ATTACHMENT A

Environmental Risk Assessment, Channel Island Power Station_ WDL 212-01

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1 INTRODUCTION

Channel Island Power Station (CIPS) is the largest power station in Northern Territory located on Channel Island Road, Channel Island, NT, 0822. CIPS is operated by Territory Generation (TGen), a corporation owned by Northern Territory Government. CIPS was commissioned in 1986 and currently has capacity of 310MW for the supply of electricity to the Darwin and Katherine region.

Since April 2016, Tropical Water Solutions (TWS) has been contracted by TGen for the CIPS monitoring program in accordance to WDL-212 and WDL 212-01. The current monitoring program under WDL 212-01 consists of 12 sites, 2 of which are sediment monitoring sites.

This report focuses on addressing condition 47 of the WDL 212-01 which includes the Environment Risk Assessment for the licenced activities in CIPS. As per Section 47 of WDL-212-01, the Environmental Risk Assessment includes:

- Condition 47.1- The characterisation of the environmental impact of discharges of wastewater and sediment from CIPS.
- Condition 47.2- Include a conceptual site model.
- Condition 47.3- Characterisation of the volumes and frequency of discharges.
- Condition 47.4- Characterisation of the contaminant concentrations in sediment in the receiving environments in the vicinity of the Norther and Southern Outlets.
- Condition 47.5- Apply the toxicant decision tree from Chapter 3.4.3.2 the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC Guidelines, 2000).
- Condition 47.6- Development site specific trigger values (SSTV).

2 WASTEWATER DISCHARGE FROM CHANNEL ISLAND POWER STATION

The CIPS has two discharge points, ADP1 and ADP2 that release wastewater effluent into two storm water drains, which release the effluent into the upper middle estuary of Middle Arm, Darwin Harbour, namely, Northern Stormwater Outlet (NODH1) and Southern Stormwater Outlet (SODH1). NODH1 is influenced by the effluent from the cooling towers, for which the discharge is monitored at ADP1, as well as any rainwater/runoff that can occur. Whilst SODH1 is under the influence of any effluent overflow from the Large and Small Cooling Ponds (ADP2), any rainwater/runoff that can occur at the island, as well as the Darwin Aquaculture Centre discharge (Figure 2-1). In order to determine the impact of the wastewater discharge on the receiving environment, quarterly monitoring on marine water (Darwin Harbour) is performed. Figure 2-2 shows the CIPS site map. Details of monitoring sites and sampling frequency at each site are provided in Table 1.

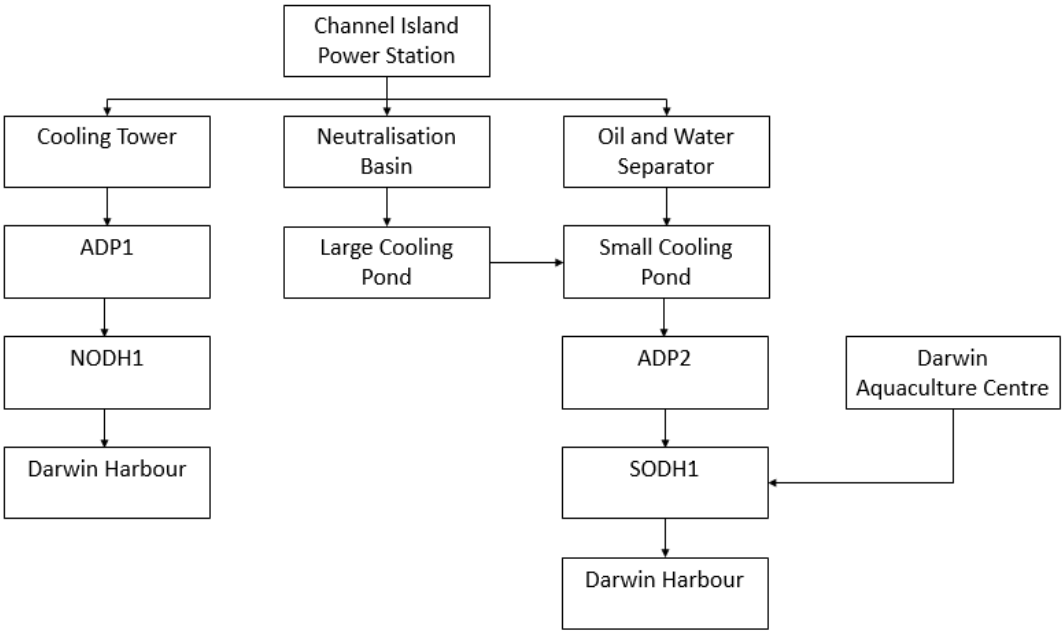

Figure 2-1 - Flowchart of wastewater at Channel Island Power Station

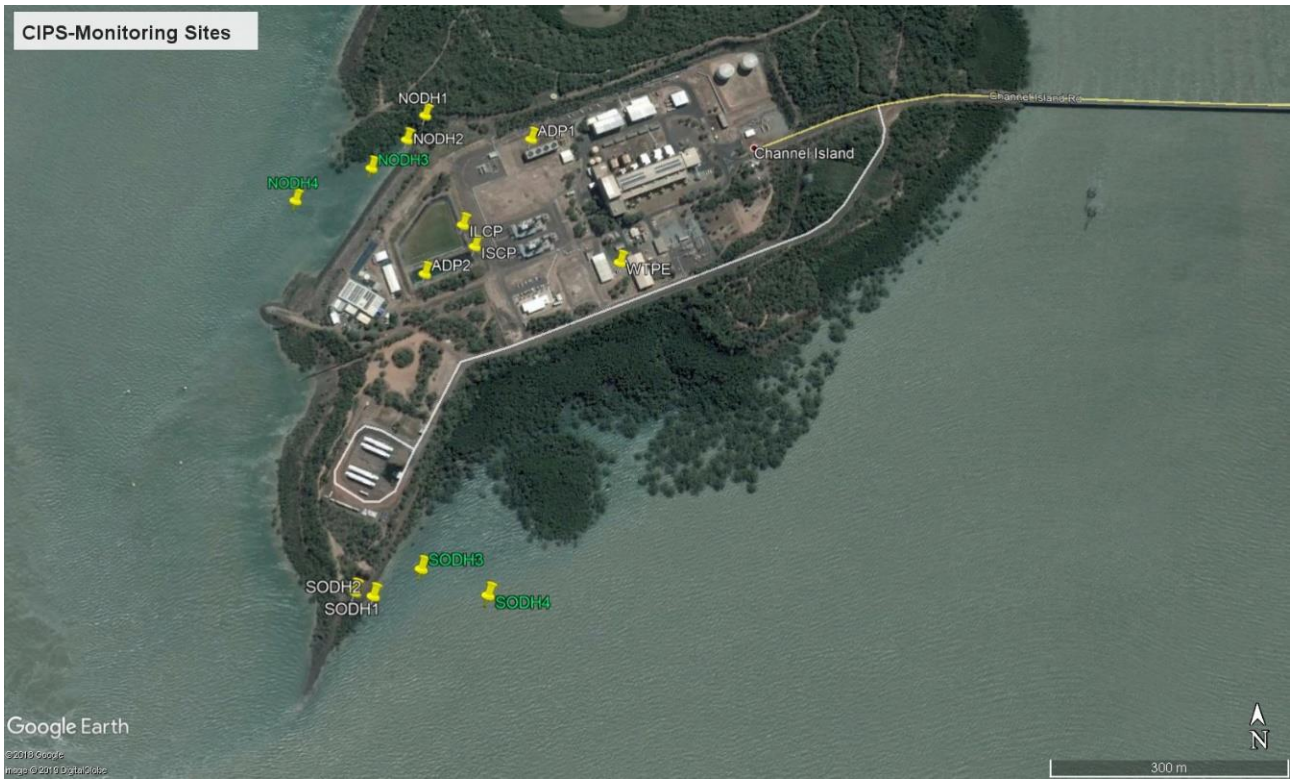

Figure 2-2 - Channel Island Power Station, Monitoring Sites

Table 1 – CIPS Monitoring Sites and Sampling Frequency

Site Code	Description	Site Coordinates (degrees)	Monitoring frequency
SODH1	Southern Outlet to Darwin Harbor (Drain prior to mixing in receiving environment	Lat: -12.560474 Long: 130.862878	Monthly
ADP2	Cooling Ponds Wastewater Discharge (Representative of discharge from cooling ponds to drainage system that flows to SODH1)	Lat: -12.556639 Long: 130.864559	
NODH1	Northern Outlet to Darwin Harbor (Drain prior to mixing in receiving environment)	Lat: -12.554271 Long: 130.863497	
ADP1	Cooling Tower Wastewater Discharge (Representative of discharge from cooling tower to drainage system that flows to NODH1)	Lat: -12.554760 Long: 130.864055	
ILCP	Large Cooling Pond Influent	Lat: -12.555856 Long: 130.86405	Quarterly
ISCP	Small Cooling Pond Influent	Lat: -12.555856 Long: 130.864055	
SODH3	Southern Discharge Point Mixing Zone	Lat: --12.560221 Long: 130.864483	
SODH4	Southern Receiving Environment Monitoring Point	Lat: -12.560540 Long: 130.864483	
NODH3	Northern Discharge Point Mixing Zone	Lat: -12.555015 Long: 130.862802	
NODH4	Northern Receiving Environment Monitoring Point	Lat: -12.555441 Long: 130.861803	
NODH2	Outfall from NODH1, Sediment monitoring site	Lat: -12.554453 Long: 130.863358	
SODH2	Outfall from SODH1, Sediment monitoring site	Lat: -12.6560485 Long: 130.862941	

3 ENVIRONMENT IMPACT ASSESSMENT

3.1 WDL 212-01 condition 47.1-Environmental Impact of CIPS Discharge

CIPS discharge receiving environment is Darwin Harbour. In order to investigate any impact on Darwin harbour due to CIPS discharge, marine water (4 sites) are being monitored in accordance with WDL 212-01. Marine water monitoring sites are SODH3, SODH4, NODH3 and NODH4 (Figure 2-2). Samples collected (quarterly) from these sites were analysed for a range of physical, chemical and biological parameters. More details on sampling sites, sampling procedures and analysis can be found in CIPS Annual Report (2020).

