dbr.abs.gov.au/ [Accessed 29 March 2023].

BERDALET, E., CHINAIN, M., KIRKPATRICK, B. & PATRICIA A. TESTER 2023. Harmful algal blooms cause ocean illnesses affecting human health. *In:* FLEMING, L. E., CREENCIA, L. B. A., GERWICK, W. H., GOH, H. C., GRIBBLE, M. O., MAYCOCK, B. & SOLO-GABRIELE, H. (eds.) *OCEANS AND HUMAN HEALTH: Opportunities and Impacts.* Academic Press,.

BLACKWELL, B. D. & GEMMILL, J. 2019. Coastal Outfall System Upgrades in Australia: Benefits, Costs, and Improved Transparency – Final Report. Wonthaggi, Victoria: Clean Ocean Foundation.

BLACKWELL, B. D. & GEMMILL, J. 2020. Chapter 11: 'New Water' for a dry continent: Costs, benefits and improved transparency for Australia's coastal wastewater outfall upgrades. *In:* WASHINGTON, H. (ed.) *Ecological Economics: Solutions for the Future.* Washington.

BOEHM, A. B., ISMAIL, N. S., SASSOUBRE, L. M. & ANDRUSZKIEWICZ, E. A. 2017. Oceans in Peril: Grand Challenges in Applied Water Quality Research for the 21st Century. *Environmental Engineering Science,* 34**,** 3-15.

CHAHAL, C., VAN DEN AKKER, B., YOUNG, F., FRANCO, C., BLACKBEARD, J. & MONIS, P. 2016. Pathogen and Particle Associations in Wastewater: Significance and Implications for Treatment and Disinfection Processes. *Advances in Applied Microbiology,* 97**,** 63-119.

CHENG, B., XIA, R., ZHANG, Y., YANG, Z., HU, S., GUO, F. & MA, S. 2019. Characterization and causes analysis for algae blooms in large river system. *Sustainable Cities and Society,* 51**,** 101707.

DECC NSW 2009. Load Calculation Protocol. Department of Environment and Climate Change NSW.

DES 2022. Licensed Data: WaTERS release point monitoring data for coastal and estuarine STPs 2020/2021 financial year. State of Queensland: Department of Environment and Science (DES).

EPA NSW 2013. Using environment protection licensing to control water pollution. *In:* ENVIRONMENT PROTECTION AUTHORITY OF NEW SOUTH WALES (ed.). Sydney, NSW.

EPA TASMANIA 1998. Permit Conditions - Environmental (Pardoe Wastewater Treatment Plant). *In:* DEPARTMENT OF ENVIRONMENT AND LAND MANAGEMENT (ed.). Hobart: EPA Tasmania.

EPA TASMANIA 2013. Environment Protection Notice No. 8880/1 (Macquarie Point Wastewater Treatment Plant). Hobart.

EPA VIC 2002. Guidelines for environmental management: Disinfection of treated wastewater. Victoria: Environment Protection Authority of Victoria.

EPA VIC 2009. Industrial waste resource guidelines: Sampling and analysis of waters, wastewaters, soils and wastes. Environment Protection Authority Victoria.

EPA VIC 2017. Licence Management. *In:* ENVIRONMENT PROTECTION AUTHORITY VICTORIA (ed.). Carlton VIC: Environment Protection Authority Victoria.

EPA VIC 2023. Melbourne Water Corporation Licence. Victoria: Environment Protection Authority of Victoria, State Government of Victoria.

FITZGIBBON, G. 2022. Environmental Reporting - Beaconsfield STP. Tasmania: TasWater.

LEMÉE, R., MANGIALAJO, L., COHU, S., AMZIL, Z., BLANFUNE, A., CHOMERAT, N., GANZIN, N., GASPARINI, S., GROSSEL, H., GUIDI-GUIVARD, L., HOAREAU, L., DUFF, F. L., MARRO, S., SIMON, N., NEZAN, E., PEDROTTI, M.-L., SECHET, V., SOLIVERES, O. & THIBAUT, T. 2012. Interactions between Scientists, Managers and Policy Makers in the Framework of the French MediOs Project on Ostreopsis (2008–2010). *Cryptogamie, Algologie,* 33**,** 137-142.

