Pine Creek Project Area Annual WDL Report 166-07

31 July 2023

AGNICO EAGLE

Document Details

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The licensee must ensure that each Monitoring Report is prepared in consultation with a Qualified Professional to determine the relevance of the information being provided as it relates to the waste discharge component of the site and in the format described in the National Water Quality Management Strategy, Australian Guidelines for Water Quality Monitoring and Reporting.

I, **Dong (Sam) Yang** (RPEQ, MAusIMM CP) declare that I am aware that Part 9 of *Mining Management Act 2001 (As in force at 31 December 2018)* makes it an offence for a person to know the document contains misleading information and the person knows the official is acting in an official capacity.

I am aware that registered professional engineer (RPEQ-Environmental) must act with honesty, integrity, fairness, without unjustified discrimination and with due respect for the rights of others and the laws of the communities in which engineering services are supplied.

Signature:

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1 Pine Creek Project Area Water Quality

1.1 Background

The Pine Creek project area (PCPA) is located within the Daly River catchment. Localised sub-catchments relevant to PCPA are the ephemeral Pine Creek and Copperfield Creek, in which the project areas drainages flow into. Both creeks flow into the Cullen River, a large tributary of the Douglas-Daly River. A further 200km west of PCPA the water eventually reaches the ocean.

The Copperfield Creek sub-catchment represents an area of 9.2 km^2. Grazing was the major land use and occurred on thinned native pastures and cleared native pastures. The sub-section consists of open woodlands, savannahs, and ephemeral creeks with riparian vegetation.

Copperfield Creek and Pine Creek flow into the Cullen River, a tributary of the Daly River and ultimately flow into the ocean, some 200 km west of the Project Area. The Daly River flows year-round but many of the associated tributaries draining its catchment area are ephemeral, flowing only during the wet season. Stream flows are highly variable and extremely responsive to rainfall, reaching peak levels between February and March each year. The regional drainage pathway and catchment plan of the Copperfield Creek sub-catchment area is described in the PCPA Mining Management Plan.

Agnico Eagle, NT Mining Operations (NTMO) have adopted an integrated, multiple lines of evidence approach to managing the environmental influences from active and passive discharges entering Copperfield Creek. This approach includes:

- Surface water monitoring
- Ecotoxicological assessment
- Macroinvertebrate, and
- Sediment monitoring programs

The results from the above programs are used to assess for potential effects to freshwater aquatic ecosystems from active and passive discharges within the NTMO operational area. This integrated environmental assessment also provides information to assist with calculation and applicability of site-specific trigger values (SSTVs) in accordance with the guidance provided in ANZAST (2018).

The most important aspect of the multiple lines of evidence approach to environmental monitoring and management are the macroinvertebrate monitoring results and ecotoxicity assessments. By monitoring the macroinvertebrates and assessing toxicity, an integrated assessment of potential long-term impacts from exposure to treated mine water can be determined.

1.2 Waste Discharge Licence

The environmental impacts of mine water actively and passively discharged from PCPA process water dam are currently regulated by WDL 166-07, which commenced on 31 October 2022 and expires on 1 November 2032.

An annual Monitoring Report must be submitted to the Northern Territory Department of Environment and Natural Resources (DENR) as per the following items:

38.0 The licensee must submit a completed Annual Return, by emailing waste@nt.gov.au as specified in Item 12.

39.0 The licensee must complete and provide to the Administering Agency areport of data and information obtained through the implementation and performance of the Monitoring Program, as prescribed by this licence, on the dates specified in Item 13.

40.0 The licensee must ensure that each Monitoring Report:

40.1. is prepared in accordance with the requirements of the Administering Agency 'Guideline for Reporting on Environmental Monitoring';

40.2. includes a tabulation, in Microsoft Excel format or another format requested by the Administering Agency, of all monitoring data required to be collected in accordance with this licence for the preceding 12-month period;

40.3. includes a tabulation of monthly and annual contaminant loads discharged from the authorised discharge point specified in Item 5 for the preceding 12 month period. Contaminant loads must be calculated for metals, metalloids, nutrients and other parameters (excluding field parameters) listed in the monitoring program specified in Item 11. The calculations must be based on the daily discharge volume and the concentration of contaminant present in the discharge on that day. On the days when a sample was not taken then the concentration of the contaminant must be estimated using Linear Interpolation methodology;

40.4. includes long term trend analysis of monitoring data to demonstrate any environmental impact associated with the Licensed Action over a minimum period of three years (of part thereof);

40.5. Includes a summary of any investigations undertaken by the licensee in accordance with this license for the preceding 12-month period;

40.6. Includes an assessment of environmental impact from the Licensed Action.

1.3 Purpose of this Report

This report assesses all water quality from 2023 Wet season to comply with WDL 166-07 and AMS condition.

This Monitoring Report fulfils the requirements of WDL 166-07 including the direction of Condition 27-43 to prepare a Monitoring and Licence Report.

1.4 Scope

This Report provides the following information to meet the relevant requirements of WDL 166-07: Analysis and interpretation of NTMO monitoring data for the period of 2022-2023 wet season for the preparation of a Monitoring and Licence Report.

This report is prepared in the format described in the *National Water Quality Management Strategy, Australian Guidelines for Water Quality Monitoring and Reporting, Chapter* 7 and includes:

- Data analysis and interpretation using National Water Quality Management Strategy, Australian Guidelines for Water Quality Monitoring and Reporting, Chapter 6
- A trend analysis and interpretation of monitoring results (field data and analytical parameters) from 2014 to 2023, and an assessment of environmental impacts resulting from the discharge of treated mine water.
- Detailed interpretation of results of the Biological Monitoring Program.
- Detailed interpretation of results of the Sediment Monitoring Plan.
- Interpretation of the ecotoxicology assessment results.
- Incorporates reporting requirements for the 2023 Water Management Strategy.
- Recommendations to necessitate meeting the WDL conditions and improvement of water management strategies.
- Recommendations for updates to the WDL.

1.5 Assumptions

Data used by NTMO was utilised in this report where relevant on the basis that NTMO have undertaken the necessary appropriate quality assurance and quality control procedures in the sampling, analysis and reporting of data for all monitoring locations.

2 Surface Water Management

2.1 Background of the Surface Water Quality Monitoring Program

The area around Pine Creek has been mined intermittently for over 100 years. Several historic mining leases existed within the vicinity of the PCPA. Those in the immediate vicinity of the site include Democrat, Chin Phillips, North Australia, Eleanor and Kohinoor. Most of these had ceased operations by 1900. The main activity in recent years has centered on the former Enterprise Mine.

While no mining activities have been undertaken by NT Mining Operations Pty Ltd (NTMO) at the PCPA, mining has been undertaken by previous operators. No mining operations are planned at the PCPA for this reporting period, however, there is some possibility that limited exploration activities may occur during the period. PCPA will remain in a care and maintenance phase.

Currently, NTMO is actively discharging mine water from (PCPWD) Process Water Dam into Creek 6. PCCK06 sits on the boundary of the PCPA lease and acts as a compliance point for monitoring wastewater discharged from PCPWD. PCPWD collects passively discharged water from the surrounding WRDs and TSFs, resulting in high concentrations of cadmium, cobalt, copper sulphate and zinc in its water.

This Report assesses all water quality from the 2022/23 wet season to comply with WDL 166-07 conditions. Where further interrogation of the data is required, the historical water quality (2014 – 2022) has been used to aid in interpretation.

SSTVs do not apply to standing water bodies or to water quality within mixing zones and in such instances NTMO applies the stock watering guidelines (SWG), where applicable.

2.2 Authorised Discharge Points

Authorised Discharge Points (AD) for PCPA, as specified in WDL 166-07, are shown in Table 1. PCPWD flows into Copperfield Creek.

Table 1 PCPA Authorised Discharge Points (WDL 166-07)

Authorised Discharge Point	Description	Location	
		Latitude	Longitude
PCPWD	Wastewater from the Process Water Dam is discharged via weir boards at the southern end of the Dam to Copperfield Creek.	-13.847°	131.835 °

2.3 Mine Affected Water Sources

The sources of mine affected waters from PCPA to Copperfield Creek originate from the legacy infrastructure associated with historical mining activity including Dams, waste rock dumps (WRDs) and tailings dams. Influences on water quality from site infrastructure are identified and discussed in the 2023 Notification and Investigation reports.

The sources of mine-affected water from PCPA originate from seepage of WRDs, TSFs and historic heap leach pads. Table 2 shows the main sources of mine water to the receiving creek. Conceptual model of water movement within the PCPA are shown in Figure 1.

Table 2 Wastewater Sources

Site	Source	Receiving Sites
Copperfield Creek	Process Water Dam	PCCK06
	PCPWD Catchment A	PCPWD
	PCPWD Catchment B (TSF)	
	Upper PCPWD Catchment	

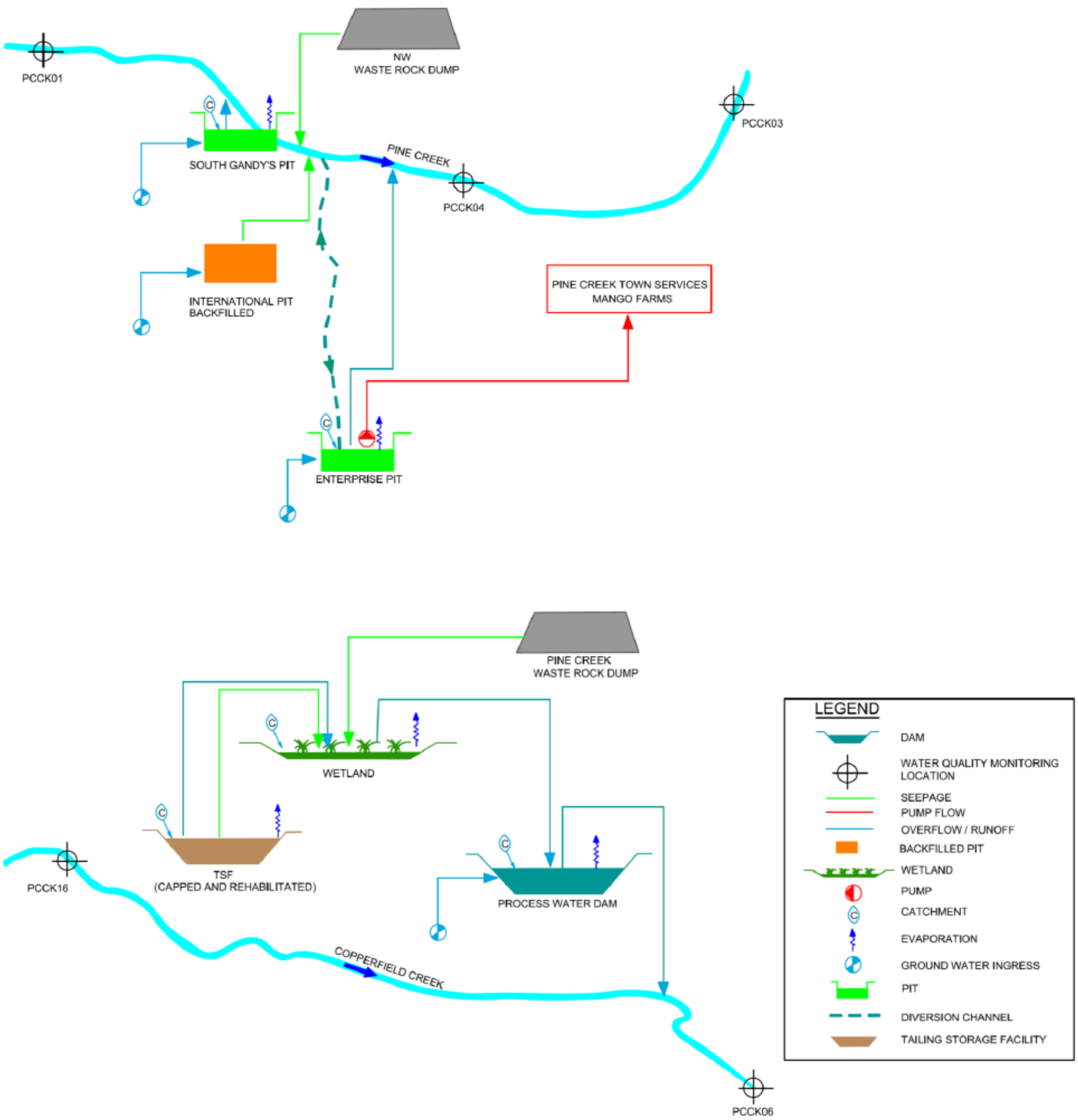

Figure 1 Conceptual Models of PCPA Water Source

2.4 Discharge Regime 2022/23

NTMO manages the discharge of mine wastewater following standard operating procedure. NTMO have discharged wastewater from the Process Water Dam through PCCK06 from February 2023 to March 2023.

The active discharge flow rate was based on the flow and electrical conductivity in PCCK06 and rainfall in the Pine creek Catchment. This was measured by using a combination of data from weekly sampling and recorded pumping rates including overflow from PCPWD.

2.5 Rainfall Data

Rain gauges are used to collect daily rainfall data onsite. A rain gauge is located at PCPWD. During the current reporting period, maximum rainfall occurred during February 2023.

The 2022/23 wet season summary from the Australian Bureau of Meteorology stated that no particularly long or extended monsoon bursts affected the NT the long-term (13 year) average of 1528.7mm (BOM). The local rainfall data for PCPA wet season recorded an average rainfall for PCPA as shown in below table. The total rainfall recorded at Pine Creek is 1528mm.

Table 3 Pine Creek Rainfall 2022/23

Month	2022/2023
May	0
June	1.4
July	20.2
Aug	0
Sep	3.4
Oct	62.6
Nov	268.8
Dec	183.6
Jan	241.2
Feb	431
Mar	172.6
April	143.2
Total (mm)	**1528**

2.6 Volume of Water Discharged

Process Water Dam water is untreated water and relies on the clean water of Creek 6 to dilute its metal content. During the 2022/23 wet season, NTMO discharged a total of 474 ML discharged from Process Water Dam into Creek 6. The discharge quality is measured at PCCK06 100m downstream of the confluence of Copperfield Creek and PCPWD.

Table 4 PCPWD Discharge Volumes to PCCK06 in 2023

Date	Average Discharge Flow Rate (L/S)	Discharge Volume (ML)
3/02/2023	35.00	3.02
4/02/2023	60.00	5.18
5/02/2023	60.00	5.18

6/02/2023	48.00	4.15
7/02/2023	28.00	2.42
8/02/2023	28.00	2.42
9/02/2023	28.00	2.42
10/02/2023	30.67	2.65
11/02/2023	69.50	5.79
12/02/2023	98.00	8.11
13/02/2023	98.00	7.76
14/02/2023	98.00	8.11
15/02/2023	98.00	8.47
16/02/2023	98.00	8.47
17/02/2023	98.00	8.47
18/02/2023	98.00	8.11
19/02/2023	98.00	8.11
20/02/2023	159.25	13.41
21/02/2023	196.00	16.93
22/02/2023	196.00	15.52
23/02/2023	196.00	16.93
24/02/2023	196.00	16.93
25/02/2023	196.00	16.93
26/02/2023	196.00	16.93
27/02/2023	196.00	16.93
28/02/2023	196.00	16.93
1/03/2023	196.00	16.93
2/03/2023	196.00	16.93
3/03/2023	196.00	16.93
4/03/2023	196.00	16.93
5/03/2023	196.00	16.93
6/03/2023	196.00	16.93
7/03/2023	196.00	16.93
8/03/2023	196.00	16.93
9/03/2023	196.00	11.64
10/03/2023	134.75	11.64
11/03/2023	98.00	8.47
12/03/2023	98.00	8.47
13/03/2023	98.00	8.47
14/03/2023	98.00	8.47
15/03/2023	98.00	8.47
16/03/2023	98.00	8.47

17/03/2023	48.13	4.16
18/03/2023	35.00	3.02
19/03/2023	35.00	3.02
20/03/2023	35.00	3.02
21/03/2023	35.00	3.02
22/03/2023	35.00	2.27
13/04/2023	21.88	1.89
14/04/2023	63.88	5.52
15/04/2023	98.00	8.47
16/04/2023	98.00	8.47
17/04/2023	98.00	8.47
18/04/2023	98.00	8.47
19/04/2023	98.00	8.47
20/04/2023	98.00	6.35

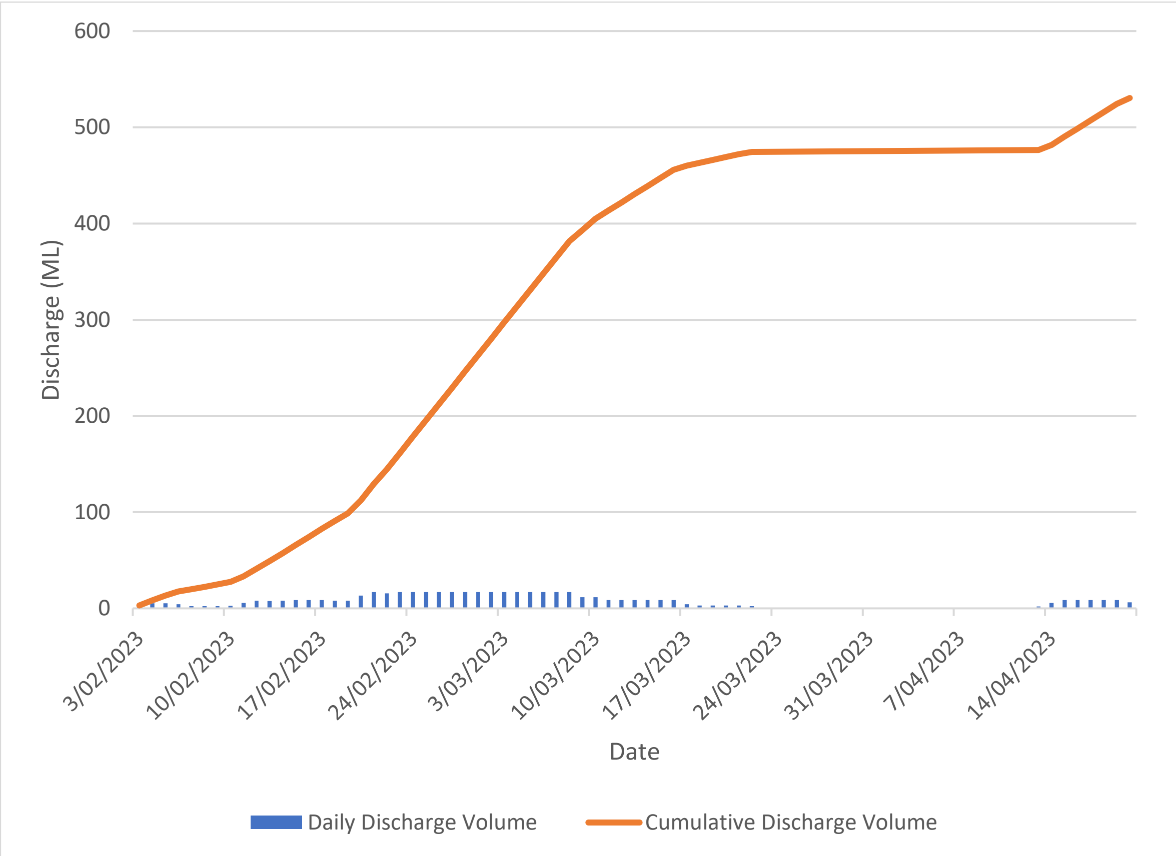

Figure 2 PCPA Water Discharge Summary (2023)

3 Surface Water Quality

3.1 Surface Water Monitoring Program

Surface water monitoring requirements are specified in WDL 166-07. The results of these monitoring programs are used to understand the influence of treated mine water discharge from the project area to the receiving environment in the Copperfield Creek system and the Daly River catchment. The results of the monitoring programs assist in identifying trends and assess the success of the various surface water management measures implemented by NTMO. Surface water WDL monitoring locations for PCPA are shown in Figure 3 and in Table 5. The surface water quality program incorporates the monitoring of the location on-site, upstream locations, discharge waters, downstream compliance site, and further downstream locations. Analytes are shown in Table 6 and sampling frequencies are shown in WDL 166-07.

