



Ludmilla WwTP WDL 150 Monitoring Report

2022

PowerWater

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Executive Summary

This report summarises the monitoring results and analysis of sampling undertaken in accordance with Waste Discharge Licence 150-08 and fulfils the reporting requirements to both the Department of Environment, Parks and Water Security under WDL 150-08 and to the Department of Agriculture, Water and the Environment under approval EPBC 2009/5113 for the period of September 2021 – July 2022.

Analysis of Ludmilla WWTP effluent and receiving water monitoring data from Darwin Harbour and Ludmilla Creek indicate the following:

- All surface water parameters at all monitoring sites met the physico-chemical trigger values required for the protection of the Beneficial Uses declared for Darwin Harbour and slightly to moderately disturbed (SMD) ecosystems.
- Some monitoring sites exceeded total phosphorus, a secondary nutrient indicator, objectives; however, none of the sites exceeded the primary indicator chlorophyll-a.
- Pathogen indicator levels were found to be in exceedance of declared Beneficial Use guideline values and of high risk at sites SLuLC01 and SLuLC02. These levels were unlikely to be influenced by the discharge from the Ludmilla WwTP as the sites are located upstream of the Ludmilla WwTP and were not influenced by the East Point Outfall (EPO1) or the overflow to Ludmilla Creek.
- Elevated levels of ammonia (NH₃) were recorded at site EPO1 in both the sediment and pore water samples but did not persist at sites further out from the EPO.
- Sediment monitoring demonstrated that nutrient and toxicant indicators were below trigger values and sediment quality guidelines (SQG) for all parameters at all sites with the exception of slightly elevated chlorophyll-a concentrations at the EPO and site SLuEP02. While the nutrient concentrations in the sediments were below trigger values, elevated TP concentrations were recorded in the water at all receiving sites, potentially available for algal uptake. The presence of algae was recorded as elevated chlorophyll-a concentrations in some of the sediments (but not in the water).

The results of this assessment indicate that the effect of the Ludmilla WwTP discharge is negligible beyond a radius of 220m from the ocean outfall site (SLUEP01) and of low risk of adverse impacts to the receiving environment.

1 Report Scope

This report presents the results of the September 2021 to July 2022 data collection and assessment required for Waste Discharge Licence (WDL) 150-08 for surface water, sediment and biological monitoring. Benthic Infauna monitoring was not conducted during this period as reported to the NT EPA on 13/5/22 due to Covid-19 Travel restrictions.

This report is prepared in accordance with conditions in WDL 150-08 issued to Power and Water Corporation, pursuant to section 74 of the *Water Act* 1992. WDL 150-08 commenced on 1st November 2020. The licence can be accessed via the NT EPA website through; <https://ntepa.nt.gov.au/your-business/public-registers/licences-and-approvals-register/waste-discharge-licences/sewerage/power-and-water-ludmilla>

Specific Licence conditions in WDL 150-08 that govern the requirements of this report are:

- 38 *The licensee must complete and provide to the Administering Authority a Monitoring Report, as prescribed by this licence, not less than 30 business days prior to the anniversary date of this licence by emailing waste@nt.gov.com.*
- 39 *The licensee must ensure that each Monitoring Report:*
- 39.1. *is prepared in accordance with the requirements of the NT EPA 'Guideline for Reporting on Environmental Monitoring';*
 - 39.2. *includes a tabulation of all monitoring data required as a condition of this licence including surface water, sediment and biological monitoring;*
 - 39.3. *includes long-term trend analysis of monitoring data to demonstrate any environmental impact associated with the Licenced activity over a minimum period of three years (where the data is available);*
 - 39.4. *Provides an assessment against the annual report reporting criteria notes in Appendix 1 Table 2.*
 - 39.5. *Includes and assessment of environmental impacts from the Activity*
 - 39.6. *contains a summary of the licence limit (site specific trigger value) exceedances that have occurred during the reporting period*
 - 39.7. *Reports on annual loads discharged from Slu080 as per Appendix 1 of this licence.*

2 Monitoring Objectives and Methods

The monitoring conducted in this reporting period including Licence Limits, Site Specific Threshold Values (SSTVs) and site locations is specified in the approved monitoring plans under WDL 150-08 in Appendixes 1, 2, 3, 4 and 5 of the licence. All site maps and other pertinent information can be found in the licence document.

Specific licence conditions related to monitoring in WDL 150-08 include:

- 22 *The Licensee must conduct water monitoring in accordance with Appendix 1 of this licence*
- 23 *The Licensee must conduct sediment monitoring in accordance with Appendix 2 of this licence*
- 24 *The Licensee must conduct biological monitoring in accordance with Appendix 3 of this licence*

- 25 The licensee must ensure that all samples and field environmental data are representative of the conditions at the time of sampling.
- 26 The licensee must ensure that all samples and field environmental data are collected in accordance with recognised Australian Standards and guidelines (such as AS/NZS 5667, ANZECC/ARMCANZ).
- 27 The licensee must ensure that all monitoring samples are analysed at a laboratory with current NATA accreditation or equivalent, for the parameters to be measured.
- 28 The licensee must for all land based monitoring points specified in Appendix 1, 2 and 3 of this licence
- 28.1. Install, maintain and provide appropriate identification signage so that they are easily identifiable at all times; and
- 28.2. Maintain safe access and egress, as is reasonably practicable
- 29 The licensee must ensure any samples collected in accordance with Appendix 1, 2 and 3 of this licence or in connection with the Licenced activity or this licence, are obtained by, or under the supervision of, a qualified sampler
- 30 The licensee must ensure that, for each sample collected in accordance with Appendix 1, 2 and 3 of this licence for the activity, the following information must be recorded and retained:
- 30.1. the date on which the sample was collected;
- 30.2. the time at which the sample was collected;
- 30.3. the location at which the sample was collected;
- 30.4. the name of the person who collected the sample;
- 30.5. the chain of custody forms relating to the sample;
- 30.6. the field measurements (if any) and analytical results relating to the sample; and
- 30.7. laboratory quality assurance and quality control documentation.

3 Overview of Assessed data

All collected data associated with WDL 150-08 and referred to in this report is contained, summarised and presented in an Excel spreadsheet, stored in Power and Water’s document storage system (Content Manager), entitled Ludmilla WDL data 2021-2022, with a document reference number D2022/15737. This document contains a very detailed analysis and presentation of all collected data and is available on request.

Table 1 below displays a summary of the data assessed in this report.

Table 1: Summary of data assessed in 2021-2022

Data Type	WQMMP Report
Influent and Effluent (Flow)	4.1 Influent and Effluent (Flow) 4.1.2 Mass Loading
Surface water and discharge	4.2.1 Surface Water and Discharge Summary Data 4.2.2 Pathogen Analysis 4.2.3 Nutrient Analysis

Data Type	WQMMP Report
	4.2.4 Physicochemical Analysis 4.2.5 Toxicant Analysis 4.2.6 All Parameters Analysis
Sediment Monitoring	4.3 Sediment
Biological: Ecotoxicology	No monitoring or assessment undertaken in this reporting period
Biological: Benthic Infauna	No monitoring or assessment undertaken in this reporting period
Biological: Blue Green Algae (Cyanobacteria)	Monitoring undertaken but no assessment as no detections of Cyanobacteria at the monitoring plan sites.

3.3 Assessment criteria

The WDL 150 compliance monitoring assessed results against SSTVs relevant to the protection of the declared Beneficial Uses under the *Water Act* (NT) and the Darwin Harbour Water Quality Objectives (DHWQO) (NRTEAS 2010). These SSTV values have been developed and refined from previous versions of WDL 150 in partnership between the NT EPA and the Power and Water Corporation.

3.3.1 Surface Water

Assessment for the reporting period for each of the parameters is against either a guideline standard or an SSTV as required in Appendixes 1, 2 and 3 of WDL 150-08. The 2021 - 2022 data set was assessed against the DHWQO guidelines for the Outer or Mid Estuary, the ANZG 95% level of species protection (ANZG 2018), and for enterococci, e NHMRC (2008) Guidelines for Recreational Water.

For this assessment, where percentiles were the required reporting statistic, the most recent 24 monthly results were used to calculate the percentile value with the exception of metals, which tend to remain in the environment for long periods. Percentiles for metals were calculated over a longer term using all data since commissioning of the augmented (duplicated) rising main in 2016. For parameters where percentiles were not the required reporting statistic, medians calculated from the most recent 24 monthly samples were used for assessment. For exceedance reporting, individual spot values were compared to guideline values. For exceedance reporting, for parameters where a percentile was the required reporting statistic, rolling 24 monthly percentiles, again with the exception of metals which used the full dataset since 2016, were used for assessing compliance.

3.3.2 Sediment

As specified in the WDL sediment monitoring plan, sediment quality was assessed against either Sediment Quality Guideline (SQG) ANZG (2018) values, water quality SSTVs for the relevant zone or against 2 x 80th percentile of reference site data from Kings Creek and Short Creek (sampled at 7 sites) in Darwin Harbour.

3.3.3 Biological

Ecotoxicology - assessment discontinued. Ecotoxicological assessments were undertaken in 2014 and 2018 and the results presented in previous reports.

Benthic infauna - No Benthic infauna monitoring or assessment was conducted during this reporting period.

Blue Green Algae – Monitoring conducted but no assessment as there were no detections of cyanobacteria during the reporting period.

3.3.4 Sampling artefacts

All data assessments should be considered in the context of relevant operational history and other factors that may temporarily influence water quality. A summary is given below:

- Redirection of the Larrakeyah and Darwin sewage catchments to Ludmilla WWTP following closure of the Larrakeyah Outfall, 31 May 2012.
- Upgrading of the Ludmilla WWTP to increase treatment and hydraulic capacity required due to the increased inflow following closure of Larrakeyah; works completed December 2012;
- Commissioning of upgraded treatment plant completed May 2014;
- Augmentation (duplication) of the East Point rising main to accommodate increased discharge via East Point Outfall, works completed August 2015;
- Effluent discharge pumps augmentation completed in February 2015;
- EPBC 2009/5113 approval to commission the augmented main received July 2016;
- Commissioning to increased flow commenced in wet season (November) 2016;
- Ongoing work to improve performance to meet design expectation – 2017 -2022 wet seasons;
- Water Monitoring WDL150-08.
- Seasonally changing discharge volumes ([section 4.1](#)).

4 Results and Assessment

4.1 Influent and Effluent (Flow)

[Table 2](#) provides a summary of monthly inflows into Ludmilla WwTP and discharges from the WwTP to both the EPO and Ludmilla Creek. [Figure 1](#) displays these flows from 2015 – 2022.

