MT TODD 2020 WDL MONITORING REPORT

Waste Discharge Licence WDL 178-07

Prepared for:

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BASIS OF REPORT

This report has been prepared by SLR Consulting Australia Pty Ltd (SLR) with all reasonable skill, care and diligence, and taking account of the timescale and resources allocated to it by agreement with Vista Gold Australia Pty Ltd (the Client). Information reported herein is based on the interpretation of data collected, which has been accepted in good faith as being accurate and valid.

This report is for the exclusive use of the Client. No warranties or guarantees are expressed or should be inferred by any third parties. This report may not be relied upon by other parties without written consent from SLR.

SLR disclaims any responsibility to the Client and others in respect of any matters outside the agreed scope of the work.

DOCUMENT CONTROL

Reference	Date	Prepared	Checked	Authorised
680.10533.00100-R01-v1.1	3 November 2020	Loren Yallop	Jill Woodworth	Jill Woodworth
680.10533.00100-R01-v1.0	30 October 2020	Loren Yallop	Jill Woodworth	Jill Woodworth

EXECUTIVE SUMMARY

SLR Consulting Australia Pty Ltd (SLR) was engaged by Vista Gold Australia Pty Ltd (Vista) to prepare this annual WDL Monitoring Report for submission to the Administering Agency: Department of Environment and Natural Resources (DENR) to meet the requirements of Conditions 54 and 55 of WDL 178-07, for the Mt Todd Gold Mine.

During 2019/20, Vista Gold continued to conduct a range of environmental monitoring programs to meet the requirements of WDL 178-07 for environmental management and assessment of the discharge of treated mine water from the Mt Todd mine site. These programs included:

- Water quality monitoring (routine and in accordance with WDL 178-07)
- Annual macroinvertebrate monitoring
- Annual sediment monitoring
- Ecotoxicology assessment.

The results of these programs are used to determine the impacts of treated mine water discharge from Vista Gold's Mt Todd mine site.

The 2019/20 water quality data indicates that the water quality in the Edith River is not being adversely impacted by the discharge of treated water from Batman Pit to the Edith River using the current dilution method. The water quality at SW4 is influenced by the upstream water quality and discharge has been managed to ensure that the SSTVs are generally met at SW4 during discharge.

Results of the 2019/2020 biological and sediment monitoring programs indicate that the Mt Todd site has not had a measurable impact on the macroinvertebrate communities of the receiving waterways. Controlled releases of treated mine water have occurred into the receiving waters during the 2019/2020 wet season, however no impact on the aquatic ecosystem or sediment quality from these releases was observed.

All receiving sites showed similarity to reference sites for aquatic macroinvertebrate communities, water quality and sediment quality.

The 2020 ecotoxicological investigation has demonstrated that the treated mine water discharged from Batman Pit to the Edith River using the current dilution method is not toxic at the compliance point, SW4, for the sensitive species and end point tested.

The weight of evidence approach used by Vista Gold has shown that discharge of treated mine water from Batman Pit at the current dilution method does not pose any risk for the aquatic communities living in Edith River downstream the discharge point.

Recommendations drawn from the findings of the 2019/20 reporting period are provided in **Table 1**.

EXECUTIVE SUMMARY

Table 1 Recommendations

Item	Recommendation
Surface Water Monitoring Program	
1	If the pH continues reducing overtime more metals may become mobilised such as observed with zinc and additional management may be required if metal concentrations become problematic at SW4.
2	Condition 49.1 should be reverted back to “three consecutive sampling occasions.”
Proposed site specific trigger values for WDL 178-08	
3	SSTV for pH 5.9 – 8.0
Biological / Sediment monitoring program	
4	Assess the suitability of monitoring sites during each survey as monitoring requirements can change with environmental or project changes.
5	Continue to monitor all sites including SCUS in future monitoring events. The site will be appropriate to replace existing reference site SCTOP if it is impacted by TSF2 construction.
Ecotoxicology program	
6	To maintain the monitoring of toxicity of the Edith River at SW4 during discharge of treated mine water to show that the discharge is not adversely impacting on the aquatic ecosystem in the Edith River, it is recommended to conduct the ecotoxicology testing as per the current approved Plan.
7	Review the SSTV of iron to reflect the influence of upstream concentrations.

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ABBREVIATIONS

Acronym	Definition
ANZG	Australian and New Zealand Guidelines for Fresh and Marine Water Quality
BMP	Biological Monitoring Program
DENR	Department of Environment and Natural Resources
DO	Dissolved oxygen
EC	Electrical conductivity
EPA	Environment Protection Authority
HLP	Heap leach facility
LGO	Low grade ore
MDS	Multi-dimensional scaling
MLN	Mineral Lease Number
MMP	Mining Management Plan
MTPA	Mount Todd Project Area
PET	Plecoptera Ephemeroptera and Trichoptera
PSD	Particle size distribution
REMP	Receiving Environment Monitoring Program
RPI	Retention Pond 1
SSTV	Site Specific Trigger Value
SWG	Stock water guidelines
TSF	Tailing Storage Facility
Vista Gold	Vista Gold Australia Pty Ltd
WDL	Waste Discharge Licence
WMP	Water Management Plan
WRD	Waste Rock Dump

1 Introduction

1.1 Background

The Mount Todd Project Area (MTPA) is located approximately 55 km North West of Katherine, in the Northern Territory (NT). The MTPA is located within the Daly River Catchment. The Edith River is located directly to the south of the mine site and intersects Mineral Lease Number 1127 (MLN 1127). The Edith River is the largest of various tributary rivers and creeks to the Fergusson River. The Fergusson River is the closest of the five main tributary river systems to the Daly River Catchment, to the mine site at approximately 15 km to the north-west. The Edith River is located directly to the south of the mine site has a high ecological and recreational value with the site located approximately 9 km downstream of Edith Falls which is situated within Nitmiluk National Park.

The Edith River is fed by several ephemeral creeks, five of which run through the MTPA (detailed in Section 2.2) and currently receive the rainwater runoff from site related catchments within the mineral leases. The river intersects the mine site to the south and flows from east to west. The volume of runoff from site related catchments has typically contributed less than 50% of the total flow within the Edith River at SW4 (current compliance location for water quality). The regional drainage pathway and catchment plan of the Edith River sub-catchment is described in detail in the Mt Todd Gold Mine Water Management Plan (WMP 2020). The Edith River enters the Fergusson River approximately 15 km to the northwest of the mine site.

Vista Gold Australia Pty Ltd (Vista Gold) have operated the care and maintenance phase of the MTPA since 2006. The site was previously mined for gold during the 1990s before its closure in 2000. Vista Gold's water management strategy for the MTPA respects that water management is an integral part of managing the mine site and its interaction with the surrounding environment. In accordance with their objectives Vista Gold have adopted an integrated multiple lines of evidence approach to manage the environmental impacts from active and passive discharges entering the Edith River. This approach includes surface water, ecotoxicological assessment, macroinvertebrate and sediment monitoring programs, the results of which are used to assess the potential impacts to aquatic ecosystems from active and passive discharges from the MTPA. This integrated environmental assessment provides information to assist with calculation and applicability of site specific trigger values (SSTVs) in accordance with the guidance provided in ANZG (2018). The most important aspect of the multiple lines of evidence approach to environmental monitoring and management is the macroinvertebrate monitoring results. By monitoring the macroinvertebrates, an integrated assessment of long-term impacts from exposure to treated mine water can be determined.

1.2 Waste Discharge Licence

The environmental impacts of treated mine impacted water actively discharged from Batman Pit to Edith River, via Batman Creek and Stow Creek, were managed by Waste Discharge Licence (WDL 178-06) until 25 November 2019 and is currently managed by WDL 178-07 which commenced on the 25 November 2019 and will expire on the 30 November 2020 (**Appendix A**).

WDL 178-07 provides the following qualitative discharge limits:

Condition *27* *The licensee must ensure that the discharge from all discharge events at the authorised discharge point does not:*

27.1. Contain any floating debris, oil, grease, petroleum hydrocarbon sheen, scum, litter or other objectionable matter;

27.2. Cause or generate odours which would adversely affect the use of surrounding waters;

27.3 Cause algal blooms in the receiving water;

27.4 Cause visible change in the behaviour of fish or other aquatic organisms in the receiving water;

27.5 Cause mortality of fish or other aquatic organisms; or

27.6 Cause adverse impacts on plants.

These discharge limits are monitored as a requirement of the WDL through the implementation of:

- Surface water monitoring as per Appendix 1 of the WDL178-07 (*Condition 29-43*)
- An approved Biological Monitoring Program (*Condition 33*)
- A Sediment Monitoring Program (*Condition 34*).
- An approved Ecotoxicology Plan (*Condition 35*)

An annual Monitoring Report, as prescribed in the licence, must be submitted to the Northern Territory Department of Environment and Natural Resources (DENR) as per:

54 The licensee must complete and provide to the administering agency an Annual Monitoring Report, as prescribed by this licence by 30 August for each year of this licence, unless otherwise agreed, for the preceding 12-month period.

55 The licensee must ensure that each Annual Monitoring Report:

55.1 Is prepared in accordance with the requirements of the Administering Agency 'Guideline for Reporting on Environmental Monitoring';

55.2 Includes a tabulation of all monitoring data required as a condition of this licence. Data must be provided electronically in Microsoft Excel format;

55.3 Includes long term trend analysis of monitoring data to demonstrate any environmental impact associated with the activity over a minimum period of three years (where the data is available). Data used in this analysis must be provided electronically in Microsoft Excel format; and

55.4 Includes assessment and determination of environmental impact determined by the Receiving Environment Monitoring Program specified in Table 1

Table 1 Licence Documents

Document Title	Document Reference Number
Biological Monitoring Program: Chapter 4 – WDL178-05 Annual Report	DENR Ref: EN2010/0195-06-077~0025
Sediment Monitoring Program: Chapter 5 – WDL178-05 Annual Report	DENR Ref: EN2010/0195-06-077~0025
Ecotoxicology Plan: Chapter 6 – WDL178-05 Annual Report	DENR Ref: EN2010/0195-06-077~0025
Discharge Plan – Revision 6	DENR Ref: EN2010/0195-06-077~0026
Water Monitoring SOP	DENR Ref: EN2010/0195-06-077~0028

1.3 Purpose of this report

This report has been prepared for Vista Gold for submission to DENR to meet Conditions 54 and 55 of WDL 187-07, requiring the preparation of an Annual Monitoring Report. This report covers the period from 1 July 2019 through to 30 June 2020.

1.4 Scope

This report provides the following to meet the requirements of WDL 178-07:

- A monitoring report using the framework that has previously been accepted by the NT Environment Protection Authority (EPA)/DENR.
- Analysis and interpretation of Vista Gold monitoring data for the period of 1 July 2019 to 30 June 2020 and preparation of a Monitoring Report, however, historical data is also included to assist in interpretation of the results. 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) required as a condition of WDL 178-07; and
  - An assessment of environmental impact from the activity.
  - Results of the Biological Monitoring Plan together with a detailed interpretation of the results.
  - Results of the Sediment Monitoring Plan together with a detailed interpretation of the results.
  - Recommendations for updating the Receiving Environment Monitoring Plan (REMP).
  - Recommendations to necessitate meeting the WDL 178-07 conditions and improvement of water management and monitoring strategies.
  - Recommendations for changes to the WDL.

1.5 Assumptions

This report has been prepared using the data provided by Vista Gold. It is assumed that appropriate quality assurance and quality control procedures have been applied by Vista Gold in the sampling, analysis and reporting of data for all monitoring locations.

1.6 Data sources applied to this report

Relevant reports data provided by Vista Gold to prepare this report included the following:

- Mt Todd 2013-2020 water quality data
- Mt Todd Gold Mine Operational Mining Management Plan (MMP) 2020
- Mt Todd Gold Mine Water Management Plan (WMP) 2020
- Mt Todd Water Discharge Plan 2018
- Receiving Environment Management Plan (REMP 2018)
  - Biological Monitoring Program
  - Sediment Monitoring Program
  - Ecotoxicology Monitoring Program
  - Water Quality Monitoring Program (as defined in WDL 178-07 and the Mt Todd WMP 2020)
- 2020 Biological Monitoring Program and Sediment Monitoring Program Report
- Ecotoxicology Report 2020

2 Surface water management

2.1 Introduction

The 2019/20 water quality for all monitoring locations at the MTPA have been assessed in this report to comply with the conditions of WDL 178-07. In accordance with Appendix 1 of WDL 178-07, water quality at monitoring site SW4 is assessed against the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZG) (2018) 80% species level of protection. Historical water quality data from 2013-2020 has been used to aid in interpretation and identify trends.

The application of the ANZG (2018) trigger values do not apply to standing water bodies on site, such as retention ponds. The stock watering guidelines (SWG) are applied to sites within mixing zones, standing water bodies and downstream of compliance points. Australian drinking water guidelines are applied at SW10 but are not reported in this document and are available on the Mt Todd website.

2.2 Authorised discharge locations

Condition 22 of WDL 178-07 permits the release of treated water from Batman Pit (formerly RP3), the authorised discharge location for the MTPA. Treated pit water is pumped into Batman Creek and flows off lease to the Edith River via Stow Creek. No other water (treated or untreated) is currently actively discharged from site.

The location of the authorised discharge location is provided in **Table 1** and shown in **Figure 1**.

Table 2 Mt Todd Gold Mine Authorised Discharge Points (WDL 178-07)

Authorised Discharge Point	Description	Location	
		Latitude	Longitude
Batman Pit (RP3)	Treated water is pumped from Batman Pit (RP3) to the authorised discharge point which is fitted with a diffuser to aid dispersion. The discharge point is located in Batman Creek on MLN1070, which flows to Stow Creek which flows off-lease to the Edith River.	-14.139117º	132.111550º

Figure 1 Authorised Batman Pit discharge location in Batman Creek

2.3 Mine affected water sources

The current potential sources of mine affected water from the MTPA to the receiving waters of the Edith River originate from legacy infrastructure associated with historical mining activity at the site. These include the Waste Rock Dump (WRD), Tailings Storage Facility (TSF), ROM pad and other mining infrastructure as described in the Water Management Plan (WMP 2020). **Table 3** provides details on the main potential sources of mine affected water. All mine affected water is diverted and treated in Batman Pit.

Table 3 Wastewater Sources

Site	Source	Receiving Sites
Mt Todd Gold Mine	Waste rock dump repository (RP1) via Batman Pit	Edith River SW4 SW10 Stow Creek via Batman Creek SW3
	Tailings Storage Facility 1(TSF) via Batman Pit	
	Heap leach facility (HLP) via Batman Pit	
	Low grade ore (LGO) dump pump sump via Batman Pit	

Each of the retention ponds on the mine site have a contributing catchment area. The water quality of the retention ponds has historically contained variable concentrations of dissolved metals and had had low levels of pH associated with AMD from mined rock faces and stockpiled rock. The major source of AMD generation is the seepage from the WRD, which drains into Retention Pond 1 (RP1), resulting from precipitation on the exposed sulphide rock in the WRD during the wet season. RP1 does not discharge into the environment.

2.4 Water management strategy

The current water management strategy at the MTPA includes a combination of onsite storage, treatment and licenced release of treated water which has been designed to minimise the uncontrolled release of acid mine drainage entering the receiving environment. The strategy includes treating the water in situ (in Batman Pit) before releasing the water into the receiving environment in accordance with the condition of WDL 178-07. A conceptual site model illustrating the water management strategy is shown in **Figure 3**.

2.5 2019/20 discharge regime

Treated water is actively discharged from Batman Pit only. Water from RP1 and HLP is pumped into RP7 during the wet season. As a contingency, to increase freeboard in the ponds and reduce the risk of overtopping in the retention ponds, water can be pumped into the Batman Pit void.

In exceptional circumstances, controlled discharge, in addition to the routine discharge from Batman Pit, may be required which override the normal onsite water actions. This controlled release of water would only be undertaken in the following scenarios:

- When there is a significant risk to the integrity of the retention pond structure, and lowering of the internal water level will contribute to a reduction in the risk of failure; or
- When there is a significant risk of an uncontrolled discharge and lowering of the internal water levels will reduce the risk of uncontrolled discharge or minimise the quantity of uncontrolled discharge.

2.5.1 Evaporation

The large surface area of RP1 is utilised by Vista Gold for evaporation efficiencies. During the 2019/20 reporting period 574.26 ML of treated water was transferred from Batman Pit to RP1 for evaporation purposes. This assisted in reducing the water inventory in Batman Pit as the low rainfall in 2019/20 limited the volume of treated water from Batman Pit able to be actively discharged into the Edith River.

2.5.2 Volume of water discharged

Vista Gold discharged a total of 253.98 ML of treated water from Batman Pit during the 2019/20 reporting period. Details are provided in **Table 4** and **Figure 2**. Discharge pumping totalled 235.22 hours over 14 days.

Table 4 Batman Pit discharges

Month	Discharge days	Average discharge rate (L/s)	Dates	ML Discharged
February	7	404	2nd, 3rd, 16th, 26-29th	168.73
March	7	199	1st-5th, 9th and 10th	85.25
			Total ML discharged	**253.98**

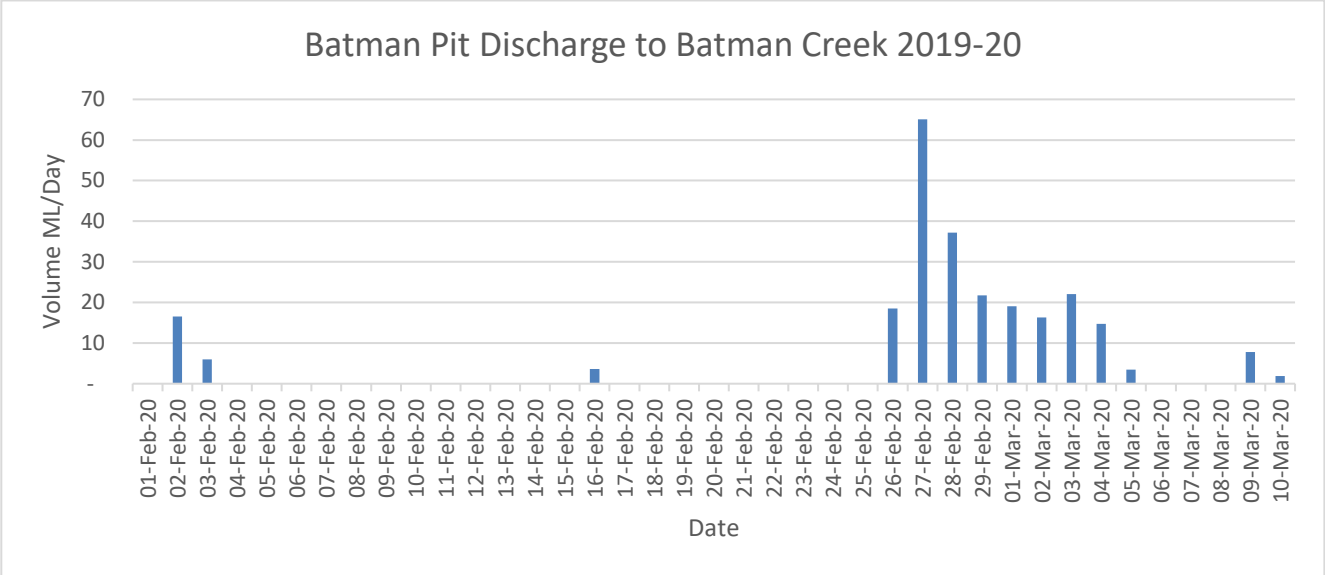


Figure 2 Discharge into Batman Creek during the 2019/20 wet season

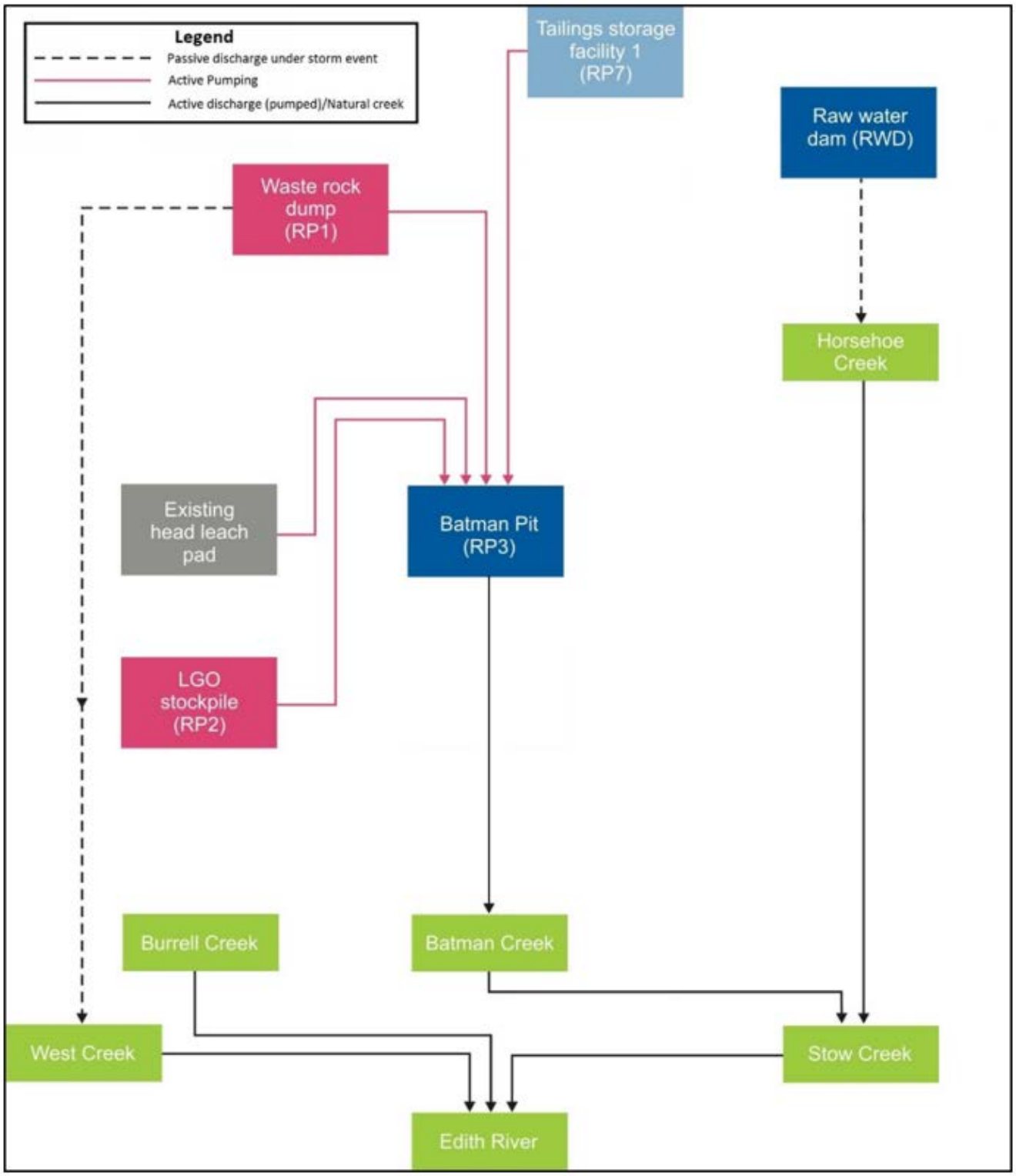


Figure 3 Water Management Concept Model - Care and Maintenance Phase

3 Surface water monitoring program

WDL 178-07 specifies the surface water monitoring requirements for the MTPA. The surface water monitoring program incorporates the monitoring of the upstream (control) locations, discharge water, the downstream compliance site, and further downstream (impact) locations. Surface water monitoring locations for the MTPA are provided in **Table 5** and are shown on **Figure 4**.

The results from the surface water monitoring program are used to understand the influence of treated mine water discharge from the project area to the receiving environment in the Edith River system. The results of the monitoring program assist in identifying trends and assess the success of the various surface water management measures implemented by Vista Gold.

The 2019/20 water quality results from all monitoring locations are provided in **Appendix B**.

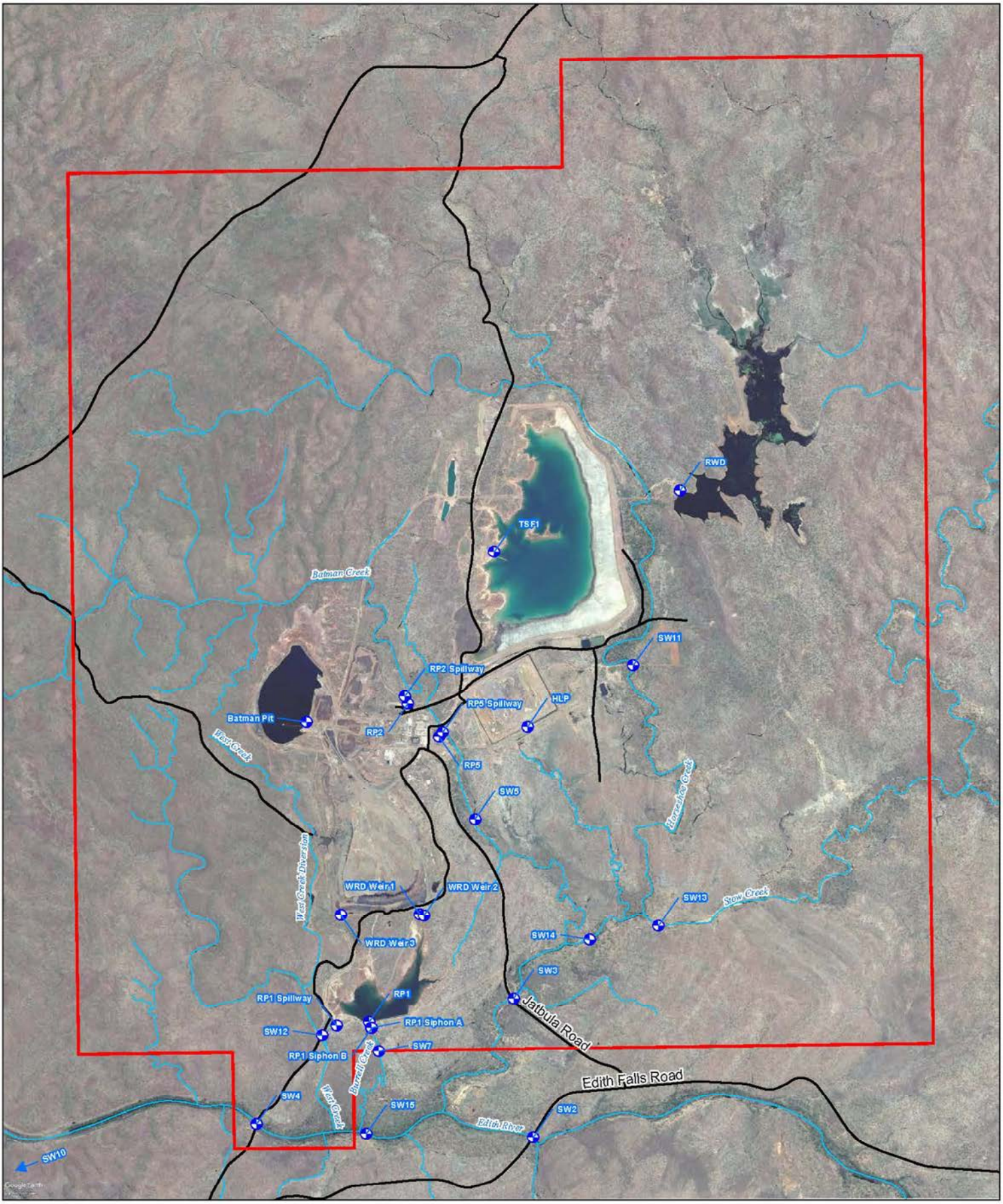
The analytes monitored in the program are listed in **Table 6**. Sampling frequencies for monitoring are undertaken in accordance with Appendix 1 of WDL 178-07. The SSTVs derived from reference site (SW2) data have been used to assess water quality at the SW4, as listed in Appendix 1 of WDL 178-07.

Table 5 Surface Water Monitoring Locations for WDL 178-07

Site Code	SW4 Online	SW4 Compliance	SW2	SW13	SW3	SW10	Batman Pit (RP3)
Latitude	-14.16925°	-14.17067°	-14.17195°	-14.15605°	-14.16144°	-14.18464°	-14.14109°
Longitude	132.09835°	132.09835°	132.11990°	132.12989°	132.11851°	132.03037°	132.10322°
Type	Compliance	Compliance	Reference	Reference	Information	Information	Wastewater Source
Description	Continuous real-time in situ telemetry station in Edith River	Compliance point in Edith River	Non-impacted reference site in Edith River	Non-impacted reference site in Stow Creek	Impacted information site in Stow Creek	Impacted downstream information site in Edith River	Wastewater discharge source Batman Pit

Table 6 Surface Water Monitoring Analytes for WDL 178-07

Type	Analytes
Field measurements	Daily rainfall, daily evaporation, air temperature (min and max), pumping rate, cumulative discharge volume, river flow, water level, dissolved oxygen, water temperature, electrical conductivity, pH
Dissolved metals and metalloids (0.45 µm filtered) µg/L	Aluminium, cadmium, chromium, cobalt, copper, iron, lead, manganese, nickel, zinc
Total metals and metalloids (Unfiltered) µg/L	Aluminium, cadmium, copper, iron
Major ions and other environmental indicators mg/L	Bicarbonate, calcium, carbonate, chloride, sodium, magnesium, potassium, sulphate, total dissolved solids, hardness (as $CaCo_3$), total suspended solids, total cyanide
Nutrients	Total nitrogen (µg/L – unfiltered), total phosphorus (µg/L – unfiltered), total organic carbon (mg/L – unfiltered)



LEGEND

- Water Sampling Sites
- Mt Todd Mineral Leases
- Roads
- Waterways

0 0.25 0.5 0.75 1
Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia
Grid: Map Grid of Australia 1994, Zone 53

N

Vista Gold Australia Pty Ltd
Mt Todd Gold Project

Water Sampling Sites

Job Number	43-22975
Revision	A
Date	10 June 2019

Figure 4

G:\43\22632\GIS\Maps\43222632_054.mxd
Level 7, 24 Mitchell Street Darwin NT 0800 Australia T 61 8 8982 0100 F 61 8 8981 1075 E drwmail@ghd.com W www.ghd.com.au

Data source: Vista Gold - Mineral Leases (2011). Google Earth Pro - Imagery (Date extracted: 19/06/2017). GHD - Waterways, Roads (2012) Water Sampling Sites (2017). Created by: CM

3.1 Application of Site Specific Trigger Values

WDL 178-07 lists SSTVs that are to be used for the assessment of water quality at compliance site SW4. As stipulated in WDL 178-07 the water quality at site SW4 is required to comply with the ANZG (2018) 80% species protection level for discharge to fresh water and identified SSTVs.

The application and management actions of SSTVs are discussed in **Section 3.3**.

3.2 Rainfall

The MTPA rain gauges are monitored daily through the wet season months. During the current reporting period, maximum rainfall occurred during February 2020. Total monthly rainfall for the 2019/20 period compared with that of 2016/17, 2017/18 and 2018/19 is presented in **Figure 7**. The 2019/20 rainfall was 745.8 mm. This is the determining factor in the low discharge volumes from Batman Pit to Batman Creek and ultimately the Edith River system.

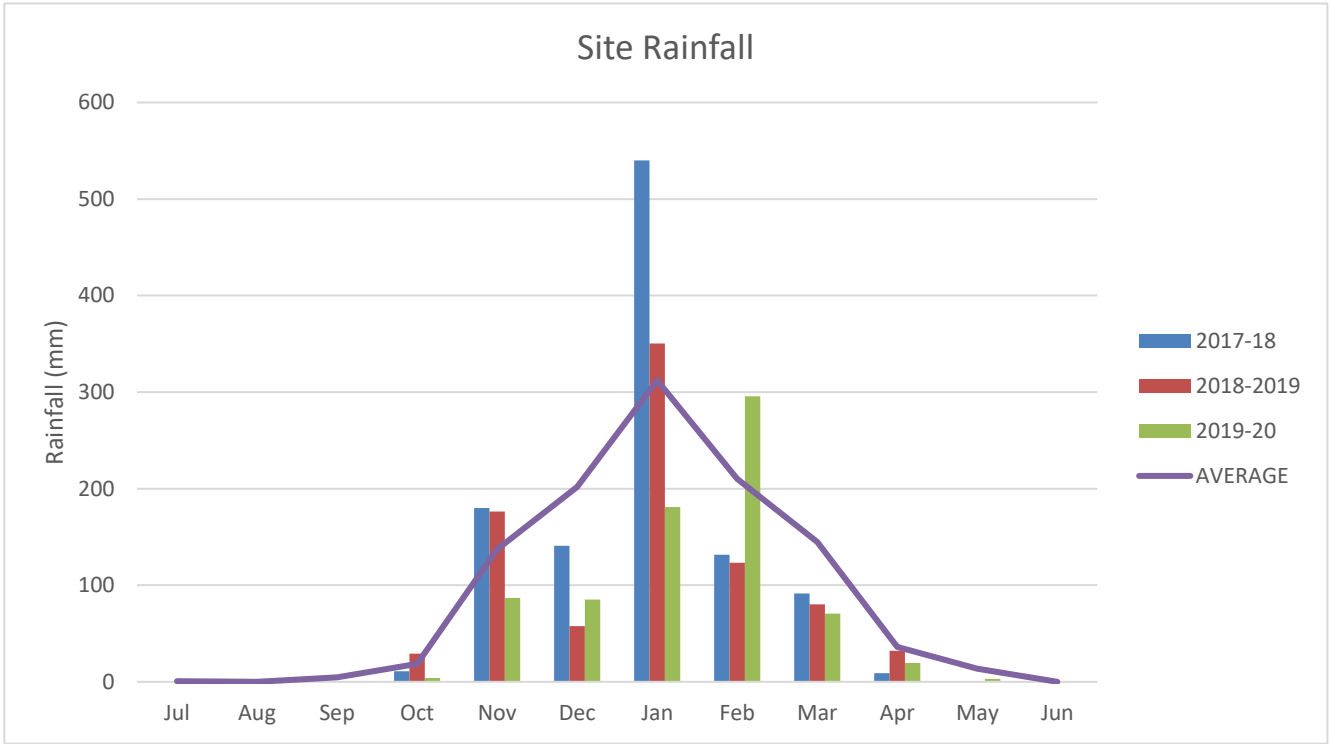


Figure 5 2017-12020 Rainfall with medium term average (2012-2020)

Wet season rainfall recorded at the Bureau of Meteorology weather station RAAF Tindall prior to the 2020 biological monitoring program field survey are shown in **Figure 6**. Below average rainfall was recorded in every month over the wet season with the majority of rainfall occurring in January and February. The RAAF Tindal weather station is located 50 km south east of the MTPA.

Figure 6 RAAF Tindall monthly rainfall for 2019/2020 wet season

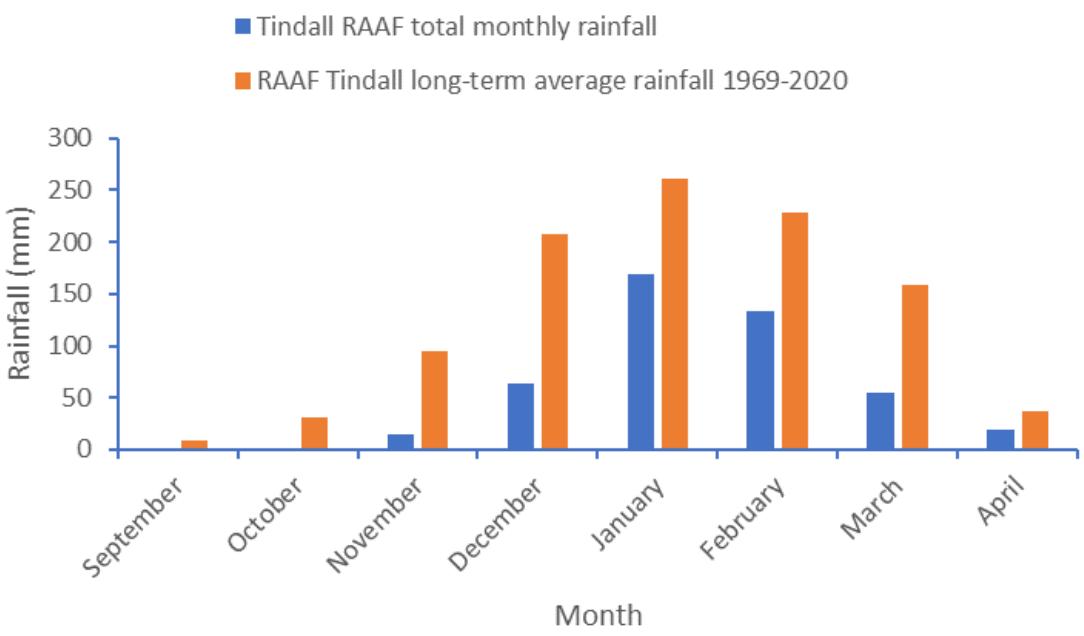


Figure 7 2016-2020 Rainfall with medium term average

3.3 SW4 SSTV Exceedances 2019/20

SSTVs listed in WDL 178-07 are applied to the Edith River downstream compliance site, SW4, during the reporting period July 2019 to June 2020 (**Table 7**). It is important to note that SSTVs only apply to the compliance point SW4 and are based on water quality data (80th percentile) from the upstream reference site, SW2. They do not apply to other sampling sites in the catchments particularly standing water bodies such as Batman Pit.

Monitoring occurred during the discharge period in accordance with WDL 178-07.

3.3.1 Reporting Exceedances

WDL 178-07 Condition 49 states:

49 A non-compliance with this licence includes:

49.1 An exceedance of a SSTV at SW4, as specified in Appendix 1, on two consecutive sampling occasions;

49.2 An exceedance of a SSTV at SW4, as specified in Appendix 1, of two times or more a trigger value on a single occasion; and

49.3 Subsequent consecutive exceedances of the SSTV from an exceedance described in condition 49.1 and 49.2.

No non-compliances with Condition 49.2 of WDL 178-07 were recorded.

Table 7 SW4 Water Quality Summary July 2019 – June 2020

Analyte	SSTV WDL 178-07	No.	Min	Med	Max	No. of SSTV exceedances during discharge	Reporting required
pH	6.0-8.0	20	5.9	6.1	6.5	2	No
EC µS/cm	250	20	32	89	255	1	No
DO %sat	85-120	20	50	88	99	3	No
Major Ions (mg/L)							
Bicarbonate	319	6	1	6.5	13	0	No
Calcium	-	6	1.3	2.9	8.2	N/A	N/A
Carbonate	-	6	1	1	3	N/A	N/A
Chloride	64	6	2	2	8	0	No
Magnesium	21	6	1.4	3.0	5.8	0	No
Potassium	-	6	1	1.4	2.4	N/A	N/A
Sodium	-	6	2.2	2.9	6.4	N/A	N/A
Sulfate	129	6	6.8	18	41	0	No
Total Dissolved Solids	-	6	40	60	3,210[1]	N/A	N/A
Nutrients							
Total Nitrogen	-	0	-	-	-	N/A	N/A
Total Phosphorus	-	0	-	-	-	N/A	N/A
TOC (%)	-	5	3	3	7	N/A	N/A
Metals (0.45 µm filtered) µg/L							
Aluminium	150	11	10	28	84	0	No
Cadmium	0.8	11	0.02	0.06	0.42	0	No
Chromium	-	11	0.2	0.3	1	N/A	N/A
Cobalt	13	11	0.47	0.91	1.34	0	No
Copper	2.5	11	0.7	1.3	2.5	0	No
Iron	350	11	130	420	1,120	2	No
Lead	9.4	11	0.01	0.13	1	0	No
Manganese	3,600	11	18	48	88	0	No
Nickel	17	11	0.7	1	4	0	No
Zinc	31	11	3	7.6	53	3	No
Metals - total µg/L							
Aluminium	-	10	30	1,030	3,060	N/A	N/A
Cadmium	-	10	0.02	0.06	0.50	N/A	N/A
Copper	-	10	0.94	3	4.7	N/A	N/A
Iron	-	10	600	2,070	3,790	N/A	N/A

[1] Suspected incorrect record as low EC was recorded on the date of sampling

Analyte	SSTV WDL 178-07	No.	Min	Med	Max	No. of SSTV exceedances during discharge	Reporting required
Other water quality parameters mg/L							
Cyanide (total)	0.007	6	0.004	0.005	0.005	0	No
TSS	-	8	10	20	120	0	No
Hardness	-	8	9.2	19	42	0	No

Exceedances of the SSTVs at site SW4, the compliance point, during discharge are summarised in **Table 8**. All other parameters at site SW4 were below the SSTV for the reporting period. SSTVs were exceeded at SW4 on eleven occasions whilst discharge was occurring. Six of these exceedances were very minor with the result falling marginally outside of the SSTV. Additional discussion of results is provided below.

