National Outfall Database Ranking Report 2018-2019 (Financial Year)

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Important Disclaimer

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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 load to prioritise the potential degree of impact of each source to the environment and human health. Water quality data were collected from 42 Water Treatment Authorities (WTAs) 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 phosphorous loads, was calculated for each outfall. Nitrogen and phosphorous 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 phosphorous.

The results showed that total nutrient load from individual outfalls sites around Australia ranged from 6.4 to 10,037,573 kg with a mean of 319,333 kg. The ranked loads throughout Australia were mapped by quartiles. The top quartile (lowest nutrient load) of outfalls seem to be more prevalent in regional areas and discharge less nitrogen and phosphorus loads into the coastal and marine environment. The bottom quartile, on the other hand, with higher nutrient loads principally occur around the major cities. The phosphorous 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 phosphorous loads vary more than those delivering lower loads. There may be many reasons for this, but it could be related to the capacities of the treatment plants and storm water management in urban areas, resulting in increased in discharge at metropolitan outfall sites. There are some exceptions to this pattern with rural/regional sites contributing higher nutrient loads than urban areas. The reasons for them may vary, however, they may primarily be due to the conditions set out in their licenses. This ranking of nutrient loads from Australian outfalls by site at a national scale can therefore be useful in prioritizing treatment upgrade resources to manage biodiversity impacts and human health concerns.

1. INTRODUCTION

Wastewater disposal into the marine environment is one of the main factors leading to the deterioration of coastal water quality. Poorly managed disposal can lead to increased concentrations of nutrients, organic and inorganic pollutants, as well as alter levels of turbidity, pH and bacteria ((Beck and Birch, 2012, Carey and Migliaccio, 2009, Cheung et al., 2015). An increase in the level of pollutants can have an impact on coastal ecology and biodiversity and affect the health of recreational users (Schwarzenbach et al., 2010, Boehm et al., 2017, Burd et al., 2012, Eugenia et al., 2016).

In order 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 environments. For example, in Victoria the EPA was established under section 5(1) of the Environmental Protection Act of 1970. In New South Wales, the Protection of the Environment Administration Act (1991) (POEA Act) served as the mechanisms 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 licenses. These licenses 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, phosphorous, 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 be in compliance with the conditions set out in their licenses. 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 – Marine Biodiversity Hub, 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 sewerage 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 Environmental Protection Authority (EPA) licenses. Given the

NOD's centralized collection of national scale water quality data the opportunity to examine the comprehensive impacts of sewerage outfalls at regional scales becomes possible.

