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National Outfall Database: Outfall ranking based on 2020/2021 nutrient loads 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 178 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 1,453 gigalitres of effluent into the marine environment between July 2020 to June 2021. The total nutrient load from individual outfall sites around Australia ranged from 7 to 4,669,238 kg with a mean of 103,552 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 2020 and June 2021 from outfalls across Australian coastal regions. This report also ranks each outfall according to the total flow volume and nutrients load to prioritise the potential degree of impact of each source to the environment. Nutrient load based on treatment levels are also investigated to understand the differences nutrient discharged between each level. 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 evidence to prioritise outfall infrastructure reform and wastewater recycling initiatives.

2. Methods

2.3 Data collection

Wastewater quality data were collected from 43 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. To standardise data collection, the NOD prepared a document outlining a predefined format in which the data was to be delivered. Through this process, the NOD collected, verified, and published data from 43 WTAs up until 2020/2021 financial year. This report analysed wastewater quality data between 1st of July 2020 to 30th June 2021 inclusive. 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.

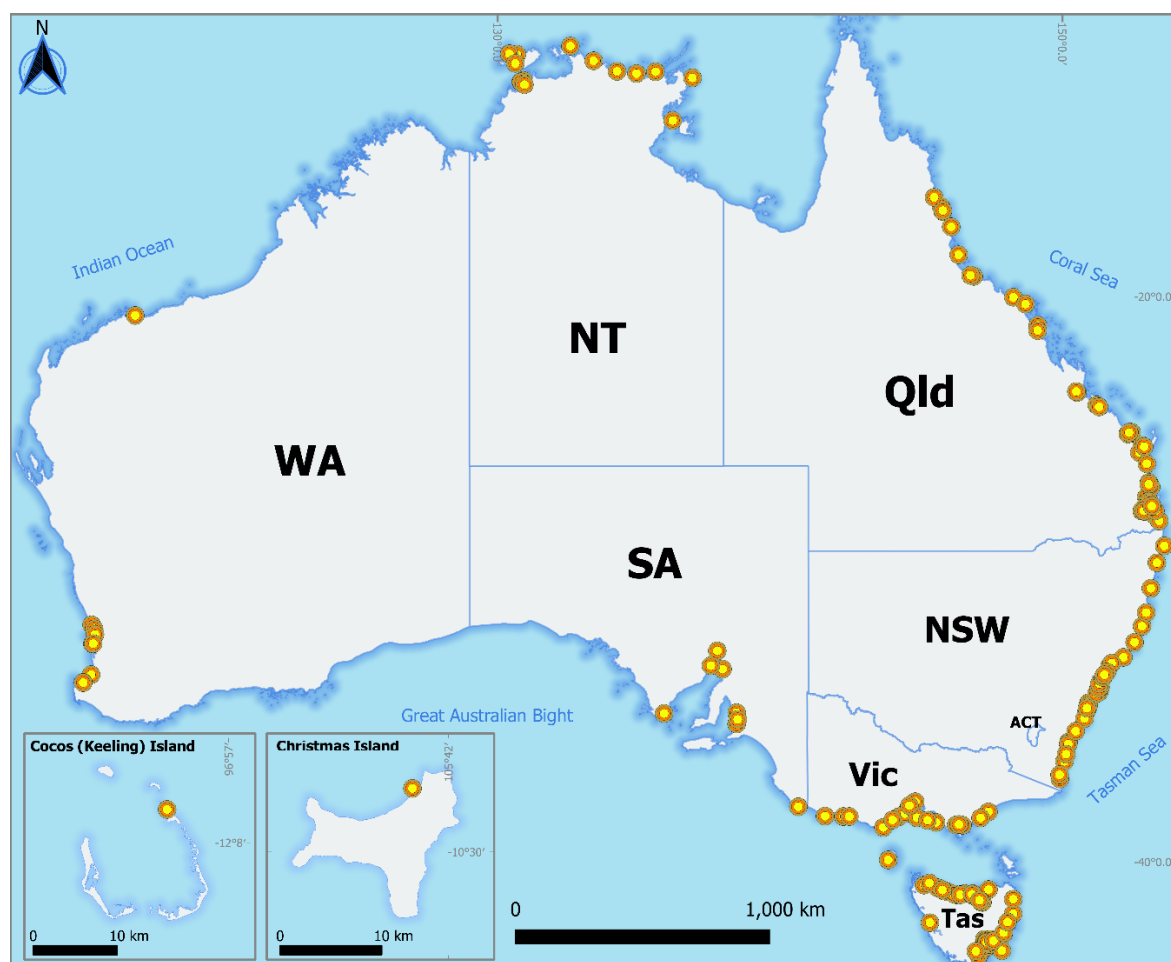


Figure 1. The location of 192 outfall sites managed by 43 water authorities.

Table 1. Number of WWTPs monitored each parameter for 2020/2021 financial year data. In bold, flow volume, total phosphorus and total nitrogen are assessed in this report.

Parameter	Unit	Number of WWTPs
Flow volume	ML	160
pH	pH	138
Total dissolved solids	mg/L	32
Total suspended solids	mg/L	151
Total phosphorus	mg/L	152
Total nitrogen	mg/L	152
Oil and grease	mg/L	84
Surfactants (MBAS)	mg/L	2
<i>E. coli</i>	cfu/100mL	56
Enterococci	cfu/100mL	85
Faecal coliforms	cfu/100mL	73
Turbidity	NTU	13
Colour	Pt.Co. Units	7
Algal blooms	cells/mL	4
Blue green algal bloom	cells/mL	4

Treatment level data were collected from the NOD website (www.outfalls.info) (NOD, 2023b). All analysed sites were then coded into three groups, primary (1), secondary (2) and tertiary (3). The population data of each outfall catchment were also gathered from the Australian Bureau of Statistics (2021).