Table 8 Exceedances recorded at SW4 during discharge February - March 2020

Date	Monitoring Frequency	Analyte	Units	SSTV	Result	Action
3/02/2020	Daily	Dissolved oxygen	(%sat)	85-120	84.7%	Minor exceedance. Previous background levels also low.
3/02/2020	Daily	Electrical conductivity	(uS/cm)	250	255	Minor exceedance.
16/02/2020	Weekly	Iron	µg/L	350	602	Turn around on results can take 10 days, however, pumping ceased 16/02/2020. Exceedance was influenced by background water iron levels of 644 µg/L at SW2.
18/02/2020	Daily	Dissolved Oxygen	(%sat)	85-120	78%	Minor exceedance. Previous background levels also low.
26/02/2020	Weekly	Iron	µg/L	350	420	Turn around on results can take 10 days. Exceedance was influenced by background water iron levels of 532 µg/L at SW2.
27/02/2020	Daily	Dissolved Oxygen	(%sat)	85-120	82%	Minor exceedance. Previous background levels also low.
27/02/2020	Daily	pH	pH units	6.0-8.0	5.9	Minor exceedance. Very close to SW2 pH reading.
28/02/2020	Daily	pH	pH units	6.0-8.0	5.9	Minor exceedance. Very close to SW2 pH reading.
29/02/20	Daily	Zinc	µg/L	31	53	Minor exceedance. Pumping ceased 05/03/2020.
01/03/2020	Monthly	Zinc	µg/L	31	53	Minor exceedance. Pumping ceased 05/03/2020.
04/03/2020	Weekly	Zinc	µg/L	31	49	Minor exceedance. Pumping ceased 05/03/2020.

3.3.2 pH

pH values outside of the SSTV (6.0-8.0) were recorded on two occasions during discharge from the Batman Pit during the 2019/20 wet season. pH values of 5.85 and 5.9 were recorded on 27 and 28 February 2020, respectively. It is worth noting that both of these readings were very similar to the pH readings taken at SW2. The pH on 28 February 2020 at SW2 (background water) was 6.01, just inside the SSTV.

Whilst these exceedances were recorded on two consecutive sampling occasions, this is not a reportable non-compliance in accordance with Condition 49.1 of WDL 178-01, due to the low pH reading recorded at SW2.

It is also worth noting that the pH was outside of the SSTV recorded at 5.96 at SW2 and SW4 on 15 January 2020 (prior to the discharge period commencing).

Low pH results recorded at downstream SW4 appear more likely to be influenced by upstream pH at SW2 rather than water discharged from Batman Pit into Batman Creek. This assessment is supported by discharge pH levels from the Pit generally around the neutral value of 7 and consistently being higher than the pH values observed at SW4 (during discharge). Upstream pH values at SW2 are generally lower than that at SW4 indicating that the discharge maybe maintaining elevated pH at SW4 unless this slight increase is related to unknown inputs from the downstream surrounding environment.

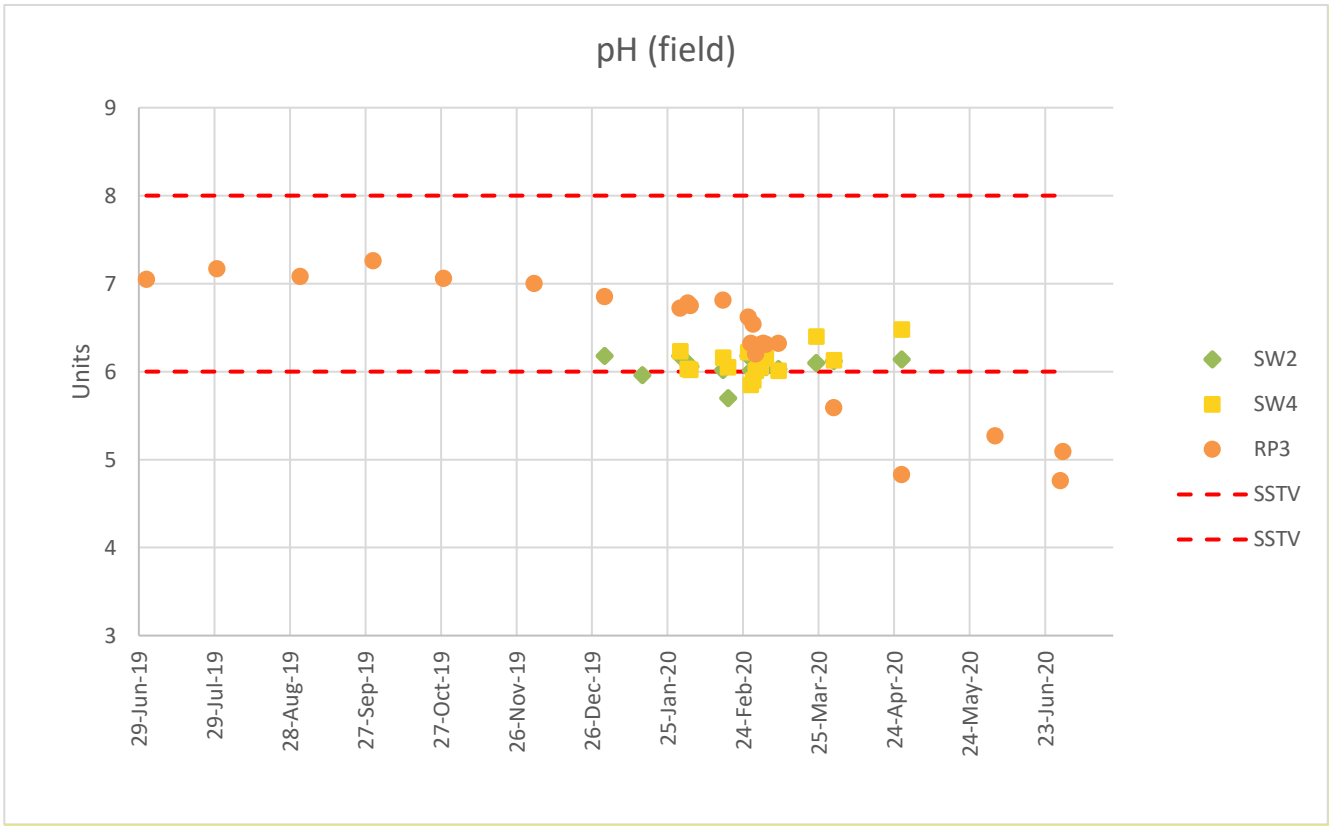


Figure 8 pH at SW4, SW2 and discharge from Batman Pit

3.3.3 Electrical Conductivity

Electrical conductivity (EC) values exceeded the SSTV of 250 µs/cm on 1 occasion during the 2019/20 wet season. A minor exceedance of the EC SSTV was recorded on 3 February 2020, the second day of discharge. The EC value for this exceedance was only marginally above the SSTV by 5.2 µs/cm (2%) and the EC level returned to below the SSTV in subsequent monitoring events, as such it is considered to be unlikely to have had any measurable environmental impact in the receiving environment.

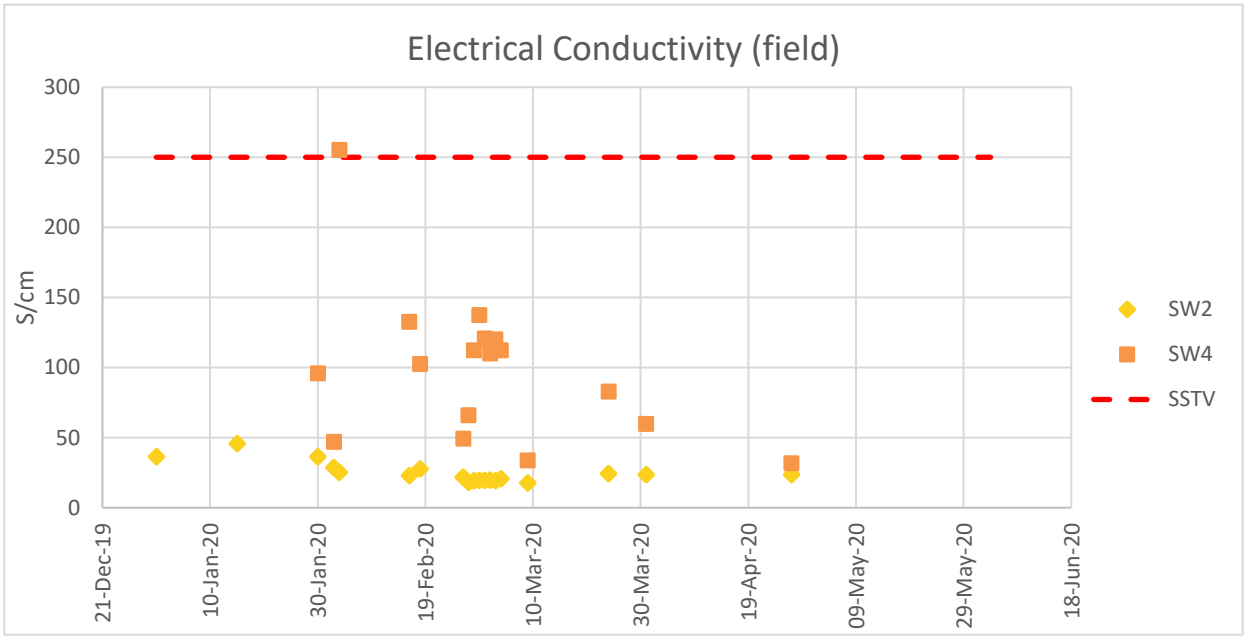


Figure 9 Electrical conductivity Edith River upstream (SW2 and SW4)

3.3.4 Dissolved Oxygen

SSTV exceedances for dissolved oxygen (DO) during the months when discharge was occurring (February and March 2020) were recorded on 3, 18 and 27 February 2020 and 24 March 2020. Results were 85%, 78% and 82%, and 81% respectively, which are below the SSTV of 85% - 120%. Discharging was not occurring on 18 February 2020 and had not occurred since 16 February 2020 when the DO was recorded at 78%. Discharge was not occurring on 24 March 2020 when DO was recorded at 81%, and had not occurred since 10 March 2020.

It is also worth noting that DO levels at SW4 had been outside of the SSTV range several times prior to discharging commencing (in February 2020) for the 2019/20 wet season. DO levels outside of the SSTV at SW4 recorded in months when discharge was not occurring, include:

- 23/12/2019 50%
- 31/12/2019 74%
- 28/01/2020 57%

No environmental impact resulting from the discharge activity is deemed likely and DO levels recorded on 26 February 2020 at SW4 were 88%.

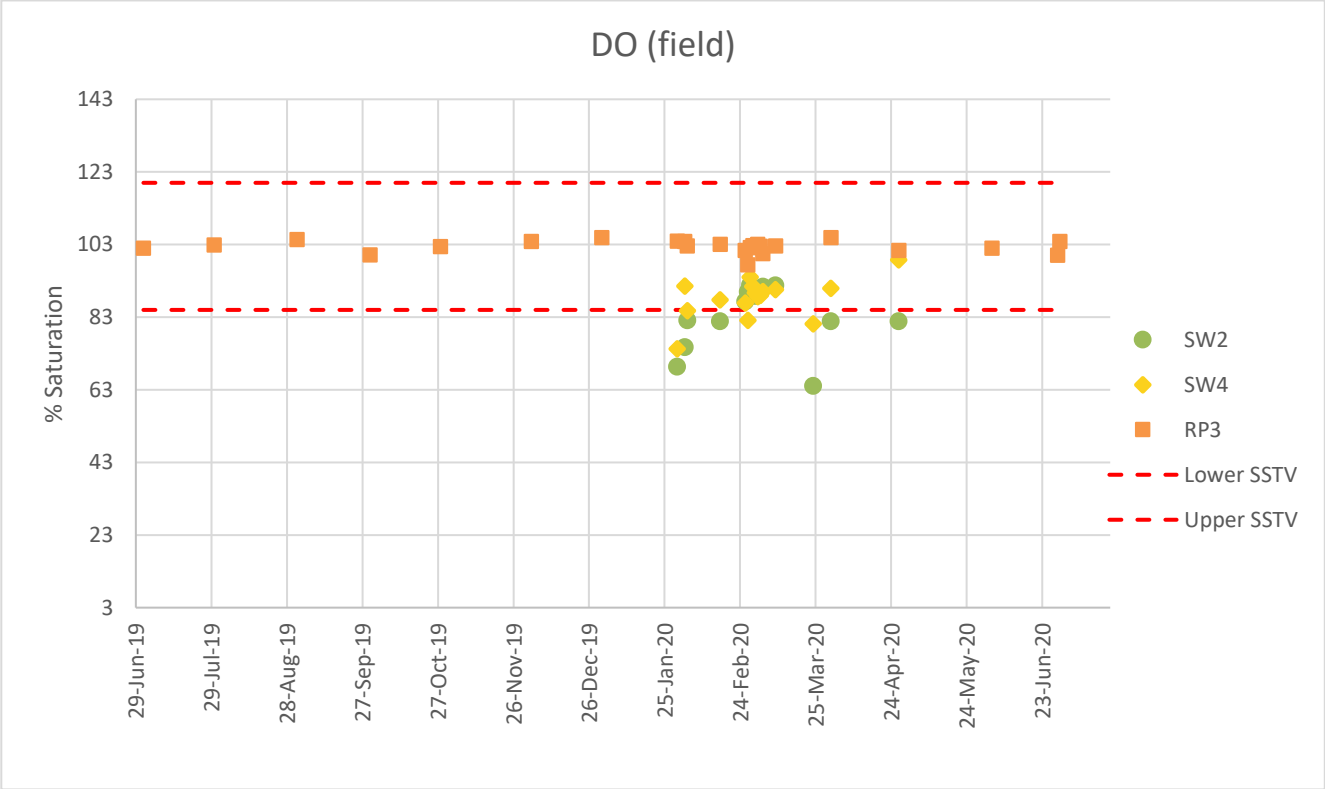


Figure 10 Dissolved oxygen Edith River upstream (SW2 and SW4)

3.3.5 Iron

The SSTV for iron (filtered) (350 µg/L) was exceeded on six occasions during the 2019/20 reporting period. Of these six records, two were recorded whilst discharge was occurring (on 16 February 2020 was 602 µg/L and on 26 February 2020 was 420 µg/L). It is clear that both exceedances are related to elevated iron levels in background water (SW2). Water samples taken in February 2020 at SW2 show elevated iron levels in upstream, background water.

Iron levels recorded at SW2 include:

- 16/02/2020 644 µg/L
- 26/02/2020 532 µg/L

Iron levels recorded at RP3 include:

- 16/02/2020 <10 µg/L
- 26/02/2020 <10 µg/L

This demonstrates that the background water level is exceeding the SSTV and that the Mt Todd discharge is likely reducing the concentration of iron in the river rather than adding to it.

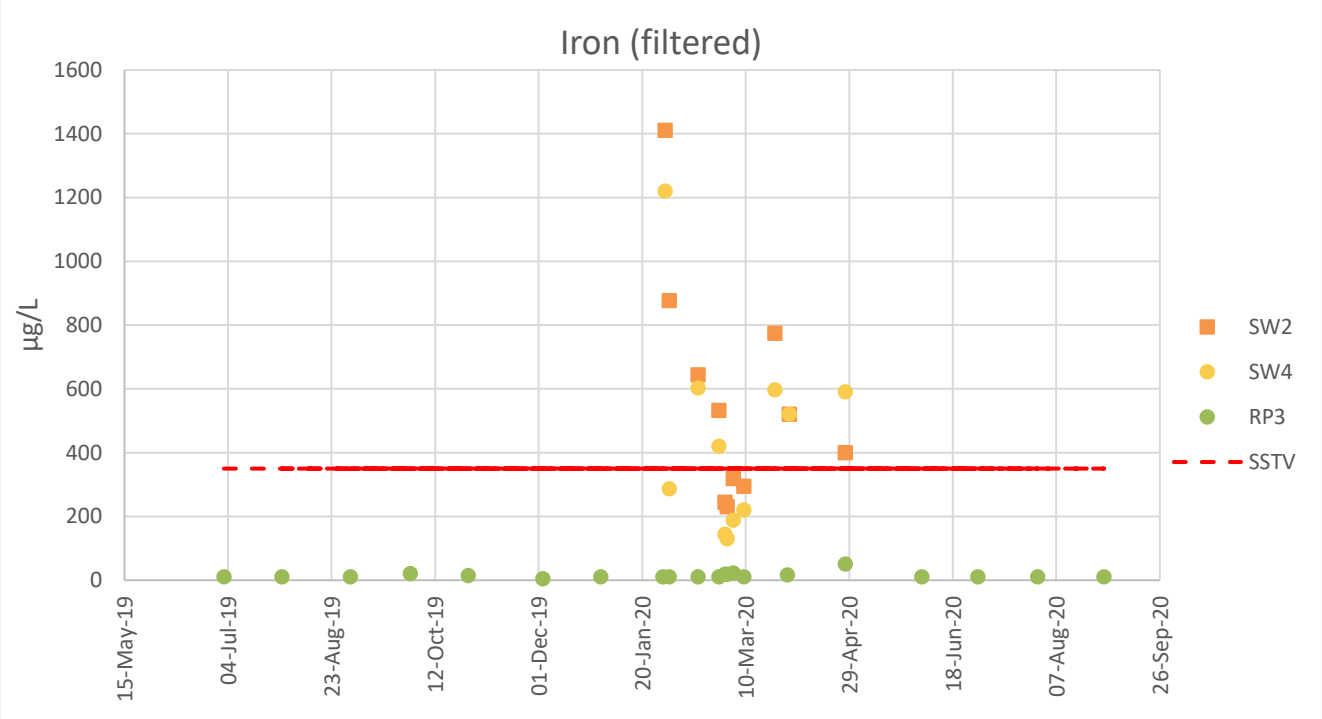


Figure 11 Iron Edith River upstream (SW2 and SW4 and Batman Pit)

3.3.6 Zinc

The SSTV for zinc (filtered) (31 µg/L) was exceeded on three occasions during the 2019/20 reporting period. On 29 February 2020 zinc was recorded at 52.8 µg/L, on 1 March 2020 it was 53 µg/L and on 4 March 2020 it was 49 µg/L. Pumping ceased on 5 March 2020 and therefore water with marginally elevated levels of zinc ceased to be released.

The lag between collecting a water sample and receiving water quality results relating to metals, means that immediate on site management actions are not possible. The Vista Gold team review water quality results when received and adjust discharge dilution ratios as required. On 9 March 2020 zinc levels had returned to 12.1 µg/L which is below the SSTV. Based on the fact that the exceedances of the SSTV at SW4 were for a relatively short period of time during the end of February and early March 2020, it is unlikely that there was a significant environmental impact as a result. This is supported by the macroinvertebrate, sediment and ecotoxicology data, which indicates that discharge of water from Batman Pit at current dilution ratios is not having a measurable impact on aquatic ecosystem health downstream of the mine site.

The low pH upstream at SW2 is likely to have contributed to the elevated zinc concentrations observed.

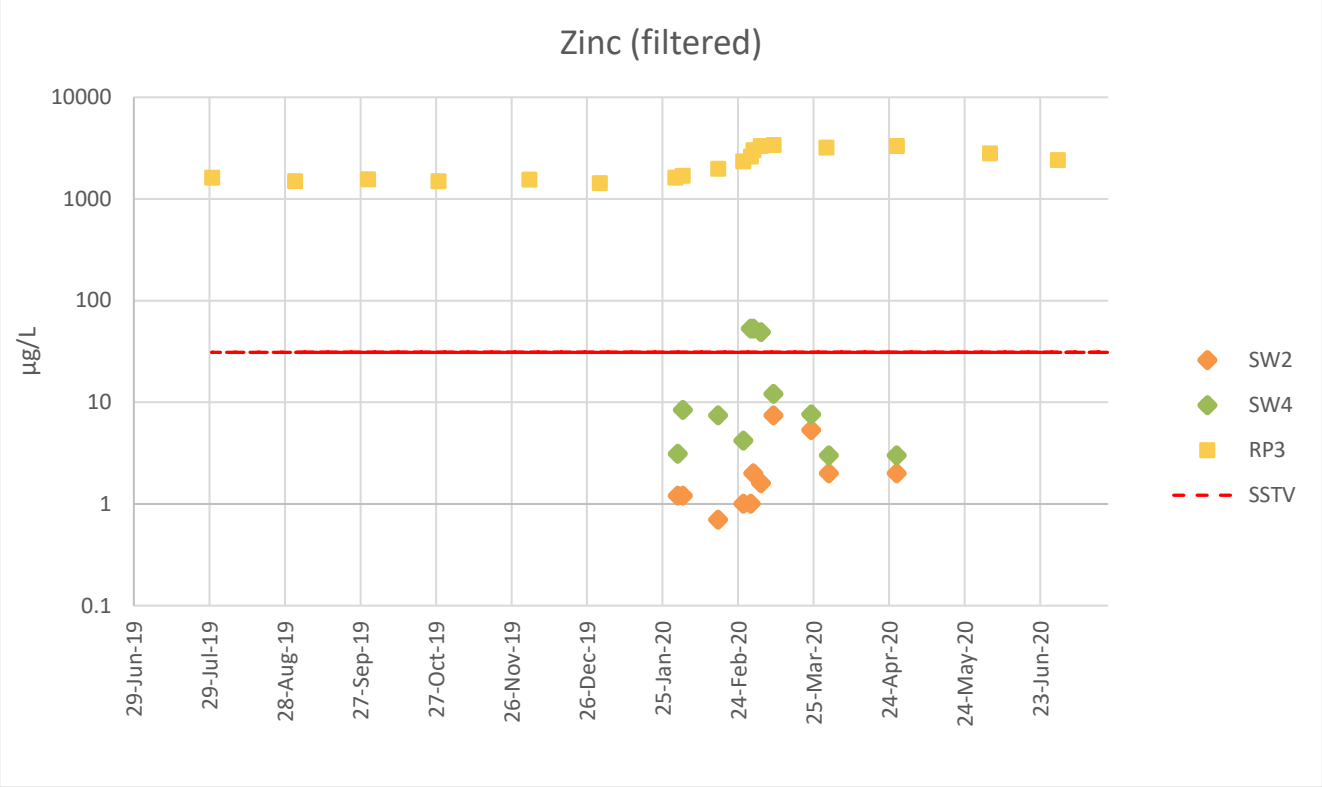


Figure 12 Zinc Edith River upstream (SW2 and SW4 and Batman Pit)

3.4 Batman Pit discharge water quality results

Table 9 provides the summary of all water quality data collected from Batman Pit for the 2019/20 wet season. Again, the ANZG (2018) stock watering guidelines are provided as a water quality comparison and are not a guideline value that the water quality is required to meet.

Table 9 Batman Pit water quality 2019/20

Analyte	SWG	Count	Minimum	Median	Maximum
Field Data					
pH	6.0-8.0	25	4.76	6.54	7.26
EC µS/cm	2,000	25	2,963	3,055	3,223
DO %sat	-	25	97	103	105
Major Ions mg/L					
Bicarbonate	-	18	1	5	20
Calcium	-	21	390	432	461
Carbonate	-	17	1	5	22
Chloride	-	20	2	8	27
Sodium	-	21	44	55	63
Magnesium	-	21	210	229	240
Potassium	-	21	8.4	8.9	9.6

Analyte	SWG	Count	Minimum	Median	Maximum
Sulphate	1000	21	1,900	2,010	2,120
Total Dissolved Solids	-	19	30	2,980	3,600
Metals (0.45 µm filtered) µg/L					
Aluminium	5,000	20	10	32.5	480
Cadmium	0.8	21	20	22	29
Chromium	-	21	0.1	0.5	1
Cobalt	13	21	7.4	26	78
Copper	2.5	20	1.22	14	190
Iron	350	21	4	10	50
Lead	9.4	21	0.05	0.23	1
Manganese	3,600	20	113	415	950
Nickel	17	21	132	152	190
Zinc	31	20	1,430	1,840	3,370
Metals total µg/L					
Aluminium	-	18	31	107	510
Cadmium	-	19	21	23	33
Copper	-	18	2.9	26	200
Iron	-	19	36	154	586
Nutrients µg/L					
Total Nitrogen	-	7	159	202	316
Total Phosphorus	-	0	-	-	-
Other water quality parameters mg/L					
Hardness ($CaCO_3$)	-	21	1,900	2,000	2,130
Total Suspended Solids	-	19	5	10	50
Cyanide (total)	0.007	16	0.004	0.004	0.02

The EC is higher in Batman Pit than the Edith River, however, the EC at SW4 was still below the SSTV on all but one occasion.

Sulfate is also elevated in Batman Pit, however, the dilution of the treated pit water is sufficient to enable the SSTV to be met at SW4 which recorded a median concentration of sulfate of 18 mg/L recorded at SW4 during 2019/20.

Generally, the metal concentrations within the pit are fairly stable. The median concentration of zinc (filtered) within the pit has increased over recent years, however the median concentration decreased from 1,950 µg/L in 2018/19 to 1,840 µg/L in 2019/20 (see trends analysis provided in **Appendix C**). The concentrations of metals are managed to ensure that the SSTVs are generally met at SW4.

The pH in Batman Pit is generally higher than that recorded at SW2, however, the differences in pH between SW2 and SW4 are smaller. The median pH has decreased in Batman Pit since 2014/15 (**Figure 13**), however the median pH for 2018/19 was higher than that recorded in 2016/17, 2017/18 and 2019/20.

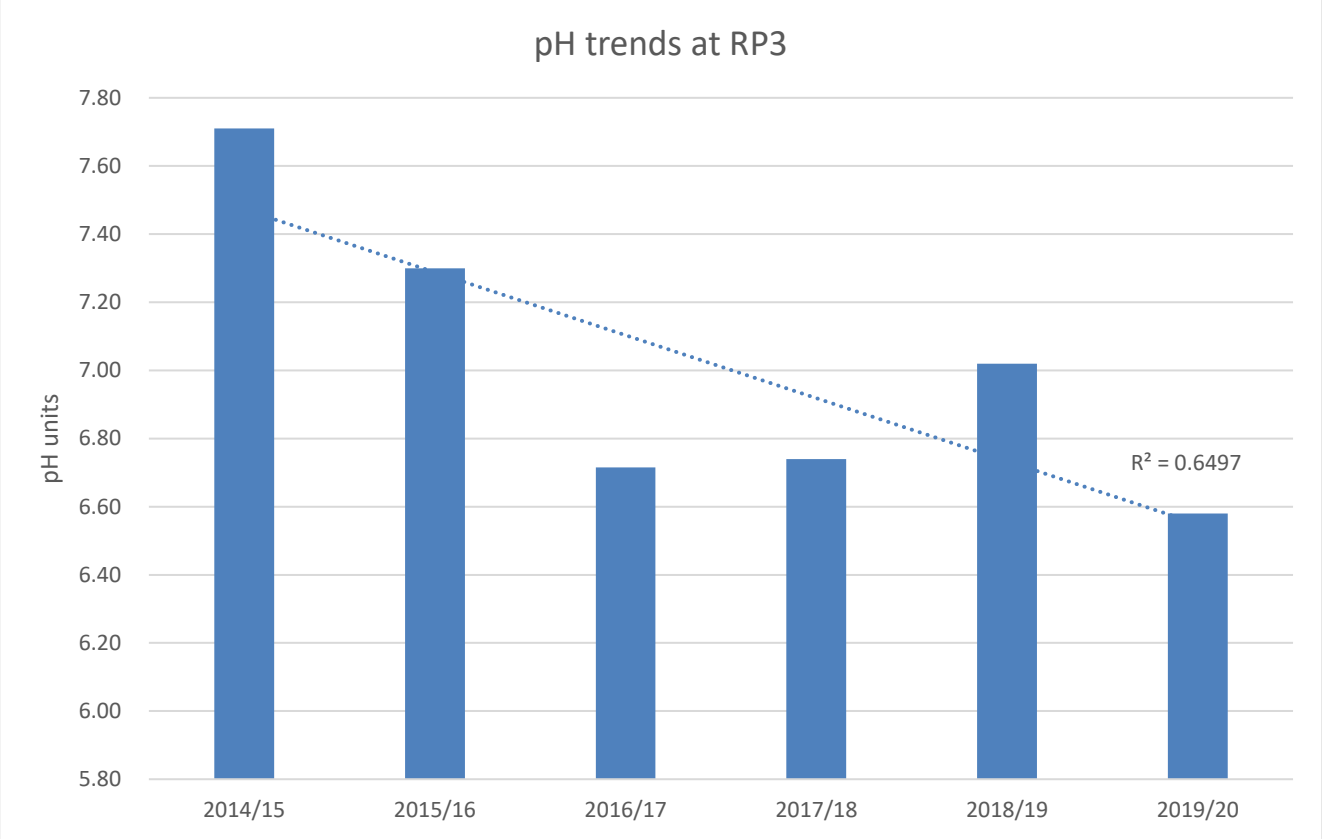


Figure 13 Median pH concentrations in Batman Pit

3.5 SW2 surface water quality results

Site SW2 provides the background water quality for Edith River for comparison with the downstream sites SW4 and SW10. It is located upstream from the MTPA compliance point at SW4. Water quality data collected from SW2 is utilised to develop SSTVs and to determine the contribution of the surrounding environment prior to discharge inputs from MTPA at SW4. A summary of the water quality at SW2 for the 2019/20 wet season is provided in **Table 10**. The SSTVs have been provided in **Table 10** for comparative purposes only and are not applied to site SW2.

The majority of results for metals have concentrations above the analysis limits of detection and suggest that the mineralisation in the surrounding environment has some contribution to the overall water quality in the receiving environment.

As SW2 is the background water quality site, the SSTVs in **Table 10** are provided for comparative purposes only. Comparing the SSTVs that are applied to the compliance site SW4 is important in understanding the contribution that upstream water quality may be having on compliance at SW4. For example, iron is elevated in the background water quality and may have some contribution to downstream water quality in conjunction with the discharge of treated mine water from Batman Pit as the volumes of water contributed from SW2 to SW4 are much greater than that of the discharge.

Table 10 SW2 water quality summary 2019/20

Analyte	SSTV	Count	Minimum	Median	Maximum
Field Data					
pH	6.0-8.0	18	5.7	6.1	6.2
EC µS/cm	250	18	18	22	46
DO %sat	85-120	18	64	87	92
Major Ions mg/L					
Bicarbonate	319	6	1	5.5	9
Calcium	-	6	0.7	0.9	1.3
Carbonate	-	6	1	1	8
Chloride mg/L	64	7	0.01	2	4
Sodium	-	6	0.9	1.8	2.1
Magnesium mg/L	21	6	0.6	0.7	1
Potassium	-	6	0.5	1	1.7
Sulphate	129	6	0.1	0.25	0.3
Total Dissolved Solids	-	6	20	25	80
Metals (0.45 µm filtered) µg/L					
Aluminium	150	11	10	53	97
Cadmium	0.8	11	0.01	0.02	0.1
Chromium	-	11	0.1	0.4	1
Cobalt	13	11	0.05	0.3	1
Copper	2.5	11	0.42	0.72	1.0
Iron	350	11	230	520	1,410
Lead	9.4	11	0.01	0.05	1
Manganese	3,600	11	8.1	21	47
Nickel	17	11	0.28	0.46	1
Zinc	31	11	0.7	1.6	7.4
Metals total µg/L					
Aluminium	-	11	30	1,300	3,300
Cadmium	-	11	0.02	0.02	0.1
Copper	-	11	0.53	1.04	3.17
Iron	-	11	840	2,600	4,440
Nutrients µg/L					
Total Nitrogen	-	0	-	-	-
Total Phosphorus	-	0	-	-	-

Analyte	SSTV	Count	Minimum	Median	Maximum
Other water quality parameters mg/L					
Hardness ($CaCO_3$)	-	6	4.3	5	7.1
Total Suspended Solids	-	8	6	10	150
Cyanide (total)	0.007	6	0.004	0.005	0.005

3.5.1 Site specific trigger values

As indicated by the data in **Table 10**, the SSTVs listed in WDL 180-07 are appropriate for use at SW4.

3.6 SW3 surface water quality results

Monitoring location SW3 is the downstream site located in Stow Creek which receives the treated water discharged from Batman Pit before the water enters the Edith River. SW3 also receives inputs from tributaries including the background monitoring site SW13.

A summary of the 2019-20 water quality at SW3 is provided in **Table 11**. Comparisons against the median water quality values for Batman Pit and SW13 have also been provided. The SSTVs have been provided in **Table 11** for comparative purposes only and are not applied to site SW3.

Table 11 SW3 water quality 2019/20

Analyte	SSTV	Count	Minimum	Median	Maximum	Batman Pit Median	SW13 Median
Field Data							
pH	6.0-8.0	12	5.96	6.21	6.48	6.54	6.45
EC µS/cm	250	12	38	145	565	3,055	16
DO %sat	85-120	12	34	84	97	103	102
Major Ions mg/L							
Bicarbonate	319	4	4	5	12	5	5
Calcium	-	4	7	26	54	432	0.5
Carbonate	-	1	5	5	5	5	5
Chloride	64	4	2	2	3	8	2
Sodium	-	4	8.1	10	12.9	54.8	1.2
Magnesium	21	4	7.8	19	32	229	0.5
Potassium	-	4	2.3	2.8	3.5	8.9	0.6
Sulphate	129	4	52.3	145	276	2,010	0.3
Total Dissolved Solids	-	3	10	130	320	2,980	25
Metals (0.45 µm filtered) µg/L							
Aluminium	150	4	6.4	9.1	10	33	30

Analyte	SSTV	Count	Minimum	Median	Maximum	Batman Pit Median	SW13 Median
Cadmium	0.8	4	0.02	1.3	3.0	23	0.02
Chromium	-	4	0.1	0.1	1	0.5	0.2
Cobalt	13	4	0.81	3.3	7.2	26	0.16
Copper	2.5	4	0.82	3.9	7.7	14	0.52
Iron	350	4	16	67	78	10	134
Lead	9.4	4	0.03	0.04	1	0.23	0.3
Manganese	3,600	4	58	144	260	415	16
Nickel	17	4	0.61	8.8	20	152	0.53
Zinc	31	4	1.7	142	345	1,840	0.6
Metals total µg/L							
Aluminium	-	3	30	682	922	107	781
Cadmium	-	3	0.04	0.1	3.1	23	0.02
Copper	-	3	1	1.65	14.4	26	0.79
Iron	-	3	320	968	1,490	154	1,070
Nutrients µg/L							
Total Nitrogen	-	3	0.2	0.43	0.53	202	0.21
Total Phosphorus	-	2	0.01	0.13	0.25	-	0.02
Other water quality parameters mg/L							
Hardness ($CaCO_3$)	-	4	49	142	267	2,000	3
Total Suspended Solids	-	3	10	10	20	10	10
Cyanide (total)	0.007	3	0.004	0.005	0.005	0.005	0.005

The median zinc and copper results, as shown in **Table 11,** show that Stow Creek is supplying sufficient dilution so that the SSTVs will be met at SW4 on most occasions. The biological monitoring results confirm that the discharge of treated mine water through this site on Stow Creek is not adversely impacting on macroinvertebrate populations (see **Section 5**).

3.7 SW10 surface water quality results

SW10 is the downstream site in the Edith River to detect water quality in the receiving environment. This site is not required to be monitored under the current licence (WDL 178-07) unless the water quality has been determined to be deteriorating at SW4.

3.8 Trend analysis

Water quality data from January 2015 to June 2020 for surface water monitoring sites has been assessed to determine the trend of the analyte concentration over time. Trend analysis has been undertaken on selected analytes of potential concern based on water quality results from the 2019/20 reporting period and historical data. Trend analysis results are included in **Appendix C**.

3.9 Conclusions

The 2019/20 water quality data shows that the water quality in the Edith River is not being adversely impacted by the discharge of treated water from the MTPA. The water quality at SW4 is influenced by the upstream water quality as indicated by the iron exceedances at related to the high iron at SW2.

MTPA staff have good knowledge of WDL requirements and management procedures in the event of an exceedance, and aim to receive laboratory water quality data as soon as possible after monitoring. However, a delay of up to 10 days can occur between sampling and receipt of laboratory results, which makes it difficult for staff to respond to exceedances after the fact. In both instances when laboratory results indicated that zinc concentrations exceeded the SSTV at SW4, discharging had already ceased, however future dilution ratios were adjusted accordingly.

Discharge from Batman Pit has been successfully managed to ensure that the SSTVs are generally met at SW4 during discharge.

3.10 Recommendations

- A reduction in Batman Pit pH may change the bioavailability of metals. Median zinc concentrations are elevated when compared to the 2017/18 and 2019/20 results. Additional management of the Batman Pit water may be required metal concentrations become problematic at SW4 in the future or are shown to be increasing at the Batman Pit discharge.
- Condition 49.1 should be reverted back to *"… three consecutive sampling occasions."*

4 Proposed site specific trigger values for WDL 178-08

The derivation of site specific trigger values (SSTVs) for Vista Gold's MTPA for WDL 178-08 aligns with ANZG (2018). These guidelines form part of Australia's National Water Quality Management Strategy.

Trigger values are an early warning mechanism to provide insight into potential adverse water quality changes, they are not intended to be an instrument to assess 'compliance' and should not be used in this capacity (Appendix 7: ANZECC 2000). Trigger values are designed for environmental protection and are to be met at the edge of the mixing zone. The SSTVs calculated in this document are to be applied to the Edith River downstream monitoring point SW4.

Site specific trigger values (SSTVs) have been selected using the 80th percentile of background water quality for those analytes above the ANZG (2018) default guideline values. SSTVs derived from upstream water quality are designed to be compared to the median values of downstream water quality data, as stated in ANZG (2018):

"A trigger for further investigation will be deemed to have occurred when the median concentration of n independent samples taken at a test site exceeds the eightieth percentile of the same indicator at a suitably chosen reference site."

4.1 Sites used for SSTV calculation

The Edith River receives active discharge of treated mine water from Batman Pit. The reference site chosen to derive the SSTVs for Edith River is SW2 located upstream of SW4 as shown in **Figure 4** and **Table 5**.

4.2 Data provided by Vista Gold

Vista Gold has provided water quality data for SW2 obtained from the Surface Water Monitoring Program and as presented in **Appendix B**. The data from the site shown in this document are representative of the background water quality of the Edith River during the period 2015 - 20. Upstream conditions in the river system have been used to establish baseline water quality and current environmental conditions.

4.3 Aquatic ecosystem trigger values

4.3.1 Derivation of SSTV

The SSTVs in this report have been derived on the basis of the ANZG (2018) procedure. The process is to calculate a series of different percentiles for different parameters as follows:

- For physicochemical parameters – 20th and/or 80th percentile;
- For nutrients and non-toxic compounds – 80th percentile;
- For metals – 80th percentile.

Then compare the:

- ANZG (2018) default trigger values for freshwater ecosystems and toxicants in freshwaters;
- Reliable background level (80th percentile) of parameters at the chosen reference sites.

4.3.2 Data requirements – chemicals and seasonal variation

A good understanding of the ambient water quality and its seasonal variations is a critical part of any environmental assessment study. The background data collected has included each chemical that may be present in pit and dam waters and that may enter the environment. This is of particular importance when natural background concentrations of these chemicals are high, as may be the case in mineralised mining environments. In this case the water quality data includes all the analytes listed in Appendix 1 Surface Water Monitoring Program of WDL178-07.

ANZECC (2000) default trigger values

For ecosystems that can be classified as highly disturbed, the 95 percent species protection trigger values may still apply. However, for the MTPA it is appropriate to apply the 80 percent protection level due to the legacy of historical mining and current water quality in the area.

4.3.3 Data availability

All available data collected to date has been considered in the determination of ambient conditions and the assessment of trigger values. The 20th percentiles and 80th percentiles have been calculated for use in the derivation of SSTVs.

4.3.4 Data below limit of reporting

When the analytical result is below the LOR for a particular chemical species, then a value of half the detection limit has been included in the calculation. This is one of the recommended approaches of the Water Quality Monitoring and Reporting Guidelines (ANZECC (2000), Section 6.2.1). It is also understood that this approach has limitations, in particular, when over 25 percent of the data is below the LOR. Where greater than 25 percent of values in a background dataset are below the LOR, the ANZECC (2000) default trigger value has been selected as the SSTV.