Impact on the Darwin harbour assessed in relation to Beneficial Use Declaration (BUD) which is a legislated process that reduces the effects of water pollution and assists in the protection and management of water. BUD relevant to WDL 212-01 is '*Darwin Harbour Region, Northern Territory Government Gazette No. 27, 7 July 2010' (NTG Gazette, 2010).* As per NTG Gazette (2010), monitoring results at four Darwin Harbour sites were compared with the guideline specified in the *Water Quality*

Objectives for the Darwin Harbour Region - Background Document, February 2010 (WQODH, 2010) and *Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC/ARMANZ (2000*).

A detail description of monitoring results is included in Section, 4.1, CIPS Annual Report (2020). In summary:

- *Dissolved oxygen (% Saturation)*- Recorded Dissolved Oxygen (DO % Sat) levels at SODH3, SODH4, NODH3 and NODH4 comply with the guideline value of >80 % (WQODH, 2010; WDL-212-01, 2018) except for one sampling occasion conducted on 14 January 2020 (Figure A 1, Appendix 1). The resulted below guideline values of DO % Sat on 14 January 2020 could be due to tidal and stormwater influence at the time of sampling.
- *pH*- pH values are within the guideline range of 6.5 - 8.0 pH unit for all sampling events at all Darwin harbour sampling sites (Figure A 2, Appendix 1).
- *Total Suspended Solids (TSS)*- TSS concentrations at site SODH3 (23 July 2019) and NODH3 (14 January 2020) was 14 mg/L. (Figure A 3, Appendix 2) and are above the guideline value of 10 mg/L (WQODH, 2010; WDL 212-01, 2018). Water movement during the hightide could have caused suspension of solids particles resulting in slightly elevated TSS concentrations at monitored sites. For the rest of the sampling events, TSS concentrations were below the guideline value of 10 mg/L.
- *Filterable Reactive Phosphorus (FRP) and Total Phosphorous (TP)*- Similar to the above parameters, FRP and TP concentrations at Darwin harbour sites comply with the guideline value of 0.01 mg/L and 0.03 mg/L (WQODH, 2010; WDL 212-01, 2018), respectively except for the sampling event on 14/01/2020 (Figure A 4 and Figure A 5, Appendix 1).
- *Total Nitrogen (TN)*- Guideline value for TN is 0.3 mg/L (WQODH, 2010; WDL 212-01, 2018) and all the recorded concentrations at Darwin harbour sites were below 0.3 mg/L (Figure A 6, Appendix 1).
- *E.coli*- *E. coli* concentrations at all the sites were below the level of reporting Figure A 7, Appendix 1). The highest recorded *E. coli* concentration was 10 MPN/100mL indicating that the concentrations are well below the guideline value of 200 MPN/100mL (WQODH, 2010; WDL 212-01, 2018).
- *Metals*- Total of 11 metal elements were analysed at each site. Metal concentrations at all the sites are below ANZECC/ARMANZ (2000) guideline values for most of the cases. An incident of ANZECC/ARMANZ (2000) guideline value exceedance can be seen at SODH3 on 22/01/2019 for Copper and Cobalt (Table A 1, Appendix 1). On this day, there was no flow from SODH1 (upstream CIPS discharge point) which indicates that this single exceedance event is likely due to unknown factors not existing on any other sampling occasion.

More details on exceedance event occurred on 14/01/2020 has been reported to NTEPA and incident investigation report (*WDL 212-01 Incident Investigation Report_17022020*, Appendix 2) was also submitted. As noted in the incident investigation report, this exceedance event is not a non-compliance as per WDL 212-01 and detectable environmental harm is unlikely.

Overall, the monitoring results demonstrate that the impact of CIPS discharge on Darwin harbour receiving environment is low risk.

3.2 WDL 212-01 condition 47.2-Conceptual Site Model

Conceptual Site Model is to summarise information about the history of use and activities on a site and surrounding properties, including potentially contaminating activities and land uses (NT EPA, 2013).

Figure 3-1 shows the schematic diagram of the CIPS activities including discharge sources, discharge points and pathways and the discharge receptor (Darwin Harbour). The mixing zone of the discharge is no more than 50 metres distant from the actual point of entry into the estuary. Further mixing occurs in open sub-tidal zones due to the rocky bed in Middle Arm (c.f. Jones et al., 2008). Tidal currents and wind forcing would further disperse any plume from CIPS discharge in Middle Arm.

As noted in Section 3.1, monitoring at Darwin harbour was performed on quarterly basis. Monitoring results shows that the environment harm that could occur from the discharge is minimal.

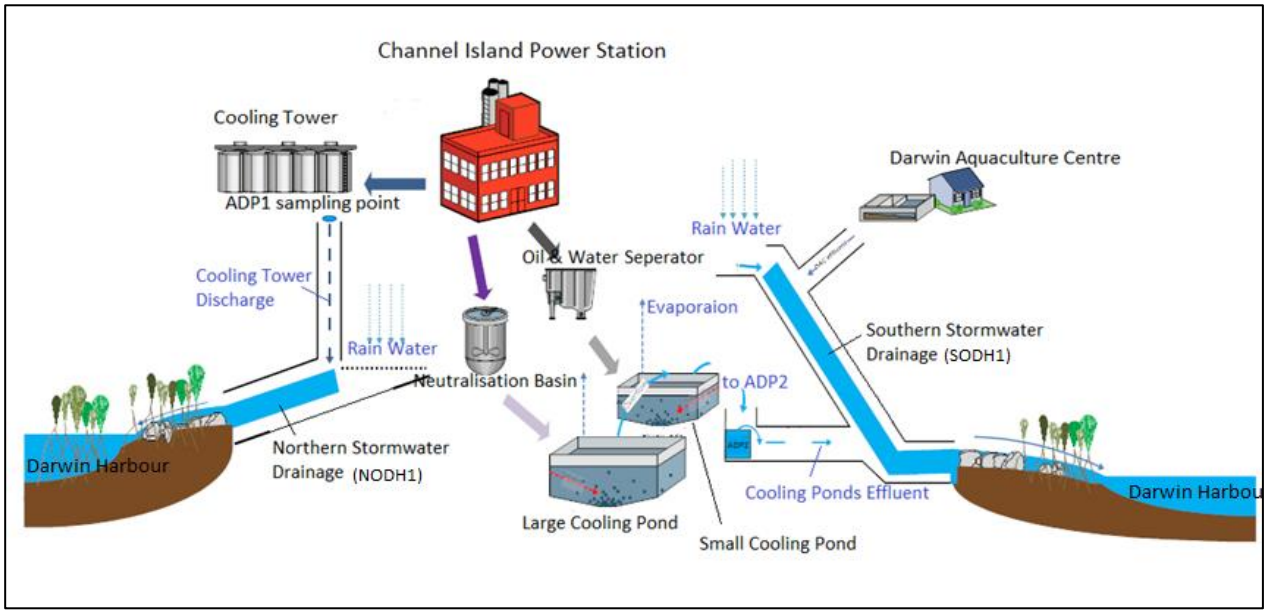

Figure 3-1: Schematic diagram of CIPS discharge pathways.

3.3 WDL 212-01 condition 47.3-Discharge volumes and Frequencies

Wastewater discharge from ADP1 (cooling tower) which flows into the NODH1 were monitored and total discharge for the past 11 months (May 2019 to March 2020) was also calculated and is 24.6 ML (CIPS Annual Report, 2020). There is a reduction in discharge from the ADP1 (>50%) for this period compared to the discharge records of year 2017-2018. Discharge from ADP1 in 2018-2019 was similar to the current reporting year. Reductions of APD1 discharge during last two years are a result of the increased number of cycles the cooling tower undergoes before discharge of water, hence saving water and in turn reducing discharge volumes.

The total annual discharge (May 2019 to March 2020) from the ADP2 was 16.3 ML, higher than the previous year's discharge (8.4 ML). However, in total, CIPS has discharged 40.9 ML of wastewater for the

11 months period (May 2019 to March 2020) which is similar to last year's (2018-2019) discharge of 37.7 ML. For the year 2017-18, the total discharge volume was 108 ML. Thus, the CIPS discharge to Darwin harbor has reduced by approximately 65 % and 62 % in year 2018-2019 and 2019-2020 respectively compared to CIPS discharge in year 2017-2018 demonstrating the continuing success of the discharge reduction plan.

More details on CIPS discharge can be found in CIPS Annual Report (2020).

3.4 WDL 212-01 condition 47.4-Sediment Analysis

Sediment monitoring in the Darwin Harbour mixing zone was conducted at sites NODH2 and SODH2 (Figure 2-2) on quarterly basis. Laboratory results of metals and hydrocarbons were compared with the ANZEC/ARMCANZ Interim Sediment Guidelines for environmental sediment monitoring (ISQG, 2000) or WDL 212-01 trigger values when available.

Metals- All the results are below the specified guideline values indicating that water/sediment transport from the CIPS facility had not influenced metals concentrations in the sediment in Darwin harbour. At NODH2, there was a slight exceedance in Zinc concentration on 19 July 2018 (207kg/kg) and Arsenic Concentration (20 mg/kg) on 14 January 2020 (highlighted in red in Table A 3, Appendix 1). Elevated concentration of Zinc was not detected again. Average Zinc concentration at NODH2 is 71 mg/kg (n=14) and is well below the guideline value of 200 mg/kg (ISQG, 2000). Arsenic concentrations will be continued to monitor any possible continuous exceedance in concentrations in future sampling events. Average Arsenic concentration at NODH2 is 14 mg/kg (n=14) and is less than the guideline value of 20 mg/kg (ISQG, 2000). The abovementioned exceedances of Zinc and Arsenic concentrations are not non-compliances as per WDL 212-01 and pose low risk to the environment.

Hydrocarbons- Total Petroleum Hydrocarbons (TPHs), Polycyclic Aromatic Hydrocarbons (PAHs) and BTEX (Benzene, Toluene, Ethylbenzene, Xylenes) concentrations at SODH2 and NODH2 were below the level of reporting (LOR) or equal to the LOR indicating no evidence of influence in Darwin harbour sediment quality in terms of hydrocarbons contamination from CIPS discharge. Results are given in Table A 4 and Table A 5, Appendix 1.