2.4 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

$$N_t = \sum \frac{(Tf * n) + (Tf * p)}{1000}$$

where, N_t is the total nutrient load in tonnes, calculated for nitrogen (n) and phosphorus (p) concentrations individually, Tf is the total daily flow from each outfall in megalitres (ML). Nitrogen and phosphorus loads were summed to provide the total 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). The last 10 bottom quartile outfalls were further calculated by population to examine the amount of nutrient load per person. All quartiles were then classed by treatment levels, primary, secondary and tertiary. Those sites with only nitrogen or only phosphorus monitored for 2020/2021 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 2020/2021 financial year, wastewater quality data were collected from 42 out of 43 WTAs with 178 out of 192 outfall sites (93%). Across the last eight years, Queensland, South Australia, Tasmania and Western Australia were able to maintain reliability in providing wastewater quality data (Table 2). Despite the complexity having various individual WTAs in Victoria and New South Wales, the NOD has successfully collected wastewater quality data for the 2020/2021 financial year. Due to various circumstances, the Northern Territory experienced difficulties in providing the requested information.

Table 2. Outfalls wastewater quality data collected for 2020/2021 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. This is due to 14 sites were not provided to the NOD and 29 sites have incomplete data. Top (38) and bottom (37) quartiles of the outfall rankings are presented in Table 3. The 2020/2021 financial year data shows that 1,453 giga litres effluent were released transporting a total nutrient load of 15,429 tonnes, almost five percent less than 2019/2020 financial year data (Rohmana et al., 2021). Total nutrient load from individual outfall sites ranged from 7 to 4,669,238 kg with a mean of 103,552 kg. Compared to Rohmana et al. (2021), New South Wales has improved from four to 14 outfall sites in the current top quartile, while Tasmania slightly declined to 12 outfall sites. Western Australia, Victoria and Queensland each had five, four and two outfall sites, respectively. Only one South Australian outfall recorded in the top quartile. The bottom quartile (highest nutrient load) was represented by 11 outfall sites from Queensland. Tasmania and Victoria each had eight and six sites, respectively. New South Wales, South Australia and Western Australia each had four outfall sites in the bottom quartile.

Table 3. Top 25% (green) and bottom 25% (red) quartiles of outfall ranking for 2020/2021 financial year data. REMS = reclaimed water management scheme, BMS = Boneo, Mt Martha and Somers, ETP = Eastern Treatment Plant.

Rank	State	Outfall	Total nutrient load (kg)
1	New South Wales	Iluka	7
2	Tasmania	Beaconsfield	21
3	Western Australia	Wickham	97
4	New South Wales	Bermagui	109
5	New South Wales	Crescent Head	125
6	Tasmania	Swansea	164
7	Western Australia	Home Island (Cocos Keeling)	172
8	Western Australia	Christmas Island	206
9	Tasmania	Sisters Beach	248
10	New South Wales	Penguin Head (REMS)	271
11	New South Wales	Merimbula	273
12	Western Australia	Busselton (North Wetlands)	277
13	South Australia	Christies Beach - Southern	311
14	New South Wales	Long Nose (Tomakin)	328
15	Tasmania	Cambridge	366
16	Tasmania	Boat Harbour	386
17	New South Wales	Camden Haven	418
18	Victoria	Toora	422
19	New South Wales	Yamba	491
20	New South Wales	Narooma	504
21	Victoria	Port Welshpool	531
22	New South Wales	Ulladulla	563
23	New South Wales	Batemans Bay	631
24	New South Wales	Skennars Head (Lennox Head)	706
25	Tasmania	Triabunna	817
26	Tasmania	Rokeby	831
27	Tasmania	St Helens	843

Rank	State	Outfall	Total nutrient load (kg)
28	New South Wales	Forster	870
29	Tasmania	Dover	886
30	Queensland	Karana Downs	1,018
31	Tasmania	Bicheno	1,183
32	Victoria	Lorne	1,378
33	Western Australia	Busselton (South Wetlands)	1,390
34	Queensland	Bowen	1,420
35	New South Wales	Bombo	1,490
36	Victoria	Apollo Bay	1,532
37	Tasmania	Stanley	1,734
38	Tasmania	Geeveston	2,083
113	New South Wales	Potter Point (Cronulla)	44,198
114	Queensland	Merrimac	45,930
115	Tasmania	Rosny	47,331
116	Tasmania	Newnham	48,989
117	South Australia	Glenelg	50,076
118	Queensland	North Rockhampton	56,804
119	Tasmania	Smithton	56,870
120	Queensland	Elanora	57,066
121	Tasmania	Cameron Bay	62,161
122	Queensland	Wynnum	68,005
123	Queensland	Coombah	68,044
124	South Australia	Bolivar High Salinity	70,562
125	South Australia	Christies Beach - Northern	72,320
126	Queensland	Gibson Island	83,354
127	Queensland	Loganholme	85,103
128	Tasmania	Prince of Wales Bay	100,255
129	Victoria	Delray Beach	107,289
130	Victoria	Boags Rock (BSM)	146,310
131	Queensland	Oxley	151,799