4.3.5 Hardness modified trigger values

The ANZECC (2000) guidelines require the trigger values for several metals to be corrected for hardness to account for the hardness of the local water. The metals which fall into this category are cadmium, chromium (iii), lead, nickel and zinc. The SSTV may be modified for hardness using the hardness recorded on the day of the sampling.

4.4 Results and discussion

4.4.1 Gap analysis

A gap analysis has been performed on the data provided by Vista Gold for SW2. The amount of water quality data provided by Vista Gold is shown in **Table 12** to provide a minimum of 24 months of data as stipulated in ANZG (2018). SSTVs are based on data from the Edith River upstream monitoring site SW2. The number of samples has been increased from the number recommended by ANZG (2018) due to the variable conditions and water quality (from monsoon and cyclone events) in the Edith River.

Table 12 Water quality data

Sites	Number of Samples (physic-chem)	Number of samples (Metals)	Dates
SW2	199-255	246-261	2015 - 2020

4.4.2 WDL 178-08 site specific trigger values

From the data shown in **Table 13** , all analytes have sufficient data points to generate SSTVs. The data in Table 13 shows the upstream Edith River water quality at SW2. The analytes presented in **Table 13** are those that have trigger values listed in WDL 178-07.

Table 13 Edith River SW2 statistical summary (Jan 2015 – Apr 2020)

Analyte	No.	Min	Median	Max	20th Percentile	80th Percentile
pH	254	4.4	6.2	7.2	**5.9**	6.4
EC µS/cm	254	8.7	17	158	15	20
DO%	254	64	92	102	89	96
Chloride mg/L	199	<1	1	4	<1	2
Sulfate mg/L	199	<1	1	19	<1	2
Magnesium mg/L	255	<0.5	0.6	1	0.5	0.7
Bicarbonate mg/L	254	<0.5	8	17	4	11
Dissolved metals						
Aluminium µg/L	258	5	30	160	17	55
Arsenic (dissolved) µg/L	246	<1	<1	<1	<1	<1
Cadmium µg/L	258	<0.002	<1	<1	<1	<1
Chromium µg/L	258	<1	<1	<1	<1	<1
Cobalt µg/L	258	<1	<1	<1	<1	<1
Copper µg/L	258	<1	<1	1.04	<1	<1
Iron µg/L	261	130	200	1,410	160	276
Lead µg/L	258	<1	<1	<1	<1	<1
Manganese µg/L	257	<0.5	0.6	68	<5	8
Nickel µg/L	258	<0.5	<1	11.7	<1	<1
Zinc µg/L	256	<0.1	1	8	<1	2
Cyanide µg/L	246	<5	<5	<5	<5	<5

4.5 Conclusions

SW2 consistently records low pH values and these influence the pH at SW4 and can increase the bioavailability of metals at the compliance site. Ph is the only parameter that was outside the ANZG (2018) guidelines and the 20th percentile will be used as a SSTV to be applied at SW4.

The 80th percentile of metals did not exceed the ANZG default guidelines, therefore there is no requirement for SSTVs to be applied for dissolved metals.

4.6 Recommendations

Based on the results shown in **Table 13** , the following SSTVs are recommended for the MTPA as shown in **Table 14**.

Table 14 Recommended SSTVs for SW4 in WDL 178-08

Parameter	SW4
pH Range	5.9 – 8.0

5 Biological Monitoring

5.1 Monitoring program 2019

5.1.1 Study design

The primary aim of the Biological Monitoring Program (BMP) is to detect any impacts on the aquatic environment in the Edith River from mine water released from discharge point at Batman Pit, in accordance with the discharge licence.

SLR conducted the 2020 BMP following the approach taken in the previous BMP surveys and following the REMP (GHD 2018) (**Appendix D**) and recent advice from the NT EPA to Vista Gold regarding the addition of a monitoring site on Stow Creek upstream of the proposed TFS2. The study design for the compares the aquatic environments between the sites upstream and downstream of the discharge location.

As a secondary objective of the study, sites were assessed on Stow Creek which receives the treated mine water through Horseshoe Creek. Sites have been located upstream and downstream of the confluence of Horseshoe Creek and Stow Creek to provide an indication of any potential impacts that the discharge may be having on the receiving environment.

Macroinvertebrate abundance, taxa richness, Plecoptera Ephemeroptera and Trichoptera (PET) taxa richness, Signal-2 scores were calculated and are presented graphically in **Section 5.3.2**. Signal-2 grades for macroinvertebrate taxa were provided by Chessman (2003).

5.1.2 Survey timing

Field work was conducted by SLR environmental scientists from 28 to 30 April 2020. Timing of fieldwork was subject to local rainfall and stream flow conditions and occurred more than four weeks after rapid stream flows had ceased, to allow a representative macroinvertebrate community to establish.

5.1.3 Survey sites

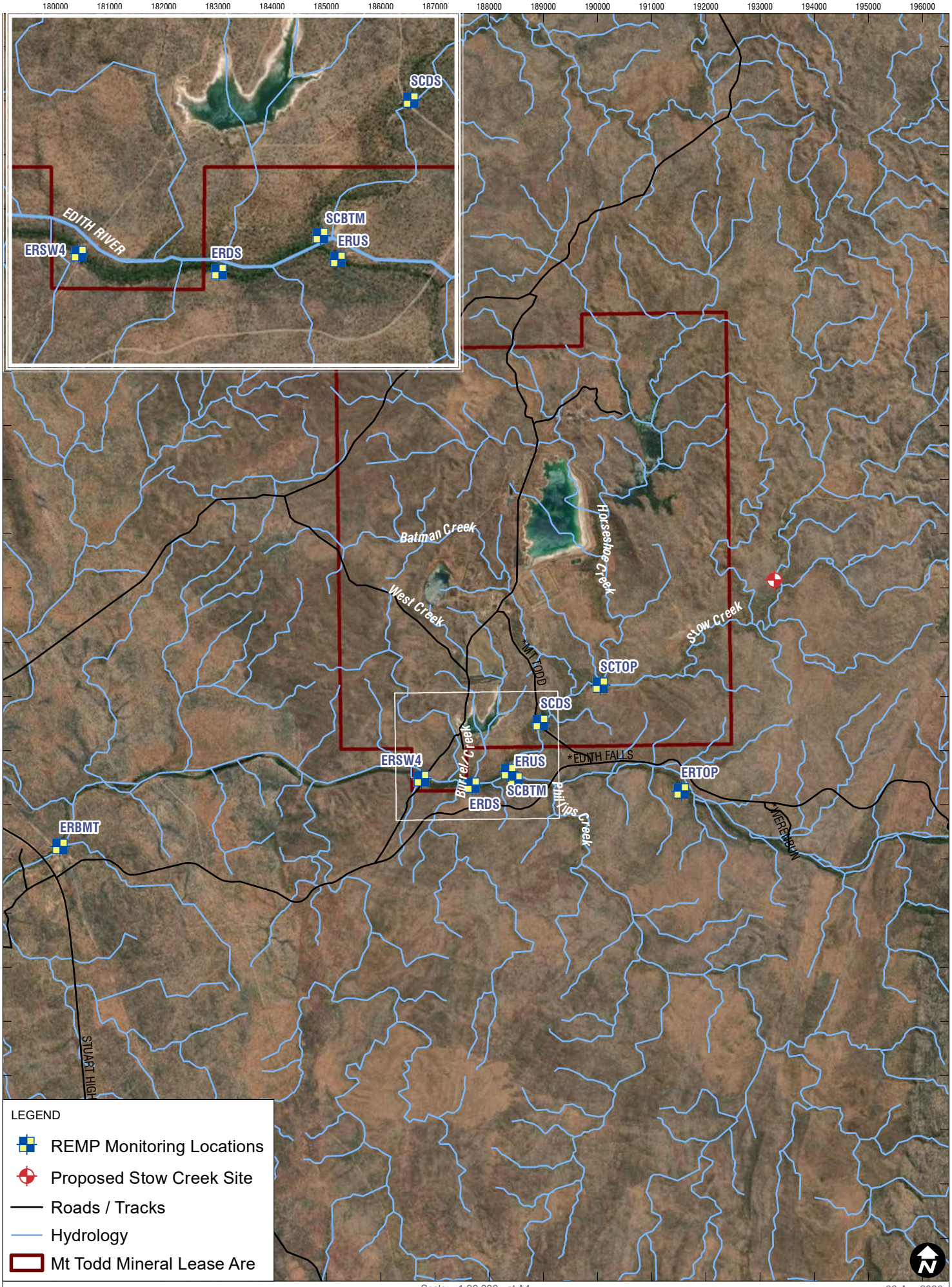
Sites for water, sediment, and macroinvertebrate sampling were chosen to provide an assessment of the state of the aquatic environment in the footprint of the mineral lease and adjacent waterways. Sites were positioned to efficiently quantify existing conditions and allow for detection of impacts from potential pollutant sources. Sites nominated for sampling included historic monitoring locations used by Vista Gold since 2008, as well as a new reference site on Stow Creek (SCUS) upstream of the proposed new tailings storage facility (TFS2), and are detailed in **Table 15** and in the REMP. The REMP provides additional details of the survey sites and methods used in the biological monitoring program.

There was no direct discharge from Batman Pit into the Edith River at the time of the survey, nor during the immediate period leading up to the survey. Discharge to Batman Creek and ultimately the Edith River ceased in March 2020.

All survey sites were accessible and had conditions which allowed sampling at the time of the survey. The locations of sampling sites are provided in **Table 15** and shown on **Figure 14**.

Table 15 Monitoring sites for the 2020 macroinvertebrate survey

Site	Latitude	Longitude	Description
Reference sites			
SCUS	-14.14703	132.15608	A new (first time sampled) site on Stow Creek. Located upstream of planned tailings dam (TFS2) and confluence with tributary of Stow Creek that may be impacted by future tailings dam construction.
SCTOP	-14.15521	132.12897	Stow Creek site located upstream of confluence with Wheelbarrow Creek.
ERTOP	-14.17297	132.14259	Edith River site located 3 km east of confluence with the receiving waters of Stow Creek.
ERUS	-14.17081	132.11420	Edith River site located immediately upstream of confluence with the receiving waters of Stow Creek.
Receiving sites			
SCDS	-14.16126	132.11871	Stow Creek downstream of the confluence with Batman Creek (where treated mine water is released).
SCBTM	-14.16939	132.11315	Stow Creek immediately upstream of confluence with Edith River
ERDS	-14.17155	132.10687	Edith River approximately 700 m downstream of the confluence with receiving waters from Stow Creek
ERSW4	-14.17046	132.09823	Edith River approximately 1.6 km downstream of the confluence with receiving waters from Stow Creek
ERBTM	-14.18093	132.03636	Edith River approximately 9 km downstream of the confluence with receiving waters from Stow Creek, located upstream of a rail track and the Stuart Highway.


SCDS
EDITH RIVER
SCBTM
ERUS
ERSW4
ERDS
Batman Creek
West Creek
Horseshoe Creek
Slow Creek
*MT TODD
SCTOP
SCDS
ERSW4
ERUS
SCBTM
ERDS
Bull Cr Creek
*EDITH FALLS
ERTOP
Phillips Creek
ERBMT
STUART HIGH
LEGEND
REMP Monitoring Locations
Proposed Stow Creek Site
Roads / Tracks
Hydrology
Mt Todd Mineral Lease Are
0
1
2
km
Scale: 1:90,000 at A4
GDA 1994 MGA Zone 53
08-Apr-2020
680.10533
Data Source:
Sheet Size : A4
SLR
www.slrconsulting.com
BMP and SMP
Monitoring Sites
FIGURE 14
H:\Projects-SLR\610-SrvSYD\680-DRW\680.10533 Vista Gold GFMP\SLR680.10533 Proposed Stow Creek site.mxd

5.1.4 Sampling methods

Aquatic macroinvertebrate samples were collected at each site in accordance with the Northern Territory Ausrivas Sampling and Processing Manual (Lloyd and Cook 2002). Three replicate macroinvertebrate samples were collected from the stream edge using a dip net and bank agitation tool.

Macroinvertebrate abundance, taxa richness, PET taxa richness, Signal-2 scores were calculated and are presented graphically in **Section 5.3.2**. Signal-2 grades for macroinvertebrate taxa were provided by Chessman (2003).

5.1.5 Laboratory processing

Samples were preserved in alcohol and transported to the SLR laboratory for identification. The samples were identified to appropriate taxonomic level and statistical analysis of the aquatic macroinvertebrate results were used to identify spatial similarities in aquatic macroinvertebrate assemblages in the Mt Todd surface waters.

5.1.6 Data analysis

Statistical analysis was undertaken to identify site variation in the macroinvertebrate assemblages at monitoring sites. The statistical package PRIMER-e (Plymouth Routines in Mulitvariate Ecological Research V7) (Clarke and Gorley 2014) was used for multivariate analysis on the macroinvertebrate data. The macroinvertebrate communities were presented using non-metric multidimensional scaling (MDS) ordination, to display similarities and differences between sites. Cluster analysis was performed and the statistical significance of clusters was tested using SIMPER and SIMPROF at significance level of 0.05. Analyses were performed on the combined results of all three sweeps per site. Rare taxa (taxa represented by a single specimen across the survey) were excluded from multivariate analyses. Fourth-root transformation was applied to normalise data, as it is suitable where a few abundant taxa dominate the macroinvertebrate communities. Similarity matrices were determined by applying the Bray-Curtis method of similarity.

5.2 Quality assurance / quality control

Quality assurance of macroinvertebrate identifications was undertaken by control identification on a random subsample of macroinvertebrate samples. Samples were observed to be affected by a degree of decomposition caused by inadequate preservative. Ethanol was in short supply at the time of preparation for the survey due to stocks nearly entirely sold out to individuals buying disinfection supplies for Covid-19. The resulting decomposition did not prevent identifications however may have contributed to some disagreement for abundance counts of soft bodied specimens. Quality control checks identified some misidentifications, including the presence of Hemicordulidae identified as Cordulidae, and Noteridae identified as Dytiscidae. The outcome of quality control checks were applied to subsequent identifications. SLR has confidence in the result provided herein.

5.3 Biological monitoring results

5.3.1 Site conditions

Site descriptions and photographs recorded during the monitoring at the MTPA are provided in **Table 16**. Water levels were sufficient for sampling at all sites at the time of the survey. Controlled release of treated mine water had occurred during the wet season, however releases ceased prior to sampling due to low water levels in the Edith River.

Table 16 Description of monitoring sites

Site description	Photograph
SCUS Stow Creek Reference site Site SCUS is a new reference site located approximately 3 km upstream of a confluence with Horseshoe Creek (a potential receiving waterway). The site was a non-flowing rocky pool at the time of sampling. There was no overhanging vegetation. The water was tea coloured. 1 km of the reach upstream from the sampling site was inspected to ensure that there was no upstream overflow confluence with a tributary of Stow Creek that may be impacted by the tailings dam. No confluence was found, therefore site SCUS is considered to be upstream of potential impacts for the planned tailings dam.	
SCTOP Stow Creek Reference site Site SCTOP is located immediately upstream of a confluence with Horseshoe Creek (a potential receiving waterway). The site was a non-flowing sandy pool at the time of sampling. Some overhanging and trailing vegetation was present, and the water was clear.	
SCDS Stow Creek Receiving site Site SCDS is located downstream of a confluence with Batman Creek (the stream where the controlled release point for Mt Todd is located), Horseshoe Creek (a potential receiving waterway), and immediately upstream of the primary access road to Mt Todd Mine. The site was a sandy pool at the time of sampling with no flow. No overhanging vegetation was present, and the water appeared turbid.	
SCBTM Stow Creek Receiving site Site SCBTM is located at the most downstream point on Stow Creek and receives controlled release water via Batman Creek. The site was a non-flowing sandy pool. There was no overhanging or aquatic vegetation present and the water was tea coloured.	

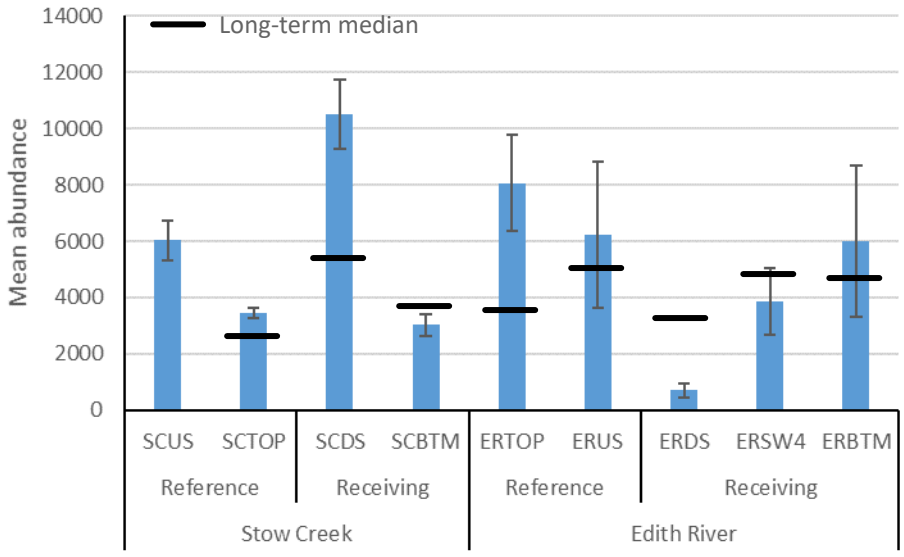
Site description	Photograph
ERTOP Edith River Reference site Site ERTOP is located approximately 3 km upstream of the confluence with Stow Creek. The site was predominately a sandy pool with moderately flowing running sections. There was overhanging vegetation present and some trailing vegetation. The water was clear.	
ERUS Edith River Reference site Site ERUS is located 150 m upstream of the confluence with Stow Creek. The site was a combination of running sections, sandy pool and aquatic plant dominated sections. The water was flowing, and a moderate amount of overhanging and trailing vegetation was present. The water was stained tea coloured.	
ERDS Edith River Receiving site Site ERDS is located 700m downstream of the confluence with Stow Creek. The site was a large, deep, sandy bottomed pool with no visible flow at the time of sampling. The water was turbid and orange coloured. Overhanging and trailing vegetation was present. Sampling was complicated by the bank height, water depth and crocodile attack risk.	
ERSW4 Edith River Receiving site Site ERSW4 is located approximately 1.7km downstream of the confluence with Stow Creek. The site was a large rocky pool with low flow at the time of sampling. There was some overhanging vegetation. The water was tea coloured.	

Site description	Photograph
ERBTM Edith River Receiving site Site ERBTM is located approximately 8 km downstream of the confluence with Stow Creek. The site was a rocky pool with slow flowing water at the time of sampling. Some overhanging vegetation was present, and the water was clear.	

5.3.2 Aquatic Macroinvertebrates

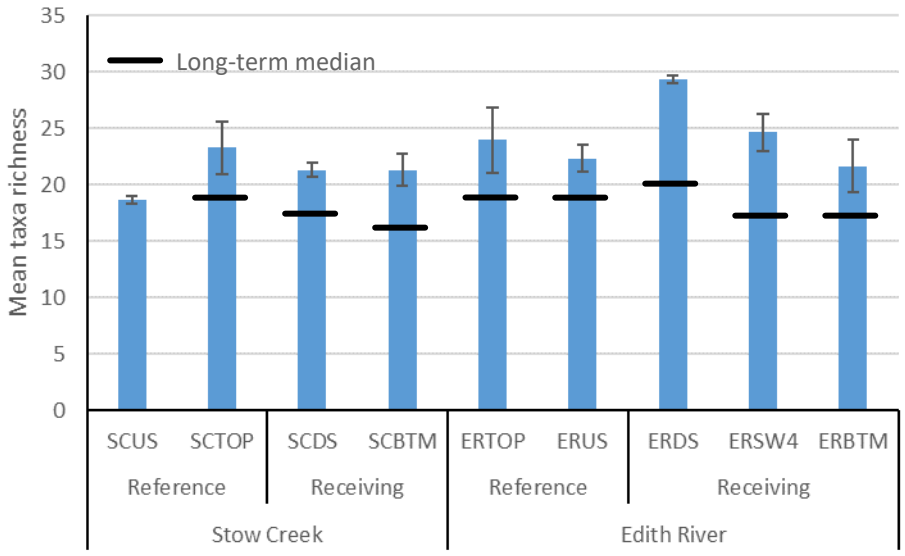
A total of 6,015 macroinvertebrates were identified in the survey, representing an equivalent of the collection of 143,593 macroinvertebrates (in consideration of Marchant subsampling rates). The most abundant taxa were non-biting midges (Chironominae) and mayflies (Caenidae). The macroinvertebrate data are presented in full in **Appendix E**.

Taxa abundance and richness are graphed to identify differences in macroinvertebrate communities at the survey sites (**Figure 15** and **Figure 16**). The data shows that taxa abundance and richness were variable across the monitoring sites and values at receiving sites were generally within or above the range recorded at reference sites, with the exception of taxa abundance at site ERDS. Most sites approached or exceeded long term median values for abundance, excluding site ERDS, taxon richness exceeded long term means at all sites. At site ERDS fewer Chironominae and Caenidae were recorded, these taxa contributed the most to abundance at other sites.



Error bars are the standard error of the mean

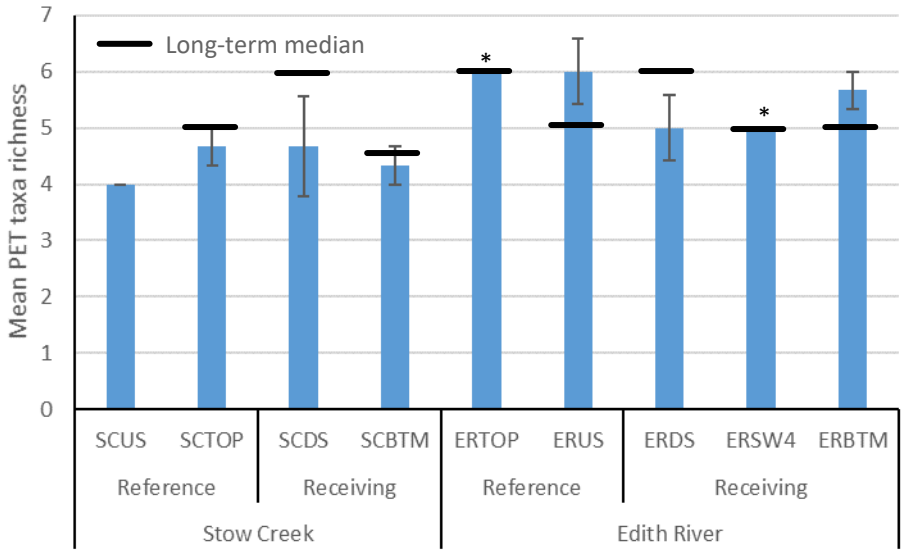
Figure 15 Aquatic macroinvertebrate taxa abundance against long term medians



Error bars are the standard error of the mean

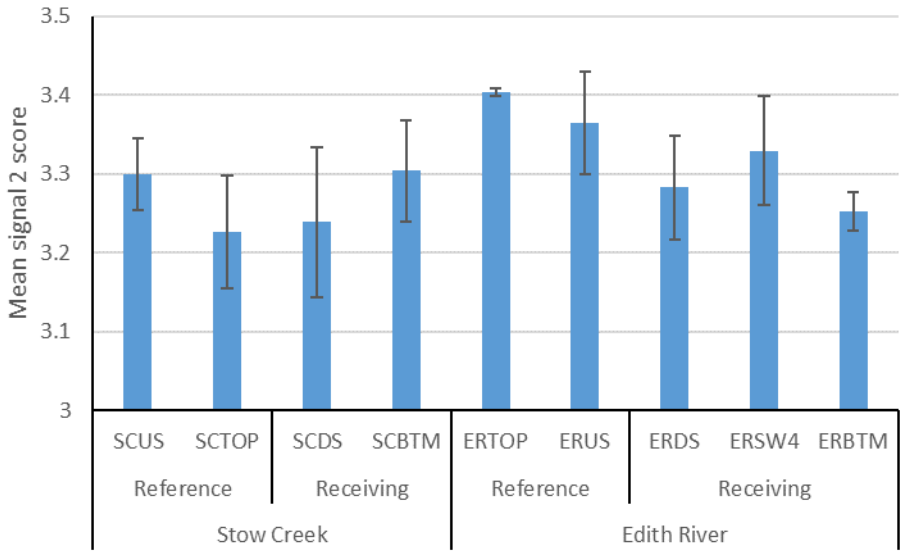
Figure 16 Aquatic macroinvertebrate taxa richness against long term medians

Mean PET taxa richness was comparable across all sites, and all receiving sites recorded more PET taxa than at least one reference site (**Figure 17**). Mean signal-2 scores were comparable across all sites, and all receiving sites recorded a higher signal-2 score than at least one reference site (**Figure 18**). Edith River reference sites recorded the highest PET taxa richness and Signal-2 scores across all monitored sites.



Error bars are the standard error of the mean, * error bars of ERTOP and ERSW4 are obscured by the long term median indicator.

Figure 17 Aquatic macroinvertebrate PET taxa richness against long term medians



Error bars are the standard error of the mean. All long term medians are between 3.75 and 4.25.

Figure 18 Aquatic macroinvertebrate Signal-2 scores

5.3.3 Community composition

Non-metric multi-dimensional scaling (MDS) of transformed abundance data which graphically presents the relationship between sites is presented in **Figure 19**. SIMPROF analysis (Similarity profile) was also performed and no groups were found to be statistically significantly different (p=0.05). SIMPER analysis for Edith River sites found that the taxa contributing most to dissimilarity between reference and receiving sites were Chironominae, Corixidae, and Simuliidae. For the Stow Creek reference and receiving sites, the taxa contributing most to dissimilarity were Gomphidae, Hirundea and Notonectidae. The results of the SIMPER analysis are provided in **Appendix F**.

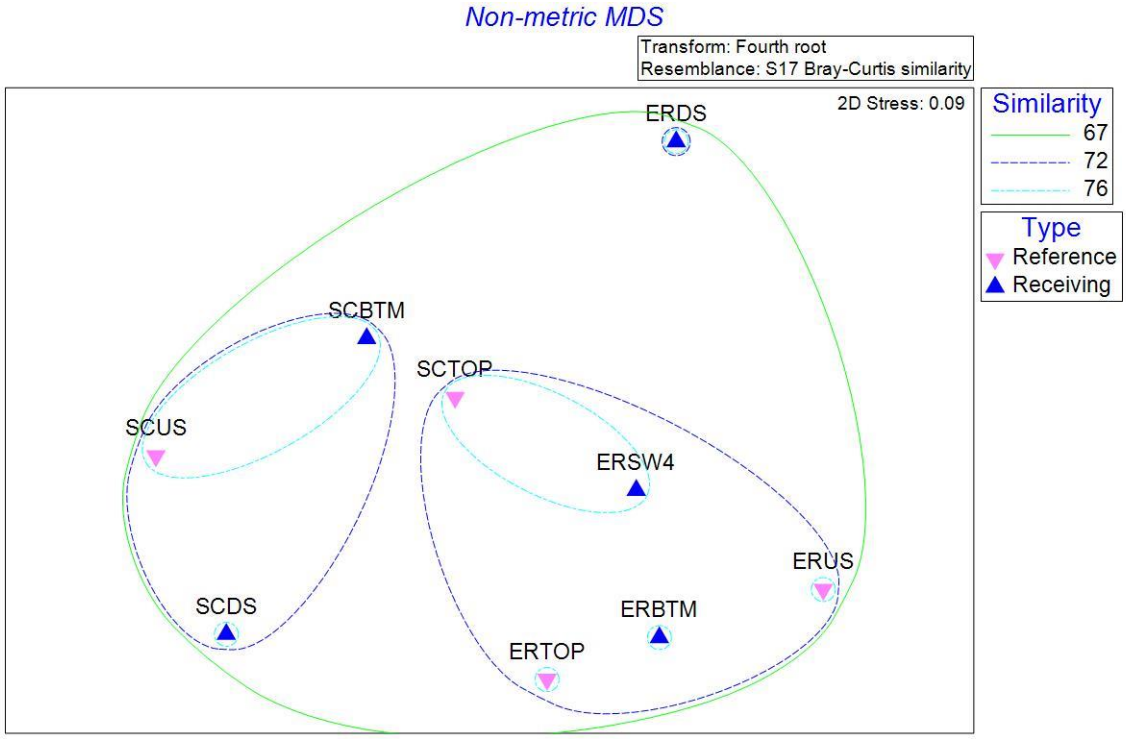


Figure 19 MDS ordination spatial comparison of macroinvertebrate communities

5.4 Discussion

The assessment of macroinvertebrate communities and stream sediment quality has been made to provide an indication of potential changes to water quality and associated aquatic ecosystem of the receiving environment of the MTPA. Assessment of variations between macroinvertebrate communities provide an integrated representation of the condition of a site that also includes the impacts of surface water quality and stream sediment quality.

The region received below average rainfall during the 2019/2020 wet season. The sampling timing was early in comparison to previous aquatic ecology surveys at the site due to the dry conditions. The field survey occurred approximately eight weeks after the previous substantial rainfall event, allowing sufficient time for macroinvertebrate communities to develop following flushing of the streams during rapid flows. All of the sites contained sufficient water to collect samples, five sites contained non-flowing pools, the remainder contained flowing water at the time of survey. Controlled release of treated mine water was conducted from the site during the 2019/2020 wet season, releases had ceased prior to the survey.

The macroinvertebrate communities of all reference and receiving sites were similar, the similarity was statically significant (p=0.05) and described at 67% according to cluster analysis. The most dissimilar site was the receiving site ERDS. This site recorded substantially less total macroinvertebrate abundance but substantially higher taxa richness than all other sites, both these characteristics contribute to the similarity result. The site was identified as having habitat characteristics different to other sites; dense trailing vegetation and deep pools were present in the sampling area, this habitat likely contributed to the high species richness. Steep banks were also present and the reduced accessibility due to dense vegetation and perceived high risk of crocodile attack may have affected the sampling technique and contributed to the low macroinvertebrate abundance recorded. Therefore, the difference in macroinvertebrate community recorded at the site is considered likely to be due to non-water quality related habitat factors and differences in sampling methodology, not a degradation of water quality as a result of the MTPA discharge. All other receiving sites recorded similarity of at least 72% to at least one reference site.

5.4.1 New monitoring site SCUS

Reference site SCUS was monitored for the first time in this survey. When operations commence Vista Gold may commission the construction of a new tailings storage facility (TSF2) which has the potential to impact water quality at the existing reference site SCTOP. The new TSF2 may affect the waters of Stow Creek and tributaries to the north of Stow Creek. The location of SCUS was selected based on its location upstream of any potential impacts from TSF2 and the ability of the site to retain water after seasonal flows. Stow Creek was inspected for one kilometre upstream of the location of site SCUS to ensure that no flood channels from the tributary to the north exist. No tributaries were identified, indicating that the reference site SCUS will not be impacted by construction of TSF2.

The monitoring results of site SCUS indicate a high degree of similarity to site SCTOP. Macroinvertebrate taxa richness and Signal-2 scores were comparable to site SCTOP. The MDS ordination showed the macroinvertebrate community at site SCUS was 67% similar to the other reference sites. Water quality, sediment quality and PSD results were all comparable to site SCTOP. Therefore, SCUS is an appropriate replacement for the existing reference site SCTOP if required in the future.

5.5 Recommendations

The suitability of monitoring sites should be assessed during each survey, as monitoring requirements can change with environmental or project changes. During this survey, all sites contained sufficient water for monitoring indicating that the sites are appropriately located. At receiving site ERDS, field observations included the difficulty of maintaining safety while sampling. Sampling safety limitations have previously been reported for the receiving site ERSW4 (GHD 2019), however this site was not observed to be difficult to sample safely during the current survey, presumably because low water levels and water clarity reduced perceived crocodile attack risk.

- Continue to monitor all sites including SCUS in future monitoring events. The site will be appropriate to replace existing reference site SCTOP if it is impacted by TSF2 construction.

6 Sediment Quality

6.1 Monitoring program

In-situ water quality measurements for pH, electrical conductivity, turbidity, dissolved oxygen and temperature were recorded using a calibrated water quality meter and values were recorded on a field proforma.

Stream sediment samples were collected from the channel bed of the watercourse at each site. A composite sediment sample was collected from ten locations within the reach of the stream covered by macroinvertebrate sampling. A trowel was used to collect sediment to a depth of five centimetres and sampling equipment was cleaned between sites. Samples were analysed by a NATA accredited laboratory for the chemical and physical properties as shown in **Table 14**.

Table 17 Analytes for sediment

Particle size distribution	<2.0 mm, 0.6 mm to 2.0 mm, 0.3 mm to 0.6 mm, 0.212 mm to 0.3 mm, 0.063 mm to 0.212 mm, <0.063 mm
1 M HCl extractable metals (mg/kg)	Aluminium, antimony, arsenic, barium, beryllium, boron, cadmium, chromium (iii + vi), cobalt, copper, iron, lead, manganese, mercury, nickel, selenium, silver, vanadium, uranium, zinc
Nutrients	Ammonia nitrogen, nitrite as N, nitrate as N, nitrite and nitrate as N, TKN as N, organic nitrogen as N, total nitrogen as N, nitrogen (total oxidised).
Others	Sulphate, fluoride

6.1.1 Data Analysis

Metal concentrations were analysed in the whole sediment fraction (<2mm) and compared against published guideline values. Particle size distribution (PSD) data was used to help interpret sediment chemical analysis data and detect if substrate smothering had occurred.

A rapid assessment of biophysical conditions was made at each site and recorded on field data sheets. This assessment records stream substrate, flow characteristics, channel morphology, scouring or deposition, and habitat characteristics. This information enables data interpretation and serves as a permanent record of conditions for future reference.

6.1.2 Quality assurance / quality control

Quality assurance and control procedures were applied to stream sediment sampling and analysis. Quality assurance procedures have been applied and monitored by SLR and subcontracted laboratories.

Quality assurance of sediment quality analyses was undertaken by collection of a duplicate sample. The duplicate sample passed reproducibility assessment for all analyses.

6.2 Surface water

Surface water quality measurements made during the survey event are provided in **Table 18**. Values in bold and underlined indicate results that were above the WDL trigger value applied to compliance point SW4. Some parameters exceed the SW4 trigger values; pH was outside trigger value range at receiving site ERDS and the two Edith River reference sites. Dissolved oxygen was outside the trigger range at all reference and receiving sites except for the compliance site, ERSW4. Electrical conductivity exceeded the trigger value at the receiving site SCDS.

6.3 Sediment quality results

Stream sediment samples were collected at reference and receiving sites during the survey. The chemical analysis results of stream sediments are presented in **Table 19**. Results for the sediment fraction are compared to published sediment guideline values (ANZG 2018). Values in bold and underlined indicate results that were above the ANZG Guideline Values (Table 1 Recommended default guideline values for toxicants in sediment). The results of the particle size distribution analysis are presented in **Figure 20**. Laboratory analytical results are provided in **Appendix G**.

Table 18 In situ water quality results for the 2019/2020 wet season monitoring event

Analyte	Units	Guideline Value[1]	Reference Range	Stow Creek Reference		Stow Creek Receiving		Edith River Reference		Edith River Receiving		
				SCUS	SCTOP	SCDS	SCBTM	ERTOP	ERUS	ERDS	ERSW4	ERBTM
Temperature	C	-	27 – 28	26	28	26	27	27	28	27	29	27
pH	pH unit	6 - 8	5.3 – 6.6	6.2	6.6	6.1	6.3	**5.3**	**5.7**	**5.9**	6.6	6.4
Electrical conductivity	µS/cm	250	20 – 213	39	213	**296**	244	20	25	26	30	74
Turbidity	NTU	-	0.97 – 4.6	4.6	0.97	13	15	2.6	3.7	2.5	2.2	1.3
Dissolved oxygen	%	85 – 120	42 – 74	**60**	**74**	**64**	**60**	**39**	**42**	**37**	104	**69**

[1] Guideline values are WDL Trigger Levels.

Table 19 Stream sediment quality results for the 2020 sediment monitoring program

Analyte	Units	Guideline value[1]		Reference Sites Range [2]	Stow Creek Reference		Stow Creek Receiving		Edith River Reference		Edith River Receiving		
		Default	High		SCUS	SCTOP	SCDS	SCBTM	ERTOP	ERUS	ERDS	ERSW4	ERBTM
Fluoride (Total)	mg/kg	-	-	<100 - 120	< 100	120	< 100	< 100	< 100	100	< 100	< 100	< 100
Sulphate as SO_4 (1:5 aqueous extract)	mg/kg	-	-	<10 - 71	71	44	56	63	< 10	< 10	290	78	14
Aluminium (1M HCl extract)	mg/kg	-	-	48 - 140	59	48	42	68	66	140	83	94	37
Antimony (1M HCl Extract)	mg/kg	2.0	25	<2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2
Arsenic (1M HCl extract)	mg/kg	20	70	<2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2
Barium (1M HCl extract)	mg/kg	-	-	3 - 17	3	5.9	1.7	5.8	9.5	17	7.3	7	3
Cadmium (1M HCl extract)	mg/kg	1.5	10	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4
Chromium (1M HCl extract)	mg/kg	80	370	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5
Cobalt (1M HCl extract)	mg/kg	-	-	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5

Analyte	Units	Guideline value[1]		Reference Sites Range [2]	Stow Creek Reference		Stow Creek Receiving		Edith River Reference		Edith River Receiving		
		Default	High		SCUS	SCTOP	SCDS	SCBTM	ERTOP	ERUS	ERDS	ERSW4	ERBTM
Copper (1M HCl extract)	mg/kg	65	270	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5
Iron (1M HCl extract)	mg/kg	-	-	220 - 1200	290	220	290	340	1200	1200	440	440	210
Lead (1M HCl extract)	mg/kg	50	220	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5
Manganese (1M HCl extract)	mg/kg	-	-	16 - 39	39	24	16	66	16	21	18	17	15
Mercury (1M HCl extract)	mg/kg	0.15	1.0	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Nickel (1M HCl extract)	mg/kg	21	52	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5
Selenium (1M HCl extract)	mg/kg	-	-	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2
Silver (1M HCl extract)	mg/kg	1.0	4.0	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2
Uranium (1M HCl extract)	mg/kg	-	-	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10
Vanadium (1M HCl Extract)	mg/kg	-	-	0.25 - 1.1	0.36	0.25	0.22	0.28	0.96	1.1	0.56	0.55	0.23
Zinc (1M HCl extract)	mg/kg	200	410	< 5 - 16	16	< 5	7.4	18	< 5	< 5	6.2	8.4	< 5
<63 Micron	%	-	-	0.1 - 21	0.9	0.8	2	0.4	21	0.1	2.5	0.5	0.1

[1] Guideline values are derived from ANZG Table 1 (Recommended default guideline values for toxicants in sediment).

[2] Reference range is values recorded at reference sites in the 2020 wet season.