Table 2: Seasonal Inflow and Outflow for July 2021 to June 2022 (Monthly total kL)

WDL150-08		Inflow		Discharge	
Month	Days	Ludmilla WwTP	Ludmilla Creek	East Point Outfall	Total discharge
Jul-21	31	382,428	0	344,692	344,748
Aug-21	31	370,522	0	342,807	342,863
Sep-21	30	366,036	0	335,431	335,463
Oct-21	31	378,608	0	349,311	349,328
Nov-21	30	378,746	0	352,943	353,007
Dec-21	31	608,432	638	595,949	596,588

WDL150-08		Inflow	Discharge		
Month	Days	Ludmilla WwTP	Ludmilla Creek	East Point Outfall	Total discharge
Jan-22	31	895,699	566	900,902	901,468
Feb-22	28	924,860	164	924,696	924,860
Mar-22	31	696,829	1147	695,682	696,829
April-22	30	574,541	0	574,541	574,541
May-22	31	418,228	17	410,414	417,414
June-22	30	369,652	0	351,032	351,032
Totals	365	6,346,581	2,532	6,178,400	6,188,141
% of Total discharge			0.04	99.84	
Seasonal Totals	Days	Inflow	Ludmilla Creek discharge	EPO discharge	Total Discharge
Wet Season	181	4,079,107	2,515	4,044,713	4,047,293
% seasonal discharge	0.06	99.94	0.04	65.36	
% Total			0.06	99.94	
Dry Season	185	2,285,474	17	2,133,687	2,140,848
% seasonal discharge			<0.0008	34.48	
% total			<0.0008	99.67	
WDL Total	365	6,346,581	2,532	6,178,400	6,188,141

Inflow vs Outflow to EPO and Ludmilla Creek (2015 - 2022)

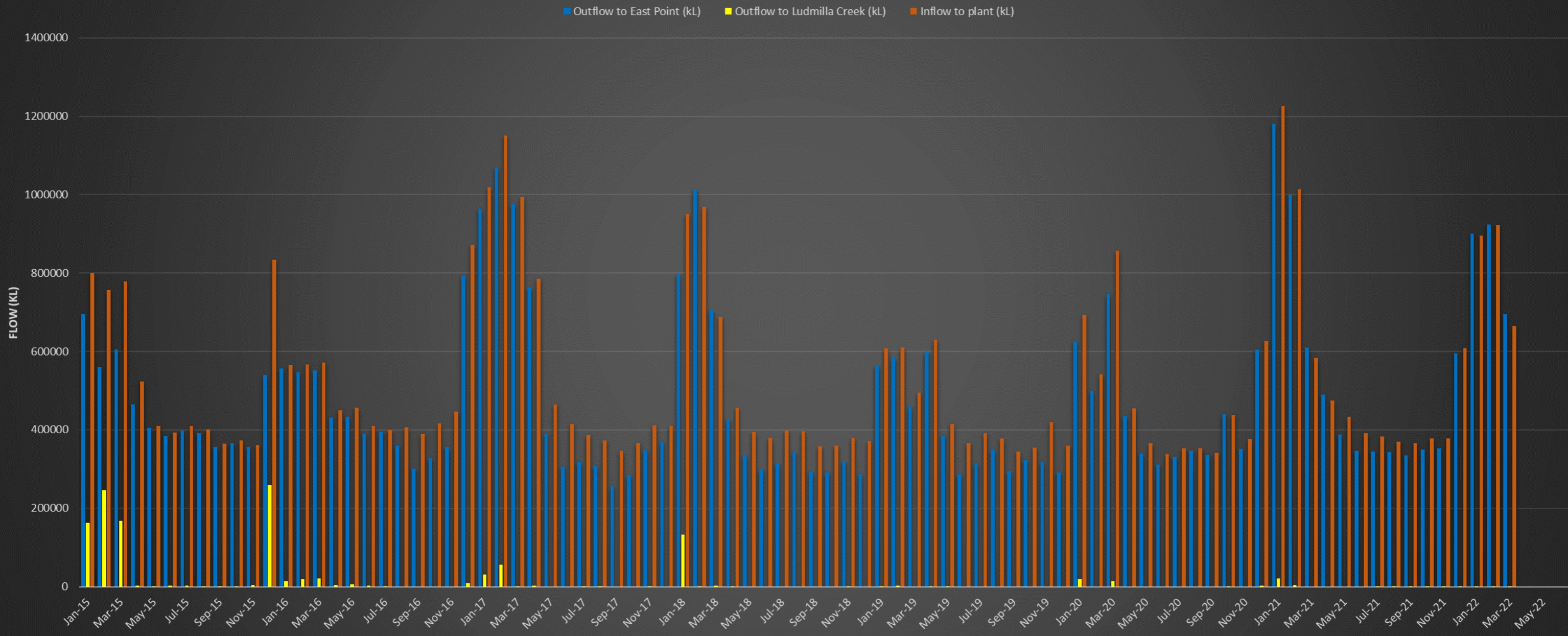


Figure 1: Monthly inflow and outflow at Ludmilla Wastewater Treatment Plant 1 Jan 2015 to March 2022

4.1.1 Flow Analysis

Treated effluent from Ludmilla WwTP is discharged via two discharge points; the primary discharge point is the intertidal EPO, with a secondary discharge point in high inflow and emergency shut down situations, into Ludmilla Creek via a bypass drain. A clear seasonality was apparent with high influent and effluent volumes in the wet season (November to April) and lower volumes in the dry season. Inflow and discharges were influenced primarily by seasonal rainfall events. Following augmentation (duplication) of the East Point Rising Main (EPRM), greater than 99.67% of the treated wastewater is transferred via the EPRM to the EPO during the dry season (May to October inclusive). The percentage of the total treated effluent discharged via the EPO reduces slightly to 99.53% in the wet season, representing a significant improvement on the pre-commissioning discharges where 99.48% of dry season flows and 89.4% of wet season flows were via the EPO. Table 2 shows that there was no overflow to Ludmilla Creek during the 2021/22 dry season and minimal overflow in May 2022.

4.1.2 Loading

Mass load estimates are provided using data from inflow and discharge points. It should be noted that reported values are subject to uncertainty due to laboratory analysis reporting limits. The method for calculating discharge loads was to multiply the reported analyte concentrations by inflow and discharge volumes. In the event that reported analyte concentrations were below the limits of reporting (LOR), half the LOR value was used for the calculation. [Table 3](#) below presents mass loads for selected parameters for the 2021 – 2022 financial year.

Table 3 confirms that the treatment at the Ludmilla WwTP is reducing the loads of contaminants entering Darwin Harbour, with the exception of a very slight increase in COD. The load of contaminants entering Ludmilla Creek has reduced significantly for all parameters between 2020/21 and 2021/22. This is related to the lower volumes of effluent discharged from SLU080 to Ludmilla Creek as shown in Figure 1.

Table 3 Mass loading estimates summary for selected parameters

Parameter	Discharge to East Point Outfall (tonnes/y)	% Change from Previous year	Outflow to Ludmilla Ck (tonnes/y)	% Change from previous year
BOD	359	-8.2	0.12	-74
COD	1050	0.29	0.37	-77
NH3-unionised	141	-2.5	0.04	-87
NH3 Organic	30	-7.3	0.01	-86
NOX	1.7	-13	0.0005	-96
TN	172	-2.3	0.05	-86
FRP	2.5	-27	0.008	-93
TP	7	-20	0.002	-89
Cu	0.32	Unavailable	0.0001	Unavailable
Zn	0.04		0.00002	

4.2 Surface Water and Discharge

4.2.1 Surface water and discharge summary data analysis

All data was collected at the frequencies defined in the Surface Water and Discharge Monitoring schedule of the WDL 150-08. The QA/QC criteria of sampling and data analysis (collection of blanks, duplicate and triplicate samples) were met for water quality monitoring (ANZG 2018).

[Table 4](#) below, includes a summary of the monitoring data for each site. [Table 5](#) characterises the risk associated with each monitoring parameter using hazard ratios based on relevant trigger values. All surface water, sediment, sediment pore water and mass load data for the 2021/22 reporting period is located in [Appendix A](#).

Table 4: Surface water and discharge monitoring data assessment.

Water Quality Monitoring Assessment: Ludmilla WwTP Discharge and East Point Receiving Waters, Comparison against Guidelines to 2/7/22																			
Indicator type	Pathogen indicators			Physico-chemical indicators						Nutrient Indicators						Toxicant Indicators			
parameter	<i>E. coli</i>		Enterococci	pH	EC	DO		Turbidity	TSS	BOD	Chl-a	FRP	TP	NH3-N	TN	NOx	NH3-N	Cu (D)	Zn (D)
Unit	cfu/100 mL			pH units	µS/cm	% sat		Ntu	mg/L	mg/L	µg/L	mg/L	mg/L	mg/L	mg/L	µg/L	mg/L	µg/L	µg/L
DHWQO	14	43	50	7.0 - 8.5 ¹		80	100						0.02	0.02	0.27	0.17	0.91	Natural estuary range	Natural estuary range 0.39-3.8
SMD							110				2	0.01	0.03		0.3	0.02		0.06-1.3	
ZOI				6.5 - 8.5 ²		50	110				4						1.2		
ANZECC level of species protection	Not applicable		40 (NHMRC)	7.0 - 8.5		80-	120			<2 ³	2	0.005	0.02	0.015	0.25	0.03	0.91	1.3 - SMD	15
Assessment criteria	Aquatic food: ^h		Primary Contact Rec ⁿ			Low	High												
percentile	50 ^t	90 ^t	95 th	50 th	50 th	20 th	80 th	50 th	50 th	95 th	50 th	50 th	50 th	50 th	50 th	50 th	95 th	95 th	95 th
Discharge point and treated effluent (receiving water quality guidelines is not directly applicable); ³ PER approved treatment plant design criteria, no guideline values for receiving waters <2 is desirable for rivers and marine waters, no guidance available for estuaries due to natural dissolved organic matter availability; ⁴ ANZECC Low Reliability Trigger Values, Section 8 of ANZECC/ARMCANZ Guidelines for Fresh and Marine Waters.																			
Colour code: (Green) - Meets National and Darwin Harbour Water Quality Objectives (DHWQO) ≤ guideline; (Orange) exceeds DHWQO, Exceeds national (ANZECC/NHMRC) trigger or control stat exceeded; (red) exceeds all objectives and disturbed (D) triggers by 3x.																			
Assessment against SSTVs: Discharge SLu080 Effluent within the treatment plant (discharges to Ludmilla Creek (overflow) and East Point Outfall via the East Point Rising Main)																			
SLu080:Effluent	36	198	172	7.76	1042	40.3	51.26	32.75	38.00	123.4	0.58	0.71	1.83	30.46	37.15	0.25	37.93	0.074	0.012
Assessment against SSTVs: ZOI East Point Outfall (intertidal outfall) within Darwin Harbour receiving waters																			
SLuEP01 ¹ outfall (discharge)	1	22	78	8.00	50500	83.98	93.7	5.37	3.50	2	0.68	0.004	0.0585	0.416	0.68	0.005	0.0685	0.002	0.003
SLuLC03 (at inlet drain)	26	91	79	7.80	51850	59.36	77.94	11.65	8.00	2	3.27	0.004	0.044	0.005	0.17	0.005	0.005	0.001	0.003
Assessment against SSTVs: Darwin Harbour receiving waters SMD (sites between 220 and 500 metres of outfall – impact zone – exceedance of triggers due to discharge low likelihood)																			
SLuEP02 ¹	0	1	6	8.10	51800	79.28	93.36	3.68	2.00	2	0.65	0.003	0.039	0.005	0.08	0.003	0.005	0.001	0.003
SLuEP03 ¹	0	1	4	8.10	51600	83.76	93.48	3.75	1.00	2	0.67	0.003	0.037	0.005	0.18	0.003	0.005	0.001	0.003
Assessment against SSTVs: SMD Catchment Inflow to Darwin Harbour receiving waters: via Ludmilla Creek																			
SLuLC01 up-stream	43	722	934	7.60	47900	36.6	48.62	9.36	6.00	2	2.54	0.009	0.0615	0.005	0.43	0.003	0.005	0.001	0.003
SLuLC02 up-stream	37	770	775	7.60	49800	32.5	49.6	8.84	2.00	2	2.41	0.010	0.0695	0.005	0.35	0.003	0.005	0.002	0.004
SLuLC04 ² (down-stream)	2	21	22	8.10	52400	84.24	95.1	4.23	2.00	2	0.69	0.003	0.038	0.005	0.1	0.003	0.005	0.00	0.00

