



EcOz Environmental Consultants

T: (08) 8981 1100
E: ecoz@ecoz.com.au
W: www.ecoz.com.au

Darwin, Northern Territory
Level 1, 70 Cavenagh St,
GPO Box 381, Darwin, NT 0801

19 January 2021

Our ref.: EZ20086

Nadine Nilon
Director Infrastructure and Operations
Litchfield Council
Nadine.nilon@litchfield.nt.gov.au

Re: Field report: Waste Transfer Stations initial water quality sampling – December 2020

Dear Nadine,

This letter summarises the results and assessment of the first water quality sampling undertaken at the three Waste Transfer Stations (WTS) in the Litchfield Council (LC): Howard Springs (HS WTS), Humpty Doo (HD WTS) and Berry Springs (BS WTS). The collection of the water quality is part of the monitoring required for the Environment Protection Licences (EPLs) EPL278 and EPL279 (Howard Springs WTS and the Humpty Doo WTS), issued by the Northern Territory Environment Protection Authority (NT EPA) under the *NT Waste Management and Pollution Control Act* (WMPC Act).

Sampling:

The samples were collected at the points where runoff leaves the premises of the WTS during rainfall. Sampling dates were 14 December 2020 at Humpty Doo, 16 December 2020 at Howard Springs and 22 December 2020 at Berry Springs. The rainfall in the early wet season is often localised, but at the same time can be very intense for short periods. The sampling points were only flowing during rainfall and for a short while after, thus, all sites were sampled on different dates.

Results:

Field and laboratory results are presented in Appendix A. Key findings include:

- The physical parameter measurements were taken in the field as well as in the laboratory to comply with EPL requirements. Turbidity was well above the Darwin Harbour Water Quality Objectives (DHWQO) at all three sites. Additionally, reduced dissolved oxygen (DO) was recorded at HD WTS and increased electrical conductivity (EC) at BS WTS. The laboratory measured total suspended solids (TSS) were also well above the DHWQO at all sites. All of these indicate the conditions usually encountered with the first rains after the dry period. The low pH recorded in the field at HS WTS is not regularly encountered with the first rains, and could be a characteristic of the HS WTS.
- It was noted that flow at the sampling points was only present during or shortly after rainfall, as the transfer stations are managed to not be wet areas. Thus, flow off the premise (at the sampling point) occurs periodically only and it is possible that similar high values in turbidity, conductivity, TSS and low DO - related to the first flush - might be measured throughout the wet season as well.
- The concentration of *E. coli* in the WTS run off was overall very high especially at HD WTS and BS WTS, well exceeding the DHWQO. Possible sources of *E. coli* include food waste and faeces of animals frequenting the sites. These high concentrations are likely associated with the first rains washing off what has collected throughout the dry season.

- The nutrient concentrations for parameters that have guideline values exceeding those guidelines mostly by an order of magnitude or more. Possible sources are green waste, food waste and faeces of animals.
- Several of the dissolved metal concentrations exceed the Australian and New Zealand Guidelines for Fresh and Marine Water Quality ANZG (2018) guideline values for 95% species protection (freshwater), namely aluminium and copper at all three WTS, zinc at HS WTS and BS WTS and chromium at BS WTS. With regards to the total metal concentrations, the following additional exceedances were recorded: chromium and zinc at all three sites, lead at HD WTS and HS WTS as well as cadmium at HS WTS.
- The hydrocarbons investigated at the WTSs include the group of Total Petroleum Hydrocarbons TPH, Total Recoverable Hydrocarbons TRH and benzene, toluene, ethylbenzene, xylene and naphthalene, collectively called BTEXN. All analytes were below the respective detection limits.
- Most analytes of the per- and polyfluoralkyl substances (PFAS) group were below their limits of detection. PFOS was detected at all three WTSs at concentrations between 0.002 µg/L to 0.006 µg/L and PFOA was recorded at 0.002 µg/L at HD WTS only. There are no guideline values for PFAS in the DHWQO or the ANZG, thus the *PFAS National Environmental Management Plan Version 2.0 (2020)* was consulted with the guideline values added in Table 10 - Table 13. The measured concentrations are all well below those guideline values.

Should you have any queries regarding the sampling, or the content of this report, please do not hesitate to contact me.

Yours sincerely,



Gisela Lamche
Senior Consultant Consultant
EcOz Environmental Consultants
Gisela.lamche@ecoz.com.au

Appendix A – Water quality data from December 2020

In the following all field and laboratory results are tabled. Values that exceed any of the relevant guideline values are highlighted in blue text for all tables.