Table 5 Surface Water Monitoring Locations as Specified in WDL 166-07.

Description	Copperfield Creek			
Site Code	PCPWD	PCCK16	PCCK22	PCCK06
Latitude	-13.847°	-13.862°	-14.011°	-13.862°
Longitude	131.834°	131.820°	131.917°	131.833°
Description	Pine Creek Process Water Dam. (Authorised Discharge Point)	Copperfield Creek upstream of any mine site discharge at the Jindare/Umbrawarra Road Crossing (control).	PCCK22 is 26 km downstream of PCCK06. Down Bonrook Stations driveway	100 m downstream of the confluence of Copperfield Creek and PCPWD.

Table 6 Surface Water Monitoring Analytes as Specified in WDL 166-07

Type	Analytes
Field measurements	Flow, water level, pH, electrical conductivity, dissolved oxygen, temperature
Dissolved metals (0.45 µm) µg/L	Aluminium, arsenic (Total), cadmium, cobalt, copper, iron, lead, manganese, nickel, zinc
Environmental indicators mg/L	Turbidity, total suspended solids, total dissolved solids, calcium, magnesium, potassium, sodium, chloride, Sulphate
Nutrients	Total nitrogen (µg/L – unfiltered), total phosphorus (µg/L – unfiltered), organic carbon (mg/L – unfiltered)

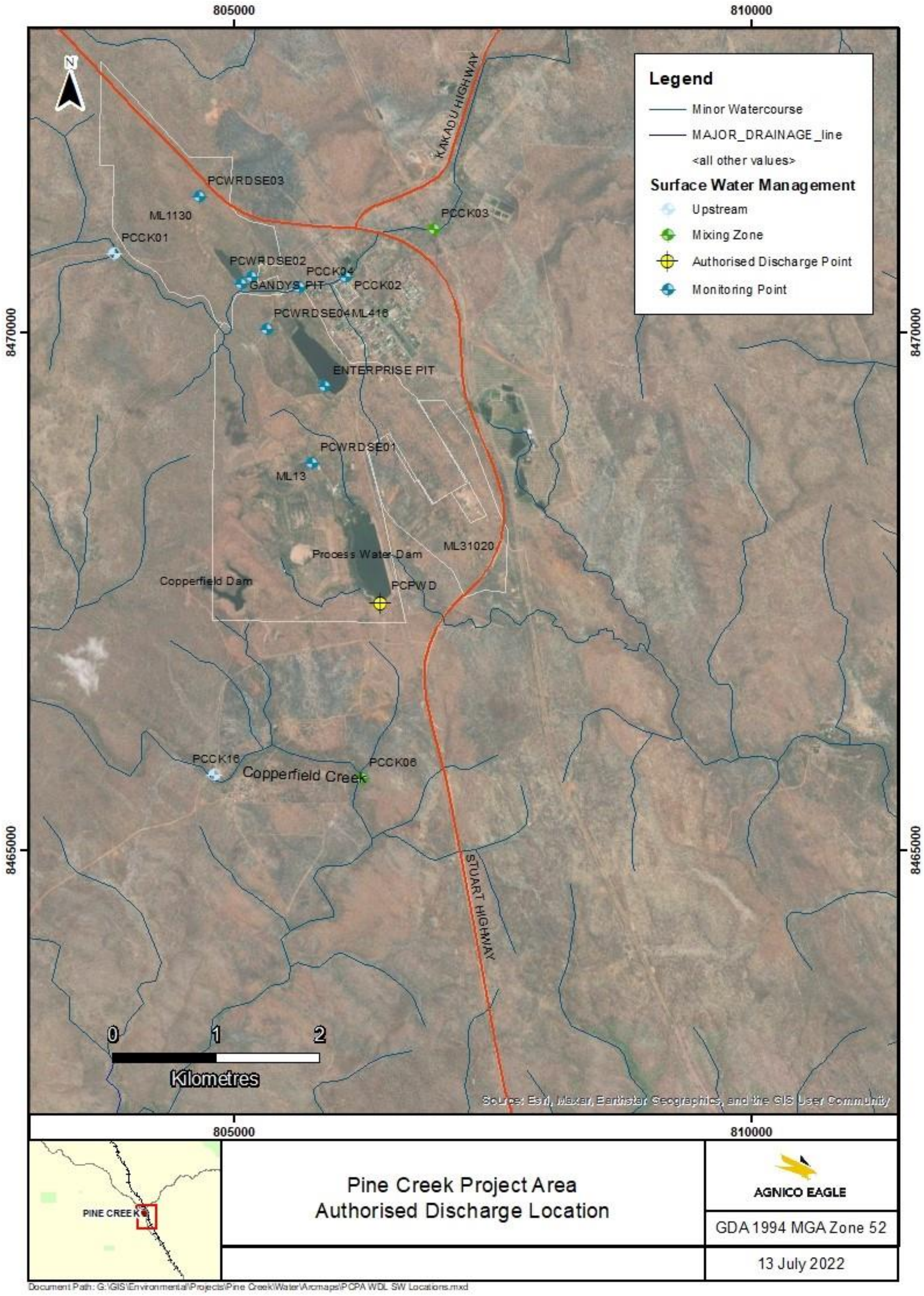

Figure 3 Regulatory Surface Water Monitoring Location

3.2 PCPA Surface Water Quality Results

This section discusses the historical water quality trends at the site for 2022/23 wet season as this period captures the water quality on and off-site to meet the requirements of WDL 166-07. Recent and historical data were also assessed where appropriate.

PCCK06

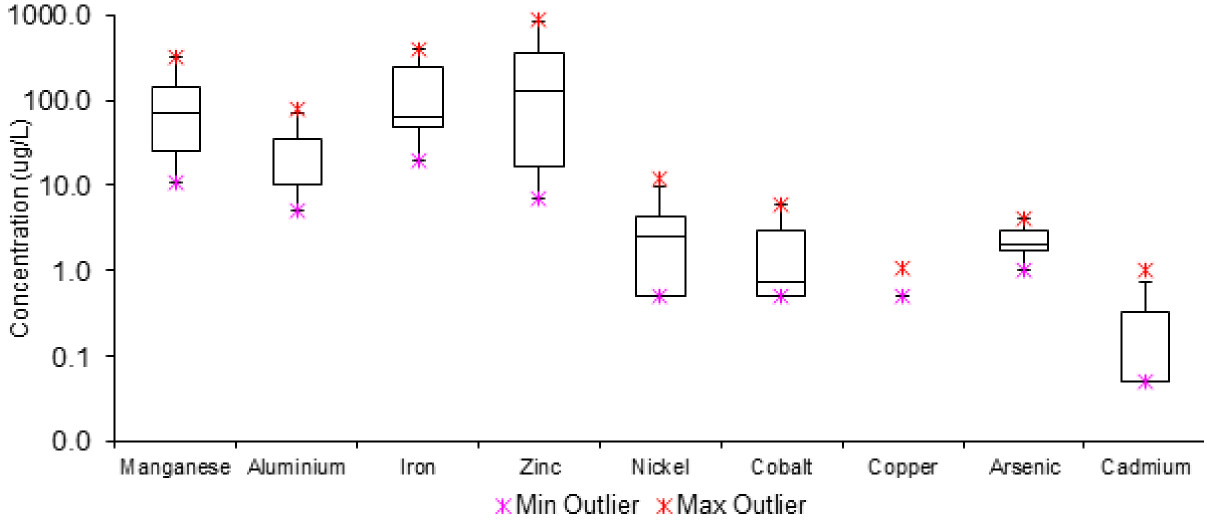

Figure 4 PCCK06 Dissolved Metal 2022-2023

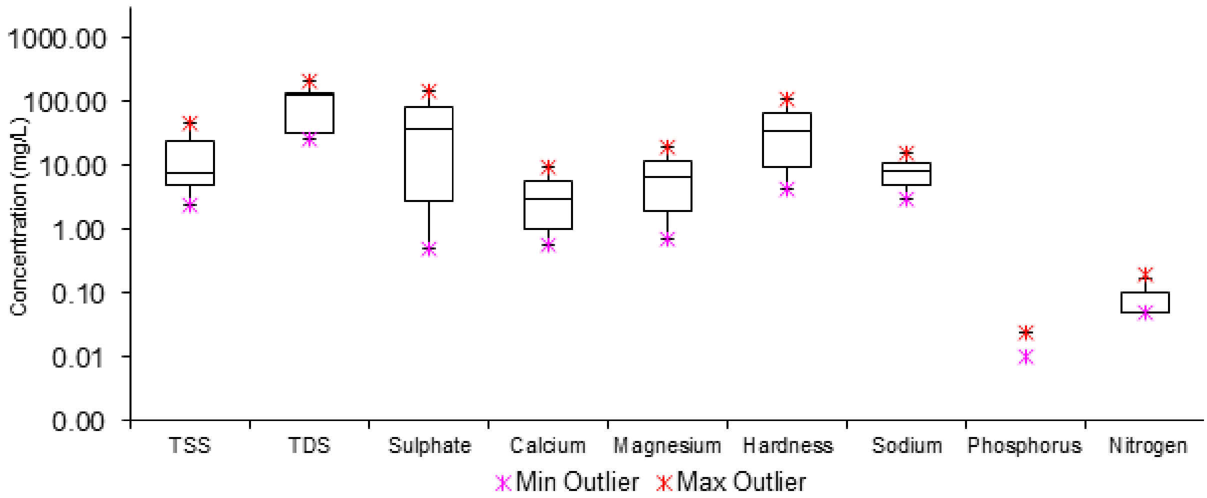

Figure 5 PCCK06 General Chemistry 2022-2023

Table 7 PCCK06 Water Quality (January 2023 to April 2023)

Analyte	PCCK06 SSTV	Count	Minimum	Median	Maximum
pH	6.0 – 8.0	15	6.04	7.2	7.55
EC (µS/cm)	20 – 250	15	40.65	191.35	335.05
DO (%sat)	57 - 120	15	91.9	99.22	108.12
Metals (dissolved) (µg/L)					
Aluminium	218	16	5	10	80
Arsenic **(Total)**	140	16	1	2	4
Cadmium	0.80	16	0.05	0.05	1
Chromium	N/A	16	0.5	0.5	0.5
Cobalt	13	16	0.5	0.75	6
Copper	2.5	16	0.5	0.5	1.1
Iron	838	16	20	65	390
Lead	9.4	16	0.5	0.5	0.5
Manganese	3600	16	11	69.5	310
Nickel	17	16	0.5	2..5	12
Selenium	N/A	16	0.5	0.5	0.5
Zinc	31	16	7	125	880
Major Chemistry					
Turbidity (NTU)	15	16	7.2	13	35
TSS (mg/L)	20	16	2.5	8	46
Chloride (mg/L)	13	16	1	2	4
Sulphate (mg/L)	N/A	16	0.5	38	150
Nutrients					
Total Nitrogen (TN) (mg/L)	N/A	16	50	100	200
Total Phosphorus (TP) (mg/L)	N/A	9	10	25	25

PCCK16

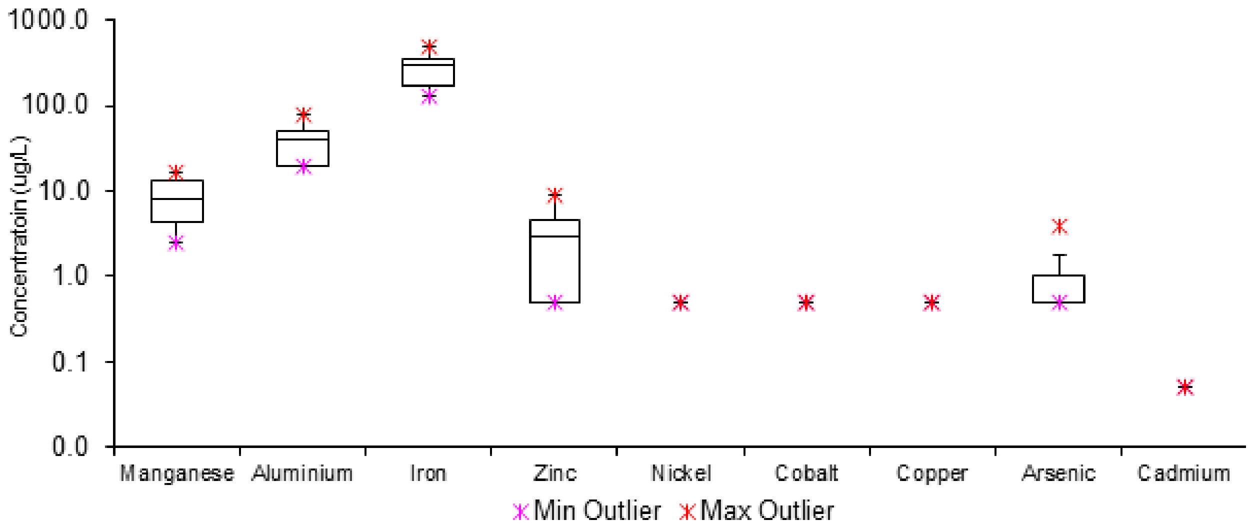

Figure 6 PCCK16 Dissolved Metal 2022-2023

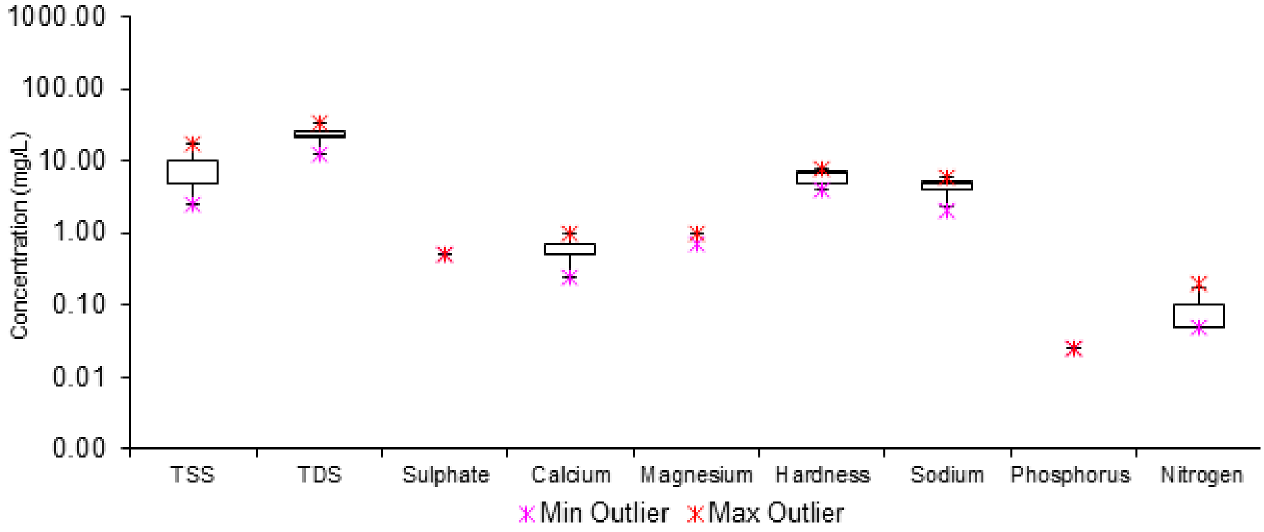

Figure 7 PCCK16 General Chemistry 2022-2023

Table 8 PCCK16 Water Quality (January 2023 to April 2023)

Analyte	PCCK06 SSTV	Count	Minimum	Median	Maximum
pH	6.0 – 8.0	14	6.35	7.24	7.62
EC (µS/cm)	20 – 250	14	19.25	35.51	51.87
DO (%sat)	57 - 120	14	84.65	97.73	105.97
Metals (dissolved) (µg/L)					
Aluminium	218	15	20	40	80
Arsenic **(total)**	140	15	0.5	0.5	4
Cadmium	0.8	15	0.05	0.05	0.05
Chromium	N/A	15	0.5	0.5	0.5
Cobalt	13	15	0.5	0.5	0.5
Copper	2.5	15	0.5	0.5	0.5
Iron	838	15	130	290	480
Lead	9.4	15	0.5	0.5	0.5
Manganese	3600	15	2.5	8	17
Nickel	17	15	0.5	0.5	0.5
Selenium	N/A	15	0.5	0.5	0.5
Zinc	31	15	0.5	3	9
Major Chemistry					
Turbidity (NTU)	15	15	7.8	15	34
TSS (mg/L)	20	15	2.5	5	17
Chloride (mg/L)	13	15	1	2	2
Sulphate (mg/L)	N/A	15	0.5	0.5	0.5
Nutrients (mg/L)					
Total Nitrogen	N/A	15	50	100	200
Total Phosphorus	N/A	12	25	25	25