Rank	State	Outfall	Total nutrient load (kg)
132	New South Wales	Bondi	156,790
133	Tasmania	Ti-tree Bend	163,687
134	Tasmania	Macquarie Point	166,568
135	Victoria	Black Rock	168,821
136	Tasmania	Pardoe	173,879
137	Western Australia	Subiaco	217,466
138	Western Australia	Point Peron (industrial only)	232,392
139	Victoria	Altona	235,723
140	Victoria	Warrnambool	271,383
141	Western Australia	Beenyup	336,292
142	South Australia	Bolivar WWTP	392,547
143	Queensland	Kawana	396,982
144	Queensland	Luggage Point	403,285
145	Western Australia	Woodman Point	492,031
146	New South Wales	North Head	542,807
147	New South Wales	Malabar	689,587
148	Victoria	Boags Rock (ETP)	3,242,411
149	Victoria	Werribee (WTP)	4,669,238

Rank 140 to 149 were further calculated by the population serviced, estimated from the ABS population data (2021) (Table 4 and Figure 2). The ten highest nutrient loads were represented by five states, Victoria (3), Queensland (2), New South Wales (2), Western Australia (2) and South Australia (1). Within this list, Werribee (Western Treatment Plant) released the highest nutrient load of 4,669,238 kg with 1,946 g nutrient load per capita. However, Warrnambool, with the lowest nutrient discharged (271,383 kg), had the highest total nutrient load per capita of 7,637 g.

Table 4. Total nutrient load per capita discharged by ten highest nutrient load producers from the bottom 25% quartile (2020/2021 FY).

Rank	Outfall	Nitrogen load (kg)	Phosphorus load (kg)	Total nutrient load (kg)	Population (ABS 2021)	Nutrient load/capita (g/C)
140	VIC - Warrnambool	165,107	106,276	271,383	35,533	7,637
141	WA - Beenyup	236,486	99,806	336,292	660,000	510
142	SA - Bolivar WWTP	323,925	68,622	392,547	470,000	835
143	QLD - Kawana	333,526	63,456	396,982	157,169	2,526
144	QLD - Luggage Point	296,781	106,505	403,285	807,000	500
145	WA - Woodman Point	422,798	69,233	492,031	760,000	647
146	NSW - North Head	483,215	59,591	542,807	1,358,440	400
147	NSW - Malabar	616,096	73,491	689,587	1,700,000	406
148	VIC - Boags Rock (ETP)	2,401,876	840,535	3,242,411	1,900,000	1,707
149	VIC - Werribee (WTP)	3,372,907	1,296,331	4,669,238	2,400,000	1,946

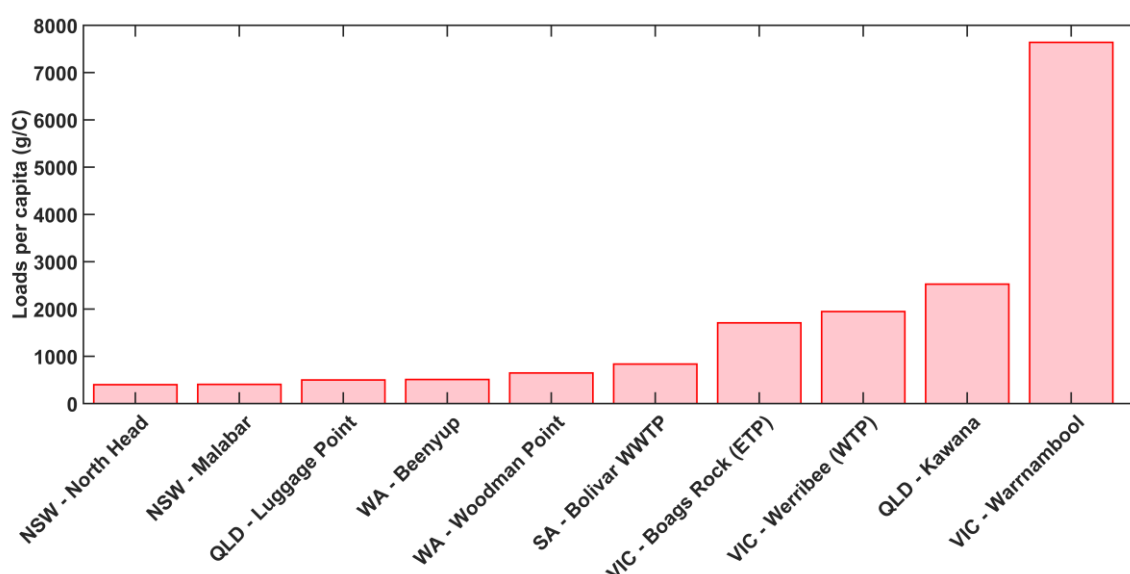


Figure 2. Total nutrient load per capita discharged by ten highest nutrient load producers from the bottom 25% quartile sorted from low (left) to high (right).

The total nutrient loads from each outfall site were grouped by treatment levels (primary, secondary and tertiary) (Table 4; Figure 3). Although primary treatment has the lowest number of outfall sites (6), the discharged load has a median value of 203,136 kg, which is 37 times more than tertiary treatment (5,360 kg) with 61 outfall sites. Secondary treatment is utilised by 82 outfall sites and produces second highest nutrient load (4,039 kg) with the median value of 12,177 kg.