Table 5: Risk characterisation of monitoring data

Water Quality Monitoring Assessment: Ludmilla WwTP Discharge and East Point Receiving Waters Hazard Quotient Determination to 28/03/2022																				
Indicator type	Pathogen indicators			Physico-chemical indicators						Nutrient Indicators					Toxicant indicators					
parameter	<i>E. coli</i>		Enterococci	pH	EC	DO		Turbidity	TSS	BOD	Chl-a	FRP	TP	NH3-N	TN	NOx	NH3-N	Cu	Zn (D)	
Unit	cfu/100 mL			pH units	µS/cm	% sat		Ntu	mg/L	mg/L	µg/L	mg/L	mg/L	mg/L	mg/L	µg/L	mg/L	µg/L	µg/L	
DHWQO	14	43	50	7.0 - 8.5 ¹		80	100							0.02	0.02	0.27	0.17	0.91	Natural estuary range	Natural estuary range 0.39-3.8
SMD											2	0.01	0.03	0.02	0.3	0.02			0.06-1.3	
ZOI				6.5 - 8.5 ²							4						1.2			
ANZECC level of species protection	Not applicable		40 (NHMRC)	7.0 - 8.5		80-	120			2	2	0.005	0.03	0.015	0.25	0.03	0.91	1.3		15
Assessment criteria	Aquatic food: ^h		Primary Contact Rec ⁿ	50 th	50 th	Low	High 80 th	50 th	50 th	95 th	50 th	50 th	50 th	50 th	50 th	50 th	95 th	95 th	95 th	95 th
percentile			95 th			20 th														
Hazard quotient: Ratio of test statistics to guideline where < 1 indicates the assessment statistic is compliant with the guideline and > 1 indicates exceedance of the guidelines: Ranked by - Green (low) <1.5, 1.5 < Orange (moderate) < 10, Red (high) exceeds by factor >10																				
Hazard Quotient applied to treated effluent and discharge point; however the correlation is not directly relevant. While aquaculture and primary contact recreation is assessed the use is not permitted in the vicinity of East Point Outfall under the Port Bylaw Section 5A.																				
SLu080	2.57	4.60	3.44							61.70	0.29	71.15	61.00	1522.75	123.83	12.30	31.61	0.01	0.00	
Hazard Quotient Applied to Receiving Waters: Darwin Harbour and Ludmilla Creek																				
Declared Beneficial Use	Aquatic food		1 ^o Recreation	Ecosystem protection: Stressors - Physico - chemical. (No cell value indicates no applicable guideline value)						Ecosystem Protection: Nutrient Indicators (No cell value indicates no applicable guideline value)					Ecosystem Protection: Toxicants					
Hazard Quotient applied to East Point Outfall discharge																				
SLuEP01	0.07	0.51	1.56							1.00	0.34	0.80	1.95	27.73	2.72	0.25	0.08	0.00	0.00	
SLuLC03 (at inlet drain)	1.86	2.11	1.58							1.00	1.64	0.80	1.47	0.33	0.68	0.25	0.01	0.00	0.00	
Hazard Quotient applied to receiving waters: Darwin Harbour Zone 1 (sites between 220 and 500 metres of outfall – impact zone)																				
SLuEP02	0.00	0.02	0.11							1.00	0.33	0.60	1.30	0.33	0.32	0.15	0.01	0.00	0.00	
SLuEP03	0.00	0.02	0.08							1.00	0.34	0.60	1.23	0.33	0.72	0.15	0.01	0.00	0.00	
Ludmilla Creek catchment input sites																				
SLuLC01(up-stream)	3.07	16.79	18.68							1.00	1.27	1.70	2.05	0.33	1.72	0.15	0.01	0.00	0.00	
SLuLC02 (up-stream)	2.64	17.91	15.50							1.00	1.21	2.00	2.32	0.33	1.40	0.15	0.01	0.00	0.00	
SLuLC04 ² (down-stream)	0.14	0.48	0.44							1.00	0.35	0.60	1.27	0.33	0.40	0.15	0.01	0.00	0.00	

4.2.2 Pathogens Analysis

Sites in Ludmilla Creek upstream of the discharge (SLuLC01 and SLuLC02) exceed DHWQO guideline values significantly and the risk assessment characterises both *E. coli* and Enterococci as being high risk contaminants for the declared Beneficial Uses at these sites. It should be noted that high pathogen concentrations at these sites is unlikely to be caused by the Ludmilla WwTP discharge evidenced by the fact that consistent high pathogen levels persist at these sites even during long absences of WwTP discharges into the creek and impacts from the EPO are observed within 220m from the outfall. Catchment inputs from urban encroachment are likely contributors to the observed consistent high levels of pathogens.

It should also be noted that while pathogen levels persist in the absence of discharges of overflows to Ludmilla Creek, there is some evidence to suggest that dry season discharges into the creek may have an impact on pathogen concentrations.

A non-compliance discharge of 17KL into Ludmilla Creek occurred on the 10/5/22 and was reported to the regulator. Subsequent monitoring indicated that an increase in pathogen concentrations occurred at some creek sites. It is difficult to ascertain if this is directly related to that discharge but it is recommended that if dry season discharges occur, specific trend analysis for pathogens should be undertaken in the proceeding months to investigate the effect of the discharge as was recommended in the Ludmilla WwTP Environmental Risk Assessment conducted in 2021 (SLR 2021).

Monitoring site SLuLC03, which is inherently more likely to be influenced by the WwTP discharge, indicates moderate exceedance of DHWQO values and moderate environmental risk, while further downstream towards the mouth of the creek at SLuLC04 pathogen levels drop below DHWQO values and the risk is low. Again, there does not seem to be any correlation between elevated pathogen levels at downstream sites as elevated levels, particularly at site SLuLC03, persist in the absence of WwTP discharges to the creek and are most likely related to animal activity within the mangroves.

4.2.3 Nutrient Analysis

No exceedances of guideline values at sites were recorded for any nutrient parameters in the assessment period. While total phosphorus (TP) values are greater than guideline values, the corresponding Chlorophyll-a values were below the guideline value, hence those TP values are not considered to be exceedances. Chlorophyll-a is considered the primary indicator of the environmental effect of nutrient loads providing a measure of algal abundance and eutrophication. As Chlorophyll-a values remain below the guideline, the higher than guideline values of TP are not causing eutrophication in the receiving environment, as would be expected given the high tidal movement in the area.

The risk of the nutrient component of the discharge adversely impacting the environment is considered to be low.

4.2.4 Physicochemical Analysis

There were some exceedances of guideline values for TSS at EPO monitoring sites, occurring on 8/2/22. This corresponds to BOM information indicating high winds and rough sea conditions in the preceding days possibly stirring up solids/sediments around the ocean sites. There were several instances of low DO readings (exceedances) at SLUEP03 and SLUEP02 but these levels were not beyond licence limits and not related to the discharge from the Ludmilla WwTP. There were a

number of low DO levels observed at the creek sites, particularly upstream sites SLUC01 and SLUC02. These levels were recorded in the absence of discharges to the creek and, therefore, not considered exceedances and are attributed to catchment sources other than the discharge.

The risk to the receiving environment from the discharge for these parameters is considered low.

4.2.5 Toxicant Analysis

High concentrations of unionised ammonia were observed at the re-carbonation channel (SLULCDP) and at elevated levels at SLUEPO1 but these quickly dissipated and were not observed at high levels outside of the zone of influence. Copper and zinc concentrations were below guideline values for all sites.

Toxicant parameters in the discharge are considered to pose a low risk of adverse impacts to the receiving environment.

Analysis of toxic endocrine disrupting chemicals (EDC's) was not included in the assessment as the current knowledge on EDC's is insufficient to make recommendations on water quality guidelines or SSTV's values. The EDC data gathered at SLuLCDP as part of the WDL monitoring plan is displayed in figures 2, 3 and 4 below