PCCK22

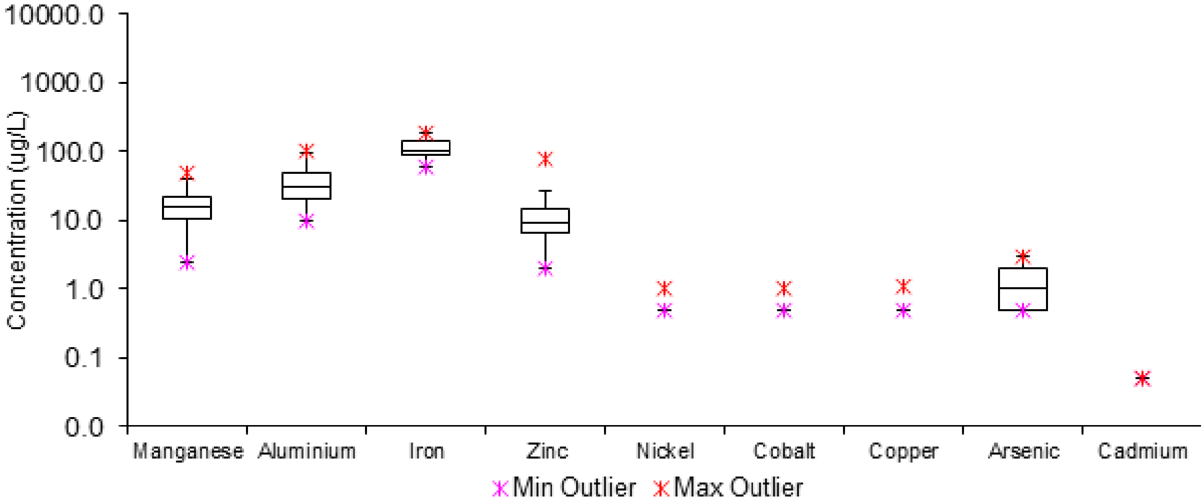

Figure 8 PCCK22 Dissolved Metal 2022-2023

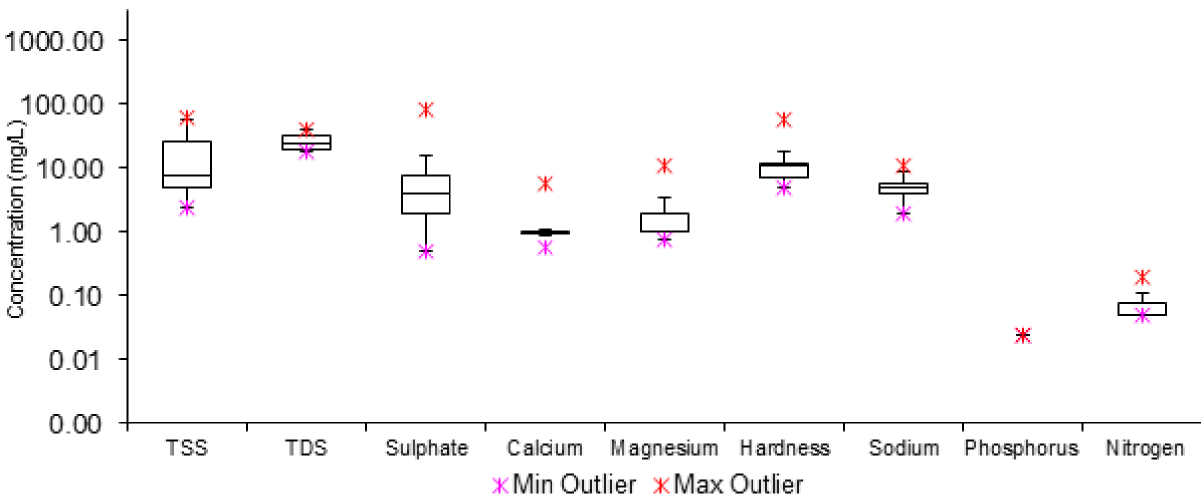

Figure 9 PCCK22 General Chemistry 2022-2023

Table 9 PCCK22 Water Quality Results (January 2023 to April 2023)

Analyte	PCCK06 SSTV	Count	Minimum	Median	Maximum
pH	6.0 – 8.0	14	6.05	7.34	7.79
EC (µS/cm)	20 – 250	14	27.35	41.52	62.42
DO (%sat)	57 - 120	14	95.48	104.86	111.39
Metals (dissolved) (µg/L)					
Aluminium	218	15	10	30	100
Arsenic **(total)**	140	15	0.5	1	3
Cadmium	0.8	15	0.05	0.05	0.05
Chromium	N/A	15	0.5	0.5	0.5
Cobalt	13	15	0.5	0.5	1
Copper	2.5	15	0.5	0.5	1.1
Iron	838	15	60	100	190
Lead	9.4	15	0.5	0.5	0.5
Manganese	3600	15	2.5	16	48
Nickel	17	15	0.5	0.5	1
Selenium	N/A	15	0.5	0.5	0.5
Zinc	31	15	2	9	78
Major Chemistry					
Turbidity (NTU)	15	15	6.4	16	57
TSS (mg/L)	20	15	2.5	8	
Chloride (mg/L)	13	15	0.5	2	3
Sulphate (mg/L)	N/A	15	0.5	4	81
Nutrients (mg/L)					
Total Nitrogen (TN)	N/A	15	50	50	
Total Phosphorus (TP)	N/A	12	25	25	25

PCPWD

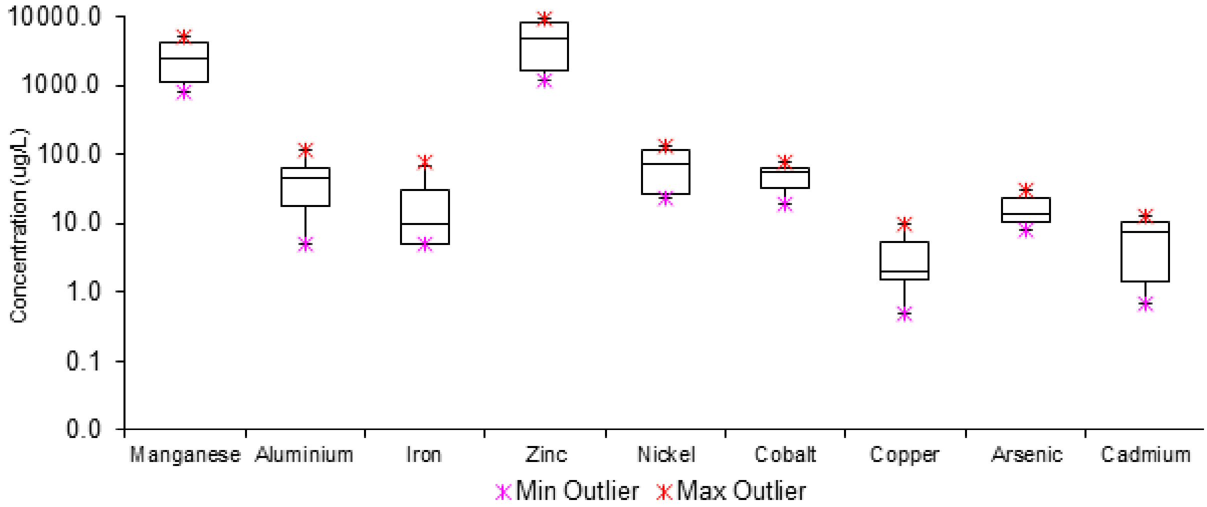

Figure 10 PCPWD Dissolved Metal 2022-2023

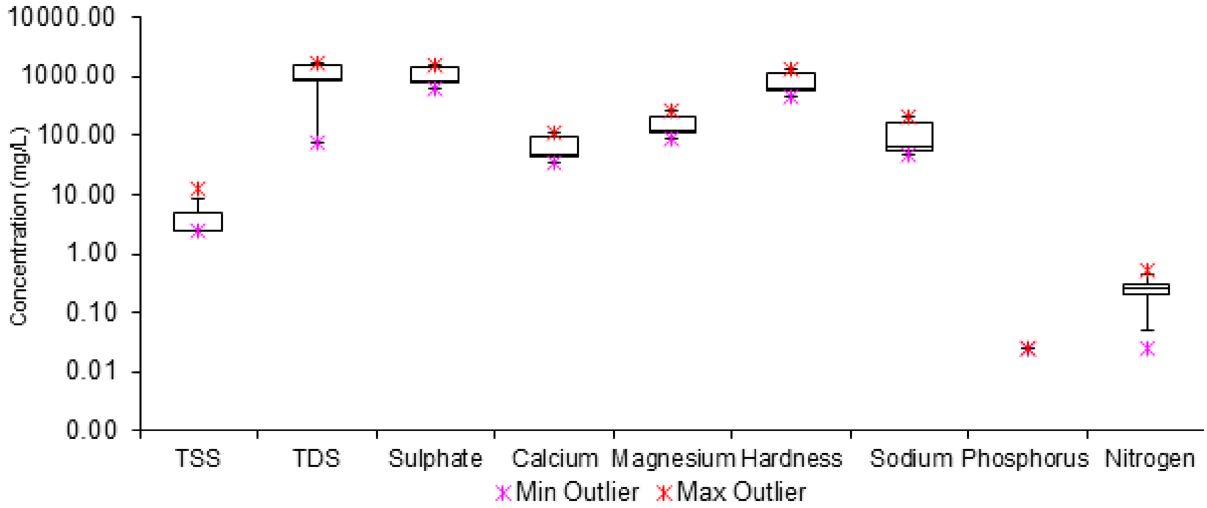

Figure 11 PCPWD General Chemistry 2022-2023

Table 10 PCPWD Water Quality Results (January 2023 to April 2023)

Analyte	PCCK06 SSTV	Count	Minimum	Median	Maximum
pH	6.0 – 8.0	18	5.79	6.71	7.75
EC (µS/cm)	20 – 250	18	1190	1441.85	2694.6
DO (%sat)	57 - 120	18	80.2	95.18	198.7
Metals (dissolved) (µg/L)					
Aluminium	218	16	5	45	120
Arsenic **(TOTAL)**	140	16	8	14	31
Cadmium	0.8	16	0.7	7.5	13
Chromium	N/A	16	0.5	0.5	1
Cobalt	13	16	19	54.5	78
Copper	2.5	16	0.5	2.05	9.9
Iron	838	16	5	10	80
Lead	9.4	16	0.5	0.5	0.5
Manganese	3600	16	830	2550	5100
Nickel	17	16	23	70.5	130
Selenium	N/A	16	0.5	0.5	0.5
Zinc	31	16	1200	5000	9700
Major Chemistry					
Turbidity (NTU)	15	16	0.6	1.5	9.2
TSS (mg/L)	20	16	2.5	5	13
Chloride (mg/L)	13	16	11	13.5	33
Sulphate (mg/L)	N/A	16	640	825	1600
Nutrients (mg/L)					
Total Nitrogen (TN)	N/A	16	50	250	500
Total Phosphorus (TP)	N/A	11	25	25	25

PCPA Creek EC and pH

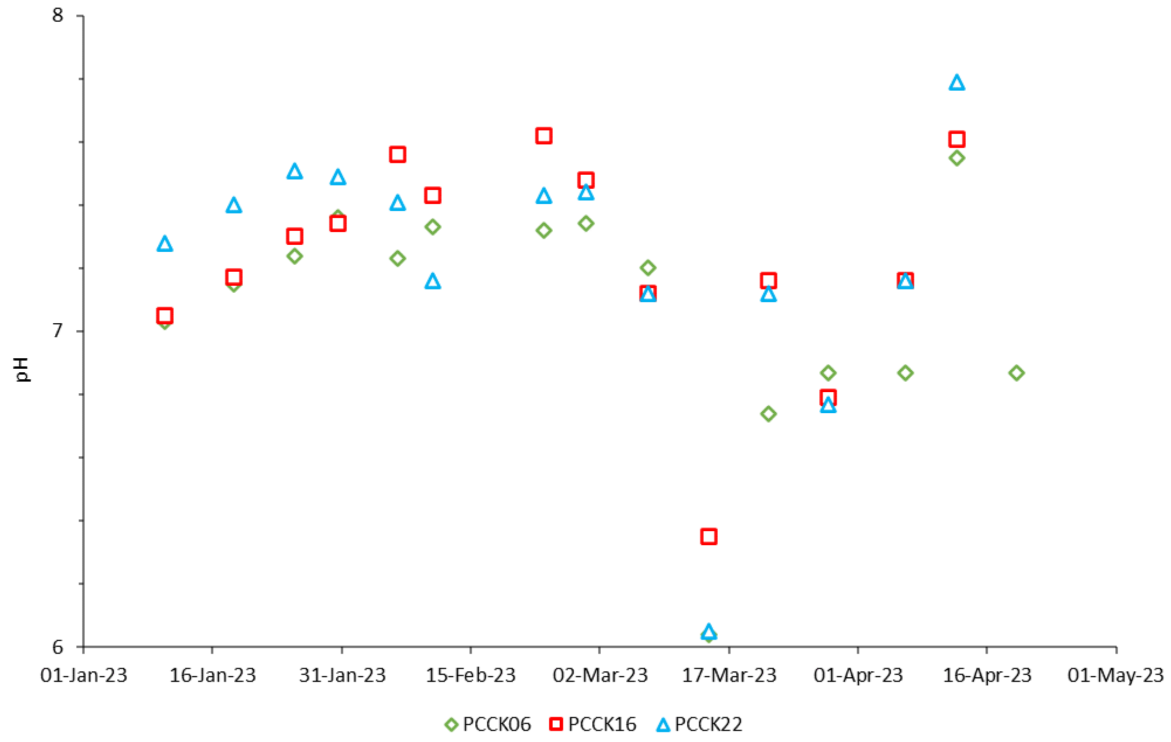

Figure 12 PCPA Creek pH 2023 wet season

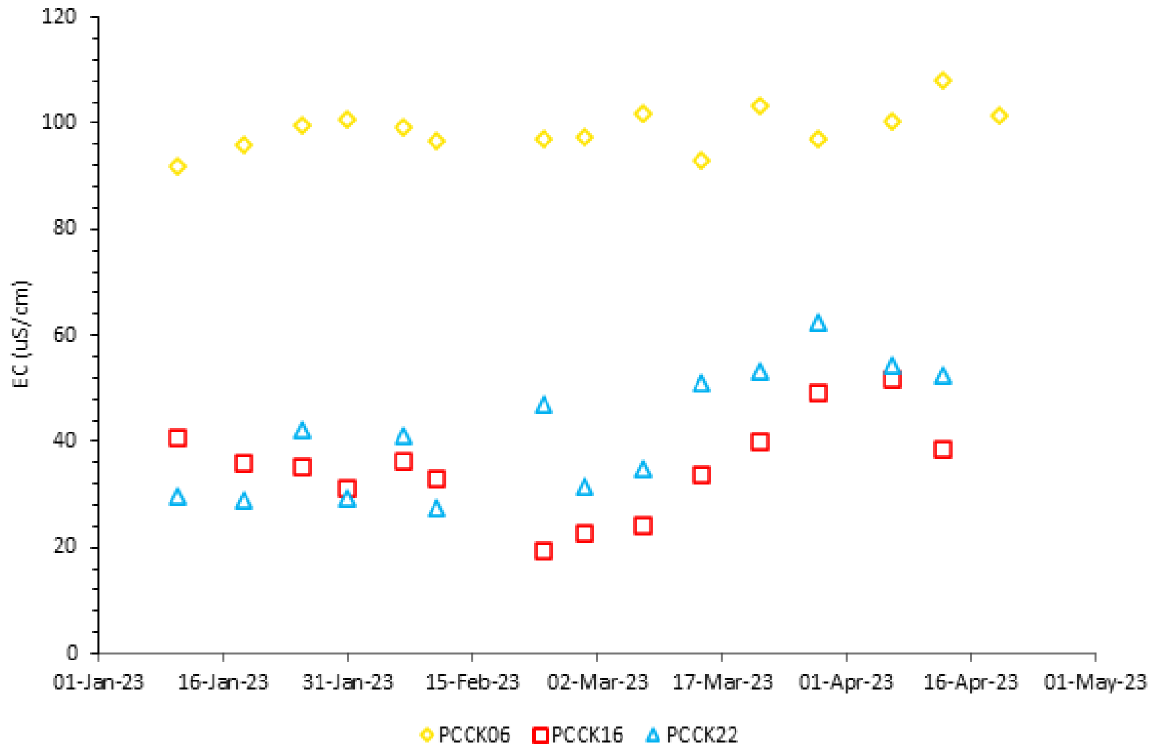

Figure 13 PCPA Creek Electrical Conductivity 2023 wet season

3.3 PCCK06 Water Quality Long Term Trend

3.3.1 PCCK06 Temporal Water Quality

Table 11 indicates that the concentrations of metals at compliance site PCCK06 have been variable over the years due to multiple factors such as rainfall, discharge volumes and dilution factors in the receiving creek.

Table 11 PCCK06 Median Water Quality Comparison (2015 to 2023)

Analyte	SSTV 2022	Median							
		2015/16	2016/17	2017/18	2018/19	2019/20	2012/21	2021/22	2022/23
pH	6.0-8.0	6.56	6.62	6.51	6.49	6.61	6.59	6.37	7.21
EC µS/cm	250	83.25	154.1	102.7	71.95	63.9	76.9	47.9	191.73
DO %	120	57.7	72.6	65.75	71.2	73	72.9	78.4	98.34
Metals (0.45 µm filtered) (µg/L)									
Aluminium	218	30	35	20	10	30	10	50	10
Arsenic (TOTAL)	140	2	2	2	2	2	2	1	2
Cadmium	0.8	0.1	0.2	0.2	0.1	0.1	<0.1	0.05	0.05
Cobalt	13	1	2	1	1	1	10	0.5	0.75
Copper	2.5	1	1	1	1	1	<1	0.5	0.5
Iron	838	495	285	175	210	290	56	260	65
Lead	9.4	1	1	1	1	1	<1	0.5	0.5
Manganese	3600	59	220	82.5	56.5	30.5	445	28	69.5
Nickel	17	1	3	2.5	1	1	8	0.5	2.5
Selenium	N/A	1	1	1	1	1	<1	0.5	0.5
Zinc	31	47	180	180	44.5	50	465	33	125
Major Chemistry (mg/L)									
Turbidity	15	9.3	9.55	11	11	19.5	9.3	17	13
TSS	20	9.5	10	10	10	10	<1	13	8
Chloride	13	2.5	3	2	3.5	2.5	2.5	2	2

3.3.2 PCCK06 Exceedances

During the 2023 reporting period EC, Cadmium, Cobalt, Total Suspended Solids, Turbidity and Zinc exceeded the SSTV at location PCCK06 under WDL166-07. Eight exceedance notifications were sent from February to May 2023 to report these occurrences. Zinc was the most common and most severe exceedance.