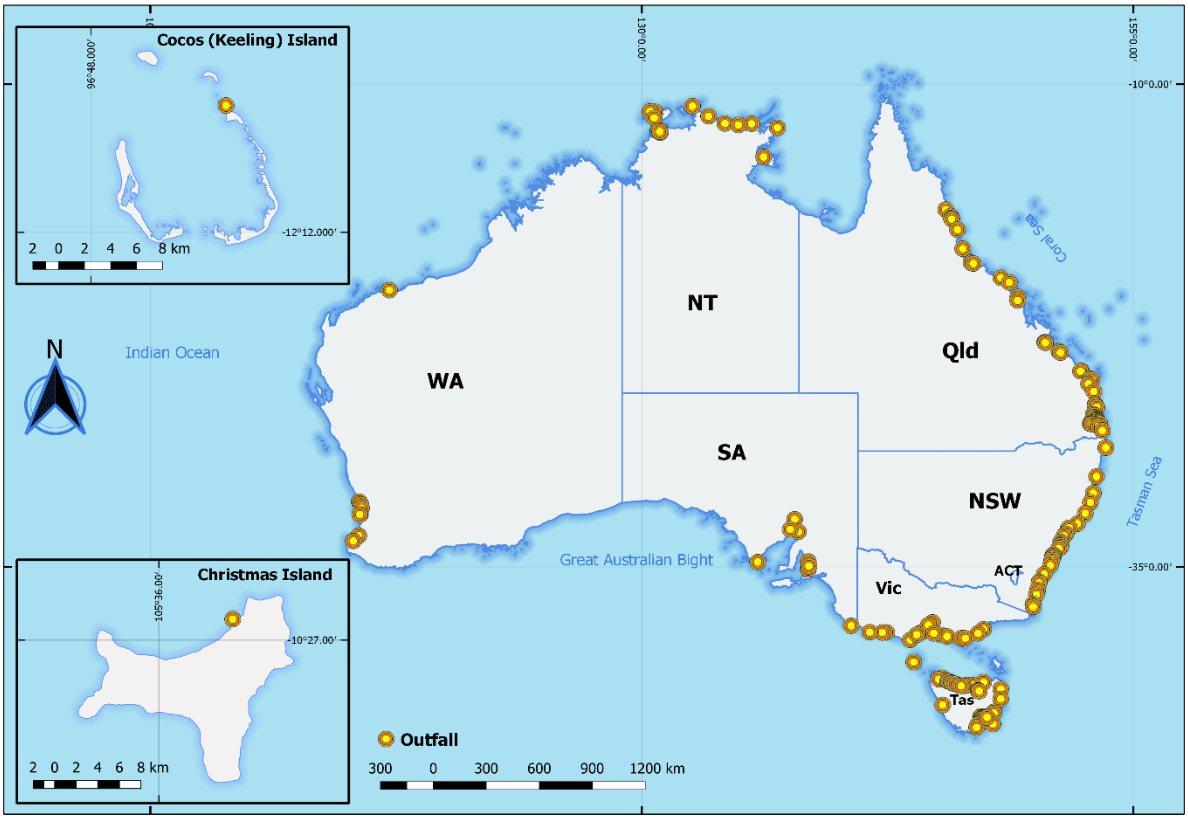
The aim of this report is to present a comprehensive collection of discharge monitoring data between 2018 and 2019 from outfalls across Australian coastal regions. This report also ranks each outfall according to the total flow volume and nutrients load to prioritise the potential degree of impact of each source to the environment and human health. In general, the results of this analysis will be able to provide stakeholders and the general community a better understanding of the relative impacts of outfalls to their coastal waterways and provide policy makers and managers evidence to prioritise outfall infrastructure reform and wastewater recycling initiatives.

2. METHODS

2.1 Data collection

Water quality data were collected from 42 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 standardize 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 42 WTAs up until 2018/2019 financial year. This report analysed 2018/2019 financial year data, which is equal to 12 months in terms of calendar year. WTA monitoring requirements varied depending on EPA license 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), as these three indicators were commonly measured across all WTAs.

Figure 1. The location of 185 wastewater discharge points managed by 42 water treatment authorities around Australia.



2.2 Data Analysis

The pollutant contribution index, based on nitrogen and phosphorous 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 phosphorous concentrations.

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

$$N_l = \sum_{n,p} \frac{Tf * N_a}{1000}. (1)$$

where, N_l is the total nutrient load in tonnes, calculated for nitrogen and phosphorous individually, Tf is the total annual flow from each outfall in megalitres (ML) and N_a is the annual average nutrient concentration in mg/L. Nitrogen and phosphorous loads were summed to provide the total nutrient load. Values were sorted and ranked for each outfall location for 150 outfall locations and grouped into quartiles. Those sites with incomplete data for 2018/2019 financial year were not considered in the final ranking.

3. RESULTS

Top and bottom quartiles of the outfall rankings are presented in Table 1. Total nutrient load from individual outfalls sites ranged from 6.4 to 10,037,573 kg, with a mean of 319,333 kg. Tasmania had 18 outfall sites in the top quartile (lowest nutrient load). South Australia and Victoria each had only one outfall in the top quartile. Queensland, New South Wales and Western Australia each had eight, five and four, respectively. Meanwhile, the Northern Territory has zero outfalls listed in the top quartile. The bottom quartile (highest nutrient load) was represented by eight outfalls each from New South Wales and Queensland. Victoria, Western Australia and Tasmania each had five. As for South Australia and Northern Territory, each had three outfalls in the bottom quartile. There is almost no difference between previous (Rohmana et al., 2019) and current results. The top and bottom quartile were dominated by the same outfalls.

Table 1. Top (green) and bottom (red) quartiles of outfall ranking for 2018/2019 financial year data. (-) means the outfalls were not ranked in the previous report.