3.5 WDL 212-01 condition 47.5-Toxicant Decision Tree (ANZEC/ARMCANZ, 2000)

As noted in Section 3.1, metals and hydrocarbon concentrations falls below the guideline values defined in WQODH (2010) for the majority of the sampling events. That ensures there is low risk to the receiving environment and under the guidelines recommendations no further investigations are necessary; a visual representation can be seen when applying the toxicant decision tree in Figure 3-2.

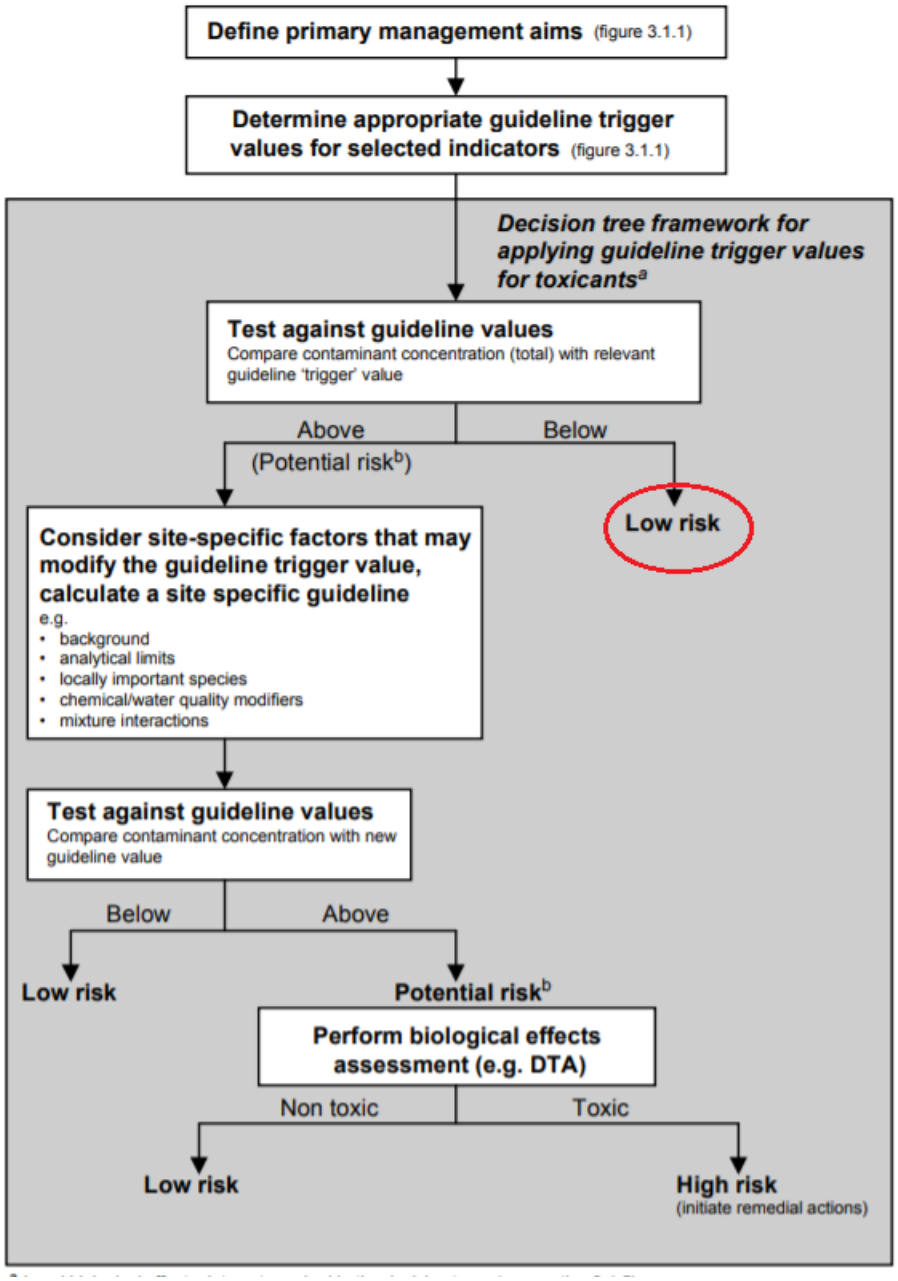

Figure 3-2 - Toxicant decision tree (adapted from ANZEC/ARMCANZ, 2000)

3.6 WDL 212-01 condition 47.6-Site Specific Trigger Values

As per WDL 212-01, site specific trigger values (SSTV) for Turbidity, Biological Oxygen Demand (BOD), Electrical Conductivity (EC), Temperature for Darwin harbour sites (SODH3, SODH4, NODH3 and NODH4) and Aluminium (Al), Cobalt (Co), Tin (Sn), Total Petroleum Hydrocarbons, Polycyclic aromatic hydrocarbons, Benzene, Ethylbenzene, Xylenes, and Toluene for sediment monitoring sites SODH2 and NODH2 need to be developed.

According to ANZECC/ARMANZ (2000), data collected after two years of monthly sampling are regarded as sufficient to indicate ecosystem variability and can be used to derive trigger values. It means that total of at least 24 datapoints are required for trigger value derivation. Only 7 and 16 datapoints are available

at marine water monitoring sites (SODH3, SODH4, NODH3 and NODH4) and sediment monitoring sites (SODH2 and NODH2) respectively. Therefore, there is insufficient data to develop site specific trigger values as at March 2020.

4 Conclusion

- The Impact of CIPS discharge on Darwin harbour is assessed in relation to the Beneficial Use Declaration- *Darwin Harbour Region, Northern Territory Government Gazette No. 27, 7 July 2010' (NTG Gazette, 2010.* Concentrations of physical, chemical and biological parameters comply with the WQGDH (2010) and ANZECC/ARMANZ (2000) guideline values for the majority of the sampling eventing events. These results indicate that the CIPS discharge poses low risk to Darwin harbour receiving environment.
- Similarly, sediment analysis results showed that the toxicant (metals and hydrocarbons) concentrations are below the ISQG (2000) defined guideline values indicating low risk to the environment.
- Total CIPS discharge for the period of May 2019-Mar 2020, May 2018-Apr 2019 and Mar 2017-Apr 2018 were 40.9 ML, 37.7 ML and 108 ML respectively. Thus, the CIPS discharge to Darwin harbor has reduced by approximately 65 % and 62 % in year 2018-2019 and 2019-2020 respectively compared to CIPS discharge in year 2017-2018. This demonstrates the continuing success of the continuous improvement plan (discharge reduction plan) implemented by Territory Generation.
- Site specific trigger values will be developed once sufficient data is available in accordance with ANZECC/ARMANZ (2000).

References

ANZECC/ARMANZ (2000): Australian and New Zealand Environment Council & Agriculture and Resource Management Council of Australia and New Zealand, Australian and New Zealand Guidelines for Fresh and Marine Water Quality.

CIPS Annual Report (2020); Channel Island Power Station, WDL 212-01 Annual Report, Report for Northern Territory Environment Protection Agency.

ANZEC/ARMCANZ Interim Sediment Guidelines for environmental sediment monitoring (ISQG, 2000)

NT EPA (2013): Guidelines on Conceptual Site Models, V 1.2, Northern Territory Environment Protection Authority

Appendix 1

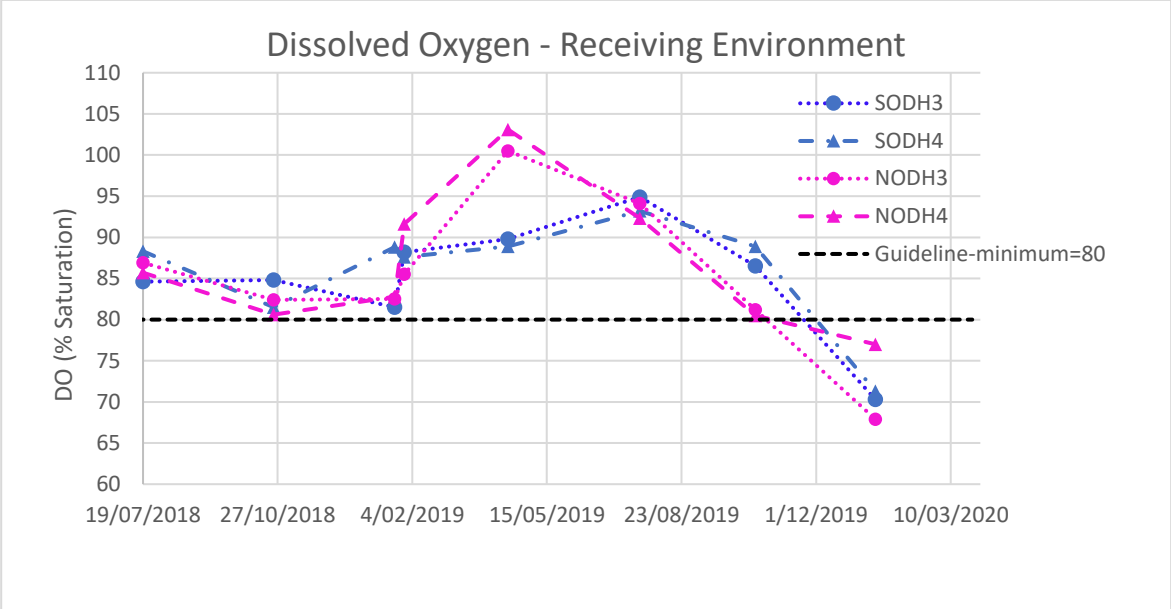

Figure A 1: Dissolved Oxygen (% Saturation) at sites in the receiving environment from July 2018 to March 2020 (Quarterly monitoring)