Table 12 PCCK06 Reportable Exceedances 2022/23

	EC (uS/cm)	Cd (µg/L)	Co (µg/L)	TSS (mg/L)	Turbidity (NTU)	Zn (µg/L)
SSTV	250	0.4	1.4	20	15	15
10/01/2023	44.6	<0.1	<1	<10	33	16
18/01/2023	41.08	<0.1	<1	11	22	17
25/01/2023	40.65	<0.1	<1	<10	22	15
6/02/2023	335.05	<0.1	2	<10	12	150
23/02/2023	267.5	0.2	3	46	35	180
28/02/2023	205.77	0.3	3	14	12	210
7/03/2023	213.51	0.6	5	29	22	450
14/03/2023	260.02	1	6	10	11	630
21/03/2023	191.35	0.4	2	6	7.4	380
28/03/2023	158.11	0.3	1	<5	7.2	340
19/04/2023	192.11	0.9	3	<10	8.4	880

3.3.3 Contributing Factors to Water Quality at PCCK06

Pine Creek Process Water Dam (PCPWD) is the primary catchment in PCPA for low quality site waters which captures most of surface water runoff from the Tailing Storage Facility (TSF) and the main Waste Rock Dump (WRD). Water quality at PCCK06, downstream of PCPWD is influenced by the low water quality found in PCPWD whilst under passive discharge conditions.

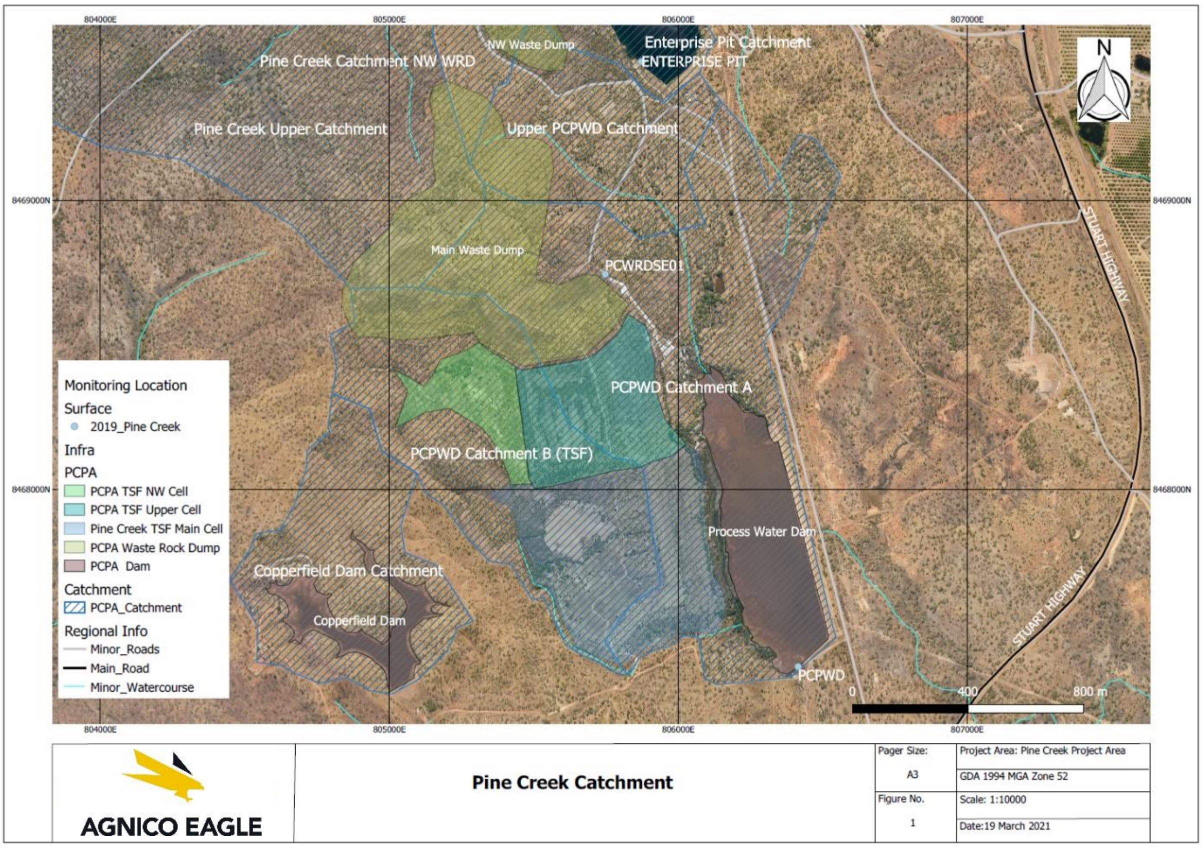

Figure 14 Process Water Dam Catchment

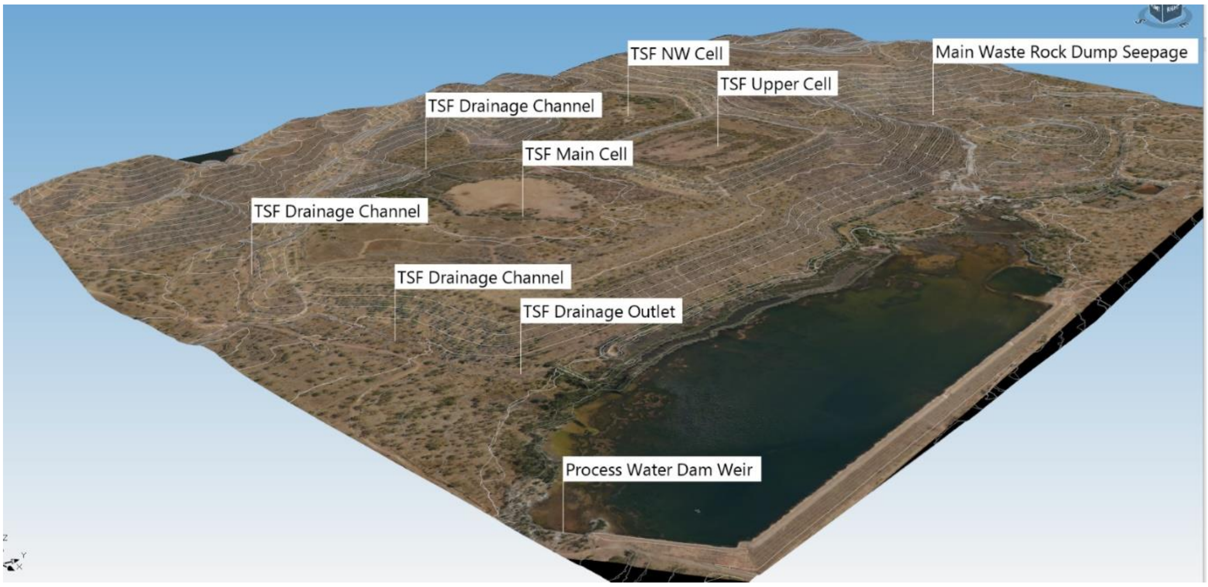

Figure 15 Process Water Source Location

Table 13 PCPWD Source Location Water Quality (Median Value)

	EC	Al	As (total)	Cd	Co	Cu	Fe	Pb	Mn	Ni	Zn
Units	uS/cm	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Site		Filtered	Filtered	Filtered	Filtered	Filtered	Filtered	Filtered	Filtered	Filtered	Filtered
TSF Drainage Outlet	170.93	30	39	1	16	8.6	20	<1	400	16	650
PCWRDSE01	4420	41,500	29	345	2,000	1,350	330	81	37,000	1,650	155,000

3.3.4 Exceedance Analysis and Discussion

Zinc concentrations exceeded the 2022/23 SSTV of 15 µg/L on 13 of the 16 sampling occasions at PCCK06, with the highest concentrations recorded through February, March and April. It is highly likely that site PCPWD (Authorised Discharge Point) contributes to most of the elevated concentrations of zinc detected at PCCK06. Zinc concentrations at PCCK06 during this period may have the potential to cause adverse environmental harm to aquatic organisms living in the receiving waters at PCCK06.

Aquatic Ecology Services was engaged by Agnico Eagle to undertake biological and sediment monitoring at PCPA, following the 2022/23 wet season. The results of this sampling showed very little indication of any impact when comparing metrics from the upstream site with those downstream for the macroinvertebrate community on Copperfield Creek. The macroinvertebrate community was composed of similar taxa across the catchment, and particularly similar in samples at each site. Active discharge to PCPA did not appear to be having any impacts on aquatic ecosystem health of Copperfield Creek, although sediments should continue to be monitored to understand long-term trends in metal accumulation. Please refer to appendix A for in-depth monitoring results.

4 References

ANZECC & ARMCANZ 2000 Australian and New Zealand Environment and Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand. National water quality management strategy, Australian and New Zealand guidelines for fresh and marine water quality. ANZECC and ARMCANZ, Canberra, Australia.

BOM 2019. *Northern Territory Wet Season: 1 May 2019 – Seasonal Climate Summary for Northern Territory.* http://www.bom.gov.au/climate/current/season/nt/summary.shtml

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Pine Creek Project Area

Biological and Sediment Monitoring 2023

Final Report

Aquatic Ecology Services

This report has been prepared for Kirkland Lake Gold as a technical document to inform the Waste Discharge Licence Report.

The opinions, conclusions and any recommendations in this report are based on information obtained from, and testing undertaken at or in connection with, specific sample points. As a result, not all relevant site features and conditions may have been identified in this report.

Sediment quality data and rainfall data were obtained from KLG. Aquatic Ecology Services has made the assumption that all data has been validated and is correct.

Version	Prepared by	Reviewed by	Review Date
Draft 1.0	T Steele	E McGowan	25/07/2023
Final 2.0	T Steele		

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Figures

Tables

1. Background

1.1 Catchment

The Pine Creek Project Area (PCPA) lies within the Daly River catchment. The local sub-catchment systems are the ephemeral Pine Creek and Copperfield Creek which drain from the Project Area. Both streams flow into the Cullen River, a large tributary of the Douglas-Daly Catchment. The Daly River flows into the ocean, approximately 200 km west of the Project Area.

Pine Creek Process Water Dam (PCPWD) drains to the south via a constructed concrete spillway and wooden weir which then discharges to an unnamed tributary of Copperfield Creek approximately 2 km downstream.

1.2 Monitoring Program

The release of this waste water from the Process Water Dam (PCPWD) to Copperfield Creek has historically been controlled by the Waste Discharge License (WDL) 166-03 pursuant to S74 of the Water Act. In 2019/2020, NT Mining Operations (NTMO) did not seek the renewal of the WDL. Irrespective of this change, biological monitoring was conducted to understand if any passive discharges from the PCPA were influencing the aquatic ecosystems of the receiving environment. In 2020, KLG applied for and was granted a WDL (166-06) and released water to Copperfield Creek during the 2020/2021 wet season as a result, which remains in place in 2022.

Biological monitoring has occurred in the PCPA since 2010. In addition to biological monitoring, sediment quality monitoring results assist with interpretation of macroinvertebrate community data. By monitoring both macroinvertebrates and sediment, an integrated assessment of long-term impacts from exposure to treated mine water can be determined should it be required.

1.3 Scope

Aquatic Ecology Services was engaged by NTMO to undertake biological and sediment monitoring at the PCPA, following the 2022-2023 wet season. This report presents the data collected during monitoring undertaken in the post-wet season of 2023.

2. Study Design

2.1 Sampling sites

Seven sampling sites were visited during sampling in 2023 (Table 1). This included one upstream site and three downstream sites on Pine Creek, as well as one upstream and two downstream sites on Copperfield Creek.

Sites on Pine Creek are located upstream and downstream of passive discharges from the PCPA, and sites on Copperfield Creek are downstream of active discharges from PCPWD. Site PCCK06 on Copperfield Creek is downstream of the PCPWD and is the compliance point for the PCPA (WDL 166-03).

Table 1 – Sampling sites at the PCPA

Site Code	Site type	Description	Easting	Northing
PCCK01	Upstream	Pine Creek upstream of Green Valley Road	803839	8470765
PCCK04	Downstream	Downstream of PCPA within Pine Creek on tenement boundary	805619	8470439
PCCK02	Downstream	Pine Creek captures water from AD PCCK04. In PC township	806079	8470548
PCCK03	Downstream	1 km further downstream from PCCK02 at Railway line culvert, Pine Creek	806926	8471010
PCCK16	Upstream	Copperfield Creek at Jindare/Umbrawarra Road Crossing	804801	8465732
PCCK06	Downstream	100 metres downstream of the confluence of Copperfield Creek with the process water dam spillway tributary	806230	8465696
PCCK22	Downstream	Copperfield Creek ~21km downstream of the PCPA	815136	8449095

2.2 Timing

Sampling has routinely been conducted in the post-wet season during the recessional flow period, to capture the potential effects of mine site runoff during the preceding wet season. The timing of sampling has generally been undertaken in late April to mid-May. In 2023, sampling was undertaken in late April to target adequate water availability at all sites.

PCPA Biological and Sedment Monitoring

Figure 1 - Sampling locations

Sampling sites
Downstream
Upstream

Mining Lease Boundary

0 1 2 km

Aquatic Ecology Services

Imagery Source: ESRI Satellite (ARC GIS World Imagery) https://server.arcgisonline.com/ArcGIS/rest/services/World_Imagery/MapServer/tile/{z}/{y}/{x}

3. Methods

3.1 Habitat assessment

At each site, descriptions of habitat characteristics were recorded following the criteria listed in the Northern Territory AUSRIVAS "Darwin-Daly Region Model" field sheets (Lamche, 2007). Habitat assessments were undertaken in consideration of the whole reach sampled, including:

- Site description
- Water quality
- Instream physical characteristics (flow velocity and depth, instream habitat characteristics, bank height, riparian zone width)
- Riparian vegetation characteristics (types, %cover, exotic species, erosion, land use)
- Water quality observations (clarity, odour, oils, foam/scum, plumes etc.)
- Sketches of the site, including a cross - section of the reach

The information recorded was used to assist interpretation of biological data and to provide input data for the Northern Territory AUSRIVAS model. Data recorded is also used in conjunction with the biological community information as the basis of the overall health assessment.

Photos were taken of upstream and downstream portions of the reach sampled, as well as bank habitat and other key habitat features. This further characterises the habitat conditions at each site, serving as a pictorial record of site conditions that can be tracked over time using photos taken from the same photo points.

3.2 Water quality

The physico-chemical parameters of the water at each site were measured using a calibrated multi-parameter water quality meter. The following parameters were recorded:

- Water temperature (°C)
- Dissolved oxygen (DO) concentrations (mg/L and % saturation)
- pH
- Electrical conductivity (EC) (µS/cm)
- Turbidity

3.3 Sediment quality

Sediment sampling methods utilised at each site were in accordance with those outlined in ANZECC (2000) and Simpson and Batley (2016) and involved:

- The collection of multiple sub-samples using a spade of inert material.
- Compositing the sub-samples into a receptacle (also composed of inert material) and mixing the contents.
- The collection of one QA/QC duplicate sample per project area to validate results.
- Collecting a sub-sample from the mixture and placing it into a laboratory-supplied container, labelled with site and sample details.
- Keeping samples in chilled eskies for onward delivery to a NATA accredited laboratory for testing.

Bioavailable metals data (from 1M HCl dilute acid digestion analysis) were analysed for the parameters shown in Table 2. Within each project area, comparisons were made between results from upstream and downstream of release points.

Table 2 – Testing parameters for sediments collected at URPA

Group	Analytes
Metals: 1 M HCl acid digest, total metals	Al, As, Cd, Co, Cu, Fe, Mn, Ni, Zn
Ions	Total sulphur, sulfate,
Others	PSD, saturated pH, TOC

3.4 Macroinvertebrates

3.4.1 Field sampling

Macroinvertebrate sampling and processing followed procedures outlined in the Northern Territory AUSRIVAS Manual for the Darwin-Daly Region (Lamche, 2007). Sampling involved one field team member scraping submerged root matter associated with the lower bank to agitate and remove macroinvertebrates into the water column, while the other field team member swept a dip net through the water column downstream of the edge habitat, to collect the dislodged animals. Areas of riffle or fast flowing habitat, Pandanus roots and severe bank undercuts were avoided when collecting edge habitat samples.

Once collected, the samples were washed through 10 mm and 250 µm mesh sieves. The course mesh sieve was examined for large, conspicuous taxa, and these were placed in the labelled sample container. The sample collected in the fine mesh sieve was also placed in the labelled sample container and filled with 70% ethanol. All samples were sent to the macroinvertebrate laboratory for further processing and identification.

3.4.2 Laboratory processing

Samples were washed through a series of sieves (10 mm, 500 µm and 250 µm mesh sizes). Any large, conspicuous taxa identified in the 10 mm mesh sieve were added to the contents of the large mesh fraction retained in the field. The contents of the 500 µm mesh sieve were retained for macroinvertebrate identification and enumeration, while the 250 µm fraction was retained as sample residue for quality assurance purposes. The contents of the 500 µm mesh fraction was poured into a Marchant sub-sampler (Marchant, 1989) and extractions made randomly from cells (aliquots) in this apparatus. These extractions were placed under a microscope and the taxa identified and counted. This process continued until either all aliquots were examined, or a total of 200 individuals had been counted and identified. The number of aliquots required to be processed to obtain a minimum 200 individual sub-sample was recorded in order to be able to calculate abundance. A Leica stereo-dissection microscope was used to examine specimens.

Taxa were identified to genus level where possible, with the exception of key taxa identified in Lamche (2007), requiring identification to order level (e.g., Conchostraca). Quality assurance processes were followed as per Lamche (2007). Five percent of samples were sent to an external laboratory and checked for correct identification by an AUSRIVAS accredited Senior Taxonomist.

