Additional Information to the Environmental Impact Statement (EIS)

Following the draft EIS and Supplement

McArthur River Mining Pty Ltd

Overburden Management Project

2018

Contents:

15 May 2018

Dr Paul Vogel
Chairman
Northern Territory Environment Protection Authority
Arnhemica House
Level 1 16 Parap Road
Parap NT 0820

Dear Paul,

RE: McArthur River Mining Pty Ltd – McArthur River Mine Overburden Management Project – Supplement to the Draft Environmental Impact Statement – Direction for Further Information

I refer to your letter dated 24 April 2018, where the Northern Territory (NT) Environment Protection Authority (EPA) requested the following:

> *The NT EPA requested in its submission to the draft Environmental Impact Statement a consolidated summary of all environmental monitoring results to date (water, air, acid and metalliferous drainage, temperature and oxygen in dumps, fish etc.) from all sites, not just compliance points, including annual trends and interpretation of environmental outcomes.*
>
> *The 2017 Operational Performance Report (OPR) was provided to the NT EPA to fulfil this request, based on the understanding that it would meet requirements.*
>
> *The OPR provides a summary of MRM's environmental performance over the preceding year and focuses on compliance with licence conditions, whereas the NT EPA expects performance trends over time, similar to a state of the environment report. This requirement still needs to be met.*

While the Main Report of the 2017 OPR was provided to the NT EPA, the supporting specialist appendices were not provided.

The Main Report of the 2017 OPR is a summary of environmental performance based on the detailed analysis (e.g. annual trends and interpretation of environmental outcomes) provided by the specialist appendices.

As such, to fulfil the NT EPA's request for information, links to the OPR specialist reports are enclosed to this letter.

Appendix A to this letter provides a summary of the monitoring data for the existing operations that are relevant to the key aspects currently under assessment as part of the Overburden Management Project Environmental Impact Statement (OMP EIS), as follows:

1. **Sulphur dioxide (SO_2) monitoring** – historic SO_2 concentrations near the NOEF, and concentrations at the nearest sensitive receiver locations (i.e. Devils Spring and Borroloola) **– data from 2015 to 2017** (note, this is all available data to end of 2017 OPR period).

2. **Water quality of on-site storages** – historic water quality captured in storages surrounding the Northern Overburden Emplacement Facility (NOEF) and Tailings Storage Facility (TSF) for key water quality parameters (pH, lead, zinc, sulphates and electrical conductivity) **– data from 2008 to 2017.**

3. **Groundwater** – historic groundwater quality from monitoring bores surrounding the NOEF and TSF for key water quality parameters (pH, zinc, sulphates and electrical conductivity) – **data from 2009 to 2017** (noting, the commencement of data period is dependent on monitoring bore installation date).

4. **Receiving environment** (McArthur River, McArthur River channel, Surprise Creek, Barney Creek and Barney Creek channel):

    - **Surface water** – historic surface water quality at downstream locations for key water quality parameters (pH, lead, zinc, sulphates and electrical conductivity) – **data from 2008 to 2017.**

    - **Fluvial sediment** – historic fluvial sediment quality at downstream locations for key parameters (zinc and lead) – **data from 2009 to 2017.**

    - **Metals in fish** – historic lead concentrations in lower order aquatic indicator species and Barramundi muscle tissue at key locations (Barney Creek haul road crossing and downstream of the Mine site near Borroloola) – **data from 2014 to 2017** (note, this is all available data to end of 2017 OPR period).

    - **Aquatic ecology** – species diversity and abundance downstream of the Mine site, with the McArthur River channel and upstream of the Mine site on the McArthur River – **data from 2011 to 2017.**

Please note the sites listed in Appendix A are a subset of all of McArthur River Mining Pty Ltd's (MRM's) monitoring data. These sites are highlighted as they:

- provide an indication of historic environmental performance for key aspects of the OMP EIS;
- will form the basis for ongoing "impact" monitoring sites for MRM's Environmental Management System, which is to be revised pending the outcomes of the NT EPA's assessment of the OMP EIS; and
- are not control/reference sites (notwithstanding, monitoring data from control/reference sites is also provided in the specialist reports).

It would be appreciated if, following review of the information provided within this letter and the relevant monitoring data in the specialist reports, the NT EPA could indicate if it is satisfied this information fulfils the request outlined in the letter dated 24 April 2018.

Should you require any additional information regarding the data proposal, please contact Ryan Pascoe, Manager – Environment, Safety and People, on 08 8975 8287 or ryan.pascoe@glencore.com.au.

Yours sincerely,

Sam Strohmayr
General Manager
McArthur River Mining Pty Ltd

Appendix A – Monitoring data representing environmental conditions and trends at MRM.

Reference Documents	Site	Location	Description	Parameters	Figure from OPR***	Period of Record Analysed in OPR
Air Quality – SO_2 Monitoring						
Sections 7.1.8 and 7.3 of TAS (2017)	Borroloola SO_2	Borroloola	SO_2 compliance monitor in Borroloola, provides an indication of SO_2 generation from the NOEF.	SO_2	Figure 2-1 of TAS (2017)	Sep 15 to Sep 16 (all available data)
	Devils Springs SO_2	Devils Springs	SO_2 compliance monitor in Devils Springs, provides an indication of SO_2 concentrations at the nearest sensitive receiver location.		Figure 10	Sep 15 to Sep 16 (all available data)
	Caravan NOEF	West of NOEF	SO_2 compliance monitor in Devils Springs, provides an indication of SO_2 concentrations at the nearest sensitive receiver location.			Oct 16 to Nov 17 (all available data)
Water Quality – On-site Storages ("Artificial Surface Water")						
Chapter 11 of ELA (2017)	NOEF SPSD	NOEF	Located to the south of the NOEF, the Southern Perimeter Sediment Dam (SPSD) provides an indication of NOEF seepage water quality.	pH, Pb_F, Zn_F, SO4 and EC in water	Figure 4-6 in ELA (2017)	2008 to 2017
	NOEF EDS	NOEF	Located to the east of the NOEF, the East Drain Sump (EDS) provides an indication of NOEF seepage water quality.			
	NOEF CWAS	NOEF	Located to the North of the NOEF, the Central West Alpha Sump (CWAS) provides an indication of NOEF seepage water quality.			
	OP Vent Raise	Open Pit	Provides an indication of the quality of water contained within the open pit and underground workings.	pH, Zn_F, SO4 and EC in water		
	TSF Cell 2	TSF	Provides an indication of the quality of water contained within the active TSF cell.	pH, Zn_F, SO4 and EC in water		
Groundwater						
Chapter 7.2.4 and Appendix B of ELA (2017)	Various	SPROD	Network of monitoring bores around Southern Perimeter Runoff Dam (SPROD).	pH, Zn_F, SO4 and EC in groundwater	Figure 30	The period of record is typically from 2009 to 2017 or 2013 to 2017. The period of record also varies for different parameters as the groundwater monitoring program has been expanded.
	Various	SEPROD	Network of monitoring bores around South Eastern Perimeter Runoff Dam (SEPROD).	pH, Zn_F, SO4 and EC in groundwater		
Appendix B of ELA (2017)	Various	TSF Cell 1	Representative network of monitoring bores between Cell 1 of the TSF and Surprise Creek.	pH, Zn_F, SO4 and EC in groundwater		

Reference Documents	Site	Location	Description	Parameters	Figure from OPR***	Period of Record Analysed in OPR
Receiving Environment - Surface Water, Fluvial Sediment and Metals in Fish						
Appendix D of ELA (2017) Chapter 13 of ELA (2017)	SW02	Surprise Creek	Mid reach site used to assess potential influence from the TSF	pH, Pb_F, Zn_F, SO4 and EC in water Pb and Zn in sediments	Figure 28 Figure 29	2008 to 2017
	SW24	Surprise Creek	Downstream site used to assess potential influence from the NOEF			2009 to 2017
	SW06	Barney Creek (old McArthur River)	Downstream of all active waste discharges and all potential influences from the Barney and Surprise Creek catchments.	pH, Pb_F, Zn_F, SO4 and EC in water Pb and Zn in sediments		2008 to 2017
	SW11	McArthur River	Downstream of all influences from the Barney Creek, Surprise Creek and Emu Creek catchments as well as the McArthur River Diversion. Downstream of Glyde River confluence.			2008 to 2017
	SW12	McArthur River	Downstream of all influences from the Barney Creek, Surprise Creek and Emu Creek catchments as well as the McArthur River Diversion. Upstream of Glyde River confluence.			2008 to 2017
Appendix D of ELA (2017) Chapter 13 of ELA (2017) IPE (2016; 2017a)	SW19	Barney Creek Diversion	Mid reach site used to assess potential influence from the Haul road crossing and upstream catchments.	pH, Pb_F, Zn_F, SO4 and EC in water Pb and Zn in sediments Pb in lower order aquatic indicator species and *Lates calcarifer* (Barramundi) muscle tissue	Figure 19 Figure 20 Figure 28 Figure 29	2008 to 2017
IPE (2016; 2017a)	SW08	McArthur River	Burketown Crossing at Borroloola	Pb in *Lates calcarifer* (Barramundi) muscle tissue	Figure 19 Figure 20	2014 to 2017
	SW08 US	McArthur River	Upstream of the Burketown Crossing at Borroloola			