Table 5. A summary and mean of nutrient loads between primary, secondary and tertiary in 2020/2021 financial year data.

Treatment level	Total nutrient load (kg)	Median nutrient load (kg)	Outfall sites
Primary	1,815,564	203,136	6
Secondary	4,038,994	12,177	82
Tertiary	9,574,692	5,360	61

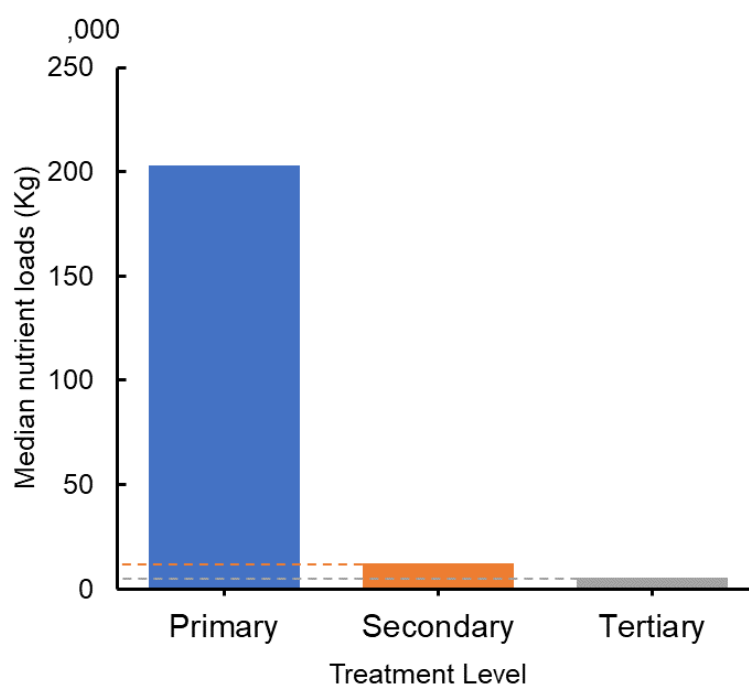


Figure 3. A comparison of average of nutrient loads between primary, secondary and tertiary treatment level in 2020/2021 financial year data.

The boxplot (Figure 4) illustrates the difference between the median contributions of nitrogen and phosphorus in the total nutrient loads across 149 sites. The outliers were removed to show clearer figure. Phosphorus concentrations consistently contribute less to the overall outfall nutrient load and vary less between outfall sites. Meanwhile, nitrogen has a higher median contribution and high variability across all sites. The outfalls contributing higher nitrogen and phosphorus loads vary more than those delivering lower loads.

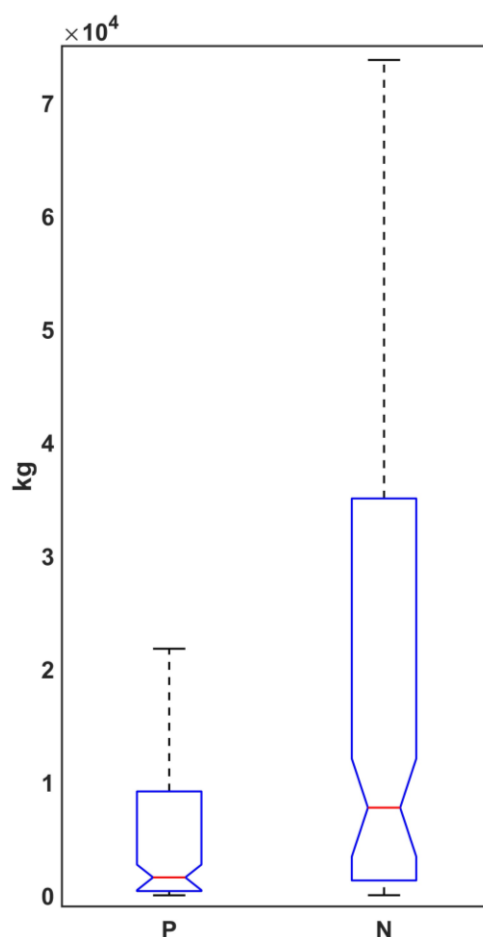


Figure 4. A boxplot of nitrogen (N) and phosphorus (P) loads in kg for each outfall reported data (n = 149).

Figure 5 shows the map of ranked outfalls distribution throughout Australia grouped by quartiles. The top quartile (lowest nutrient load) outfalls are spread dominantly in regional areas which mostly utilise tertiary treatment and discharge less nutrient into the coastal and marine environment. Discharges in the top quartile ranged between 7 to 2,083 kg (Table 3). The 50th and 75th quartiles consist of the outfalls that are mixed of metro and regional areas across six states, which majority operate secondary treatment for their effluent. The bottom quartile with higher nutrient loads appears to occur around the major cities. The total load discharged by this quartile ranged between 44,198 to 4,669,238 kg. Each quartile consisted of 37 outfalls, except the top quartile has 38 sites. The rankings for all outfalls are presented in Appendix A.