3.5 Data analysis

A number of indices can be used to assess and/or quantify the influence of anthropogenic activities on macroinvertebrate communities. Responses to contaminants or changes in flow can result in anything from changes in abundance and diversity through to changes in community composition through the loss or reduction of sensitive taxa. As such, a multiple lines of evidence approach has been adopted with regards to interpreting macroinvertebrate community data. Where possible, data from 2022 was compared against historical data collected by NTMO, as well as Crocodile Gold macroinvertebrate monitoring data from 2010 and 2012.

In previous years, macroinvertebrate data was assessed using the NT AUSRIVAS Darwin-Daly Early (dry season) Family level Edge habitat model. New guidance on the use of these models in the NT to understand impacts of point source pollution have been published (ANZG 2021). The updated guidance states that the models are not useful in understanding aquatic ecosystem health outside of the large rivers where macroinvertebrates have been collects, and therefore the use of AUSRIVAS modelling has been discontinued.

Macroinvertebrate community indices were calculated for each sample at each site. Long - term medians were be calculated using historical data. The use of median values allows for consideration of the overall performance of metrics at a particular site over previous years. Metrics and their long-term median values were compared between sites to understand the temporal and spatial differences of sites within the catchment. A one-way ANOVA was performed, comparing metric results from each treatment (upstream or downstream). Analyses were conducted in Statistica v12.

A summary of the univariate macroinvertebrate indices assessed as part of this study are provided below:

- Relative abundance – Total number of individual taxa collected at a site. This information is calculated based on processing requirements in the laboratory (% of sample processed).
- Taxa richness (Family) – Total number of taxa present at the site used as a measure of diversity of families (used for long-term data analysis).
- Taxa Richness (Genus) - Total number of taxa present at the site used as a measure of diversity of genera.
- PET richness (Family) – total number of families from orders Plecoptera, Ephemeroptera and Trichoptera. PET taxa are generally more sensitive to disturbance.
- PET richness (Genus) – total number of genera from orders Plecoptera, Ephemeroptera and Trichoptera.
- SIGNAL-2 – a biotic index that allocates a value to each macroinvertebrate family based on their sensitivity to pollution. The metric is calculated by averaging the index of all families collected. Lamche (2007) cautions against the use of the SIGNAL-2 index for assessing the status of Northern Territory macroinvertebrate communities. This measure is however, considered appropriate for this study as the number of pollution-sensitive versus pollution-tolerant families does provide some insight to the level of stress that the macroinvertebrate community is experiencing.

In addition to univariate analysis of metrics, an assessment of differences in the macroinvertebrate community composition will be undertaken. NMDS Ordination provides a representation of the relative similarity of entities (i.e., samples) based on their attributes (i.e., macroinvertebrate community composition) within a reduced dimensional space. The more similar sites are to each other, the closer they are located in the NMDS ordination space. In this study, NMDS plots were used to display the similarity between site types (Impacted and Control) and Years (sampling events). A similarity matrix for all pairs of samples based on the Bray-Curtis similarity coefficient was calculated. Stress, which is a measure of the distortion produced by compressing multi-dimensional data into a reduced set of dimensions, was used to gauge how reliable the patterns presented in two-dimensional NMDS plots are. Stress levels above 0.20 indicate a poor representation of inter-sample similarity and, as such, the NMDS results with stress values of this order require interpretation with caution (Clarke *et al.* 2014).

The ANOSIM (ANalysis Of SIMilarity) routine was applied on the similarity matrix for each ordination analysis to determine if the differences between sites observed within the ordination plots were significantly different. This analysis provides a measure of the dissimilarity of groups of samples (years) in the form of an R-statistic that typically lies between 0 and 1; values close to 1 imply that these groups are very dissimilar and those approaching 0 are very similar. A p-value is calculated to determine the statistical significance of the site groupings. The interpretation of group separation is not wholly based upon the p-value, but rather the R-statistic, as the numbers of replicates within the groups being compared does not unduly affect the R value. Where significant differences were seen in community composition, a similarity percentages (SIMPER) analysis was performed to understand which taxa had the greatest influence on differences in site types.

4. Results and Discussion

4.1 Site conditions

4.1.1 Rainfall and flow

Rainfall recorded at Union Reefs Mine, approximately 13km north of the PCPA is presented below in Figure 2. A total of 1383mm of rain was recorded in the 2022-2023 wet season, the majority of that rain fell between January and March. Active discharge to Copperfield Creek occurred from PCPWD and passive discharge from seepage points across the PCPA was observed during the wet season (Emer McGowan, KLG *pers comm).*

Continuous rainfall records are only available from 2020, and so no comparisons to long-term rainfall data were undertaken. The 2022-2023 wet season experienced more rainfall compared with the 2021-2022 west season (AES 2022). Recorded rainfall was spread evenly across wet season months, and this is likely to have resulted in consistent flow in both Pine and Copperfield Creeks, including baseflow through both creeks in the study area when rain ceased.

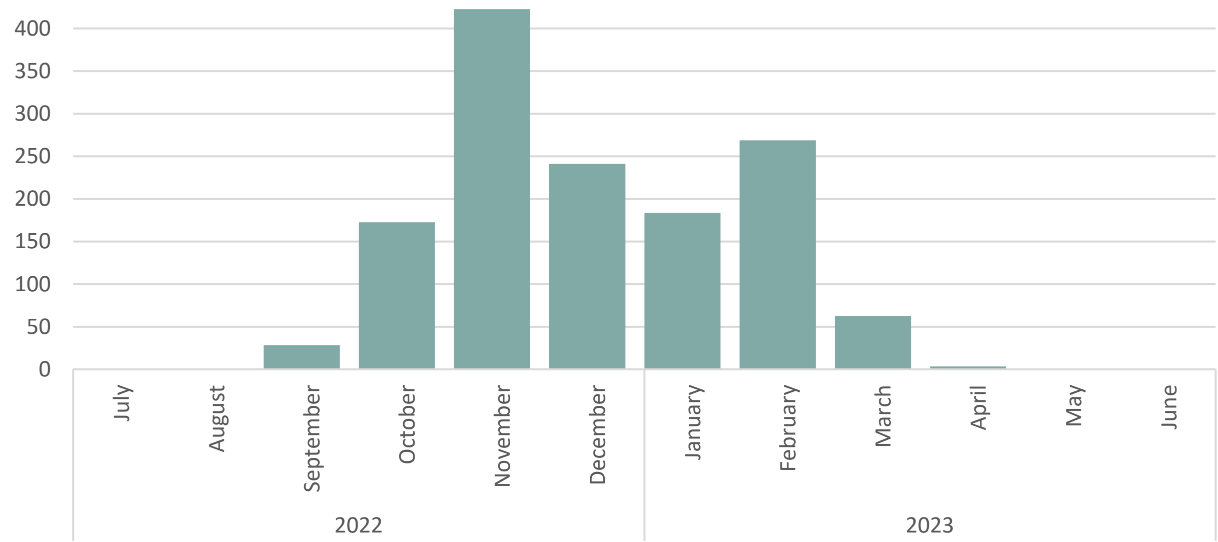


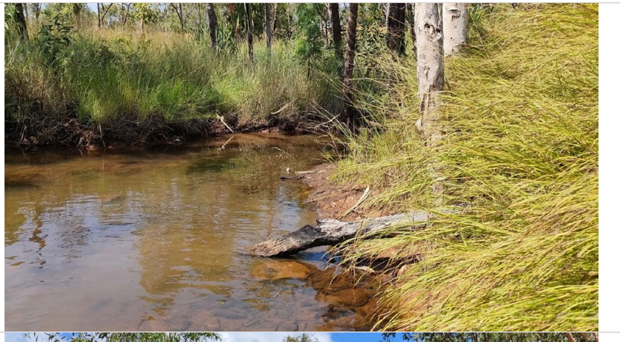
Figure 2 – Monthly Rainfall recorded at Union Reefs Mine July 2022-June 2023

4.1.2 Habitat characteristics

Habitat characteristics of each site are detailed below in Table 3. All sites were flowing at the time of sampling. Sufficient water was present for replicate sampling to take place at each site, and sample timing was considered appropriate. Macroinvertebrate sampling was not completed at PCCK03 due to safety concerns at the site in 2023. Although biological sampling wasn't possible, water and sediment samples were collected at the site.

Table 3 – BMP site descriptions, April 2023

Site description	Site photo
PCCK01 – Upstream The site is intersected by Tabletop Road and was characterised by a series of deep pools., connected by shallow runs. The riparian zone was narrow and discontinuous and dominated by pandanus, paperbarks and native grasses. The substrate of pools was dominated by sand and clay covered by dine detritus. The banks of the site were vertical and made up of clay and gravel. Water was turbid and shading was moderate.	
PCCK04 – Downstream The site was a long, shallow pool, connected to a run at the downstream end. The substrate was a mixture of bedrock, cobbles and sand, and the riparian vegetation was a majority pasture grass and pandanus lining the banks. Flow was present at the time of sampling and fish were present.	
PCCK02 – Downstream The site was located in the township of Pine Creek, downstream of a culvert/road crossing. The site was a long pool with a cleared riparian zone, besides a number of large trees that provided shade. There were emergent and floating macrophytes present throughout the site in shallow areas.	

Site description	Site photo
PCCK03 – Downstream The site was not accessed due to safety concerns	
PCCK16 – Upstream The site is located at the crossing of Umbawarra Road. The substrate of the site was a mixture of sand, silt and cobbles. Native grasses lined the pool and trailed in the water. Sparse native trees were present and provided dappled shade. Water was flowing slowly at the time of sampling.	
PCCK06 – Downstream The site was located just upstream of a low-level weir. The stream bed was predominantly sand, gravel and cobbles. Edge habitat consisted of grasses, exposed roots and overhanging vegetation, while instream habitat was mainly made up of snags.	
PCCK22 – Downstream A large, deep isolated pool was upstream, and a run/pool downstream. The banks were mostly vertical, with continuous vegetation lining the banks. The vegetation was made up of melaleucas and some pandanus. Available habitat was mostly exposed roots and detritus. Shading was high, and substrate was a mixture of sand and gravel.	

4.2 Water quality

In situ water quality data collected at sampling sites is presented below in Table 4. The following observations can be made about water physico-chemical parameters at sites associated with the PCPA:

- Water temperatures were similar at all sites, with the warmest temperatures recorded during the middle of the day. Warmer temperatures at sites corresponded with higher dissolved oxygen. .
- Conductivity readings were higher at sites on Pine Creek downstream of the PCPA compared with the upstream site, indicating some influence from passive discharges. EC decreased slightly with distance downstream on Pine Creek. Comparatively, EC readings were much lower on Copperfield Creek, and although they increase downstream of PCPWD, there was very little difference between any site in the catchment, regardless of their position relative to the PCPA.
- pH results were similar for sites in each watercourse. pH values at sites and were circumneutral.
- Turbidity was highest at PCCK01, but all readings reflected the clarity of water at all sites.

Table 4 – In situ water quality results from sites visited in April 2023

Site Code	Time	Temp (°C)	DO (%)	DO (mg/L)	EC (µS/cm)	pH	Turbidity (NTU)
PCCK01	11:10	36.02	100.10	7.74	25.75	6.41	22.07
PCCK04	12:11	37.97	99.73	7.59	105.47	6.49	16.48
PCCK02	13:45	28.5	106.74	8.06	115.76	6.68	22.40
PCCK03	16:05	32.14	95.30	9.10	120.10	6.60	18.20
PCCK16	9:05	27.29	87.02	6.70	34.31	6.45	13.60
PCCK06	11:47	28.41	104.18	7.92	50.89	6.72	10.05
PCCK22	10:18	27.58	108.19	8.41	47.87	7.10	10.23

4.3 Sediment

The results of laboratory analysis of sediments are presented in Table 5 along with long-term medians. There were no exceedances of the SQGVs at any site. Further, the majority of acid-extractible metal concentrations were below long-term medians.

Proportions of total organic carbon (TOC) in samples were variable. Overall, the proportion of TOC in a given sample was low (It is unlikely that these quantities of TOC would ameliorate the bioavailability of metals in sediments of Pine or Copperfield Creeks (ANZG 2018).

Table 5 – Analysis results of sediment parameters from 2023, compared with long-term medians. All values are presented in mg/kg

Catchment position	Site	TOC	Aluminium	Arsenic	Cadmium	Chromium	Cobalt	Copper	Iron	Lead	Manganese	Nickel	Zinc
Low				20	1.5			65		50		21	200
High				70	10			270		220		52	410
Upstream	PCCK01	4000	120	8	0.5	<1	1	16	390	6	6	1	2
	Median	8850	360	12	0.5	<1	1.15	16	1900	9	36	1	3
	PCCK16	3000	560	17	<0.5	<1	8.2	8	1800	25	140	3	130
	Median	4100	420	17	<0.5	<1	1.8	2	2600	4	120	2	2
Downstream	PCCK04	3000	130	<4	<0.5	<1	<1	<1	1100	2	44	<1	1
	Median	3000	130	<4	<0.5	<1	<1	<1	1100	2	44	<1	1
	PCCK02	6000	580	11	<0.5	<1	11	5	1000	14	210	4	100
	Median	6600	995	17.5	0.55	<1	22	9.5	2600	24.5	465	7	245
	PCCK06	3000	160	<4	<0.5	<1	4.4	2	670	4	110	1	55
	Median	2000	290	4	0.5	8.8	1	5	915	4.5	225	2	101
	PCCK22	2000	84	<4	<0.5	<1	1.1	<1	520	2	45	<1	23
	Median	6500	205	<4	<0.5	<1	2.2	4	910	3.5	60.5	1	31

4.4 Macroinvertebrates

The following sections summarise the findings of results from 2023, including historical comparisons of aquatic ecosystem health where available. Raw data is available in Appendix B.

4.4.1 Relative abundance

The relative abundance of macroinvertebrates collected at the PCPA in 2023 is presented in Figure 3. The highest relative abundances were observed at sites on Copperfield Creek, with samples upstream and furthest downstream containing a higher number of individuals compared with PCCK06 There was no significant difference (p=>0.05) between site types in the Copperfield Creek catchment (Appendix A, Table 7). On Pine Creek, there was some variability between samples at each site, but lower relative abundances were recorded at sites downstream of the PCPA. The differences in abundances resulted in a significant difference was found between site types on Pine Creek (p=0.003, Table 6).

The relative abundance of samples collected upstream on Pine creek were above the long-term median, whereas sites downstream returned values that were similar to, or lower than historical results. Similarly, results upstream on Copperfield Creek were above the long-term median, and those downstream were lower or relatively similar at each site.

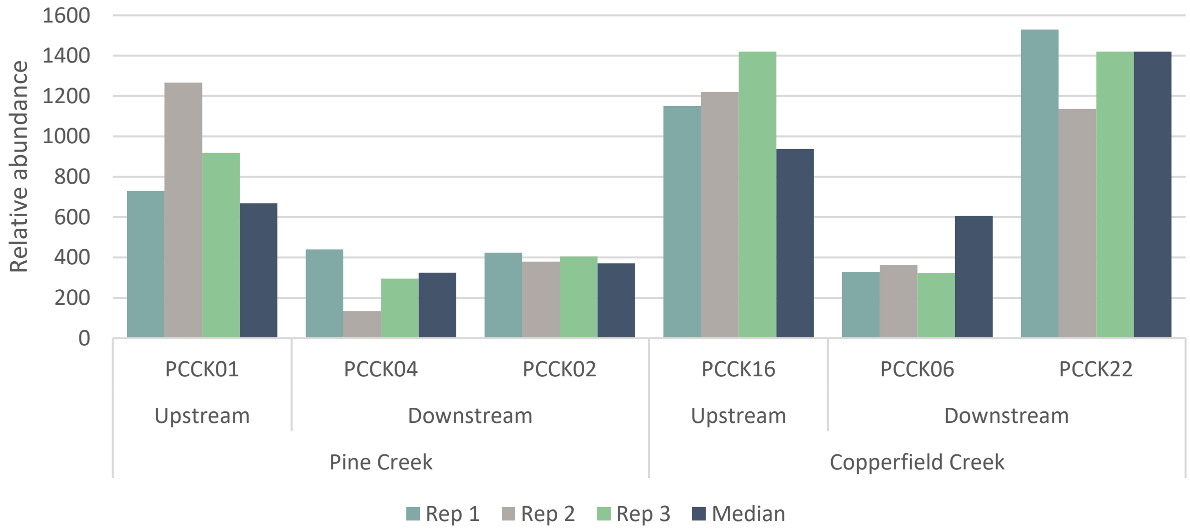


Figure 3 – Relative abundance of samples collected in 2023 compared to long-term medians

Table 6 - One-way ANOVA results of relative abundance data – Pine Creek

Effect	df	SS	MS	F	*p*
Groups (between groups)	1	770281.6922	770281.6922	22.5708	0.003156
Error (within groups)	6	204763.8767	34127.3128		
Total	7	975045.5689	139292.2241		

4.4.2 Taxa richness (Family)

The family taxa richness for samples collected in 2023 are presented in Figure 4. The highest taxa richness was recorded at PCCK06, and results at PCCK22 was similar to the upstream site on Copperfield Creek. Results were more variable on Pine Creek, where almost all samples collected downstream were above the long-term median and those upstream were below, and results downstream were more variable. There was no significant difference (*p*=>0.05) in family taxa richness between sites upstream and downstream of the PCPA in both catchments (Appendix A, Table 8 and Table 9).