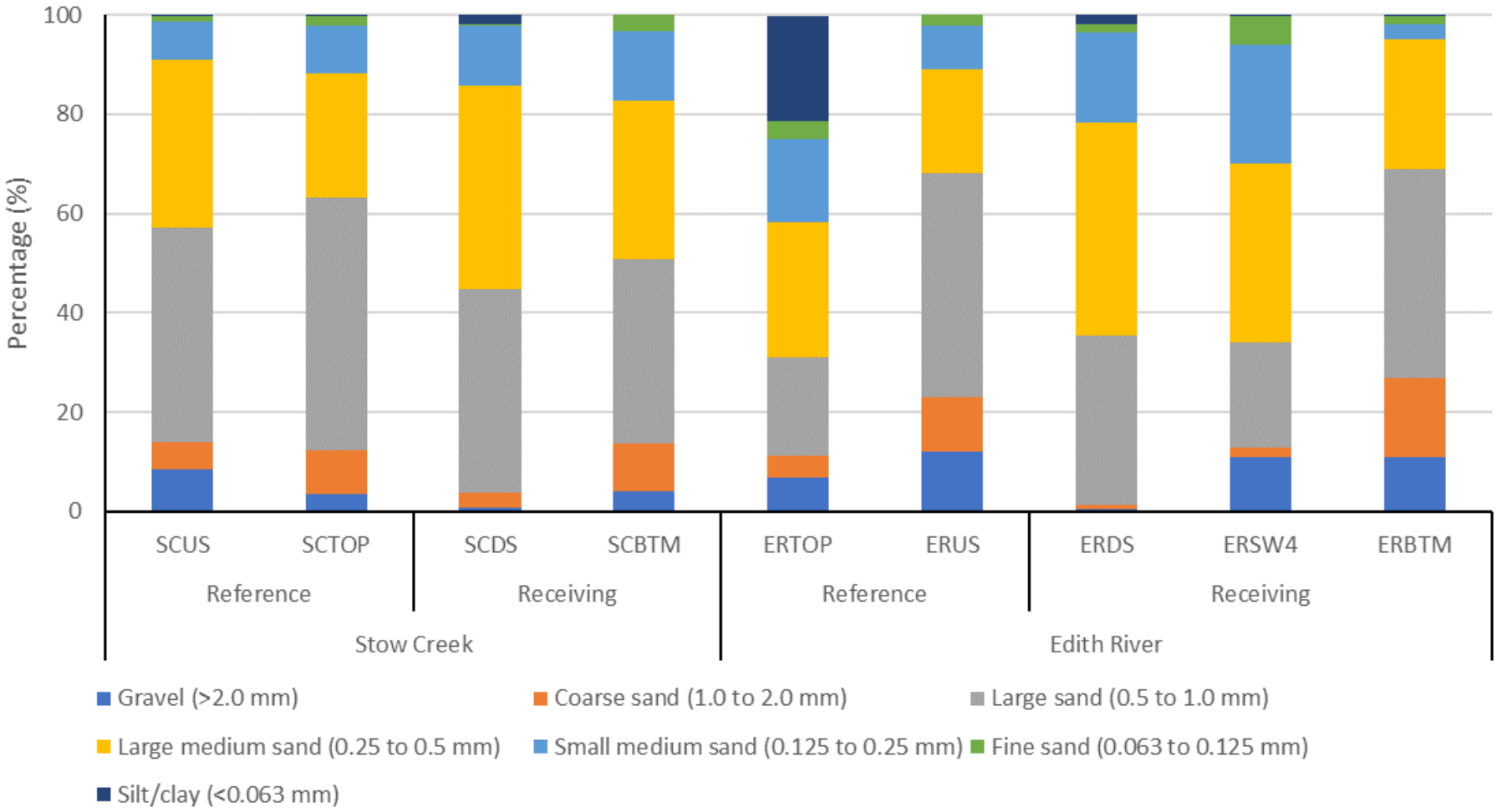


Figure 20 Particle size distribution results for the 2020 sediment monitoring program

6.4 Historical sediment quality results

When the results of sediment monitoring from 2020 are compared with those from previous sampling events (**Appendix H**), observations include:

- In 2020, copper was below the limit of recording at all sites. At site ERSW4 copper remains low after displaying elevated concentrations between 2011 and 2016, and a significant downward trend is shown in **Figure 21** as all samples since 2017 were below the limit of reporting.
- As reported in previous surveys, concentrations of iron and manganese varied year to year at all sites, generally related to the rainfall and surface water runoff. There are no SQGVs for iron and manganese as these are not considered to be toxicants in sediments.
- Historically, zinc levels have been elevated at sites ERSW4 and ERBTM (between 2012 and 2015). Concentrations have decreased at both sites over time with the discharge of treated mine water. No elevated zinc concentrations were recorded in 2020 and zinc concentrations have been below the SQGV at every site in every year of monitoring.
- Historically, aluminium levels have been elevated at downstream sites on Edith River, particularly in 2011/2012. Concentrations in 2020 remain low. Aluminium concentrations are related to rain events.
- Arsenic, cadmium, cobalt, chromium, lead and nickel have all been recorded below the LOR at all sites in almost all years. There have been no exceedances of the SQGVs for any analyte where a guideline exists. Due to multiple results below the LOR, no trends in concentrations for these parameters were seen.

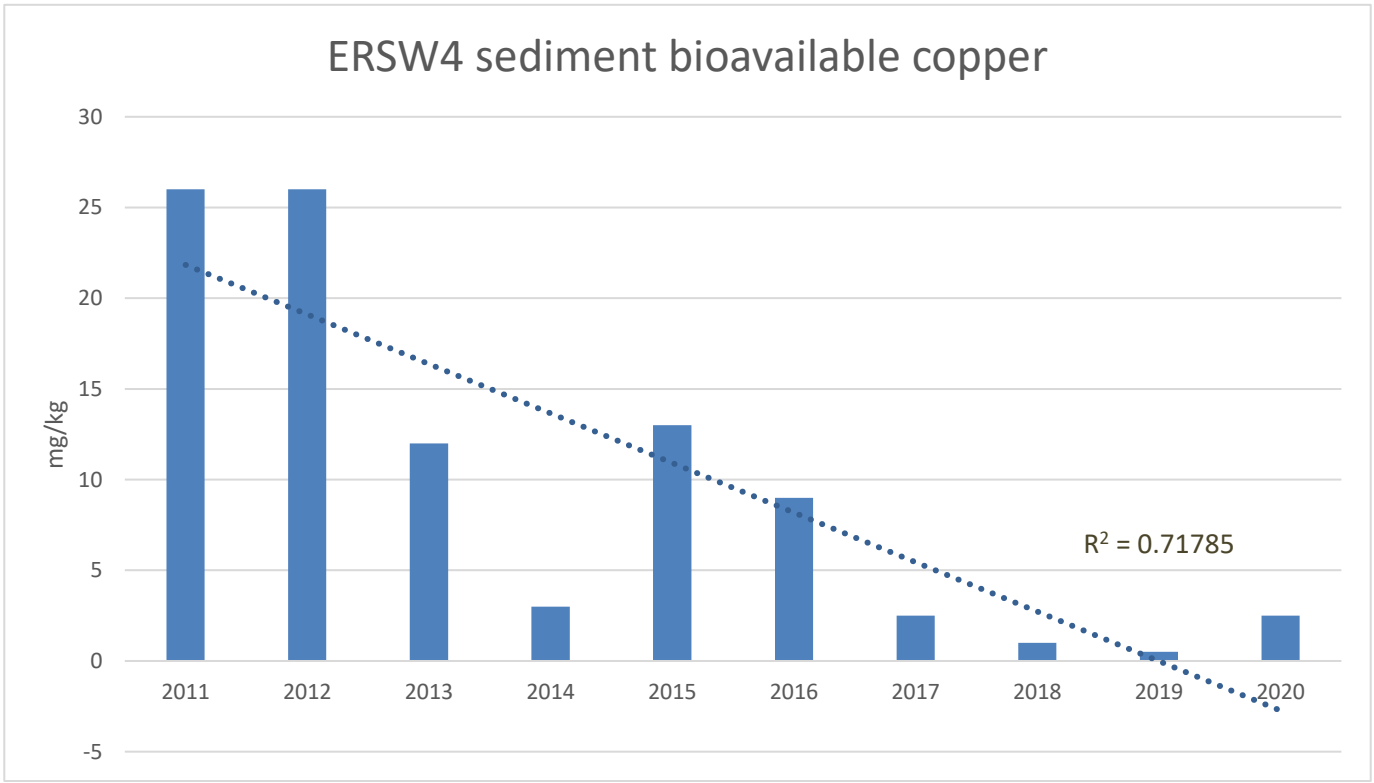


Figure 21 Bioavailable copper at ERSW4

6.5 Discussion

The assessment of macroinvertebrate communities and stream sediment quality has been made to provide an indication of potential changes to water quality and associated aquatic ecosystem of the receiving environment of the MTPA. Assessment of variations between macroinvertebrate communities provide an integrated representation of the condition of a site that also includes the impacts of surface water quality and stream sediment quality.

In-situ surface water quality measurements during the survey showed receiving sites were comparable to reference sites. Site ERDS recorded pH outside the guideline values, though comparable to both Edith River reference sites which were also both outside guideline values. Electrical conductivity was higher than the guideline value at receiving site SCDS, as would be expected as this site was reduced to stagnant pools with no flow and subject to evaporation. Elevated electrical conductivity commonly occurs in drying pools within previously flowing streams. Dissolved oxygen was outside the guideline value range for all reference and receiving sites except for the compliance point site ERSW4. Dissolved oxygen guideline values are relevant to flowing and stabilised waterways, as the majority of sites were non-flowing pools, the low DO was not unexpected. The monitoring sites were all experiencing decreased flows since the previous rainfall events and these low dissolved oxygen levels measured during this monitoring program do not reflect a degradation of water quality associated with treated mine water impacts.

Stream sediment analysis results indicates that sediment contaminant concentrations at all reference and receiving sites are below guideline values. The PSD results were variable across the sites. Sites that recorded a non-negligible silt/clay proportion were reference site ERTOP (21%) and receiving sites SCDS and ERDS (2% and 2.5% respectively). These results indicate that no substantial sediment smothering or build-up of metals has occurred in the catchment.

As discussed in **Section 5.4.1**, reference site SCUS was monitored for the first time in this survey. The monitoring results of site SCUS indicate a high degree of similarity to site SCTOP. Water quality, sediment quality and PSD results were all comparable to site SCTOP. SCUS is therefore an appropriate replacement for the existing reference site SCTOP if required in the future.

6.6 Conclusions and recommendations

Results of the 2019/2020 biological and sediment monitoring programs indicate that the MTPA has not had a measurable impact on the macroinvertebrate communities of the receiving waterways. Controlled releases of treated mine water have occurred into the receiving waters during the 2019/2020 wet season, however no impact on the aquatic ecosystem or sediment quality from these releases was observed.

All receiving sites showed similarity to reference sites for aquatic macroinvertebrate communities, water quality and sediment quality.

As discussed in **Section 5.5**, the suitability of monitoring sites should be assessed during each survey, as monitoring requirements can change with environmental or project changes.

Continue to monitor all sites including SCUS in future monitoring events. The site will be appropriate to replace existing reference site SCTOP if it is impacted by TSF2 construction.

7 Ecotoxicology Program

Ecotoxicological assessment of treated mine water from the MTPA is sampled after mixing in the Edith River is conducted to assess the potential impacts on the ecosystem within the Edith River. Ecotoxicological testing is undertaken on water sampled at two locations in the Edith River (i.e. SW2 and SW4) during discharge. The testing follows the protocol outlined in the approved Mt Todd Ecotoxicological Plan Chapter 6 – WDL 178-05 Annual Report (2018). This testing was conducted to meet the following conditions of WDL 178-07 which is authorised by the NT EPA:

Condition 35 *The licensee must implement, maintain and follow the Ecotoxicology Plan as specified in Table 1 for the life of this licence.*

Condition 36 *The licensee must revert back to the previously approved Ecotoxicology Plan if the results of the current Ecotoxicological Plan confirm the presence of toxicity at SW4*

The Ecotoxicology Report for 2019/20 is attached in **Appendix I**. The report presents the results of ecotoxicological assessment of water discharged from the MTPA.

7.1 Ecotoxicology plan

7.1.1 Sample Collection

Vista Gold collected water samples for ecotoxicity testing from the Edith River at the compliance point (SW4) during the discharge of treated water from Batman Pit and at the Edith River upstream site at SW2 for use in screening bioassays on 16 February 2020. Vista Gold also collected samples from the Edith River at SW2 and SW4 and a sample from Batman Pit for chemical analysis on that date. Samples were collected in accordance with the following Australian standard method:

AS/NZS 5667.1:1998 – Guidance on the design of sampling programs, sampling techniques and the preservation and handling of samples

All sample containers for ecotoxicity testing were filled to the top (i.e. no air spaces) to maintain sample integrity.

The SW2 and SW4 samples for ecotoxicity testing were immediately chilled on ice then maintained at 4°C prior to transport to Ecotoxicology Services Australasia (ESA) where the samples were received on 18 February 2020. Samples for chemistry were transported directly to Intertek's Darwin laboratory.

7.1.2 Water Quality Analysis

All water samples used for ecotoxicity testing were analysed for the suite of analytes listed in Appendix 1 of WDL 178-07. Analyses were conducted by Intertek, a NATA accredited laboratory based in Darwin.

7.1.3 Screening Bioassays

Water quality of natural waterways is not expected to show toxicity to representative species, therefore a screening bioassay is used to assess if the water shows any toxicity. An undiluted water sample from each site is used in the screening bioassays and the results are compared to an upstream sample and a laboratory control water sample. Significant toxicity is observed when the test organisms exposed to the sample exhibit more than 20% difference in an adverse response compared with controls[2] . If the difference observed in the response being investigated is ≤20% that of the controls, this is taken to mean the sample does not cause significant toxicity. Screening bioassays can be useful for comparing water quality spatially and temporally across a site.

The 7 day *Ceriodaphnia dubia* reproduction bioassay was used as the screening bioassay for the SW4 sample and the *C.dubia* acute bioassay was used as the initial screening bioassay for SW2 and SW4. *C. dubia* was determined to be the sensitive species by previous studies conducted for the MTPA. Historically the SW2 sample (upstream of discharge) has shown toxicity to *C. dubia*, with no survivors after the 7-day exposure period due to the low electrical conductivity (EC) of the water. *C. dubia* were exposed to 100% of SW4 water only (sampled during Batman Pit discharge) and 100% SW2 water. The screening bioassays were run concurrently with a laboratory control sample. As discussed above, toxicity of the sample is considered to occur if the difference in mortality between the test and controls is >20%. Ecotoxicology testing was conducted by Ecotoxicology Services Australasia (ESA) based in Sydney.

7.1.4 Laboratory Controls

Upstream water (SW2) may adversely impact on cladoceran reproduction as shown in previous monitoring programs, due to its low EC. To identify any confounding influence from SW2 on the results obtained from SW4, the *C. dubia* bioassay was conducted using the SW2 survival bioassay to assist in interpreting the SW4 results. Laboratory dilution water was used as the control in all studies.

7.1.5 Quality Assurance

NATA accredited bioassays were used in this study and, as such, they have met quality assurance in order to be released to the client. Each bioassay was conducted in conjunction with a laboratory control (the water in which the organisms are grown) and a reference toxicant (KCl for the cladoceran bioassays). All bioassays met the laboratory QA parameters.

7.2 Water quality results

Water quality results for Batman Pit, upstream site SW2 and compliance site SW4 are presented in **Table 20**. The electrical conductivity at the upstream site, SW2, of 24 µS/cm, indicates that there will be some toxicity associated with this site as discussed in previous reports. Batman Pit treated water discharge is characterised by elevated concentrations of dissolved metals, including cadmium, copper, nickel, and zinc with high conductivity and sulfate.

[2] Responses investigated differ depending on what organisms are tested but typically refer to immobilization or a decrease in growth or reproduction.

Water quality at the compliance point at SW4 shows considerably lower metal concentrations when compared to Batman Pit. The concentrations of metals at SW4 are compliant with the site-specific trigger values (SSTVs) listed in WDL 178-07, with two exceptions. The only metal exceedance at SW4 is for iron at 602 µg/L and this is similar to the upstream (SW2) iron concentration of 644 µg/L. It is noted, however, the screening toxicity tests using the cladoceran reproduction bioassay show that there is no toxicity in the sample when compared to laboratory controls, even with the elevated iron concentrations.

Table 20 Water Quality Data

Analyte	Batman Pit		SW2		SW4		
	2020	Long-term median	2020	Long-term median	2020	Long-term median	SSTV
EC (µS/cm)	2,785	2,818	24	17	175	86	250
pH	6.99	7.2	6.4	6.2	6.09	6.2	6 - 8
Ions (mg/L)							
Bicarbonate	7	34	9	8	13	9	319
Chloride	2	7	2	1	8	2	64
Magnesium	235	190	0.7	0.6	5.8	3.4	21
Sulfate	2,080	1,800	0.3	0.5	41	16	129
Cyanide (µg/L)	NA	2	<5	2	NA	<4	7
Dissolved Metals (µg/L)							
Aluminium	34	110	95	29	84	12	150
Cadmium	23	23	<0.02	<0.1	0.06	0.1	0.8
Chromium	<0.5	<1	0.4	<1	0.3	<1	-
Cobalt	30	83	0.08	<1	0.6	1	13
Copper	15	9	0.47	<1	1.3	1	2.5
Iron	<10	5	644	220	**602**	150	350
Lead	0.08	<1	0.06	<1	0.16	<1	9.4
Manganese	449	700	8.3	7	88	40	3,600
Nickel	143	200	0.46	<1	1.1	2	17
Zinc	1,980	480	0.7	1	7.4	10	31

NA = Not analysed
Bold denotes exceedance of the SSTV at compliance point SW4

7.3 Ecotoxicology results

Table 21 shows reproduction and survival from each site as a percentage of controls. The results from historical ecotoxicology assessment from 2015, 2018 and 2019 have been compared to the 2020 ecotoxicity assessment and are also shown in **Table 21**. Results from the 2015 DTA (GHD 2015), 2018 Ecotox Report (GHD 2018) and 2019 Ecotoxicology Program Report (GHD 2019) have been included for comparative purposes.

The screening results for SW2 show that the water upstream of the discharge site can be chronically toxic to the cladoceran as measured by the reproduction bioassay in previous years. Insufficient sample was available to conduct the chronic bioassay on SW2 in 2020. However, as the survival after 48 hours was 100% in 2020, it may be expected that reproduction would be unaffected, similar to observations in 2015.

All screening bioassays conducted on SW4 show that there is no toxicity at the Edith River compliance site during the treated mine water discharge even though iron was elevated above the SSTV.

Table 21 Ecotoxicology Screen Bioassay Results

Year	Site	*C. dubia* Reproduction	*C.dubia* Survival
2015	SW2	50%	90%
	SW4	102%*	100%
2018	SW2	6%	0%
	SW4	98%	100%
2019	SW2	0%	0%
	SW4	92%	100%
2020	SW2	Not tested	100% (48 hours)
	SW4	100%	100% (48 hours)

**Reproduction in SW4 water was greater than controls hence the result is >100%*

7.4 Conclusion

The 2020 ecotoxicological investigation commissioned by Vista Gold for assessment of the MTPA discharge has demonstrated that the treated mine water discharged from Batman Pit to the Edith River is not toxic at the compliance point, SW4, for the sensitive species and end point tested.

The dilution of the treated mine water is managed using a dilution ratio based on Batman Pit water quality and the Edith River flow. The dilution ratio is usually in the order of 1:33 (as a minimum), however, during the 2020 wet season the dilution ranged from 1:33 to 1:96 due to the low rainfall and resulting low flow in the Edith River. Based on operating data provided by Vista Gold the dilution ratio during the 16 February 2020 sampling was 1:47. The results of the ecotoxicity testing indicate that the current dilution methodology application and discharge management is averting any environmental harm in the receiving waters of Edith River. The chemistry results and the screening toxicity tests conducted on the SW4 water during discharge have confirmed the absence of toxicity. Jointly, these results validate the safety of the current dilution rate and treated mine water management for the protection of the receiving environment. The compilation of the wet season data for water quality and the health of aquatic macroinvertebrate populations at SW4 to be provided in the WDL 178-07 Monitoring Report later in 2020 will also be used to confirm the lack of toxicity of the treated mine water discharge.

The previous and the current investigations suggest that the low conductivity observed at the upstream site (SW2), may be affecting the results of the cladoceran screening test conducted on the SW2 water. This has been confirmed by Dr Rick Krassoi at ESA as this species has been reported to be sensitive to low conductivity. However, the use of this species is still recommended as it is one of the few NATA accredited bioassays that assess a full life cycle of a sensitive aquatic invertebrate. Vista Gold also have historical data from 2009 so that results from this bioassay can be used to assess historical changes in water quality and toxicity at the MTPA.

Iron was the only chemical that exceeded the SSTV at SW4. This exceedance was not associated with any risk of detrimental effects in the receiving environment as has been validated by the absence of toxicity in the receiving water at SW4.

In conclusion, the ecotoxicological assessment, undertaken following the WDL 178-07 requirements and the approved Ecotoxicological Plan, has shown that discharge of treated mine water from Batman Pit using the current dilution method does not pose any risk of harm to the aquatic communities living in the Edith River downstream of the discharge point.

7.5 Recommendations

- To maintain the monitoring of toxicity of the Edith River at SW4 during discharge of treated mine water to show that the discharge is not adversely impacting on the aquatic ecosystem in the Edith River, it is recommended to conduct the ecotoxicology testing as per the current approved Plan.
- It is recommended to review the SSTV of iron to reflect the influence of upstream concentrations.

8 Conclusions

The 2019/20 water quality data indicates that the water quality in the Edith River is not being adversely impacted by the discharge of treated water from Batman Pit to the Edith River using the current dilution method. The water quality at SW4 is influenced by the upstream water quality and discharge has been managed to ensure that the SSTVs are generally met at SW4 during discharge.

Results of the 2019/2020 biological and sediment monitoring programs indicate that the MTPA has not had a measurable impact on the macroinvertebrate communities of the receiving waterways. Controlled releases of treated mine water have occurred into the receiving waters during the 2019/2020 wet season, however no impact on the aquatic ecosystem or sediment quality from these releases was observed.

All receiving sites showed similarity to reference sites for aquatic macroinvertebrate communities, water quality and sediment quality.

The 2020 ecotoxicological investigation has demonstrated that the treated mine water discharged from Batman Pit to the Edith River using the current dilution method is not toxic at the compliance point, SW4, for the sensitive species and end point tested.

The weight of evidence approach used by Vista Gold has shown that discharge of treated mine water from Batman Pit at the current dilution method does not pose any risk for the aquatic communities living in Edith River downstream the discharge point.

9 Recommendations

Table 22 lists the recommendations from each of the monitoring programs, for implementation during 2020/2021 monitoring programs.

Table 22 Recommendations

Item	Recommendation
Surface Water Monitoring Program	
1	If the pH continues reducing overtime more metals may become mobilised such as observed with zinc and additional management may be required if metal concentrations become problematic at SW4.
2	Condition 49.1 should be reverted back to “three consecutive sampling occasions.”
Proposed site specific trigger values for WDL 178-08	
3	SSTV for pH 5.9 – 8.0
Biological / Sediment monitoring program	
4	Assess the suitability of monitoring sites during each survey as monitoring requirements can change with environmental or project changes.
5	Continue to monitor all sites including SCUS in future monitoring events. The site will be appropriate to replace existing reference site SCTOP if it is impacted by TSF2 construction.
Ecotoxicology program	
6	To maintain the monitoring of toxicity of the Edith River at SW4 during discharge of treated mine water to show that the discharge is not adversely impacting on the aquatic ecosystem in the Edith River, it is recommended to conduct the ecotoxicology testing as per the current approved Plan.
7	Review the SSTV of iron to reflect the influence of upstream concentrations.

10 References

Australian & New Zealand Guidelines for fresh & Marine Water quality (ANZG 2018), available <https://www.waterquality.gov.au/anz-guidelines>

Bureau of Meteorology (BoM) 2020, *Climate data online,* monthly rainfall data for Tindall RAAF station number 014932, Commonwealth of Australia, accessed 8/05/2020, available <http://www.bom.gov.au/climate/data>

Chessman (2003). SIGNAL-2 - A scoring system for macroinvertebrates ('water bugs') in Australian rivers: User manual, September 2003. National River Health Initiative Technical Report Number 3.

Clarke, K.R. and Gorley, R.N. (2014) Primer v7: User Manual/Tutorial. Plymouth Marine Laboratory, Plymouth, U.K.

Lamche, G. (2007). The Darwin-Daly Regional AUSRIVAS Models –Northern Territory: User Manual. Aquatic Health Unit – Department of Natural Resources, Environment and the Arts. Report 06/2007D.

Lloyd and Cook (2002). Northern Territory Ausrivas Sampling and Processing Manual. Natural Resources Division, Department of Lands, Planning and Environment.

GHD (2018). Receiving Environment Monitoring Program Design. Prepared by GHD for Vista Gold Australia Pty Ltd, July 2019.

GHD (2019). Mt Todd 2019 WDL Reporting WDL 178-06 Monitoring Report 2019. Prepared by GHD for Vista Gold Australia Pty Ltd, July 2019.

APPENDIX A

WDL 178-07

Northern Territory Government

WASTE DISCHARGE LICENCE

(Pursuant to section 74 of the *Water Act)*

Licensee	Vista Gold Australia Pty Ltd
Licence Number:	**WDL178-07**
Registered Business Address:	1/4 Manning Road DOUBLE BAY NSW 2028
ABN:	117 327 509
Premises Address:	Mount Todd Mine Edith Falls Road, Edith Falls 0852
Anniversary Date:	26 November
Commencement Date:	26 November 2019
Amendment Date:	September 2019
Expiry Date:	30 November 2020
Licensed Activity:	Controlled discharge of treated water, in accordance with the licence conditions, from Batman Pit through the authorised discharge point to the Edith River.

Contents

INFORMATION ABOUT THIS LICENCE

Definitions of Terms

- A section on the definition of terms used in this licence can be found at the end of this licence.
- Terms used in the waste discharge licence which are defined in the *Water Act* (the Act) have the meaning given in that Act unless specifically indicated otherwise.

Responsibilities of Licensee

- It is an offence under the *Water Act*, if the holder of a waste discharge licence contravenes or fails to comply with the conditions of a waste discharge licence.
- Licensees must comply at all times with the requirements of these Acts and all other applicable laws.
- Except as expressly provided for in this licence, the licensee must not:
    - cause environmental harm either directly or indirectly;
    - allow waste to come into contact with water; or
    - allow water to be polluted.
- Without limiting the conditions of this licence, in conducting the activity, the licensee must do all things reasonable and practicable to:
    - prevent or minimise the likelihood of pollution occurring as a result of, or in connection with, the activity;
    - prevent or minimise the likelihood of environmental harm occurring as a result, or in connection with, the activity;
    - effectively respond to pollution and the risk of pollution occurring as a result of, or in connection with, the activity;
    - effectively respond to environmental harm and the risk of environmental harm occurring as a result of or in connection with the activity; and
    - apply the principles of ecologically sustainable development.

Duration of licence

- This licence will remain in force until its expiry date, it is surrendered by the licensee, or until it is suspended or revoked by the Controller of Water Resources.
- As set out in section 94 of the Water Act, the holder of a licence may, at any time, surrender the licence.

Amendment, Modification or Revocation of Licence (section 93 of the *Water Act*)

- As set out in section 93 of the Water Act, the Controller of Water Resources may, by notice:
    - amend or modify the terms and conditions of a licence;
    - revoke a licence; or

- suspend a licence.

Public Register

- A copy of waste discharge licences and any plans for environmental management, reports, submissions or documents required as a condition of a waste discharge licence, will be placed on a register.
- A copy of the Annual Return will be placed on the register.
- The Administering Agency makes this register freely available from the Northern Territory Environment Protection Authority (NT EPA) website.

Beneficial Use Declaration (section 73 of the Water Act)

- Beneficial Use Declaration (BUD) is a legislated process that reduces the effects of water pollution and assists in the protection and management of water. The community decides how a particular water body should be used by choosing on one or more Beneficial Use categories.

Environmental Interests

- This section highlights the beneficial uses as declared under the *Water Act* and the sensitivity of the surrounding land use and environment associated with the location of the approved activity.
    - declared beneficial uses and or water quality objectives. Daly Roper Beetaloo Water Control District. Surface water from all natural waterways located in the Daly Roper Beetaloo Water Control District (the District), and all ground water located in the District, to be agriculture, aquaculture, public water supply, environment, cultural, industry and rural stock and domestic (Northern Territory Government Gazette: no. S057/2018);
    - sites of conservation significance (SOCS), Yinberrie Hills (SOCS Site Number 30); and
    - there are no Ramsar wetlands present.

Cultural Interests

- It is the licensee's responsibility to contact the Aboriginal Areas Protection Authority, appropriate land council or other governing body and ensure that any Authority Certificates required as a result of conducting the licenced activity are obtained and complied with.

RULES FOR INTERPRETING THE CONDITIONS OF THIS LICENCE

- Where there is a discrepancy between the conditions of this licence and any plan, standard, guideline or other document referred to in this licence, the conditions of this licence prevail to the extent of the inconsistency.
- Any reference to any standard (Australian or international) in this licence means the relevant parts of the current version of that standard.
- A reference to any guideline or code of practice (or to the relevant parts of any guideline or code of practice) in this licence means the current version of the guideline or code of practice.
- Under section 76 of the *Water Act*, any contravention of or failure to comply with this licence by the licensee may be an offence.
- In this licence, unless the contrary intention appears, words that are defined in the *Water Act* are intended to have the meaning given to them in that Act.

LICENCE CONDITIONS

GENERAL

1. The licensee must ensure the contact details recorded with Administering Agency for this licence are correct at all times.
2. The licensee must at all times have a 24 hour emergency contact.
3. The licensee must notify the Administering Agency prior to making any operational change that will cause, or is likely to cause, an increase in the potential for environmental harm.
4. The licensee must cause clear and legible signage, in English, to be displayed in a prominent location at each public entrance to the premises that includes the following details:
   - 4.1. waste discharge licence number issued under the *Water Act*; and
   - 4.2. 24 hour emergency contact details.
5. The licensee must cause a copy of this licence to be available for inspection by any person, in hard copy form, at the premises.
6. The licensee must provide to the Administering Agency, within 10 business days of a request, a copy of any document, monitoring data or other information in relation to the activity, in the format requested by the Administering Agency.
7. All notices, reports, documents or other correspondence required to be provided as a condition of this licence, unless otherwise specified as a condition of this licence, must be provided in electronic form by emailing waste@nt.gov.au.
8. The licensee must maintain, implement and follow the documents listed in Table 1.

Table 1 Licence Documents

Document Title	Document Reference Number
Biological Monitoring Program: Chapter 4 – WDL178-05 Annual Report	DENR Ref: EN2010/0195-06-077~0025
Sediment Monitoring Program: Chapter 5 – WDL178-05 Annual Report	DENR Ref: EN2010/0195-06-077~0025
Ecotoxicology Plan: Chapter 6 – WDL178-05 Annual Report	DENR Ref: EN2010/0195-06-077~0025
Discharge Plan – Revision 6	DENR Ref: EN2010/0195-06-077~0026
Water Monitoring SOP	DENR Ref: EN2010/0195-06-077~0028

9. Within 10 business days of any amendment being made to a document listed in Table 1 the licensee must provide the amended document to the Administering Agency, along with:
   - 9.1. a tabulated summary of the amendment(s) with document references;
   - 9.2. reasons for the amendment(s); and
   - 9.3. an assessment of environmental risk associated with the amendment(s).
10. The Administering Agency may require the licensee to revise or amend and resubmit any document. Where the Administering Agency requires a document to be resubmitted, the licensee must submit it to the Administering Agency by the date specified by the Administering Agency.
11. The licensee must, for the duration of this licence, implement, maintain and follow a Consultation and Communication Plan which includes a strategy for communicating with persons who are likely to have a real interest in, or be affected by, the activity.
12. The licensee must operate and maintain a community feedback number.
13. The licensee must display the community feedback number:

13.1. where the licensee has a website, in a prominent location on the licensees website;

13.2. in the Consultation and Communication Plan; and

13.3. in other publicly available documents relating to the activity.

14. The licensee must maintain a Complaint Log for all complaints received by the licensee in relation to the activity.

15. The licensee must ensure that the Complaint Log includes, for each complaint received by the licensee, the following information:

15.1. the person to whom the complaint was made;

15.2. the person responsible for managing the complaint;

15.3. the date and time the complaint was reported;

15.4. the date and time of the event(s) that led to the complaint;

15.5. the contact details of the complainant if known, or where no details are provided a note to that effect;

15.6. the nature of the complaint;

15.7. the nature of event(s) giving rise to the complaint;

15.8. prevailing weather conditions at the time (where relevant to the complaint);

15.9. the action taken in relation to the complaint, including any follow-up contact with the complainant; and

15.10. if no action was taken, why no action was taken.

16. The licensee must implement, maintain and follow an Emergency Response Plan that addresses procedures for responding to emergencies associated with the activity that may cause environmental harm.

EARLY SURRENDER OF LICENCE

17. Any reports, records or other information required or able to be provided by the licensee under this licence must be submitted to the Administering Agency prior to the licensee surrendering the licence. If the date on which a report, record or other information is required falls after the date the licensee requests to surrender this licensee, the licensee must provide the report, record or information as far as possible using data available to the licensee up to and including the date the request to surrender the licence is made.

OPERATIONAL

18. The licensee must, without limiting any other condition of this licence, in conducting the activity do all things reasonable and practicable to ensure the activity does not adversely affect the Declared Beneficial Uses and Objectives as declared from time to time, including those applying to:

- *Declaration Beneficial Uses and Objectives Daly Roper Beetaloo Water Control District*

19. The licensee must ensure any plant and equipment used by the licensee in conducting the activity:

19.1. is reasonably fit for the purpose and use to which it is put;

19.2. is maintained; and

19.3. is operated by a person trained to use the plant and equipment.

20. No change, replacement or alteration of plant and equipment is permitted if the change, replacement or alteration increases the risk of environmental harm for the licenced activity, unless approved by the Administering Agency.

DISCHARGES

21. This licence authorises the controlled discharge of treated water from the authorised discharge point as identified in Table 2.

22. The licensee must ensure that the controlled discharge of treated water from the authorised discharge point consist only of water from the source identified in Table 2.

Table 2 Authorised Discharge Point

Authorised Discharge Point	Source	Location
RP3	Treated water is pumped from Batman Pit to the authorised discharge point which is fitted with a diffuser to aid dispersion.	Latitude: -14.139117° Longitude: 132.111550°

Note: See Figure 1 for map showing locations.

23. The licensee must ensure that all discharge events at the authorised discharge point take place when there is sufficient flow in Edith River to meet the trigger values specified in Appendix 1.

24. The licensee must, for the authorised discharge point, install, operate and maintain a device to measure and record, for each discharge event:

    24.1. the time the discharge commenced and the duration of the discharge;

    24.2. the discharge rate of flow; and

    24.3. the discharge volume.

25. The licensee must, within 24 hours of commencing discharge from the authorised discharge point identified in Table 2, notify the Administering Agency by emailing waste@nt.gov.au.

26. The licensee must, within 24 hours of ceasing discharge from the authorised discharge point identified in Table 2, notify the Administering Agency by emailing waste@nt.gov.au.

27. The licensee must ensure that the discharge from all discharge events at each authorised discharge point does not:

    27.1. contain any floating debris, oil, grease, petroleum hydrocarbon sheen, scum, litter or other objectionable matter;

    27.2. cause or generate odours which would adversely affect the use of surrounding waters;

    27.3. cause algal blooms in the receiving water;

    27.4. cause visible change in the behaviour of fish or other aquatic organisms in the receiving water;

    27.5. cause mortality of fish or other aquatic organisms; or

    27.6. cause adverse impacts on plants.

28. The licensee must, within 24 hours after first becoming aware of a non-compliance as described in condition 49:

    28.1. cease discharge of water from the authorised discharge point;

    28.2. notify and provide an investigation report to the Administering Agency in accordance with conditions of this licence;

    28.3. implement corrective actions to achieve the water quality objectives specified in condition 27, prior to recommencing discharge.

MONITORING

29. The licensee must conduct surface water monitoring in accordance with Appendix 1.

30. The licensee must assess the concentration of pollutants at the compliance point, SW4, against site specific trigger values specified in Appendix 1.

31. The licensee must maintain continuous water quality monitoring equipment to ensure it is capable of undertaking continuous water quality monitoring at RP3 and SW4 for the duration of any month when a discharge occurs.

32. The licensee must ensure that the continuous water quality monitoring equipment:

    32.1. measures water flow rate, pH, electrical conductivity and temperature at intervals sufficient to detect a change relevant to the parameter being measures and the duration of discharge;

    32.2. measures, records and transmits measured data in real time to the Vista Gold data management system; and

    32.3. achieves greater than or equal to 90% valid data capture for all measurements.

33. The licensee must implement, maintain and follow the Biological Monitoring Program as specified in Table 1 for the life of this licence.

34. The licensee must implement, maintain and follow the Sediment Monitoring Program as specified in Table 1 for the life of this licence.

35. The licensee must implement, maintain and follow the Ecotoxicology Plan as specified in Table 1 for the life of this licence.

36. The licensee must revert back to the previously approved Ecotoxicological Plan if the results of the current Ecotoxicological Plan confirm the presence of toxicity at SW4.

37. The licensee must ensure that all samples and field environmental data are representative of the conditions at the time of sampling.

38. The licensee must ensure that all samples and field environmental data are collected in accordance with current recognised Australian Standards and guidelines (such as AS/NZS 5667, ANZECC/ARMCANZ)

39. The licensee must for all land based monitoring points specified in the licence:

    39.1. install and maintain appropriate identification signage so that they are reasonably identifiable at all times; and

    39.2. maintain safe access and egress, as is reasonable practicable.

40. 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.

41. The licensee must for all land based monitoring points specified in the Monitoring Plan:

    41.1. install and maintain appropriate identification signage so that they are reasonably identifiable at all times; and

    41.2. maintain safe access and egress, as is reasonably practicable.

42. The licensee must ensure any samples collected in accordance with this licence, are obtained by, or under the supervision of a qualified sampler.

43. The licensee must ensure that, for each sample collected in accordance with the Monitoring Plan or the activity the following information must be recorded and retained:

    43.1. the date on which the sample was collected;

    43.2. the time at which the sample was collected;

    43.3. the location at which the sample was collected;

    43.4. the name of the person who collected the sample;

    43.5. the chain of custody forms relating to the sample;

    43.6. the field measurements (if any) and analytical results (if any) relating to the sample; and

    43.7. laboratory quality assurance and quality control documentation.

RECORDING AND REPORTING

44. The licensee must keep records of all non-compliances with this licence. These records must be adequate to enable the licensee to comply with the non-compliance notification conditions of this licence.

45. The licensee must notify the Administering Agency of any non-compliance with this licence by emailing waste@nt.gov.au, within 24 hours after first becoming aware of the non-compliance.

46. The licensee must include in the notification of non-compliance the following information:

    46.1. when the non-compliance was detected and by whom;

    46.2. the date and time of the non-compliance;

    46.3. the actual and potential causes and contributing factors to the non-compliance;

47. The licensee must, within 10 business days of the notifying the Administering Agency of the non-compliance provide an incident investigation report to the Administering Agency.

48. The licensee must ensure that the incident investigation report includes the following information:

    48.1. when the non-compliance was detected and by whom;

    48.2. the date and time of the non-compliance;

    48.3. the actual and potential causes and contributing factors to the non-compliance;

    48.4. the risk of environmental harm arising from the non-compliance;

    48.5. the action(s) that have or will be undertaken to mitigate any environmental harm arising from the non-compliance;

    48.6. corrective actions that have or will be undertaken to ensure the non-compliance does not reoccur; and

    48.7. if no action was taken, why no action was taken.

49. A non-compliance with this licence includes:

    49.1. an exceedance of a SSTV at SW4, as specified in Appendix 1, on two consecutive sampling occasions;

    49.2. an exceedance of a SSTV at SW4, as specified in Appendix 1, of two times or more a trigger value on a single occasion; and

    49.3. subsequent consecutive exceedances of the SSTV from an exceedance described in condition 49.1 and 49.2.

50. The licensee must keep records of all exceedances of SSTVs specified in Appendix 1 of this licence.

51. The licensee must ensure that the records of the SSTV exceedance includes the following information:

    51.1. when the exceedance was detected and by whom;

    51.2. the date and time of the exceedance;

    51.3. the actual and potential causes and contributing factors to the exceedance;

    51.4. the risk of environmental harm arising from the exceedance;

    51.5. the action(s) that have or will be undertaken to address the exceedance and/or environmental harm; and

    51.6. if no action was taken, why no action was taken.

52. The licensee must submit to the Administering Agency a Monthly Discharge Report for any month when a discharge occurs via the authorised discharge point by emailing waste@nt.gov.au. The Monthly Discharge Report is due by the last business day of the following month and must include:

52.1. tabulated water quality data for RP3 and SW4 for each day of the month where a discharge occurred. Data must be provided electronically in Microsoft Excel format;

52.2. tabulated daily environmental field data, relating to the particular month, for SW4 and RP3 as required in Appendix 1. Data must be provided electronically in Microsoft Excel format;

52.3. tabulated water quality data for all monitoring locations associated with this licence and specified in Appendix 1. Data must be provided electronically in Microsoft Excel format;

52.4. surface water quality management actions taken in the event of trigger value exceedance measured at SW4;

52.5. assessment of surface water monitoring results for SW4 against the SSTVs specified in Appendix 1;

52.6. where SSTVs were exceeded an assessment of the environmental impact, resulting from the discharge activity and exceedances, on the receiving environment at SW4; and

52.7. details of current water inventory on site.

53. The licensee must submit a completed Annual Return, by emailing waste@nt.gov.au, by 30 August, unless otherwise agreed, for each year of this licence, which report relates to the preceding 12 month period.

54. The licensee must complete and provide to the Administering Agency a Monitoring Report, as prescribed by this licence by 30 August for each year of this licence, unless otherwise agreed, which report relates to the preceding 12 month period.