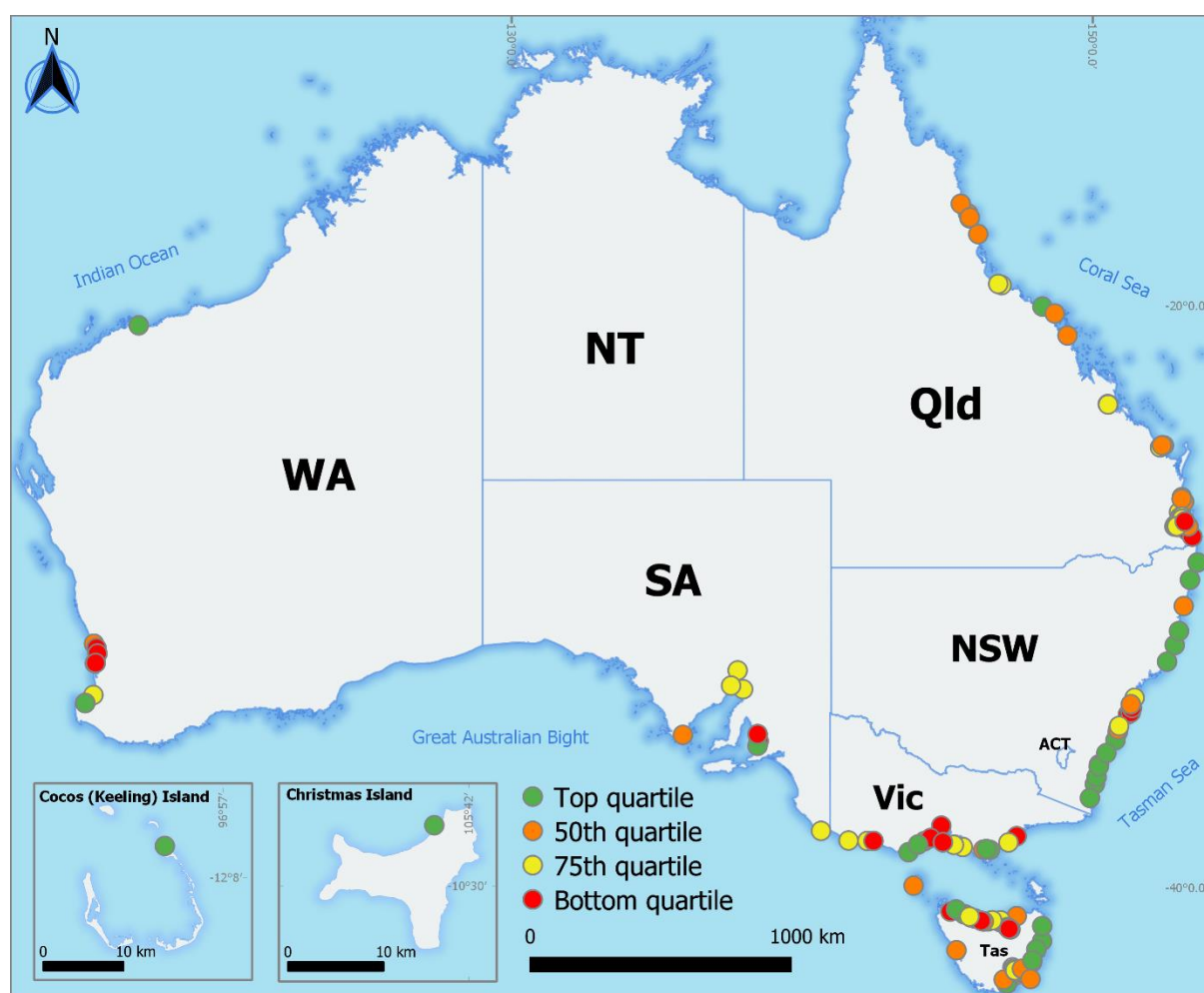


Figure 5. Australian coastal and estuarine/riverine outfalls ranked by quartiles for 2020/2021 financial year data. Cocos (Keeling) and Christmas islands are not in position.

4. Discussion

Nitrogen, phosphorus, and flow volume data were collected from 149 (77%) 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. In addition, higher nutrient loading could be related to high levels of industrial influent to WWTPs within service areas, such as in Pardoe, 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 bottom 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 four years, including current 2020/2021 financial year data, due to high flow volume (Rohmana et al., 2019, Rohmana et al., 2020a, Rohmana et al., 2021).

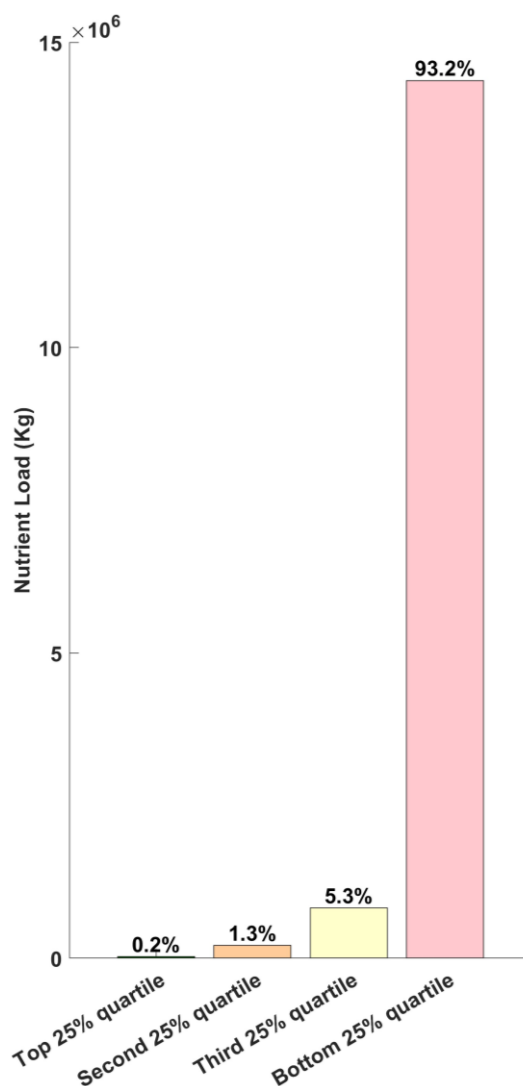


Figure 6. Total nutrient load comparison based on quartile group.