Table 1. Physical parameters measured in the field

Parameter		pH	Temp	ORP	EC	Salinity	DO	Turbidity	TDS
Unit		-	°C	mV	µS/cm	ppt	%	NTU	mg/L
Darwin Harbour WQO – upper estuary		6-8.5	-	-	-	-	80-100	-	-
Darwin Harbour WQO – freshwater rivers & streams		6-7.5	-	-	200	-	50-100	20	-
ANZG (2018) freshwater – 95% species protection		-	-	-	-	-	-	-	-
Monitoring Site	Date								
Humpty Doo WTS	14/12/2020	6.71	27.2	75	121	0.06	63	393	79
Howard Springs WTS	16/12/2020	5.39	27.3	160	47.4	0.02	93.5	>1000	31
Berry Springs WTS	22/12/2020	7.47	26.1	215	275.9	0.1	85.1	160	179.3

WQO: Water quality objectives

ORP: Oxidation reduction potential

EC: Electrical Conductivity

DO: dissolved Oxygen

TDS: Total Dissolved Solids

Table 2. Physical parameters measured in the laboratory

Parameter		pH	Temp	EC	DO	Turbidity	TDS	TSS
Unit		-	°C	µS/cm	%	NTU	mg/L	mg/L
Darwin Harbour WQO – upper estuary		6-8.5	-	-	80-100	-	-	10
Darwin Harbour WQO – freshwater rivers & streams		6-7.5	-	200	50-100	20	-	5
ANZG (2018) freshwater – 95% species protection		-	-	-	-	-	-	-
Monitoring Site	Date							
Humpty Doo WTS	14/12/2020	6.73	-	110	6.4	311	114	95
Howard Springs WTS	16/12/2020	6.04	-	39	7.5	616	59	470
Berry Springs WTS	22/12/2020	6.98	-	218	8.7	112	209	32

ORP: Oxidation reduction potential

EC: Electrical conductivity

DO: dissolved oxygen

TDS: Total dissolved solids

TSS: Total suspended solids

Table 3. Concentrations of *E. coli*

Parameter		<i>Escherichia coli</i>
Unit		Per 100 mL
Darwin Harbour WQO – upper estuary		200
Darwin Harbour WQO – freshwater rivers & streams		200
ANZG (2018) freshwater – 95% species protection		-
Monitoring Site	Date	
Humpty Doo WTS	14/12/2020	1,900,000
Howard Springs WTS	16/12/2020	>500
Berry Springs WTS	22/12/2020	500,000

Table 4. Nutrient concentrations

Parameter		Ammonia	Nitrite	Nitrate	Nitrite + Nitrate (as Nox)	Total Kjeldahl Nitrogen	Total Nitrogen	Total Phosphorus	Total organic carbon (TOC)
Unit		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Darwin Harbour WQO – upper estuary		0.02	-	-	0.02	-	0.3	0.03	-
Darwin Harbour WQO – freshwater rivers & streams		0.02	-	-	0.008	-	0.23	0.01	-
ANZG (2018) freshwater – 95% species protection		0.9	-	-	-	-	-	-	-
Monitoring Site	Date								
Humpty Doo WTS	14/12/2020	0.56	0.04	1.74	1.78	2.2	4	0.31	9
Howard Springs WTS	16/12/2020	0.12	0.06	1.12	1.18	9.6	10.8	0.92	17
Berry Springs WTS	22/12/2020	0.11	0.02	0.25	0.27	2.6	2.9	0.1	25

Table 5. Dissolved metals

Parameter		Al	As	Cd	Cr	Cu	Pb	Ni	Se	Zn	Fe	Hg
Unit		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Darwin Harbour WQO – upper estuary		-	-	-	-	-	-	-	-	-	-	-
Darwin Harbour WQO – freshwater rivers & streams		-	-	-	-	-	-	-	-	-	-	-
ANZG (2018) freshwater – 95% species protection		0.055	0.013	0.0002	0.001	0.0014	0.0034	0.011	0.011	0.008	-	0.0006
Monitoring site	Date											
Humpty Doo WTS	14-Dec-20	0.18	0.001	<0.0001	<0.001	0.002	<0.001	<0.001	<0.01	0.008	0.11	<0.0001
Howard Springs WTS	16-Dec-20	0.12	<0.001	0.0001	<0.001	0.004	<0.001	0.002	<0.01	0.074	0.15	<0.0001
Berry Springs WTS	22-Dec-20	1.38	0.001	<0.0001	0.004	0.006	0.002	0.002	<0.01	0.01	1.76	<0.0001