55. The licensee must ensure that each Monitoring Report:

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

55.2. includes a tabulation of all monitoring data required as a condition of this licence. Data must be provided electronically in Microsoft Excel format;

55.3. includes long term trend analysis of monitoring data to demonstrate any environmental impact associated with the activity over a minimum period of three years (where the data is available). Data used in this analysis must be provided electronically in Microsoft Excel format; and

55.4. includes an assessment and determination of environmental impact determined by the Receiving Environment Monitoring Program specified in Table 1.

PERFORMANCE IMPROVEMENT

56. The licensee must provide to the Administering Agency, prior to commencing authorised discharge for the 2018/19 wet season, the final version of the Water Management Plan.

57. The licensee must implement, maintain and follow the approved final version of the Water Management Plan following the Administering Agency review for the life of this licence.

58. The licensee must provide to the Administering Agency an updated Receiving Environment Monitoring Plan, prior to commencing authorised discharge for the 2018/19 wet season, to include the following:

58.1. in addition to edge habitat sampling, riffle habitat sampling must also be done;

58.2. the Receiving Environment Monitoring Plan should be designed to detect impact through multivariate, ANOVA and other analyses. Hypotheses and the statistical test (and support design) should to be explicit in the document; and

58.3. recommendations from the 2017/18 monitoring program.

59. The licensee must implement, maintain and follow the approved final version of the Receiving Environment Monitoring Plan following the Administering Agency review for the life of this licence.

END OF LICENCE CONDITIONS

This licence is not valid unless signed below:

JOANNE TOWNSEND

Controller of Water Resources

Dated the 25 September 2019

END NOTES

This licence supersedes WDL178-06 which was issued 26 November 2018

WDL178-05 was issued on 16 January 2017

WDL178-4 was issued on 23 December 2014

WDL178-3 was issued on 26 November 2013

WDL178-2 was issued on 5 February 2013

WDL178-1 was issued on 9 March 2012

WDL178 was issued on 21 January 2011

DEFINITIONS

In this licence, unless a contrary intention appears:

Term	Definition
24 hour emergency contact	the phone number of a person who can be contacted at any time and be capable of responding to and providing information about any incident associated with the activity.
Activity	the Licenced activity as described on the covering page of this licence.
Administering Agency	means the Department of Environment and Natural Resources, or if dissolved, another Government Department with responsibility for administering the Water Act.
Annual Return	an Administering Agency prescribed format for demonstrating and reporting compliance with the conditions of this licence.
ANZECC/ARMCANZ	Australian and New Zealand Environment and Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand, 2000: National Water Quality Management Strategy: *Australian Guidelines for Water Quality Monitoring and Reporting.*
Business days	a day not Saturday, Sunday or a public holiday, in the Northern Territory.
Community feedback number	a telephone number enabling members of the public to contact, at any time, a person or voice mail system that can accept, on behalf of the licensee, enquiries or complaints about the activity, and to which the licensee must respond.
Complaint Log	a register of complaints to be maintained by the Licensee that records the details of each complaint received in relation to the activity.
Consultation and Communication Plan	a written plan documenting proposed consultation and communications for the activity before, during and after the activity which includes a strategy for communicating with members of the public who are likely to have a real interest in, or be affected by, the activity.
Contact details	includes the 24 hour emergency contact, and name, position title and phone number of a representative of the licensee who can be contacted about the licence and activity.
Contaminant	a solid, liquid or gas or any combination of such substances and includes: (a) noise, odour, heat and electromagnetic radiation; (b) a prescribed substance or prescribed class of substances; and (c) a substance having a prescribed property or prescribed class of properties.
Discharges	allow a liquid, gas or other substance to flow out from where it has been confined.
Emergency Response Plan	a written plan documenting the licensee's procedures for responding to emergencies caused by, resulting from or associated with the activity and that may cause environmental harm.
Environmental harm	any harm to or adverse effect on, or potential harm to or potential adverse effect on, the environment
incident	includes: (a) an accident, emergency or malfunction; and (b) a deliberate action, whether or not that action was taken by the person conducting the activity in the course of which the incident occurred.

Term	Definition
Land	includes water and air on, above or under land.
Maintain	kept in a manner that it does not present or cause a risk of environmental harm or a hazard to persons or property or, for the purposes of documents including plans, a process of reviewing and amending documentation to ensure it is relevant.
Material environmental harm	environmental harm that: (a) is not trivial or negligible in nature; (b) results, or is likely to result, in not more than $50,000 or prescribed amount (whichever is greater) being spent in taking appropriate action to prevent or minimise the harm or rehabilitate the environment; or (c) results in actual or potential loss or damage to the value of not more than $50,000.
NATA	National Association of Testing Authorities, Australia.
Non-compliance	failure or refusal to comply, whether by act or omission, with obligations or requirements and includes any exceedance of a licence limit.
Non-compliance notification	an Administering Agency prescribed format for notifying the Administering Agency of a non-compliance.
Plant and equipment	all material items used in association with the activity, including (but not limited to) storage vessels and containers, pipe work and hosing, vehicles (including vessels), tools, and measuring equipment.
Point source discharge	means any discernible, confined or discrete conveyance from which contaminants or waste are or may be discharged.
Pollute	in relation to water, means directly or indirectly to alter the physical, thermal, chemical, biological or radioactive properties of the water so as to render it less fit for a prescribed beneficial use for which it is or may reasonably be used, or to cause a condition which is hazardous or potentially hazardous to: (a) public health, safety or welfare; (b) animals, birds, fish or aquatic life or other organisms; or (c) plants.
Pollution	(a) a contaminant or waste that is emitted, discharged, deposited or disturbed or that escapes; or (b) a contaminant or waste, effect or phenomenon, that is present in the environment as a consequence of an emission, discharge, deposition, escape or disturbance or a contaminant or waste.
Premises	the premises identified in this licence which includes equipment, plant and structures, whether stationary or portable, and the land on which premises are situated.
Public entrance	access to the premises that is utilised by the public.
Qualified person	a person registered under Section 68 of the WMPC Act.
Qualified sampler	a person who has training and experience in obtaining samples from the relevant environmental medium.
Serious environmental harm	environmental harm that is more serious than material environmental harm and includes environmental harm that: (a) results or is likely to result in more than $50,000 or prescribed amount (whichever is greater) being spent in taking appropriate

Term	Definition
	action to prevent or minimise the harm or rehabilitate the environment; (b) results in actual or potential loss or damage to the value of more than $50,000; (c) damages an aspect of the environment that is of a high conservation value or of special significance; and (d) is irreversible or otherwise of a high impact or on a wide scale.
Trigger values	assigned value for each indicator used to assess the risk to an environmental value, a value that initiates some type of pre-defined management action.
Waste	Includes matter or a thing, whether wholly or partly in a solid, liquid or gaseous state, which, if added to water, may pollute the water.
Wastewater	water that contains a contaminant or waste.
Water	means water, whether or not it contains impurities.
WMPC Act	the Northern Territory *Waste Management and Pollution Control Act*.

APPENDIX 1: SURFACE WATER MONITORING PROGRAM

Site Code	SW2	SW13	SW3	SW10[1]	RP3 (Batman Pit)	SW4 Online	SW4 Compliance	
Description	Non-Impacted Reference Site in Edith River	Non-Impacted Reference Site in Stow Creek	Impacted Information Site in Stow Creek	Impacted Downstream Information Site in Edith River	Wastewater Discharge Source Batman Pit	Continuous real-time in situ telemetry station in Edith River	Compliance Point in Edith River	
Longitude	-14.17195°	-14.15605°	-14.16144°	-14.18464°	-14.14109°	- 14.16925°	-14.17067°	
Latitude	132.11990°	132.12989°	132.11851°	132.03037°	132.10322°	132.09835°	132.09835°	

Parameter	Abbrev.	Units	Sample Type	Sample Frequency							SSTV[3]
Environmental Field Data											
Daily Site Rainfall	Rain	mm	Field measure	N/A	N/A	N/A	N/A	D	N/A	N/A	N/A
Daily Site Evaporation	Evap	mm	Field measure	N/A	N/A	N/A	N/A	D	N/A	N/A	N/A
Daily Maximum Air Temperature	T_{max}	° C	Field measure	N/A	N/A	N/A	N/A	D	N/A	N/A	N/A
Daily Minimum Air Temperature	T_{min}	° C	Field measure	N/A	N/A	N/A	N/A	D	N/A	N/A	N/A
Pumping Rate	Discharge	L/s	Field measure	N/A	N/A	N/A	N/A	D	N/A	N/A	N/A

			Site Code	SW2	SW13	SW3	SW10[1]	RP3 (Batman Pit)	SW4 Online	SW4 Compliance	
Cumulative Discharge Volume	Cum Discharge	m^3	Calculation	N/A	N/A	N/A	N/A	C	N/A	N/A	N/A
River Flow	Flow	m^3	Calculation	N/A	N/A	N/A	N/A	N/A	C	N/A	N/A
Water Level	Gauge height	m	Field measure	N/A	N/A	N/A	N/A	D	C	N/A	N/A
Dissolved Oxygen[4]	DO	% saturation	Field measure	D	M	M	M	D	N/A	D	85 - 120
Water Temperature	T_{water}	°C	Field measure	D	M	M	M	D	C	D	N/A
Electrical conductivity[4]	EC	µS/cm	Field & lab measure	D	M	M	M	D	N/A	D	250
Electrical conductivity[5]	EC	µS/cm	Field measure	N/A	N/A	N/A	N/A	D	C	N/A	N/A
pH[4]	pH	pH units	Field measure	D	M	M	M	D	N/A	D	6.0 – 8.0
pH[5]	pH	pH units	Field measure	N/A	N/A	N/A	N/A	D	C	N/A	N/A
Metals and Metalloids											
Aluminium	Al	µg/L	Filtered	WF	M	M	M	WF	N/A	WF	150
Aluminium	Al	µg/L	Total	WF	M	M	M	WF	N/A	WF	N.D
Cadmium	Cd	µg/L	Filtered	WF	M	M	M	WF	N/A	WF	0.8
Cadmium	Cd	µg/L	Total	WF	M	M	M	WF	N/A	WF	N.D
Cobalt	Co	µg/L	Filtered	WF	M	M	M	WF	N/A	WF	13[10]

			Site Code	SW2	SW13	SW3	SW10[1]	RP3 (Batman Pit)	SW4 Online	SW4 Compliance	
Copper	Cu	µg/L	Filtered	WF	M	M	M	WF	N/A	WF	2.5
Copper	Cu	µg/L	Total	WF	M	M	M	WF	N/A	WF	N.D
Chromium[6]	Cr	µg/L	Filtered	WF	M	M	M	WF	N/A	WF	N.D
Iron	Fe	µg/L	Filtered	WF	M	M	M	WF	N/A	WF	350
Iron	Fe	µg/L	Total	WF	M	M	M	WF	N/A	WF	N.D
Lead	Pb	µg/L	Filtered	WF	M	M	M	WF	N/A	WF	9.4
Manganese	Mn	µg/L	Filtered	WF	M	M	M	WF	N/A	WF	3,600
Nickel	Ni	µg/L	Filtered	WF	M	M	M	WF	N/A	WF	17
Zinc	Zn	µg/L	Filtered	WF	M	M	M	WF	N/A	WF	31
Nutrients											
Total Nitrogen[2]	TN	µg/L	Total	WF	M	M	M	WF	N/A	WF	N.D
Total phosphorus	TP	µg/L	Total	WF	M	M	M	WF	N/A	WF	N.D
Organic carbon (total)	TOC	mg/L	Total	N/A	N/A	N/A	M	N/A	N/A	M	N.D
Major Ions											
Bicarbonate	HCO_3	mg/L	Filtered	WF	M	M	M	WF	N/A	WF	319
Calcium	Ca	mg/L	Filtered	WF	M	M	M	WF	N/A	WF	N.D
Carbonate	CO_3	mg/L	Filtered	WF	M	M	M	WF	N/A	WF	N.D
Chloride	Cl	mg/L	Filtered	WF	M	M	M	WF	N/A	WF	64
Sodium	Na	mg/L	Filtered	WF	M	M	M	WF	N/A	WF	N.D
Magnesium	Mg	mg/L	Filtered	WF	M	M	M	WF	N/A	WF	21[9]

			Site Code	SW2	SW13	SW3	SW10[1]	RP3 (Batman Pit)	SW4 Online	SW4 Compliance	
Potassium	K	mg/L	Filtered	WF	M	M	M	WF	N/A	WF	N.D
Sulphate	SO42-	mg/L	Filtered	WF	M	M	M	WF	N/A	WF	129
Total Dissolved Solids	TDS	mg/L	Calculated	WF	M	M	M	WF	N/A	WF	N.D
Other Water Quality Parameters											
Hardness	hardness as CaCO3	mg/L	Filtered	WF	M	M	M	WF	N/A	WF	N.D
Total Suspended Solids[7]	TSS	mg/L	Total	WF	M	M	M	WF	N/A	WF	N.D
Total Cyanide[8]	HCN	µg/L	Total	M	M	M	M	M	N/A	WF	7

NOTE: Monitoring in accordance with this program is only required during months where a discharge is occurring from the authorised discharge point. Where a discharge ceases prior to the end of the month monitoring must continue until for at least 7 days after ceasing discharge

KEY:

Filtered: All filtered samples must be filtered in the field at the time of sample collection using membrane filters with pore diameter of 0.45µm

N.D: Not Determined

N/A: Not Applicable

C: Continuous, real-time, online measurement

D: Daily during months where a discharge is occurring from the authorised discharge point

WF: Weekly when discharging and at least once per discharge event, fortnightly when not discharging during months where a discharge is occurring from the authorised discharge point

M: Monthly during months where a discharge is occurring from the authorised discharge point

FOOTNOTES:

[1] The licensee is no longer required to monitor SW10. The licensee must resume monitoring of SW10, in accordance with this monitoring program, if at any time during the life of this licence, the licensee or the Administering Agency determine that the water quality at SW4 is deteriorating.

[2] The licensee must resume monitoring of NO_2, NO_3 and NH_3 at the same locations and frequency as total nitrogen if the concentration of total nitrogen increases for three monitoring rounds in succession or the licensee or administering agency identifies an increasing trend in total nitrogen.

[3] SSTVs are derived from 80th percentile of reference site dataset at SW2, being the Edith River ambient water quality and default ANZECC values for 80% species protection. SSTVs only apply to SW4 as the Compliance Point. SSTVs do not apply to SW4 online data.

[4] Field measurements must be taken using a properly maintained and calibrated hand-held field instrument and the reading compared to the SSTV. The laboratory measurement value is for information.

[5] The online value measured is for operational control to provide warning that water quality has changed and to trigger operational corrective action, if required.

[6] If total Chromium of the filtered sample returns a result greater than the practical quantification limit, the sample is to be reanalyses for speciated Chromium.

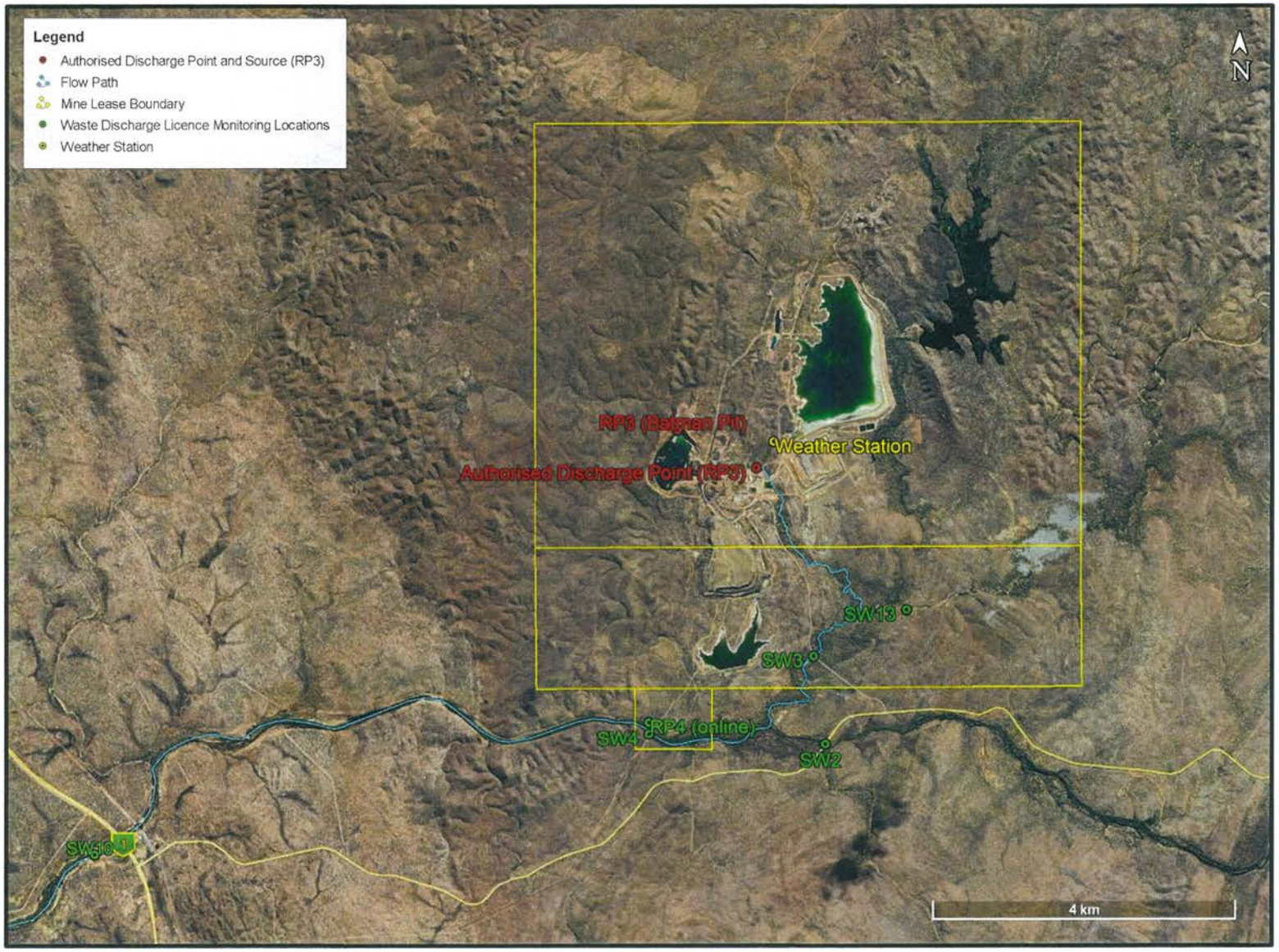
[7] Calculated using residue remaining on filter with nominal pore size of 0.45 µm.

[8] WAD Cyanide is required if Total Cyanide analysis (by APHA 4500-CN-C) is greater than 4 µg/L. WAD cyanide must then be conducted on the same day as the analysis for Total Cyanide.

[9] The trigger value for Magnesium was derived by ERISS for protection of Magela Creek for 80% species protection.

[10] The trigger value for Cobalt is a Canadian guideline adopted by ANZECC.

FIGURE 1 – LOCATION OF WDL POINTS OF INTEREST



APPENDIX B

2019/20 Water Quality Results

Mt Todd Gold Mine - 2019/20 Water Quality Data

LEGEND	Exceeds SSTV
	Was below detection limit/LOR. < has been
	Discharge was occuring

		Field Data			Major Ions									Nutrients		Metals (filtered)											Metals (total)				Other		
LOCATION	DATE	pH	EC	DO	Bicarbonate	Calcium	Carbonate	Chloride	Sodium	Magnesium	Potassium	Sulphate	TDS	Total Nitrogen	Total Phosphorus	Al	Cd	Cr	Co	Cu	Fe	Pb	Mn	Ni	Zn	Al	Cd	Cu	Fe	Hardness	TSS	Cyanide (total)
			µS/cm	% Sat	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	mg/L	mg/L	µg/L
SW2	31-12-2020	6.18	36.4	69.3																												
SW2	15-01-2020	5.96	45.8	87.5																												
SW2	31-01-2020							0.01								36.8	0.02	0.5	0.045	0.51	1410	0.05	41.4	0.62	1.2	180	0.02	0.54	3650			0.005
SW2	02-02-2020	6.09	28.6	74.7	1	1.3	8	2	1.9	0.9	1.4	0.1	20			41	0.02	0.4	0.33	0.44	876	0.03	26	0.51	1.2	1430	0.02	1.04	3820	7.1	60	
SW2	03-02-2020	6.06	25.1	82.1																												
SW2	16-02-2020	6.02	22.9	81.8	9	0.9	1	2	1.7	0.7	1.1	0.3	80			94.8	0.02	0.4	0.08	0.47	644	0.06	8.31	0.46	0.7	2000	0.02	1.04	3230	4.9	10	0.005
SW2	18-02-2020	5.70	27.8	81																												
SW2	26-02-2020	6.18	21.7	87.3	6	0.8	1	2	0.9	0.7	1.7	0.3	30			52.6	0.02	0.1	0.33	0.68	532	0.06	41.2	0.28	1	3300	0.02	3.17	4440	5.1	150	
SW2	27-02-2020	6.01	18.2	89.9																												
SW2	28-02-2020	6.01	19.2	91.8																												
SW2	29-02-2020	6.00	19.5	90.4												65	0.02	0.3	0.17	0.81	244	0.01	9.6	0.31	1	1320	0.02	1.22	1070			0.005
SW2	01-03-2020	6.06	19.4	88.8												70	0.01	1	1	1	230	1	9	1	2	1300	0.1	1	840			0.004
SW2	02-03-2020	6.10	19.8	89.2																												
SW2	03-03-2020	6.18	19.2	89.9																												
SW2	04-03-2020	6.05	20.6	91.3	5	0.7	1	4	1.8	0.7	0.7	0.2	20			68.7	0.02	0.3	0.19	0.72	318	0.02	12.2	0.37	1.6	844	0.02	1.15	1300	4.6	10	
SW2	09-03-2020	6.03	17.7	91.7	5	0.7	1	2	1.3	0.6	0.9	0.3	20			96.6	0.02	0.3	0.15	1.04	294	0.04	8.07	0.4	7.4	3300	0.02	1.81	2050	4.3	20	
SW2	24-03-2020	6.10	24.4	64	8	1	1	2	2.1	1	0.5	0.1	30			25.2	0.02	0.3	0.3	0.42	774	0.02	27.8	0.44	5.3	126	0.02	0.53	2840	6.5	10	
SW2	31-03-2020	6.12	23.7	81.8												20	0.1	1	1	1	520	1	21	1	2	50	0.1	1	2100		8	0.004
SW2	27-04-2020	6.14	23.7	81.8												10	0.1	1	1	1	400	1	47	1	2	30	0.1	2	2600		6	0.004
	Count	18	18	18	6	6	6	7	6	6	6	6	6			11	11	11	11	11	11	11	11	11	11	11	11	11	11	6	8	6
	Minimum	5.70	17.70	64.00	1.0	0.70	1	0.01	0.90	0.6	0.5	0.1	20			10.0	0.01	0.10	0.05	0.42	230	0.01	8.07	0.28	0.7	30	0.02	0.53	840	4.3	6	0.004
	Median	6.06	22.30	87.40	5.5	0.85	1	2	1.75	0.7	1.0	0.3	25			52.6	0.02	0.40	0.30	0.72	520	0.05	21	0.46	1.6	1300	0.02	1.04	2600	5.0	10	0.005
	Maximum	6.18	45.80	91.80	9.0	1.30	8	4	2.10	1.0	1.7	0.3	80			96.6	0.10	1.00	1.00	1.04	1410	1.00	47	1.00	7.4	3300	0.10	3.17	4440	7.1	150	0.005
	SSTV @ SW4	6.0-8.0	250	85-120	319			64		21		129				150	0.8		13	2.5	350	9.4	3600	17	31							7

		Field Data			Major Ions									Nutrients		Metals (filtered)											Metals (total)				Other		
LOCATION	DATE	pH	EC	DO	Bicarbonate	Calcium	Carbonate	Chloride	Sodium	Magnesium	Potassium	Sulphate	TDS	Total Nitrogen	Total Phosphorus	Al	Cd	Cr	Co	Cu	Fe	Pb	Mn	Ni	Zn	Al	Cd	Cu	Fe	Hardness	TSS	Cyanide (total)
			µS/cm	% Sat	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	mg/L	mg/L	µg/L
SW3	04-12-2019	5.97	38.00	63.80																												
SW3	21-12-2019	6.48	66.10	34.40																												
SW3	23-12-2019	6.05	70.80	60.90																												
SW3	31-12-2019	6.31	164.00	79.50																												
SW3	02-01-2020	6.34	126.60	83.90																												
SW3	15-01-2020	5.96	100.70	84.90																												
SW3	30-01-2020	6.31	164	79.5																												
SW3	31-01-2020				12	7		2	8.1	7.8	3.5	52.3	130	0.43	0.25	6.4	0.02	0.1	0.81	0.82	78	0.04	86	0.61	1.7	682	0.04	1.65	1490	49.3	20	0.005
SW3	18-02-2020	6.21	254.7	84.6																												
SW3	26-02-2020	6.2	222.4	90.28																												
SW3	27-02-2020	6.03	110.5	92.8																												
SW3	29-02-2020	6.04	565	96																												
SW3	01-03-2020				5	54		2	12.9	32.1	2.7	276	10	0.53	0.005	9.5	2.96	0.1	7.23	7.73	70	0.03	260	20.4	345	922	3.1	14.4	968	267	10	0.005
SW3	04-03-2020				4	41.4		2	10	24.4	2.3	207	320			8.7	2.42	0.1	5.56	6.77	64	0.03	201	16.6	276					204	10	
SW3	31-03-2020	6.24	225.9	97	5	11	5	3	10	13	2.8	83		0.2		10	0.1	1	1	1	16	1	58	1	8	30	0.1	1	320	79		0.004
	Count	12	12	12	4	4	1	4	4	4	4	4	3	3	2	4	4	4	4	4	4	4	4	4	4	3	3	3	3	4	3	3
	Minimum	6.0	38.0	34.4	4	7.0	5.0	2.0	8.1	7.8	2.3	52.3	10	0.2	0.0	6.4	0.0	0.1	0.8	0.8	16.0	0.03	58.0	0.6	1.7	30	0.0	1.0	320.0	49.3	10	0.004
	Median	6.2	145.3	84.3	5	26.2	5.0	2.0	10.0	18.7	2.8	145	130	0.4	0.1	9.1	1.3	0.1	3.3	3.9	67.0	0.04	143.5	8.8	142	682	0.1	1.7	968.0	141.5	10	0.005
	Maximum	6.5	565.0	97.0	12	54.0	5.0	3.0	12.9	32.1	3.5	276	320	0.5	0.3	10.0	3.0	1.0	7.2	7.7	78.0	1.00	260.0	20.4	345	922	3.1	14.4	1490.0	267.0	20	0.005
	SSTV @ SW4	6.0-8.0	250	85-120	319			64		21		129				150	0.8		13	2.5	350	9.4	3600	17	31							7

		Field Data			Major Ions									Nutrients			Metals (filtered)										Metals (total)				Other		
LOCATION	DATE	pH	EC µS/cm	DO % Sat	Bicarbonate mg/L	Calcium mg/L	Carbonate mg/L	Chloride mg/L	Sodium mg/L	Magnesium mg/L	Potassium mg/L	Sulphate mg/L	TDS mg/L	Total Nitrogen µg/L	Total Phosphorus µg/L	TOC mg/L	Al µg/L	Cd µg/L	Cr µg/L	Co µg/L	Cu µg/L	Fe µg/L	Pb µg/L	Mn µg/L	Ni µg/L	Zn µg/L	Al µg/L	Cd µg/L	Cu µg/L	Fe µg/L	Hardness mg/L	TSS mg/L	Cyanide (total) µg/L
SW4	23-12-2019	6.06	53.5	50																												
SW4	31-12-2019	6.23	95.9	74.2																												
SW4	15-01-2020	5.96	45.8	87.5																												
SW4	28-01-2020	6.21	79.4	56.5																												
SW4	31-01-2020															7	32.6	0.02	0.4	0.64	0.85	1220	0.09	78	0.71	3.1	291	0.02	0.94	2830			0.005
SW4	02-02-2020	6.03	47	91.5	1	1.7	3	2	2.5	1.9	1.5	11.7					54	0.04	0.2	0.91	1.75	286	0.13	80.3	1.09	8.4	2280	0.04	4.7	3160	12.2	110	0.005
SW4	03-02-2020	6.02	255.2	84.7																												
SW4	16-02-2020	6.16	132.6	87.7	13	5.8	1	8	6.4	5.8	2.4	41.3	3210				83.9	0.06	0.3	0.6	1.28	602	0.16	88.1	1.08	7.4	1850	0.06	2.66	2600	38.1	10	
SW4	18-02-2020	6.05	102.5	78.4																												
SW4	26-02-2020	6.22	49.4	86.8	8	2	1	2	2.2	1.9	1.8	9.2	40				19.2	0.02	1	0.49	1.22	420	0.14	46.1	0.72	4.2	1970	0.06	3.05	3790	12.9	120	0.005
SW4	27-02-2020	5.85	66	82.1																												
SW4	28-02-2020	5.9	112.3	94																												
SW4	29-02-2020	6.01	137.5	91.4												5	28.2	0.42	0.2	1.34	2.47	144	0.01	55.1	3.7	52.8	1480	0.4	4.1	1120			0.005
SW4	01-03-2020	6.06	120.7	89.7												3	30	0.4	1	1	2	130	1	53	4	53	960	0.5	3	600			0.004
SW4	02-03-2020	6.05	110.1	88.6																												
SW4	03-03-2020	6.26	120.2	89																												
SW4	04-03-2020	6.15	112.4	90	6	8.2	1	2	3.2	5.1	1.2	38.1	80				24.9	0.38	0.2	1.07	1.91	188	0.02	47.9	3.16	48.9	1030	0.38	3.28	1180	41.6	10	0.005
SW4	09-03-2020	6.01	33.7	90.5	5	1.3	1	2	2.3	1.4	1	6.8	40				64.6	0.02	0.2	0.47	1.8	220	0.1	30.3	0.79	12.1	3060	0.04	4.07	2070	9.2	30	0.005
SW4	24-03-2020	6.4	82.9	81.1	7	3.7	1	2	4.5	4	1.2	23.4	60				14.6	0.02	0.2	0.82	0.7	596	0.03	46.8	1	7.6	106	0.02	1.24	2710	25.6	10	0.005
SW4	31-03-2020	6.13	59.7	90.9												3	10	0.1	1	1	1	520	1	29	1	3	50	0.1	1	1900			0.004
SW4	27-04-2020	6.48	31.8	98.7												3	10	0.1	1	1	1	590	1	18	1	3	30	0.1	2	2000			0.004
	Count	20	20	20	6	6	6	6	6	6	6	6	5			5	11	11	11	11	11	11	11	11	11	11	11	11	11	11	6	6	10
	Minimum	5.85	31.80	50.00	1.00	1.30	1	2.00	2.20	1.40	1.00	6.80	40			3.00	10.0	0.02	0.20	0.47	0.70	130	0.01	18.0	0.71	3.00	30.00	0.02	0.94	600	9.20	10	0.004
	Median	6.06	89.40	88.15	6.50	2.85	1	2.00	2.85	2.95	1.35	17.55	60			3.00	28.2	0.06	0.30	0.91	1.28	420	0.13	47.9	1	7.60	1030.00	0.06	3.00	2070	19.25	20	0.005
	Maximum	6.48	255.20	98.70	13.00	8.20	3	8.00	6.40	5.80	2.40	41.30	3210			7.00	83.9	0.42	1.00	1.34	2.47	1220	1.00	88.1	4	53.00	3060.00	0.50	4.70	3790	41.60	120	0.005
	SSTV @ SW4	6.0-8.0	250	85-120	319			64		21		129					150	0.8		13	2.5	350	9.4	3600	17	31							7

		Field Data			Major Ions									Nutrients			Metals (filtered)										Metals (total)				Other		
LOCATION	DATE	pH	EC µS/cm	DO % Sat	Bicarbonate mg/L	Calcium mg/L	Carbonate mg/L	Chloride mg/L	Sodium mg/L	Magnesium mg/L	Potassium mg/L	Sulphate mg/L	TDS mg/L	Total Nitrogen µg/L	Total Phosphorus µg/L	TOC mg/L	Al µg/L	Cd µg/L	Cr µg/L	Co µg/L	Cu µg/L	Fe µg/L	Pb µg/L	Mn µg/L	Ni µg/L	Zn µg/L	Al µg/L	Cd µg/L	Cu µg/L	Fe µg/L	Hardness mg/L	TSS mg/L	Cyanide (total) µg/L
SW13	31-01-2020	6.55	23.2	101.8	7	0.9		2	1	1	1.5	0.3	30	0.42	0.03	6	156	0.02	0.2	0.12	0.52	438	0.11	15.5	0.53	0.6	781	0.02	0.79	1620	6.3	10	0.005
SW13	29-02-2020	6	15.6	100.8																													
SW13	01-03-2020				4	0.4		0.055	1.2	0.5	0.6	0.3	20	0.21	0.015	3	29.9	0.02	0.1	0.16	0.29	134	0.3	16.8	0.34	0.4	1160	0.02	0.68	1070	3	10	0.005
SW13	31-03-2020	6.45	15.7	106.7	5	0.5	5	2	1.3	0.5	0.5	1		0.1		2	20	0.1	1	1	1	120	1	12	1	1	60	0.1	1	400	3		0.004
	Median	6.45	15.7	101.8	5	0.5		2	1.2	0.5	0.6	0.3	25	0.21		3	29.9	0.02	0.2	0.16	0.52	134	0.3	15.5	0.53	0.6	781	0.02	0.79	1070	3	10	0.005

		Field Data			Major Ions									Nutrients		Metals (filtered)										Metals (total)				Other		
LOCATION	DATE	pH	EC µS/cm	DO % Sat	Bicarbonate mg/L	Calcium mg/L	Carbonate mg/L	Chloride mg/L	Sodium mg/L	Magnesium mg/L	Potassium mg/L	Sulphate mg/L	TDS mg/L	Total Nitrogen µg/L	Total Phosphorus µg/L	Al µg/L	Cd µg/L	Cr µg/L	Co µg/L	Cu µg/L	Fe µg/L	Pb µg/L	Mn µg/L	Ni µg/L	Zn µg/L	Al µg/L	Cd µg/L	Cu µg/L	Fe µg/L	Hardness mg/L	TSS mg/L	Cyanide (total) µg/L
RP3	02-07-2019	7.05	2963	102	1	421	21	8	53	218	8.5	1900	2940	187			22	0.5	8.88		10	0.2		147			22.4		36	1950	10	0.005
RP3	29-07-2020				17	400		8	47	220	8.4	2000	3100			10	20	1	26	10	10	1	370	150	1700					1900	5	0.004
RP3	30-07-2019	7.17	2982	102.8	1	435	22	8	54.8	221	8.7	2010	2980	188		25.4	21.2	0.5	9.42	3.99	10	0.09	161	153	1620	48.2	21.6	7.86	62	2000	10	0.005
RP3	30-08-2019				20	390		10	60	220	8.4	2000	3600			20	22	1	24	2	10	1	380	140	1500					1900	5	0.004
RP3	01-09-2019	7.08	2969	104.3	1	431	21	8	54	222	8.7	1970	2910	209		15.2	20.2	0.5	9	1.22	10	0.05	156	143	1490	30.6	21.2	4.65	62	1990	20	0.015
RP3	30-09-2019	7.26	3073	100.1	1	437	21	12	53.1	221	8.7	1990	2990	316		30.7	21.8	1	9.88	8.98	20	0.1	143	151	1560	47.4	22.6	10.9	56	2000	50	0.02
RP3	28-10-2019	7.06	3106	102.4		453	21	8	56.3	233	8.9	2060	3070			11.2	21.4	0.5	7.38	1.32	14	0.05	113	148	1490	60.3	22	2.88	70	2090	10	0.005
RP3	03-12-2019	7	3191	103.8		461	21	8	58.2	238	9.6	2120	3180			18.2	22.2	0.1	7.49	2.02	4	0.23	113	152	1540	55.4	21.4	4.57	134	2130	10	0.005
RP3	31-12-2019	6.85	3223	104.9		451	16	8	56.6	234	9.3	2090	3220			21.3	20.6	0.5	9.36	2.91	10	0.05	152	133	1430	35.1	21	11.5	218	2090	20	0.005
RP3	30-01-2020	6.72	3146	103.9	13	452		10	56.4	236	9.4	2110	3200			37	20.4	0.5	18.1	9.16	10	0.06	292	132	1610	65	21.6	16.8	136	2100	10	0.005
RP3	02-02-2020	6.78	3141	103.8	1	451	13	8	56.0	235	9.2	2090	1970			62	22.5	0.5	20.2	13.1	10	0.12	320	133	1680	114	22.5	23.2	154	2090	10	
RP3	03-02-2020	6.75	3142	102.6																												
RP3	16-02-2020	6.81	3126	103.0	7	449	1	2	56	235	9.1	2080	30	159		34.2	23.4	0.5	29.5	15.2	10	0.08	449	143	1980	174	23.4	27.7	252	2090	10	
RP3	26-02-2020	6.62	3144	101.3	9	430	1		52.7	219	8.5	1960	3090	202		56.3	22	0.5	38.7	27.6	10	0.08	566	157	2340	162	23.8	24.2	236	1980	10	
RP3	27-02-2020	6.32	2969	97.4																												
RP3	28-02-2020	6.54	3043	102.1																												
RP3	29-02-2020	6.2	3071	102.7	9	400	5	8	52	230	9.2	2100				110	25	1	53	120	18	1	640	160	2600	180	26	130	160	1900		0.004
RP3	01-03-2020	6.28	3047	102.1	4	441		8	56.2	229	9.1	2050	2970			122	26.6	0.2	59.1	137	18	0.54	685	177	3020	418	29.2	156	586	2050	10	0.005
RP3	02-03-2020	6.31	3023	103.0																												
RP3	03-03-2020	6.32	3020	102.5																												
RP3	04-03-2020	6.31	3026	100.5	3	432	1	8	53.3	224	8.9	2020	3020			164	28.6	0.1	64	148	22	0.78	869	184	3310	373	29.6	163	444	2000	10	
RP3	09-03-2020	6.32	3021	102.6	2	432	1	10	53.6	227	9	2010	2960	210		141	27.6	0.5	72.9	154	10	0.49	936	189	3370	298	27.6	171	344	2010	10	
RP3	30-03-2020				5	460	5	8	63	240	8.9	2000				200	28	1	68	160	16	1	860	170	3200	210	28	160	100	2100		0.004
RP3	31-03-2020	**5.59**	3049	104.9																												
RP3	27-04-2020	**4.83**	3081	101.3	5	390	5	8	53	230	9	2000	2200			480	28	1	78	190	50	1	950	190	3300	510	33	200	230	1900	5	0.004
RP3	03-06-2020	**5.27**	3109	102	10	390	5	27	61	210	8.7	2000	2800			30	27	1	63	82	10	1	830	190	2800	100	27	96	180	1900	5	0.004
RP3	29-06-2020	**4.76**	3041	100																												
RP3	30-06-2020	**5.09**	3055	103.8	13	430	5	8	44	240	9.1	2000	2500			30	25	1	44	37	10	1	650	160	2400	50	25	55	120	2100	5	0.004
	Count	25	25	25	18	21	17	20	21	21	21	21	19	7	0	20	21	21	21	20	21	21	20	21	20	18	19	18	19	21	19	16
	Minimum	4.76	2963	97.4	1	390	1	2	44	210	8.4	1900	30	159	0	10	20	0.1	7.38	1.22	4	0.05	113	132	1430	30.6	21	2.88	36	1900	5	0.004
	Median	6.54	3055	102.6	5	432	5	8	54.8	229	8.9	2010	2980	202		32.45	22.2	0.5	26	14.15	10	0.23	414.5	152	1840	107	23.4	25.95	154	2000	10	0.005
	Maximum	7.26	3223	104.9	20	461	22	27	63	240	9.6	2120	3600	316	0	480	28.6	1	78	190	50	1	950	190	3370	510	33	200	586	2130	50	0.02
	SWG SSTV	**6.0-8.0**	**250**	**85-120**	**319**			**64**		**21**		**129**				**150**	**0.8**		**13**	**2.5**	**350**	**9.4**	**3600**	**17**	**31**							**7**

APPENDIX C

Trend Analysis

Trend analysis – metals

Water quality data from January 2015 to June 2020 for surface water monitoring sites has been assessed to determine the trend of the analyte concentration over time. Trend analysis has been undertaken on analytes based on water quality results from the 2019/20 reporting period and historical data. Linear regression with R^2 analysis has been undertaken to determine the trend of the analyte concentration over time. Sites with an R^2 value of >0.700 are considered to show a significant trend (i.e. there is a correlation between the analyte concentration and time of sampling 70% of the time).