As illustrated here, 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. The top quartile (38 outfalls) contributes only 0.2% nutrient load, compared to 37 outfalls in the bottom quartile. These contribute over 90% of the overall nutrients loads (Figure 6). This may indicate that bottom quartile outfalls should be the primary target for an upgrade feasibility assessment in order to achieve the greatest benefit per cost in upgrade investment (Blackwell and Gemmill, 2019, Blackwell and Gemmill, 2020, Rohmana et al., 2020b). In addition, some sites (e.g., Richmond in Tasmania and Lucinda in Queensland) reported zero discharge (NOD, 2023c, NOD, 2023a). 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.

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Appendix A – Outfall ranking

Table 6. Outfall rankings based on the total nutrients (Kg) for the 2020/2021 financial year data.

Rank	State	Location	Treatment Level	Total nutrient (Kg)
1	New South Wales	Iluka	Tertiary	7
2	Tasmania	Beaconsfield	Secondary	21
3	Western Australia	Wickham	Tertiary	97
4	New South Wales	Bermagui	Tertiary	109
5	New South Wales	Crescent Head	Secondary	125
6	Tasmania	Swansea	Secondary	164
7	Western Australia	Home Island	Secondary	172
8	Western Australia	Christmas Island	Secondary	206
9	Tasmania	Sisters Beach	Tertiary	248
10	New South Wales	REMS	Tertiary	271
11	New South Wales	Merimbula	Tertiary	273
12	Western Australia	North Wetlands	Secondary	277
13	South Australia	Southern outfall	Tertiary	311
14	New South Wales	Tomakin	Tertiary	328
15	Tasmania	Cambridge	Tertiary	366
16	Tasmania	Boat Harbour	Tertiary	386
17	New South Wales	Camden Head	Tertiary	418
18	Victoria	Toora	Secondary	422
19	New South Wales	Yamba	Tertiary	491
20	New South Wales	Narooma	Tertiary	504
21	Victoria	Port Welshpool	Secondary	531
22	New South Wales	Ulladulla	Tertiary	563
23	New South Wales	Batemans Bay	Tertiary	631
24	New South Wales	Skennars Head	Tertiary	706
25	Tasmania	Triabunna	Secondary	817
26	Tasmania	Rokeby	Tertiary	831
27	Tasmania	St Helens	Tertiary	843
28	New South Wales	Forster	Tertiary	870
29	Tasmania	Dover	Secondary	886
30	Queensland	Karana Downs	Secondary	1,018

Rank	State	Location	Treatment Level	Total nutrient (Kg)
31	Tasmania	Bicheno	Secondary	1,183
32	Victoria	Lorne	Tertiary	1,378
33	Western Australia	South Wetlands	Secondary	1,390
34	Queensland	Bowen	Secondary	1,420
35	New South Wales	Bombo	Secondary	1,490
36	Victoria	Apollo Bay	Tertiary	1,532
37	Tasmania	Stanley	Secondary	1,734
38	Tasmania	Geeveston	Secondary	2,083
39	Tasmania	Cygnet	Secondary	2,425
40	Queensland	Port Douglas	Tertiary	2,474
41	Tasmania	Orford	Secondary	2,602
42	Victoria	Anglesea	Tertiary	2,649
43	Tasmania	Sorell	Secondary	2,663
44	Tasmania	Currie	Secondary	3,261
45	Tasmania	Risdon	Secondary	3,692
46	New South Wales	Coffs Harbour	Tertiary	3,697
47	Queensland	Landsborough	Secondary	3,780
48	Tasmania	Strahan	Secondary	3,917
49	Tasmania	Beauty Point	Secondary	4,114
50	Queensland	Fairfield	Secondary	4,171
51	Queensland	Cannonvale	Tertiary	4,181
52	Queensland	Thorneside	Tertiary	4,604
53	Queensland	Capalaba	Tertiary	4,699
54	Queensland	Bargara	Tertiary	4,711
55	Queensland	Edmonton	Tertiary	4,737
56	Victoria	Foster	Secondary	4,935
57	Queensland	Victoria Point	Tertiary	5,076
58	Queensland	Innisfail	Tertiary	5,360
59	Queensland	Nambour	Secondary	5,381
60	Tasmania	Bridport	Secondary	5,716
61	Western Australia	Alkimos	Secondary	5,736
62	New South Wales	Shellharbour	Secondary	6,190
63	Tasmania	Somerset	Secondary	6,361
64	Queensland	Woree	Tertiary	6,682