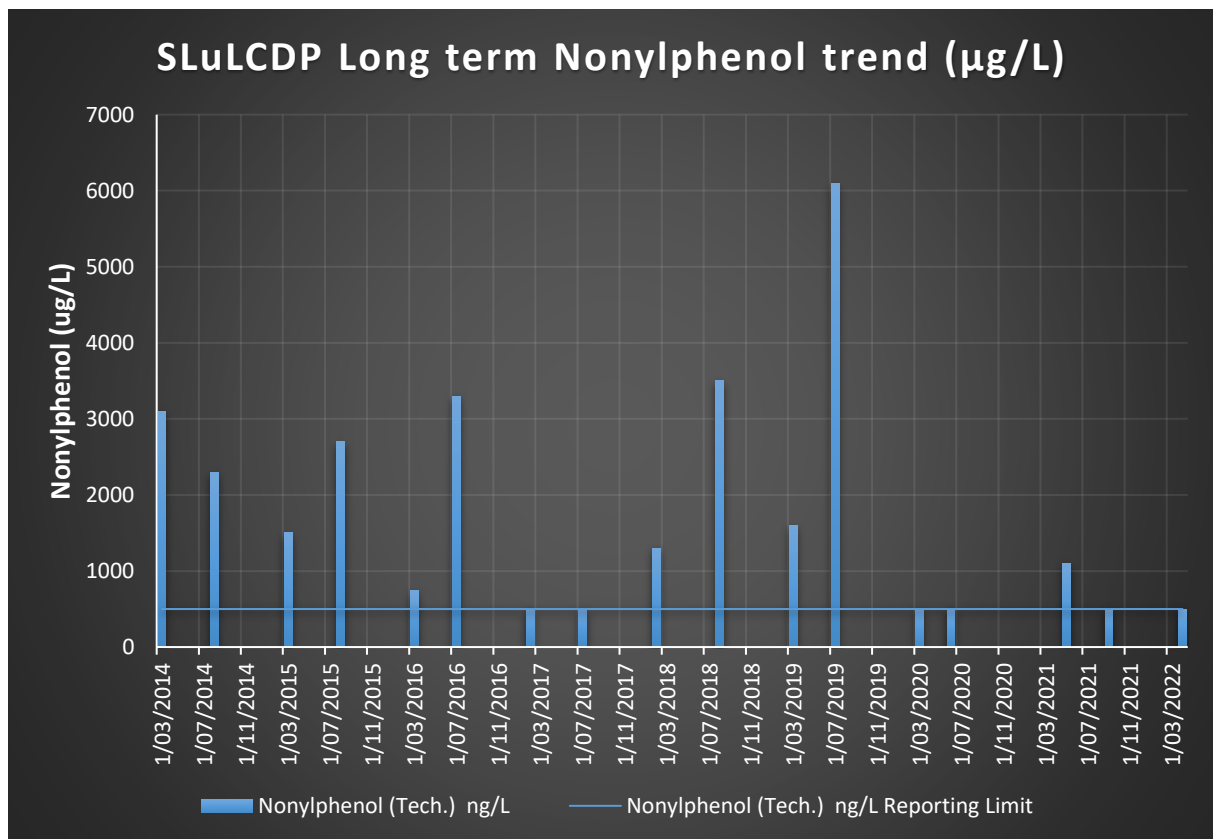


Figure 2: Long term Nonylphenol Trend

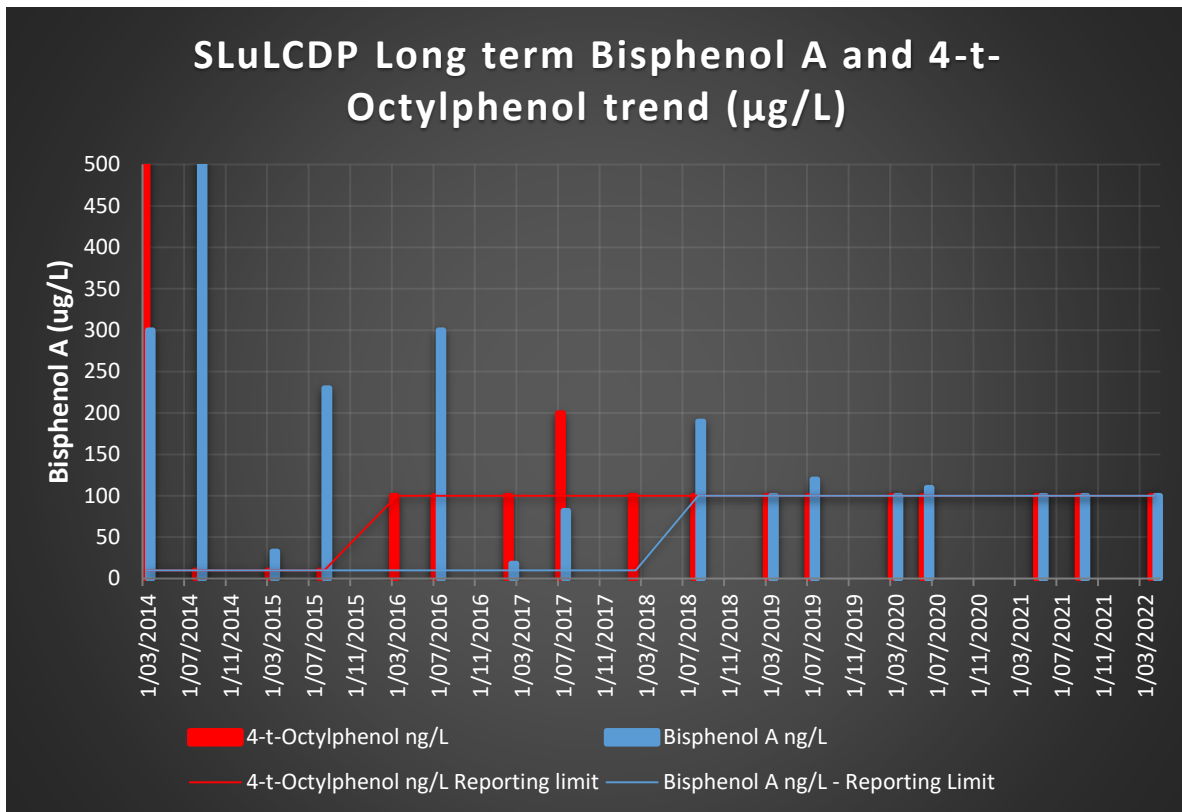
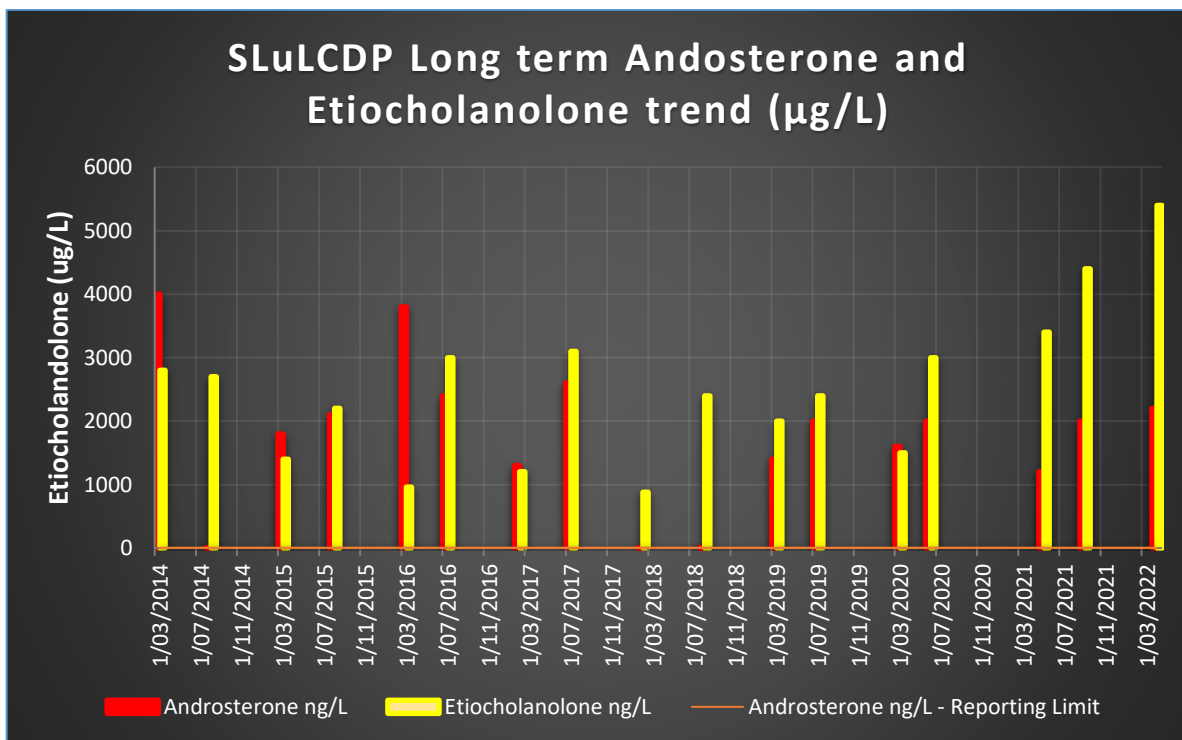


Figure 3: Long term Biphenol A and 4-t-Octylphenol Trend



4.2.6 All Surface Water Parameters Analysis

The results indicated that the effluent discharged via the EPO posed a low risk to the declared Beneficial Uses of the receiving waters including Darwin Harbour and Ludmilla Creek.

4.3 Sediment

4.3.1 Sediment Summary Analysis

All data was collected at the frequencies defined in the sediment monitoring schedule of WDL 150-08. The QA/QC criteria of sampling and data analysis (collection of blanks, duplicate and triplicate samples) as described in ANZG (2018) were met for sediment monitoring. [Table 6](#) below provides values for the sediment data collected in the 2022 dry season.

Table 6: Sediment and Pore Water Assessment

2022																		
Sediments											Pore Water							
Indicator type	Nutrient Indicators						Toxicant Indicators						Nutrient Indicators			Toxicant Indicators		
Parameter	Chl-a	Chl-a : Phaeophytin	TP	TN	TOC	TN : TOC	Cu (D)	Bioavailable Cu	Al Normalised Cu	Zn (D)	Bioavailable Zn	Al Normalised Zn	TP	FRP	TN	NH3 unionised	Cu (D)	Zn (D)
Unit	mg/kg	none	mg/kg	mg/kg	mg/kg	none	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
SQG Lower							65	65		210	210						65	210
SQG Upper							270	270		400	400						270	400
ANZG (2018) SMD																	1.3	15
ANZG (2018) ZOI																	3	15
Assessment criteria	> 2 x Reference site 80th Percentile	<1 OR >1	> 2 x Reference site 80th Percentile	> 2 x Reference site 80th Percentile	<1 OR >1		SQG	SQG	> 2 x Reference site 80th Percentile	SQG	SQG	> 2 x Reference site 80th Percentile	> 2 x Reference site 80th Percentile	> 2 x Reference site 80th Percentile	> 2 x Reference site 80th Percentile	> 2 x Reference site 80th Percentile	SQG	> 2 x Reference site 80th Percentile
> 2 x Reference site 80th Percentile	11.784	1	1018.8	3532	64560	1	270	270	10.36194074	400	400	36.23809659	0.536	0.02	10.32	6.684	0.1	5
Impact zone																		
SLUEP01	6.44	128.8	713	270	8600	0.03	0.05	0.05	0.2	5.3	4.2	20.4	1.96	0.005	13	7.85	0.05	2.5
SLULC03	9	3.27	558	2680	22200	0.12	9.4	5.5	5.6	39.6	17.2	23.4	0.85	0.005	7.5	1.99	0.05	2.5
East Point site 02 is located Zone 1 and sites 03/04 are located Zone 2, both control sites considered outside impact zone. Ludmilla Creek sites 01/02/04 are considered outside impact zone																		
SLULC01	1.05	0.38	394	1440	20200	0.07	6.8	3.6	4.3	33.7	24.8	21.1	0.4	0.04	4.2	1.81	0.05	2.5
SLULC02	5.24	1.13	671	1490	22100	0.07	9.7	5.7	6.9	45.8	25.2	32.5	0.22	0.005	4.1	2.11	0.05	2.5
SLULC04	5.66	113.2	417	800	11000	0.07	3.6	2.6	5.1	14.8	7	21.1	0.34	0.01	3.2	2.54	0.05	2.5
SLUEP02	4.41	88.2	695	250	1800	0.14	0.05	0.05	4.3	4.9	2.9	21.1	0.34	0.005	7.5	3.56	0.05	2.5
SLUEP03	3.02	60.4	706	210	1400	0.14	0.05	0.05	3.8	3.9	3.2	14.9	0.61	0.005	7	4.08	0.05	2.5
SLUEP04	2.56	51.2	740	260	5000	0.15	0.05	0.05	0.1	5.5	3.7	15.1	0.05	0.005	6.2	4.08	0.05	2.5
Short Creek and Kings Creek reference sites where site 01 is most upper estuary in series - Total concentration in sediment (mg/kg) or concentration in sediment porewater (mg/L)																		
SLEKC01	4.82	0.90	471	920	9000	0.10	3.6	4.9	2.59	19.8	6.3	14.24	0.27	0.005	6.2	3.52	0.05	2.5
SLEKC02	2.53	1.02	451	600	5500	0.11	2.5	8.7	1.98	14.9	4.9	11.83	0.19	0.005	1.4	0.61	0.05	2.5
SLEKC03	3.79	1.06	367	560	8200	0.07	2.8	7.8	1.75	14.8	5.1	9.25	0.23	0.005	2.2	1.1	0.05	2.5
SPASC01	6.16	0.88	521	1810	28100	0.06	9.8	4.8	4.97	35.4	16.9	17.97	0.17	0.005	3.4	2.55	0.05	2.5
SPASC02	4.52	0.87	419	1630	29000	0.06	9	4.3	5.23	33.4	15.1	19.42	0.26	0.005	5.5	3.88	0.05	2.5
SPASC03	6.41	1.34	519	1750	33100	0.05	9.4	5.1	5.25	32.5	17	18.16	0.4	0.005	3.8	2.63	0.05	2.5
SPASC04	0.05	0.00	424	1770	43500	0.04	7	2.6	4.38	25.8	11.9	16.13	0.22	0.005	2.1	1.48	0.05	2.5

4.3.2 All Sediment and Pore water Parameters Analysis

Compared to the reference sites in Ludmilla Creek, elevated levels of TP, TN and unionised NH₃ were observed in pore water samples at SLuEP01. This is reflected in the surface water results for the EPO1 site suggesting some accumulation of these substances in the sediments in the vicinity of the EPO may be occurring. For TP and TN however, this does not appear to translate to eutrophication as chlorophyll-a levels in both surface water and sediments remain within guideline values and reference creek assessment levels. Levels of ammonia in pore waters at site SLuEP01 have exceeded the corresponding reference creek 2x80th percentile value in 2019, 2020 and 2022. Elevated levels of ammonia, present in surface and sediment samples at this site do not persist past the zone of influence to the next nearest site SLUEP02 suggesting any potential environmental impacts are limited to the immediate vicinity of the EPO. Figure 5 below displays the ammonia in sediment pore water trend from 2019 to 2022.