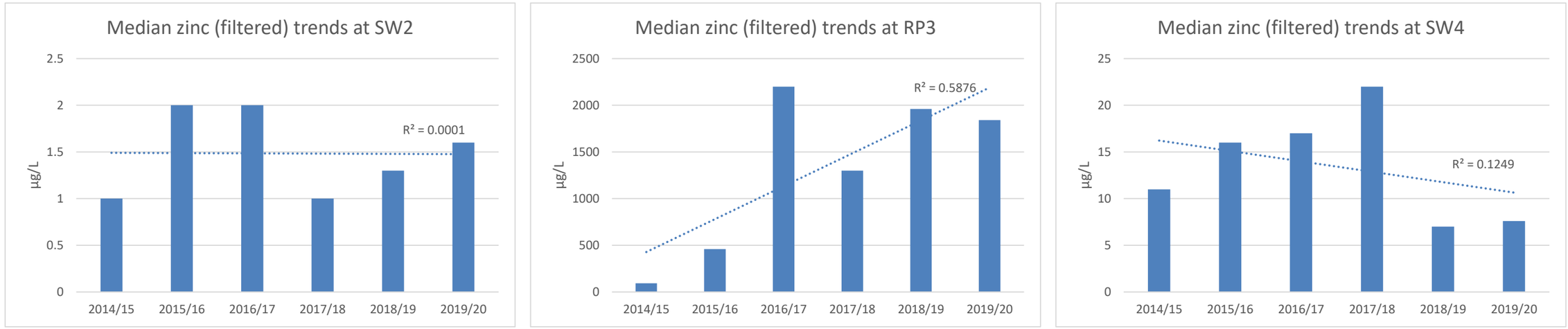


Figure 1 Median Zinc (filtered) trends (2015-2020)

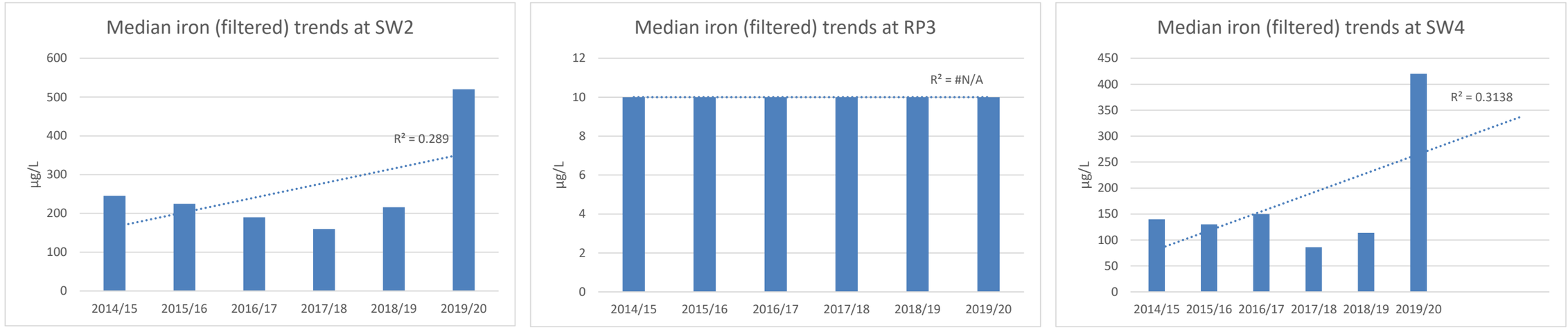
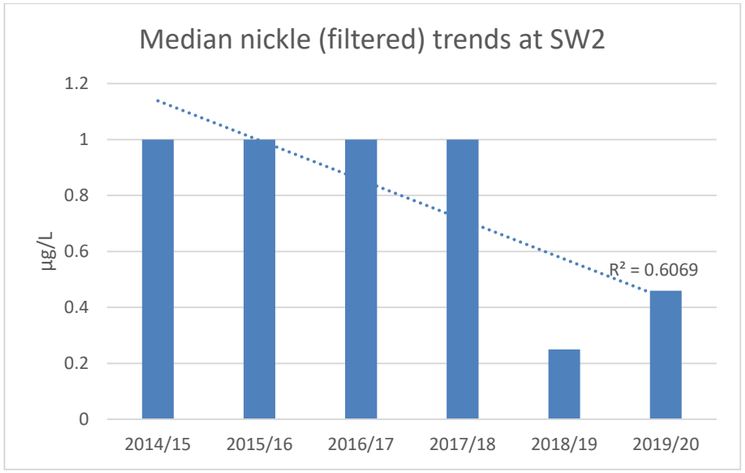
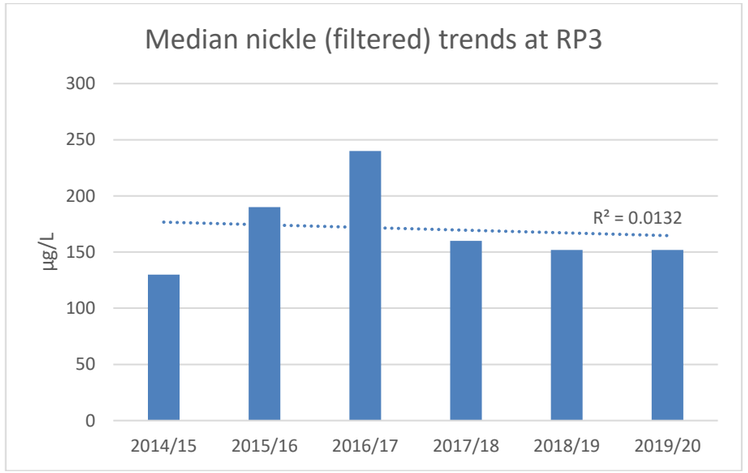


Figure 2 Median Iron (filtered) trends (2015-2020)





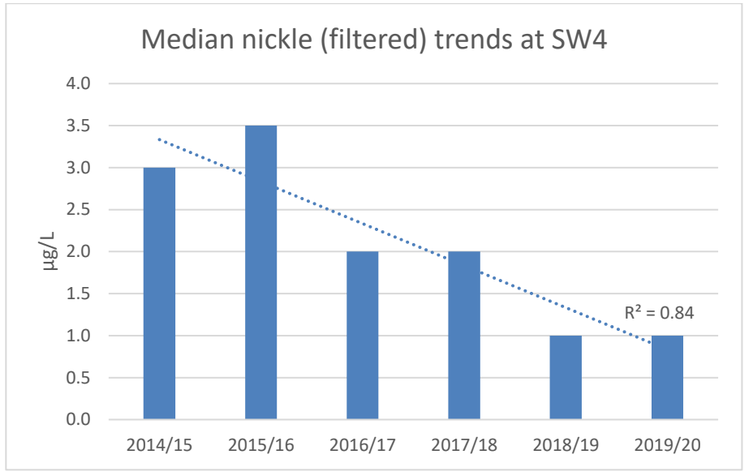
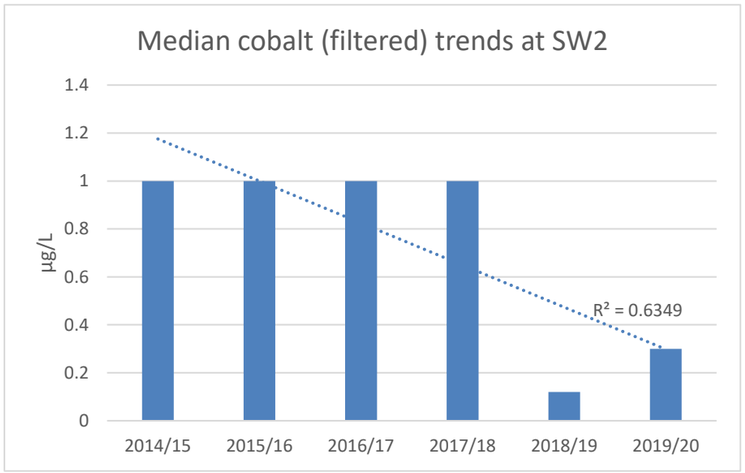
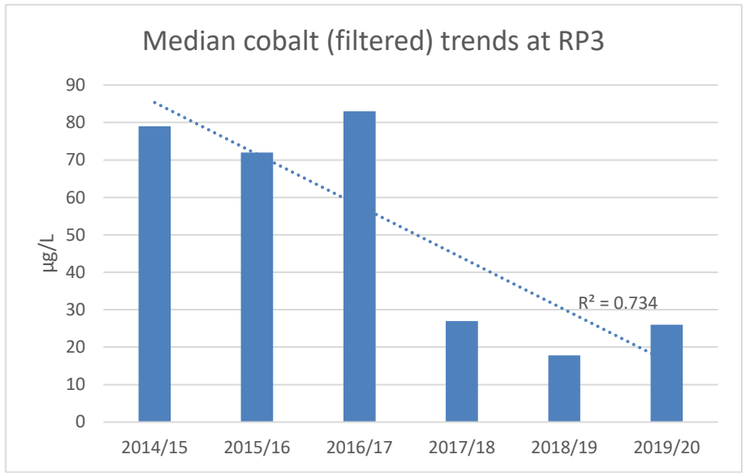


Figure 3 Median Nickle (filtered) trends (2015-2020)





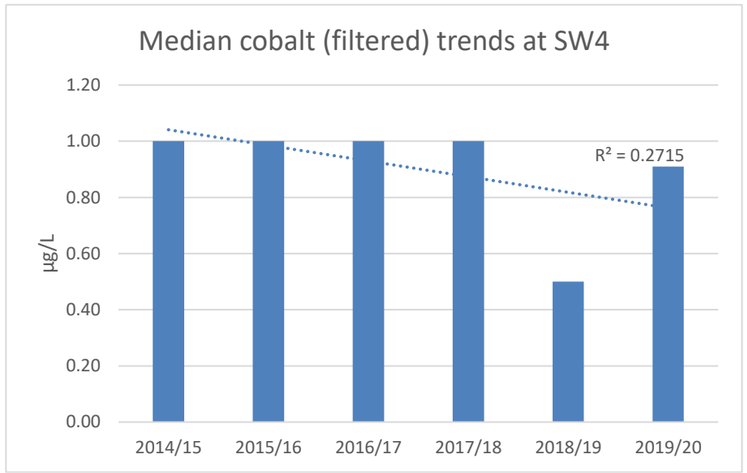
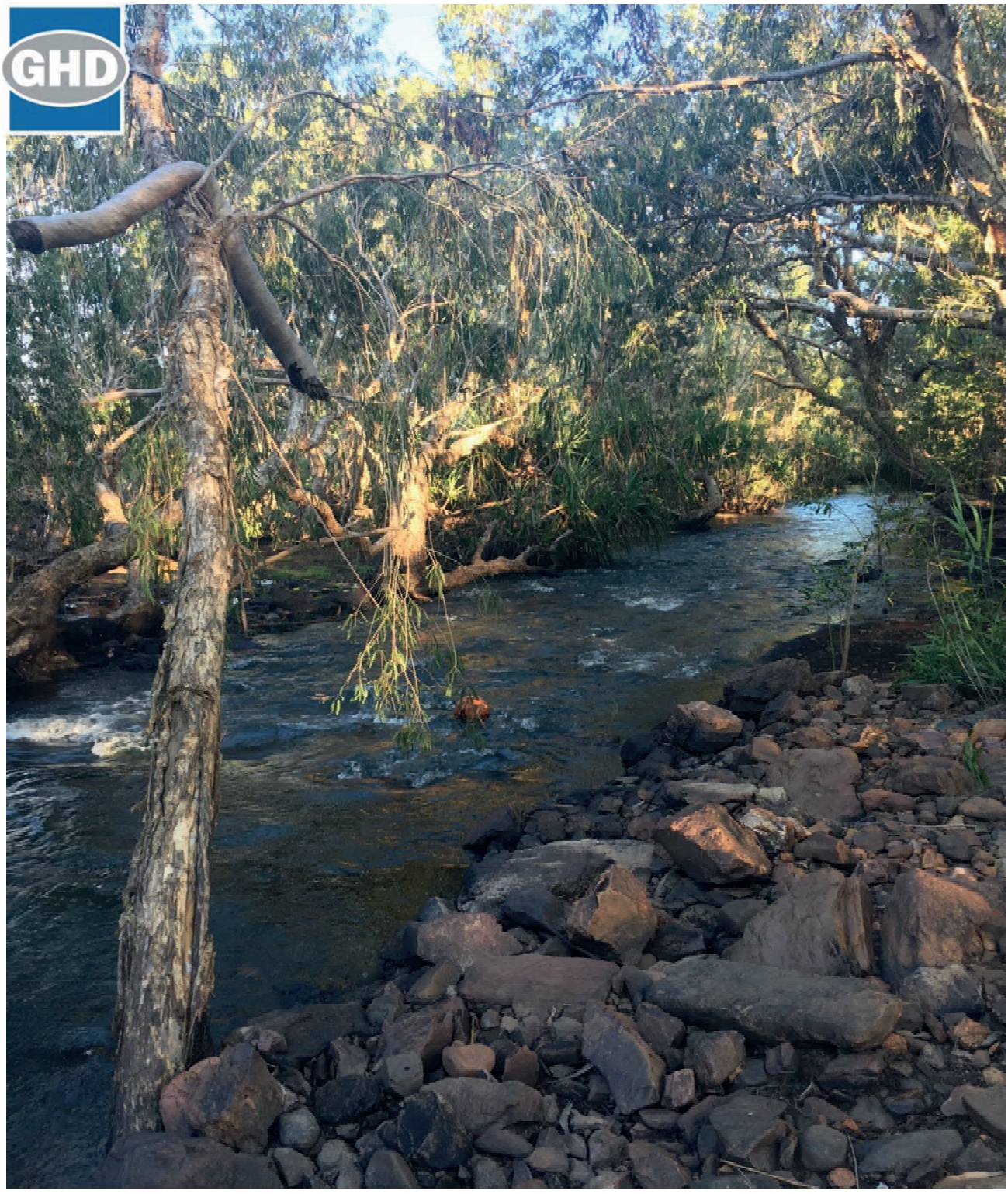


Figure 4 Median Cobalt (filtered) trends (2015-2020)

APPENDIX D

Receiving Environment Monitoring Program 2018



Vista Gold Australia Pty Ltd

Receiving Environment Monitoring Program Design 2018

December 2018

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1. Introduction

1.1 Background

The Mt Todd Gold Mine site is located approximately 55 km north-west of Katherine and 250 km south of Darwin in the Northern Territory (NT). The Mt Todd Gold Mine site is a brownfield site that was previously mined for gold in the 1990's until the year 2000. Mining infrastructure such as tailing dams, waste rock dumps and the remanent processing facilities remain on site.

The current manager of the site is Vista Gold Australia Pty Ltd, a wholly owned subsidiary of Vista Gold Corporation. Vista Gold purchased the rights to the Mt Todd property on 1 March 2006. Under the terms of an agreement between Vista Gold and the NT Government (Agreement D92226).

Mt Todd mine is currently discharging treated waste water from RP3 to the Edith River according to WDL 178 requirements. The current iteration of WDL178 is version 06 which is valid from 26 November 2018 until 31 November 2020.

1.2 Scope of Works

Condition 58 of WDL 178 dictates that Vista Gold prepare a Receiving Environment Monitoring Plan (REMP) that is capable of measuring and reporting on the level of impact (if any) of wastewater discharges on the Beneficial Uses that have been declared for the Edith River.

As the focus of the REMP is on waterways downstream of discharge locations on Mt Todd Mine, this document does not discuss WDL monitoring requirements in relation to water storages, release points or groundwater. However, it is noted that the water quality results collected by Vista Gold as described in the Water Management Plan and for WDL requirements are an integral part of the interpretation of the biological monitoring and sediment monitoring results.

1.3 Objectives

This document has been developed to meet the following objectives:

Condition 58. The licensee must provide to the Administering Agency an updated Receiving Environment Monitoring Plan, prior to commencing authorised discharge for the 2018/19 wet season, to include the following:

58.1. in addition to edge habitat sampling, riffle habitat sampling must also be done;

58.2. the Receiving Environment Monitoring Plan should be designed to detect impact through multivariate, ANOVA and other analyses. Hypotheses and the statistical test (and support design) should to be explicit in the document; and

58.3. recommendations from the 2017/18 monitoring program.

1.4 Relevant documents

This REMP design has been developed with reference the following documents:

- Mt Todd Mine WDL 178
- 2018 Mt Todd Macroinvertebrate and Sediment Report (GHD 2018)
- Receiving Environment Monitoring Program guideline (EHP 2014);
- Australian and New Zealand Guidelines for Fresh and Marine Water Quality Volume 1 (ANZECC & ARMCANZ 2000);

- Handbook for Sediment Quality Assessment (Simpson and Batley 2016); and
- NT Darwin Daly AUSRIVAS Sampling and Processing Manual (Lamche 2007).

1.5 Assumptions

This report cites WDL conditions for Mt Todd Mine, which may be subject to change. GHD is not responsible for updating this report based on any changes that occur subsequent to the submission of this report. This also applies with respect to any new guidelines that may come into effect at a later date.

2. Study Area

The Mt Todd Mine site lies within the Pine Creek bioregion. The Pine Creek bioregion comprises foothill environments below and to the west of the western Arnhem Land sandstone massif. Its main defining feature is the highly mineraliferous Pine Creek Geosyncline, comprising Archaean granite and gneiss overlain by Palaeoprotozoic sediments.

Land types of the Pine Creek bioregion are mainly hilly to rugged ridges with undulating plains. Vegetation communities include eucalypt woodlands, patches of monsoon forests, Melaleuca woodlands, riparian vegetation and tussock grasslands. The major vegetation types are eucalypt tall open forests typically dominated by Darwin Woollybutt (*Eucalyptus miniata*) and Darwin Stringybark (*E. tetradonta*), and woodlands (dominated by a range of *Eucalyptus* species); with smaller areas of monsoon rainforest.

2.1 Climate and flow conditions

The climate in the Katherine Region is characterised by hot, humid wet seasons lasting from November to March followed by a hot dry season from April to October. Transition periods occur between the wet and dry seasons.

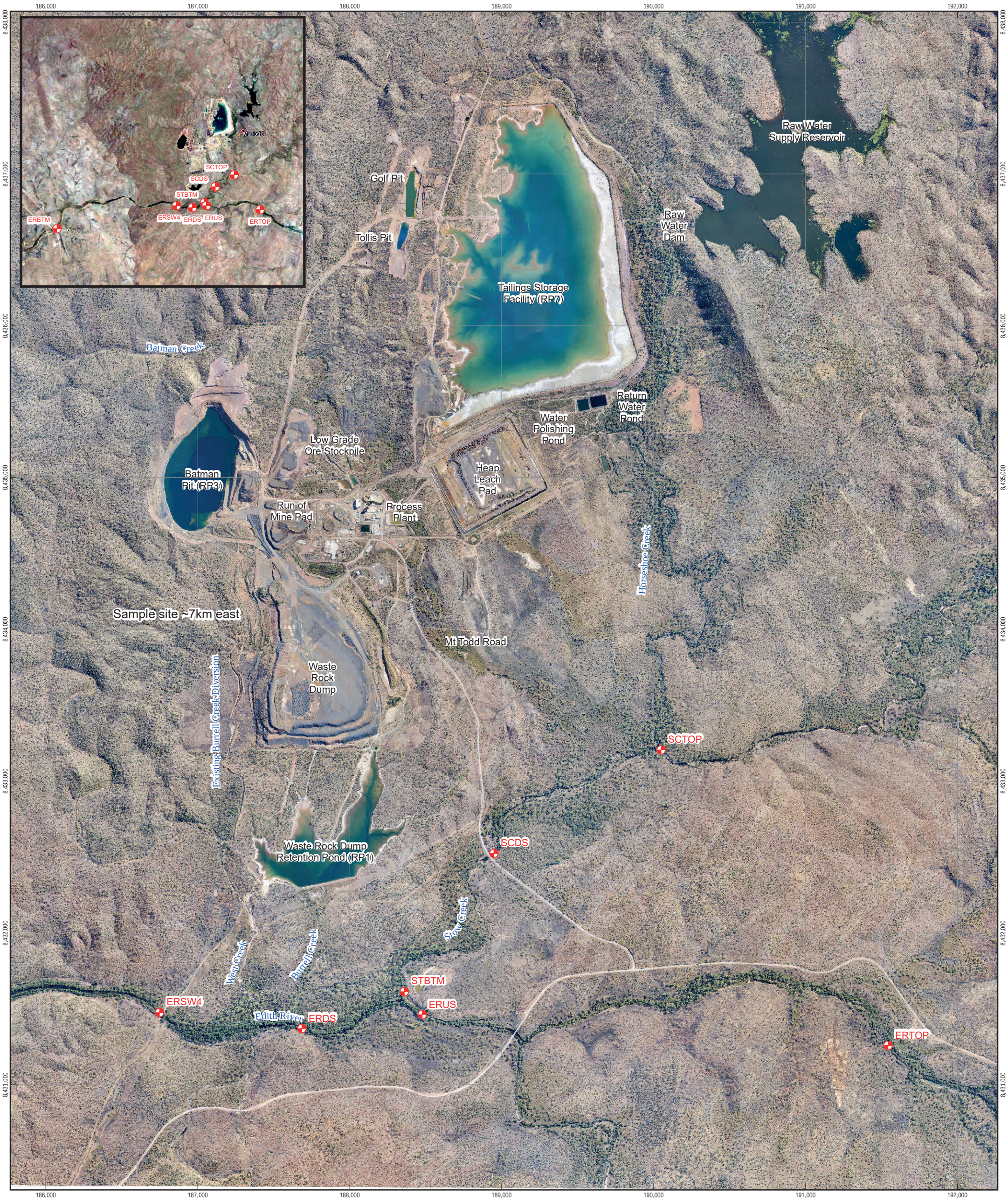
The Katherine region has a long term average rainfall of approximately 1,100 mm, which is highly seasonal. Water courses in the study area are ephemeral and cease to flow during the late dry season, but have regular flows during the wet season. Some of the larger major watercourses remain inundated into the early dry season and seasonal and semi-permanent waterholes exist in the area. Remaining waterholes are likely to be ecologically important and serve as a refuge for fish and aquatic reptiles during the dry season.

Waterways found within the spatial boundaries of this study can be characterised as ephemeral in nature, with many of them and their tributaries drying up with intermittent refuge pools during the dry season. The two main creeks are Stow Creek and Batman Creek, which lead into the Edith River.

2.1.1 Edith River Catchment

The study area is located on the Edith River, which is part of the Daly River catchment. The Daly River is one of the Northern Territory's largest rivers with a catchment area of 52,577 square kilometres, and is one of the few catchments in the Northern Territory that flows perennially. The Edith River is an important tributary of the Daly River, with a catchment of 1,057 square kilometres. The Edith River flows to the Fergusson River before joining the Daly River downstream. The greater region that the Edith River is located in is classified under the Australian River Assessment System (AUSRIVAS) as the Darwin-Daly Region.

The Edith River rises at an elevation of 257 m and ends at an elevation of 81.8 m where it merges with the Fergusson River, dropping around 175 m over its 69.1 km length. The Edith River is the largest waterway in the immediate vicinity of the mine and has been the recipient of mine overflow waters via Stow Creek and West Creek. In the past, it has received licensed discharge from Mt Todd mine's RP1 waste rock retention pond. Currently, the Edith River receives treated mine water from Batman Pit (RP3) through Batman Creek and Stow Creek. The Edith River has been intensively sampled because it is the end receiving environment of the Mt Todd Mine Site catchment.



LEGEND

Sampling Locations

1:23,000 @ A3

0 0.25 0.5 0.75 1

Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia
Grid: Map Grid of Australia 1994, Zone 53

N

Vista Gold Australia Pty Ltd
Mt Todd Gold Project

Project Site & Sampling Locations

Job Number 43-22878
Revision 1
Date 24 Dec 2018

Figure 2-1

G:\43\22187\GIS\Maps\Working\4322187_Project_Site_RevA.mxd

66 Smith Street Darwin NT 0800 Australia T 61 8 8982 0100 F 61 8 8981 1075 E drwmail@ghd.com W www.ghd.com.au

Data source: Tetra Tech - Existing Mine Layout (2011). Vista Gold - Imagery (2011). GHD - Access Roads (2011). Created by: CM

3. Monitoring Methodology

3.1 Introduction

As water quality monitoring is conducted under the Mine Management Plan and the WDL requirements, it has not been included as part of this Methodology. However, the water quality data is used to assist in interpreting the results of the REMP. To assess the long-term impacts on the receiving ecosystem in the Edith River, a macroinvertebrate monitoring program and a sediment monitoring program have been selected. Both these programs have been developed following current Australian guidelines and standard methods. Sediments have been collected for approximately seven years and the 2019 sampling will provide additional results that enhanced confidence in the long-term trend analysis can be gained to assess trends in deposition of metals downstream of the mine site.

3.2 Site selection

The primary aim of the study is to detect impacts on the aquatic environment in the Edith River from treated mine water released from discharge point Batman Pit (RP3), in accordance with the discharge licence. Sites for sediment and macroinvertebrate sampling have been chosen to provide an assessment of the state of the aquatic environment in the footprint of the mineral leases and adjacent waterways. The study design has been simplified from previous years, as the use of the Ferguson River as a reference system in previous studies was found to be unsuitable as discussed in GHD (2015); this was confirmed by the NT EPA and the DME in 2015. Consequently, the current study focusses on the comparison of the aquatic environments between the sites upstream and downstream of discharge locations and any detectable significant variation between sites.

As a secondary objective of the study design, sites will be assessed on Stow Creek which receives the treated mine water through Horseshoe Creek. Sites have been located upstream and downstream of the confluence of Horseshoe Creek (SCTOP) and Stow Creek (SCDS) to provide an indication of any potential impacts that the discharge may be having on the receiving environment.

Consistency of sampling locations is important to enable the creation of a long-term data set with which to assess any temporal changes that might indicate adverse impacts on the receiving environment. A comprehensive historic data set is also important towards establishing background water levels and natural variation in the receiving environment. Table 3-1 outlines the sites that will meet the objectives of the REMP, and be in line with the current licence conditions set out in WDL 178-06. As recommended in the WDL178-05 Annual Monitoring report site ERSW4 may be relocated slightly (within 200 m) due to safety concerns regarding crocodile habitat. It is not expected that water quality would change significantly within 200 m upstream or downstream of the current sampling site ERSW4, and so a more appropriate location for ongoing biological monitoring should be able to be found within this distance.

Table 3-1 REMP locations for Mt Todd Mine.

Site	GPS Coordinate UTM (GDA 94 Zone 53L)		Altitude (m)	Location	Treatment
	Easting	Northing			
Edith River					
ERTOP	191545	8431259	121.0	Edith River farthest upstream site	Control
ERUS	188476	8431460	117.2	Edith River upstream of Stow Creek confluence.	Control
ERDS	187685	8431369	116.7	Edith River downstream of Stow Creek confluence.	Potentially Impacted
ERSW4	186750	8431478	114.0	Edith River downstream of site ERSW4	Potentially Impacted
ERBTM	180080	8430235	101.1	Edith River farthest downstream site	Potentially Impacted
Stow Creek					
SCTOP	53019005	8433207	-	Stow Creek upstream site	Control
SCDS	53018895	8432524	-	Stow Creek downstream site	Potentially Impacted
SCBTM	53018836	8431616	-	Stow Creek farthest downstream site	Potentially Impacted

3.3 Survey Timing

Sampling of macroinvertebrates under stable conditions allows for a robust characterisation of the macroinvertebrate community of the receiving waters and is consistent with the methodology stated in the NT Darwin Daly AUSRIVAS Sampling and Processing Manual (Lamche 2007). For consistency between years and to meet the guidelines set out by Lamche (2007), REMP sampling will take place during the early dry season period, when the Edith River and Stow Creek have stabilised in flow.

3.4 Physical Habitat Assessment

Descriptions of habitat conditions are to be recorded at each site following the criteria listed in the Northern Territory AUSRIVAS “Darwin-Daly Region Model” field sheets (Lamche, 2007). Habitat assessments will be undertaken in consideration of the whole reach sampled (100 m longitudinal section of the river) and include:

- Site description
- Water quality
- Characteristics of macroinvertebrate habitat
- Instream physical characteristics (flow velocity and depth, instream habitat characteristics, bank height, riparian 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 is used to help interpret 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 are to be taken of upstream and downstream portions of the reach sampled, as well as bank habitat and other key habitat features. This will further characterise 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.

3.5 Water and Sediment Quality

3.5.1 Collection

The physico-chemical parameters of the water at each site is to be measured *in-situ* using a calibrated multi-parameter water quality meter. *In situ* parameters to be recorded on the AUSRIVAS proforma are:

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

As per the WDL, field environmental data and sample collection must be undertaken in accordance with recognised Australian Standards and guidelines. Hence sediment sampling will be undertaken at each site in accordance with methods described by Simpson and Batley (2016).

Under WDL 178-06 Condition 43 the following information for each sample collected is retained:

43.1. The date on which the sample was collected

43.2 The time at which the sample was collected

43.3 The location at which the sample was collected

43.4 The name of the person who collected the sample

43.5 The chain of custody forms relating to the same

43.6 The field measurements (if any) and analytical results (if any) relating to the sample

43.7 Laboratory quality assurance and quality control documentation

3.5.2 Analysis

Sediment samples will be analysed at a laboratory with current NATA accreditation for the parameters to be measured.

Water quality grab samples are to be collected at the same time as macroinvertebrate samples during the annual monitoring event. The details of analysis and methods are discussed further in the Water Management Plan (Vista Gold 2018).

3.5.3 Assessment of impacts

The determination of compliance with WDL specifications for water quality is outlined in condition 18 of WDL 178-06, and is to be covered in the WDL Report.

The results of sediment and water quality testing are to be included in REMP reporting to assist in the interpretation of biological monitoring results.

3.6 Biological monitoring

The following methodology relate to macroinvertebrate samples collected using AUSRIVAS protocols. Macroinvertebrate monitoring has been previously selected as the bioindicator for biological monitoring in relation to the Mt Todd Mine, and for consistency, it will be used in future REMPs to assess the impacts of the treated mine water discharge on the receiving ecosystem in the Edith River.

The macroinvertebrate monitoring techniques are based on AUSRIVAS Manual for the Darwin-Daly Region protocols (Lamche 2007). The following elements are discussed in the sampling manual document and will be considered in relation to biological monitoring:

- Habitat sampled
- Collection procedure and equipment
- Sample replication
- Field processing method (e.g. live-pick or bulk)
- Lab processing method (e.g. sub-sorting)
- Level of identification
- Quality assurance

3.6.1 Sample Collection

Macroinvertebrate sample collection and analysis will follow procedures outlined in the AUSRIVAS Manual for the Darwin-Daly Region (Lamche, 2007). Three replicate samples are to be collected at each site to increase the statistical power of any analyses required. All samples will be collected by trained environmental scientists.

Sampling will involve 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 sweeps 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 are to be avoided when collecting edge habitat samples.

Condition 58.1 of WDL178-06 dictates that “riffle habitat sampling must also be done”. As riffle habitat may not be present at all sample sites this method of sampling will be undertaken where possible, however, if appropriate habitat is not present at the existing sites then riffle habitat sampling will not be able to be undertaken.

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

3.6.2 Laboratory processing

Each sample received by the nominated macroinvertebrate laboratory will follow standard procedures for processing as set out by Lamche (2007).

Samples are to be 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 are separated to be

identified separately. The contents of the 500 µm mesh sieve are retained for macroinvertebrate identification and enumeration, while the 250 µm fraction is retained as sample residue for quality assurance purposes. The contents of the 500 µm mesh fraction is poured into a Marchant sub-sampler (Marchant, 1989) and extractions made randomly from cells (aliquots) in this apparatus. These extractions are placed under a microscope and the taxa identified and counted.

This process continues until either all aliquots are examined, or a total of 200 individuals have been counted and identified (excluding those from the 10 mm fraction). The number of aliquots required to be processed to obtain a minimum 200 individual sub-sample is recorded in order to calculate abundance.

Taxa are identified to family level where possible, with the exception of key taxa identified in Lamche (2007) as either requiring identification to sub-family level (e.g. Chironomidae) or only to order level (e.g. Acarina). All taxa are identified using the keys specified in Hawking (2000). Following identification, taxa counts are to be recorded in a database and samples preserved and archived.

Quality assurance is to be maintained by ensuring that identifiers are adequately trained and qualified. As specified in AUSRIVAS (Lamche 2007), 5% of samples identified in the laboratory are verified by a secondary check undertaken by a senior taxonomist.

3.6.3 Data analysis

The macroinvertebrate data collected will be analysed using univariate and multivariate statistical techniques. Univariate metrics provide an indication of waterway 'health', whilst multivariate analysis focusses on variability in community composition between sites.

Univariate techniques

Univariate measures (biotic indices) are used to assess the 'health' status of the macroinvertebrate community at each site. For each analysis, replicate samples are combined to provide an overall site community. The macroinvertebrate community biotic indices used for this study will include:

- Abundance
- Taxonomic Richness
- PET Richness
- SIGNAL-2
- Northern Territory AUSRIVAS Observed over Expected (O/E) scores and bandings

Abundance is the count of macroinvertebrates per sample, this is an applicable index in this study as sampling methods were quantitative. To derive whole of sample abundance counts, the percentage of the total sample counted is used with the count in the subsample to calculate the number of macroinvertebrates in the entire sample. This index can be useful in detecting impacts on pollution-affected sites if counts are significantly different between control and impact sites. It can also indicate declines in habitat availability and therefore will be interpreted with a degree of caution, in conjunction with other indices.

Taxonomic Richness refers to the number of different taxa contained in a sample. In theory, the higher the taxa richness value, the healthier a community is, but there are some instances where anthropogenic activities promote taxa richness through increased supply of nutrients or habitat (e.g. riffles through additional flows). Therefore, taxa richness data needs to be interpreted on a case by case basis.

EPT Richness refers to the proportional representation of key macroinvertebrate taxa belonging to the sensitive macroinvertebrate orders of Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies). High EPT richness is indicative of a healthy macroinvertebrate community, though it must be noted that some EPT taxa have more tolerance to pollution than others, so generally EPT richness data is interpreted together with other data such as community composition and SIGNAL score information (discussed further below). It should be noted that in the Northern Territory there are no known Plecoptera species, so in this study, the number of EPT taxa is limited to the number of ephemeropteran and trichopteran families.

SIGNAL 2 Scores (Stream Invertebrate Grade Number – Average Level) are based on the sensitivity of each macroinvertebrate family to environmental conditions, including forms of water pollution (Chessman 2003). Macroinvertebrate families are assigned a pollution sensitivity grade between 1 (most tolerant) and 10 (most sensitive). Families in a sample that have not been assigned a grade are excluded from the analysis. This assessment allows an additional line of evidence for assessing the potential impacts of water quality. Lamche (2007) cautions against the use of the SIGNAL 2 index for assessing the status of Northern Territory macroinvertebrate communities, however, GHD still view the assessment of pollution-sensitive versus pollution-tolerant species as a useful indicator to provide some insight as to the level of stress the macroinvertebrate community is currently subjected to from the environment.

Northern Territory AUSRIVAS O/E 50 is a predictive system that uses macroinvertebrates to assess the biological health of rivers in the Darwin-Daly Region (Lamche, 2007). AUSRIVAS uses site-specific predictions of the macroinvertebrate fauna expected to be present in the absence of environmental stress. The expected (E) fauna from reference sites with similar sets of predictor variables (natural physical and chemical characteristics) are compared to the observed (O) fauna and the ratio derived is used to indicate the extent of any impact. The ratio can range from zero, when none of the expected taxa are found at a site, to one, when all the expected taxa are found. Values greater than one are achieved when more families are found at the site than predicted by the model. The scores derived from the model can be placed in bands delineated by the Monitoring River Health Initiative (Table 3-2), which allows assessment of the level of environmental health at a site.

For this study, macroinvertebrate data will be assessed using the NT AUSRIVAS Darwin-Daly Early (dry season) Family level Edge habitat model.

Table 3-2 AUSRIVAS bands for the Darwin-Daly Model

Band Label	Upper Limit	Band Name	Band Description
Band X	O/E greater than 90th percentile of reference sites used to create the model.	More biologically diverse than reference sites	More families found than expected. Potential biodiversity "hot-spot" or mild organic enrichment. Continuous irrigation flow in a normally intermittent stream.
Band A	O/E within range of central 80% of reference sites used to create the model.	Reference condition	Expected number of families within the range found at 80% of the reference sites.
Band B	O/E below 10th percentile of reference sites	Significantly impaired	Potential impact either on water and/or habitat quality resulting in a loss of families.

Band Label	Upper Limit	Band Name	Band Description
	used to create the model. Same width as band A.		
Band C	O/E below band B. Same width as band A.	Severely impaired	Many fewer families than expected. Loss of families from substantial impairment of expected biota caused by water and/or habitat quality.
Band D	O/E below band C down to zero.	Extremely impaired	Few of the expected families and only the hardy, pollution tolerant families remain. Severe impairment.

An analysis of similarity (ANOSIM) should be undertaken to identify any statistically significant differences between sites upstream and downstream of mine inputs for the abundance, taxonomic richness, EPT richness, and SIGNAL 2 indices. Statistical significant will be set at a P-value of <0.05, therefore the null hypothesis of no difference between upstream and downstream sites is accepted for any P-value >0.05.

Multivariate techniques

Multivariate data analysis is used to assess variation in community composition between samples. Site based replicate samples are kept separate for this analysis.

The multivariate analysis methods used to assess macroinvertebrate data will include:

- Non-metric Multi-Dimensional Scaling (NMDS) Ordination
- Analysis of Similarity (ANOSIM)
- Similarity Percentage (SIMPER) Analysis

NMDS Ordination provides a representation of the relative similarity of entities (i.e. site 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. The initial step in this process is to square root transform the data to reduce the biasing influence of highly abundant taxa on results.

Following data transformation**,** a similarity matrix for all pairs of samples based on the Bray-Curtis similarity coefficient is calculated. The number of dimensions (axes) used in the NMDS procedure is based on the resultant Stress levels. The stress level is a measure of the distortion produced by compressing multi-dimensional data into a reduced set of dimensions and would increase as the number of axes (i.e. dimensions) is reduced. 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.

The NMDS is used to display the similarity between treatments ('potentially impacted' and ‘control' site groups). This is done in order to establish whether or not there is any evidence of treated mine water discharge impacts on macroinvertebrate community composition.

In order to assess whether between-treatment differences in macroinvertebrate community composition observed are significant, a one-way ANOSIM will also be undertaken.

3.6.4 Assessment of impacts

Assessment of impacts from mine affected water release will consider the following:

- Qualitative assessment of community composition and sensitivity metrics

- Comparison of macroinvertebrate metrics and community composition between sites upstream and downstream of the release points
- Comparison of community composition and sensitivity metrics to historic data collected prior to commencement of releases
- Comparison of macroinvertebrate metrics to water quality and sediment quality collected at the time of sampling

The use of statistical analysis techniques such as Analysis of Variance (ANOVA) will be considered when determining impacts to macroinvertebrate metrics between sites upstream or downstream of release points as part of a hypothesis testing framework. Multivariate techniques such as ordination and cluster analysis may assist in identifying complex patterns in biological data between sites, while community composition can be compared statistically between sites using techniques such as Analysis of Similarities (ANOSIM) or PERMANOVA. The use of these statistical methods will only be employed where sufficient and appropriate data are available. All statistical methodology used will be explained and justified.

4. Reporting

Condition 54 in WDL 178-06 requires Vista Gold Australia Pty Ltd to provide to the administering agency an Annual Monitoring Report by 30 August of each reporting year..