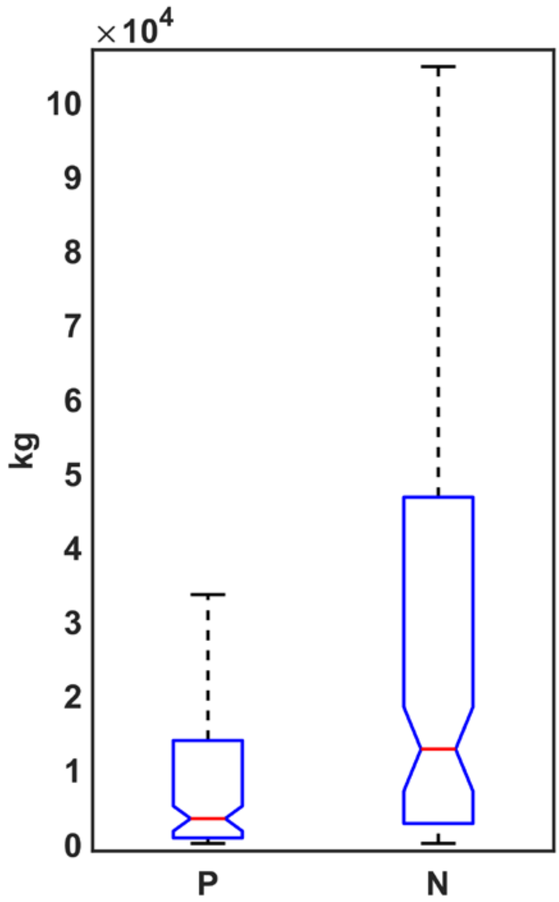
Outfall	Nutrients Load (kg)	State	Rank	Previous Rank
Iluka	6	New South Wales	1	1
Christies Beach - Southern	32	South Australia	2	2
Crescent Head	52	New South Wales	3	12
Bicheno	205	Tasmania	4	8
Busselton (North)	251	Western Australia	5	7
Toora	298	New South Wales	6	-
Cocos (Keeling) Island	355	Western Australia	7	3
Port Welshpool	384	Victoria	8	4
Boat Harbour	399	Tasmania	9	6
Christmas Island	408	Western Australia	10	13
St Helens	447	Tasmania	11	9
Sisters Beach	612	Tasmania	12	5
Midway Point	694	Tasmania	13	-
Cambridge/Airport	849	Tasmania	14	15
Bundaberg North	1085	Queensland	15	-
Dover	1325	Tasmania	16	11
Port Arthur	1410	Tasmania	17	18
Stanley	1471	Tasmania	18	20
Electrona	1659	Tasmania	19	25
Karana Downs	1659	Queensland	20	21
Bermagui	1800	New South Wales	21	14
Orford	1852	Tasmania	22	16
Geeveston	1915	Tasmania	23	-
Busselton (South)	2205	Western Australia	24	10
Port Douglas	2456	Queensland	25	27
Risdon	2539	Tasmania	26	24

Outfall	Nutrients Load (kg)	State	Rank	Previous Rank
Penguin Heads (REMS)	2851	New South Wales	27	-
Currie	2954	Tasmania	28	28
Bargara	3019	Queensland	29	-
Strahan	3112	Tasmania	30	29
Sorell	3285	Tasmania	31	-
Bowen	3516	Queensland	32	36
Landsborough	3607	Queensland	33	32
Cygnet	3675	Tasmania	34	26
Victoria Point	4190	Tasmania	35	33
Nambour	4209	Queensland	36	44
Rubyanna	4263	Queensland	37	-
Loganholme	69863	Queensland	111	108
Bunbury	70126	Western Australia	112	104
Blackmans Bay	73766	Tasmania	113	111
Gibson Island	74685	Queensland	114	107
Coombabah	89843	Queensland	115	110
Northern outfall	92311	South Australia	116	102
Kawana	93407	Queensland	117	-
Smithton	101897	Tasmania	118	109
Prince of Wales Bay	118477	Tasmania	119	114
Boneo	123234	Victoria	120	112
Ti-tree Bend	127109	Queensland	121	113
Palmerston	140213	Northern Territory	122	118
Ludmilla	141415	Northern Territory	123	122
Shellharbour	155904	New South Wales	124	117
Leanyer Sanderson	160687	Northern Territory	125	120
Macquarie Point	160807	Tasmania	126	116
Oxley	175909	Queensland	127	115
Pardoe	202115	Tasmania	128	123
Glenelg	260662	South Australia	129	125
Kincumber	281819	New South Wales	130	121
Warriewood	306144	New South Wales	131	126
St Vincent Gulf	334688	South Australia	132	129
Subiaco	410247	Western Australia	133	127
Warrnambool	422635	Victoria	134	124
Point Peron	506945	Western Australia	135	130
Luggage Point	533848	Queensland	136	132
Potter Point	586205	New South Wales	137	131
Beenyup	697025	Western Australia	138	134
Coniston Beach	967939	New South Wales	139	133
South Trees Inlet	1430333	Queensland	140	-