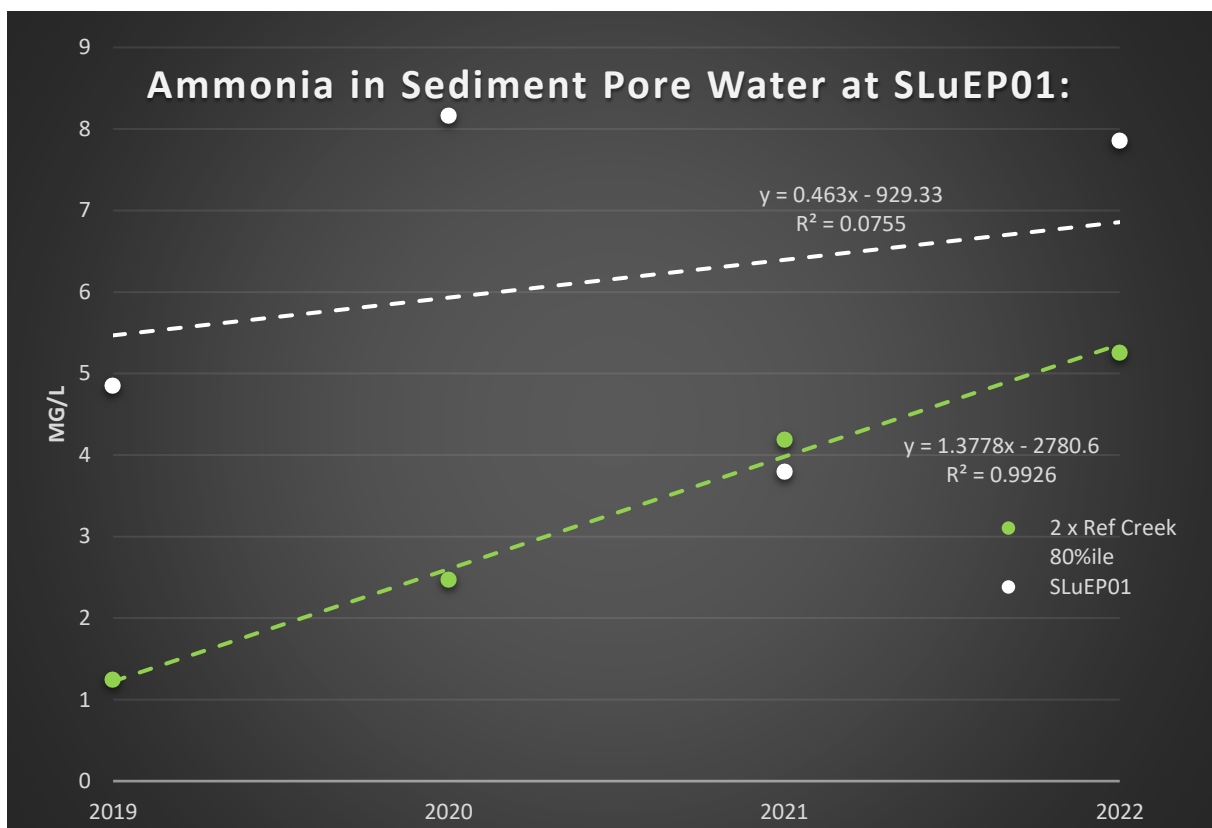


Figure 5: Ammonia in Porewater trend at SLuEP01

Some unusual results were observed in the chlorophyll-a to phaeophytin ratios for sediments at most sites. On investigation, chlorophyll-a concentrations were found to be within the historically normal range, but the absence of phaeophytin (or values below detection limits) resulted in unusually high ratios across all sites.

Chlorophyll – a is an indirect measure of algal abundance and hence an indicator of eutrophication. One serious weakness of the use of chlorophyll-a as an abundance indicator is the great variability of cellular chlorophyll content (0.1 to 9.7 % of fresh algal weight) depending on algal species. A great variability in individual cases can be expected, either seasonally or on an annual basis due to a species composition, light conditions and nutrient availability. Phaeophytin is a non-photo-

synthetically active degradation product of chlorophyll-a that can interfere with the analysis of chlorophyll-a by contributing to the pigment signal and as such is often used as a corrector for reporting “actual” chlorophyll-a concentrations. The ratio can be used as an indicator of the physiological condition of the algal species.

The absence, or below LOR levels of phaeophytin in these samples could indicate a problem with either the sampling or analysis for this set. But if these values are true and representative, they simply imply that the bulk of the algal matter present in samples is alive and photo-synthetically active and if inferences are to be made about algal biomass from chlorophyll-a samples then the maximum, non-corrected values should be used. It must be noted that the chlorophyll a results for the WDL sample sites (1.1 – 9.0 mg/kg, median 4.8 mg/kg) are similar to the range of the reference sites (0.05 -6.4 mg/kg, median 4.5 mg/kg) and not significantly different ($p=0.611$).

Aluminium, copper and zinc concentrations in sediments and pore waters were below the low SQG (ANZG 2018) and reference creek comparators, indicating a low risk of adverse environmental impact from the Ludmilla WwTP discharge. The figures below show the trend over time for bioavailable copper and zinc in sediments.

4.4 Biological

Ecotoxicological

There was no ecotoxicological monitoring, or benthic infauna monitoring conducted under the BIMMP for the reporting period. No fish kills have been observed or reported in relation to Ludmilla Creek or in the vicinity of the EPO this reporting period.

Benthic Infauna Monitoring

The Benthic infauna monitoring was not conducted during 2020 or 2021 due to Covid travel restrictions. However, a review of the previous three years monitoring concluded that the results of the 2017 to 2019 BIMMP surveys showed that the level and extent of the effect of the discharge on the benthic infauna ecosystem indicators were clearly identified during both wet and dry seasons. The conclusions were derived using a multiple lines of evidence approach and the results after three years of seasonal surveys showed that an effect of the EPO discharge is detectable on infauna indicators up to 200 metres from the outfall during both seasons, and is particularly evident in the dry season. Therefore, foraging habitat of marine turtles, inshore dolphins and dugong (>500 m from the EPO) was not affected by the EPO discharge in any season, and this conclusion is not considered to vary in the future.

Blue Green Algae (Cyanobacteria)

For Blue Green Algae, the only detections of cyanobacteria were at the re-carbonation channel - site SLuLCDP, which is not part of the monitoring plan under the WDL. Cyanobacteria was in moderately Low Abundance at this site (approx. 100 to 1 000 cells/mL). There were no instances of detections of cyanobacteria at any of the sites in the monitoring plan.

5 Exceedance summary

Table 8: Summary of exceedances and non-compliances with the licence during the reporting period

Date	Site	Zone	Parameter	Value	WDL	WDL condition	Reporting Statistic	Exceedance / Non-compliance	Comment / Significance	EPA Notified ?	CM Reference
12/10/2021	SLuLCDP	Recarb Channel	Enterococci	660	150-08		Individual result	Exceedance	Less than 3x SSTV value	No, not required	
7/06/2022	SLuLCDP	Recarb Channel	pH (lab)	8.6	150-08		Individual result	Exceedance	Less than 3x SSTV value	No, not required	
5/07/2022	SLuLCDP	Recarb Channel	pH (lab)	8.9	150-08		Individual result	Exceedance	Less than 3x SSTV value	No, not required	
7/06/2022	SLuLCDP	Recarb Channel	E. coli	68	150-08		Individual result	Exceedance	Less than 3x SSTV value	No, not required	
8/02/2022	SLuEP01	ZOI - Darwin Harbour	Suspended Solids	18	150-08		Individual result	Exceedance	Less than 3x SSTV value	No, not required	
5/07/2022	SLuEP01	ZOI - Darwin Harbour	Enterococci	220	150-08		Individual result	Exceedance	Less than 3x SSTV value	No, not required	
8/02/2022	SLuEP02	SMD Darwin Harbour	Suspended Solids	14	150-08		Individual result	Exceedance	Less than 3x SSTV value	No, not required	
8/03/2022	SLuEP02	SMD Darwin Harbour	Dissolved oxygen (field)	71	150-08		Individual result	Exceedance	Less than 3x SSTV value	No, not required	
5/04/2022	SLuEP02	SMD Darwin Harbour	Dissolved oxygen (field)	79.4	150-08		Individual result	Exceedance	Less than 3x SSTV value	No, not required	
7/06/2022	SLuEP02	SMD Darwin Harbour	Dissolved oxygen (field)	55.8	150-08		Individual result	Exceedance	Less than 3x SSTV value	No, not required	
8/02/2022	SLuEP03	SMD Darwin Harbour	Suspended Solids	14	150-08		Individual result	Exceedance	Less than 3x SSTV value	No, not required	
5/04/2022	SLuEP03	SMD Darwin Harbour	Suspended Solids	6	150-08		Individual result	Exceedance	Less than 3x SSTV value	No, not required	
5/04/2022	SLuEP03	SMD Darwin Harbour	Dissolved oxygen (field)	78.9	150-08		Individual result	Exceedance	Less than 3x SSTV value	No, not required	
7/06/2022	SLuEP03	SMD Darwin Harbour	Dissolved oxygen (field)	68.5	150-08		Individual result	Exceedance	Less than 3x SSTV value	No, not required	
8/04/2022	Ludmilla WWTP	NA			150-08	Condition 20 - "Discharges from authorised discharge point SLuLCDP must only occur when average inflows to	Non-Compliance	Low environmental risk. Comparatively low volume (56kl), fully treated effluent.	Yes	D2022/149993	
10/05/2022	Ludmilla WWTP	NA			150-08	Condition 20 - "Discharges from authorised discharge point SLuLCDP must only occur when average inflows to	Non-Compliance	Low environmental risk. Comparatively low volume (17kl), fully treated effluent.	Yes	D2022/192333	
13/05/2022	Ludmilla WWTP	NA			150-08	Condition 24 - "the licensee must conduct biological monitoring in accordance with Appendix 3 of this licence."	Non-Compliance	Contractor unable to perform work due to Covid-19 travel restrictions. Low environmental risk. Independent technical advice already recommended significantly reducing BIMMP monitoring requirements.	Yes	D2022/193385	

6 Conclusion

This report summarises monitoring and results of sampling undertaken in accordance with WDL 150 - 08 and fulfils the reporting requirements to the DEPaWS under the licence. A detailed summary of all results, from both this and previous years, is contained in a document entitled “Ludmilla WDL data” (D2022/15737) and is available on request.

Surface water analysis at WDL sites indicate little change from previous years. However, pathogens *E-coli* and enterococci at SLULC01 and SLULC02 can pose a high risk to the declared Beneficial Uses of the Ludmilla Creek upstream areas. The concentration of these pathogens are unlikely to be related to the discharge from the Ludmilla WwTP as the site is not impacted by the EPO and the overflow to Ludmilla Creek was not occurring during these exceedances.

Based on the chlorophyll-a concentrations, elevated levels of nutrients in sediments and pore water at some sites do not appear to be translating to eutrophication. Elevated levels of ammonia at the ocean outfall site SLUEP01 do not constitute exceedances under WDL licence conditions but pose a moderate risk to the declared Beneficial Uses. This site, discussed in more detail in the 2022 Ludmilla Wastewater Treatment Plant Environmental Risk Assessment (D2022/205561), is not used as a swimming beach and the impact of the discharge from Ludmilla WwTP via the EPO is negligible further than 220m from the outfall.

Recommendations

Points to consider for the revised WDL:

WDL 150-08 Sediment monitoring.

1. Sediment quality guidelines are no longer interim (ANZG 2018). Now referred to as SQG.
2. SQGs were developed to apply to bioavailable metals
3. Pore waters do not have specific guidelines. It must be noted that pore water chemistry can change rapidly following extraction (through oxidation of Fe (II) and volatilisation of ammonia and organic contaminants). The analysis of most contaminants in pore waters is a highly specialised activity, particularly when dealing with saline waters (Simpson and Batley 2016).
4. Suggest that pore water be removed from the WDL.
5. The use of AI normalised total metals is not recognised in the ANZG (2018).
6. Sufficient data has been collected to show that the low, or below detection limits for phaeophytin-a does not provide additional information on the viability of algae in sediments.