Reference Documents	Site	Location	Description	Parameters	Figure from OPR***	Period of Record Analysed in OPR
Receiving Environment – Aquatic Ecology (Species Diversity and Abundance)						
IPE (2017b; 2017c)	USC	McArthur River	Complex habitat sites upstream of the McArthur River Diversion	Mean fish per metre and total number of species	Figure 21 Figure 22	2011 to 2017
	DVB	McArthur River Diversion	Bare bank sites within the McArthur River Diversion			
	DVC	McArthur River Diversion	Complex habitat within the McArthur River Diversion			
	DSC	McArthur River	Complex habitat sites directly downstream of the McArthur River Diversion			

*** Figure from Main Report of OPR unless described otherwise

Enclosure 1 – Links to Specialist Reports

Environmental Aspect	Specialist Report	Download Link
Surface water (artificial) Surface water (receiving environment) Groundwater Fluvial sediments	EcoLogical Australia Pty Ltd (ELA) (2017) *Groundwater, Surface Water and Fluvial Sediment Monitoring Report 2016/2017*.	https://resourcestrategies.sharefile.com/d-se9b765568a240af9
Metals in Fish	Indo-Pacific Environmental (IPE) (2016) *Interim Report on the Monitoring of Metals and Lead Isotope Ratios in Fish, Crustaceans and Molluscs of the McArthur River, 2016*.	https://resourcestrategies.sharefile.com/d-s92cb7922177436e8
	Indo-Pacific Environmental (IPE) (2017a) *Report on the Monitoring of Metals and Lead Isotope Ratios in Fish, Crustaceans and Molluscs of the Limmen Bight, McArthur and Robinson Rivers, Late Dry Season 2016*.	
Aquatic Ecology	Indo-Pacific Environmental (IPE) (2017b) *Report on the Aquatic Fauna of the McArthur River, Northern Territory, Late Dry Season 2016*.	https://resourcestrategies.sharefile.com/d-s5c7f56a50c0430a9
	Indo-Pacific Environmental (IPE) (2017c) *Report on the Aquatic Fauna of the McArthur River, Northern Territory, Early Dry Season 2017*.	
Air Quality	Todoroski Air Sciences (TAS) (2017) *Ambient Air Monitoring Report – McArthur River Mine and Bing Bong Loading Facility*.	https://resourcestrategies.sharefile.com/d-sea1a78225e542738

Overburden Management Project

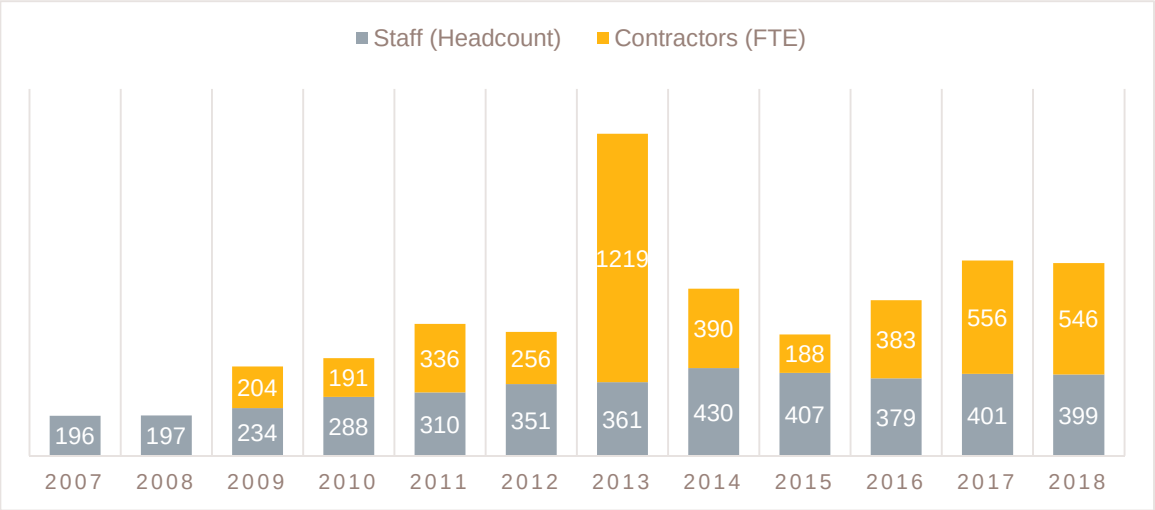
RESPONSE TO NTEPA BOARD QUESTIONS

May 2018

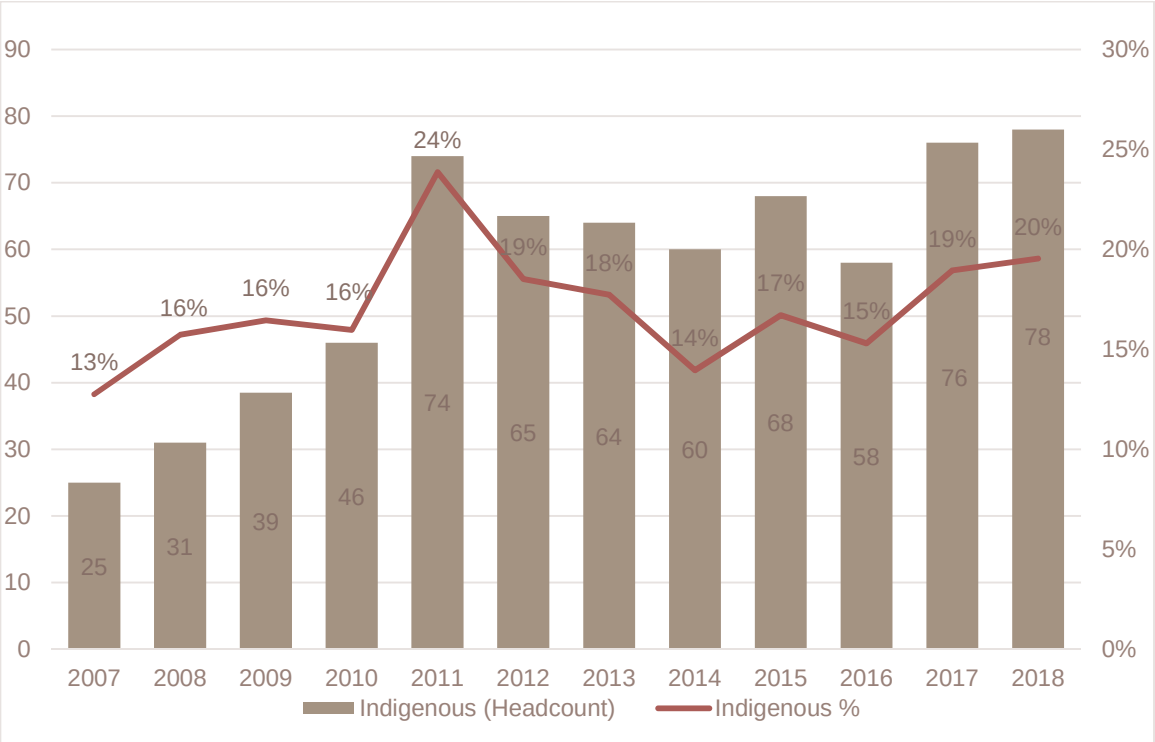
1. What's the % of MRM workforce living in Borroloola compared to broader NT and also the % of indigenous employees?

The workforce at MRM consists of employees and contractors residing locally, within the Territory and inter-state. Of the 399 employees, approximately 55% are from Darwin or elsewhere in the Territory with 45% of employees from inter-state.

Of the Territory-based employees, 37 live locally in Borroloola, which equates to approximately 17% and 9% of all employees.



Indigenous employment is currently at 20% with a total of number 78 people. These positions are located in all areas of the mine with key roles positioned in mining, metallurgy, administration and environment departments.



2. What local procurement does MRM have or source?

Draft EIS Section 12.5

In 2017, approximately 30% of MRM procurement was through Northern Territory businesses. This included approximately $250M in OPEX expenditure and $50M in CAPEX expenditure. MRM dealt with approximately 500 Northern Territory businesses in 2017.

The Overburden Management Project EIS committed to continue the local procurement practices committed to in the Phase 3 EIS, in line with the NT Government initiatives. The Phase 3 Project committed to a local procurement policy where McArthur River Mining would utilise local business that are technically capable and commercially competitive. All potential suppliers to the Project would have to be accredited by McArthur River Mining and be able to demonstrate that they:

- enforce high standards of occupational health and safety for their employees and contractors;
- have regard to environmental considerations when manufacturing, packing or transporting their goods;
- respect human rights;
- are appropriately insured; and
- are providing products and services that are fit for purpose.

Within the Draft Overburden Management Project EIS, MRM committed to improve communication with local business to increase the level of awareness of opportunities and requirements for supplier accreditation.

McArthur River Mining will explore opportunities to work with both Indigenous and non-Indigenous business and industry groups to support local businesses wishing to meet requirements to supply and provide services to the mine. McArthur River Mining will report on the success and development of local procurement programs through the MRM Community Reference Group and other community based communication activities.

3. What additional /extra services can local region or community expect if the project proceeds?

Draft EIS Section 12.5

Table 12-8 in the Draft EIS highlights the project benefits to local region and the community. In summary these benefits include:

- increased frequency and scope of environmental monitoring;
- youth employment opportunities;
- increased job stability;
- extension of the MRM Community Benefits Trust (CBT) and associated funding provision from MRM;
- opportunities for local and regional business to engage with MRM;
- increased opportunities for custodians/Indigenous leaders to be involved in the rehabilitation process;
- increased involvement by custodians in cultural heritage management activities;
- continued partnership with Borroloola School to encourage education outcomes and pathway to employment; and
- taxes and royalties for the government.

a. Observation made that we have tended to express our socio-economic contribution in terms of dollar value rather than explaining some of the detail.