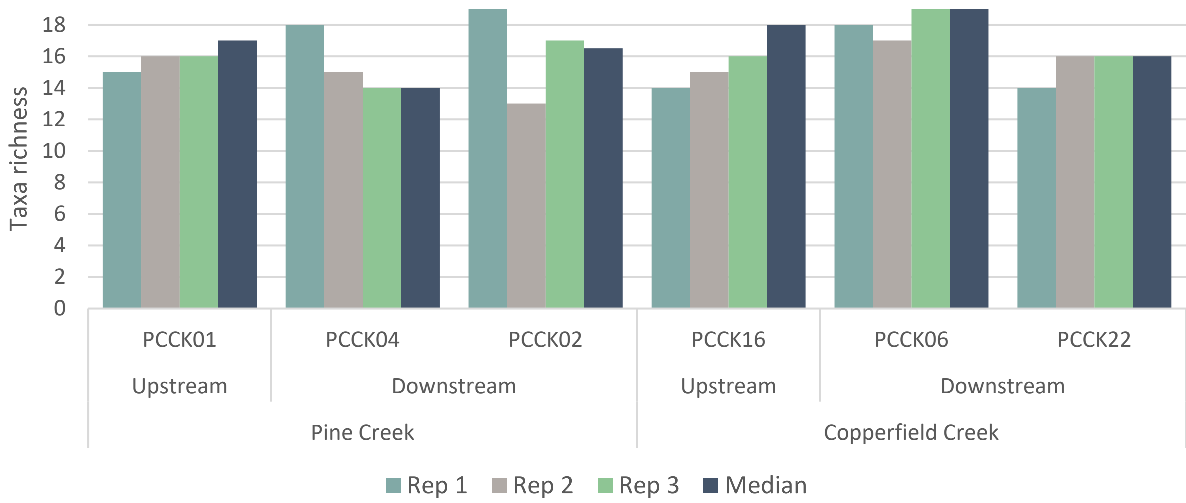


Figure 4 -Family taxa richness from sites at the PCPA sampled in 2023 compared to long-term medians

4.4.3 Taxa richness (Genus)

The results of genus-level data collected in 2023 is presented in Figure 5. As for family taxa richness, the highest values were found at PCCK06, and results were consistently higher at the site when compared to the upstream site. There was very little variability in richness between samples at each site, and the number of genera at all sites was below the long-term median, besides at PCCK02. The lowest genus-level taxa richness results were from sites on Pine Creek downstream of the PCPA. No significant differences were found between site types in either catchment (*p*=>0.05, Appendix A, Table 10 and Table 11).

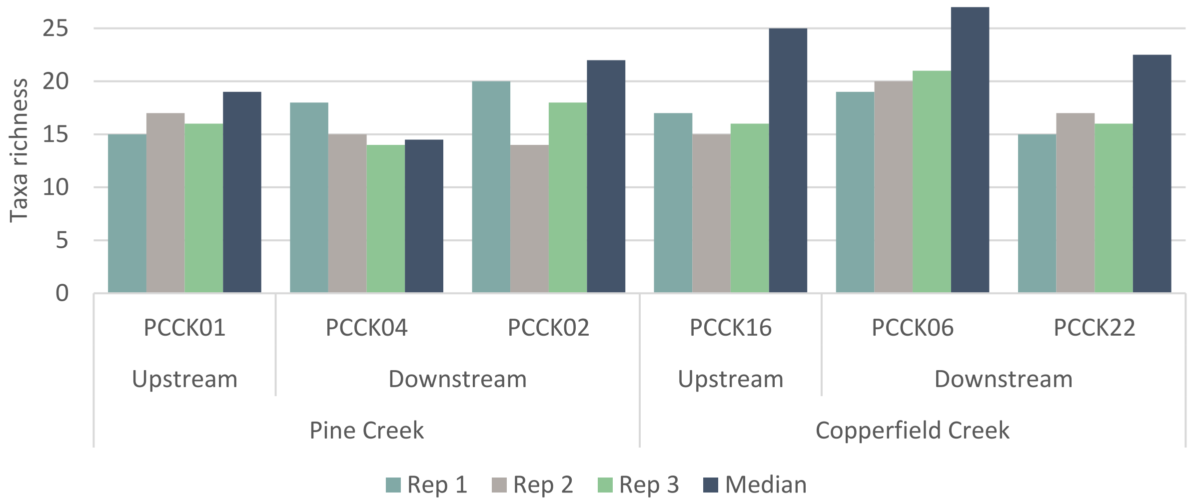


Figure 5 – Genus taxa richness at sites collected at the PCPA in 2023

4.4.4 PET richness

PET richness results for samples collected in 2023 are presented in Figure 6. Sites on Copperfield Creek were generally higher in PET taxa than sites on Pine Creek, which was consistent with PET genera richnessv (Figure 7). This indicates a more pollution sensitive community in Copperfield Creek and little impact on the community from active discharges. Pine Creek sites showed a similar diversity of PET taxa at all sites, with a slight increase at downstream sites. There was no significant difference (p=>0.05) between upstream and downstream results for PET Richness (Appendix A, Table 12 and Table 13).

Genus-level PET richness followed the same pattern as family PET richness (Figure 7).

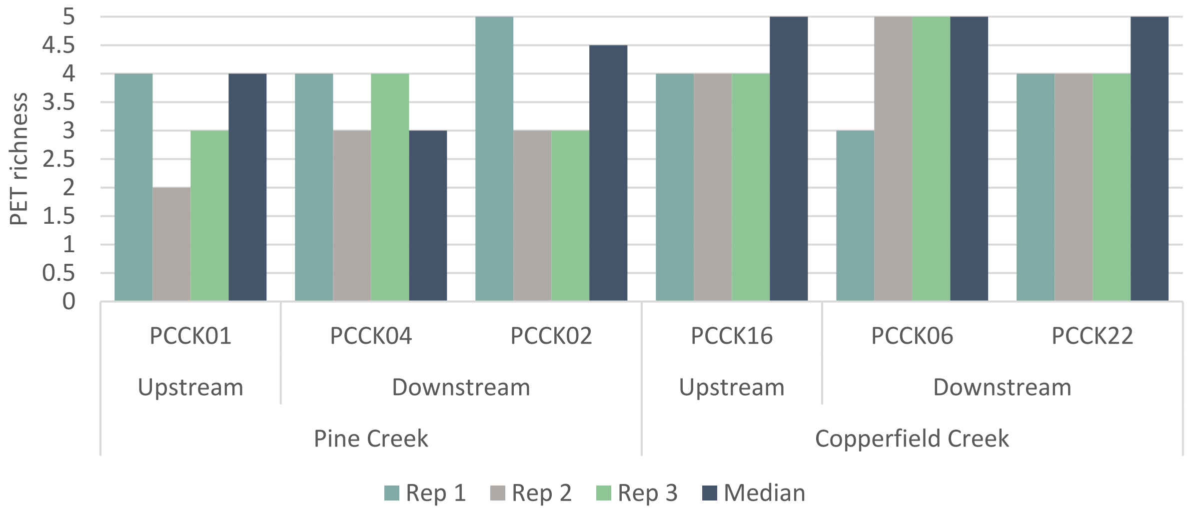


Figure 6 – PET richness from sites at the PCPA sampled in 2023 compared to long-term medians

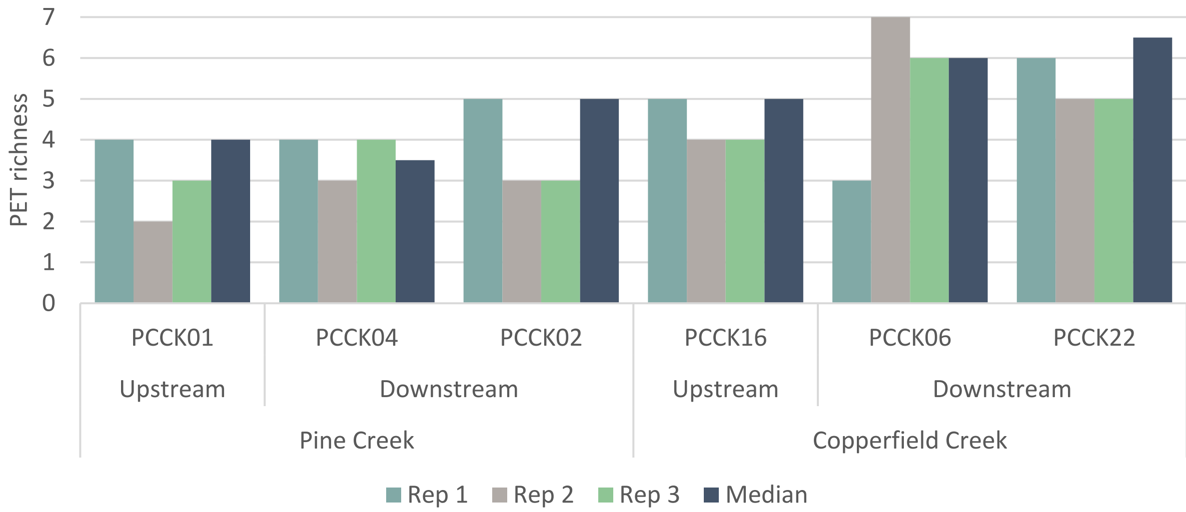


Figure 7 - Genus-level PET Richness at the PCPA in 2023

4.4.5 SIGNAL-2

SIGNAL-2 scores calculated for samples collected in 2023 are presented in Figure 8. A high amount of similarity in SIGNAL-2 scores was observed. SIGNAL-2 scores from sites on Copperfield and Pine Creek are indicative of a pollution tolerant community, which does not appear to be related to position in either catchment. Scores were similar to, or above the long-term median for each site, and there was no significant difference (*p*=>0.05) between sites upstream and downstream of the PCPA in 2023 in both catchments (Appendix A, Table 14 and Table 15).

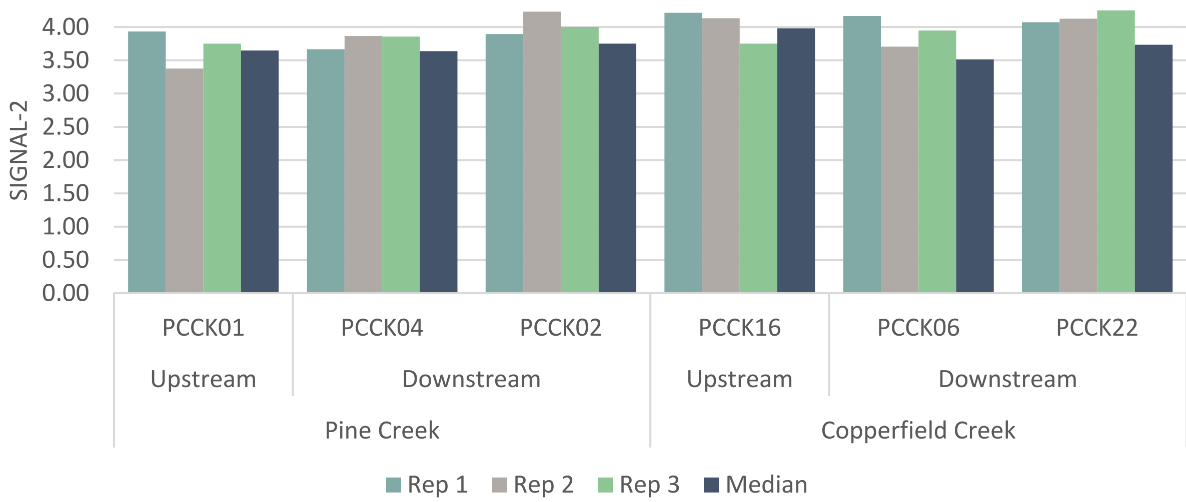


Figure 8 – SIGNAL-2 scores for samples collected at the PCPA in 2023

4.4.6 Community composition

Genus-level data was used to analyse community composition of 2023 data. Sites on Pine Creek were grouped most strongly by site type (Figure 9), whereas community composition of macroinvertebrates at sites on Copperfield Creek were most strongly associated to each site (Figure 10). In both catchments, all samples were at least 50% similar to each other, regardless of their position in the catchment.

The NMDS plot shows that samples from each site were generally more similar to each other than to those of any other site in both catchments. The similarities between samples at sites, rather than grouping by site type demonstrates that habitat characteristics at each site are likely to be a stronger driver of macroinvertebrate community composition than position within the catchment (relative to influences of the PCPA).

The results of ANOSIM in each catchment showed mixed results. Pine Creek results reflected the significant difference in relative abundances between, with significant differences also found between upstream and downstream communities (Global R = 0.802, p = 0.012). The results of SIMPER analysis (Table 7) show that the greatest contributor to differences between upstream and downstream sites is the higher abundance of PET taxa (Mayfly) *Tasmanocoenis* at PCCK01. Complete SIMPER results are available in Appendix B.

Copperfield Creek sites on the other hand, did not show any no significant difference in the community regardless of each site's position in the catchment (Global R = 0.210, p = 0.143).

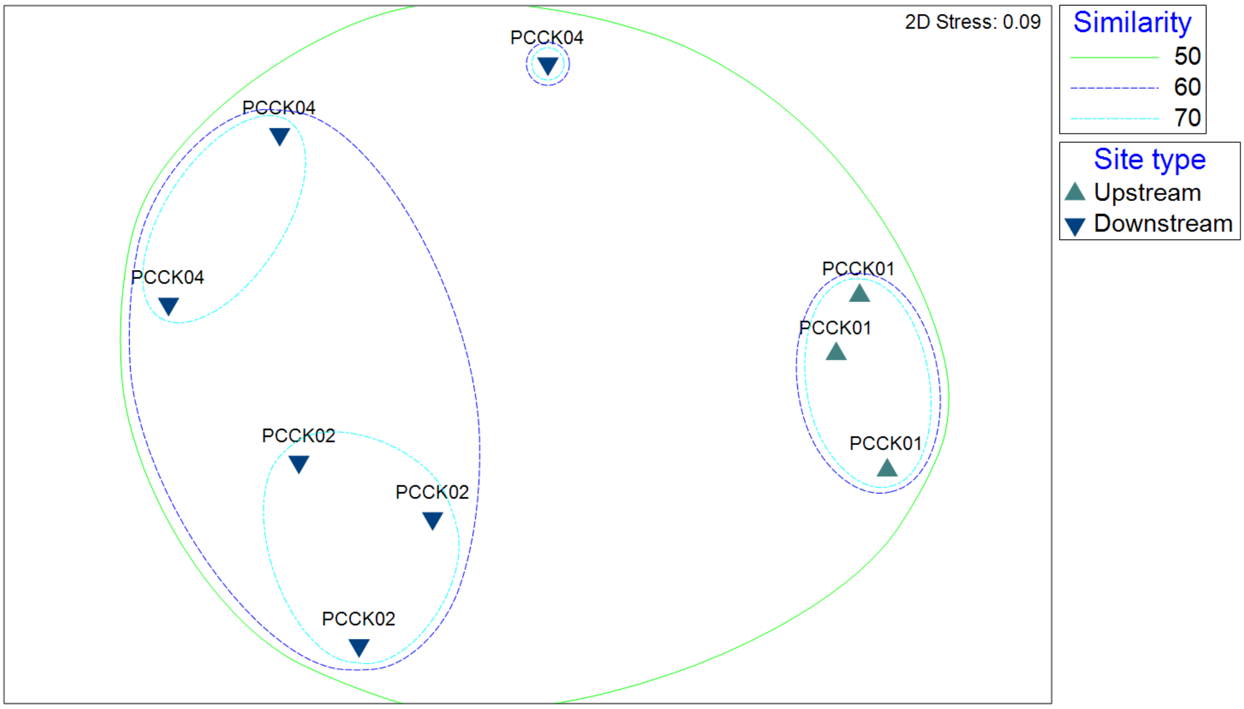


Figure 9 - NMDS plot showing variation in community composition between sites and site types on Pine Creek in 2023

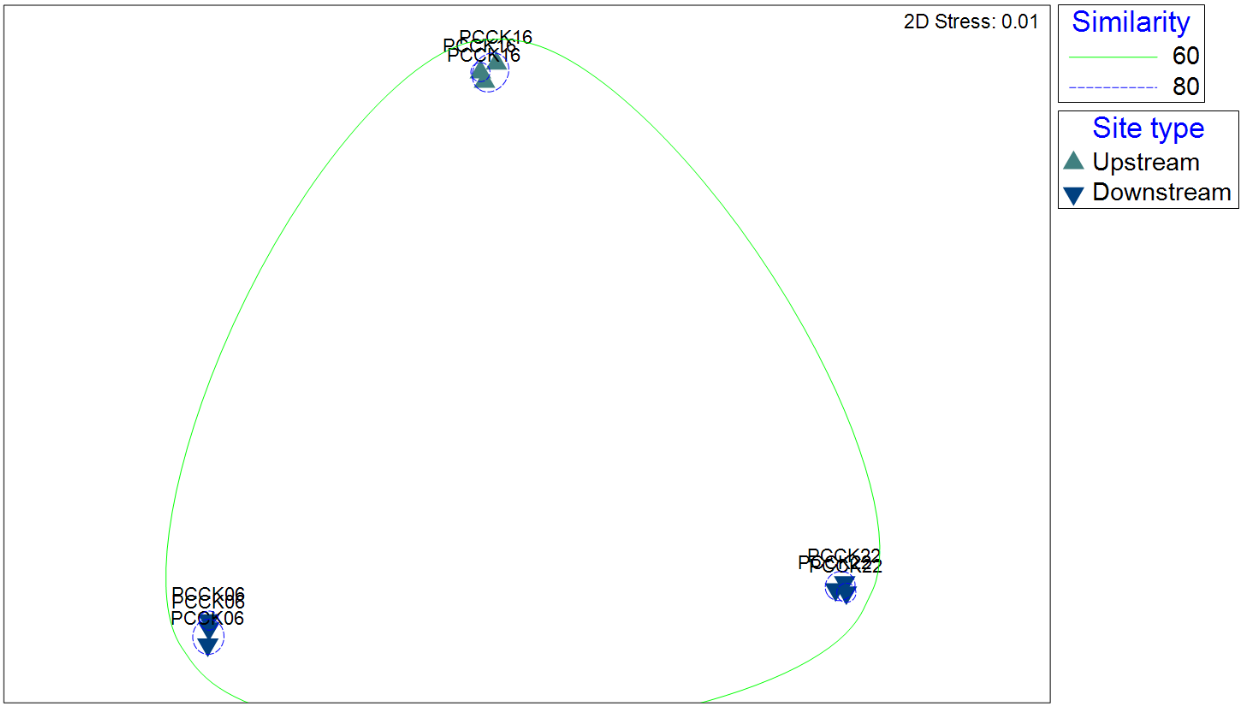


Figure 10 - NMDS plot showing variation in community composition between sites and site types on Copperfield Creek in 2022

Table 7 – SIMPER results of taxa contributing most to differences between site types

Species	Average Abundance		Average Dissimilarity	Contribution (%)	Cumulative (%)
	Upstream	Downstream			
Tasmanocoenis	2.81	0.84	2.98	6.44	6.44
Paracymus	2.22	0.25	2.92	6.3	12.74
Orthocladiinae	2.08	0.25	2.75	5.93	18.67
Cloeon	3.28	1.76	2.23	4.81	23.48
Micronecta	1.92	0.77	2.18	4.7	28.18
Triplecides	1.48	0.22	2.14	4.61	32.79

4.5 Discussion

Weak-acid extraction of metals showed that bioavailability of the majority of metals was higher at sites on Pine Creek downstream of the PCPA compared with upstream sediments, including downstream of the Pine Creek Township. The concentration of most metals was below the long-term median for each site and there were no exceedances of a SQGV recorded at any site in the catchment. This indicates there is influence from the PCPA, which is potentially accumulating in sediments at the furthest downstream site, but the neutrality of waters at sites on Pine Creek indicate that metals do not present an immediate risk to aquatic ecosystems as they are not currently bioavailable. The sieving of sediments to a similar particle size distribution helps to preclude the particle size from influencing the results at any site and so the results can be viewed with confidence.