Outfall	Nutrients Load (kg)	State	Rank	Previous Rank
Woodman Point	1727410	Western Australia	141	135
Boags Rock (ETP)	2815886	Victoria	142	136
Bondi	3151192	New South Wales	143	137
Werribee (WTP)	4738642	Victoria	144	138
Black Rock	5545540	Victoria	145	119
North Head	8471248	New South Wales	146	139
Malabar	10037573	New South Wales	147	140

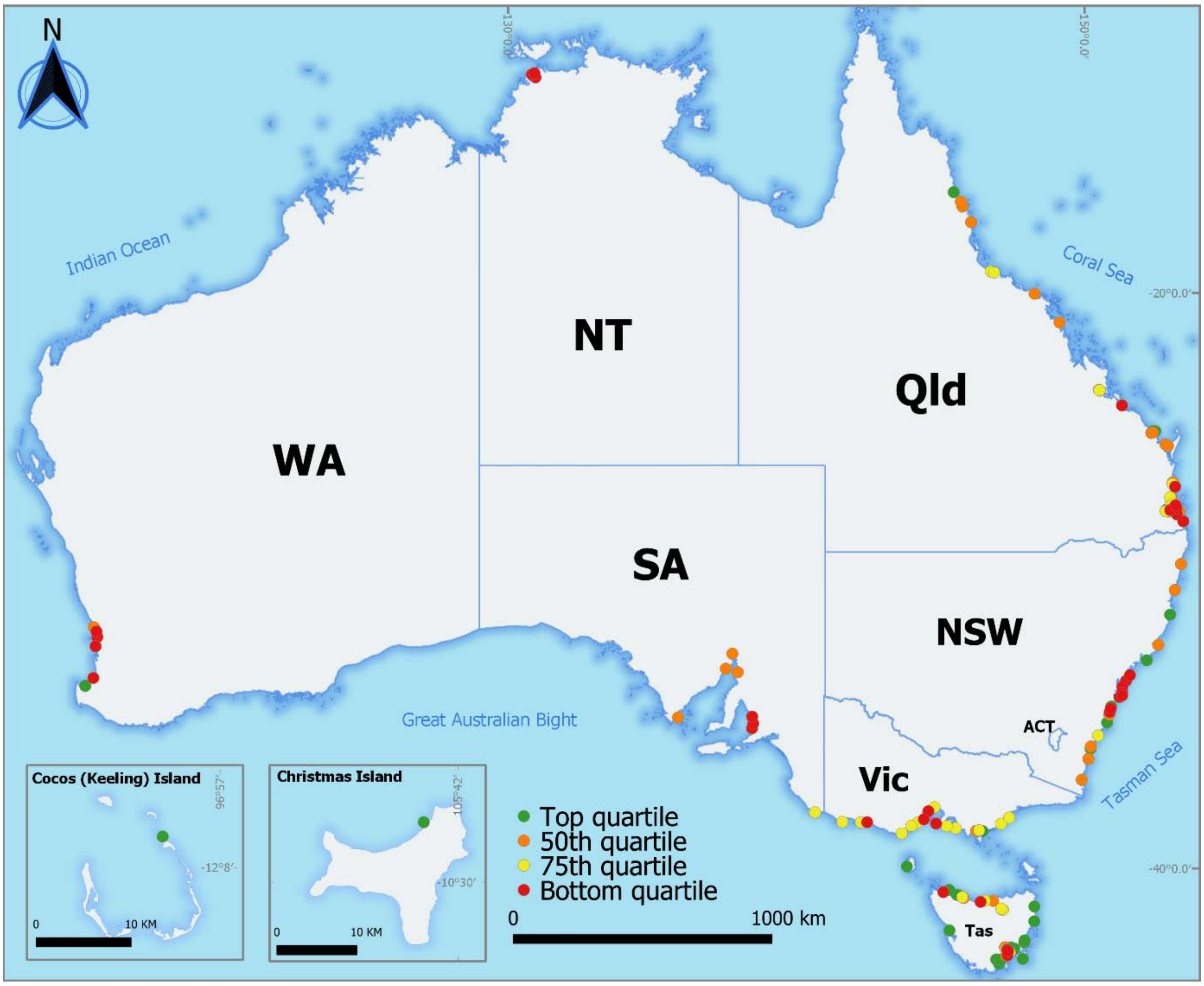
The boxplot (Figure 2), with outliers removed, shows the difference between the median contributions of nitrogen and phosphorous in the total nutrient load. Phosphorous concentrations contribute less to the overall outfall nutrient load and vary less between outfall sites. Nitrogen, on the other hand has a higher median contribution and high variability across the sites. The outfalls contributing higher nitrogen and phosphorous loads vary more than those delivering lower loads.