Whilst the socio-economic contribution from Project may have been expressed in dollar value terms as funding provided to the CBT, it should be noted that this funding is used to create tangible community/ social benefits. Furthermore, how that funding is spent is decided by the CBT and not MRM. The CBT invites applications for grant funding from organisations interested in undertaking projects or programs, which align with and support the achievement of the CBT's objectives and the community's specific needs. To be eligible the project must be of benefit to the community of the Gulf region.

A project is eligible for support by the CBT if it is conducted for a charitable purpose, such as grants, scholarships, bursaries and other assistance. Proposals deemed appropriate under the CBT are categorised under education, vocational training, enterprise development or provision of assistance for community infrastructure, and community development including the promotion of initiatives in the areas of health, law, arts, sport and culture.

All applications are considered and preference given to applications which address the expressed priorities of the community to resolve the primary issues impacting on the sustainability of the region, help build local capacity in a long-term, sustainable manner and are catalysts for greater investment in the community either through additional external funding opportunities, revenue-generation or other self-sustaining methods.

Generally, projects will not be considered for funding when, in the opinion of the CBT Board, they are the operational responsibility of Federal, Northern Territory or Local government.

The CBT website (http://www.mrmcommunitytrust.com/) provides a detailed description of all the Projects the funding has helped facilitate since 2007. The website also provides the details of how application for grant funding can be made.

b. Asked to document more of the services, projects we do on the ground.

As part of the Draft EIS, McArthur River Mining provided a link to the CBT Website (http://www.mrmcommunitytrust.com/). The website provides the details of all projects the CBT has funded. The money contributed by McArthur River Mining ($1.25 million per year) into the CBT is used on projects which support culture and art, education, enterprise and job creation, environment, health and community development.

4. What role of any does MRM see itself playing in relation to the acknowledged issue of housing shortages in Borroloola?

Draft EIS 12.5.2.2.4

Sixty-eight local employment positions will be sourced from within Borroloola, Robinson River and surrounding stations for the Project. Based on the current pool of available residents who are unemployed within the local community, there is no need for McArthur River Mining to attract new residents to Borroloola/Gulf SLA (SA2). Therefore, there will be no requirement for additional public housing associated with the Project and no material impact on local housing demand and/or prices are expected as a result of the Project.

Draft EIS Section 12.2.7.5

Many remote communities (including Borroloola) rely on social housing due to a lack of:

- private housing, with construction costs in remote communities often being prohibitive; and
- available freehold land.

In Borroloola 95.2% of dwellings are occupied private dwellings, with 4.8% being unoccupied. Of the 95.2% of private occupied dwellings, 8.1% are owned outright, 2.0% are owned with a mortgage and 72.7% are rented (ABS, 2011).

The NT and Australian governments reached an agreement in 2013 for the provision of Essential Services that are critical to supporting Aboriginal people in the NT over the next 10 years (Department of Housing and Community Services, 2014). Under this "National Partnership Agreement on Stronger Futures" in the NT, a secured commitment of $3.56 billion has been established from the Australian Government. This will allow outstations or homelands to have access to funding arrangements to improve their municipal and essential services as well as housing maintenance services (Department of Housing and Community Development, 2014).

In 2015, a National Partnership Agreement on Homelessness (NPAH) commenced. Under the 2015-17 NPAH, the Commonwealth Government has agreed to provide $230 million over two years matched by states and territories, and funding frontline homelessness services. This NPAH gives priority to services, which focus on women and children experiencing domestic and family violence, and homeless youth (Department of Social Services - Australian Government, 2016).

Additionally, the NT Government has proposed to construct 22 new community houses in Borroloola and release an additional 35 residential lots for future development (Department of Infrastructure, Planning and Logistics, 2016).

5. In relation to water events – asked if we had a release this year?

As of 26 April 2018, MRM had released 2,650 megalitres (ML) of water from the site over the 2017-18 wet season in full compliance with, and without any exceedance of, the conditions of Waste Discharge Licence 174-10 (WDL 174-10).

6. Confusion from some stakeholders as to what actually is the project that is being assessed?

Significant effort was placed on delineating which aspects of the project were subject to the EIS assessment process and which were not (refer to Draft EIS **Tables 3-4** and **3-6)**. This was necessary because the Final Terms of Reference only required certain aspects of the project to be subject to the EIS. Supplementary EIS **Section 4 – Summary of Project Changes** provided updates on Project changes since the Draft was submitted. Draft EIS **Tables 3-4** and **3-6** have been reproduced and updated where relevant, based on the Supplementary EIS updates, below.

A significant portion of the consultation activities undertaken included presentation of project information and discussion of alternatives (refer to Supplementary EIS Appendix Q – Stakeholder Consultation Report).

Draft EIS Table 3-4 Comparison of Current Operations to Project Operations

Component	Current Operations (i.e. Phase 3 Operations + MMP amendments)	Project Operations
Ore remaining from 2018	90 Mt	92 Mt
Mining Rate	Up to 5.5 million tonnes per annum (Mtpa) of ROM ore.	No change.
Mining life	Until 2036 (at 5.0 Mtpa).	Until 2037 (at 5.0 Mtpa) plus 10 years of tailings reprocessing (to 2047).
Mining method	Open cut mine using conventional drilling, blasting, loading and haulage methods.	No change.

Component	Current Operations (i.e. Phase 3 Operations + MMP amendments)	Project Operations
Open cut dimensions	Length: 1,750 metres (m) Width: 1,500 m Depth: 420 m Overall footprint: 210 hectares (ha) (within the existing approved bunded area).	Length: 1,950 m Width: 1,550 m Depth: 420 m Overall footprint – 265 ha (within the existing approved bunded area)
Overburden	530 Mt Stored on surface in two existing OEFs (NOEF, WOEF) and two new permanent facilities (SOEF, EOEF).	595 Mt (this volume includes additional benign material specifically mined to supply closure materials). Stored on surface in two permanent OEFs (WOEF and redesigned NOEF), two temporary OEFs within the mine levee wall (SOEF, EOEF) and in-pit placement.
Processing	Heavy Media Plant (HMP) treats some ore in a pre-concentration phase. Flotation process producing bulk concentrate and separate zinc and lead concentrates.	No change to HMP. No material change to processes or concentrates produced.
Power	Gas power station with a capacity total of 54 MW.	No change.
Product	Up to 800 ktpa of total concentrates, comprised of bulk, lead and zinc concentrates.	No change.
Tailings	Tailings discharged to TSF. Phase 3 used Cells 2, 3 and 4. 2017 amendment uses Cells 1 and 2 only.	No change to tailings deposition details during operations (Cells 1 and 2 only). Tailings reprocessed and placed back into the open cut when mining complete. The TSF footprint will be rehabilitated.

Component	Current Operations (i.e. Phase 3 Operations + MMP amendments)	Project Operations
Transport	Concentrate trucked 115 km to Bing Bong, transferred to barge, barged to offshore loading area onto bulk carriers (18 truck movements per day and 250 barge movements per year). Lead concentrate transport to Mount Isa or Darwin.	No change.
Water management system	Borefields for water supply. Mine water collected and utilised in the process. Evaporation from on-site dams. Water discharge licence granted. TSF Cell 3 dams and NOEF PRODs for water management. WTP (6 ML/d).	No material change to TSF Cell 3 dam and PROD concepts. Increased WTP capacity (to 15 ML/d total).
Workforce	Approximately 440 permanent staff and contractors (head count). Construction phase workforce peak at approximately 930. Operational phase workforce peak at approximately 735 permanent staff and contractors.	Operational phase workforce head count average at approximately 840 permanent staff and contractors with fluctuations between 550 and 1,020 depending on Project stage and activities. Tailings reprocessing phase average of approximately 180 staff and contractors.