Rank	State	Location	Treatment Level	Total nutrient (Kg)
65	Queensland	Rubyanna	Tertiary	6,907
66	Tasmania	Turners Beach	Secondary	7,115
67	Western Australia	East Rockingham	Secondary	7,122
68	Queensland	Marlin Coast	Tertiary	7,393
69	New South Wales	Warriewood	Secondary	7,464
70	Tasmania	Port Arthur	Secondary	7,970
71	Tasmania	Legana	Secondary	8,931
72	Queensland	Mackay North	Tertiary	9,754
73	Queensland	Coolum	Secondary	10,047
74	South Australia	Port Lincoln	Secondary	10,375
75	Tasmania	George Town	Secondary	10,439
76	Queensland	Mt St John	Tertiary	10,552
77	Queensland	Millbank	Tertiary	11,098
78	Queensland	Wacol	Secondary	11,738
79	Queensland	Maroochydore	Secondary	12,617
80	South Australia	Whyalla	Secondary	14,344
81	Queensland	Burpengary East	Secondary	14,908
82	Queensland	Beenleigh	Tertiary	15,113
83	Tasmania	Burnie	Tertiary	15,527
84	South Australia	Port Augusta	Secondary	15,759
85	Victoria	Portland	Secondary	16,095
86	Tasmania	Selfs Point	Tertiary	16,280
87	Tasmania	Hoblers Bridge	Secondary	16,862
88	Queensland	Carole Park	Secondary	17,635
89	New South Wales	Kincumber	Secondary	17,811
90	Tasmania	Bridgewater	Secondary	18,374
91	Queensland	Sandgate	Secondary	18,508
92	Queensland	Luggage Point Advanced	Tertiary	19,863
93	Tasmania	Port Sorell	Secondary	19,896
94	Victoria	McGaurans	Primary	20,109
95	Queensland	Goodna	Secondary	21,227
96	Tasmania	Blackmans Bay	Secondary	21,434
97	South Australia	Port Pirie	Secondary	21,813
98	Queensland	Redcliffe	Secondary	22,147

Rank	State	Location	Treatment Level	Total nutrient (Kg)
99	Queensland	Murrumba Downs	Secondary	22,206
100	Queensland	South Rockhampton	Tertiary	24,424
101	Victoria	Cowes	Tertiary	24,643
102	Victoria	Port Fairy	Tertiary	27,400
103	Western Australia	Bunbury	Secondary	27,537
104	Queensland	Bundamba	Secondary	28,126
105	Tasmania	Riverside	Secondary	30,007
106	Queensland	Caboolture South	Secondary	30,899
107	New South Wales	Coniston Beach (Wollongong)	Tertiary	32,799
108	Tasmania	Wynyard	Secondary	33,644
109	South Australia	Finger Point	Secondary	34,117
110	Victoria	Baxters Beach	Secondary	34,425
111	Queensland	Cleveland Bay	Tertiary	40,650
112	Tasmania	Ulverstone	Secondary	41,876
113	New South Wales	Cronulla	Tertiary	44,198
114	Queensland	Merrimac	Tertiary	45,930
115	Tasmania	Rosny	Secondary	47,331
116	Tasmania	Newnham	Secondary	48,989
117	South Australia	Glenelg	Tertiary	50,076
118	Queensland	North Rockhampton	Tertiary	56,804
119	Tasmania	Smithton	Secondary	56,870
120	Queensland	Elanora	Tertiary	57,066
121	Tasmania	Cameron Bay	Secondary	62,161
122	Queensland	Wynnum	Secondary	68,005
123	Queensland	Coombabah	Tertiary	68,044
124	South Australia	Bolivar	Tertiary	70,562
125	South Australia	Northern outfall	Tertiary	72,320
126	Queensland	Gibson Island	Secondary	83,354
127	Queensland	Loganholme	Secondary	85,103
128	Tasmania	Prince of Wales Bay	Secondary	100,255
129	Victoria	Delray Beach	Tertiary	107,289
130	Victoria	BMS	Tertiary	146,310
131	Queensland	Oxley	Secondary	151,799
132	New South Wales	Bondi	Primary	156,790

Rank	State	Location	Treatment Level	Total nutrient (Kg)
133	Tasmania	Ti-tree Bend	Secondary	163,687
134	Tasmania	Macquarie Point	Secondary	166,568
135	Victoria	Black Rock	Tertiary	168,821
136	Tasmania	Pardoe	Primary	173,879
137	Western Australia	Subiaco	Tertiary	217,466
138	Western Australia	Point Peron	Primary	232,392
139	Victoria	Altona	Tertiary	235,723
140	Victoria	Warrnambool	Secondary	271,383
141	Western Australia	Beenyup	Secondary	336,292
142	South Australia	Bolivar WWTP	Secondary	392,547
143	Queensland	Kawana	Secondary	396,982
144	Queensland	Luggage Point	Secondary	403,285
145	Western Australia	Woodman Point	Secondary	492,031
146	New South Wales	North Head	Primary	542,807
147	New South Wales	Malabar	Primary	689,587
148	Victoria	Boags Rock (ETP)	Tertiary	3,242,411
149	Victoria	Werribee (WTP)	Tertiary	4,669,238
Total				15,429,250

Note:

	= Top quartile
	= 50 th quartile
	= 75 th quartile
	= Bottom quartile

Appendix B - Outfalls histogram

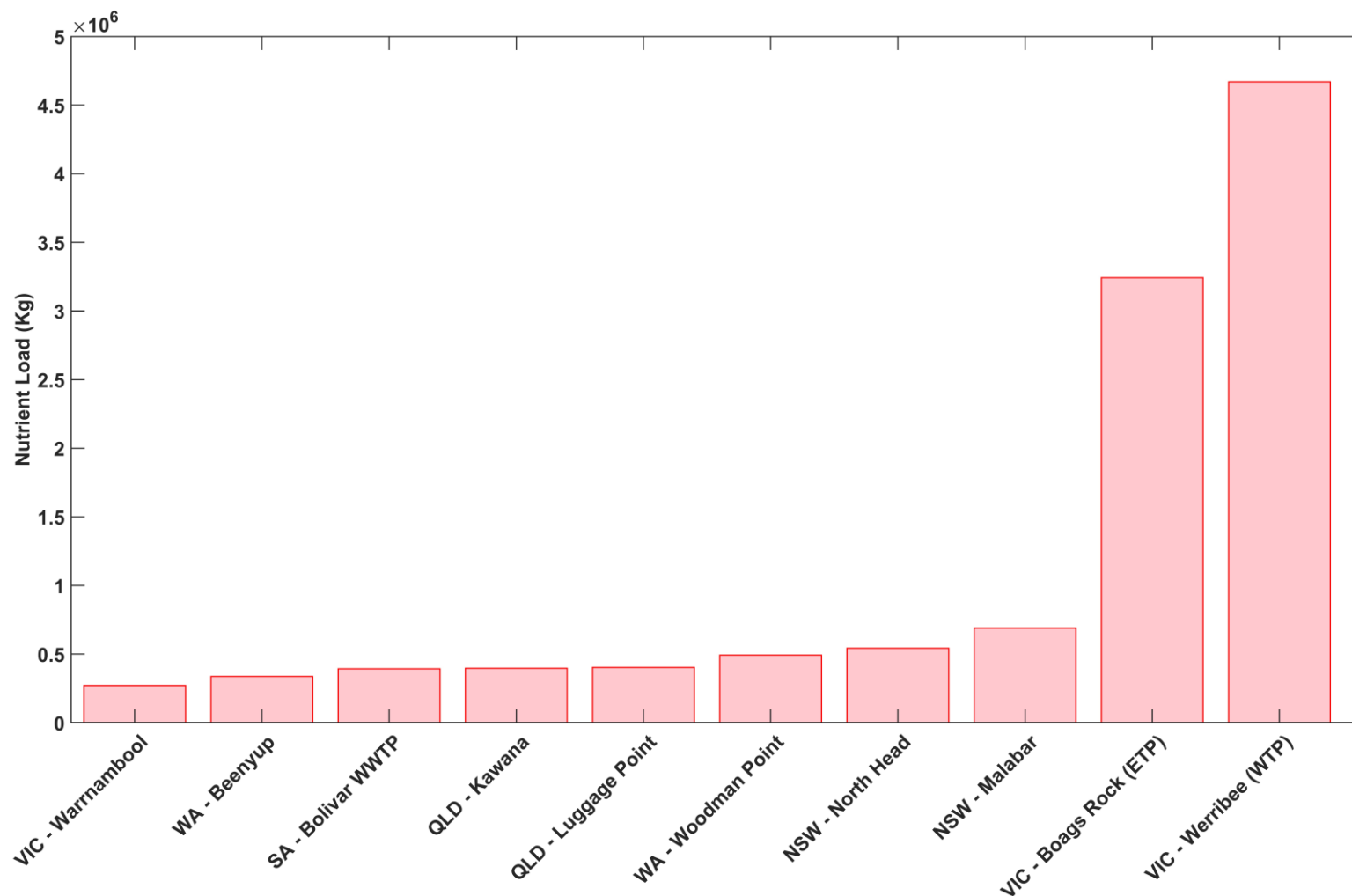


Figure 7. Ten outfalls with highest nutrient load discharged from the bottom 25% quartile.

Appendix C – Distribution list

Clean Ocean Foundation	John Gemmill
University of Tasmania	Andrew Fischer
Federal	
Minister for Environment and Water	The Hon. Tanya Plibersek MP
Assistant Minister for Waste Reduction and Environmental Management	The Hon. Trevor Evans MP
Minister for Agriculture, Fisheries and Forestry and Emergency Management	Senator the Hon. Murray Watt
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 Linda White
Victoria	
Minister for Environment	Ingrid Stitt MLC
Minister for Water	The Hon. Harriet Shing MLC
EPA Victoria	Lee Miezis
EPA Victoria - Victoria's Chief Environmental Scientist	Prof. Mark Patrick Taylor
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	Brett Corven
Central Coast Council	Stephen Shinnars
Queensland	
Minister for the Environment and the Great Barrier Reef	The Hon. Meaghan Scanlon MP
Minister for Water	The Hon. Glenn Butcher MP
Department of Environment and Science (WaTERS)	Dr Vaitea Pambrun

Northern Territory	
Minister for Environment, Climate Change and Water Security	The Hon. Lauren Moss ML
EPA Northern Territory	Dr Paul Vogel AM
Power and Water Corporation	Ms Djuna Pollard
Western Australia	
Minister for Environment	The Hon. Reece Whitby MLA
Minister for Water	The Hon. Simone McGurk MLA
EPA Western Australia - Director General of the DWER	Ms Michelle Andrews
EPA Western Australia	Prof. Matthew Tonts
Water Corporation	Gillian Griffin
South Australia	
Minister for Climate, Environment and Water	The Hon. Susan Close MP
EPA South Australia	Keith Baldry
SA Water – Chief Executive Officer	David Ryan
SA Water	Julia De Cicco
Tasmania	
Minister for Environment and Climate Change	The Hon. Roger Jaensch MP
Minister for Primary Industries and Water	The Hon. Jo Palmer MLC
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



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