Biological monitoring:

Remove ecotoxicological monitoring unless discharge quality significantly deteriorates

Remove benthic infauna monitoring unless discharge quality significantly deteriorates

7 References

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Appendix A – Data

Ludmilla Surface Water Data (all sites)		Algae, Cyanoba	Bacteriological		Metals		Nutrients and Organics					Physical and General Chemical					Ludmilla Surface Water Field		Field Measurements		
Sample Date	Location	Chlorophyll a (ug/L)	E. Coli (CFU/100mL)	Enterococci (CFU/100mL)	Copper - Filtered (mg/L)	Zinc - Filtered (mg/L)	Ammonia (NH3 unionised) as N (mg/L)	Ammonia Nitrogen (NH3-N) (mg/L)	Nitrate + Nitrite as N (NOx) (mg/L)	Phosphorus - Filterable Reactive as P. (mg/L)	Phosphorus - Total (mg/L)	Total Nitrogen (N-Total) (mg/L)	Biochemical Oxygen Demand (mg/L)	Electrical Conductivity (Lab) (uS/cm)	Suspended Solids (mg/L)	Temperature (lab) (deg C)	pH (lab) (pH units)	Sample Date	Location	Dissolved Oxygen (DO) - field (%sat)	Turbidity (field) (NTU)
14/09/2021	SLULCDP	1.16	36.0	30.0	0.0263	0.01	0.513	31.0	0.252	0.05	2.2	39.95	108.0	1,150.0	51.0	22.2	7.5	14/09/2021	SLULCDP	45.3	45.9
14/09/2021	SLULC03	3.52	17.0	17.0	0.001	0.003	0.005	0.005	0.003	0.003	0.044	0.1	2.0	55,100.0	4.0	21.9	7.9	14/09/2021	SLULC03	76.6	8.5
14/09/2021	SLULC04	0.58	0.0	1.0	0.001	0.003	0.005	0.005	0.003	0.004	0.048	0.08	2.0	53,500.0	1.0	22.0	8.1	14/09/2021	SLULC04	83.9	2.86
14/09/2021	SLUEP01	0.36	5.0	0.0	0.001	0.003	0.005	0.5	0.003	0.003	0.031	0.08	2.0	52,300.0	1.0	22.1	8.0	14/09/2021	SLUEP01	93.4	3.8
14/09/2021	SLUEP02	0.55	0.0	0.0	0.001	0.003	0.005	0.005	0.003	0.006	0.028	0.08	2.0	53,000.0	1.0	22.1	8.1	14/09/2021	SLUEP02	53.8	3.78
14/09/2021	SLUEP03	0.39	0.0	0.0	0.001	0.003	0.005	0.005	0.003	0.005	0.033	0.08	2.0	53,000.0	1.0	22.3	8.1	14/09/2021	SLUEP03	92.6	3.1
14/09/2021	SLULC01	7.48	10.0	49.0	0.001	0.003	0.005	0.005	0.003	0.014	0.061	0.18	2.0	59,700.0	2.0	22.2	7.5	14/09/2021	SLULC01	53.7	6.89
14/09/2021	SLULC02	8.16	5.0	110.0	0.001	0.003	0.005	0.005	0.003	0.015	0.087	0.32	2.0	60,300.0	4.0	22.4	7.5	14/09/2021	SLULC02	29.9	5.9
12/10/2021	SLULC03	2.13	6.0	17.0	0.001	0.003	0.005	0.005	0.003	0.01	0.05	0.08	2.0	55,700.0	8.0	22.4	7.8	12/10/2021	SLULC03	64.4	13.9
12/10/2021	SLULC04	0.72	2.0	2.0	0.001	0.003	0.005	0.005	0.003	0.007	0.045	0.08	2.0	53,700.0	2.0	22.5	8.0	12/10/2021	SLULC04	88.6	4.42
12/10/2021	SLUEP01	0.9	3.0	2.0	0.001	0.003	0.008	0.168	0.047	0.032	0.063	0.24	2.0	51,600.0	5.0	22.3	8.0	12/10/2021	SLUEP01	86.5	8.32
12/10/2021	SLUEP02	0.92	0.0	0.0	0.001	0.003	0.005	0.005	0.003	0.005	0.042	0.08	2.0	53,200.0	4.0	22.4	8.0	12/10/2021	SLUEP02	81.7	6.62
12/10/2021	SLUEP03	1.1	1.0	0.0	0.001	0.003	0.005	0.005	0.003	0.007	0.047	0.08	2.0	54,000.0	1.0	22.3	8.1	12/10/2021	SLUEP03	85.9	6.02
12/10/2021	SLULC01	6.89	42.0	53.0	0.001	0.003	0.005	0.005	0.003	0.014	0.074	0.08	2.0	61,700.0	6.0	22.3	7.6	12/10/2021	SLULC01	31.0	5.59
12/10/2021	SLULC02	6.36	37.0	58.0	0.001	0.003	0.005	0.005	0.009	0.024	0.074	0.09	2.0	61,600.0	1.0	22.3	7.6	12/10/2021	SLULC02	32.5	5.93
12/10/2021	SLULCDP	0.29	46.0	660.0	0.02	0.0039	15.2	29.2	0.512	0.757	1.86	37.11	120.0	1,300.0	40.0	22.2	8.4	12/10/2021	SLULCDP	41.2	31.0
14/10/2021	SLUEP04	2.76	1.0	0.0	0.001	0.003	0.005	0.005	0.012	0.003	0.036	0.09	2.0	54,500.0	1.0	22.2	7.9	9/11/2021	SLULC01	45.2	9.26
14/10/2021	SLUEP01	1.08	23.0	35.0	0.001	0.003	0.005	0.008	0.017	0.003	0.04	0.1	2.0	53,000.0	2.0	22.2	8.0	9/11/2021	SLULC02	49.4	9.62
14/10/2021	SLUEP02	1.11	0.0	0.0	0.001	0.003	0.005	0.01	0.027	0.003	0.027	0.38	2.0	53,300.0	4.0	22.3	7.9	9/11/2021	SLULC03	67.3	15.2
14/10/2021	SLUEP03	1.02	0.0	3.0	0.001	0.003	0.005	0.005	0.012	0.003	0.037	0.09	2.0	53,400.0	1.0	22.3	8.0	9/11/2021	SLULCDP	40.3	22.6
9/11/2021	SLULC01	4.99	75.0	46.0	0.001	0.003	0.005	0.005	0.003	0.007	0.008	0.38	2.0	48,900.0	5.0	22.5	7.6	9/11/2021	SLULC04	88.9	6.32
9/11/2021	SLULC02	5.12	80.0	59.0	0.001	0.003	0.005	0.005	0.026	0.006	0.008	0.17	2.0	48,300.0	15.0	22.3	7.6	9/11/2021	SLUEP01	95.4	5.11
9/11/2021	SLULC03	3.19	23.0	43.0	0.001	0.003	0.005	0.005	0.003	0.005	0.008	0.08	2.0	52,300.0	6.0	22.5	7.8	9/11/2021	SLUEP02	97.8	3.33
9/11/2021	SLULC04	2.27	17.0	15.0	0.001	0.003	0.005	0.012	0.003	0.005	0.008	0.08	2.0	52,700.0	4.0	22.4	8.1	9/11/2021	SLUEP03	95.3	3.76
9/11/2021	SLUEP01	0.98	1.0	1.0	0.001	0.003	0.005	0.057	0.005	0.004	0.008	0.2	2.0	52,100.0	1.0	22.4	8.1	9/12/2021	SLULC01	41.0	10.8
9/11/2021	SLUEP02	1.47	0.0	0.0	0.001	0.003	0.005	0.005	0.003	0.003	0.008	0.08	2.0	52,400.0	1.0	22.4	8.1	9/12/2021	SLULC02	49.9	10.6
9/11/2021	SLUEP03	1.16	0.0	0.0	0.001	0.003	0.006	0.104	0.006	0.004	0.005	0.18	2.0	52,300.0	1.0	22.3	8.1	9/12/2021	SLULCDP	35.4	25.9

Ludmilla Surface Water Data (all sites)		Algae, Cyanobacteria	Bacteriological		Metals		Nutrients and Organics						Physical and General Chemical					Ludmilla Surface Water Field		Field Measurements	
Sample Date	Location	Chlorophyll a (ug/L)	E. Coli (CFU/100mL)	Enterococci (CFU/100mL)	Copper - Filtered (mg/L)	Zinc - Filtered (mg/L)	Ammonia (NH3 unionised) as N (mg/L)	Ammonia Nitrogen (NH3-N) (mg/L)	Nitrate + Nitrite as N (NOx) (mg/L)	Phosphorus - Filterable Reactive as P. (mg/L)	Phosphorus - Total (mg/L)	Total Nitrogen (N-Total) (mg/L)	Biochemical Oxygen Demand (mg/L)	Electrical Conductivity (Lab) (uS/cm)	Suspended Solids (mg/L)	Temperature (lab) (deg C)	pH (lab) (pH units)	Sample Date	Location	Dissolved Oxygen (DO) - field (%sat)	Turbidity (field) (NTU)
9/12/2021	SLULC01	2.91	79	93	< 0.001	< 0.003	< 0.005	< 0.005	< 0.003	0.003	0.033	0.13	< 2	54000	< 1	22.9	7.5	9/12/2021	SLULC03	68.8	10.5
9/12/2021	SLULC02	2.36	91	82	< 0.001	< 0.003	< 0.005	< 0.005	< 0.003	0.004	0.033	0.32	< 2	54100	< 1	22.8	7.5	9/12/2021	SLULC04	89.7	5.01
9/12/2021	SLULCDP	0.87	41.0	14.0	0.0037	0.002	0.941	31	0.316	0.732	1.42	36.42	100.0	1,570.0	31	22.8	7.8	9/12/2021	SLUEP01	89.6	6.3
9/12/2021	SLULC03	5.26	4	32	< 0.001	< 0.003	< 0.005	< 0.005	< 0.003	< 0.003	0.028	0.08	< 2	55000	2	22.8	7.8	9/12/2021	SLUEP02	85.7	4.8
9/12/2021	SLULC04	0.9	0	2	< 0.001	< 0.003	< 0.005	< 0.005	< 0.003	0.004	0.014	0.08	< 2	53700	< 1	22.8	8	9/12/2021	SLUEP03	85.1	4.25
9/12/2021	SLUEP01	0.9	1	2	0.001	< 0.003	0.029	0.613	0.004	0.005	0.062	1.06	< 2	52900	< 1	22.9	8	31/01/2022	SLULCDP	52.5	19.6
9/12/2021	SLUEP02	0.79	1	0	< 0.001	< 0.003	< 0.005	< 0.005	< 0.003	0.003	0.043	0.08	< 2	53700	< 1	22.5	8	31/01/2022	SLULC02	117.5	19.6
9/12/2021	SLUEP03	0.84	0	0	< 0.001	< 0.003	< 0.005	< 0.005	< 0.003	< 0.003	0.035	0.08	< 2	53600	< 1	22.9	8	31/01/2022	SLULC01	44	18.9
8/02/2022	SLULCDP	0.19	0	0	0.0222	0.0024	0.236	16	0.289	0.221	0.741	19.19	61	634	20	22.2	7.5	8/02/2022	SLULCDP	40.9	15.4
8/02/2022	SLULC01	3.01	1000	470	< 0.001	< 0.003	< 0.005	< 0.005	0.126	0.006	0.095	0.84	2	6080	24	22.2	7.7	8/02/2022	SLULC01	43.7	51.3
8/02/2022	SLULC02	1.33	1100	450	< 0.001	< 0.003	< 0.005	< 0.005	0.155	0.01	0.096	1.48	3	6270	28	22.6	7.6	8/02/2022	SLULC02	75.4	50.5
8/02/2022	SLULC03	11.5	130	78	< 0.001	< 0.003	< 0.005	< 0.005	0.064	0.005	0.063	0.58	< 2	22800	12	22.5	7.6	8/02/2022	SLULC03	70	23.6
8/02/2022	SLULC04	3.49	12	24	< 0.001	< 0.003	< 0.005	< 0.005	< 0.003	< 0.003	0.075	0.2	< 2	48300	6	22.5	8	8/02/2022	SLULC04	94.4	17.7
8/02/2022	SLUEP01	1.21	2	2	0.001	< 0.003	0.029	0.744	0.028	< 0.003	0.079	2.49	< 2	49700	18	22.5	7.9	8/02/2022	SLUEP01	89.4	25.8
8/02/2022	SLUEP02	1.46	6	6	< 0.001	< 0.003	< 0.005	< 0.005	< 0.003	0.004	0.044	0.36	< 2	49700	16	22.5	7.9	8/02/2022	SLUEP02	94.2	17.4
8/02/2022	SLUEP03	1.63	8	4	< 0.001	< 0.003	< 0.005	< 0.005	< 0.003	< 0.003	0.045	0.26	< 2	48600	14	22	7.9	8/02/2022	SLUEP03	92.2	21
8/03/2022	SLUEP01	0.97	0	1	< 0.001	< 0.003	< 0.005	0.044	0.035	0.018	0.026	0.51	< 2	50400	4	22.4	8	8/03/2022	SLULCDP	55.7	20.1
8/03/2022	SLUEP02	1.09	1	3	< 0.001	< 0.003	< 0.005	0.035	< 0.003	< 0.003	0.024	0.15	2	50500	< 1	22.3	8	8/03/2022	SLULC03	68.5	14.9
8/03/2022	SLUEP03	1.3	1	1	< 0.001	< 0.003	< 0.005	< 0.005	< 0.003	< 0.003	0.017	0.42	< 2	50500	< 1	22.4	8	8/03/2022	SLULC01	38	17.9
8/03/2022	SLULC01	3.88	16	39	< 0.001	< 0.003	< 0.005	< 0.005	< 0.003	< 0.003	0.03	0.55	< 2	40500	5	22.3	7.6	8/03/2022	SLULC02	37.3	21.7
8/03/2022	SLULC02	3.04	19	40	< 0.001	< 0.003	< 0.005	< 0.005	< 0.003	0.004	0.038	0.64	< 2	40000	< 1	22.4	7.6	8/03/2022	SLULC04	71.6	16.8
8/03/2022	SLULC03	6.46	1	21	< 0.001	< 0.003	< 0.005	< 0.005	< 0.003	< 0.003	0.041	0.55	< 2	49500	5	22.4	7.9	8/03/2022	SLUEP01	80.8	12.9
8/03/2022	SLULC04	1.46	12	5	< 0.001	< 0.003	< 0.005	< 0.005	< 0.003	< 0.003	0.02	0.18	< 2	50300	20	22.4	8	8/03/2022	SLUEP02	71	14
8/03/2022	SLULCDP	0.15	0	9	0.032	0.0037	0.298	15.4	0.27	0.245	0.69	22.17	62	723	24	22.4	7.6	8/03/2022	SLUEP03	90.9	10.9