Draft EIS Table 3-6 Overview of Mine Site Approval Status

Project Domain/Component	Remains in accordance with Phase 3 EIS (or prior) approval	Approved since Phase 3 via current or proposed MMP	Assessed as part of the Project EIS	Comments
OPEN CUT				
Mining within the open cut	X			Mining of all Project open cut stages was approved through the Phase 3 EIS.
Mining of Stages H, I and J		X		A change to full length open cut staging was made from Stage J onwards as part of the approved MMP.
IPD			X	Disposal of limited mined overburden for last approximately 6 years of mining operations.
Temporary SOEF		X	X	SOEF approved for Phase 3 defined NAF to mid-2018. Project EIS seeks to leave the SOEF in place until mining is completed then relocate.
Temporary EOEF		X	X	EOEF approved for Phase 3 defined NAF to mid-2018. Project EIS seeks to alter the currently approved EOEF with an updated plan.
WOEF	X	X		
Clay and topsoil stockpile areas (2018 onwards)			X	

Project Domain/Component	Remains in accordance with Phase 3 EIS (or prior) approval	Approved since Phase 3 via current or proposed MMP	Assessed as part of the Project EIS	Comments
Clay and topsoil borrow areas (2018 onwards)			X	
Mine levee wall	X			
Woyzbun Quarry			X	
Footwall cutback excavation		X		
Northern dewatering bores		X		Construction of northern dewatering bores into the underground mine workings.
NOEF				
Western stage PAF cell and halo construction	X			Relocation of MS-NAF and PAF materials from around the NOEF LGO stockpiles to the west stage of the NOEF
LGO rehandling		X		Rehandling of LGO from the NOEF for processing through the mill
CW stage construction to the top of the PAF cell	X	X		CW stage approved through MMP, however largely in accordance with approved Phase 3 EIS proposal.
CW cover system			X	

Project Domain/Component	Remains in accordance with Phase 3 EIS (or prior) approval	Approved since Phase 3 via current or proposed MMP	Assessed as part of the Project EIS	Comments
NOEF development on basis of redesign (mid-2018 onwards)			X	
EPROD		X		MMP to incorporate EPROD proposed to be submitted in 2018.
SEPROD	X			To be operated as per MMP.
SPROD	X	X		SPROD lining to be completed in 2017.
WPROD	X	X		
New clay and topsoil stockpile areas (2018 onwards)			X	
New clay borrow areas (2018 onwards)			X	
Flood protection		X	X	Flood protection works on the south face of the NOEF are planned for 2017. Project EIS covers the east and north faces.
NOEF north drain			X	No material change in requirements from Phase 3.
TSF				
Cell 1 and 2 amalgamation (2018 onwards)			X	Incorporated as part of the Supplementary EIS

Project Domain/Component	Remains in accordance with Phase 3 EIS (or prior) approval	Approved since Phase 3 via current or proposed MMP	Assessed as part of the Project EIS	Comments
Cell 3 tailings deposition	NA			Cell 3 approved for tailings storage in Phase 3 EIS, however no longer proposed for this as part of the Project.
Cell 4 tailings deposition	NA			Cell 4 approved in Phase 3 EIS, however no longer proposed to be constructed as part of the Project.
Benign material (clay and LS-NAF) borrow areas (2017-2018)	X	X		No material change in requirements.
Benign material (clay and LS-NAF) borrow areas (2018 onwards)			X	No detail on locations was provided in Phase 3.
Clay and topsoil stockpiles (2017-2018)	X	X		No material change in requirements.
Clay and topsoil stockpiles (2018 onwards)			X	No detail on locations was provided in Phase 3.
New haul roads (2018 onwards)			X	No detail on locations was provided in Phase 3.
INFRASTRUCTURE				
Potable water supply	X			
The MRM power station	X			

Project Domain/Component	Remains in accordance with Phase 3 EIS (or prior) approval	Approved since Phase 3 via current or proposed MMP	Assessed as part of the Project EIS	Comments
Fuel storage	X			
Explosives storage	X			
Sewerage	X			
Telecommunications	X			
The accommodation village	X			
The McArthur River Aerodrome	X			
MIA	X			
The Administration Area	X			
WTP		X		Construction and operation of an initial WTP subject to WDL approved through existing MMP.
			X	WTP capacity and function will be modified throughout the Project to address LOM requirements. These proposed modifications are subject to this EIS.
The mining fleet (2018 onwards)	X			
Key mining consumables (2018 onwards)	X			

Project Domain/Component	Remains in accordance with Phase 3 EIS (or prior) approval	Approved since Phase 3 via current or proposed MMP	Assessed as part of the Project EIS	Comments
Ore processing facility	X			
Concentrate haulage	X	X		
Concentrate storage	X			
Product export (via Bing Bong and Mt Isa)	X	X		

7. Request for table of what approvals we have and what is required going forward?

McArthur River Mining has provided a table in the Draft EIS Chapter 3 **Table 3-6** (reproduced and updated in the response to Question 6 above) which presents and overview of the mine site approval status.

8. Question asked if we were posting our supplementary online for public to see and if not why not?

MRM consulted with the NTEPA on 6 December 2017 to confirm proposed timing of publication of the Supplementary EIS. MRM was advised that the Supplementary EIS would be published on the NTEPA's website, 'at the same time as the Assessment Report'. MRM will publish the Supplementary EIS on its website at a similar time to the NTEPA.

9. What broader consultation did we do on the closure option and how have we addressed the stakeholder opinions calling for backfill of the pit?

Supplementary EIS Appendix Q – Executive Summary

- An additional 169 individuals were engaged as part of the Supplementary EIS.
- Individuals who participated in the consultation process during the Draft EIS were also largely involved throughout the Supplementary consultation process.

Supplementary EIS Appendix Q – Section 5.6

There still remained mixed reactions to the proposal for the open cut closure and the final mine pit lake. At a broad community level, fewer people raised concerns, although a small number of individuals still only supported complete backfill.

Supplementary EIS – Appendix C

MRM provided an appendix in the Supplementary EIS, which detailed the open cut void backfill closure alternatives. The report was prepared to address stakeholder comments by presenting an assessment of a number of open cut void backfilling scenarios, including complete backfilling and number of partial backfilling options.

Additionally, McArthur River Mining invited Professor Gavin Mudd (who had been an advocate for the backfill scenario and who's work had informed, in part, the submissions from a number of NGO's) to site to discuss his findings and MRM's assessment of the complete backfill closure option, however this invitation was declined.

a. Want to see expert opinions backing our option as the preferred

MRM engaged with the NTEPA Assessment Team throughout 2017 following provision of the NTEPA's submission on the Draft EIS. Part of this engagement addressed the NTEPA's requests for independent verification of certain aspects of the Draft EIS. Additional information was supplied by MRM and Ecometrix. On 6 October 2017, MRM received confirmation that the works completed as

part of the EIS review process and the additional information was sufficient. A copy of this confirmation is provided in **Attachment A**.

b. Discussion about what efforts we had taken to engage with NGOs

MRM consulted with many NGO's throughout the Draft EIS and the Supplementary EIS consultation programs. A summary is provided below:

Draft EIS Appendix Y – Appendix 2 and Appendix 8

The NGOs who participated in consultation during the Draft EIS included:

- Mabunji Aged Care;
- Mungoorbada Association;
- Action Aid Australia;
- Mabunji;
- Li-Anthawirriyarra Sea Rangers;
- Borroloola School;
- Northern Land Council Darwin;
- Northern Land Council Borroloola;
- Environmental Defenders Office;
- Community Members;
- MAWA;
- Wunala Creche;
- Minerals Policy Institute;
- Malandari Store;
- Aged Care;
- Il-Kurluluwa Aboriginal Corporation;

Supplementary EIS Appendix Q – Appendix A and Appendix B

Two additional NGOs were consulted with during the Supplementary EIS process. These included:

- Mabunji Women's Shelter;
- John Moriarty Foundation;

The following table highlights the efforts made by McArthur River Mining to engage with NGOs.

Table 1 Consulted NGOs

Organisation	Consultation Activity
Northern Land Council (NLC)	A briefing session was held with six representatives from Northern Land Council head office in Darwin in October 2016. Chief Operating Officer Greg Ashe from Glencore Zinc Assets in Australia met with NLC Chief Executive Officer Joe Morrison on numerous occasions during 2016 and 2017. Representatives of NLC's field office in Borroloola were regular attendees at local open town meetings.
Environment Defenders Office	Chief Operating Officer Greg Ashe from Glencore Zinc Assets in Australia met with the EDO to discuss their concerns. Professor Gavin Mudd who was engaged by the Environmental Defenders Office to provide independent expert comment on certain sections of the current Draft EIS and was invited to site to discuss his findings and MRM's assessment, however this invitation was declined.
Action Aid	Numerous letters from Greg Ashe to Action Aid Chair John Dowd requested an opportunity to brief the organisation on the EIS and MRM operations between July 2016 and September 2016. At first Action Aid refused to meet but later agreed to a meeting, which did not eventuate.
Minerals Policy Institute	Letter from Greg Ashe to Professor Gavin Mudd offering a site tour and briefing on the EIS following the release of his report on open cut closure options (included as **Attachment B**).
Borroloola community members	A meeting was arranged between MRM management and a number of local people who had been vocal critics of the mine at their request in September 2016. They had requested that senior managers and environmental consultants attend. Unfortunately the community members did not attend and the meeting was abandoned after one hour of waiting.
Amateur Fisherman's Association of the Northern Territory (AFANT)	A number of meetings were held between senior managers at the AFANT Executive officer through 2016 and 2017.
Northern Territory Cattlemen's Association (NTCA)	A number of meetings were held between senior managers at the NTCA Executive officer through 2016 and 2017.

10. Raised issue of indigenous cultural risks and reliance on agreement with custodians to manage these risks, what is the current status of the AAPA?

A third party anthropological review of the relevant custodianship, in the context of the list of custodians provided by the AAPA, has been completed. MRM is in the process of communicating the review outcomes to the AAPA.

a. Acknowledgement that negotiation on certification / custodian agreement AAPA is likely to go beyond the EPA EIS process

Noted.

11. What is plan B if MRM doesn't get approval for increasing the height of the NOEF?

The EIS demonstrates the environmental merits of the proposed NOEF configuration. NOEF configurations limited to the approved 80 m height are no longer favourable.

12. Does the NOEF have to all be the same height?

The proposed NOEF comprises multiple heights with a maximum plateau height of 140 m (refer to Draft EIS Figure 3-45).