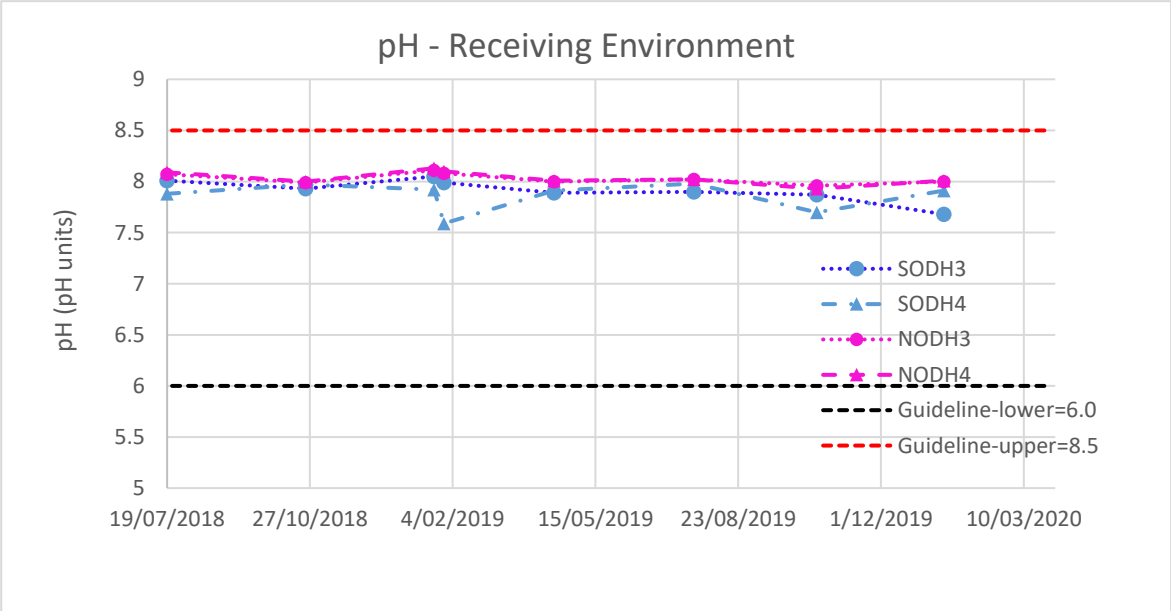

Figure A 2: pH at sites in the receiving environment from July 2018 to March 2020 (Quarterly monitoring)

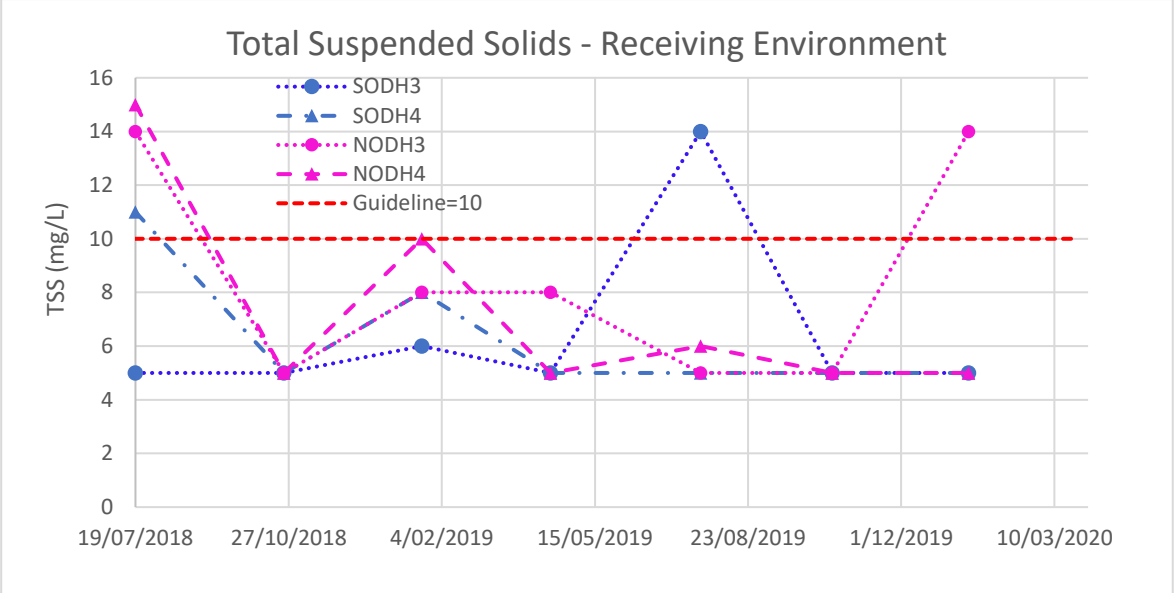

Figure A 3: Total Suspended Solids (TSS) at sites in the receiving environment from July 2018 to March 2020 (Quarterly monitoring)

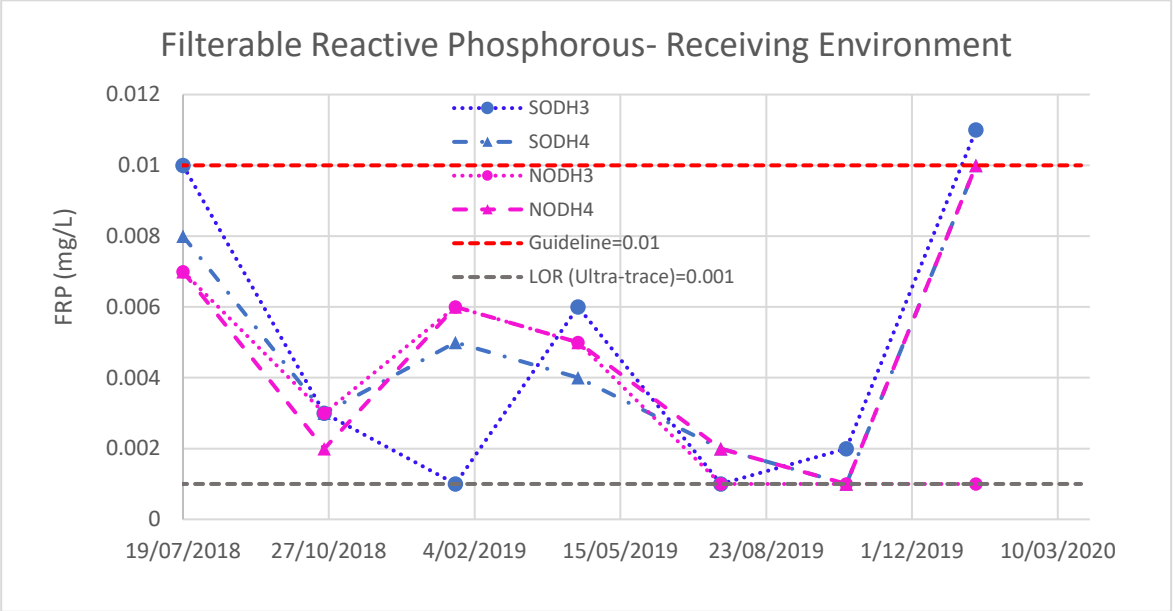

Figure A 4: Filterable Reactive Phosphorous (FRP) concentration at sites in the receiving environment from July 2018 to March 2020 (Quarterly monitoring)

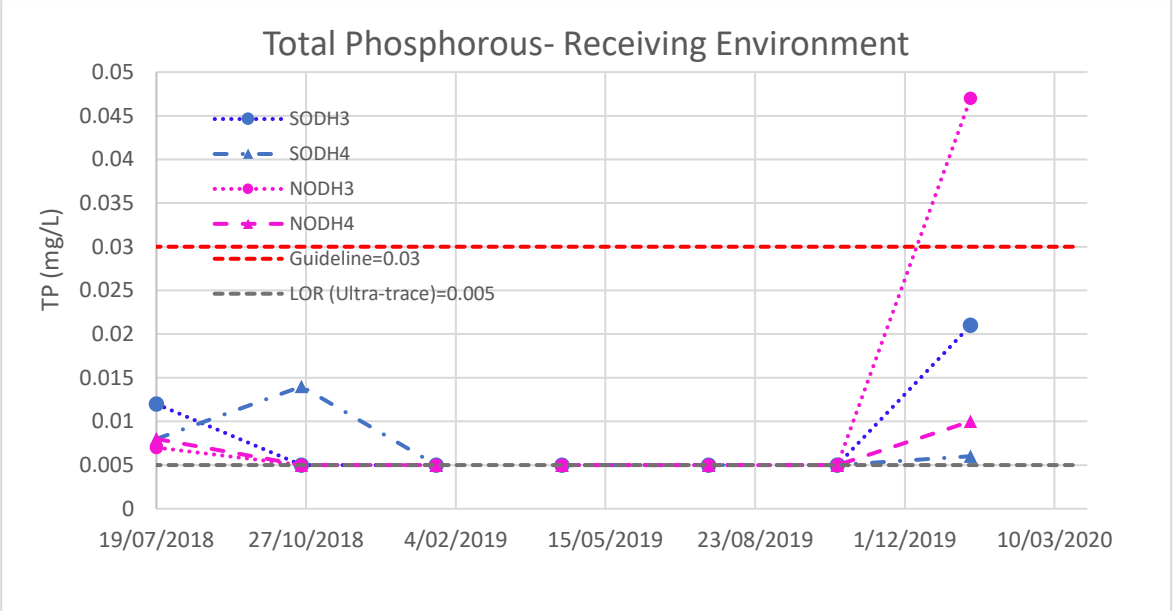

Figure A 5: Total Phosphorous (TP) concentration at sites in the receiving environment from July 2018 to March 2020 (Quarterly monitoring)