Ludmilla Surface Water Data (all sites)		Algae, Cyanobacteria	Bacteriological		Metals		Nutrients and Organics						Physical and General Chemical					Ludmilla Surface Water Field		Field Measurements	
Sample Date	Location	Chlorophyll a (ug/L)	E. Coli (CFU/100mL)	Enterococci (CFU/100mL)	Copper - Filtered (mg/L)	Zinc - Filtered (mg/L)	Ammonia (NH3 unionized) as N (mg/L)	Ammonia Nitrogen (NH3-N) (mg/L)	Nitrate + Nitrite as N (NOx) (mg/L)	Phosphorus - Filterable Reactive as P. (mg/L)	Phosphorus - Total (mg/L)	Total Nitrogen (N-Total) (mg/L)	Biochemical Oxygen Demand (mg/L)	Electrical Conductivity (Lab) (uS/cm)	Suspended Solids (mg/L)	Temperature (lab) (deg C)	pH (lab) (pH units)	Sample Date	Location	Dissolved Oxygen (DO) - field (%sat)	Turbidity (field) (NTU)
5/04/2022	SLULC01	2.52	59	50	< 0.001	0.003	< 0.005	< 0.005	< 0.003	0.004	0.056	0.08	< 2	47900	< 1	22.4	7.7	5/04/2022	SLULC01	93	8.89
5/04/2022	SLULC02	2.46	22	38	0.003	0.016	< 0.005	< 0.005	< 0.003	0.003	0.067	0.25	< 2	48100	< 1	22.4	7.7	5/04/2022	SLULC02	56.3	8.46
5/04/2022	SLULC03	1.27	23	32	< 0.001	< 0.003	< 0.005	< 0.005	< 0.003	< 0.003	0.044	0.08	< 2	50400	< 1	22.4	7.9	5/04/2022	SLULC03	79.8	6.94
5/04/2022	SLULC04	0.65	23	5	< 0.001	< 0.003	< 0.005	< 0.005	< 0.003	< 0.003	0.04	0.08	< 2	50300	< 1	22.3	8	5/04/2022	SLULC04	84	4.88
5/04/2022	SLUEP01	0.61	3	0	< 0.001	< 0.003	0.016	0.416	0.005	0.006	0.061	0.73	< 2	49800	< 1	22.4	7.9	5/04/2022	SLUEP01	83.1	8.66
5/04/2022	SLUEP02	0.65	0	1	< 0.001	< 0.003	< 0.005	< 0.005	< 0.003	< 0.003	0.051	0.08	< 2	50700	< 1	22.3	8	5/04/2022	SLUEP02	79.4	7.07
5/04/2022	SLULCDP	0.12	0	0	0.0341	0.0032	0.446	18.8	0.276	0.22	0.68	20.08	54	905	19	22.2	7.7	5/04/2022	SLULCDP	65.2	116.2
5/04/2022	SLUEP03	0.61	0	0	< 0.001	< 0.003	< 0.005	0.037	< 0.003	< 0.003	0.04	0.1	< 2	50500	< 1	22.3	7.9	5/04/2022	SLUEP03	78.9	4.62
9/05/2022	SLUEP01	0.68	0	0	< 0.001	0.003	0.01	0.278	< 0.003	0.003	0.035	0.27	2	50400	1	22.3	7.9	9/05/2022	SLUEP01	93.7	2.16
9/05/2022	SLULCDP	0.53	4	0	0.0527	0.0042	1	33	0.238	0.727	1.33	38.64	102	1350	29	22.6	7.8	9/05/2022	SLULCDP	37.9	0.66
9/05/2022	SLUEP03	0.71	0	0	< 0.001	0.004	< 0.005	0.009	< 0.003	0.004	0.063	0.08	< 2	51300	4	22.4	8	9/05/2022	SLUEP03	94	2.26
9/05/2022	SLUEP02	0.69	0	0	< 0.001	0.003	< 0.005	0.01	< 0.003	0.003	0.031	0.08	< 2	51500	2	22.3	8	9/05/2022	SLUEP02	94.9	1.88
9/05/2022	SLULC01	2.56	110	40	< 0.001	0.004	< 0.005	0.005	< 0.003	0.011	0.067	0.48	< 2	29600	8	22.3	7.3	9/05/2022	SLULC01	51.8	6.49
9/05/2022	SLULC02	0.93	56	41	< 0.001	0.004	< 0.005	< 0.005	< 0.003	0.005	0.057	0.16	< 2	38100	4	22.2	7.3	9/05/2022	SLULC02	32	6.72
9/05/2022	SLULC03	12.2	72	48	< 0.001	0.004	< 0.005	0.009	< 0.003	0.006	0.075	0.51	2	49000	12	22.2	7.5	9/05/2022	SLULC03	73.5	11.9
9/05/2022	SLULC04	0.61	0	0	< 0.001	0.003	< 0.005	0.009	< 0.003	0.003	0.032	0.08	< 2	52100	6	22.2	8	9/05/2022	SLULC04	96	1.54
7/06/2022	SLUEP02	0.49	0	0	< 0.001	< 0.003	< 0.005	< 0.005	< 0.003	0.004	0.035	0.08	< 2	51500	4	21.8	8	7/06/2022	SLUEP02	55.8	2
7/06/2022	SLULCDP	0.87	68	0	0.0263	0.007	5.74	33.5	0.214	0.794	1.43	35.31	78	993	32	21.9	8.6	7/06/2022	SLULCDP	8.66	25.9
7/06/2022	SLULC03	2.19	70	32	< 0.001	< 0.003	< 0.005	< 0.005	< 0.003	0.004	0.024	0.08	< 2	52600	10	21.8	7.7	7/06/2022	SLULC03	51	10.2
7/06/2022	SLULC01	0.6	280	63	< 0.001	< 0.003	< 0.005	< 0.005	< 0.003	0.022	0.057	0.46	< 2	40700	< 1	21.8	7.3	7/06/2022	SLULC01	28.3	6.09
7/06/2022	SLULC04	0.69	1	0	< 0.001	< 0.003	< 0.005	< 0.005	< 0.003	0.003	0.009	0.08	< 2	51800	< 1	21.8	8	7/06/2022	SLULC04	99.6	1.48
7/06/2022	SLULC02	0.36	140	84	< 0.001	< 0.003	< 0.005	< 0.005	< 0.003	0.018	0.051	0.77	< 2	42200	< 1	21.8	7.3	7/06/2022	SLULC02	15.6	5.79
7/06/2022	SLUEP01	0.34	0	0	< 0.001	< 0.003	0.07	1.727	0.008	0.008	0.08	1.81	< 2	50500	< 1	21.7	7.9	7/06/2022	SLUEP01	72.3	3.05
7/06/2022	SLUEP03	0.54	0	0	< 0.001	< 0.003	< 0.005	< 0.005	< 0.003	0.006	0.006	0.49	< 2	51500	6	21.8	8	7/06/2022	SLUEP03	68.5	2.45
5/07/2022	SLULC01	0.74	38	71	< 0.001	< 0.003	< 0.005	< 0.005	< 0.003	0.018	0.062	0.51	< 2	51500	< 1	21.7	7.5	5/07/2022	SLULC01	30.5	8.66
5/07/2022	SLULC03	0.55	0	0	< 0.001	< 0.003	< 0.005	< 0.005	< 0.003	0.004	0.023	0.67	< 2	51800	2	21.7	8.1	5/07/2022	SLULC03	83	10.9
5/07/2022	SLULC02	0.81	28	72	< 0.001	< 0.003	< 0.005	< 0.005	< 0.003	0.019	0.066	0.96	< 2	50400	3	21.7	7.5	5/07/2022	SLULC02	33.5	8.07
5/07/2022	SLULC04	0.37	7	3	< 0.001	< 0.003	< 0.005	< 0.005	< 0.003	0.003	0.028	0.38	< 2	52000	36	21.7	8.1	5/07/2022	SLULC04	91.9	1.89
5/07/2022	SLUEP02	0.56	0	0	< 0.001	< 0.003	< 0.005	< 0.005	< 0.003	0.003	0.024	0.41	< 2	51500	< 1	21.7	8.1	5/07/2022	SLUEP02	81.16	4.22
5/07/2022	SLUEP03	1.75	11	36	< 0.001	< 0.003	< 0.005	< 0.005	< 0.003	0.004	0.037	0.54	< 2	52900	2	21.7	7.9	5/07/2022	SLUEP03	92.8	3.8
5/07/2022	SLULCDP	0.58	20	6	0.0894	0.0064	13	47.6	0.329	1.22	2.05	56.53	70	1100	42	21.8	8.9	5/07/2022	SLUEP03	93.8	4.1
5/07/2022	SLUEP01	0.52	13	220	< 0.001	< 0.003	0.018	0.35	0.012	0.004	0.047	1.15	< 2	50900	< 1	21.8	8.1	5/07/2022	SLULCDP	47.9	35.7