Figure 2. A boxplot of nitrogen (N) and phosphorous (P) loads (kg) for each outfall's reported data (n=150).



The map in Figure 3 shows the distribution ranked outfalls throughout Australia grouped by quartiles. The top quartile (lowest nutrient load) of outfalls seem to be more prevalent in regional areas and discharge less nitrogen and phosphorus loads into the coastal and marine environment. Discharges in the top quartile ranged between 6 to 4,263 kg (Table 1). The bottom quartile, on the other hand, with higher nutrient loads appear to occur around the major cities. The total load discharged by this quartile ranged between 69,863 to 10,037,573 kg. Each quartile consisted of 37 outfalls. The rankings for all the outfalls appear in Appendix A.

Figure 3. Australian coastal and river/estuary outfalls ranked by quartiles for 2018/2019 financial year data.



4. DISCUSSION

Nutrient concentrations and discharge flow data was collected from 185 outfalls around Australia. These outfalls were ranked according to their combined nutrient load (nitrogen and phosphorous). General patterns show that the highest nutrient loads tend to occur through those outfalls serving metropolitan and surrounding areas. Outfalls with lower nutrient loads seem to occur in regional areas, however, the loads varied across individual outfalls. The nitrogen and phosphorous loads seemed to vary more across sites with higher nutrient loads. This may simply be related to the high population levels in urban areas and the resulting increase in general discharge at metropolitan and outfall sites. There are some exceptions to this pattern, with rural/regional sites contributing higher nutrient loads than urban areas. These include places such as Smithton in Tasmania, Rockhampton in Queensland and Warrnambool, Victoria. The reasons for them may vary, however, and they may primarily be due to the condition set out in the licenses. License conditions are determined by a variety of factors, including the conditions of the waterway being discharged to, and the communities uses of the waterway (EPA NSW, 2013, EPA VIC, 2017). For example, Warrnambool has a nitrogen concentrations limit of 30 mg/L, compared to the combined Boag's Rock and Boneo (Table 1) outfalls that have a combined concentration limit of 25 mg/L. In addition to existing conditions and the uses of waterways, available resources for treatment plant upgrades and community pressure may also contribute to WWTP load. Both Boag's Rock and Boneo outfalls, which are run by the Eastern Treatment Plant have come under significant community pressure in the past and upgraded to tertiary treatment in 2012 (Melbourne Water, 2017). Therefore, Warrnambool, which is a secondary treatment plant ranks in the bottom quartile with the outfalls that service the Melbourne metropolitan area.

Several sites that ranked toward the bottom of the highest quartile were sites that do not have nitrogen and phosphorous concentration limits as conditions in their licenses (Appendix B - Figure 4). This essentially means that they will not be in breach of their license regardless of the amount of nitrogen and phosphorous discharged. These include Malabar, Bondi and North Head, three treatment pants that service the Sydney Metropolitan area and discharge effluent after the primary treatment (Sydney Water, 2015). The Werribee treatment plant in Victoria also has no nitrogen concentration limit restrictions in its license. 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 phosphorous.

As illustrated here, this ranking and the identification of nutrient loads by site can therefore be useful in prioritizing treatment upgrade resources. In addition, these discrepancies in treatment level and license conditions warrant further examination of water quality guidelines at a national scale, as well as wastewater reuse policies. The top quartile (lowest nutrient load) of wastewater treatment plants contribute only 0.1% of the overall nutrient load to the coastal and marine environment, while the bottom quartile contributes about 97%. Perhaps treatment plants in the bottom quartile should be the target of an upgrade feasibility assessment in order to achieve the greatest benefit per cost in upgrade investment. In addition, some sites (e.g. Richmond and Rokeby in Tasmania) reported zero discharge. 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.