The Annual Monitoring Report must include as detailed in Condition 55 at a minimum:

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

55.2. includes a tabulation of all monitoring data required as a condition of this licence;

55.3. includes long term trend analysis of monitoring data to demonstrate any environmental impact associated with the activity over a minimum period of three years (where the data is available); and

55.4. includes an assessment and determination of environmental impact determined by the Receiving Environment Monitoring Program. Which includes the following:

- Biological Monitoring Program
- Sediment Monitoring Program
- Ecotoxicology Monitoring Program
- Water Quality Monitoring Program (as defined in WDL178-06 and the Mt Todd Water Management Plan 2018)

The REMP report will be a component of the Annual Monitoring Report and the REMP report requirements will be incorporated into the Annual Monitoring Report and will include as a minimum:

- Clearly stated objectives of the study and predicted outcomes
- The date, time and location of sample collection
- A clear description of sampling and analysis methods, detailing quality assurance and controls
- Flow and hydrological information and environmental conditions in the interpretation of water quality and biological data
- Results of all monitoring conducted and samples analysed including the use of visual aids such as graphs and tables
- Application of guidelines from ANZECC & ARMCANZ (2000) and other relevant guideline documents, including comparisons to long-term water quality objectives and SSTVs
- A comparison of macroinvertebrate based metrics and community composition between sites upstream and downstream of release points and at the mining lease boundary
- Evaluation of the current study design and its ability to meet the objectives of the monitoring program
- Recommendations of improvements (if any) to be made for future monitoring

5. References

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Document Status

Rev No.	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
A	James Hill	J. Woodworth		J. Woodworth		24/12/2018

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APPENDIX E

2020 Macroinvertebrate Results

Taxa	Taxa	SCUS T1	SCUS T2	SCUS T3	SCTOP T1	SCTOP T2	SCTOP T3	SCDS T1	SCDS T2	SCDS T3	SCBTM T1	SCBTM T2	SCBTM T3	ERTOP T1	ERTOP T2	ERTOP T3
Arachnida	Acarina	13	10	10	20	15	22	7	35	3	17	9	19	17	20	19
Aranea	Pisauridae	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0
Bivalvia	Corbiculidae	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Clitellata	Hirudinea	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0
Coleoptera	Dytiscidae	4	3	1	6	3	3	3	6	0	7	2	3	3	7	1
Coleoptera	Elmidae	0	0	0	0	0	0	0	0	0	0	0	0	2	3	2
Coleoptera	Hydraenidae	0	1	0	11	0	0	6	2	0	0	1	0	0	1	0
Coleoptera	Hydrochidae	0	1	0	3	3	1	0	0	0	0	1	0	0	2	0
Coleoptera	Hydrophilidae	2	2	1	3	2	1	1	0	0	1	0	1	1	1	0
Coleoptera	Limnichidae	0	0	0	0	0	0	0	0	0	2	0	2	0	0	0
Coleoptera	Noteridae	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Coleoptera	scirtidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Coleoptera	Staphylinidae	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Crustacea	Conchostraca	0	0	0	3	15	3	0	0	0	0	0	1	0	0	0
Decapoda	Atyidae	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0
Decapoda	Palaemonidae	0	0	0	0	2	1	0	0	0	0	0	0	1	2	0
Decapoda	Parathelphusidae	1	0	0	0	0	0	1	0	1	0	0	1	0	0	0
Diptera	Ceratopogonidae	2	6	9	2	2	3	0	2	3	2	4	3	11	15	12
Diptera	Chaoboridae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Diptera	Chironominae	10	21	48	0	53	30	17	14	14	7	31	12	57	86	81
Diptera	Culicidae	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Diptera	Dolichopodidae	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Diptera	Orthocladiinae	0	0	0	0	0	2	0	0	0	0	0	1	1	1	0
Diptera	Simuliidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Diptera	Tabanidae	0	0	0	0	1	0	0	0	0	0	1	1	0	0	1
Diptera	Tanypodinae	23	50	38	31	31	21	9	37	7	30	46	35	14	13	16
Diptera	Tipulidae	0	0	0	1	4	0	0	0	0	0	0	0	0	2	0
Ephemeroptera	Baetidae	16	5	8	20	12	10	10	17	25	9	8	15	1	5	2
Ephemeroptera	Caenidae	87	114	72	68	28	12	44	90	83	76	103	69	51	31	27
Ephemeroptera	Leptophlebiidae	0	0	0	0	0	0	2	2	0	0	0	0	2	1	1
Gastropda	Ancylidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gastropda	Planorbidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hemiptera	Corixidae	5	6	3	6	10	8	6	4	6	1	4	2	11	1	9
Hemiptera	Gelastocoridae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hemiptera	Gerridae	0	0	1	0	0	0	0	2	1	2	0	1	0	0	0
Hemiptera	Mesoveliidae	0	0	0	0	0	0	0	1	0	0	0	0	0	1	2
Hemiptera	nepidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hemiptera	Notonectidae	4	2	8	0	0	0	0	3	1	0	0	1	2	0	0
Hemiptera	Ochteridae	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Hemiptera	Pleidae	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Hemiptera	Veliidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lepidoptera	Pyralidae	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0
Microcrustacea	Cladocera	4	5	7	14	1	22	3	9	5	10	4	4	1	1	0
Microcrustacea	Copepoda	22	5	25	10	8	14	24	15	5	8	11	2	1	1	0
Microcrustacea	Ostrocoda	7	17	14	27	29	38	64	25	32	31	25	32	2	4	5
Nematoda	Nematoda	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0
Odonata	Coenagrionidae	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0
Odonata	Hemicorduliidae	0	0	0	0	0	1	0	0	2	0	0	0	0	2	0
Odonata	Gomphidae	0	0	0	0	0	0	1	2	2	2	3	0	1	1	1
Odonata	Libellulidae	5	6	2	3	4	2	1	8	3	5	4	3	0	2	1
Odonata	Platycnemididae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Odonata	Zygoptera sp.	0	0	0	0	0	1	2	0	2	0	1	0	1	0	0
Oligochaeta	Oligochaeta	1	4	5	0	1	2	0	0	1	0	0	1	10	17	6
Temnocephalia	platyhelminthe	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Trichoptera	Ecnomidae	4	1	7	1	3	1	9	11	6	3	1	1	5	8	2
Trichoptera	Hydropsychidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Trichoptera	Hydroptilidae	0	0	0	1	2	2	0	2	0	0	0	1	11	12	11
Trichoptera	Leptoceridae	1	1	2	0	1	4	2	1	0	1	2	1	3	2	5
Marchant sampler multiple factor		28	28	18.6	14	14	18.6	56	28	56	11.2	14	14	28	28	56

Taxa	Taxa	ERUS T1	ERUS T2	ERUS T3	ERDS T1	ERDS T2	ERDS T3	ERSW4 T1	ERSW4 T2	ERSW4 T3	ERBTM T1	ERBTM T2	ERBTM T3
Arachnida	Acarina	5	15	7	6	19	18	18	13	4	2	5	4
Aranea	Pisauridae	0	0	0	0	1	0	0	0	0	0	0	0
Bivalvia	Corbiculidae	0	0	0	0	0	0	1	0	0	1	0	0
Clitellata	Hirudinea	0	0	0	0	0	0	0	0	0	0	0	0
Coleoptera	Dytiscidae	1	5	2	7	3	8	9	3	3	1	2	4
Coleoptera	Elmidae	0	5	1	6	3	9	4	0	2	1	0	0
Coleoptera	Hydraenidae	0	0	0	4	0	3	2	4	0	0	2	0
Coleoptera	Hydrochidae	0	2	0	0	3	0	0	0	0	0	1	0
Coleoptera	Hydrophilidae	0	0	1	3	2	5	2	1	1	0	0	1
Coleoptera	Limnichidae	0	0	0	0	0	0	0	0	0	0	0	0
Coleoptera	Noteridae	0	0	0	0	0	0	0	0	0	0	0	0
Coleoptera	scirtidae	0	0	0	0	0	0	0	0	0	0	0	1
Coleoptera	Staphylinidae	0	0	0	0	0	0	0	0	0	0	0	0
Crustacea	Conchostraca	0	2	7	12	4	6	4	3	2	0	10	4
Decapoda	Atyidae	0	0	0	3	6	7	3	1	0	0	0	0
Decapoda	Palaemonidae	1	0	1	2	0	0	0	1	2	0	0	0
Decapoda	Parathelphusidae	0	0	0	0	0	0	0	0	0	0	0	0
Diptera	Ceratopogonidae	3	19	9	1	44	0	2	1	3	2	4	2
Diptera	Chaoboridae	0	0	0	0	0	1	0	0	0	0	0	0
Diptera	Chironominae	117	101	97	25	27	20	62	65	88	51	29	42
Diptera	Culicidae	0	1	0	13	11	2	1	1	0	0	1	1
Diptera	Dolichopodidae	0	0	0	0	0	0	0	0	0	0	0	0
Diptera	Orthocladiinae	1	2	0	0	1	0	0	0	1	0	0	0
Diptera	Simuliidae	12	5	0	0	0	1	0	0	0	0	0	0
Diptera	Tabanidae	0	0	4	3	0	0	0	0	0	7	0	0
Diptera	Tanypodinae	4	17	25	24	22	2	26	29	20	31	23	43
Diptera	Tipulidae	0	0	0	0	1	0	0	0	0	0	0	0
Ephemeroptera	Baetidae	2	3	4	9	6	12	5	6	3	1	1	2
Ephemeroptera	Caenidae	9	21	9	10	16	15	19	17	13	17	41	20
Ephemeroptera	Leptophlebiidae	0	0	3	1	0	1	0	2	0	1	1	2
Gastropda	Ancylidae	0	1	0	0	0	0	2	0	0	0	0	0
Gastropda	Planorbidae	0	0	0	0	0	0	1	0	0	0	0	0
Hemiptera	Corixidae	0	0	0	12	1	0	3	0	1	0	0	0
Hemiptera	Gelastocoridae	0	0	0	1	0	0	0	0	0	0	0	0
Hemiptera	Gerridae	0	2	0	0	1	0	0	0	0	0	2	2
Hemiptera	Mesoveliidae	0	0	0	1	1	2	0	0	0	0	0	1
Hemiptera	nepidae	0	0	0	0	1	1	0	1	0	0	0	0
Hemiptera	Notonectidae	0	0	0	0	4	2	1	0	0	0	0	0
Hemiptera	Ochteridae	0	0	0	0	0	0	0	0	0	0	0	0
Hemiptera	Pleidae	0	0	0	0	0	0	0	0	0	0	0	1
Hemiptera	Veliidae	0	0	0	0	0	1	0	0	0	0	0	0
Lepidoptera	Pyralidae	0	0	0	0	0	0	0	0	0	0	0	0
Microcrustacea	Cladocera	5	1	1	4	16	7	1	5	1	0	4	6
Microcrustacea	Copepoda	4	1	1	14	11	30	7	2	1	0	3	0
Microcrustacea	Ostrocoda	6	0	3	2	20	15	17	17	15	26	29	27
Nematoda	Nematoda	0	0	0	0	0	0	0	0	1	5	0	0
Odonata	Coenagrionidae	0	0	0	0	0	0	0	0	0	0	1	0
Odonata	Hemicorduliidae	0	0	0	1	0	0	1	1	0	0	3	0
Odonata	Gomphidae	0	0	0	1	0	2	4	0	2	0	1	1
Odonata	Libellulidae	5	6	11	3	7	4	14	8	5	8	21	5
Odonata	Platycnemididae	0	0	3	0	1	0	0	0	0	0	0	0
Odonata	Zygoptera sp.	4	2	1	2	2	4	0	0	0	0	0	2
Oligochaeta	Oligochaeta	4	6	12	4	5	7	3	2	11	37	7	11
Temnocephalia	platyhelminthe	0	0	0	0	0	0	0	0	0	0	0	0
Trichoptera	Ecnomidae	6	1	4	6	4	7	1	0	2	3	4	5
Trichoptera	Hydropsychidae	2	0	1	0	0	0	0	0	0	0	0	0
Trichoptera	Hydroptilidae	11	9	5	0	0	2	1	11	13	9	5	6
Trichoptera	Leptoceridae	2	5	2	12	8	19	9	15	12	0	6	9
Marchant sampler multiple factor		56	14	18.6	1.6	4.6	3.1	18.6	8	28	56	14	18.6

APPENDIX F

2020 Macroinvertebrate SIMPER Results

SIMPER
Similarity Percentages - species contributions

One-Way Analysis

Data worksheet
Name: Data1
Data type: Abundance
Sample selection: All
Variable selection: All

Parameters
Resemblance: S17 Bray-Curtis similarity
Cut off for low contributions: 70.00%

Factor Groups

Sample	Group
SCUS	Stow Creek Reference
SCTOP	Stow Creek Reference
SCDS	Stow Creek Receiving
SCBTM	Stow Creek Receiving
ERTOP	Edith River Reference
ERUS	Edith River Reference
ERDS	Edith River Receiving
ERSW4	Edith River Receiving
ERBTM	Edith River Receiving

Group Stow Creek Reference
Average similarity: 72.53

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Caenidae	7.72	6.13	SD=0!	8.46	8.46
Chironominae	6.24	5.86	SD=0!	8.07	16.53
Tanypodinae	6.60	5.81	SD=0!	8.01	24.53
Ostrocoda	5.87	5.39	SD=0!	7.43	31.96
Acarina	5.42	5.23	SD=0!	7.21	39.18
Baetidae	5.12	4.89	SD=0!	6.74	45.92
Copepoda	5.34	4.64	SD=0!	6.40	52.32
Cladocera	4.71	4.31	SD=0!	5.94	58.26
Corixidae	4.38	4.26	SD=0!	5.87	64.13
Dytiscidae	3.75	3.58	SD=0!	4.94	69.07
Libellulidae	3.86	3.32	SD=0!	4.58	73.65

Group Stow Creek Receiving
Average similarity: 70.16

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Caenidae	8.73	6.46	SD=0!	9.21	9.21
Tanypodinae	6.41	5.29	SD=0!	7.54	16.75
Ostrocoda	7.32	4.97	SD=0!	7.09	23.84
Chironominae	5.95	4.37	SD=0!	6.22	30.06
Acarina	5.59	4.20	SD=0!	5.99	36.05
Baetidae	5.78	3.88	SD=0!	5.53	41.57
Copepoda	5.39	3.47	SD=0!	4.95	46.52
Cladocera	4.51	3.31	SD=0!	4.71	51.23
Libellulidae	4.06	3.01	SD=0!	4.29	55.53
Dytiscidae	3.89	2.98	SD=0!	4.25	59.78
Ceratopogonidae	3.59	2.83	SD=0!	4.04	63.82
Corixidae	4.21	2.67	SD=0!	3.81	67.62
Gomphidae	3.35	2.42	SD=0!	3.45	71.07

Group Edith River Reference
Average similarity: 72.78

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Chironominae	9.78	7.71	SD=0!	10.59	10.59
Caenidae	6.72	4.47	SD=0!	6.14	16.74
Tanypodinae	5.95	4.43	SD=0!	6.08	22.82
Hydroptilidae	5.67	4.31	SD=0!	5.92	28.74
Acarina	5.88	4.00	SD=0!	5.50	34.24
Ceratopogonidae	5.54	3.97	SD=0!	5.46	39.70
Oligochaeta	5.28	3.85	SD=0!	5.29	44.99
Ecnomidae	4.61	3.64	SD=0!	5.00	50.00
Ostrocoda	4.53	3.57	SD=0!	4.90	54.90
Baetidae	3.99	3.12	SD=0!	4.28	59.18
Leptoceridae	4.19	3.09	SD=0!	4.24	63.42
Dytiscidae	3.93	2.87	SD=0!	3.94	67.36
Libellulidae	4.07	2.61	SD=0!	3.58	70.95

Group Edith River Receiving
Average similarity: 71.88

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Chironominae	6.63	4.76	2.70	6.62	6.62
Tanypodinae	5.59	3.93	3.92	5.47	12.09
Ostrocoda	5.29	3.76	5.02	5.24	17.33
Caenidae	5.14	3.73	4.94	5.19	22.52
Acarina	4.12	3.40	53.28	4.73	27.25
Ceratopogonidae	3.65	3.25	9.11	4.53	31.78
Leptoceridae	4.09	3.24	22.05	4.50	36.28
Libellulidae	4.23	3.02	3.75	4.21	40.49
Oligochaeta	4.69	2.97	4.36	4.14	44.63
Cladocera	3.28	2.87	12.26	3.99	48.61
Baetidae	3.36	2.83	29.40	3.94	52.55
Conchostraca	3.37	2.76	12.91	3.84	56.40
Dytiscidae	3.43	2.72	10.09	3.78	60.18
Copepoda	3.26	2.70	3.72	3.76	63.93
Ecnomidae	3.27	2.54	43.11	3.54	67.47
Elmidae	2.93	2.50	16.23	3.47	70.94

Groups Stow Creek Reference & Stow Creek Receiving
Average dissimilarity = 25.41

	Group Stow Creek Reference		Group Stow Creek Receiving		
Species	Av.Abund	Av.Diss	Diss/SD	Av.Abund	Contrib%	Cum.%
Gomphidae	0.00	1.52	12.56	3.35	5.98	5.98
Hirudinea	0.00	1.06	10.19	2.33	4.16	10.13
Notonectidae	2.11	0.96	2.10	2.69	3.79	13.93
Conchostraca	2.09	0.95	1.35	0.97	3.74	17.67
Zygoptera sp.	1.04	0.86	1.31	2.90	3.40	21.07
Caenidae	7.72	0.81	1.67	8.73	3.18	24.25
Gerridae	1.04	0.80	1.48	2.85	3.16	27.41
Hydrochidae	2.74			0.97		

	0.77		1.61		
	3.02		30.43		
Leptophlebiidae		0.00			1.80
	0.75		0.87		
	2.95		33.39		
Hemicorduliidae		1.04			1.63
	0.72		1.18		
	2.83		36.22		
Parathelphusidae		1.15			2.59
	0.71		1.39		
	2.81		39.03		
Ostrocoda		5.87			7.32
	0.70		1.12		
	2.77		41.81		
Hydroptilidae		1.49			2.33
	0.70		1.43		
	2.74		44.55		
Limnichidae		0.00			1.33
	0.67		0.87		
	2.63		47.18		
Ecnomidae		3.50			4.31
	0.66		1.45		
	2.60		49.78		
Tipulidae		1.45			0.00
	0.65		0.86		
	2.54		52.32		
Copepoda		5.34			5.39
	0.61		1.93		
	2.41		54.73		
Atyidae		0.97			1.37
	0.61		1.13		
	2.40		57.13		
Coenagrionidae		0.97			1.37
	0.61		1.13		
	2.40		59.53		
Palaemonidae		1.31			0.00
	0.58		0.86		
	2.29		61.82		
Pisauridae		0.00			1.37
	0.57		0.87		
	2.24		64.07		
Orthocladiinae		1.24			0.97
	0.57		1.10		
	2.23		66.30		
Hydraenidae		2.91			3.19
	0.56		1.66		
	2.22		68.52		
platyhelminthe		1.15			0.00
	0.54		0.86		
	2.14		70.66		

Groups Stow Creek Reference & Edith River Reference
Average dissimilarity = 31.98

	Group Stow Creek Reference		Group Edith River Reference	
Species	Av.Abund	Av.Diss	Av.Abund	Diss/SD
	Contrib%	Cum.%		
Hydroptilidae	1.49	1.85	5.67	2.25
		5.80		5.80
Chironominae	6.24	1.56	9.78	10.48
		4.87		10.67
Elmidae	0.00	1.55	3.53	8.04
		4.84		15.51

Leptophlebiidae	1.36	4.24	0.00	9.37	19.75	3.09
Corixidae	1.21	3.77	4.38	1.34	23.52	2.69
Simuliidae	1.18	3.69	0.00	0.87	27.21	2.61
Zygoptera sp.	0.97	3.02	1.04	1.31	30.23	3.18
Notonectidae	0.94	2.94	2.11	1.14	33.16	1.37
Conchostraca	0.92	2.88	2.09	1.01	36.04	1.77
Copepoda	0.87	2.71	5.34	1.99	38.75	3.37
Oligochaeta	0.86	2.69	3.29	2.41	41.44	5.28
Tabanidae	0.84	2.62	0.97	1.60	44.06	2.84
Caenidae	0.80	2.49	7.72	1.35	46.55	6.72
Hydraenidae	0.78	2.44	2.91	1.16	49.00	1.15
Hydropsychidae	0.76	2.39	0.00	0.87	51.39	1.69
Palaemonidae	0.75	2.36	1.31	1.09	53.75	2.98
Orthocladiinae	0.74	2.32	1.24	1.12	56.07	2.88
Mesoveliidae	0.74	2.31	0.00	0.87	58.38	1.72
Ceratopogonidae	0.73	2.28	3.85	1.85	60.65	5.54
Gomphidae	0.70	2.18	0.00	0.87	62.83	1.63
Tipulidae	0.64	1.99	1.45	0.91	64.82	1.37
Platycnemididae	0.62	1.93	0.00	0.87	66.75	1.37
Hemicorduliidae	0.60	1.87	1.04	1.07	68.62	1.37
Ostrocoda	0.59	1.84	5.87	3.56	70.47	4.53

Groups Stow Creek Receiving & Edith River Reference
Average dissimilarity = 33.21

Group Stow Creek Receiving	Group Edith River Reference

Species	Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%	Av.Abund
Chironominae	5.95	1.63	2.82	4.90	4.90	9.78
Elmidae	0.00	1.47	6.42	4.41	9.32	3.53
Hydroptilidae	2.33	1.40	4.09	4.22	13.53	5.67
Palaemonidae	0.00	1.24	10.18	3.74	17.28	2.98
Oligochaeta	2.33	1.24	3.38	3.72	21.00	5.28
Corixidae	4.21	1.14	1.33	3.42	24.42	2.69
Simuliidae	0.00	1.12	0.86	3.36	27.78	2.61
Ostrocoda	7.32	1.11	1.81	3.36	31.13	4.53
Parathelphusidae	2.59	1.06	4.94	3.19	34.32	0.00
Hirudinea	2.33	0.96	9.43	2.89	37.21	0.00
Hydraenidae	3.19	0.90	1.39	2.71	39.92	1.15
Caenidae	8.73	0.88	1.37	2.64	42.56	6.72
Ceratopogonidae	3.59	0.81	2.45	2.45	45.01	5.54
Gomphidae	3.35	0.81	1.16	2.44	47.45	1.63
Leptophlebiidae	1.80	0.80	1.13	2.39	49.85	3.09
Copepoda	5.39	0.79	1.26	2.38	52.23	3.37
Orthocladiinae	0.97	0.77	1.92	2.31	54.53	2.88
Conchostraca	0.97	0.75	1.31	2.25	56.78	1.77
Hydropsychidae	0.00	0.72	0.86	2.18	58.95	1.69
Notonectidae	2.69	0.71	1.42	2.15	61.11	1.37
Mesoveliidae	1.15	0.71	1.09	2.14	63.24	1.72
Baetidae	5.78	0.70	1.33	2.12	65.36	3.99

Gerridae		2.85			1.15
	0.68		1.24		
	2.06		67.42		
Hemicorduliidae		1.63			1.37
	0.67		1.00		
	2.01		69.43		
Tabanidae		1.15			2.84
	0.66		1.36		
	2.00		71.43		

Groups Stow Creek Reference & Edith River Receiving
Average dissimilarity = 31.71

	Group Stow Creek Reference		Group Edith River Receiving	
Species		Av.Abund		Av.Abund
	Av.Diss		Diss/SD	
	Contrib%		Cum.%	
Elmidae		0.00		2.93
	1.39		8.69	
	4.39		4.39	
Caenidae		7.72		5.14
	1.33		1.26	
	4.20		8.59	
Hydroptilidae		1.49		3.78
	1.30		1.69	
	4.10		12.69	
Corixidae		4.38		1.75
	1.24		2.05	
	3.90		16.59	
Culicidae		0.00		2.55
	1.22		4.81	
	3.85		20.45	
Gomphidae		0.00		2.48
	1.17		3.61	
	3.68		24.13	
Leptophlebiidae		0.00		2.23
	1.04		3.30	
	3.29		27.42	
Conchostraca		2.09		3.37
	1.02		1.42	
	3.20		30.62	
Notonectidae		2.11		1.44
	1.01		1.64	
	3.20		33.82	
Copepoda		5.34		3.26
	0.99		2.49	
	3.12		36.93	
Chironominae		6.24		6.63
	0.94		3.64	
	2.96		39.90	
Baetidae		5.12		3.36
	0.84		3.37	
	2.66		42.56	
Nematoda		0.97		2.13
	0.84		1.23	
	2.65		45.21	
Tabanidae		0.97		1.98
	0.84		1.16	
	2.64		47.85	
Oligochaeta		3.29		4.69
	0.83		1.17	
	2.61		50.46	
Tanypodinae		6.60		5.59
	0.75		0.97	
	2.36		52.83	
Atyidae		0.97		1.85
	0.74		1.28	

	2.33		55.16		
Cladocera		4.71		3.28	
	0.68		3.52		
	2.14		57.30		
Hydrochidae		2.74		1.29	
	0.68		1.35		
	2.13		59.44		
Tipulidae		1.45		0.49	
	0.68		1.18		
	2.13		61.57		
Palaemonidae		1.31		1.39	
	0.66		1.22		
	2.07		63.64		
Ostrocoda		5.87		5.29	
	0.65		1.26		
	2.04		65.68		
Mesoveliidae		0.00		1.32	
	0.63		1.29		
	2.00		67.68		
Acarina		5.42		4.12	
	0.63		1.95		
	1.98		69.67		
Gerridae		1.04		1.44	
	0.61		1.31		
	1.91		71.58		

Groups Stow Creek Receiving & Edith River Receiving
Average dissimilarity = 31.08

	Group Stow Creek Receiving		Group Edith River Receiving	
Species		Av.Abund		Av.Abund
	Av.Diss		Diss/SD	
	Contrib%		Cum.%	
Caenidae		8.73		5.14
	1.60		1.84	
	5.14		5.14	
Elmidae		0.00		2.93
	1.31		6.73	
	4.23		9.37	
Parathelphusidae		2.59		0.00
	1.14		5.14	
	3.66		13.03	
Ostrocoda		7.32		5.29
	1.07		1.38	
	3.43		16.47	
Corixidae		4.21		1.75
	1.04		1.46	
	3.36		19.83	
Baetidae		5.78		3.36
	1.04		1.88	
	3.35		23.18	
Oligochaeta		2.33		4.69
	1.04		1.23	
	3.34		26.52	
Hirudinea		2.33		0.00
	1.03		8.96	
	3.32		29.84	
Conchostraca		0.97		3.37
	1.02		2.51	
	3.30		33.14	
Chironominae		5.95		6.63
	0.93		2.11	
	2.99		36.13	
Copepoda		5.39		3.26
	0.89		1.49	
	2.88		39.01	
Hydroptilidae		2.33		3.78

	0.86		1.80		
	2.76		41.76		
Leptophlebiidae		1.80			2.23
	0.82		1.89		
	2.65		44.41		
Tabanidae		1.15			1.98
	0.81		1.37		
	2.62		47.03		
Nematoda		1.15			2.13
	0.78		1.08		
	2.51		49.54		
Hemicorduliidae		1.63			1.98
	0.74		1.99		
	2.39		51.93		
Corbiculidae		0.00			1.60
	0.69		1.25		
	2.21		54.14		
Zygoptera sp.		2.90			1.57
	0.69		1.36		
	2.21		56.36		
Gerridae		2.85			1.44
	0.69		1.41		
	2.21		58.56		
Culicidae		0.97			2.55
	0.68		1.51		
	2.18		60.74		
Tanypodinae		6.41			5.59
	0.66		1.10		
	2.13		62.87		
Ecnomidae		4.31			3.27
	0.66		1.22		
	2.12		64.99		
Limnichidae		1.33			0.00
	0.65		0.91		
	2.10		67.09		
Atyidae		1.37			1.85
	0.65		0.92		
	2.09		69.18		
Acarina		5.59			4.12
	0.64		1.59		
	2.06		71.24		

Groups Edith River Reference & Edith River Receiving
Average dissimilarity = 28.04

	Group Edith River Reference		Group Edith River Receiving	
Species	Av.Abund	Av.Diss	Av.Abund	Diss/SD
	Contrib%	Cum.%		
Chironominae	9.78	1.41	6.63	1.35
	5.02	5.02		
Corixidae	2.69	1.15	1.75	1.64
	4.10	9.12		
Simuliidae	2.61	1.15	0.44	1.07
	4.09	13.21		
Nematoda	0.00	0.88	2.13	1.17
	3.13	16.33		
Hydroptilidae	5.67	0.85	3.78	1.02
	3.02	19.36		
Caenidae	6.72	0.84	5.14	1.24
	2.99	22.35		

Tabanidae	0.83	2.95	2.84	2.85	1.98
Atyidae	0.82	2.92	0.00	1.29	1.85
Ceratopogonidae	0.80	2.87	5.54	3.01	3.65
Conchostraca	0.79	2.80	1.77	1.14	3.37
Acarina	0.76	2.69	5.88	1.52	4.12
Oligochaeta	0.75	2.68	5.28	1.72	4.69
Hydropsychidae	0.75	2.66	1.69	0.91	0.00
Mesoveliidae	0.74	2.63	1.72	1.59	1.32
Gomphidae	0.73	2.59	1.63	1.48	2.48
Zygoptera sp.	0.72	2.57	3.18	1.13	1.57
Orthocladiinae	0.69	2.47	2.88	1.63	1.26
Palaemonidae	0.68	2.43	2.98	1.32	1.39
Culicidae	0.68	2.41	0.97	1.42	2.55
Corbiculidae	0.66	2.36	0.00	1.26	1.60
Tanypodinae	0.63	2.24	5.95	1.36	5.59
Ostrocoda	0.63	2.23	4.53	2.11	5.29
Platycnemididae	0.60	2.13	1.37	1.15	0.49
Hemicorduliidae	0.60	2.12	1.37	1.47	1.98
Notonectidae	0.59	2.11	1.37	1.23	1.44

				25.30	
				28.21	
				31.08	
				33.88	
				36.58	
				39.26	
				41.93	
				44.55	
				47.15	
				49.71	
				52.18	
				54.61	
				57.02	
				59.38	
				61.62	
				63.85	
				65.98	
				68.10	
				70.21	

APPENDIX G

Laboratory Certificates of Analysis – 2020 Sediment Results

SLR Consulting (NT)
GPO Box 654
Darwin
NT 0801

NATA Accredited
Accreditation Number 1261
Site Number 1254

Accredited for compliance with ISO/IEC 17025 – Testing
The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards.

Attention: **Sara Smith**

Report **716870-S**
Project name VISTA BMP AND SMP 2020
Received Date May 01, 2020

Client Sample ID			**ERBTM**	**ERDS**	**ERUS**	**SCBTM**
Sample Matrix			**Solid**	**Solid**	**Solid**	**Solid**
Eurofins Sample No.			**M20-My00616**	**M20-My00618**	**M20-My00619**	**M20-My00620**
Date Sampled			**Apr 30, 2020**	**Apr 29, 2020**	**Apr 29, 2020**	**Apr 29, 2020**
Test/Reference	LOR	Unit				
Fluoride (Total)	100	mg/kg	< 100	< 100	100	< 100
Sulphate as SO4 (1:5 aqueous extract)	10	mg/kg	14	290	< 10	63
% Moisture	1	%	4.5	1.1	14	14
Particle Size by Sieve analysis*						
<63 Micron	0.1	% w/w	0.1	2.5	0.1	0.4
>2000 Micron	0.1	% w/w	11	0.6	12	4.1
1000-2000 Micron	0.1	% w/w	16	0.8	11	9.7
125-250 Micron	0.1	% w/w	3.1	18	8.8	14
250-500 Micron	0.1	% w/w	26	43	21	32
500-1000 Micron	0.1	% w/w	42	34	45	37
63-125 Micron	0.1	% w/w	1.6	1.6	2.2	3.4
Heavy Metals (1M HCl Extract)						
Aluminium (1M HCl extract)	20	mg/kg	37	83	140	68
Antimony (1M HCl Extract)	2	mg/kg	< 2	< 2	< 2	< 2
Arsenic (1M HCl extract)	2	mg/kg	< 2	< 2	< 2	< 2
Barium (1M HCl extract)		mg/kg	3.0	7.3	17	5.8
Cadmium (1M HCl extract)	0.4	mg/kg	< 0.4	< 0.4	< 0.4	< 0.4
Chromium (1M HCl extract)	5	mg/kg	< 5	< 5	< 5	< 5
Cobalt (1M HCl extract)	5	mg/kg	< 5	< 5	< 5	< 5
Copper (1M HCl extract)	5	mg/kg	< 5	< 5	< 5	< 5
Iron (1M HCl extract)	20	mg/kg	210	440	1200	340
Lead (1M HCl extract)	5	mg/kg	< 5	< 5	< 5	< 5
Manganese (1M HCl extract)	10	mg/kg	15	18	21	66
Mercury (1M HCl extract)*	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1
Nickel (1M HCl extract)	5	mg/kg	< 5	< 5	< 5	< 5
Selenium (1M HCl extract)	2	mg/kg	< 2	< 2	< 2	< 2
Silver (1M HCl extract)	2	mg/kg	< 2	< 2	< 2	< 2
Uranium (1M HCl extract)	10	mg/kg	< 10	< 10	< 10	< 10
Vanadium (1M HCl Extract)		mg/kg	0.23	0.56	1.1	0.28
Zinc (1M HCl extract)	5	mg/kg	< 5	6.2	< 5	18

Client Sample ID			SCUS	ERSW4	SCTOP	SCDS
Sample Matrix			Solid	Solid	Solid	Solid
Eurofins Sample No.			M20-My00621	M20-My00622	M20-My00623	M20-My00624
Date Sampled			Apr 29, 2020	Apr 28, 2020	Apr 28, 2020	Apr 28, 2020
Test/Reference	LOR	Unit				
Fluoride (Total)	100	mg/kg	< 100	< 100	120	< 100
Sulphate as SO4 (1:5 aqueous extract)	10	mg/kg	71	78	44	56
% Moisture	1	%	11	< 1	7.0	10
Particle Size by Sieve analysis*						
<63 Micron	0.1	% w/w	0.9	0.5	0.8	2.0
>2000 Micron	0.1	% w/w	8.4	11	3.5	0.9
1000-2000 Micron	0.1	% w/w	5.6	2.0	8.8	2.9
125-250 Micron	0.1	% w/w	7.7	24	9.6	12
250-500 Micron	0.1	% w/w	34	36	25	41
500-1000 Micron	0.1	% w/w	43	21	51	41
63-125 Micron	0.1	% w/w	1.1	5.6	1.9	0.4
Heavy Metals (1M HCl Extract)						
Aluminium (1M HCl extract)	20	mg/kg	59	94	48	42
Antimony (1M HCl Extract)	2	mg/kg	< 2	< 2	< 2	< 2
Arsenic (1M HCl extract)	2	mg/kg	< 2	< 2	< 2	< 2
Barium (1M HCl extract)		mg/kg	3.0	7.0	5.9	1.7
Cadmium (1M HCl extract)	0.4	mg/kg	< 0.4	< 0.4	< 0.4	< 0.4
Chromium (1M HCl extract)	5	mg/kg	< 5	< 5	< 5	< 5
Cobalt (1M HCl extract)	5	mg/kg	< 5	< 5	< 5	< 5
Copper (1M HCl extract)	5	mg/kg	< 5	< 5	< 5	< 5
Iron (1M HCl extract)	20	mg/kg	290	440	220	290
Lead (1M HCl extract)	5	mg/kg	< 5	< 5	< 5	< 5
Manganese (1M HCl extract)	10	mg/kg	39	17	24	16
Mercury (1M HCl extract)*	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1
Nickel (1M HCl extract)	5	mg/kg	< 5	< 5	< 5	< 5
Selenium (1M HCl extract)	2	mg/kg	< 2	< 2	< 2	< 2
Silver (1M HCl extract)	2	mg/kg	< 2	< 2	< 2	< 2
Uranium (1M HCl extract)	10	mg/kg	< 10	< 10	< 10	< 10
Vanadium (1M HCl Extract)		mg/kg	0.36	0.55	0.25	0.22
Zinc (1M HCl extract)	5	mg/kg	16	8.4	< 5	7.4

Client Sample ID			ERTOP	QA DUPLICATE
Sample Matrix			Solid	Solid
Eurofins Sample No.			M20-My00625	M20-My00626
Date Sampled			Apr 29, 2020	Apr 28, 2020
Test/Reference	LOR	Unit		
Fluoride (Total)	100	mg/kg	< 100	< 100
Sulphate as SO4 (1:5 aqueous extract)	10	mg/kg	< 10	63
% Moisture	1	%	11	< 1
Particle Size by Sieve analysis*				
<63 Micron	0.1	% w/w	21	22
>2000 Micron	0.1	% w/w	6.8	6.6
1000-2000 Micron	0.1	% w/w	4.3	2.4
125-250 Micron	0.1	% w/w	17	35
250-500 Micron	0.1	% w/w	27	7.0
500-1000 Micron	0.1	% w/w	20	22
63-125 Micron	0.1	% w/w	3.5	4.8

Client Sample ID			ERTOP	QA DUPLICATE
Sample Matrix			**Solid**	**Solid**
Eurofins Sample No.			**M20-My00625**	**M20-My00626**
Date Sampled			**Apr 29, 2020**	**Apr 28, 2020**
Test/Reference	LOR	Unit		
Heavy Metals (1M HCl Extract)				
Aluminium (1M HCl extract)	20	mg/kg	66	95
Antimony (1M HCl Extract)	2	mg/kg	< 2	< 2
Arsenic (1M HCl extract)	2	mg/kg	< 2	< 2
Barium (1M HCl extract)		mg/kg	9.5	7.1
Cadmium (1M HCl extract)	0.4	mg/kg	< 0.4	< 0.4
Chromium (1M HCl extract)	5	mg/kg	< 5	< 5
Cobalt (1M HCl extract)	5	mg/kg	< 5	< 5
Copper (1M HCl extract)	5	mg/kg	< 5	< 5
Iron (1M HCl extract)	20	mg/kg	1200	430
Lead (1M HCl extract)	5	mg/kg	< 5	< 5
Manganese (1M HCl extract)	10	mg/kg	16	18
Mercury (1M HCl extract)*	0.1	mg/kg	< 0.1	< 0.1
Nickel (1M HCl extract)	5	mg/kg	< 5	< 5
Selenium (1M HCl extract)	2	mg/kg	< 2	< 2
Silver (1M HCl extract)	2	mg/kg	< 2	< 2
Uranium (1M HCl extract)	10	mg/kg	< 10	< 10
Vanadium (1M HCl Extract)		mg/kg	0.96	0.54
Zinc (1M HCl extract)	5	mg/kg	< 5	8.1

Sample History

Where samples are submitted/analysed over several days, the last date of extraction and analysis is reported.
A recent review of our LIMS has resulted in the correction or clarification of some method identifications. Due to this, some of the method reference information on reports has changed. However, no substantive change has been made to our laboratory methods, and as such there is no change in the validity of current or previous results.

If the date and time of sampling are not provided, the Laboratory will not be responsible for compromised results should testing be performed outside the recommended holding time.