Other than relative abundance, there were no significant differences or trends in macroinvertebrate metrics between sites upstream and downstream of the PCPA on Pine Creek. When examining differences in macroinvertebrate community composition, there were a number of genera that were more abundant upstream than at downstream sites. Results of sediment analysis do not indicate that metal bioavailability is causing these differences, but there were some notable differences in habitat available upstream compared to downstream sites. Fine detritus was noted as being abundant in samples taken upstream, whereas downstream, sites were dominated by sand substrates and macrophytes. The highest contributor to differences in the macroinvertebrate community was *Tasmanocoenis,* which has been found to prefer fine detritus microhabitats (Hearnden & Pearson 1991). This microhabitat was more prevalent upstream at PCCK01 compared with downstream sites. The results show there were no impacts to aquatic ecosystems as a result of passive discharges from the PCPA to Pine Creek, and differences are related to habitat differences at sites.

The macroinvertebrate community on Copperfield Creek showed very little indication of any impact when comparing metrics from the upstream site with those downstream. The macroinvertebrate community was composed of similar taxa across the catchment, and particularly similar in samples at each site. Active discharge to PCPA did not appear to be having any impacts on aquatic ecosystem health of Copperfield Creek, although sediments should continue to be monitored to understand long-term trends in metal accumulation.

Sediment and macroinvertebrate results from 2023 monitoring indicate there has been no impact to the receiving environment as a result of water management activities at the PCPA.

5. Conclusions and Recommendations

- There were no exceedances of sediment guideline values at any site in 2023. Although some values were higher downstream of the PCPA compared to upstream sites, circumneutral pH at sites downstream of the PCPA, metal concentrations in sediments pose a low risk of adversely affecting aquatic biota.
- There were no significant differences in the macroinvertebrate community between sites upstream and downstream of the PCPA in Copperfield Creek. The similarities in the composition of taxa are stronger within sites than between them, denoting that there is high variability in micro-habitat between sites regardless of their position in the catchment.
- There were differences in the macroinvertebrate community observed on Pine Creek. This did not align well with sediment quality results. Differences are more likely to be related to habitat availability upstream compared with downstream sites.
- The distance between sites downstream of the PCPWD is vast, a mid-catchment site that allows for a more robust assessment of any impacts would allow site PCCK22 to be utilised as a recovery site. Similarly, a recovery site downstream on Pine Creek would assist with understanding the extent of impacts associated with passive discharges.

6. References

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Appendix A. Macroinvertebrate Univariate Results

Table 8 – One-way ANOVA results of relative abundance data – Copperfield Creek

Effect	df	SS	MS	F	*p*
Groups (between groups)	1	341826.6795	341826.6795	1.4103	0.2737
Error (within groups)	7	1696705.436	242386.4909		
Total	8	2038532.116	254816.5144		

Table 9 – One-way ANOVA results of family-level taxa richness – Pine Creek

Effect	df	SS	MS	F	*p*
Groups (between groups)	1	0.2222	0.2222	0.05426	0.8225
Error (within groups)	7	28.6667	4.0952		
Total	8	28.8889	3.6111		

Table 10 – One-way ANOVA results of family-level taxa richness – Copperfield Creek

Effect	df	SS	MS	F	*p*
Groups (between groups)	1	5.5556	5.5556	2.2436	0.1778
Error (within groups)	7	17.3333	2.4762		
Total	8	22.8889	2.8611		

Table 11 – Results of one-way ANOVA performed on genus-level taxa richness – Pine Creek

Effect	df	SS	MS	F	*p*
Groups (between groups)	1	2.7778	2.7778	0.3298	0.5785
Error (within groups)	10	84.2222	8.4222		
Total	11	87	7.9091		

Table 12 – One-way ANOVA results of genus-level taxa richness – Copperfield Creek

Effect	df	SS	MS	F	*p*
Groups (between groups)	1	0.05556	0.05556	0.004281	0.9497
Error (within groups)	7	90.8333	12.9762		
Total	8	90.8889	11.3611		

Table 13 – Results of one-way ANOVA performed on PET Richness – Pine Creek

Effect	df	SS	MS	F	*p*
Groups (between groups)	1	0.02778	0.02778	0.02551	0.8763
Error (within groups)	10	10.8889	1.0889		
Total	11	10.9167	0.9924		

Table 14 – Results of one-way ANOVA performed on PET Richness – Copperfield Creek

Effect	df	SS	MS	F	*p*
Groups (between groups)	1	0.05556	0.05556	0.05691	0.8183
Error (within groups)	7	6.8333	0.9762		
Total	8	6.8889	0.8611		

Table 15 – Results of one-way ANOVA performed on SIGNAL-2 data – Pine Creek

Effect	df	SS	MS	F	*p*
Treatment	1	0.02768	0.02768	0.8019	0.3916
Intercept	10	0.3452	0.03452		
Error	11	0.3729	0.0339		

Table 16 – Results of one-way ANOVA performed on SIGNAL-2 data – Copperfield Creek

Effect	df	SS	MS	F	*p*
Treatment	1	0.001489	0.001489	0.02536	0.878
Intercept	7	0.411	0.05872		
Error	8	0.4125	0.05156		

Appendix B. SIMPER Results

Species	Average Abundance		Average Dissimilarity	Diss/SD	Contribution (%)	Cumulative (%)
	Upstream	Downstream				
Tasmanocoenis	2.81	0.84	2.98	2.02	6.44	6.44
Paracymus	2.22	0.25	2.92	2.74	6.3	12.74
Orthocladiinae	2.08	0.25	2.75	2.67	5.93	18.67
Cloeon	3.28	1.76	2.23	3	4.81	23.48
Micronecta	1.92	0.77	2.18	1.82	4.7	28.18
Triplecides	1.48	0.22	2.14	1.42	4.61	32.79
Oecetis	0	1.39	2.02	2	4.37	37.16
Austroepigomphus	0	1.2	1.81	2.13	3.91	41.07
Tipulidae	1.12	0	1.73	1.36	3.73	44.8
Culicinae	1.19	0	1.71	1.36	3.68	48.48
Limnogonus	1.73	0.89	1.53	1.2	3.31	51.79
Mesovelia	0	1.01	1.49	1.36	3.22	55.01
Hydrochus	1.38	1.33	1.45	1.32	3.13	58.15
Orthetrum	0.61	1.01	1.41	1.24	3.05	61.2
Hemicordulia	1.12	0.87	1.41	1.22	3.05	64.24
Macrobrachium	3.02	2.09	1.36	2.25	2.93	67.17
Tanypodinae	3.95	3.06	1.33	1.99	2.86	70.03

Appendix C. Raw Macroinvertebrate Data

Order-Suborder	Family	Lowest Taxon	PCCK01_1	PCCK01_2	PCCK01_3	PCCK04_1	PCCK04_2	PCCK04_3	PCCK02_1	PCCK02_2	PCCK02_3	PCCK03_1	PCCK03_2	PCCK03_3	PCCK06_1	PCCK06_2	PCCK06_3	PCCK16_1	PCCK16_2	PCCK16_3	PCCK22_1	PCCK22_2	PCCK22_3
Coleoptera	Dytiscidae	Hyphydrus	8	0	17	0	0	0	0	0	0	0	0	0	0	13	0	0	0	0	0	0	0
Coleoptera	Dytiscidae	Laccophilus	0	0	0	0	0	0	0	0	0	0	0	0	0	13	13	0	0	0	0	0	0
Coleoptera	Hydraenidae	Hydraena	0	0	0	0	0	0	0	0	0	0	0	0	11	50	25	0	0	0	0	0	0
Coleoptera	Hydrophilidae	Berosus	0	0	0	0	0	0	10	7	6	10	20	30	22	38	13	0	0	0	0	0	0
Coleoptera	Hydrophilidae	Enochrus	0	0	0	8	0	10	5	4	0	0	0	0	0	0	0	0	0	0	0	0	0
Coleoptera	Hydrophilidae	Hydrochus	17	27	17	8	8	10	14	4	17	0	0	0	22	13	13	36	88	7	0	0	0
Coleoptera	Hydrophilidae	Paracymus	0	0	0	0	0	0	0	0	0	0	0	0	11	0	0	0	0	0	0	0	0
Coleoptera	Noteridae	Notomicrus	0	9	0	0	0	0	0	4	6	0	0	0	0	13	50	0	13	7	0	0	0
Decapoda	Palaemonidae	Macrobrachium	50	109	67	0	8	20	19	19	11	10	40	20	0	0	0	45	63	20	0	10	10
Decapoda	Parathelphusidae	Austrothelphusa	8	18	17	17	0	30	10	4	11	10	20	10	11	25	25	9	13	7	10	10	10
Diptera	Ceratopogonidae	Bezzia	50	36	33	33	17	50	14	4	6	80	50	50	78	38	63	36	63	20	50	60	40
Diptera	Chironominae	Chironominae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	0	0
Diptera	Chironominae	Cryptochironomus	0	9	8	0	8	0	10	7	6	0	0	0	22	25	25	18	38	13	30	20	20
Diptera	Chironominae	Dicrotendipes	0	9	0	0	0	0	10	11	0	0	0	0	11	0	0	9	13	0	40	50	40
Diptera	Chironominae	Polypedilum	0	0	0	17	33	20	0	0	0	60	50	40	11	50	38	0	0	0	10	0	0
Diptera	Chironominae	Tanytarsus	0	73	17	233	117	140	5	4	0	340	280	290	356	163	263	45	0	33	780	150	520
Diptera	Culicidae	Anopheles	0	0	0	0	0	0	5	0	6	0	0	0	0	13	13	18	38	13	10	10	10
Diptera	Dolichopodidae	Dolichopodidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	13	0	0	0	0
Diptera	Orthocladiinae	Cricotopus	33	0	17	0	0	0	5	4	17	0	0	0	0	13	13	9	13	7	10	30	20
Diptera	Tanyderidae	Eutanyderus	25	0	8	0	0	0	0	0	6	0	0	0	67	13	50	45	13	20	30	0	10
Diptera	Tanypodinae	Ablabesmyia	175	164	150	8	8	0	110	41	83	30	0	10	267	75	238	364	250	133	300	380	310
Diptera	Tanypodinae	Procladius	67	118	75	25	0	10	0	4	6	40	50	30	44	100	63	9	13	20	120	0	100
Diptera	Tanypodinae	Tanypodinae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	60	50
Diptera	Tipulidae	Tipulidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	20	20	20
Ephemeroptera	Baetidae	Centroptilum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ephemeroptera	Baetidae	Cloeon	8	9	8	0	0	0	14	30	39	90	80	90	11	75	38	45	38	20	100	0	20
Ephemeroptera	Caenidae	Tasmanocoenis	42	9	33	25	17	30	62	41	6	140	100	110	11	63	38	9	38	47	460	110	330
Ephemeroptera	Leptophlebiidae	Atalophlebia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ephemeroptera	Leptophlebiidae	Thraulus	0	0	0	0	0	0	0	0	0	0	0	0	11	0	0	0	0	7	0	0	0
Gastropoda	Ancylidae	Ferrissia	0	0	0	0	0	0	0	0	0	0	0	0	11	0	13	18	13	7	20	0	0

Order-Suborder	Family	Lowest Taxon	PCCK01_1	PCCK01_2	PCCK01_3	PCCK04_1	PCCK04_2	PCCK04_3	PCCK02_1	PCCK02_2	PCCK02_3	PCCK03_1	PCCK03_2	PCCK03_3	PCCK06_1	PCCK06_2	PCCK06_3	PCCK16_1	PCCK16_2	PCCK16_3	PCCK22_1	PCCK22_2	PCCK22_3
Hemiptera	Gerridae	Limnogonus	17	27	25	0	8	10	14	7	11	0	0	0	0	0	0	18	63	20	0	10	0
Hemiptera	Hebridae	Hebrus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	13	7	0	0	0
Hemiptera	Mesoveliidae	Mesovelia	8	9	8	8	0	10	5	0	6	0	10	10	11	13	13	9	13	13	0	10	10
Hemiptera	Micronectidae	Micronecta	0	18	0	0	0	0	14	7	22	10	20	20	22	38	38	27	63	27	10	30	10
Hemiptera	Notonectidae	Paranisops	0	0	0	8	33	10	0	0	0	0	0	0	0	13	13	0	0	0	0	0	0
Hemiptera	Notonectidae	Walambianisops	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hemiptera	Pleidae	Neoplea	0	9	8	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	30	10
Hemiptera	Veliidae	Microvelia	0	0	0	0	0	0	5	4	0	0	0	0	11	0	13	9	0	7	0	0	0
Hydracarina		Hydracarina	17	0	17	0	0	0	0	0	6	20	20	20	33	0	13	0	0	0	50	0	10
Odonata	Coenagrionidae	Caliagrion	0	0	0	0	0	0	0	0	0	30	20	20	0	0	0	0	13	0	0	0	0
Odonata	Gomphidae	Austroepigomphus	8	0	8	17	17	20	0	0	0	0	0	0	11	25	13	9	13	0	0	0	0
Odonata	Hemicorduliidae	Hemicordulia	0	0	0	0	0	0	0	0	0	0	0	0	0	50	0	0	0	0	0	0	0
Oligochaeta		Oligochaeta	4	0	8	0	0	1	14	4	6	0	2	2	0	2	2	27	0	7	0	0	0
Trichoptera	Ecnomidae	Ecnomus	8	9	8	17	8	10	5	15	11	40	50	20	56	13	25	18	13	27	20	60	40
Trichoptera	Hydroptilidae	Hellyethira	0	9	0	0	0	0	0	0	0	0	0	0	100	13	50	0	0	7	30	0	10
Trichoptera	Hydroptilidae	Orthotrichia	0	0	0	0	0	0	0	0	0	10	20	20	11	0	0	0	0	0	50	0	10
Trichoptera	Hydroptilidae	Oxyethira	33	9	33	0	0	0	14	4	6	0	0	0	22	13	25	45	25	40	20	110	50
Trichoptera	Leptoceridae	Oecetis	0	0	0	0	17	10	0	15	6	30	30	50	67	13	75	0	13	7	30	0	10

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Client:	Agnico Eagle Australia Dorat Rd Hayes Creek NT 0822	**ESA Job #:**	PR2161
		Date Sampled:	06 April 2023
		Date Received:	13 April 2023
Attention:	Sam Yang	**Sampled By:**	Client
Client Ref:	PO 71639	**ESA Quote #:**	PL2161_q01

Lab ID No.:	Sample Name:	Sample Description:
10035	CHCK06	Aqueous sample, pH 7.5*, conductivity 646µS/cm*, total ammonia <2.0mg/L*. Sample received at 12ºC* in apparent good condition.
10036	CHCK04A	Aqueous sample, pH 6.5*, conductivity 549µS/cm*, total ammonia <2.0mg/L*. Sample received at 12ºC* in apparent good condition.
10037	Cosmo PIT	Aqueous sample, pH 7.2*, conductivity 4180µS/cm*, total ammonia <2.0mg/L*. Sample received at 12ºC* in apparent good condition.
10038	Dam 3	Aqueous sample, pH 6.9*, conductivity 2450µS/cm*, total ammonia <2.0mg/L*. Sample received at 12ºC* in apparent good condition.
10039	PCPWD	Aqueous sample, pH 6.4*, conductivity 1414µS/cm*, total ammonia <2.0mg/L*. Sample received at 12ºC* in apparent good condition.
10040	PCCK06	Aqueous sample, pH 7.4*, conductivity 61µS/cm*, total ammonia <2.0mg/L*. Sample received at 12ºC* in apparent good condition.

*NATA accreditation does not cover the performance of this service

Test Performed:	Partial life-cycle toxicity test using the freshwater cladoceran *Ceriodaphnia dubia*
Test Protocol:	ESA SOP 102 (ESA 2016), based on USEPA (2002) and Bailey *et al*. (2000)
Test Temperature:	The test was performed at 25±1°C.
Deviations from Protocol:	Nil
Comments on Solution Preparation:	The samples were tested undiluted. A DMW control was tested concurrently with the sample.
Source of Test Organisms:	ESA Laboratory culture
Test Initiated:	14 April 2023 at 1700h

Sample	% Unaffected at 7 days (Mean ± SD)	Sample	Number of Young (Mean ± SD)
DMW Control	100 ± 0.0	DMW Control	16.1 ± 1.9
CHCK06	100 ± 0.0	CHCK06	15.8 ± 1.3
CHCK04A	100 ± 0.0	CHCK04A	13.6 ± 1.3 **
Cosmo PIT	50.0 ± 52.7 *	Cosmo PIT	3.0 ± 2.5 **
Dam 3	100 ± 0.0	Dam 3	8.8 ± 2.5 **
PCPWD	0.0 ± 0.0	PCPWD	0.0 ± 0.0
PCCK06	100 ± 0.0	PCCK06	8.3 ± 2.4 **

*Significantly lower percent unaffected compared with the DMW Control (Dunnett's Test, 1-tailed, P=0.05)
*Significantly lower number of young compared with the DMW Control (Heteroscedastic t test, 1-tailed, P=0.05)

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ECOTOX SERVICES AUSTRALIA PTY LIMITED
ABN 95 619 426 201

Toxicity Test Report: TR2161/1

QA/QC Parameter	Criterion	This Test	Criterion met?
Control mean % unaffected	≥80.0%	100%	Yes
Control mean number of young per surviving adult	≥15.0	16.1	Yes
Reference Toxicant within cusum chart limits	176.2-217.3mgKCl/L	201.83mgKCl/L	Yes

Test Report Authorised by: Dr Rick Krassoi, Director on 9 May 2023

Results are based on the samples in the condition as received by ESA.

NATA Accredited Laboratory Number: 14709

Citations:

Bailey, H.C., Krassoi, R., Elphick, J.R., Mulhall, A., Hunt, P., Tedmanson, L. and Lovell, A. (2000) Application of *Ceriodaphnia cf. dubia* for whole effluent toxicity tests in the Hawkesbury-Nepean watershed, New South Wales, Australia: method development and validation. *Environmental Toxicology and Chemistry* 19:88-93.