13. What is the situation with storing water in the underground workings and how has this been considered?

A water balance for the underground workings was completed for the Draft OMP EIS and is discussed in Section 3.5 of Draft EIS **Appendix T – Groundwater Impact Assessment Report**. It used the following components:

- Recorded daily abstraction data from the Evase pumping system (and predecessor systems) which is installed in the redundant air vent shaft to the underground voids.
- Recorded daily water levels in the vent shaft.
- Modelled underground/open cut rainfall runoff in ML/day (WRM 2015).
- Estimates of stage-storage volumes for the underground workings
- 3D model of the underground workings.

Section 7.2.8 of Draft EIS **Appendix U – Surface Water Impact Assessment** describes the reduction in storage capacity of the underground workings as they are mined out by development of the open cut. Table 7.3 from that section is reproduced below.

Draft EIS Appendix U Table 7.3 – Adopted open cut invert, open cut surface area and underground mine void storage volume.

Stage	Mine year	Open cut invert (mAHD)	Open cut invert mLMD	Open cut surface area (ha)	Open cut storage capacity (ML)	Underground mine void volume (ML)
0	2016	-129	9871	111.5	74,820	3,922
1	2018	-144	9856	123.3	99,815	3,743
2	2019	-160	9840	146.0	128,232	3,490

Stage	Mine year	Open cut invert (mAHD)	Open cut invert mLMD	Open cut surface area (ha)	Open cut storage capacity (ML)	Underground mine void volume (ML)
3	2022	-192	9808	161.3	175,427	3,088
4	2027	-264	9736	212.2	280,196	1,794
5	2032	-304	9696	212.0	323,544	1,089
6	2037	-384	9616	216.1	330,367	135
7	2042	-198	9803	216.1	286,127	-
8	2047	-150	9850	216.1	252,839	-

Section 3.3.4 of Supplementary EIS **Appendix N – Updated Water Balance and Waterways Modelling for the MRM OMP** presents this reduction in capacity in Figure 3.5 (reproduced below - refer dotted line).

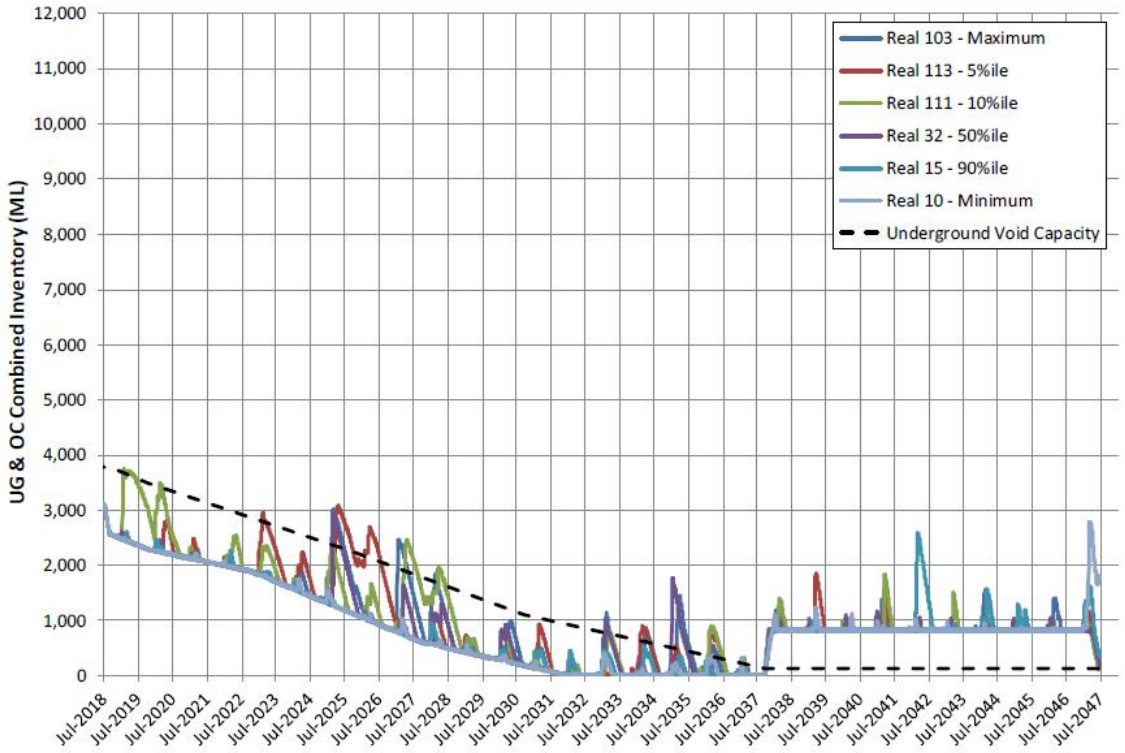


Figure 3.5 - Simulated storage performance of OC UG&OC inventory - minimum, dry, median, wet, very wet and maximum sequences

14. **What's the summary of findings from the Independent Review Board – expectation that there would be a 2pg signatory page from the authority declaring this was signed off.**

As discussed above, MRM engaged with the NTEPA Assessment Team throughout 2017 following provision of the NTEPA's submission on the Draft EIS. Part of this engagement addressed the NTEPA's requests for independent verification of certain aspects of the Draft EIS. Additional information was supplied by MRM and Ecometrix. On 6 October 2017, MRM received confirmation that the works completed as part of the EIS review process and the additional information was sufficient. A copy of this confirmation is provided in **Attachment A**.

a. **Doesn't see evidence of someone (third party) putting their name to these reviews and signing off (I Joe Bloggs take responsibility for this conclusion)**

As above.

b. **Wants to see a list of major domain/ topics issues / expert reviews and their sign off or evidence of support – this is critical to documenting our credibility**

As above.

15. **Is there really value in the IM doing a report every year?**

Not an EIS issue. To be discussed with operations.

a. **Discussion that perhaps better outcome is that the IM only reports every 3 years.**

Not an EIS issue. To be discussed with operations.

b. **Observation that the ToR for the IM should be reviewed**

Not an EIS issue. To be discussed with operations.

c. **It's strange that given MRM is meeting 75% or better of the recommendations that the risk management table in IM report isn't reflecting this.**

Not an EIS issue. To be discussed with operations.

16. **Question around the high sulphate levels in McArthur River at south end of the pit and why is that.**

The presence of highly mineralised zones in the McArthur River region results in increased sulphate concentrations in base-flow inputs to the McArthur River. The pyritic and/or mineralised shales of the Barney Creek Formation in particular have potential to act as a local source of sulphate in shallow groundwater and infiltration from rainfall that may ultimately be expressed in the McArthur River. These geological units the McArthur River are shown in Figure 3-15 of **Draft EIS Chapter 3 – Project Description and Justification**.

Dissolved sulphate concentrations in the McArthur River are observed to have an inverse relationship with stream flow (Section A3.3 of **Draft EIS Appendix U – Surface Water Impact Assessment**). That is, sulphate concentrations increase when stream flows decrease and vice versa. The McArthur River Diversion Channel intercepts a small mineralised zone which in periods of low flow, contributes elevated sulphates to the river.

These natural mineralised zones and their potential impact on water resources is one of the key areas of focus of the proposed groundwater monitoring program outlined in Section 8.7.2.1 of the Supplementary EIS. Groundwater to the north, east and south of the open cut area in alluvium, weathered bedrock and shallow bedrock will be subject to monitoring as will groundwater discharge as base-flow to the Barney Creek Channel and the McArthur River Channel.

17. How long does the GSL material last for and does it come with a guarantee of any sort?

Supplementary EIS **Appendix H – Geosynthetic Liner Design Details** discusses the GSL alternatives which were considered for use in the NOEF cover and discusses anticipated performance. There are many GSLs which are commercially available as discussed in Supplementary EIS **Appendix H**. McArthur River Mining provided a comparison of seven potential GSL covers against a set criteria to assist with the identification of the most suitable for the NOEF (refer to **Table 3** in Supplementary EIS **Appendix H**). Of the various GSL materials considered, expected service lifetime information has not been conducted or is not readily available for all of them, however literature reviews indicate the HDPE and BGM materials show the potential to provide reasonable durability. McArthur River Mining determined the four best GSL materials for use as the barrier layer within the NOEF cover system were:

- HDPE, for its demonstrated durability and cost;
- LLDPE, for its flexibility and ductility and cost;
- BGM, for its long life; and
- EPDM, for its extensibility and ability to tolerate rough surfaces.

Testing to determine the most appropriate product for the NOEF has commenced and will continue throughout 2018 and 2019. The additional planned test work will be conducted with site specific materials and currently include (but are not limited to):

- puncture and cushioning tests;
- rock deployment on geomembrane;
- friction angle tests;
- seam weld tests;
- accelerated aging,
- drainage and permeability; and
- interior and peripheral rock temperatures.

Until McArthur River Mining completes these tests and a GSL material is selected, it is not yet possible to comment on specific product life and available product guarantees.

Supplementary EIS **Appendix H – Geosynthetic Liner Design Details** provides the details of all the GSL alternatives which were considered for use in the NOEF and discusses anticipated performance.

Supplementary EIS **Appendix G – GSL Cover Design Report** discusses the proposed application of a GSL cover on the MRM NOEF.

18. What sign off or expert third party opinion do we have that supports reduced base clay layer from 0.5 to 0.25?

Supplementary EIS **Appendix K – Updated NOEF Flow and Water Quality Modelling Report** presents an update on the work undertaken to assess contaminant seepage from the NOEF under current and future conditions.