REFERENCES

BECK, H. J. & BIRCH, G. F. 2012. Spatial and Temporal Variance of Metal and Suspended Solids Relationships in Urban Stormwater-Implications for Monitoring. *Water, Air, & Soil Pollution,* 223**,** 1005-1015.

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.

BURD, B., BERTOLD, S. & MACDONALD, T. 2012. Responses of infaunal composition, biomass and production to discharges from a marine outfall over the past decade. *Marine Pollution Bulletin,* 64**,** 1837-1852.

CAREY, R. O. & MIGLIACCIO, K. W. 2009. Contribution of Wastewater Treatment Plant Effluents to Nutrient Dynamics in Aquatic Systems: A Review. *Environmental Management,* 44**,** 2015-2017.

CHEUNG, P. K., YUEN, K. L., LI, P. F., LAU, W. H., CHIU, C. M., YUEN, S. W. & BAKER, D. M. 2015. To swim or not to swim? A disagreement between microbial indicators on beach water quality assessment in Hong Kong. *Marine Pollution Bulletin,* 101**,** 53-60.

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

EPA NSW 2013. Using environment protection licensing to control water pollution. Sydney NSW: Environment Protection Authority.

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.

EUGENIA, B., SANTIAGOLUCERITO, RODOLFO, B. & ALBERTO, V. 2016. Assessing sewage impact in a South-West Atlantic rocky shore intertidal algal community. *Marine Pollution Bulletin,* 106**,** 388-394.

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 2017. Environmental Improvement Plan for the Eastern and Western Treatment Plants. Melbourne: Melbourne Water.

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

SCHWARZENBACH, R. P., EGLI, T., HOFSTETTER, T. B., GUNTEN, U. V. & WEHRLI, B. 2010. Global Water Pollution and Human Health. *Annual Review of Environment and Resources,* 35**,** 109-136.

SYDNEY WATER. 2015. *Wastewater treatment plants* [Online]. Sydney, NSW: Sydney Water. Available: http://www.sydneywater.com.au/SW/water-the-environment/how-we-manage-sydney-s-water/wastewater-network/wastewater-treatment-plants/index.htm [Accessed 27 September 2016].

APPENDIX A – OUTFALL RANKINGS

Table 2. Australian coastal outfalls ranking by quartiles.

Rank	Outfall	State	Total nutrients load (kg)
1	Iluka	New South Wales	6
2	Christies Beach - Southern	South Australia	32
3	Crescent Head	New South Wales	52
4	Bicheno	Tasmania	205
5	Busselton (North)	Western Australia	251
6	Toora	Victoria	298
7	Cocos (Keeling) Island	Western Australia	355
8	Port Welshpool	Victoria	384
9	Boat Harbour	Tasmania	399
10	Christmas Island	Western Australia	408
11	St Helens	Tasmania	447
12	Sisters Beach	Tasmania	612
13	Thorneside	Queensland	663
14	Midway Point	Tasmania	694
15	Cannonvale	Queensland	752
16	Cambridge	Tasmania	849
17	Bundaberg North	Queensland	1085
18	Dover	Tasmania	1325
19	Eden	New South Wales	1405
20	Port Arthur	Tasmania	1410
21	Stanley	Tasmania	1471
22	Electrona	Tasmania	1659
23	Karana Downs	Queensland	1659
24	Bermagui	New South Wales	1800
25	Orford	Tasmania	1852
26	Geeveston	Tasmania	1915
27	Busselton (South)	Western Australia	2205
28	Port Douglas	Queensland	2456
29	Risdon	Tasmania	2539
30	Penguin Heads	New South Wales	2851
31	Currie	Tasmania	2954
32	Bargara	Queensland	3019
33	Strahan	Tasmania	3112
34	Sorell	Tasmania	3285
35	Bowen	Queensland	3516
36	Landsborough	Queensland	3607