Table 6. Total metals

Parameter		Al	As	Cd	Cr	Cu	Pb	Ni	Se	Zn	Fe	Hg
Unit		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Darwin Harbour WQO – upper estuary		-	-	-	-	-	-	-	-	-	-	-
Darwin Harbour WQO – freshwater rivers & streams		-	-	-	-	-	-	-	-	-	-	-
ANZG (2018) freshwater – 95% species protection		0.055	0.013	0.0002	0.001	0.0014	0.0034	0.011	0.011	0.008	-	0.0006
Monitoring site	Date											
Humpty Doo WTS	14-Dec-20	2.82	0.003	<0.0001	0.003	0.006	0.009	0.002	<0.01	0.061	0.11	<0.0001
Howard Springs WTS	16-Dec-20	3.54	0.004	0.0016	0.007	0.056	0.093	0.009	<0.01	0.535	7.07	<0.0001
Berry Springs WTS	22-Dec-20	1.67	0.001	<0.0001	0.003	0.008	0.003	0.002	<0.01	0.017	1.64	<0.0001

Table 7. Major ions

Parameter		Bicarbonate Alkalinity as CaCO ₃	Carbonate Alkalinity as CaCO ₃	Hydroxide Alkalinity as CaCO ₃	Total Alkalinity as CaCO ₃	Sulfate as SO ₄	Chloride	Calcium	Magnesium	Potassium	Sodium	Total Anions	Total Cations
Unit		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Darwin Harbour WQO – upper estuary		-	-	-	-	-	-	-	-	-	-		-
Darwin Harbour WQO – freshwater rivers & streams		-	-	-	-	-	-	-	-	-	-		-
ANZG (2018) freshwater – 95% species protection		-	-	-	-	-	-	-	-	-	-		-
Monitoring site	Date												
Humpty Doo WTS	14-Dec-20	12	<1	<1	12	17	6	7	2	8	3	0.76	0.85
Howard Springs WTS	16-Dec-20	3	<1	<1	3	<10	6	2	1	2	2	0.23	0.32
Berry Springs WTS	22-Dec-20	36	<1	<1	36	<5	38	9	5	19	11	1.79	1.82

Table 8. Hydrocarbons (total and recoverable)

Parameter		Total Petroleum Hydrocarbons TPH					Total Recoverable Hydrocarbons TRH						
Unit		C6 - C9 Fraction	C10 - C14 Fraction	C15 - C28 Fraction	C29 - C36 Fraction	C10 - C36 Fraction (sum)	C6 - C10 Fraction	C6 - C10 Fraction minus BTEX (F1)	>C10 - C16 Fraction	>C16 - C34 Fraction	>C34 - C40 Fraction	>C10 - C40 Fraction (sum)	>C10 - C16 Fraction minus Nap
Darwin Harbour WQO - upper estuary		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Darwin Harbour WQO - freshwater rivers and streams		-	-	-	-	-	-	-	-	-	-	-	-
ANZECC 2000 freshwater - 95% species protection		-	-	-	-	-	-	-	-	-	-	-	-
Monitoring site	Date												
Humpty Doo WTS	14-Dec-20	<20	<50	<100	<50	<50	<20	<20	<100	<100	<100	<100	<100
Howard Springs WTS	16-Dec-20	<20	<50	<100	<50	<50	<20	<20	<100	<100	<100	<100	<100
Berry Springs WTS	22-Dec-20	<20	<50	<100	<50	<50	<20	<20	<100	<100	<100	<100	<100

Table 9. Hydrocarbons (BTEXN)

Parameter		BTEXN							
Unit		Benzene	Ethylbenzene	Sum of BTEX	Toluene	Total Xylenes	meta- & para-Xylene	ortho-Xylene	Naphthalene
Darwin Harbour WQO - upper estuary		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Darwin Harbour WQO - freshwater rivers and streams		-	-	-	-	-	-	-	-
ANZECC 2000 freshwater - 95% species protection		0.95	-	-	-	-	-	0.35	0.016
Monitoring site	Date								
Humpty Doo WTS	14-Dec-20	<1	<2	<1	<2	<2	<2	<2	<5
Howard Springs WTS	16-Dec-20	<1	<2	<1	<2	<2	<2	<2	<5
Berry Springs WTS	22-Dec-20	<1	<2	<1	<2	<2	<2	<2	<5