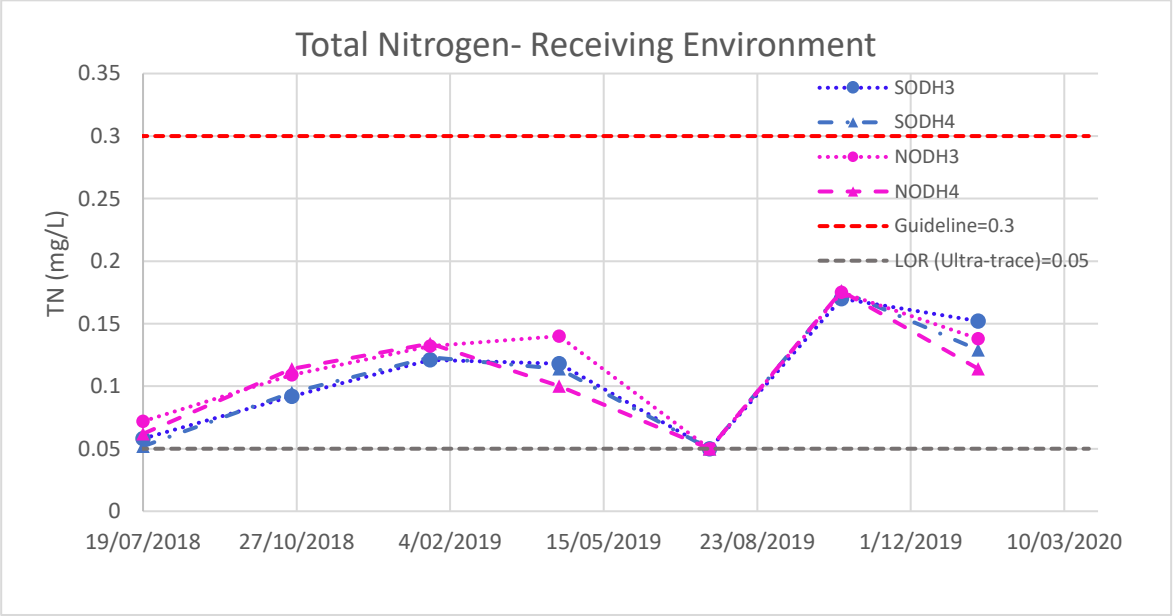

Figure A 6: TN concentration at sites in the receiving environment from July 2018 to March 2020 (Quarterly monitoring)

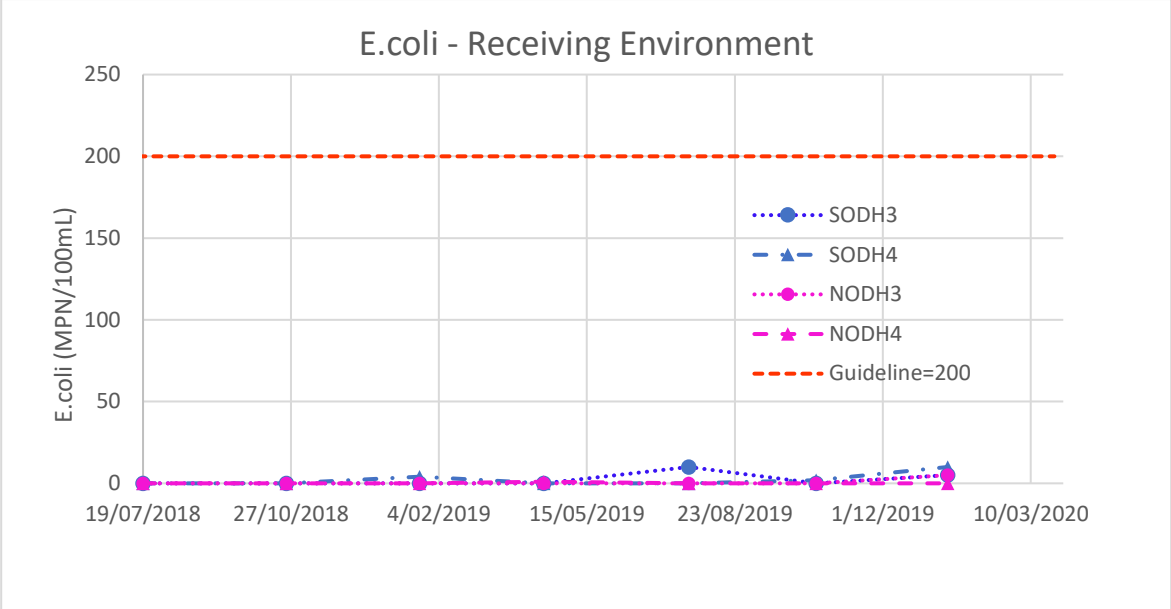

Figure A 7: *E.coli* results (MPN/100mL) at sites in the receiving environment from July 2018 to March 2020 (Quarterly monitoring)

Table A 1: Filtered and Total metal concentrations at sites in the receiving environment from July 2018 to March 2020 (Quarterly monitoring)

SODH3	Filtered Metal Concentrations (µg/L)										
	Mercury*	Aluminium	Chromium	Cobalt	Copper	Lead	Arsenic	Nickel	Tin	Zinc	Cadmium
LOR	*0.00004*	*5*	*0.5*	*0.2*	*1*	*0.2*	*0.5*	*0.5*	*5*	*5*	*0.2*
19/07/2018	0.00004	164	0.5	0.2	1	0.2	1.7	0.5	5	5	0.2
24/10/2018	0.00004	5	0.5	0.2	1	0.2	1.7	0.5	5	5	0.2
22/01/2019	0.00004	5	0.5	0.2	1	0.2	1.6	0.5	5	5	0.2
16/04/2019	0.00004	45	0.5	0.2	1	0.2	1.5	0.5	5	5	0.2
23/07/2019	0.00004	5	0.5	0.2	1	0.2	1.2	0.5	5	5	0.2
17/10/2019	0.00004	5	0.5	0.2	1	0.2	1.8	0.5	5	5	0.2
14/01/2020	0.00004	5	0.5	0.2	1	0.2	2.2	0.5	5	5	0.2

SODH3	Total Metal Concentrations (µg/L)										
	Mercury*	Aluminium	Chromium	Cobalt	Copper	Lead	Arsenic	Nickel	Tin	Zinc	Cadmium
LOR	*0.00004*	*5*	*0.5*	*0.2*	*1*	*0.2*	*0.5*	*0.5*	*5*	*5*	*0.2*
ANZECC (2000) guideline value	0.00007		27.4	1	1.3	4.4		70		15	5.5
19/07/2018	0.00004	236	0.5	0.2	1	0.2	2.3	0.5	5	5	0.2
24/10/2018	0.00004	91	0.5	0.2	1	0.2	1.7	0.5	5	5	0.2
22/01/2019	0.00004	421	1.5	1.1	6	1.4	2.5	1.8	5	8	0.2
16/04/2019	0.00004	98	0.5	0.2	1	0.2	1.3	0.5	5	5	0.2
23/07/2019	0.00004	90	0.5	0.2	1	0.2	0.7	0.5	5	5	0.2
17/10/2019	0.00004	112	0.5	0.2	1	0.2	2.1	0.5	5	5	0.2
14/01/2020	0.00004	301	0.5	0.3	1	0.2	2.5	0.6	5	5	0.2

SODH4	Filtered Metal Concentrations (µg/L)										
	Mercury*	Aluminium	Chromium	Cobalt	Copper	Lead	Arsenic	Nickel	Tin	Zinc	Cadmium
LOR	*0.00004*	*5*	*0.5*	*0.2*	*1*	*0.2*	*0.5*	*0.5*	*5*	*5*	*0.2*
19/07/2018	0.00004	156	0.5	0.2	1	0.2	1.6	0.5	5	5	0.2
24/10/2018	0.00004	5	0.5	0.2	1	0.2	1.6	0.6	5	5	0.2
22/01/2019	0.00004	5	0.5	0.2	1	0.2	1.4	0.5	5	5	0.2
16/04/2019	0.00004	46	0.5	0.2	1	0.2	1.4	0.5	5	5	0.2
23/07/2019	0.00004	5	0.5	0.2	1	0.2	0.5	0.5	5	5	0.2
17/10/2019	0.00004	5	0.5	0.2	1	0.2	1.9	0.5	5	5	0.2
14/01/2020	0.00004	5	0.5	0.2	1	0.2	2.1	0.5	5	5	0.2

SODH4	Total Metal Concentrations (µg/L)										
	Mercury*	Aluminium	Chromium	Cobalt	Copper	Lead	Arsenic	Nickel	Tin	Zinc	Cadmium
LOR	*0.00004*	*5*	*0.5*	*0.2*	*1*	*0.2*	*0.5*	*0.5*	*5*	*5*	*0.2*
ANZECC (2000) guideline value	0.00007		27.4	1	1.3	4.4		70		15	5.5
19/07/2018	0.00004	258	0.5	0.2	1	0.2	2.1	0.5	5	5	0.2
24/10/2018	0.00004	82	0.5	0.2	1	0.2	1.7	0.5	5	5	0.2
22/01/2019	0.00004	414	1	0.3	1	0.3	1.9	0.8	5	5	0.2
16/04/2019	0.00004	156	0.5	0.2	1	0.2	1.4	0.5	5	5	0.2
23/07/2019	0.00004	81	0.5	0.2	1	0.2	1.2	0.5	5	5	0.2
17/10/2019	0.00004	62	0.5	0.2	1	0.2	2.3	0.5	5	5	0.2
14/01/2020	0.00004	187	0.5	0.2	1	0.2	2.4	0.5	5	5	0.2

Table A 1 continued:

NODH3	Filtered Metal Concentrations (µg/L)										
	Mercury*	Aluminium	Chromium	Cobalt	Copper	Lead	Arsenic	Nickel	Tin	Zinc	Cadmium
LOR	*0.00004*	*5*	*0.5*	*0.2*	*1*	*0.2*	*0.5*	*0.5*	*5*	*5*	*0.2*
19/07/2018	0.00004	75	0.5	0.2	1	0.2	1.7	0.5	5	5	0.2
24/10/2018	0.00004	11	0.5	0.2	1	0.2	1.7	0.5	5	5	0.2
22/01/2019	0.00004	5	0.5	0.2	1	0.2	1.8	0.5	5	5	0.2
16/04/2019	0.00004	115	0.5	0.2	1	0.2	1.4	0.5	5	5	0.2
23/07/2019	0.00004	5	0.5	0.2	1	0.2	0.7	0.5	5	5	0.2
17/10/2019	0.00004	5	0.5	0.2	1	0.2	2.1	0.5	5	5	0.2
14/01/2020	0.00004	5	0.5	0.2	1	0.2	2.4	0.5	5	5	0.2