LIM, C. C., YOON, J., REYNOLDS, K., GERALD, L. B., AULT, A. P., HEO, S. & BELL, M. L. 2023. Harmful algal bloom aerosols and human health. *eBioMedicine,* 93.

MARINE BIODIVERSITY HUB. 2015. *Project C4 - National Outfall Database* [Online]. NESP Marine Biodiversity Hub. Available: http://www.nespmarine.edu.au/project/project-c4-national-outfall-database [Accessed 15 March 2016].

MELBOURNE WATER. 2022. *Eastern Treatment Plant* [Online]. Melbourne: Melbourne Water. Available: https://www.melbournewater.com.au/water-and-environment/water-management/sewerage/eastern-treatment-plant [Accessed 15 March 2023].

NOD 2023. Lucinda Outfall. Australia: National Outfall Database.

ROBERTS, P. J. W., REIFF, F. M., LABBE, A., SALAS, H. J., LIBHABER, M. & THOMSON, J. C. 2010. *Marine Wastewater Outfalls and Treatment Systems,* London, UK, IWA Publishing.

ROHMANA, Q. A., FISCHER, A., GEMMILL, J. & CUMMING, J. 2019. National Outfall Database: Outfall Ranking Report 2017-2018. *Report to the National Environmental Science Program, Marine Biodiversity Hub.* Australia: Clean Ocean Foundation.

ROHMANA, Q. A., FISCHER, A., GEMMILL, J. & CUMMING, J. 2020a. National Outfall Database: Outfall Ranking Report 2018/2019 Financial Year. *Report to the National Environmental Science Program, Marine Biodiversity Hub.* Australia: Clean Ocean Foundation.

ROHMANA, Q. A., FISCHER, A. M., CUMMING, J., BLACKWELL, B. D. & GEMMILL, J. 2020b. Increased Transparency and Resource Prioritization for the Management of Pollutants From Wastewater Treatment Plants: A National Perspective From Australia. *Frontiers in Marine Science*.

ROHMANA, Q. A., FISCHER, A. M. & GEMMILL, J. 2021. National Outfall Database: Outfall Ranking Report 2019/2020 Financial Year. *Report to the Department of Agriculture, Water and Environment.* Australia: Clean Ocean Foundation and University of Tasmania.

ROHMANA, Q. A., FISCHER, A. & GEMMILL, J. 2023. National Outfall Database: Outfall ranking based on 2021/2022 nutrient loads discharge. *Report to the National Science Program*: Clean Ocean Foundation and University of Tasmania.

SYDNEY WATER. 2020 Review of Environmental Factors Refresh Vaucluse Diamond Bay. Available at https://www.sydneywater.com.au/content/dam/sydneywater/documents/review-of-environmental-factors-.pdf

VCAT 2021. VCAT REFERENCE NO. P11348/2021. *In:* VICTORIAN CIVIL AND ADMINISTRATIVE TRIBUNAL (ed.). Victoria: VCAT.

WEAR, S. L., ACUNA, V., MCDONALD, R. & FONT, C. 2021. Sewage pollution, declining ecosystem health, and cross-sector collaboration. *Biological Conservation***,** 1-9.

WHITEHEAD, P. G., BUSSI, G., BOWES, M. J., READ, D. S., HUTCHINS, M. G., ELLIOTT, J. A. & DADSON, S. J. 2015. Dynamic modelling of multiple phytoplankton groups in rivers with an application to the Thames river system in the UK. *Environmental Modelling & Software,* 74**,** 75-91.

ZIAJAHROMI, S., NEALE, P. A. & LEUSCH, F. D. L. 2016. Wastewater treatment plant effluent as a source of microplastics: review of the fate, chemical interactions and potential risks to aquatic organisms. *Water Science and Technology,* 74**,** 2253-2269.

Appendix A

Table 4: Outfall rankings based on the total nutrients (kg) for the 2022/2023 financial year data. BMS = Boneo, Mt Martha and Somers, ETP = Eastern Treatment Plant, WTP = Western Treatment Plant, SWOP = Saline Water Outfall Pipe, ROS = Regional Outfall System.