Rank	Outfall	State	Total nutrients load (kg)
37	Cygnet	Tasmania	3675
38	Victoria Point	Queensland	4190
39	Nambour	Queensland	4209
40	Rubyanna	Queensland	4263
41	Capalaba	Queensland	4289
42	Foster	Victoria	4525
43	Yamba	New South Wales	4634
44	Fairfield	Queensland	4875
45	Merimbula	New South Wales	4922
46	Edmonton	Queensland	5174
47	Bridport	Tasmania	5467
48	Millbank	Queensland	5699
49	Somerset	Tasmania	5712
50	Tomakin	New South Wales	5717
51	Innisfail	Queensland	6242
52	West Rockhampton	Queensland	6633
53	Berrimah	Northern Territory	6684
54	Marlin Coast	Queensland	7306
55	Margate	Tasmania	7729
56	Bridgewater	Tasmania	8322
57	Mackay North	Queensland	8648
58	Alkimos	Western Australia	8748
59	Port Lincoln	South Australia	8823
60	East Rockingham	Western Australia	9096
61	Narooma	New South Wales	9198
62	Whyalla	South Australia	9477
63	Coolum	Queensland	9696
64	Wynnum	Queensland	10233
65	Forster	New South Wales	11026
66	Bombo	New South Wales	11341
67	Wacol	Queensland	11391
68	Batemans Bay	New South Wales	11689
69	Port Pirie	South Australia	11815
70	Port Augusta East	South Australia	13267
71	Carole Park	Queensland	13286
72	Redcliffe	Queensland	13356
73	Coffs Harbour	New South Wales	14065
74	Ulladulla	New South Wales	14634
75	George Town	Tasmania	15214
76	Burpengary East	Queensland	15448
77	Murrumba Downs	Queensland	15754

Rank	Outfall	State	Total nutrients load (kg)
78	McGaurans	Victoria	16526
79	Goodna	Queensland	16579
80	Caboolture South	Queensland	16920
81	Sandgate	Queensland	16960
82	Port Sorell	Tasmania	17698
83	Mt St John	Queensland	18242
84	Wynyard	Tasmania	18393
85	Selfs Point	Tasmania	18546
86	Turners Beach	Tasmania	19030
87	Beenleigh	Queensland	20189
88	Bundamba	Queensland	20490
89	South Rockhampton	Queensland	21495
90	Portland	Victoria	21631
91	Rosny	Tasmania	21727
92	Hoblers Bridge	Tasmania	21946
93	Woree	Queensland	22030
94	Round Hill	Tasmania	22705
95	Ulverstone	Tasmania	24234
96	Baxter's Beach	Victoria	24396
97	Riverside	Tasmania	27552
98	Finger Point	South Australia	30129
99	Merrimac	Queensland	33270
100	Phillip Island	Victoria	34001
101	Anglesea	Victoria	35333
102	Delray Beach	Victoria	36341
103	Maroochydore	Queensland	37040
104	Altona	Victoria	37984
105	Elanora	Queensland	45699
106	Cameron Bay	Tasmania	48379
107	Newnham	Tasmania	49024
108	Cleveland Bay	Queensland	49274
109	Apollo Bay	Victoria	51129
110	Lorne	Victoria	57664
111	Port Fairy Domestic	Victoria	57962
112	North Rockhampton	Queensland	62561
113	Bolivar High Salinity	South Australia	66043
114	Loganholme	Queensland	69863
115	Bunbury	Western Australia	70126
116	Blackmans Bay	Tasmania	73766
117	Gibson Island	Queensland	74685
118	Coombabah	Queensland	89843

Rank	Outfall	State	Total nutrients load (kg)
119	Christies Beach - Northern	South Australia	92311
120	Kawana	Queensland	93407
121	Smithton	Tasmania	101897
122	Prince of Wales Bay	Tasmania	118477
123	Boags Rock (Boneo)	Victoria	123234
124	Ti-tree Bend	Tasmania	127109
125	Palmerston	Northern Territory	140213
126	Ludmilla	Northern Territory	141415
127	Shellharbour	New South Wales	155904
128	Leanyer Sanderson	Northern Territory	160687
129	Macquarie Point	Tasmania	160807
130	Oxley	Queensland	175909
131	Pardoe	Tasmania	202115
132	Glenelg	South Australia	260662
133	Kincumber	New South Wales	281819
134	Warriewood	New South Wales	306144
135	Bolivar WWTP	South Australia	334688
136	Subiaco	Western Australia	410247
137	Warrnambool WRP	Victoria	422635
138	Point Peron	Western Australia	506945
139	Luggage Point	Queensland	533848
140	Potter Point	New South Wales	586205
141	Beenyup	Western Australia	697025
142	Coniston Beach	New South Wales	967939
143	South Trees Inlet	Queensland	1430333
144	Woodman Point	Western Australia	1727410
145	Boags Rock (ETP)	Victoria	2815886
146	Bondi	New South Wales	3151192
147	Werribee (WTP)	Victoria	4738642
148	Black Rock	Victoria	5545540
149	North Head	New South Wales	8471248
150	Malabar	New South Wales	10037573