ESA (2016) ESA SOP 102 – *Acute Toxicity Test Using Ceriodaphnia dubia.* Issue No 11. Ecotox Services Australasia, Sydney, NSW.

USEPA (2002) *Short-term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Freshwater Organisms.4th Ed.* United States Environmental Protection Agency, Office of Water, Washington DC.

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Chain-of-Custody Documentation

Datasheet ID: 601.1
Last Revised: 20 September 2018

Chain-of-Custody / Service Request Form

ecotox SERVICES AUSTRALIA

Customer: Agnico Eagle
Contact Name: Sam Yang
Phone: 08 8978 1737 Email: sam.yang@agnicoeagle.com

Ship To: Ecotox Services Aust
Attention: Rich Kronor
(please provide an email address for sample receipt notification)

Sampled by:

12°C

	Sample Date (day/month /year)	Sample Time	Sample Name (exactly as written on the sample vessel)	Sample Method (eg. Grab, composite etc.)	Number and Volume of Containers (eg 2 x 1L)	Tests Requested (See reverse for guidance): Chronic Cerio Screening						Comments / Instructions
												Note that testing will be delayed if an incomplete chain of custody is received • Additional treatment of samples (i.e. spiking) • Sub-contracted services (i.e. chemical analyses) • Dilutions required (if different than 100% down to 6.25%) • Sample holding time restriction (if applicable) • Sample used for litigation (if applicable) *Note: An MSDS must be attached if Available* **ESA Project Number: PR** 2161
11035	6/4/23 ①		CHCK06			✓						① date taken from bottles.
11036	↓		CHCK04A			✓						
11037	↓		Cosmo Pit			✓						
11038	↓		Dam 3			✓						
11039	↓		PCPWD			✓						
11040	↓		PCCK06			✓						increase EC to 100 uS/cm
												if less than 100

1) Released By:	Date:	2) Received By:	Date: 13/4/23	3) Released By:	Date:	4) Received By:	Date:
Of:	Time:	Of: ESA	Time: 1130	Of:	Time:	Of:	Time:

Note that the chain-of-custody documentation will provide definitive information on the tests to be performed.

Ecotox Services Australia . Unit 27, 2 Chaplin Drive, Lane Cove NSW 2066 AUSTRALIA
Phone: 61 2 9420-9481 Fax 61 2 9420-9484 info@ecotox.com.au

Sample Receipt Notification

Attention : Sam Yang

Client : Agnico Eagle Australia
Dorat Rd
Hayes Creek NT 0822

Email : sam.yang@agnicoeagle.com
Telephone : 08 8978 1737
Facsimile :

Date : 13/04/2023

Re : Receipt of Samples **Pages : 2**

ESA Project : PR2161 ☑ For Review ☐ Additional Documentation Required - Please Respond

Sample Delivery Details

Completed Chain of Custody accompanied samples:	**YES**
Samples received in apparent good condition and correctly bottled:	**YES**
Security seals on sample bottles and esky intact:	**YES**

Date samples received : 13/04/2023
Time samples received : 11:30
No. of samples received : 6
Sample matrix : Aqueous
Sample temperature : 11-15°C

Comments : 1x5L of each sample received at 12oC in apparent good condition

Contact Details

Projects Manager : Dr Rick Krassoi
Telephone : 61 2 9420 9481
Facsimile : 61 2 9420 9484
Email : rkrassoi@ecotox.com.au

Please contact customer services officer for all queries or issues regarding samples

Note that the chain-of-custody provides definitive information on the tests to be performed

Ecotox Services Australia
ABN 95619426201
Unit 27, 2 Chaplin Drive
Lane Cove NSW 2066 Australia

Phone : 61 2 9420 9481
Fax : 61 2 9420 9484
Email : info@ecotox.com.au

Statistical Printouts for the 3-brood Partial Life Cycle Test with *Ceriodaphnia dubia*

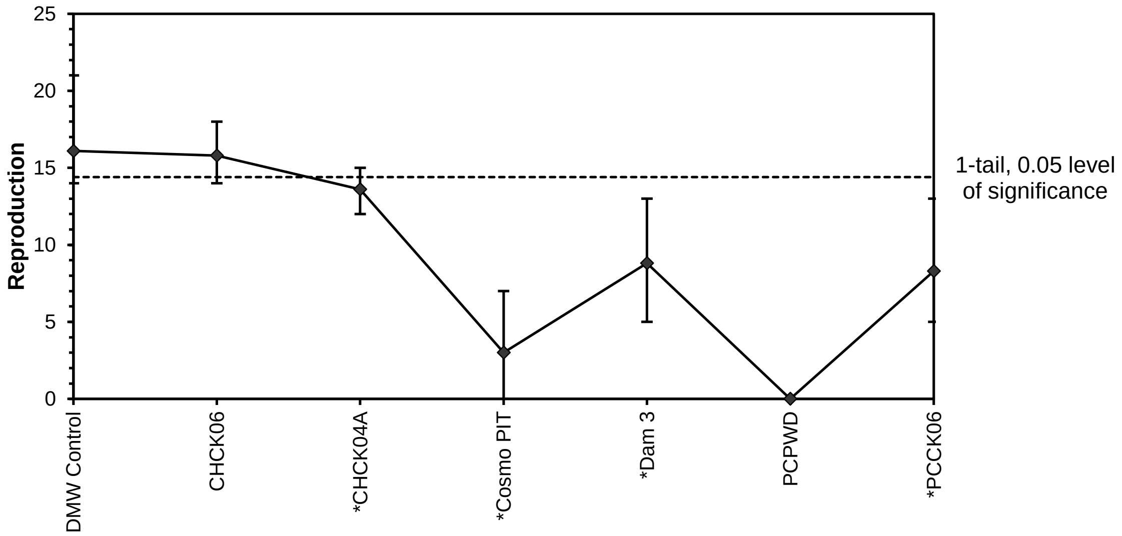
Ceriodaphnia Partial Life-Cycle Test-Reproduction					
Start Date:	14/04/2023 17:00	Test ID:	PR2161/02	Sample ID:	Screens
End Date:	20/04/2023 17:00	Lab ID:	Various	Sample Type:	AQ-Aqueous
Sample Date:		Protocol:	ESA 102	Test Species:	CD-Ceriodaphnia dubia
Comments:					

Conc-	1	2	3	4	5	6	7	8	9	10
DMW Control	16.000	14.000	16.000	21.000	17.000	15.000	15.000	16.000	16.000	15.000
CHCK06	16.000	14.000	16.000	17.000	14.000	15.000	17.000	15.000	18.000	16.000
CHCK04A	12.000	14.000	15.000	15.000	12.000	13.000	15.000	12.000	14.000	14.000
Cosmo PIT	0.000	0.000	3.000	2.000	4.000	6.000	7.000	3.000	0.000	5.000
Dam 3	8.000	8.000	5.000	11.000	8.000	13.000	7.000	7.000	12.000	9.000
PCPWD	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
PCCK06	6.000	9.000	7.000	7.000	9.000	13.000	7.000	5.000	10.000	10.000

			Transform: Untransformed						1-Tailed	
Conc-	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD
DMW Control	16.100	1.0000	16.100	14.000	21.000	11.875	10			
CHCK06	15.800	0.9814	15.800	14.000	18.000	8.333	10	0.409	1.753	1.287
*CHCK04A	13.600	0.8447	13.600	12.000	15.000	9.301	10	3.449	1.753	1.271
*Cosmo PIT	3.000	0.1863	3.000	0.000	7.000	84.620	10	13.035	1.746	1.755
*Dam 3	8.800	0.5466	8.800	5.000	13.000	28.244	10	7.362	1.746	1.731
PCPWD	0.000	0.0000	0.000	0.000	0.000	0.000	10			
*PCCK06	8.300	0.5155	8.300	5.000	13.000	28.426	10	8.122	1.740	1.671

Auxiliary Tests	Statistic		Critical		Skew	Kurt
Kolmogorov D Test indicates normal distribution (p > 0.05)	0.720034		0.895		0.534756	0.161614
Equality of variance cannot be confirmed						
Hypothesis Test (1-tail, 0.05)	**MSDu**	**MSDp**	**MSB**	**MSE**	**F-Prob**	**df**
Heteroscedastic t Test indicates significant differences	1.670586	0.103763	263.8267	4.196296	2.7E-21	5, 54
Treatments vs DMW Control						

Dose-Response Plot



Ceriodaphnia Partial Life-Cycle Test-Reproduction

Start Date:	14/04/2023 17:00	Test ID:	PR2161/02	Sample ID:	Screens
End Date:	20/04/2023 17:00	Lab ID:	Various	Sample Type:	AQ-Aqueous
Sample Date:		Protocol:	ESA 102	Test Species:	CD-Ceriodaphnia dubia
Comments:					

Auxiliary Data Summary

Conc-	Parameter	Mean	Min	Max	SD	CV%	N
DMW Control	No of Young	16.10	14.00	21.00	1.91	8.59	10
CHCK06		15.80	14.00	18.00	1.32	7.26	10
CHCK04A		13.60	12.00	15.00	1.26	8.27	10
Cosmo PIT		3.00	0.00	7.00	2.54	53.11	10
Dam 3		8.80	5.00	13.00	2.49	17.92	10
PCPWD		0.00	0.00	0.00	0.00		10
PCCK06		8.30	5.00	13.00	2.36	18.51	10
DMW Control	% unaffected	100.00	100.00	100.00	0.00	0.00	10
CHCK06		100.00	100.00	100.00	0.00	0.00	10
CHCK04A		100.00	100.00	100.00	0.00	0.00	10
Cosmo PIT		50.00	0.00	100.00	52.70	14.52	10
Dam 3		100.00	100.00	100.00	0.00	0.00	10
PCPWD		0.00	0.00	0.00	0.00		10
PCCK06		100.00	100.00	100.00	0.00	0.00	10
DMW Control	pH	8.10	8.10	8.10	0.00	0.00	1
CHCK06		7.50	7.50	7.50	0.00	0.00	1
CHCK04A		6.50	6.50	6.50	0.00	0.00	1
Cosmo PIT		7.20	7.20	7.20	0.00	0.00	1
Dam 3		6.90	6.90	6.90	0.00	0.00	1
PCPWD		6.40	6.40	6.40	0.00	0.00	1
PCCK06		7.40	7.40	7.40	0.00	0.00	1
DMW Control	DO %	99.60	99.60	99.60	0.00	0.00	1
CHCK06		101.60	101.60	101.60	0.00	0.00	1
CHCK04A		87.60	87.60	87.60	0.00	0.00	1
Cosmo PIT		98.90	98.90	98.90	0.00	0.00	1
Dam 3		98.10	98.10	98.10	0.00	0.00	1
PCPWD		97.30	97.30	97.30	0.00	0.00	1
PCCK06		105.10	105.10	105.10	0.00	0.00	1
DMW Control	Cond uS/cm	172.00	172.00	172.00	0.00	0.00	1
CHCK06		646.00	646.00	646.00	0.00	0.00	1
CHCK04A		549.00	549.00	549.00	0.00	0.00	1
Cosmo PIT		4180.00	4180.00	4180.00	0.00	0.00	1
Dam 3		2450.00	2450.00	2450.00	0.00	0.00	1
PCPWD		1414.00	1414.00	1414.00	0.00	0.00	1
PCCK06		103.00	103.00	103.00	0.00	0.00	1

Ceriodaphnia Partial Life-Cycle Test-7 Day Unaffected

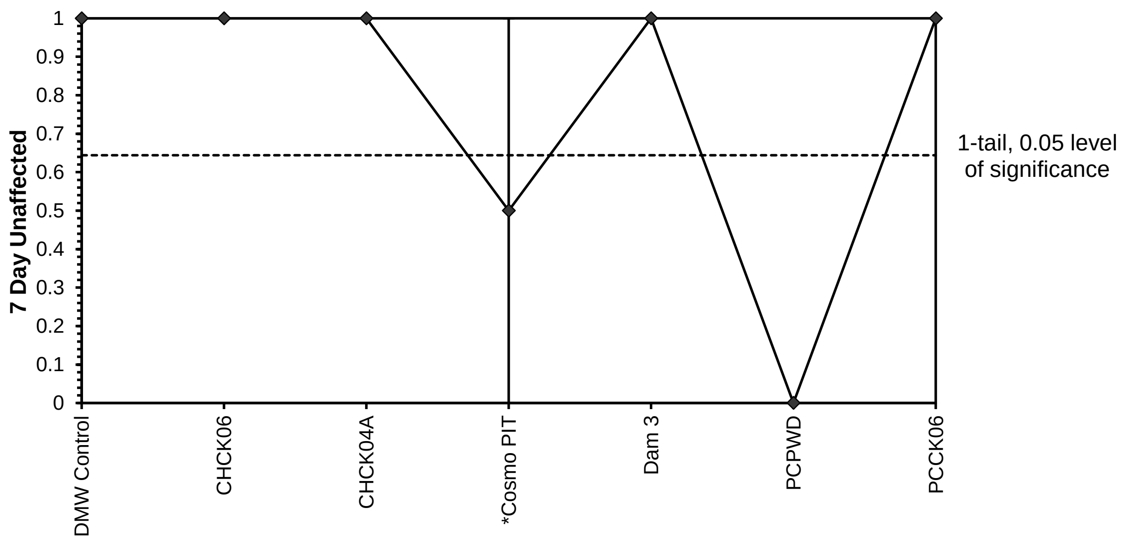
Start Date:	14/04/2023 17:00	Test ID:	PR2161/02	Sample ID:	Screens
End Date:	20/04/2023 17:00	Lab ID:	Various	Sample Type:	AQ-Aqueous
Sample Date:		Protocol:	ESA 102	Test Species:	CD-Ceriodaphnia dubia
Comments:					

Conc-	1	2	3	4	5	6	7	8	9	10
DMW Control	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
CHCK06	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
CHCK04A	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Cosmo PIT	0.0000	0.0000	1.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	1.0000
Dam 3	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
PCPWD	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PCCK06	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000

			Transform: Arcsin Square Root						1-Tailed	
Conc-	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD
DMW Control	1.0000	1.0000	1.0472	1.0472	1.0472	0.000	10			
CHCK06	1.0000	1.0000	1.0472	1.0472	1.0472	0.000	10	0.000	2.287	0.1152
CHCK04A	1.0000	1.0000	1.0472	1.0472	1.0472	0.000	10	0.000	2.287	0.1152
*Cosmo PIT	0.5000	0.5000	0.7854	0.5236	1.0472	35.136	10	5.196	2.287	0.1152
Dam 3	1.0000	1.0000	1.0472	1.0472	1.0472	0.000	10	0.000	2.287	0.1152
PCPWD	0.0000	0.0000	0.5236	0.5236	0.5236	0.000	10			
PCCK06	1.0000	1.0000	1.0472	1.0472	1.0472	0.000	10	0.000	2.287	0.1152

Auxiliary Tests	Statistic		Critical		Skew	Kurt
Kolmogorov D Test indicates non-normal distribution (p <= 0.05)	3.269042		0.895		4.92E-15	3.372958
Equality of variance cannot be confirmed						
Hypothesis Test (1-tail, 0.05)	**MSDu**	**MSDp**	**MSB**	**MSE**	**F-Prob**	**df**
Dunnett's Test indicates no significant differences	0.105501	0.140669	0.114232	0.012692	2.9E-06	5, 54
Treatments vs DMW Control						

Dose-Response Plot



Ceriodaphnia Partial Life-Cycle Test-7 Day Unaffected

Start Date:	14/04/2023 17:00	Test ID:	PR2161/02	Sample ID:	Screens
End Date:	20/04/2023 17:00	Lab ID:	Various	Sample Type:	AQ-Aqueous
Sample Date:		Protocol:	ESA 102	Test Species:	CD-Ceriodaphnia dubia
Comments:					

Auxiliary Data Summary

Conc-	Parameter	Mean	Min	Max	SD	CV%	N
DMW Control	No of Young	16.10	14.00	21.00	1.91	8.59	10
CHCK06		15.80	14.00	18.00	1.32	7.26	10
CHCK04A		13.60	12.00	15.00	1.26	8.27	10
Cosmo PIT		3.00	0.00	7.00	2.54	53.11	10
Dam 3		8.80	5.00	13.00	2.49	17.92	10
PCPWD		0.00	0.00	0.00	0.00		10
PCCK06		8.30	5.00	13.00	2.36	18.51	10
DMW Control	% unaffected	100.00	100.00	100.00	0.00	0.00	10
CHCK06		100.00	100.00	100.00	0.00	0.00	10
CHCK04A		100.00	100.00	100.00	0.00	0.00	10
Cosmo PIT		50.00	0.00	100.00	52.70	14.52	10
Dam 3		100.00	100.00	100.00	0.00	0.00	10
PCPWD		0.00	0.00	0.00	0.00		10
PCCK06		100.00	100.00	100.00	0.00	0.00	10
DMW Control	pH	8.10	8.10	8.10	0.00	0.00	1
CHCK06		7.50	7.50	7.50	0.00	0.00	1
CHCK04A		6.50	6.50	6.50	0.00	0.00	1
Cosmo PIT		7.20	7.20	7.20	0.00	0.00	1
Dam 3		6.90	6.90	6.90	0.00	0.00	1
PCPWD		6.40	6.40	6.40	0.00	0.00	1
PCCK06		7.40	7.40	7.40	0.00	0.00	1
DMW Control	DO %	99.60	99.60	99.60	0.00	0.00	1
CHCK06		101.60	101.60	101.60	0.00	0.00	1
CHCK04A		87.60	87.60	87.60	0.00	0.00	1
Cosmo PIT		98.90	98.90	98.90	0.00	0.00	1
Dam 3		98.10	98.10	98.10	0.00	0.00	1
PCPWD		97.30	97.30	97.30	0.00	0.00	1
PCCK06		105.10	105.10	105.10	0.00	0.00	1
DMW Control	Cond uS/cm	172.00	172.00	172.00	0.00	0.00	1
CHCK06		646.00	646.00	646.00	0.00	0.00	1
CHCK04A		549.00	549.00	549.00	0.00	0.00	1
Cosmo PIT		4180.00	4180.00	4180.00	0.00	0.00	1
Dam 3		2450.00	2450.00	2450.00	0.00	0.00	1
PCPWD		1414.00	1414.00	1414.00	0.00	0.00	1
PCCK06		103.00	103.00	103.00	0.00	0.00	1