NODH3	Total Metal Concentrations (µg/L)										
	Mercury*	Aluminium	Chromium	Cobalt	Copper	Lead	Arsenic	Nickel	Tin	Zinc	Cadmium
LOR	*0.00004*	*5*	*0.5*	*0.2*	*1*	*0.2*	*0.5*	*0.5*	*5*	*5*	*0.2*
ANZECC (2000) guideline value	0.00007		27.4	1	1.3	4.4		70		15	5.5
19/07/2018	0.00004	250	0.5	0.2	1	0.2	2.2	0.5	5	5	0.2
24/10/2018	0.00004	40	0.5	0.2	3	0.2	1.7	0.5	5	5	0.2
22/01/2019	0.00004	389	0.9	0.3	1	0.2	1.9	0.7	5	5	0.2
16/04/2019	0.00004	274	0.6	0.2	1	0.2	1.7	0.5	5	5	0.2
23/07/2019	0.00004	76	0.5	0.2	1	0.2	1.2	0.5	5	5	0.2
17/10/2019	0.00004	34	0.5	0.2	1	0.2	2.2	0.5	5	5	0.2
14/01/2020	0.00004	216	0.6	0.2	1	0.2	2.4	0.9	5	5	0.2

NODH4	Filtered Metal Concentrations (µg/L)										
	Mercury*	Aluminium	Chromium	Cobalt	Copper	Lead	Arsenic	Nickel	Tin	Zinc	Cadmium
LOR	*0.00004*	*5*	*0.5*	*0.2*	*1*	*0.2*	*0.5*	*0.5*	*5*	*5*	*0.2*
19/07/2018	0.00004	105	0.5	0.2	1	0.2	1.9	0.5	5	5	0.2
24/10/2018	0.00004	5	0.5	0.2	1	0.2	1.7	0.8	5	5	0.2
22/01/2019	0.00004	5	0.5	0.2	1	0.2	1.7	0.5	5	5	0.2
16/04/2019	0.00004	85	0.5	0.2	1	0.2	1.6	0.5	5	5	0.2
23/07/2019	0.00004	5	0.5	0.2	1	0.2	0.5	0.5	5	5	0.2
17/10/2019	0.00004	6	0.5	0.2	1	0.2	1.9	0.5	5	5	0.2
14/01/2020	0.00004	5	0.5	0.2	1	0.2	2.3	0.5	5	5	0.2

NODH4	Total Metal Concentrations (µg/L)										
	Mercury*	Aluminium	Chromium	Cobalt	Copper	Lead	Arsenic	Nickel	Tin	Zinc	Cadmium
LOR	*0.00004*	*5*	*0.5*	*0.2*	*1*	*0.2*	*0.5*	*0.5*	*5*	*5*	*0.2*
ANZECC (2000) guideline value	0.00007		27.4	1	1.3	4.4		70		15	5.5
19/07/2018	0.00004	220	0.5	0.2	1	0.2	2	0.5	5	5	0.2
24/10/2018	0.00004	74	0.5	0.2	1	0.2	1.8	0.5	5	5	0.2
22/01/2019	0.00004	227	0.5	0.2	1	0.2	1.8	0.5	5	5	0.2
16/04/2019	0.00004	261	0.5	0.2	1	0.2	1.5	1	5	5	0.2
23/07/2019	0.00004	75	0.5	0.2	1	0.2	0.5	0.5	5	5	0.2
17/10/2019	0.00004	77	0.5	0.2	1	0.2	2.4	0.5	5	5	0.2
14/01/2020	0.00004	205	0.5	0.2	1	0.2	2.3	0.5	5	5	0.2

*Mercury Concentrations are in mg/L

Table A 2: Sediment-Metal concentrations at SODH2

Metal	Aluminium	Copper	Lead	Nickel	Tin	Zinc	Arsenic	Cadmium	Chromium	Cobalt
Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
LOR	50	5	5	2	5	5	5	1	2	2
ISQG trigger value-low	Develop SSTV	65	50	21	Develop SSTV	200	20	1.5	80	Develop SSTV
14/04/2016	16200	7	10	10	5	24	14	1	33	7
21/07/2016	8340	5	8	6	5	16	9	1	23	4
25/10/2016	13200	6	10	9	5	23	10	1	30	7
19/01/2017	7880	5	6	5	5	17	7	1	19	4
27/04/2017	10900	5	9	8	5	19	11	1	25	6
31/07/2017	3940	5	5	3	5	10	5	1	12	2
24/10/2017	13600	6	11	9	5	43	16	1	32	7
18/01/2018	19700	8	13	14	5	55	13	1	46	10
19/04/2018	5780	5	7	5	5	15	8	1	16	4
19/07/2018	11900	6	8	8	5	26	13	1	28	6
24/10/2018	12000	5	8	8	5	20	11	1	28	6
22/01/2019	7040	5	6	4	5	20	9	1	19	3
16/04/2019	9910	6	10	7	5	20	14	1	25	6
23/07/2019	10400	5	10	8	5	23	14	1	26	5
17/10/2019	11800	5	10	8	5	22	12	1	29	6
14/01/2020	12000	6	10	8	5	20	13	1	32	6

Table A 3: Sediment-Metal concentrations at NODH2

Metal	Aluminium	Copper	Lead	Nickel	Tin	Zinc	Arsenic	Cadmium	Chromium	Cobalt
Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
LOR	50	5	5	2	5	5	5	1	2	2
ISQG trigger value-low	Develop SSTV	65	50	21	Develop SSTV	200	20	1.5	80	Develop SSTV
21/07/2016	14000	7	12	10	5	70	14	1	35	8
25/10/2016	20400	9	13	14	5	81	15	1	44	9
19/01/2017	16100	8	12	12	5	108	15	1	39	8
31/07/2017	17200	8	12	13	5	86	15	1	42	9
24/10/2017	6400	5	6	4	5	13	9	1	17	3
18/01/2018	6480	5	7	5	5	15	10	1	27	3
19/04/2018	13400	8	12	11	5	162	15	1	36	8
19/07/2018	16100	9	11	11	5	207	15	1	38	8
24/10/2018	16200	7	11	11	5	35	13	1	38	7
22/01/2019	8520	5	8	5	5	28	6	1	16	4
16/04/2019	12500	7	12	10	5	38	16	1	34	8
23/07/2019	12800	7	12	10	5	36	18	1	33	8
17/10/2019	15300	8	12	12	5	65	17	1	40	8
14/01/2020	20000	9	14	13	5	47	20	1	50	9

Table A 4: Sediment-Hydrocarbons results at SODH2

Chemical Name	Units	LOR/EQL	14/04/2016	21/07/2016	25/10/2016	19/01/2017	27/04/2017	31/07/2017	24/10/2017	18/01/2018	19/04/2018	19/07/2018	24/10/2018	22/01/2019	16/04/2019	23/07/2019	17/10/2019	14/01/2020
C10 - C14 Fraction	mg/kg	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50
>C10 - C16 Fraction	mg/kg	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50
C15 - C28 Fraction	mg/kg	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
>C16 - C34 Fraction	mg/kg	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
C29 - C36 Fraction	mg/kg	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
>C34 - C40 Fraction	mg/kg	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
C10 - C36 Fraction (sum)	mg/kg	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50
>C10 - C40 Fraction (sum)	mg/kg	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50
>C10 - C16 Fraction minus Naphthalene (F2)	mg/kg	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50
C6 - C10 Fraction	mg/kg	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
C6 - C9 Fraction	mg/kg	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
C6 - C10 Fraction minus BTEX (F1)	mg/kg	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
Naphthalene	mg/kg	1	0.8	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Benzene	mg/kg	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Ethylbenzene	mg/kg	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
meta- & para-Xylene	mg/kg	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
ortho-Xylene	mg/kg	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Total Xylenes	mg/kg	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Sum of BTEX	mg/kg	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Toluene	mg/kg	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5

Table A 5: Sediment-Hydrocarbons results at NODH2

Chemical Name	Units	LOR	14/04/2016	21/07/2016	25/10/2016	19/01/2017	31/07/2017	24/10/2017	18/01/2018	19/04/2018	19/07/2018	24/10/2018	22/01/2019	16/04/2019	23/07/2019	17/10/2019	14/01/2020
C10 - C14 Fraction	mg/kg	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50
>C10 - C16 Fraction	mg/kg	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50
C15 - C28 Fraction	mg/kg	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
>C16 - C34 Fraction	mg/kg	100	100	100	100	100	140	100	100	100	100	100	100	100	100	100	100
C29 - C36 Fraction	mg/kg	100	100	100	100	100	130	100	100	100	100	100	100	100	100	100	100
>C34 - C40 Fraction	mg/kg	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
C10 - C36 Fraction (sum)	mg/kg	50	50	50	50	50	130	50	50	50	50	50	50	50	50	50	50
>C10 - C40 Fraction (sum)	mg/kg	50	50	50	50	50	240	50	50	50	50	50	50	50	50	50	50
>C10 - C16 Fraction minus Naphthalene (F2)	mg/kg	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50
C6 - C10 Fraction	mg/kg	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
C6 - C9 Fraction	mg/kg	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
C6 - C10 Fraction minus BTEX (F1)	mg/kg	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
Benzene	mg/kg	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Toluene	mg/kg	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Ethylbenzene	mg/kg	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
meta- & para-Xylene	mg/kg	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
ortho-Xylene	mg/kg	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Total Xylenes	mg/kg	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Sum of BTEX	mg/kg	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Naphthalene	mg/kg	1	0.8	1	1	1	1	1	1	1	1	1	1	1	1	1	1

Appendix 2

WDL 212-01 Incident Investigation Report_17022020.pdf

Waste Discharge Licence 212-01

Incident Investigation Report - Channel Island Power Station Sampling Exceedances on 14 January 2020

[19/02/2020]

Report Prepared by: Janel Gaube

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Executive Summary

- Channel Island Power Station (CIPS) quarterly sampling event as detailed by their Waste Discharge Licence (WDL 212-01) was conducted on 14 January 2020. Sediment sampling was conducted at sites SODH2 and NODH2. Water sampling was conducted at sites: SODH3, SODH4, NODH3, NODH4, ILCP, ISCP, SODH1, ADP2, NODH1 and ADP1.