Note:

= Top quartile

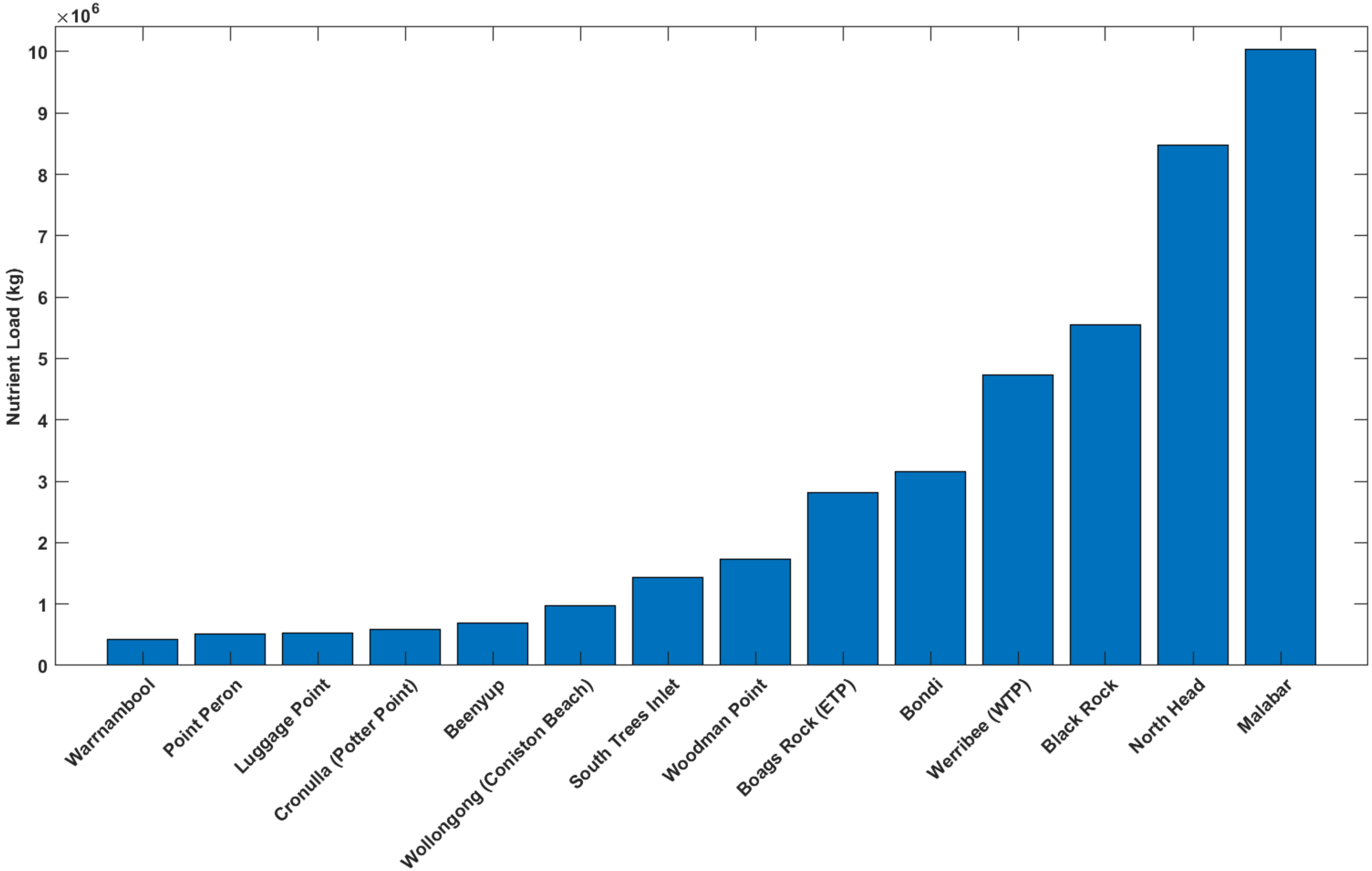
= 50th quartile

= 75th quartile

= Bottom quartile

APPENDIX B – OUTFALLS HISTOGRAM

Figure 4. A histogram of total nutrient load (kg) for the most emitters outfall (14 sites) from the bottom quartile.



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