Sediment Data		TP	TKN	TN	NOx-N	Al	Cu (T)	Cu (Bio)	Zn (T)	Zn (Bio)	Cu_T:Al X10000 [calc]	Zn_T:Al X10000 [calc]	Moisture Co	TOC	TOC	Chl-a	Phaeophytin	chl-a:phaeo-a (calc)	TN:TOC (calc)
		mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg			%	%	mg/kg	mg/km (dry weight)	mg/km (dry weight)		
Dry Season 2022																			
Ludmilla Ck.																			
SLULC01	SLULC01	394	1,440	1,440	0.4	16,000	6.8	3.6	33.7	24.8	4.3	21.1	56.2	2.02	20,200	1.05	2.75	0.38	0.07
SLULC02	SLULC02	671	1,490	1,490	0.5	14,100	9.7	5.7	45.8	25.2	6.9	32.5	49.6	2.21	22,100	5.24	4.64	1.13	0.07
SLULC03	SLULC03	558	2,680	2,680	0.4	16,900	9.4	5.5	39.6	17.2	5.6	23.4	54.2	2.22	22,200	7.22	2.21	3.27	0.12
	TRIPLICATE 1	442	1,880	1,880	0.3	18,400	8.5	5.5	37.0	23.2	4.6	20.1	52.2	2.86	28,600	8.58	3.43	2.50	0.07
	TRIPLICATE 1	382	1,630	1,630	0.3	18,200	6.5	5.1	32.6	22.0	3.6	17.9	55.1	2.78	27,800	0.05	41.42	0.00	0.06
SLULC04	SLULC04	417	800	800	0.8	7,020	3.6	2.6	14.8	7.0	5.1	21.1	45.3	1.10	11,000	5.66	0.05	113.20	0.07
	TRIPLICATE 1	534	1,680	1,680	0.4	18,500	10.9	5.6	53.5	27.7	5.9	28.9	58	2.08	20,800	7.84	3.69	2.12	0.08
	TRIPLICATE 1	435	1,560	1,560	0.6	14,400	9.7	6.1	85.1	25.0	6.7	59.1	47.9	2.08	20,800	0.05	38.49	0.00	0.08
East point.																			
SLUEP01	SLUEP01	713	270	270	0.5	2,600	0.05	0.05	5.3	4.2	0.2	20.4	32.2	0.86	8,600	6.44	0.05	128.80	0.03
SLUEP02	SLUEP02	695	250	250	0.5	2,320	0.05	0.05	4.9	2.9	4.3	21.1	28.1	0.18	1,800	4.41	0.05	88.20	0.14
	TRIPLICATE 1	642	220	220	0.5	2,550	0.05	0.05	4.5	3.1	3.9	17.6	30.5	0.16	1,600	7.97	0.05	159.40	0.14
	TRIPLICATE 1	672	230	230	0.5	2,380	0.05	0.05	4.3	3.3	4.2	18.1	28.3	0.16	1,600	6.55	0.05	131.00	0.14
SLUEP03	SLUEP03	706	210	210	0.4	2,610	0.05	0.05	3.9	3.2	3.8	14.9	29.9	0.14	1,400	3.02	0.05	60.40	0.15
	TRIPLICATE 1	704	150	150	0.5	2,190	0.05	0.05	3.8	2.9	4.6	17.4	30.7	0.12	1,200	3.17	0.05	63.40	0.13
	TRIPLICATE 13B			190	0.5	2,190	0.05	0.05	4.1	3.0	0.2	18.7	27.4	0.12	1,200	3.85	0.05	77.00	0.16
SLUEP04	SLUEP04			260	0.6	3,640	0.05	0.05	5.5	3.7	0.1	15.1	39.4	0.50	5,000	2.56	0.05	51.20	0.05
	TRIPLICATE 14A			360	0.3	2,630	0.05	0.05	4.6	3.3	0.2	17.5	31.3	0.16	1,600	2.82	0.05	56.40	0.23
	TRIPLICATE 1	740	230	230	0.6	2,730	0.05	0.05	4.2	3.7	0.2	15.4	31.3	0.17	1,700	1.61	0.93	1.73	0.14
Kings Creek																			
	SLEKC01	471	920	920	0.3	13,900	3.6	4.9	19.8	6.3	2.6	14.2	49.1	0.9	9,000	4.82	5.34	0.90	0.10
	SLEKC02	451	600	600	0.2	12,600	2.5	8.7	14.9	4.9	2.0	11.8	44.1	0.55	5500	2.53	2.49	1.02	0.11
	SLEKC03	367	560	560	0.2	16,000	2.8	7.8	14.8	5.1	1.8	9.3	47	0.82	8200	3.79	3.57	1.06	0.07
	TRIPLICATE 4	310	680	680	0.3	18,300	3.3	7.5	17.4	4.4	1.8	9.5	48.8	0.79	7900	3.90	4.07	0.96	0.09
	TRIPLICATE 4	378	810	810	0.2	19,600	3.7	8.1	19.3	5.5	1.9	9.8	52.6	1.97	19700	1.87	2.45	0.76	0.04
Short Ck.																			
	SPASC01	521	1,810.0	1,810.0	0.6	19,700	9.8	4.8	35.4	16.9	5.0	18.0	58.6	2.81	28,100	6.16	7.00	0.88	0.06
	SPASC02	419	1,630.0	1,630.0	0.4	17,200	9.0	4.3	33.4	15.1	5.2	19.4	55.2	2.90	29,000	4.52	5.19	0.87	0.06
	SPASC03	519	1,750.0	1,750.0	0.5	17,900	9.4	5.1	32.5	17.0	5.3	18.2	60.5	3.31	33,100	6.41	4.78	1.34	0.05
	SPASC04	424	1,770.0	1,770.0	0.3	16,000	7.0	2.6	25.8	11.9	4.4	16.1	62.7	4.35	43,500	0.05	14.18	0.00	0.04
	TRIPLICATE 7	418	1,480.0	1,480.0	0.2	153,000	8.0	1.6	27.0	9.1	0.5	1.8	56.2	2.08	20,800	2.03	2.95	0.69	0.07
	TRIPLICATE 7	211	1,080.0	1,080.0	0.3	22,400	10.7	2.6	42.3	11.8	4.8	18.9	57.2	3.92	39,200	0.56	6.66	0.08	0.03

PoreWater			pH	NH ₃ -N mg/L	Cu	Zn	FRP	NO _x -N	TKN	TN	TP	Organic N
Dry Season 2022 Sampled			Lab result	Lab result	µg/L	µg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Ludmilla Ck.												
SLULC01	SLULC01	16/02/2022	7.79	1.81	<1	<5	0.04	0.04	4.2	4.2	0.40	2.4
SLULC02	SLULC02	16/02/2022	7.56	2.11	<1	<5	<0.01	0.07	4.0	4.1	0.22	1.9
SLULC03	SLULC03	16/02/2022	7.42	1.99	<1	<5	<0.01	0.04	3.9	3.9	0.85	<2
	TRIPLICATE	16/02/2022	7.60	2.75	<1	<5	<0.01	0.04	5.2	5.2	0.49	2.4
	TRIPLICATE	16/02/2022	7.42	2.41	<1	<5	<0.01	0.05	3.3	3.4	0.44	<2
SLULC04	SLULC04	16/02/2022	7.55	2.54	<1	<5	0.01	0.06	3.1	3.2	0.34	<2
	TRIPLICATE	16/02/2022	7.50	3.72	<1	<5	<0.01	0.02	6.1	6.1	0.59	2.4
	TRIPLICATE	16/02/2022	7.56	2.43	<1	<5	<0.01	0.02	4.9	4.9	0.48	2.5
East point.												
SLUEP01	SLUEP01	16/02/2022	7.47	7.85	<1	<5	<0.01	<0.001	13	13.0	2.0	5.2
SLUEP02	SLUEP02	16/02/2022	7.45	3.56	<1	<5	<0.01	0.04	7.5	7.5	0.3	3.9
	TRIPLICATE	16/02/2022	7.63	4.98	<1	<5	<0.01	<0.001	9.1	9.1	1.2	4.1
	TRIPLICATE	16/02/2022	7.72	3.27	<1	<5	<0.01	0.04	7.6	7.6	0.7	4.3
SLUEP03	SLUEP03	16/02/2022	7.75	4.08	<1	<5	<0.01	0.01	7	7.0	0.6	2.9
	TRIPLICATE	16/02/2022	7.79	2.80	<1	<5	0	0.05	4.2	4.2	0.3	<2
SLUEP04	SLUEP04	16/02/2022	7.99	4.08	<1	<5	<0.01		6.2	6.2	<0.10	
	TRIPLICATE	16/02/2022	7.95		<1	<5	<0.01	0.03				
	TRIPLICATE	16/02/2022	7.74		<1	<5	<0.01		6.2	6.2	<0.10	2.1
Kings Creek												
	SLEKC01	16/02/2022	7.67	3.52	<1	<5	<0.01	0.02	6.2	6.2	0.27	2.7
	SLEKC02	16/02/2022	7.72	0.61	<1	<5	<0.01	0.04	1.4	1.4	0.19	<1
	SLEKC03	16/02/2022	7.73	1.1	<1	<5	<0.01	<0.01	2.2	2.2	0.23	1.1
	TRIPLICATE	16/02/2022	7.73	1.6	<1	<5	<0.01	0.01	3.1	3.1	0.26	1.5
	TRIPLICATE	16/02/2022	7.75	1.15	<1	<5	<0.01	<0.01	2.4	2.4	0.23	1.2
Short Ck.												
	SPASC01	16/02/2022	7.65	2.55	<1	<5	<0.01	0.05	3.3	3.4	0.17	<1
	SPASC02	16/02/2022	7.79	3.88	<1	<5	<0.01	0.07	5.4	5.5	0.26	1.5
	SPASC03	16/02/2022	7.82	2.63	<1	<5	<0.01	0.09	3.7	3.8	0.40	1.1
	SPASC04	16/02/2022	7.81	1.48	<1	<5	<0.01	0.06	2.0	2.1	0.22	<1
	TRIPLICATE	16/02/2022	7.78	1.01	<1	<5	<0.01	0.06	1.3	1.4	0.18	<1
	TRIPLICATE	16/02/2022	7.79	1.38	<1	<5	<0.01	0.07	1.9	2.0	0.16	<1

Mass Loads

Year	Item	BOD (tonnes/yr)	COD (tonnes/yr)	NH3-N Free (tonnes/yr)	NH3-N Organic (tonnes/yr)	NOX - N (tonnes/yr)	(tonnes/yr) Calculations	P_Reactive High (tonnes/yr)	P_Total High Level (tonnes/yr)	SS (tonnes/yr)	VSS (tonnes/yr)	Copper (tonnes/yr)	Zinc (tonnes year/1)
2021-2022	Inflow	640.81	2,485.35	191.49	60.55	0.60	252.63	19.90	29.93	1,160.75	1,059.01	1.89	1.39
	Discharge to East Point	358.57	1,050.01	141.42	30.42	1.69	172.74	2.46	7.00	204.80	162.16	0.32	0.04
	Outflow to Ludmilla Ck	0.12	0.37	0.04	0.01	0.00	0.05	0.00	0.00	0.06	0.05	0.00	0.00
	Total Outflow	358.69	1,050.38	141.46	30.43	1.69	172.79	2.46	7.00	204.86	162.21	0.32	0.04
	Mass removed	282.12	1,434.97	50.03	30.12	-1.09	79.84	17.45	22.92	955.89	896.80	1.57	1.35
	Percentage removed	44.03%	57.74%	26.12%	49.74%	-183.22%	31.60%	87.65%	76.60%	82.35%	84.68%	83.01%	97.07%