Rank	State	Location	Total Nutrient (Kg)	Population (ABS 2023)	T-Nutrient/Pop (Kg)
1	New South Wales	Iluka	7.8	1764	0.004
2	Victoria	Delray Beach (ROS)	13	77000	0.0002
3	New South Wales	Crescent Head	39	1500	0.026
4	New South Wales	Bermagui	49	6000	0.008
5	Queensland	Karana Downs	90	6000	0.015
6	Queensland	Bargara	151	9500	0.016
7	New South Wales	Merimbula	160	15500	0.010
8	Victoria	Port Welshpool	170	250	0.68
9	Queensland	Bowen	182	9900	0.018
10	New South Wales	Long Nose (Tomakin)	189	6000	0.032
11	New South Wales	Narooma	219	6300	0.035
12	Queensland	Port Douglas	226	5582	0.040
13	Queensland	Millbank	254	14000	0.018
14	Queensland	Cannonvale	264	10700	0.025
15	New South Wales	Camden Haven	274	18500	0.015
16	Tasmania	Boat Harbour	306	450	0.68
17	Western Australia	Home Island	352	400	0.88
18	New South Wales	Yamba	372	7000	0.053
19	Queensland	Edmonton	389	24814	0.016
20	Queensland	Marlin Coast	472	30740	0.015
21	Victoria	Toora	476	700	0.68
22	New South Wales	Batemans Bay	514	18000	0.029
23	Tasmania	Dover	547	900	0.61
24	Queensland	Landsborough	575	11805	0.049
25	New South Wales	Ulladulla	613	32000	0.019
26	Western Australia	Christmas Island	619	1692	0.37
27	Tasmania	Sisters Beach	643	500	1.29
28	Tasmania	St Helens	687	2200	0.31

29	Queensland	Capalaba	691	30000	0.023
30	Queensland	Thorneside	716	30000	0.024
31	Queensland	Victoria Point	735	34000	0.022
32	New South Wales	Skennars Head (Lennox Head)	747	28000	0.027
33	New South Wales	Forster	752	14700	0.051
34	Queensland	Nambour	831	49102	0.017
35	New South Wales	Penguin Heads (REMS)	847	102500	0.008
36	Queensland	Fairfield	865	15200	0.057
37	Queensland	Rubyanna	887	50000	0.018
38	Queensland	Innisfail	950	9600	0.099
39	New South Wales	Bombo	994	16000	0.062
40	Queensland	Mackay North (Bucasia)	1127	20000	0.056
41	Tasmania	Midway Point	1148	7000	0.164
42	Victoria	Apollo Bay WRP	1165	2300	0.51
43	Queensland	Woree (Southern WWTP)	1192	71851	0.017
44	Queensland	Mt St John	1252	106000	0.012
45	Tasmania	Cambridge/Hobart Airport	1454	2900	0.50
46	Queensland	Wynnum	1548	45000	0.034
47	Queensland	Wacol	1646	37000	0.044
48	Victoria	Lorne WRP	1696	1350	1.26
49	Tasmania	Sorell	1703	7000	0.24
50	Queensland	Carole Park	1711	23000	0.074
51	Tasmania	Rokeby	1921	14500	0.133
52	Tasmania	Geeveston	1984	2000	0.99
53	New South Wales	Coffs Harbour	1985	51000	0.039
54	Tasmania	Stanley	1989	600	3.32
55	Victoria	Anglesea WRP	2032	3200	0.63
56	Queensland	Coolum	2069	31106	0.067
57	Queensland	Maroochydore	2085	86459	0.024
58	Tasmania	Triabunna	2176	900	2.42
59	Queensland	Murrumba Downs	2282	147003	0.016
60	Tasmania	Beauty Point	2305	1300	1.77