Table 10. Per- and polyfluoroalkyl substances PFAS (part 1 of 4)

		Perfluoroalkyl Sulfonic Acids						
Parameter		PFBS	PFPeS	PFHxS	PFHpS	PFOS	PFDS	PFBS
Unit		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Darwin Harbour WQO – upper estuary		-	-	-	-	-	-	-
Darwin Harbour WQO – freshwater rivers & streams		-	-	-	-	-	-	-
ANZG (2018) freshwater – 95% species protection		-	-	-	-	-	-	-
PFAS NEMP v2 Jan 2020 - aquatic ecosystems - freshwater 95% species protection		-	-	-	-	0.13	-	-
Monitoring Site	Date							
Humpty Doo WTS	14/12/2020	<0.002	<0.002	<0.002	<0.002	0.003	<0.002	<0.002
Howard Springs WTS	16/12/2020	<0.002	<0.002	<0.002	<0.002	0.006	<0.002	<0.002
Berry Springs WTS	22/12/2020	<0.002	<0.002	<0.002	<0.002	0.002	<0.002	<0.002

Table 11. Per- and polyfluoroalkyl substances PFAS (part 2 of 4)

		Perfluoroalkyl Carboxylic Acids											
Parameter		PFBA	PFPeA	PFHxA	PFHpA	PFOA	PFNA	PFDA	PFUnDA	PFDoDA	PFTTrDA	PFTeDA	PFHxDA
Unit		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Darwin Harbour WQO - upper estuary		-	-	-	-	-	-	-	-	-	-	-	-
Darwin Harbour WQO - freshwater rivers and streams		-	-	-	-	-	-	-	-	-	-	-	-
ANZECC 2000 freshwater - 95% species protection		-	-	-	-	-	-	-	-	-	-	-	-
PFAS NEMP v2 Jan 2020 - aquatic ecosystems – freshwater 95% species protection		-	-	-	-	220	-	-	-	-	-	-	-
Monitoring site	Date												
Humpty Doo WTS	14-Dec-20	<0.01	<0.002	<0.002	<0.002	0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.005	<0.005
Howard Springs WTS	16-Dec-20	<0.01	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.005	<0.005
Berry Springs WTS	22-Dec-20	<0.01	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.005	<0.005

Table 12. Per- and polyfluoroalkyl substances PFAS (part 3 of 4)

		Perfluoroalkyl Sulfonamides						
Parameter		FOSA	MeFOSA	EtFOSA	MeFOSE	EtFOSE	MeFOSAA	EtFOSAA
Unit		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Darwin Harbour WQO - upper estuary		-	-	-	-	-	-	-
Darwin Harbour WQO - freshwater rivers and streams		-	-	-	-	-	-	-
ANZECC 2000 freshwater - 95% species protection		-	-	-	-	-	-	-
PFAS NEMP v2 Jan 2020 - aquatic ecosystems – freshwater 95% species protection		-	-	-	-	-	-	-
Monitoring site	Date							
Humpty Doo WTS	14-Dec-20	<0.002	<0.005	<0.005	<0.005	<0.005	<0.002	<0.002
Howard Springs WTS	16-Dec-20	<0.002	<0.005	<0.005	<0.005	<0.005	<0.002	<0.002
Berry Springs WTS	22-Dec-20	<0.002	<0.005	<0.005	<0.005	<0.005	<0.002	<0.002

Table 13. Per- and polyfluoroalkyl substances PFAS (part 4 of 4)

		(n:2) Fluorotelomer Sulfonic Acids				PFAS Sums		
Parameter		4:2 FTS	6:2 FTS	8:2 FTS	10:2 FTS	Sum of PFAS	Sum of PFHxS and PFOS	Sum of PFAS (WA DER List)
Unit		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Darwin Harbour WQO - upper estuary		-	-	-	-	-	-	-
Darwin Harbour WQO - freshwater rivers and streams		-	-	-	-	-	-	-
ANZECC 2000 freshwater - 95% species protection		-	-	-	-	-	-	-
PFAS NEMP v2 Jan 2020 - aquatic ecosystems – freshwater 95% species protection		-	-	-	-	-	-	-
Monitoring site	Date							
Humpty Doo WTS	14-Dec-20	<0.005	<0.005	<0.005	<0.005	0.005	0.003	0.005
Howard Springs WTS	16-Dec-20	<0.005	<0.005	<0.005	<0.005	0.006	0.006	0.006
Berry Springs WTS	22-Dec-20	<0.005	<0.005	<0.005	<0.005	0.002	0.002	0.002