- Water and sediment quality (nutrients, metals, physical parameters) at the Darwin Harbour monitoring sites (CIPS discharge receiving environment) were compared with the specified guidelines in the CIPS waste discharge licence, WDL 212-01.

- As per WDL 212-01, exceedances require notification to the NT EPA.

- Important to note is that, all exceedances recorded from sampling on 14 January 2020 are not non-compliances. A non-compliance is defined as:
    - An exceedance of a trigger value on three (3) consecutive sampling occasions, or
    - An exceedance three (3) times or greater of a specified trigger value.

The notification requirements for the NT EPA pertaining to section 40 of the WDL 212-01 are as follows:

- **Section 40.1:** The exceedances were detected on 05 February 2020 by Janel Gaube.

- **Section 40.2:** Exceedances were recorded at the following sites on 14 January 2020:
    - SODH3 for Filterable Reactive Phosphorus, Nitrite and Nitrate, Dissolved Oxygen at 0829 hrs
    - SODH4 for Reactive Phosphorus, Nitrite and Nitrate, Dissolved Oxygen at 0838 hrs
    - NODH2 for Arsenic at 0912 hrs
    - NODH3 for Total Phosphorus, Nitrite and Nitrate, Dissolved Oxygen, Total Suspended Solids at 0906 hrs
    - NODH4 for Filterable Reactive Phosphorus, Nitrite and Nitrate, Dissolved Oxygen at 0856 hrs.

- **Section 40.3:** Outside sources, including storm water across the Channel Island catchment and tidal influences, likely caused the majority of the recorded exceedances.

- **Section 40.4:** No environmental harm is expected from any or all fourteen (14) exceedances recorded on 14 January 2020.

- **Section 40.5:** No further action was taken. Future results from routine monthly and quarterly monitoring as specified in WDL 212-01 will continue to be monitored.

- **Section 40.6:** No further action was taking for the following reasons:
    - No exceedances were non-compliances.
    - Most exceedances were only slightly above their specified trigger values.
    - The causes of these exceedances are likely due to storm water and tidal influences.

1. Introduction

This report details the results from routine quarterly monitoring on 14 January 2020 as specified by the Waste Discharge Licence 212-01 (WDL 212-01) for Channel Island Power Station. Further, this report investigates the likely causes of the exceedances recorded during routine quarterly monitoring on 14 January 2020.

1.1. Sampling details and site-specific observations

Table 1-1 displays the sites sampled on 14 January 2020 and site-specific observations.

Table 1-1: Sites sampled on 14 January 2020

	Sample Site											
Sampling event	**SODH1**	**NODH1**	**ADP1**	**ADP2**	**ISCP**	**ILCP**	**SODH2 (sediment)**	**SODH3**	**SODH4**	**NODH2 (sediment)**	**NODH3**	**NODH4**
	Monthly Monitoring				Quarterly Monitoring							
Time (hrs)	1009	1059	1040	1134	1118	1109	0849	0829	0838	0912	0906	0856
14/01/2020	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Total water depth (m)	N/A						4.7	4.7	5.9	3.6	3.6	5.9
Site-specific observations (if any)							Fine sediment with sand	Moderate mangrove debris on the water surface; visible suspended particles; water colour was blue-green	Moderate mangrove debris on the water surface; visible suspended particles; water colour was blue-green	Fine sediment with sand	Heavy mangrove debris on the water surface; visible suspended particles; water colour was blue-green	Heavy mangrove debris on the water surface; visible suspended particles; water colour was blue-green

✓-Sampled ✗ -Not sampled N/A -Not Applicable

2. Exceedances

2.1. WDL 212-01 Quarterly Sampling Event - 14 January 2020

Table 2-1 shows results for all exceedances recorded including Nutrients, *in-situ* measurements and physical parameters related to the water samples collected from the receiving environment (Darwin Harbour) for the January 2020 sampling event. The results were compared with the trigger values specified in the WDL 212-01. As shown in Table 2-1, values in red text indicate exceedances of the specified trigger values (WDL 212-01). Filterable Reactive Phosphorus concentration at sites SODH3, SODH4 and NODH4, Total Phosphorus concentration at site NODH3, Nitrite and Nitrate (NOx) and Dissolved Oxygen at sites SODH3, SODH4, NODH3 and NODH4 and Total Suspended Solids at site NODH3 were all above their specified trigger values.

Table 2-1: Exceedance monitoring results on 14 January 2020 and trigger values imposed by WDL 212-01 for the four marine water monitoring sites located on Darwin Harbour

	Trigger Value	Unit	SODH3	SODH4	NODH3	NODH4
	Nutrients					
Filterable Reactive Phosphorus	<10	$\mu g/L$	11	10	<1	10
Total Phosphorus	<30	$\mu g/L$	21	6	47	10
Nitrate and Nitrite (NOx)	<20	$\mu g/L$	29	30	30	29
	in-situ Measurements					
Dissolved Oxygen	>80	%	70.3	71.3	67.9	77.0
	Physical Parameters					
Total Suspended Solids	<10	mg/L	<5	<5	14	<5

Table 2-2 shows the metal concentration exceedances on 14 January 2020 and the trigger value imposed by WDL 212-01 for the two sediment monitoring sites located on Darwin Harbour. As shown in Table 2-2, Arsenic concentration at site NODH2 (20 mg/kg) was just above the specified trigger value (red text, Table 2-2).

Table 2-2: Exceedance metal concentrations on 14 January 2020 and trigger values imposed by WDL 212-01 for the two sediment monitoring sites located on Darwin Harbour

Metals	Trigger Value	Units	SODH2	NODH2
Arsenic	<20	mg/kg	13	20

3. Reporting Requirements

3.1. Exceedance reporting requirements

All exceedances from specified trigger values require notification to the NT EPA as specified by section 40 in the WDL 212-01. All exceedances from sampling on 14 January 2020 are not non-compliances.

A non-compliance that requires reporting to the NT EPA is defined as:

- an exceedance of a trigger value on three (3) consecutive sampling occasions, or
- an exceedance of three (3) times or more a trigger value.

Further explanation can be found in Appendices 1 and 2.

Section 40.1: Exceedance discovery details

The exceedances were detected on 05 February 2020 by Janel Gaube.

Section 40.2: Exceedance details

Exceedances were recorded at the following sites on 14 January 2020:

- SODH3 for Filterable Reactive Phosphorus, Nitrite and Nitrate, Dissolved Oxygen at 0829 hrs
- SODH4 for Reactive Phosphorus, Nitrite and Nitrate, Dissolved Oxygen at 0838 hrs
- NODH2 for Arsenic at 0912 hrs
- NODH3 for Total Phosphorus, Nitrite and Nitrate, Dissolved Oxygen, Total Suspended Solids at 0906 hrs
- NODH4 for Filterable Reactive Phosphorus, Nitrite and Nitrate, Dissolved Oxygen at 0856 hrs.

Section 40.3: Probable causes for exceedances

Tidal influence

A spring tide was occurring during sampling on 14 January 2020, with an expected total water movement of 5.89 m; hide tide was at 0756 hrs at a height of 6.79 m and low tide was at 1438 hrs at 0.90 m. Sediments (gravel, clays, etc) settled on the seafloor can be resuspended into the water column by large water movements, affecting TSS concentration. Large water movements can also affect Nutrient (FRP, TP and NOx) and DO% readings. Samples were collected in the Darwin Harbour monitoring sites (CIPS discharge receiving environment) just after high tide.

Storm water influence

Attending TWS field staff noted evidence of recent rainfall in the area surrounding CIPS on 14 January 2020. Rainfall over the Channel Island catchment would carry sediments and detritus into the harbour surrounding CIPS. This storm water could influence the results collected on 14 January 2020, causing elevated TSS and Nutrient concentrations and low surface water DO% readings.

As detailed in Table 3-1, the Bureau of Meteorology (BoM) records rainfall data from a myriad of weather stations in various locations across the Northern Territory. The BoM subsequently publishes data collected from these stations online (Bom.gov.au, 2020). Unfortunately, data is not collected daily from each station of BoM property and data from the station on Channel Island was last collected on 30 January 2018. Consequently, TWS looked at rainfall data from the next four (4) nearest stations to CIPS with current rainfall data, as detailed in Table 3-1 and Figure 3-1.

Table 3-1: BoM Weather Station Details and Rainfall Data

Station Name	Channel Island	Fort Hill Wharf	Wagait Beach	Territory Wildlife Park	Noonamah Airstrip
BoM Station ID	014009	014050	014238	014264	014314
Latitude	12.55°S	12.47°S	12.43°S	12.71°S	12.61°S
Longitude	130.87°E	130.85°E	130.75°E	130.99°E	131.05°E
Rainfall recorded 11-13 January 2020 [mm]	Not Recorded	177.0	516.2	103.2	77.6

Figure 3-1: BoM Stations in close proximity to Channel Island Power Station

Though great variation in rainfall volumes between these four (4) stations is present as detailed in Table 3-1, it is highly likely a significant volume of rain fell in the area around Channel Island Power Station in the days previous to sampling (11 – 13 January 2020) due to the proximity of these stations to Channel Island. This would cause a significant volume of storm water runoff to enter Darwin Harbour in the days previous to sampling, influencing the results collected from the harbour around Channel Island on 14 January 2020.

Additionally, the Electrical Conductivity (EC) of the marine sites (NODH3, NODH4, SODH3 and SODH4) on 14 January 2020 was significantly lower than the EC on previous sampling occasions, as specified by Table 3-2. This lowered EC relative to the previous two (2) sampling occasions can be attributed to the incoming storm water (i.e. non-saline water) entering the harbour before sampling.

Table 3-2: Electrical Conductivity at marine sites as specified by WDL 212-01 for the previous three (3) sampling events.