61	Western Australia	Wickham	2612	2300	1.14
62	Tasmania	East Strahan	2672	700	3.82
63	Tasmania	Cygnet	2835	1700	1.67
64	Tasmania	Swansea	2945	1000	2.95
65	Tasmania	Orford	3000	680	4.41
66	Queensland	Sandgate	3030	125000	0.024
67	Tasmania	Risdon East	3249	7000	0.46
68	Queensland	Goodna	3259	60000	0.054
69	Tasmania	Bicheno	3645	1050	3.47
70	Queensland	Caboolture South	3710	73067	0.051
71	Queensland	Beenleigh	3810	55000	0.069
72	Queensland	Burpengary East	4070	65546	0.062
73	Victoria	Foster	4085	1500	2.72
74	Queensland	Redcliffe	4093	65377	0.063
75	Tasmania	Currie	4312	750	5.75
76	Queensland	Cleveland Bay	5156	126000	0.041
77	New South Wales	Shellharbour	5200	77500	0.067
78	Western Australia	Busselton	5504	40600	0.136
79	Tasmania	Somerset	5688	4000	1.42
80	Tasmania	Bridport	6022	1700	3.54
81	Tasmania	Turners Beach	6379	3400	1.88
82	Queensland	South Rockhampton	6422	25000	0.26
83	Queensland	Luggage Point Advanced	6573	-	*6573*
84	Queensland	Bundamba	6609	133000	0.050
85	Tasmania	Legana	6643	4800	1.38
86	Queensland	Merrimac	6683	150000	0.045
87	Queensland	Elanora	6831	100000	0.068
88	Queensland	Gibson Island	7113	68000	0.105
89	New South Wales	Warriewood	7523	74500	0.101
90	South Australia	Port Lincoln	9515	16300	0.58
91	Tasmania	George Town	9849	7000	1.41
92	Queensland	North Rockhampton	11041	45000	0.25
93	Queensland	Loganholme	11086	300000	0.037
94	Western Australia	East Rockingham	14344	135500	0.106

95	Queensland	Oxley	15885	315000	0.050
96	Queensland	Coombabah	15950	360000	0.044
97	South Australia	Port Augusta East	17372	13950	1.25
98	Tasmania	Port Sorell	19841	5200	3.82
99	South Australia	Port Pirie	19966	13000	1.5
100	Victoria	McGaurans Beach (SWOP)	21538	-	*21538*
101	South Australia	Whyalla	22022	21000	1.05
102	Victoria	Phillip Island	22497	15500	1.45
103	New South Wales	Winney Bay (Kincumber)	24686	160000	0.154
104	Western Australia	Alkimos	26142	205000	0.128
105	Victoria	Portland	28521	11200	2.55
106	Tasmania	Riverside	28726	12000	2.39
107	South Australia	Finger Point	30442	29500	1.03
108	New South Wales	Coniston Beach (Wollongong)	31168	210000	0.148
109	Tasmania	Hoblers Bridge	32447	11000	2.95
110	Victoria	Baxter’s Beach	37927	16700	2.27
111	Tasmania	Bridgewater (Green Point)	39708	15000	2.65
112	Victoria	Altona	46626	150000	0.31
113	New South Wales	Potter Point (Cronulla)	46952	241000	0.195
114	Western Australia	Bunbury	47169	76500	0.62
115	Queensland	Kawana	50273	150722	0.33
116	Queensland	Luggage Point	63598	830000	0.077
117	South Australia	Bolivar High Salinity	70952	59250	1.20
118	Tasmania	Blackmans Bay	86086	38000	2.27
119	Tasmania	Selfs Point	107675	18300	5.88
120	Tasmania	Burnie	108689	19900	5.46
121	Tasmania	Prince Of Wales Bay	117441	32200	3.65
122	Victoria	Boags Rock (BMS)	152833	168000	0.91
123	Tasmania	Wynyard	162311	6900	24
124	Victoria	Port Fairy WRP	164298	3500	47
125	Victoria	Black Rock WRP	168608	271000	0.62
126	New South Wales	Bondi	170415	316000	0.54

127	South Australia	Christies Beach	203649	150000	1.36
128	Tasmania	Newnham	229508	13600	17
129	Victoria	Warrnambool WRP	232152	35533	6.63
130	Tasmania	Ulverstone	244359	11600	21
131	Tasmania	Cameron Bay	268165	18800	14
132	South Australia	Glenelg	288525	290000	0.99
133	Tasmania	Smithton	307297	3900	79
134	Tasmania	Rosny	357764	32500	11
135	Western Australia	Subiaco	392426	300000	1.31
136	Western Australia	Point Peron	457152	-	*457152*
137	South Australia	Bolivar WWTP	495659	895000	0.55
138	New South Wales	North Head	514658	1360000	0.38
139	Tasmania	Ti Tree Bend	581139	22070	26
140	Western Australia	Beenyup	655128	740000	0.89
141	New South Wales	Malabar	682777	1700000	0.40
142	Tasmania	Pardoe (Devonport and Latrobe)	830537	37000	22
143	Tasmania	Macquarie Point	839592	35700	24
144	Western Australia	Woodman Point	1228639	790000	1.56
145	Victoria	Boags Rock (ETP)	3234298	1900000	1.70
146	Victoria	Port Phillip Bay (WTP)	5375025	2500000	2.15