The approach used for the EIS Supplementary was the use of industry accepted Tough2 and GoldSim modelling software. The models were used to provide flow quantity and quality estimates for the two final NOEF cover system designs considered as part of the EIS:

- a cover with a Compacted Clay Liner (CCL) as the barrier layer as proposed in the Draft EIS; and
- a cover based on a Geosynthetic liner (GSL) proposed as part of the Supplementary EIS submission. For the GSL cover, an imperfect GSL was simulated.

For the GSL case, comparisons for several options, including various thickness low permeability foundations, were also evaluated. These results indicated that once the GSL cover is in place, the difference in flows between a thicker (500 mm thickness) and slighter reduced (250 mm thickness) low permeability foundation (permeability of 1 x 10^{-9} m/s) are small and the two are almost identical within 15 years of cover placement (Figure I reproduced below). The reduced thickness does not have an effect on the environmental outcome and therefore the management and closure strategies proposed.

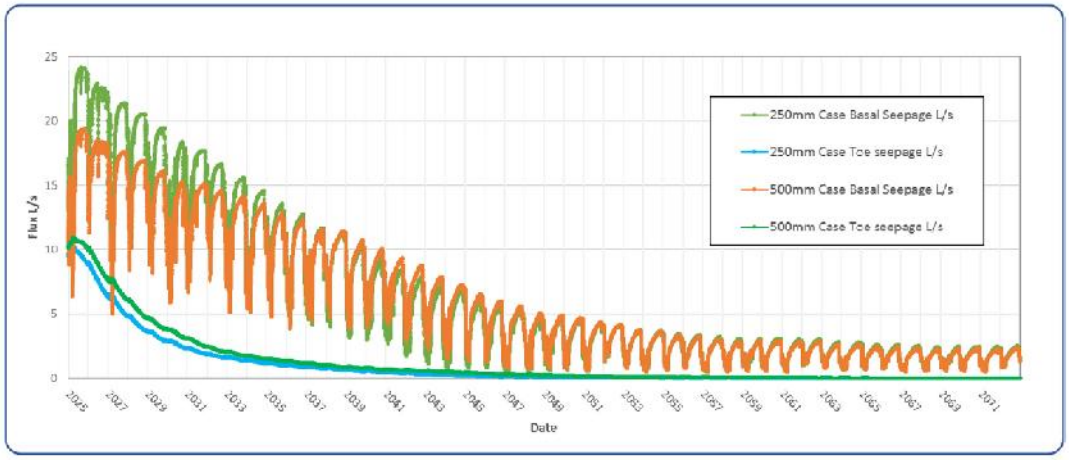


Figure I: Toe and basal seepage for the proposal GSL cover case

As discussed above, MRM engaged with the NTEPA Assessment Team throughout 2017 following provision of the NTEPA's submission on the Draft EIS. Part of this engagement addressed the NTEPA's requests for independent verification of certain aspects of the Draft EIS. Additional information was supplied by MRM and Ecometrix. On 6 October 2017, MRM received confirmation that the works completed as part of the EIS review process and the additional information was sufficient. A copy of this confirmation is provided in **Attachment A**.

a. How do we guarantee coverage and depth

In situ clays will be sampled to verify depth, quality and physical characteristics. Where this is deemed to be insufficient, in situ clays will be removed and replaced with suitable material sourced from elsewhere on site.

b. Need a diagram to show design and how erosion, drainage etc. works

Draft EIS **Appendix AE – Borrow Pit and NOEF Subsoil Drainage Designs** presents conceptual drainage design diagrams for the NOEF base. These have been provided in **Attachment C**.

c. Also wants a diagram to show visuals of NOEF and Barra dreaming – what can you see from different POV

Addressed in response to point 'd.' below

d. Note that cultural impacts not just confined to what you can / can't see from the highway

The montages provided in the Draft EIS **Chapter 12 – Socio-economic Environment** were presented to provide a visual representation of the aesthetic changes one would encounter when travelling the Carpentaria Highway. This was identified as the most suitable area to undertake an aesthetic impact assessment as the Carpentaria Highway is a public road and represents the closest the public can come to the mine and its infrastructure. McArthur River Mining does not consider that cultural impacts are confined to the highway and as such created a 3D model of a number of final landform arrangements to communicate the potential impacts, from all angles, to community members during the Draft EIS and Supplementary EIS consultation meetings. Additionally McArthur River Mining assessed cultural heritage impact from all aspects of the Project. Cultural heritage impacts were assessed in the following chapters:

- **Draft EIS Chapter 8 – Water Resources – Section 8.1.3.3;**
- **Draft EIS Chapter 11 – Cultural Heritage; and**
- **Draft EIS Chapter 12 – Socio-economic Environment – Section 12.6.1.**

19. What is the current status of NOEF material – if it's still hot isn't it acid forming? It would be a fatal flaw if EPA approves the EIS and in 2 years' time there is a smoking waste rock pile.

Remediation of the current NOEF has been completed and spontaneous combustion has been extinguished across the entire NOEF. Ongoing internal temperature monitoring indicates that the vast majority of the NOEF is cool, and localised areas where elevated temperatures (above 100°C) were present have recorded significant temperature decreases (65°C) over the last two years indicating that remediation efforts are effective (refer **Supplementary EIS Appendix F – NOEF Temperature Update**).

Besides an isolated hot spot on the southern batter, the only area still exhibiting elevated internal temperatures is the Eastern portion of the northern NOEF batter. The steady temperature profiles and low oxygen measurements indicate that the temperatures most likely reflect internal heat transport mechanisms within the NOEF associated with ongoing sulphide and organic carbon oxidation close to the surface of the batter rather than ongoing combustion. The presence of heat indicates sulphide oxidation, but not necessarily acid seepage generation owing to the high acid neutralising capacity in the NOEF. Battering of the NOEF to a low angle has been undertaken to reduce oxygen ingress and a low air permeability layer has been placed to reduce percolation of water, further limit oxygen ingress and further reduce sulphide oxidation rates.

MRM has implemented a program of monitoring to identify any potential spontaneous combustion well in advance. This includes:

- in-pit monitoring using thermal monitoring techniques to identify potentially combustive materials;
- daily inspections of the overburden emplacement facility inspections including assessment of surface moisture, temperature, cracking, heaving or efflorescent salts; and
- daily gas monitoring including sulphur dioxide monitoring

From this weekly hazard maps of the NOEF are generated showing areas of interest. At MRM, material classification has taken into consideration the propensity for spontaneous combustion. PAF(RE) is the only classification that is considered to have a high risk for combustion and it subject to most stringent handling and encapsulation procedures on site. This includes:

- Dedicated PAF(RE) cells – the reactive PAF will be segregated from all other overburden in order to prevent the material from acting as a catalyst for otherwise less reactive material.
- Low lift Construction – PAF(RE) will be exclusively paddock dumped and compacted to limit oxygen ingress and avoid particle size segregation. This constitutes leading industry practice in the management of reactive material. The PAF(RE) cells will be built in maximum 2 m lifts, with 100 millimetres (mm) of compacted fine grained alluvial material above every lift.
- Dry Season Mining – in order to limit to a maximum the possible ingress of water into PAF(RE) cells, the reactive PAF will be mined primarily during the dry season over the LOM.
- Wet Season Covers – Prior to every wet season, a 1 m compacted fine grained alluvial material cover will be placed to enclose the PAF(RE) cells to limit both oxygen and water ingress into the cell. This will in turn be protected from erosion by a 1.5 m layer of MS-NAF.

Greater detail of forward work has been provided in Supplementary EIS **Appendix X – Spontaneous Combustion Scope of Works and Forward Work Program**.

20. A lot of gaps in our documentation around adaptive management – a lot of "to be developed"

MRM discussed the scope of the Adaptive Management Framework with the NTEPA on multiple occasions. Specifically, on the 13 July 2017, MRM met with the NTEPA to clarify the scope of the supplementary EIS. This included discussion of the level of detail to be included in the Adaptive Management Framework. The relevant extract from the associated meeting minutes is provided in **Attachment D**.

a. Is doing intercept bores realistic

MRM believes there are a number of locations at the site where interception bores will be effective.

b. Who is the regulator for this aspect as it will need a lot of oversight.

Under the current regulatory framework and as presented in Figure 3.1 of the Adaptive Management Framework (Supplementary EIS **Appendix R – Adaptive Management Framework)**, the most relevant regulator would be the Department of Primary Industries and Resources under the *Mining Management Act*.

21. EPA want a list of each major element of the EIS and show documentary evidence of third party sign off.

As discussed above, MRM engaged with the NTEPA Assessment Team throughout 2017 following provision of the NTEPA's submission on the Draft EIS. Part of this engagement addressed the NTEPA's requests for independent verification of certain aspects of the Draft EIS. Additional information was supplied by MRM and Ecometrix. On 6 October 2017, MRM received confirmation that the works completed as part of the EIS review process and the additional information was sufficient. A copy of this confirmation is provided in **Attachment A**.

22. Have we mapped our approach against ICMM or industry best practice standards – is there evidence of this?

The ICMM presents an Integrated Mine Closure Planning Toolkit for the mining and metals sector and is encouraged to be used to provide a more disciplined approach to integrated closure planning and to increase the uniformity of good practices across the sector. See **Table 2** below for a breakdown of how McArthur River Mining's approach meets the relevant strategies of the ICMM toolkit.