Description	Testing Site	Extracted	Holding Time
Fluoride (Total)	Melbourne	May 05, 2020	28 Days
- Method: LTM-INO-4150 Determination of Total Fluoride PART B – ISE			
Sulphate as SO4 (1:5 aqueous extract)	Melbourne	May 04, 2020	28 Days
- Method: LTM-INO-4110 Sulfate by Discrete Analyser			
Particle Size by Sieve analysis*	Melbourne	May 04, 2020	28 Days
- Method: AS1289.C6.1-1977 Determination of Particle Size by Sieving			
Heavy Metals (1M HCl Extract)	Melbourne	May 05, 2020	180 Days
- Method: USEPA 6010/6020 Heavy Metals - 1M HCl Extract			
% Moisture	Melbourne	May 01, 2020	14 Days
- Method: LTM-GEN-7080 Moisture			

APPENDIX H

Historical Sediment Results

Table 6 Historical Sediment Results 2011 – 2020 Bioavailable Metals

Site	Date	Aluminium mg/kg	Arsenic mg/kg	Cadmium mg/kg	Cobalt mg/kg	Chromium mg/kg	Copper mg/kg	Iron mg/kg	Lead mg/kg	Manganese mg/kg	Nickel mg/kg	Silver mg/kg	Uranium mg/kg	Zinc mg/kg
Trigger values*			20 - 70	1.5 - 10	N/A	80 - 370	65 - 270	N/A	50 - 220	N/A	21 - 52	1		200 - 410
ERSW4	2011	1200	NT	<0.5	<5	<5	26	7,200	<5	79	<5	<5	NT	24
	2012	1200	NT	<0.5	<5	<5	26	7,200	<5	79	<5	<5	NT	24
	2013	245	<4	NT	<1	<1	12	1,350	3	50	<1	NT	NT	<1
	2014	210	<4	<0.4	<1	<1	3	530	2	20	<1	NT	<1	<1
	2015	660	7	NT	6	<5	13	4,500	6	180	NT	NT	NT	30
	2016	NT	3	<0.4	<2	<5	9	1,900	<5	61	<4	<2	<5	7
	2017	NT	<2	<0.4	<5	<5	<5	1,200	<5	53	<5	<2	<10	9.8
	2018	NT	<3	<0.5	<10	<1	1	440	<2	19	<1	<0.5	<0.1	6
	2019	80	<1	0.1	1.7	<1	<1	800	<1	97	1.1	<1	NT	14
	2020	94	<2	<0.4	<5	<5	<5	440	<5	17	<5	<2	<10	8.4
ERUS	2011	990	NT	<0.5	<5	<5	<5	12,000	<5	20	<5	<5	NT	<5
	2012	990	NT	<0.5	<5	<5	<5	12,000	<5	20	<5	<5	NT	<5
	2013	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
	2014	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
	2015	810	<2	NT	<2	<5	<5	5,000	<5	120	NT	NT	NT	<5
	2016	NT	<2	<0.4	<2	<5	<5	1,900	<5	42	<4	<2	<5	<5
	2017	NT	<2	<0.4	<5	<5	<5	2,500	<5	37	<5	<2	<10	<5
	2018	NT	<3	<0.5	<10	<1	<1	640	<2	29	<1	0.6	<0.1	1
	2019	140	<1	<0.1	0.5	<1	<1	1,230	<1	<10	<1	<1	NT	<1
	2020	140	<2	<0.4	<5	<5	<5	1,200	<5	21	<5	<2	<10	<5

Site	Date	Aluminium mg/kg	Arsenic mg/kg	Cadmium mg/kg	Cobalt mg/kg	Chromium mg/kg	Copper mg/kg	Iron mg/kg	Lead mg/kg	Manganese mg/kg	Nickel mg/kg	Silver mg/kg	Uranium mg/kg	Zinc mg/kg
ERDS	2011	940	NT	<0.5	<5	5.4	<5	8,500	<5	130	<5	<5	NT	9.2
	2012	940	NT	<0.5	<5	5.4	<5	8,500	<5	130	<5	<5	NT	9.2
	2013	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
	2014	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
	2015	1,200	2	NT	4	5	6	8,900	5	110	NT	NT	NT	15
	2016	NT	2	<0.4	3	<5	6	4,200	<5	130	<4	<2	<5	9
	2017	NT	<2	<0.4	<5	<5	<5	3,400	<5	34	<5	<2	<10	10
	2018	NT	<3	<0.5	<10	<1	5	3,300	2	57	2	<0.5	<0.1	18
	2019	120	<1	<0.1	0.6	<1	1.4	800	1.1	<10	<1	<1	NT	8.1
	2020	83	<2	<0.4	<5	<5	<5	440	<5	18	<5	<2	<10	6.2
ERTOP	2016	NT	<2	<0.4	<2	<5	<5	1,800	<5	20	<4	<2	<5	<5
	2017	NT												
	2018	NT	<3	<0.5	<10	<1	<1	1,100	<2	21	<1	1.5	<0.1	1
	2019	50	<1	<0.1	<0.5	<1	<1	480	<1	11	<1	<1	NT	<1
	2020	66	<2	<0.4	<5	<5	<5	1200	<5	16	<5	<2	<5	<5
ERBTM	2013	730	<4	NT	2	<1	45	3,700	5	14	2	NT	NT	37
	2014	200	<4	<0.4	2.7	<1	7	2,800	2	96	1	NT	<1	21
	2015	1,000	<2	NT	4	<5	10	4,600	<5	99	NT	NT	NT	17
	2016	NT	<2	<0.4	<2	<5	<5	1,100	<5	42	<4	<2	<5	<5
	2017	NT	<2	<0.4	<5	<5	<5	1,200	<5	19	<5	<2	<10	12
	2018	NT	<3	<0.5	<10	<1	1	970	<2	65	<1	<0.5	<0.1	8
	2019	260	<1	<0.1	1.6	<1	8.3	1,080	3.6	67	<1	<1	NT	11
	2020	37	<2	<0.4	<5	<5	<5	210	<5	15	<5	<2	<10	<5
SCTOP	2016	NT	<2	<0.4	<2	<5	<5	1,100	<5	19	<4	<2	<5	<5
	2017	NT	<2	<0.4	<5	<5	<5	600	<5	11	<5	<2	<10	<5
	2018	NT	<3	<0.5	<10	<1	<1	180	<2	15	<1	<0.5	<0.1	4

Site	Date	Aluminium mg/kg	Arsenic mg/kg	Cadmium mg/kg	Cobalt mg/kg	Chromium mg/kg	Copper mg/kg	Iron mg/kg	Lead mg/kg	Manganese mg/kg	Nickel mg/kg	Silver mg/kg	Uranium mg/kg	Zinc mg/kg
	2019	80	<1	<0.1	<0.5	<1	<1	500	<1	16	<1	<1	NT	<1
	2020	48	<2	<0.4	<5	<5	<5	220	<5	24	<5	<2	<10	<5
SCDS	2016	NT	<2	<0.4	<2	<5	<5	1,400	<5	76	<4	<2	<5	6
	2017	NT	<2	<0.4	<5	<5	<5	860	<5	45	<5	<2	<10	11
	2018	NT	<3	<0.5	<10	<1	2	510	4	35	<1	<0.5	<0.1	6
	2019	90	<1	0.2	1.4	<1	3.8	1,130	1.1	50	1.3	<1	NT	16
	2020	42	<2	<0.4	<5	<5	<5	290	<5	16	<5	<2	<10	7.4
SCBTM	2016	NT	<2	<0.4	<2	<5	<5	1,300	<5	44	<4	<2	<5	<5
	2017	NT	<2	<0.4	<5	<5	<5	460	<5	63	<5	<2	<10	6.2
	2018	NT	<3	<0.5	<10	<1	1	600	<2	120	<1	<0.5	<0.1	8
	2019	50	<1	<0.1	0.5	<1	1.4	300	1	13	<1	<1	NT	6
	2020	68	<2	<0.4	<5	<5	<5	340	<5	66	<5	<2	<10	18
SCUS	2020	59	<2	<0.4	<5	<5	<5	290	<5	39	<5	<2	<10	16

* Sediment Quality Guideline Values (Simpson and Batley 2016)

APPENDIX I

Ecotoxicology Report 2020

2020 ECOTOXICOLOGY REPORT

Mt Todd Gold Project

Prepared for:

Vista Gold Australia Pty Ltd
Level 3, 43 Cavenagh Centre
Cavenagh Street
DARWIN NT 0800

SLR Ref: 680.10533-R13
Version No: 1.1
April 2020

EXECUTIVE SUMMARY

PREPARED BY

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BASIS OF REPORT

This report has been prepared by SLR Consulting Australia Pty Ltd (SLR) with all reasonable skill, care and diligence, and taking account of the timescale and resources allocated to it by agreement with Vista Gold Australia Pty Ltd (the Client). Information reported herein is based on the interpretation of data collected, which has been accepted in good faith as being accurate and valid.

This report is for the exclusive use of the Client. No warranties or guarantees are expressed or should be inferred by any third parties. This report may not be relied upon by other parties without written consent from SLR.

SLR disclaims any responsibility to the Client and others in respect of any matters outside the agreed scope of the work.

DOCUMENT CONTROL

Reference	Date	Prepared	Checked	Authorised
680.10533-R13-v1.0	23 April 2020	Jill Woodworth	Tarah Hagen	Tarah Hagen
680.10533.R13-v1.1	30 April 2020	Jill Woodworth	Loren Yallop	Paul Turyn

CONTENTS

DOCUMENT REFERENCES

TABLES

APPENDICES

1 Introduction

1.1 Background

Ecotoxicological assessment of treated mine water from the Mount Todd Project Area (MTPA) sampled after mixing in the Edith River is conducted to assess the potential impacts on the ecosystem within the Edith River. Vista Gold has commissioned the ecotoxicological testing on water sampled at two locations in the Edith River (i.e. SW2 and SW4) during discharge. The testing follows the protocol outlined in the approved Mt Todd Ecotoxicological Plan Chapter 6 – WDL 178-05 Annual Report (2018). This testing was conducted to meet the following conditions of WDL 178-07 which is authorised by the Northern Territory (NT) Environmental Protection Authority (EPA):

- *Condition 35: The licensee must implement, maintain and follow the Ecotoxicology Plan as specified in Table 1 for the life of this licence.*
- *Condition 36: The licensee must revert back to the previously approved Ecotoxicology Plan if the results of the current Ecotoxicological Plan confirms the presence of toxicity at SW4.*

This report presents the results of the 2020 ecotoxicological assessment of water in the Edith River during discharge of treated mine water from the MTPA.

1.2 Scope of Work

To meet the requirements of WDL 178-07 the following work was conducted:

- Review and assessment of ecotoxicity testing results.
- Review and assessment of water chemistry results.
- Interpretation of ecotoxicity and chemistry results.
- Reporting ecotoxicity to meet the WDL requirements.

1.3 Objectives

This report has been developed to meet Conditions 35 and 36 of WDL 178-07 as listed in **Section 1.1** and to comply with the approved Mt Todd Ecotoxicological Plan Chapter 6 – WDL 178-05 Annual Report (2018).

1.4 Assumptions

In interpreting the ecotoxicological and chemistry results provided by Vista Gold, SLR assumes the following:

- All samples collected by Vista Gold are representative of each of the identified sample sites and were handled according to procedures identified by the laboratory.

2 Methodology

2.1 Sample Collection

Vista Gold collected water samples for ecotoxicity testing from the Edith River at the compliance point (SW4) during the discharge of treated water from Batman Pit and at the Edith River upstream site at SW2 for use in screening bioassays on 16 February 2020. Vista Gold also collected samples from the Edith River at SW2 and SW4 and a sample from Batman Pit for chemical analysis on that date. Samples were collected in accordance with the following Australian standard method:

AS/NZS 5667.1:1998 – Guidance on the design of sampling programs, sampling techniques and the preservation and handling of samples

All sample containers for ecotoxicity testing were filled to the top (i.e. no air spaces) to maintain sample integrity.

The SW2 and SW4 samples for ecotoxicity testing were immediately chilled on ice then maintained at 4°C prior to transport to Ecotoxicology Services Australasia (ESA) where the samples were received on 18 February 2020. Samples for chemistry were transported directly to Intertek's Darwin laboratory.

2.2 Water Quality Analysis

All water samples used for ecotoxicity testing were analysed for the suite of analytes listed in Appendix 1 of WDL 178-07. Analyses were conducted by Intertek, a NATA accredited laboratory based in Darwin.

2.3 Screening Bioassays

Water quality of natural waterways is not expected to show toxicity to representative species, therefore a screening bioassay is used to assess if the water shows any toxicity. An undiluted water sample from each site is used in the screening bioassays and the results are compared to an upstream sample and a laboratory control water sample. Significant toxicity is observed when the test organisms exposed to the sample exhibit more than 20% difference in an adverse response compared with controls[1] . If the difference observed in the response being investigated is ≤20% that of the controls, this is taken to mean the sample does not cause significant toxicity. Screening bioassays can be useful for comparing water quality spatially and temporally across a site.

The 7 day *Ceriodaphnia dubia* reproduction bioassay was used as the screening bioassay for the SW4 sample and the *C.dubia* acute bioassay was used as the initial screening bioassay for SW2 and SW4. *C. dubia* was determined to be the sensitive species by previous studies conducted for the MTPA. Historically the SW2 sample (upstream of discharge) has shown toxicity to *C. dubia*, with no survivors after the 7-day exposure period due to the low electrical conductivity (EC) of the water. *C. dubia* were exposed to 100% of SW4 water only (sampled during Batman Pit discharge) and 100% SW2 water. The screening bioassays were run concurrently with a laboratory control sample. As discussed above, toxicity of the sample is considered to occur if the difference in mortality between the test and controls is >20%. Ecotoxicology testing was conducted by Ecotoxicology Services Australasia (ESA) based in Sydney.

[1] Responses investigated differ depending on what organisms are tested but typically refer to immobilization or a decrease in growth or reproduction.

2.4 Laboratory Controls

Upstream water (SW2) may adversely impact on cladoceran reproduction as shown in previous monitoring programs, due to its low EC. To identify any confounding influence from SW2 on the results obtained from SW4, the *C. dubia* bioassay was conducted using the SW2 survival bioassay to assist in interpreting the SW4 results. Laboratory dilution water was used as the control in all studies.

2.5 Quality Assurance

NATA accredited bioassays were used in this study and, as such, they have met quality assurance in order to be released to the client. Each bioassay was conducted in conjunction with a laboratory control (the water in which the organisms are grown) and a reference toxicant (KCl for the cladoceran bioassays). All bioassays met the laboratory QA parameters (**Appendix A**).

3 Results and Discussion

3.1 Water Quality

Water quality results for Batman Pit, upstream site SW2 and compliance site SW4 are presented in **Table 1**. The electrical conductivity at the upstream site, SW2, of 24 µS/cm, indicates that there will be some toxicity associated with this site as discussed in previous reports (**Appendix A**). Batman Pit treated water discharge is characterised by elevated concentrations of dissolved metals, including cadmium, copper, nickel, and zinc with high conductivity and sulfate. Chemistry results are located in **Appendix A**.

Water quality at the compliance point at SW4 shows considerably lower metal concentrations when compared to Batman Pit. The concentrations of metals at SW4 are compliant with the site-specific trigger values (SSTVs) listed in WDL 178-07, with two exceptions. The only metal exceedance at SW4 is for iron at 602 µg/L and this is similar to the upstream (SW2) iron concentration of 644 µg/L. It is noted, however, the screening toxicity tests using the cladoceran reproduction bioassay show that there is no toxicity in the sample when compared to laboratory controls, even with the elevated iron concentrations (see **Section 3.2**).

Table 1 Water Quality Data

Analyte	Batman Pit		SW2		SW4		
	2020	Long-term median	2020	Long-term median	2020	Long-term median	SSTV
EC (µS/cm)	2,785	2,818	24	17	175	86	250
pH	6.99	7.2	6.4	6.2	6.09	6.2	6 - 8
Ions (mg/L)							
Bicarbonate	7	34	9	8	13	9	319
Chloride	2	7	2	1	8	2	64
Magnesium	235	190	0.7	0.6	5.8	3.4	21
Sulfate	2,080	1,800	0.3	0.5	41	16	129
Cyanide (µg/L)	NA	2	<5	2	NA	<4	7
Dissolved Metals (µg/L)							
Aluminium	34	110	95	29	84	12	150
Cadmium	23	23	<0.02	<0.1	0.06	0.1	0.8
Chromium	<0.5	<1	0.4	<1	0.3	<1	-
Cobalt	30	83	0.08	<1	0.6	1	13
Copper	15	9	0.47	<1	1.3	1	2.5
Iron	<10	5	644	220	**602**	150	350
Lead	0.08	<1	0.06	<1	0.16	<1	9.4
Manganese	449	700	8.3	7	88	40	3,600
Nickel	143	200	0.46	<1	1.1	2	17
Zinc	1,980	480	0.7	1	7.4	10	31

Analyte	Batman Pit		SW2		SW4		
	2020	Long-term median	2020	Long-term median	2020	Long-term median	SSTV
NA = Not analysed Bold denotes exceedance of the SSTV at compliance point SW4							

3.2 Ecotoxicology Results

Table 2 shows reproduction and survival from each site as a percentage of controls. The results from historical ecotoxicology assessment from 2015, 2018 and 2019 have been compared to the 2020 ecotoxicity assessment and are also shown in **Table 2**. Results from the 2015 DTA (GHD 2015), 2018 Ecotox Report (GHD 2018) and 2019 Ecotoxicology Program Report (GHD 2019) have been included for comparative purposes. The ESA (2020) ecotoxicity report for SW2 and SW4 is located in **Appendix B**.

The screening results for SW2 show that the water upstream of the discharge site can be chronically toxic to the cladoceran as measured by the reproduction bioassay in previous years. Insufficient sample was available to conduct the chronic bioassay on SW2 in 2020. However, as the survival after 48 hours was 100% in 2020, it may be expected that reproduction would be unaffected, similar to observations in 2015.

All screening bioassays conducted on SW4 show that there is no toxicity at the Edith River compliance site during the treated mine water discharge even though iron was elevated above the SSTV.

Table 2 Ecotoxicology Screen Bioassay Results

Year	Site	*C. dubia* Reproduction	*C.dubia* Survival
2015	SW2	50%	90%
	SW4	102%*	100%
2018	SW2	6%	0%
	SW4	98%	100%
2019	SW2	0%	0%
	SW4	92%	100%
2020	SW2	Not tested	100% (48 hours)
	SW4	100%	100% (48 hours)

**Reproduction in SW4 water was greater than controls hence the result is >100%*

4 Conclusions and Recommendations

4.1 Conclusions

The 2020 ecotoxicological investigation commissioned by Vista Gold for assessment of the MTPA discharge has demonstrated that the treated mine water discharged from Batman Pit to the Edith River is not toxic at the compliance point, SW4, for the sensitive species and end point tested.

The dilution of the treated mine water is managed using a dilution ratio based on Batman Pit water quality and the Edith River flow. The dilution ratio is usually in the order of 1:33 (as a minimum), however, during the 2020 wet season the dilution ranged from 1:33 to 1:96 due to the low rainfall and resulting low flow in the Edith River. Based on operating data provided by Vista Gold the dilution ratio during the 16 February 2020 sampling was 1:47. The results of the ecotoxicity testing indicate that the current dilution methodology application and discharge management is averting any environmental harm in the receiving waters of Edith River. The chemistry results and the screening toxicity tests conducted on the SW4 water during discharge have confirmed the absence of toxicity. Jointly, these results validate the safety of the current dilution rate and treated mine water management for the protection of the receiving environment. The compilation of the wet season data for water quality and the health of aquatic macroinvertebrate populations at SW4 to be provided in the WDL 178-07 Monitoring Report later in 2020 will also be used to confirm the lack of toxicity of the treated mine water discharge.

The previous and the current investigations suggest that the low conductivity observed at the upstream site (SW2), may be affecting the results of the cladoceran screening test conducted on the SW2 water. This has been confirmed by Dr Rick Krassoi at ESA as this species has been reported to be sensitive to low conductivity. However, the use of this species is still recommended as it is one of the few NATA accredited bioassays that assess a full life cycle of a sensitive aquatic invertebrate. Vista Gold also have historical data from 2009 so that results from this bioassay can be used to assess historical changes in water quality and toxicity at the MTPA.

Iron was the only chemical that exceeded the SSTV at SW4. This exceedance was not associated with any risk of detrimental effects in the receiving environment as has been validated by the absence of toxicity in the receiving water at SW4.

In conclusion, the ecotoxicological assessment, undertaken following the WDL 178-07 requirements and the approved Ecotoxicological Plan, has shown that discharge of treated mine water from Batman Pit using the current dilution method does not pose any risk of harm to the aquatic communities living in the Edith River downstream of the discharge point.

4.2 Recommendations

- To maintain the monitoring of toxicity of the Edith River at SW4 during discharge of treated mine water to show that the discharge is not adversely impacting on the aquatic ecosystem in the Edith River, it is recommended to conduct the ecotoxicology testing as per the current approved Plan.
- It is recommended to review the SSTV of iron to reflect the influence of upstream concentrations.

APPENDIX A

Water Quality Data

CHEMICAL
TEST REPORT

intertek
Total Quality. Assured.

Vista Gold Australia Pty Ltd

Robert Friel
rfriel@mttodd.com.au
Mt Todd Mine
PO Box 1616 Katherine NT 0851
AUSTRALIA

JOB NUMBER	**NT51292**
PO NUMBER	
PROJECT	WDL Water monitoring - Quote: 18037 v2
CHAIN OF CUSTODY	16/02/2020
DATE RECEIVED	17/02/2020
DATE REPORTED	27/02/2020
NO. SAMPLES	3 Water/Solution(s) for Analysis

COMMENTS

> Results required for compliance may be compromised by:

1. Use of non-laboratory supplied sample containers
2. Holding time breaches
3. Field related preparation or preservation techniques
4. Laboratory Measurement Uncertainty

Potentially affected results will be highlighted in the report.

> Samples will be discarded one month from final report date.

> Due to high levels of dissolved solids some samples have been diluted to reduce matrix effects.
The dilution factors are listed in the report & the detection levels are raised accordingly.

TESTED BY

Intertek NTEL
55 Export Drive
East Arm NT 0822
AUSTRALIA
P: +61 8 8947 0510
E: ntel@intertek.com

RESULTS AUTHORISED BY

NAME **Fiona Dunbar-Smith**
POSITION Intertek NTEL signatory

Accredited for compliance with ISO/IEC17025 - Testing
Accreditation Number 14610
Report is only valid when reproduced or presented in full.

REPORT CODE: **NT51292**
Methodology:

Analysis Code	Description	Method Reference	Analytical Scheme	Technique / Instrument	Detection Limit	Data Units
Alkalinity	Total Alkalinity (as CaCO3)	WWM08	ALK1	ELECTRODE	1	mg/L
CO3	Carbonate Alkalinity (as CaCO3)	WWM08	ALK1	ELECTRODE	1	mg/L
HCO3	BiCarbonate Alkalinity (as CaCO3)	WWM08	ALK1	ELECTRODE	1	mg/L
OH	Hydroxide Alkalinity (as CaCO3)	WWM08	ALK1	ELECTRODE	1	mg/L
TSS	Total Suspended Solids	WWM14	TSSTDS	GRAV	10	mg/L
TDS	Total Dissolved Solids	WWM14	TSSTDS	GRAV	10	mg/L
Cl	Chloride	WWM19	CL	DA	2	mg/L
Total CN	Total Cyanide by distillation & FIA/DA	WWM17	CN_TOT	COLOUR	0.005	mg/L
Total N	Total Nitrogen	WWM22	N3	COLOUR	0.01	mg/L
Total P	Total Phosphorous	WWM25	P3	COLOUR	0.005	mg/L
Hardness	Total Hardness (as CaCO3 - calculated)	WWM11	TH1	CALC.	0.1	mg/L
Ca_F	Calcium_Filtered 0.45µm	W108	W108I	ICPOES	0.1	mg/L
K_F	Potassium_Filtered 0.45µm	W108	W108I	ICPOES	0.1	mg/L
Mg_F	Magnesium_Filtered 0.45µm	W108	W108I	ICPOES	0.1	mg/L
Na_F	Sodium_Filtered 0.45µm	W108	W108I	ICPOES	0.1	mg/L
SO4_F	Sulfur as Sulfate_Filtered 0.45µm	W108	W108I	ICPOES	0.1	mg/L
ACBalance	Anion Cation Balance	WWM40	ACB	CALC.	0.1	%
Al_F	Aluminium_Filtered 0.45µm	W100	W100M	ICPMS	0.1	µg/L
Al_T	Aluminium_Total Recoverable	W200	W200M	ICPMS	0.1	µg/L
B_F	Boron_Filtered 0.45µm	W100	W100M	ICPMS	0.5	µg/L
Cd_F	Cadmium_Filtered 0.45µm	W100	W100M	ICPMS	0.02	µg/L
Cd_T	Cadmium_Total Recoverable	W200	W200M	ICPMS	0.02	µg/L
Co_F	Cobalt_Filtered 0.45µm	W100	W100M	ICPMS	0.01	µg/L
Cr_F	Chromium_Filtered 0.45µm	W100	W100M	ICPMS	0.1	µg/L
Cu_F	Copper_Filtered 0.45µm	W100	W100M	ICPMS	0.01	µg/L
Cu_T	Copper_Total Recoverable	W200	W200M	ICPMS	0.01	µg/L
Fe_F	Iron_Filtered 0.45µm	W100	W100M	ICPMS	2	µg/L
Fe_T	Iron_Total Recoverable	W200	W200M	ICPMS	2	µg/L
Hg_F	Mercury_Filtered 0.45µm - unpreserved	W100	W100M	ICPMS	0.02	µg/L
Li_F	Lithium_Filtered 0.45µm	W100	W100M	ICPMS	0.05	µg/L
Mn_F	Manganese_Filtered 0.45µm	W100	W100M	ICPMS	0.01	µg/L
Ni_F	Nickel_Filtered 0.45µm	W100	W100M	ICPMS	0.01	µg/L
Pb_F	Lead_Filtered 0.45µm	W100	W100M	ICPMS	0.01	µg/L
Zn_F	Zinc_Filtered 0.45µm	W100	W100M	ICPMS	0.1	µg/L

REPORT CODE: **NT51292** **Project:** **16/02/2020**

Element:	Alkalinity	CO3	HCO3	OH	TSS	TDS	Cl	Total CN	Total N
Units:	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Method:	ALK1	ALK1	ALK1	ALK1	TSSTDS	TSSTDS	CL	CN_TOT	N3
Detection Limit	1	1	1	1	10	10	2	0.005	0.01
Analysis Date:	18/02/2020	18/02/2020	18/02/2020	18/02/2020	26/02/2020	26/02/2020	19/02/2020	25/02/2020	25/02/2020
Sample ID									
RP3 16/02/20	7	<1	7	<1	<10	30	2	N.A.	0.02
SW2 16/02/20	9	<1	9	<1	<10	80	2	<0.005	0.06
SW4 16/02/20	13	<1	13	<1	<10	3210	8	N.A.	3.17

REPORT CODE: **NT51292** **Project:** **16/02/2020**

Element:	Total P	Hardness	Ca_F	K_F	Mg_F	Na_F	SO4_F	AC Balance	DF
Units:	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	%	--
Method:	P3	TH1	W108I	W108I	W108I	W108I	W108I	ACB	W100M
Detection Limit	0.005	0.1	0.1	0.1	0.1	0.1	0.1	0.1	1
Analysis Date:	25/02/2020	26/02/2020	18/02/2020	18/02/2020	18/02/2020	18/02/2020	18/02/2020	18/02/2020	18/02/2020
Sample ID									
RP3 16/02/20	0.025	2090	449	9.1	235	56.0	2080	1.0	5
SW2 16/02/20	0.015	4.9	0.9	1.1	0.7	1.7	0.3	PASS	--
SW4 16/02/20	<0.005	38.1	5.8	2.4	5.8	6.4	41.3	PASS	--

REPORT CODE: **NT51292** **Project:** **16/02/2020**

Element:	Al_F	Al_T	B_F	Cd_F	Cd_T	Co_F	Cr_F	Cu_F	Cu_T
Units:	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Method:	W100M	W200M	W100M	W100M	W200M	W100M	W100M	W100M	W200M
Detection Limit	0.1	0.1	0.5	0.02	0.02	0.01	0.1	0.01	0.01
Analysis Date:	18/02/2020	18/02/2020	18/02/2020	18/02/2020	18/02/2020	18/02/2020	18/02/2020	18/02/2020	18/02/2020
Sample ID									
RP3 16/02/20	34.2	174	64.0	23.2	23.4	29.5	<0.5	15.2	27.7
SW2 16/02/20	94.8	2000	12.5	<0.02	<0.02	0.08	0.4	0.47	1.04
SW4 16/02/20	83.9	1850	11.0	0.06	0.06	0.60	0.3	1.28	2.66

REPORT CODE: **NT51292** **Project:** **16/02/2020**

Element:	Fe_F	Fe_T	Hg_F	Li_F	Mn_F	Ni_F	Pb_F	Zn_F	
Units:	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	
Method:	W100M	W200M	W100M	W100M	W100M	W100M	W100M	W100M	
Detection Limit	2	2	0.02	0.05	0.01	0.01	0.01	0.1	
Analysis Date:	18/02/2020	18/02/2020	18/02/2020	18/02/2020	18/02/2020	18/02/2020	18/02/2020	18/02/2020	
Sample ID									
RP3 16/02/20	<10	252	<0.1	159	449	143	0.08	1980	
SW2 16/02/20	644	3230	<0.02	0.80	8.31	0.46	0.06	0.7	
SW4 16/02/20	602	2600	<0.02	0.90	88.1	1.08	0.16	7.4	

APPENDIX B

Ecotoxicology Report

Toxicity Assessment of SW-2 and SW-4 Wastewater Samples

SLR for Vista Gold

Test Report

March 2020

T +61 2 9420 9481
Unit 27, 2 Chaplin Drive
Lane Cove NSW 2066 Australia
www.ecotox.com.au
ECOTOX SERVICES AUSTRALIA PTY LIMITED
ABN 95 619 426 201

Toxicity Test Report: TR1886/1

Accredited for compliance with ISO/IEC 17025

Client:	SLR Consulting 503 Murray Street Perth WA 6000	**ESA Job #:**	PR1886
		Date Sampled:	16 February 2020
		Date Received:	18 February 2020
Attention:	Jill Woolworth	**Sampled By:**	Vista Gold
Client Ref:	Not Supplied	**ESA Quote #:**	PL1886_q01

Lab ID No.:	Sample Name:	Sample Description:
9468	SW2	Aqueous sample, 6.4 pH*, conductivity 24 µS/cm*, total ammonia <2.0mg/L*. Sample received at 8ºC* in apparent good condition.
9469	SW4	Aqueous sample, 6.9 pH*, conductivity 329 µS/cm*, total ammonia <2.0mg/L*. Sample received at 8ºC* in apparent good condition.

*NATA accreditation does not cover the performance of this service

Test Performed:	48-hr acute toxicity test using the freshwater cladoceran *Ceriodaphnia dubia*
Test Protocol:	ESA SOP 101 (ESA 2017), 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 Dilute Mineral Water (DMW) control was tested concurrently with the sample.
Source of Test Organisms:	ESA Laboratory culture
Test Initiated:	19 February 2020 at 1400h

Sample 9468 and 9469: *SW2 and SW4*

Concentration (%)	% Unaffected (Mean ± SD)
DMW Control	100 ± 0.0
SW2	100 ± 0.0
SW4	100 ± 0.0

Vacant

QA/QC Parameter	Criterion	This Test	Criterion met?
Control mean % unaffected	≥90.0%	100%	Yes
Reference Toxicant within cusum chart limits	187.4-221.0mg KCl/L	191.2 mg KCl/L	Yes

T +61 2 9420 9481
Unit 27, 2 Chaplin Drive
Lane Cove NSW 2066 Australia
www.ecotox.com.au
ECOTOX SERVICES AUSTRALIA PTY LIMITED
ABN 95 619 426 201

Test Report Authorised by: Dr Rick Krassoi, Director on 9 March 2020

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 (2017) *SOP 101 – Acute toxicity test using Ceriodaphnia dubia*. Issue No. 10. Ecotox Services Australasia, Sydney, New South Wales.

USEPA (2002) *Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms. 4th Ed.* United States Environmental Protection Agency, Office of Water, Washington DC.

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ECOTOX SERVICES AUSTRALIA PTY LIMITED
ABN 95 619 426 201

Toxicity Test Report: TR1886/2

Accredited for compliance with ISO/IEC 17025

Client:	SLR Consulting 503 Murray Street Perth WA 6000	**ESA Job #:**	PR1886
		Date Sampled:	16 February 2020
		Date Received:	18 February 2020
Attention:	Jill Woolworth	**Sampled By:**	Vista Gold
Client Ref:	Not Supplied	**ESA Quote #:**	PL1886_q01

Lab ID No.:	Sample Name:	Sample Description:
9469	SW4	Aqueous sample, 6.9 pH*, conductivity 329 µS/cm*, total ammonia <2.0mg/L*. Sample received at 8ºC* 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 cf 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 Dilute Mineral Water (DMW) control was tested concurrently with the sample.
Source of Test Organisms:	ESA Laboratory culture
Test Initiated:	17 March 2020 at 1230h

Sample 9469: *SW4* **Concentration (%)**	**% Unaffected at 7 days (Mean ± SD)**
DMW Control	100 ± 0.0
SW4	100 ± 0.0

Sample 9469: *SW4* **Concentration (%)**	**Number of Young (Mean ± SD)**
DMW Control	16.9 ± 1.6
SW4	16.5 ± 1.3

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	16.9	Yes
Reference Toxicant within cusum chart limits	179.9-228.5 mg KCl/L	199.1 mg KCl/L	Yes

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Test Report Authorised by: Dr Rick Krassoi, Director on 18 April 2020

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

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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: 601.2
Last Revised: 21 September 2018

Sample Receipt Notification

Attention : Jill Woodworth

Client : SLR Consulting
503 Murray St
Perth WA 6000

Email : jwoodworth@slrconsulting.com
Telephone : 08 9422 5900
Facsimile :

Date : 23/02/2020

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

ESA Project : PR1886 ☑ 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 : 18/02/2020
Time samples received : 8:50
No. of samples received : 2
Sample matrix : Aqueous
Sample temperature : 6-10°C

Comments : 2 x 1L of each sample received at 8oC 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

Chain-of-Custody / Service Request Form

Datasheet ID: 601.1
Last Revised: 20 September 2018

Customer: Vista Gold
Contact Name: Robert Friel
Phone: (08) 89754297 Email: rfriel@mttodd.com.au (please provide an email address for sample receipt notification)
Sampled by: Robbie Friel

Ship To: Ecotox Services Australia
Attention: Dr Rick Krassoi

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)						Comments / Instructions
					Cerio						**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** 1886
16/02/20	0905	SW2	Grab	2 x L	X						
16/02/20	0950	SW4	Grab	2 x L	X						

8 °C
9468
9469

1) Released By:	Date:	2) Received By:	Date:	3) Released By:	Date:	4) Received By:	Date:
Robbie Friel	17/02/20		18/2/20				
Of: Vista Gold, MTTodd	Time: 11:15am	Of: ESA	Time: 0850	Of:	Time:	Of:	Time:

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

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

Statistical Printouts for the Acute Test with *Ceriodaphnia dubia*

-48 Hr Unaffected

Start Date:	19/02/2020 16:00	Test ID:	PR1886/01	Sample ID:	SW2 and SW4
End Date:	21/02/2020 16:00	Lab ID:	9468 and 9469	Sample Type:	AQ-Aqueous
Sample Date:	16/02/2020	Protocol:	ESA 101	Test Species:	CD-Ceriodaphnia dubia
Comments:	Screening tests (undiluted only)				

Conc-%	1	2	3	4
DMW Control	1.0000	1.0000	1.0000	1.0000
SW2	1.0000	1.0000	1.0000	1.0000
SW4	1.0000	1.0000	1.0000	1.0000

			Transform: Arcsin Square Root					Rank	1-Tailed
Conc-%	Mean	N-Mean	Mean	Min	Max	CV%	N	Sum	Critical
DMW Control	1.0000	1.0000	1.3453	1.3453	1.3453	0.000	4		
SW2	1.0000	1.0000	1.3453	1.3453	1.3453	0.000	4	18.00	11.00
SW4	1.0000	1.0000	1.3453	1.3453	1.3453	0.000	4	18.00	11.00

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates normal distribution (p > 0.05)	1	0.859		
Equality of variance cannot be confirmed				

Hypothesis Test (1-tail, 0.05)

Steel's Many-One Rank Test indicates no significant differences
Treatments vs DMW Control

-48 Hr Unaffected

Start Date:	19/02/2020 16:00	Test ID:	PR1886/01	Sample ID:	SW2 and SW4
End Date:	21/02/2020 16:00	Lab ID:	9468 and 9469	Sample Type:	AQ-Aqueous
Sample Date:	16/02/2020	Protocol:	ESA 101	Test Species:	CD-Ceriodaphnia dubia
Comments:	Screening tests (undiluted only)				

Auxiliary Data Summary

Conc-%	Parameter	Mean	Min	Max	SD	CV%	N
DMW Control	% un-immobilised	100.00	100.00	100.00	0.00	0.00	4
SW2		100.00	100.00	100.00	0.00	0.00	4
SW4		100.00	100.00	100.00	0.00	0.00	4
DMW Control	pH	8.20	8.20	8.20	0.00	0.00	1
SW2		6.40	6.40	6.40	0.00	0.00	1
SW4		6.90	6.90	6.90	0.00	0.00	1
DMW Control	DO %	98.30	98.30	98.30	0.00	0.00	1
SW2		73.80	73.80	73.80	0.00	0.00	1
SW4		81.20	81.20	81.20	0.00	0.00	1
DMW Control	Cond uS/cm	176.00	176.00	176.00	0.00	0.00	1
SW2		24.00	24.00	24.00	0.00	0.00	1
SW4		329.00	329.00	329.00	0.00	0.00	1

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

Ceriodaphnia Partial Life-Cycle Test-Reproduction

Start Date:	17/03/2020 12:30	Test ID:	PR1886/3	Sample ID:	SW4
End Date:	24/03/2020 19:00	Lab ID:	9469	Sample Type:	AQ-Aqueous
Sample Date:		Protocol:	ESA 102	Test Species:	CD-Ceriodaphnia dubia
Comments:	screen only				

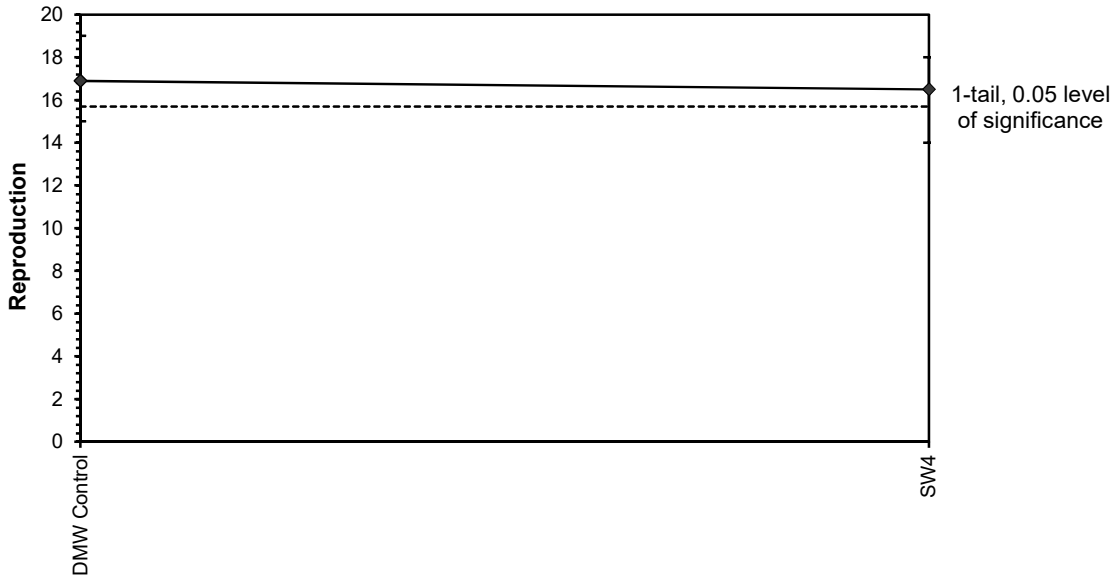
Conc-%	1	2	3	4	5	6	7	8	9	10
DMW Control	19.000	16.000	18.000	15.000	15.000	18.000	18.000	18.000	15.000	
SW4	18.000	15.000	17.000	18.000	14.000	16.000	17.000	17.000	16.000	17.000

			Transform: Untransformed					1-Tailed		
Conc-%	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD
DMW Control	16.889	1.0000	16.889	15.000	19.000	9.568	9			
SW4	16.500	0.9770	16.500	14.000	18.000	7.693	10	0.587	1.740	1.153

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates normal distribution (p > 0.05)	0.915492	0.901	-0.40598	-1.17606
F-Test indicates equal variances (p = 0.49)	1.62069	6.6933		

Hypothesis Test (1-tail, 0.05)	MSDu	MSDp	MSB	MSE	F-Prob	df
Homoscedastic t Test indicates no significant differences	1.153229	0.068283	0.716374	2.081699	0.565165	1, 17
Treatments vs DMW Control						

Dose-Response Plot



Ceriodaphnia Partial Life-Cycle Test-Reproduction

Start Date:	17/03/2020 12:30	Test ID:	PR1886/3	Sample ID:	SW4
End Date:	24/03/2020 19:00	Lab ID:	9469	Sample Type:	AQ-Aqueous
Sample Date:		Protocol:	ESA 102	Test Species:	CD-Ceriodaphnia dubia
Comments:	screen only				

Auxiliary Data Summary

Conc-%	Parameter	Mean	Min	Max	SD	CV%	N
DMW Control	No of Young	16.89	15.00	19.00	1.62	7.53	9
SW4		16.50	14.00	18.00	1.27	6.83	10
DMW Control	% unaffected	100.00	100.00	100.00	0.00	0.00	9
SW4		100.00	100.00	100.00	0.00	0.00	10
DMW Control	pH	8.30	8.30	8.30	0.00	0.00	1
SW4		7.00	7.00	7.00	0.00	0.00	1
DMW Control	DO %	100.30	100.30	100.30	0.00	0.00	1
SW4		86.50	86.50	86.50	0.00	0.00	1
DMW Control	Cond uS/cm	178.00	178.00	178.00	0.00	0.00	1
SW4		328.00	328.00	328.00	0.00	0.00	1

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