EcOz Environmental Consultants

T: (08) 8981 1100
E: ecoz@ecoz.com.au
W: www.ecoz.com.au

Darwin, Northern Territory
Level 1, 70 Cavenagh St,
GPO Box 381, Darwin, NT 0801

17 February 2021

Our ref.: EZ20086

David Jan
Manager Operations & Environment
Litchfield Council
David.Jan@litchfield.nt.gov.au

Re: Field report: Waste Transfer Stations mid-wet season water quality sampling – January 2021

Dear David,

This letter summarises the results and assessment of the second round of water quality sampling (representing the mid-wet season) undertaken by EcOz at the three Waste Transfer Stations (WTS) managed by Litchfield Council (LC): Howard Springs (HS WTS), Humpty Doo (HD WTS) and Berry Springs (BS WTS). The collection of water quality data is a requirement of the Environment Protection Licences (EPLs) EPL278 and EPL279 (Howard Springs WTS and the Humpty Doo WTS), issued by the Northern Territory Environment Protection Authority (NT EPA) under the *NT Waste Management and Pollution Control Act* (WMPC Act).

Sampling:

Sampling was undertaken in accordance with the:

- *Australian Guidelines for Water Quality Monitoring and Reporting* (ANZECC 2000a, now ANZG 2018)
- Australian/New Zealand Standard (1998), *Water Quality Sampling - Part 1: Guidance on the design of sampling programs, sampling techniques and the preservation and handling of samples* (AS/NZS 5667.1:1998).
- Australian/New Zealand Standard (1998), *Water Quality Sampling - Part 10: Guidance on sampling of waste waters* (AS/NZS 5667.10:1998).

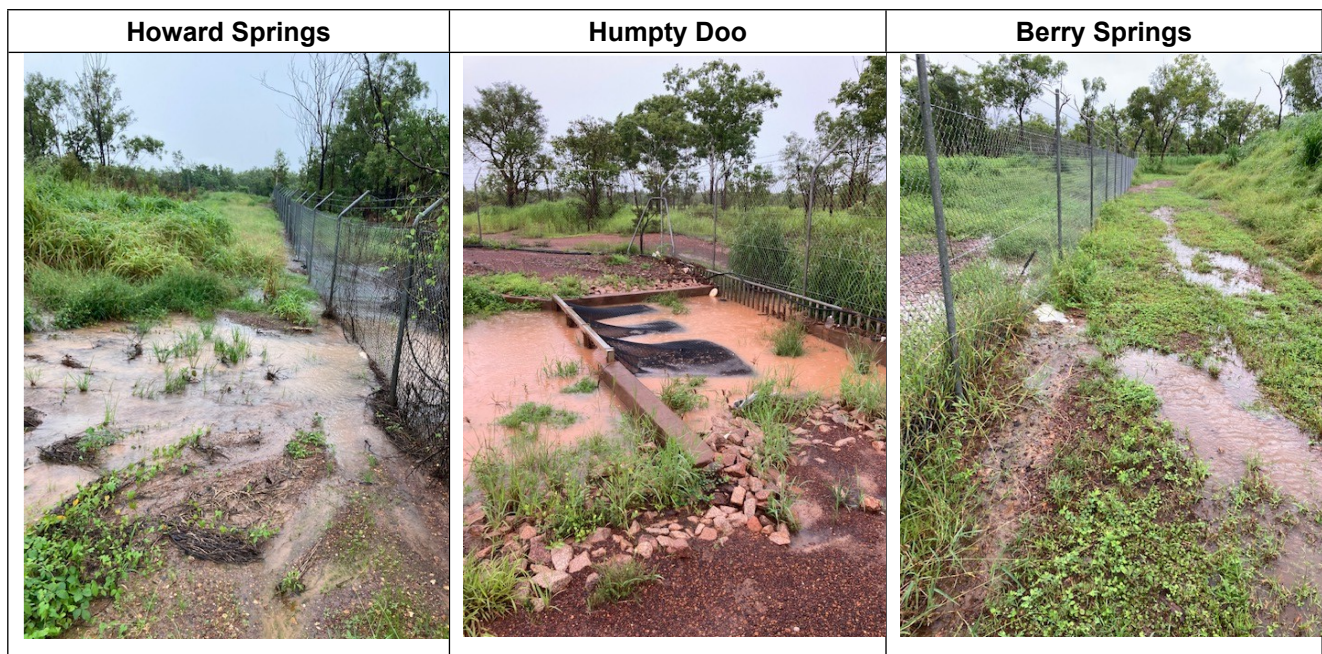
Sample analysis was undertaken by the NATA accredited ALS laboratories.