Additionally **Section 3.3** of the Draft EIS describes the approach McArthur River Mining utilised to develop and define the Project including the progressive development of a site-wide conceptual understanding, the setting of closure objectives through consultation, conduct of supporting technical studies, identification of design and operational alternatives and completion of a multi-staged Project risk assessment process.

McArthur River Mining's design philosophy is driven by the closure objectives, which focussed on managing and mitigating key long-term environmental risks from the outset, as part of the Project design and operational phase. The concept behind this approach is to reduce the reliance on the post-mining phase to address potential long-term environmental risks. As part of this holistic approach McArthur River Mining developed ten site specific closure objectives which are presented in **Section 3.3.4.1** of the Draft EIS.

Table 2 Comparison of MRM approach with key elements of ICMM toolkit

Components of the ICMM toolkit	McArthur River Mining's implementation
1 Participates in effective closure planning	
External stakeholders **Internal stakeholders**	McArthur River Mining has continuously engaged with its stakeholders over the time that it has existed. There are frequent meetings held at Borroloola and McArthur River Mining attends all shows and carnivals hosted in Borroloola where community members and other stakeholders are free to discuss their concerns. The closure objectives were developed in consultation with site Custodians and regulatory departments. A full day workshop was held in Darwin in July 2016 involving both DPIR and the environmental assessment team for EIS with all closure objectives being presented as Draft for input. Additional standalone meetings were also undertaken with the DPIR closure team where presentations were provided on closure strategies.
Balancing the expectations and viewpoints of participants	Over the Draft EIS and Supplementary EIS process of the Overburden Management Project McArthur River Mining undertook an extensive stakeholder consultation program. All stakeholders were invited to participate at multiple meetings, formal and informal. The Draft EIS **Appendix Y** and the Supplementary EIS **Appendix Q** present the finding of these. The closure of the site was one aspect which was heavily discussed during both the Draft EIS and Supplementary EIS processes. The Draft EIS Section 12.8 outlines some of the ways that the consultation has helped determine and shape the closure of the site. McArthur River Mining is committed to on-going stakeholder consultation over the duration of the Project.
2 Framework of a conceptual closure plan	
Risk/opportunity assessment and management	As part of the Draft EIS process McArthur River Mining undertook a risk identification assessment and risk management process which assessed all the relevant domains of the Project and phases of activity (i.e. a whole-of-project approach) including the mining activities, operational activities and the decommissioning, rehabilitation and closure activities including an adaptive management and long-term monitoring assessment. The details of this assessment and management process were presented in the **Draft EIS Chapter 7 and Appendix F**.

Components of the ICMM toolkit	McArthur River Mining's implementation
Contextual information	Contextual information has been considered in all aspects of the closure phase. Traditional owners and government have been involved in the decision making process to ensure there is a balance between closure expectations and the viewpoints of the mine and stakeholders. The Conceptual Closure Plan which is presented in the **Draft EIS Appendix S** was prepared in accordance with the *Terms of Reference for the Preparation of an Environmental Impact Statement: McArthur River Mine – Overburden Management Project* (EIS TOR) and the *Northern Territory Department of Mines and Energy's Draft Guidelines for Mine Closure Plans 2016.* The Northern Territory draft guidelines were developed around the elements and regulations that are unique to the Northern Territory mining sector but do draw upon the good practice guidelines from other sources including: Western Australian *Guidelines for Preparing Mine Closure Plans* (2011 and 2015 draft update) and the Australian and New Zealand Mineral and Energy Council and the Mineral Council of Australia's *Strategic Framework for Mine Closure* (2000) and the International Council on Mining and Minerals' *Planning for Integrated Mine Closure* (ICMM, 2008).
Target closure outcome and goals	The Conceptual Closure Plan sets out the target closure outcomes and goals which have been developed and negotiated with governments and local community.
Monitoring and evaluation	The **Draft EIS Appendix S** highlights the monitoring and management of all aspects of the Project including groundwater, surface water, aquatic and terrestrial flora and fauna and cultural heritage.
Closure costs	The closure costs were assessed within the Project Risk Assessment, **Draft EIS Chapter 7 and Appendix F** but further addressed in the **Section 10.4 of the Draft EIS Appendix S.** McArthur River Mining accounts for rehabilitation and restoration costs in accordance with the International Financial Reporting Standards (IFRS) adopted in Australia (consistent with Glencore accounting Policy). As discussed in **Section 10.4 of the Draft EIS Appendix S** McArthur River Mining recognises that updating the conceptual mine closure plan is necessary and therefore it is periodically reviewed (annually, each anniversary of the MMP) and updated based on the facts and circumstances available at the time. Changes to the estimated future costs for operating sites are recognised in the balance sheet by adjusting both the restoration and rehabilitation asset and provision. Such changes give rise to a change in future depreciation and financial charges. Note that it was not appropriate to present specific closure costs in the Draft EIS or Supplementary EIS.

Components of the ICMM toolkit	McArthur River Mining's implementation
Updating the conceptual closure plan	As discussed in **Section 1.2.2 of the Draft EIS Appendix S** the Conceptual Mine Closure Plan is intended to be a dynamic document that is subject to review and refinement during the life of operations and mine closure. Key components of the Conceptual Mine Closure Plan will be included in the MMP and will be reviewed and updated to align with the submission of future versions of the MMP as the mine progresses. This Conceptual Mine Closure Plan will be reviewed and updated in accordance with new legislation, standards, guidelines and operational requirements, as required by Glencore. It is intended that rehabilitation will be undertaken progressively during the life of the mine. This will allow rehabilitation methods to be trialled and refined to determine the most suitable and successful methods for final closure of the McArthur River Mine operation.
3 Framework of a detailed closure plan	
Contextual information **Target closure outcome and goals** **Action plans** **Closure costs** **Updating the detailed closure plan** **Facilities with long and short lives** **Sudden closure** **Application to existing operations**	As discussed in the **Section 1.2** of the **Draft EIS Appendix S** the CMCP goes beyond the EIS TOR requirements by also addressing the more comprehensive requirements of the former Northern Territory Department of Mines and Energy's (DME) *Draft Guidelines for Mine Closure Plans* (the NT Draft MCP Guideline) (DME, 2016). The NT Draft Mine Closure Plan Guideline is relevant for the development of a detailed Mine Closure Plan, which would typically be submitted with the operational Mining Management Plan (MMP) following the approval of the EIS.

Components of the ICMM toolkit	McArthur River Mining's implementation
4 Decommissioning and post-closure	McArthur River Mining as part of the Draft EIS prepared a Decommissioning, Rehabilitation and Closure **Chapter 4**. The purpose of this chapter is to provide a summary of the key features of the Project's closure strategy and to direct readers to other relevant sections of this environmental impact statement (EIS) where important information regarding the potential risks to local environmental values, and proposed mitigation measures to minimize these risks, may be found. As discussed in the **Draft EIS Chapter 1 – Introduction**, this EIS has assessed, where relevant, the various natural systems of the Project for up to a 1,000 year period. Therefore, the closure and long-term management requirements of the site are inherently addressed throughout the EIS. To help support this McArthur River Mining also prepared an Adaptive Management Framework which is presented in the **Supplementary EIS Appendix R.** This framework provides a step by step process of how to project will transition from operation through the decommissioning, rehabilitation, closure, adaptive management and relinquishment.
5 Challenges and conclusions	
Exploration	Exploration does not constitute a significant component of the OMP.
Feasibility and closure planning	McArthur River Mining has undertaken feasibility studies already. For the purposes of rehabilitation and closure a bond will be determined once the MMP is established.
Feasibility and closure planning	McArthur River Mining has undertaken feasibility studies already. For the purposes of rehabilitation and closure a bond will be determined once the MMP is established.
Mergers and acquisitions	**Draft EIS Appendix S – Conceptual Mine Closure Plan** provides discussion of succession planning measures.
Changes in management	**Draft EIS Appendix S – Conceptual Mine Closure Plan** provides discussion of succession planning measures.
Relinquishment	McArthur River Mine's Adaptive Management Framework, presented in the **Supplementary EIS Appendix R** indicates McArthur River Mining's commitment to facilitate maintenance of the site until it is suitable for relinquishment. Traditional Owners and government departments will be involved in the adaptive management transition.

Furthermore, Draft EIS **Appendix S – Conceptual Mine Closure Plan** was developed utilising a number of guideline documents, including the draft NT Mine Closure Plan Guideline. Tables 1-2, 1-3, 1-4 and 1-5 from the conceptual Mine Closure Plan, which map the plan content against the guideline requirements are replicated below.

Table 1-2 MCP Guideline Reference Table

NT Draft MCP Guideline Minimum Requirements	Section of this CMCP where this requirement is addressed
Introduction (including a Mine Closure Plan checklist)	Section 1
Scope, purpose and project summary	Section 2
Closure legal obligations and commitments	Section 3
Closure knowledge and gaps	Section 4
Collection and analysis of closure data	Section 4.1
Schedule for addressing knowledge gaps	Section 4.2
Stakeholder identification and consultation	Section 5
Post-mining end uses and closure objectives	Section 6
Conceptual landform design	Section 6.4
Development of completion criteria	Section 6.2
Mine closure risk assessment and management	Section 7
Identification and management of key closure issues, (whole site and by features)	Section 7.1
Closure integration and implementation of progressive remediation	Section 8
Progressive remediation of mine landforms	Section 8.1
Contingency plans for premature closure	Section 8.2
Research, investigations and trials	Section 8.3
Plan for decommissioning and removal of infrastructure	Section 8.4
Post-closure management, maintenance and monitoring	Section 9
Review of performance against objectives and completion criteria	Section 10
Performance evaluation framework	Section 10.1
Third-party reviews of performance (where applicable)	Section 10.2
Corrective action plans	Section 10.3
Detailed closure costing calculations	Section 10.4
Knowledge management	Section 11
Data collection and records management	Section 11.1
Succession planning for retention of key closure knowledge	Section 11.2

The NT Draft MCP Guideline requires the following Mine Closure Plan Checklist (**Table 1-3**) and corporate endorsement to be included in the Introduction of this CMCP.