Appendix B – Distribution List

Clean Ocean Foundation	John Gemmill
University of Tasmania	Andrew Fischer
Federal	
Minister for Environment and Water	Senator the Hon. Murray Watt
Minister for Agriculture, Fisheries and Forestry and Emergency Management	The Hon. Julie Collins MP
Minister for Infrastructure, Transport, Regional Development and Local Government	The Hon. Catherine King MP
Minister for Health and Aged Care	The Hon. Mark Butler MP
Senator for Victoria	Senator Lisa Darmanin
Victoria	
Minister for Environment	The Hon. Steve Dimopoulos MP
Minister for Water	The Hon. Gayle Tierney MP
EPA Victoria	Joss Crawford
EPA Victoria Victoria's Chief Environmental Scientist	Dr Jen Martin
Barwon Water	Luke Christie
Greater Western Water (Previously City West Water)	Joshua Mah
Gippsland Water	Boon Huang Goo
Melbourne Water	Marcus Mulcare
South East Water	Ben Spedding
South Gippsland Water	Bree Wiggins
Wannon Water	Jimena Harrington

Westernport Water	Johanna Randall
New South Wales	
Minister for Environment	The Hon. Penny Sharpe, MLC
Minister for Water	The Honourable Rose Jackson MLC
EPA New South Wales – Chief Executive Officer	Tony Chappel
Bega Valley Shire Council	Ken McLeod
Ballina Shire	Thomas Lees
Clarence Valley	Greg Mashiah
Coffs Harbour	Sam Pinnuck
Kempsey	Bobbie Brenton
Port Macquarie Hastings Shire	Belinda Green
Midcoast City Council	Craig Dowler
Hunter Water	Darren Cleary
Sydney Water	Sharmila Lakshmanaa
Shoalhaven City Council	Daniel Page
Eurobodalla Shire Council	Tim Neenan
Central Coast Council	Stephen Shinners
Queensland	
Minister for the Environment and Tourism	The Hon. Andrew Powell MP
Minister for Water	The Hon. Anne Leahy MP
Department of Environment and Science (WaTERs)	Patricia O’Callaghan

Northern Territory	
Minister for Water Resources	The Hon. Joshua Burgoyne MLA
EPA Northern Territory	Dr Paul Vogel AM
Power and Water Corporation	Ms Djuna Pollard
Western Australia	
Minister for Environment	The Hon. Matthew Swinbourn MLC
Minister for Water	The Hon. Don Punch MLA
EPA Western Australia Director General of the DWER	Alistair Jones
EPA Western Australia	Anne Marie Homes
Water Corporation	Gillian Griffin
South Australia	
Minister for Climate, Environment and Water	The Hon. Lucy Hood MP
EPA South Australia	Dr Jon Gorvett
SA Water – Chief Executive Officer	David Ryan
SA Water	Julia De Cicco
Tasmania	
Minister for Environment	The Hon. Madeleine Ogilvie MP
Minister for Primary Industries and Water	The Hon. Gavin Pierce MP
EPA Tasmania	Jason De Weys
TasWater	Kate Westgate
Other Bodies	

Australia Institute	Richard Dennis
Australia New Zealand Society for Ecological Economics	Dr Boyd Blackwell
Australian Conservation Foundation	Liana Downey
Environment Victoria	Tyler Rotche
Friends of the Earth	Cam Walker
Ocean Decade Australia	Jas Chambers
ORCV	Tim Boucat
SO Shire	Sarah Jo Lobwein
Surfrider Australia	Damien Cole
Water Services Association Australia	Adam Lovell
Western Sydney University	Assoc Professor Ian Wright
Western Sydney University	Katherine Warwick

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