	23/07/2019	17/10/2019	14/01/2020
Site	Electrical Conductivity (µS/cm)		
NODH3	55100	56600	52000
NODH4	55300	56700	52000
SODH3	55100	56900	51500
SODH4	55100	56900	51600

CIPS Northern and Southern discharge influence

Table 3-3 details the monitoring results from CIPS discharge points (ADP1 and ADP2) and CIPS discharge outlets (NODH1 and SODH1) for all analytes with a recorded exceedance value at sites SODH3, SODH4, NODH3 or NODH4. Both NODH1 and SODH1 are located outside of the CIPS property boundary and are affected by storm water. Important to note is that the sites listed in Table 3-3 are not in the Darwin Harbour receiving environment and therefore, are not considered to be exceedances of the specified trigger values in WDL 212-01.

Table 3-3: Monitoring results for relevant analytes from CIPS discharge points on 14 January 2020

	Unit	ADP2	SODH1	ADP1	NODH1
	Nutrients				
Filterable Reactive Phosphorus	$\mu g/L$	<10	<10	90	10
Total Phosphorus	$\mu g/L$	30	30	290	60
Nitrate and Nitrite (NOx)	$\mu g/L$	130	860	270	1960
	in-situ Measurements				
Dissolved Oxygen	%	56.5	65.1	61.5	70.4
	Physical Parameters				
Total Suspended Solids	mg/L	23	<5	<5	<5

TP concentration at ADP1 is greater than the TP concentration at NODH1. In contrast, NOx concentration at ADP1 is significantly less than the NOx concentration at NODH1. The Nutrient concentrations at NODH1, a CIPS discharge outlet, are fluctuating irrespective of the Nutrient concentrations at APD1, a CIPS discharge point. It is possible these fluctuations are caused by outside sources, such as storm water and/or the presence of cane toads. Similar to NODH1, the fluctuations in Nutrient concentrations at ADP2, a CIPS discharge point, and SODH1, a CIPS discharge outlet, could be caused by outside sources.

DO% results in the water fluctuate between sampling sites. The lower DO% could be due to several factors including water temperature and the presence of oxygen demanding materials in the water. The TSS concentration at the CIPS discharge outlet, NODH1, is below the laboratory detection limit and are unlikely to have caused the TSS exceedance found at NODH3.

Other outside source influence

The Darwin Aquaculture Centre (DAC) is one of other facilities located on Channel Island. The DAC discharges into Darwin Harbour from a location directly beside SODH1 and could have influence on results collected from SODH3 and SODH4.

Section 40.4: Environmental harm

Negative effects expected from the fourteen (14) recorded exceedances in relation to sampling on 14 January 2020 for WDL 212-01 are unlikely. Marine water trigger values in WDL 212-01 are taken directly from Marine and Estuarine Systems - Upper Estuary guidelines from the water quality objectives for Darwin Harbour (Department of Natural Resources and Environment, 2010). An exceedance of these trigger values only indicates potential risk for environmental harm. As the exceedances recorded on 14 January 2020 are only slightly above, or in the case of DO% slightly below, the specified trigger values, it is unlikely environmental harm will occur.

Marine sediment trigger values in WDL 212-01 are based on the *low* Interim Sediment Quality Guidelines (Australia and New Zealand Environment and Conservation Council, 2000). The Arsenic trigger value of <20 mg/kg is a default guideline value, below which "there is a low risk of unacceptable effects occurring" (Australia and New Zealand Environment and Conservation Council, 2000). The upper guideline for Arsenic is <70 mg/kg. As the concentration of Arsenic found at NODH2 on 14 January 2020 is just above the low guideline and is significantly below the upper guideline, it is unlikely environmental harm will occur.

As most exceedances recorded from CIPS monitoring were only slightly above the specified trigger values and no exceedance was a non-compliance, it is unlikely adverse ecological effects will occur.

Section 40.5: Further action(s)

No further action was taken in relation to exceedances found during the 14 January 2020 quarterly sampling event in relation to WDL 212-01.

Section 40.6: Further action(s) explanation

No further action was taken in relation to exceedances found during the 14 January 2020 quarterly sampling event in relation to WDL 212-01 for the following reasons:

1. No exceedances were non-compliances.
2. Most exceedances were only slightly above their specified trigger values.
3. The causes of these exceedances were likely due to storm water and tidal influences.

4. References

Australia and New Zealand Environment and Conservation Council. (2000). *Australia and New Zealand Guidelines for Fresh and Marine Water Quality, Volume 1.* Australia and New Zealand Environment and Conservation Council.

Bom.gov.au. (2020). *Climate Data Online*. [online] Available at: http://www.bom.gov.au/climate/data/ [Accessed 17 Feb. 2020].

Department of Natural Resources and Environment. (2010). *Water Quality Objectives for the Darwin Harbour Region – Background Document*. Northern Territory Government, Department of Natural Resources and Environment, Aquatic Health Unit.

WDL 212-01, *Waste Discharge Licence 212-01 (June 2018).* Northern Territory Government.

Appendix 1

Trigger value exceedances - Marine water samples

Slightly elevated Filterable Reactive Phosphorus (FRP) concentrations were recorded at sites SODH3, SODH4 and NODH4; however, these values of 11 µg/L, 10 µg/L and 10 µg/L respectively were lower than three (3) times the trigger value of <10 µg/L (10 or 11 µg/L < <10 µg/L * 3). As well, there were no exceedances of the trigger values on three (3) consecutive sampling events as the previous two sampling events for sites SODH3, SODH4 and NODH4 had results lower than 10 µg/L (see Appendix 2).

An elevated Total Phosphorus concentration was recorded at site NODH3; however, this value of 47 µg/L was lower than three (3) times the trigger value of <30 µg/L (47 µg/L < 30 µg/L * 3). As well, there was no exceedance of the trigger value on three (3) consecutive sampling events as the previous two sampling events at site NODH3 had results lower than 30 µg/L (see Appendix 2Appendix 1).

Elevated Nitrate and Nitrate (NOx) concentrations were recorded at sites SODH3, SODH4, NODH3 and NODH4; however, these values of 29 µg/L, 30 µg/L, 30 µg/L and 29 µg/L respectively were lower than three (3) times the trigger value of <20 µg/L (29 or 30 µg/L < 20 µg/L * 3). As well, there were no exceedances of the trigger values on three (3) consecutive sampling events as the previous two sampling events for sites SODH3, SODH4, NODH3 and NODH4 had results lower than 20 µg/L (see Appendix 2).

Low Dissolved Oxygen (DO%) percentages were recorded at sites SODH3, SODH4, NODH3 and NODH4; however, these values of 70.3%. 71.3%, 67.9% and 77.0% respectively are greater than three (3) times lower the trigger value of >80% (67% – 77% > 80% ÷ 3). As well, there were no exceedances of the trigger values on three (3) consecutive sampling events as the previous two sampling events for sites SODH3, SODH4, NODH3 and NODH4 had results higher than >80% (see Appendix 2).

A high Total Suspended Solids (TSS) concentration was recorded at site NODH3; however, this value of 14 mg/L was lower than three (3) times the trigger value of 10 mg/L (14 mg/L < 10 mg/L * 3). As well, there was no exceedance of the trigger value on three (3) consecutive sampling events as the previous two sampling events had results lower than 10 mg/L (see Appendix 2).

Trigger value exceedances - Sediment samples

Since the beginning of sampling of CIPS sites by TWS in April 2016, there have been no exceedances reported in Arsenic at site NODH2. Arsenic concentration on 14 January 2020 was 20 mg/kg and was just above the specified trigger value of <20 mg/kg (WDL 212-01). TWS will continue to monitor this slightly elevated Arsenic result during routine quarterly sampling.

Appendix 2

Table 5-1, Table 5-2, Table 5-43, Table 5-54 and Table 5-35 detail results from the current and previous two (2) sampling events relevant to the analytes with exceedances found from sampling on 14 January 2020. No exceedance found on 14 January 2020 is a not non-compliance as exceedances at no sites (SODH3, SODH4, NODH2, NODH3, or NODH4) occurred three (3) times consecutively, as detailed by Tables 5 below. Values in red text indicate exceedances of the specified trigger values (WDL 212-01).

Table 5-1: Site SODH3 monitoring results for current and previous two (2) sampling events

			SODH3		
	Trigger Value	**Unit**	**23/07/2019**	**17/10/2019**	**14/01/2020**
	Nutrients				
Filterable Reactive Phosphorus	<10	$\mu g/L$	1	2	11
Nitrate and Nitrite (NOx)	<20	$\mu g/L$	7	6	29
	in-situ Measurements				
Dissolved Oxygen	>80	%	94.9	86.5	70.3

Table 5-2: Site SODH4 monitoring results for current and previous two (2) sampling events

			SODH4		
	Trigger Value	**Unit**	**23/07/2019**	**17/10/2019**	**14/01/2020**
	Nutrients				
Filterable Reactive Phosphorus	<10	$\mu g/L$	2	1	10
Nitrate and Nitrite (NOx)	<20	$\mu g/L$	<2	10	30
	in-situ Measurements				
Dissolved Oxygen	>80	%	93.2	88.9	71.3

Table 5-3: Site NODH2 monitoring results for current and previous two (2) sampling events

			NODH2		
	Trigger Value	**Unit**	**23/07/2019**	**17/10/2019**	**14/01/2020**
Arsenic	<20	mg/kg	18	17	20

Table 5-4: Site NODH3 monitoring results for current and previous two (2) sampling events

			NODH3		
	Trigger Value	**Unit**	**23/07/2019**	**17/10/2019**	**14/01/2020**
	Nutrients				
Total Phosphorus	<30	$\mu g/L$	<5	<5	47
Nitrate and Nitrite (NOx)	<20	$\mu g/L$	3	9	30
	in-situ Measurements				
Dissolved Oxygen	>80	%	94.1	81.2	67.9
	Physical Parameters				
Total Suspended Solids	<10	mg/L	<5	<5	14

Table 5-5: Site NODH4 monitoring results for current and previous two (2) sampling events

			NODH4		
	Trigger Value	**Unit**	**23/07/2019**	**17/10/2019**	**14/01/2020**
	Nutrients				
Filterable Reactive Phosphorus	<10	$\mu g/L$	2	<1	10
Nitrate and Nitrite (NOx)	<20	$\mu g/L$	3	9	29
	in-situ Measurements				
Dissolved Oxygen	>80	%	92.3	80.5	77.0