Water quality samples were collected at all three waste transfer stations on 28 January 2021 at the points where runoff leaves the WTS premises. The Top End of the Northern Territory was experiencing monsoonal conditions at the time, and all three sites were flowing rapidly (see photos in Table 1). Note that surface water only flows at these sites for a short period during, and for a short period following, heavy rainfall.

Water quality assessment criteria

EPL278 and EPL279 specify that water quality results be compared against the Darwin Harbour Water Quality Objectives (DHWQO) for the upper estuary and freshwater rivers and streams (NRTEAS 2010), and the *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (ANZG 2018).

Table 1. Photos of sample sites on 28 January 2021



Results:

Sampling results have been entered into an Excel database, which is submitted electronically along with this brief summary report – please refer to this database for the concentrations discussed below. Key findings are as follows:

- The physical parameter measurements were taken in the field, as well as in the laboratory to comply with EPL requirements. Turbidity was well above the DHWQO at all three sites. Additionally, reduced dissolved oxygen (DO) and increased electrical conductivity (EC) were recorded at HS WTS. The laboratory-measured total suspended solids (TSS) were also well above the DHWQO at all sites.
- The concentrations of *E. coli* in the WTS run off was overall very high and well exceeding the DHWQO. They were, however, overall substantially lower than during the first sampling round in December 2020.
- Nutrient concentrations were considerably lower in January 2021 compared to December 2020, but still mostly exceeded guideline concentrations. Very high concentrations of ammonia and of total nitrogen were recorded at HS WTS. Possible sources are green waste, food waste and animal faeces.
- Several of the dissolved metal concentrations exceeded the ANZG (2018) guideline values for 95% species protection (freshwater). These include copper at all three WTSs, aluminium at HD WTS and BS WTS, zinc at HD WTS and HS WTS, and lead at HD WTS. Exceedances of total metal concentrations were apparent at all three sites for aluminium, chromium, copper and zinc, while an additional exceedance for lead was measured at HD WTS.
- All hydrocarbon analytes i.e. all total petroleum hydrocarbon/total recoverable hydrocarbon (TPH/TRH) fractions, and benzene, toluene, ethylbenzene, xylene, naphthalene (BTEXN) were below their respective detection limits.
- Most analytes of the per- and polyfluoralkyl substances (PFAS) group were below their respective limits of detection. PFOS, PFPeA, PFHxA and PFOA were detected at HD WTS and HS WTS. An additional eight other PFAS types were recorded at HS WTS. There are no guideline values for PFAS in the DHWQO or the ANZG (2018), thus the *PFAS National Environmental Management Plan Version 2.0* (HEPA 2020) is referenced, which has an aquatic

ecosystems protection guideline value for PFOS of 0.13 µg/L and for PFOA, which is 220 µg/L. The HS WTS PFOS concentration of 0.132 µg/L was slightly exceeding that guideline value, whilst all other results for PFOS and PFOA were below those guidelines.

Should you have any queries regarding the sampling, or the content of this report, please do not hesitate to contact me.

Yours sincerely,



Gisela Lamche
Senior Consultant Consultant
EcOz Environmental Consultants
Gisela.lamche@ecoz.com.au

References:

ANZECC (2000a) now ANZG (2018), *Australian and New Zealand guidelines for fresh and marine water quality, National Water Quality Management Strategy Paper No 4*, Canberra: Australian and New Zealand Environment and Conservation Council & Agriculture and Resource Management Council of Australia and New Zealand.

ANZG 2018. Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Australian and New Zealand Governments and Australian state and territory governments, Canberra ACT, Australia. Available at www.waterquality.gov.au/anz-guidelines [Accessed 15 February 2021].

HEPA (2020), *PFAS National Environmental Management Plan (NEMP)*, Version 2.0, January 2020, National Chemicals Working Group of the Heads of EPAs Australia and New Zealand (HEPA).

NRETAS (2010), *Water Quality Objectives for the Darwin Harbour Region – Background Document*, Aquatic Health Unit, Department of Natural Resources, Environment, the Arts and Sport, NT Government, Darwin. See Table 8 for guideline values.