Table 1-3 Mine Closure Plan Checklist

Q#	Mine Closure Plan Checklist Requirement	Y/N or N/A	Section	Comments
	Introduction			
A1	Has the Mine Closure Plan been signed off by the site General Manager?	Y	Section 1.2	
A2	Is this checklist included in the Introduction and have you also checked 'yes to all' as outlined in Figure 2.1 and Figure 2.2 of The *Northern Territory Draft Mine Closure Plan Guidelines*?	Y	Section 1.2	
A3	Does the introduction include: • project title; • company name; • contact details (including phone number and email addresses); • document ID and version number; and • date of the Mine Closure Plan.	Y	Section 1.1	
A4	Is there a table of contents?	Y	Table of Contents	
	Scope, Purpose and Project Summary			
A5	Have you stated the purpose of your Mine Closure Plan?	Y	Section 2.2	
A6	Does the project summary include: • land ownership details; • location of the project; • comprehensive site plans; and • background information on the history and status of the project that is relevant to the Mine Closure Plan (1 page maximum).	Y	Section 2.2.1	
	Closure Legal Obligations and Commitments			
A7	Has a consolidated summary or register of closure obligations and commitments been included? See Attachment A (e.g. compliance with the Australian National Committee on Large Dams (ANCOLD) guidelines on tailings dams — planning, design, construction, operation and closure (2012)) www.ancold.org.au/?page_id=334	Y	Section 3	
	Closure Knowledge and Gaps			
A8	Has information related to mine closure been collected and analysed for each feature, as well as for the whole site? Has this data been analysed in the context of pre-mining baseline studies for environmental and socio-economic aspects and in the context of agreed post-mining end uses?	Y	Section 4.1	

Q#	Mine Closure Plan Checklist Requirement	Y/N or N/A	Section	Comments
A9	Have knowledge gaps been identified and a program developed to address those gaps?	Y	Section 4.2	
	Stakeholder Identification and Engagement			
A10	Have all stakeholders involved in closure been identified and the process explained to them?	Y	Section 5.1	
A11	Have you included a consultation register where stakeholder engagement details and closure commitments are recorded, as detailed in Appendix B?	Y	Section 5.2	
	Post-Mining Land Use and Closure Objectives			
A12	Have the post-mining land uses been agreed with stakeholders including land owners?	Y	Section 6.3	
A13	Has a conceptual post-mining landform design been prepared?	Y	Section 6.4	
A14	Have closure objectives been outlined to address safety, stability, pollution mitigation and how sustainability of post-mining landforms will be achieved?	Y	Section 6.1.1	
A15	Have completion criteria and performance measures been developed to address the closure objectives?	Y	Section 6.2	
A16	Does the Mine Closure Plan identify limitations on post-mining land uses due to pre-existing or potential legacies?	Y	Section 6.3	
	Closure Risk Assessment and Management			
A17	Has the company undertaken a mine closure risk assessment and does the Mine Closure Plan include a summary of these risks and their potential significance?	Y	Section 7.1	
A18	Does the Mine Closure Plan include the control measures that will be applied to mitigate those risks drawing on evidence to justify their likely success?	Y	Section 7.1	
	Closure Integration and Implementation			
A19	Does the Mine Closure Plan demonstrate how implementation will be integrated into all relevant functions of the mining operation?	Y	Section 8.2	
A20	Are the risks and control measures described for each mine domain or feature and included in management plans?	Y	Section 7.1	
A21	Does the Mine Closure Plan describe closure water management, treatment, monitoring of remediation and other activities required to meet environmental requirements?	Y	Section 9	

Q#	Mine Closure Plan Checklist Requirement	Y/N or N/A	Section	Comments
A22	Does the Mine Closure Plan show disturbance types and progressive remediation schedules, including any trial areas?	Y	Section 8.2	
A23	Does the Mine Closure Plan show how unexpected closure will be managed (e.g. water management, treatment, care and maintenance)	Y	Section 8.3	
A24	Does the Mine Closure Plan include a decommissioning schedule for management and removal of infrastructure?	Y	Section 8.4	
A25	Does the Mine Closure Plan include a performance-monitoring program (e.g. progressive remediation, decontamination, water treatment, and for arid areas, tailings dust control)?	Y	Section 9	
A26	Does the Mine Closure Plan describe how data about mine closure planning, implementation and review of performance are collected and managed in line with good practice standards?	Y	Section 8.1	
	Research, Investigations and Trials			
A27	Does the Mine Closure Plan report on progress of research, investigations and other trials summarising new knowledge that supports achieving closure objectives?	Y	Section 8.3	
	Performance Evaluation			
A28	Is there a closure performance evaluation framework to enable tracking of progress toward closure objectives against interim and final completion criteria or other performance measures related to planning, implementation and review?	Y	Section 10.1	
A29	Does the Mine Closure Plan include a third-party review of performance, if applicable?	Y	Section 10.2	
A30	Does the performance evaluation framework include corrective actions to make appropriate changes to ensure continual improvement and closure objectives will be achieved?	Y	Section 10.3	
	Knowledge Management			
A31	Does the Mine Closure Plan include a description of management strategies for retention of mine closure planning commitments, relevant records and spatially accurate data on wastes and their remediation, e.g. DTM, GIS and other sources?	Y	Section 11.1	

(Source: NT Draft MCP Guideline)

In addition to the Mine Closure Plan Checklist presented in **Section 1.2.1**, the NT Draft MCP Guideline requires MCPs to include key elements and also more specific aspects of mine closure planning that are important in the NT. The NT Draft MCP Guideline states that, if any of these items are not addressed, the CMCP is likely to be inadequate. **Table 1-4** and **Table 1-5** present checklists of these requirements. McArthur River Mining considers that the CMCP addresses all these requirements.

Table 1-4 Evaluating the Adequacy of this CMCP

Q#	NT Draft MCP Guideline Figure 2.1 Requirement	Y/N or N/A	Section	Comments
B1	Is the Closure Plan site-specific, representing the area likely to be impacted by mining?	Y	Section 2.1	
B2	Is stakeholder consultation documented in the Plan, including how stakeholder concerns have been addressed?	Y	Section 5.2	
B3	Has material and site characterisation been undertaken to identify potential closure issues?	Y	Section 7.2	
B4	Have appropriate closure outcomes been defined, including final land use(s) and objectives, closure criteria and where applicable, performance indicators and milestones?	Y	Section 6	
B5	Have closure issues been identified with workable management measures proposed or in place to address those issues?	Y	Section 7.1	
B6	Has experience from similar sites been applied to this site (where applicable)?	Y	Section 7.1	
B7	Are there appropriate plans proposed or in place for progressive rehabilitation?	Y	Section 8.2	
B8	Are there appropriate plans proposed or in place for closure monitoring and maintenance?	Y	Section 9	
B9	Are there appropriate plans proposed or in place for unexpected closure and temporary closure (care and maintenance)?	Y	Section 8.3	
B10	Are there appropriate plans in place for further research and field trials to increase confidence in closure outcomes (where applicable)?	Y	Section 8.4	

(Source: Figure 2.1 of NT Draft MCP Guideline)

Table 1-5 Evaluating the Adequacy of Specific Closure Issues

Q#	NT Draft MCP Guideline Figure 2.2 Requirement	Y/N or N/A	Section	Comments
C1	Is there adequate information to identify the potential for AMD and other contaminated mine drainage?	Y	Section 7.2	

Q#	NT Draft MCP Guideline Figure 2.2 Requirement	Y/N or N/A	Section	Comments
C2	If there is potential for AMD and/or other contaminated mine drainage, have measures been identified that are capable of managing it?	Y	Section 6.4	
C3	Where a cover system is required, has appropriate modelling been completed to demonstrate required performance life?	Y	Section 6.4	
C4	Where cover systems or containment structures are required, is there sufficient material with the necessary properties available to construct the design?	Y	Section 6.4	
C5	Where long-term containment is required (e.g. tailings) has this been accounted for in the design and verified with appropriate modelling?	Y	Section 6.4	
C6	If dispersive and inherently unstable materials are present, are closure designs appropriate for these materials?	Y	Section 6.4	
C7	Has there been an assessment of long-term water quality in final voids?	Y	Section 6.4	
C8	Have measures been identified to ensure that any pit lake(s) will be ecologically sustainable?	Y	Section 6.4	
C9	Have potential beneficial uses of final voids or pit lakes or pit lake water been identified?	Y	Section 6.4	
C10	If radioactive materials are present, have measures been identified that are capable of long-term protection of the environment, workers and public?	N/A		

(Source: Figure 2.2 of the NT Draft MCP Guideline)

a. Discussion around rehab R&D and growing trends around rehab expectations and financial assurance.

Section 8.3 of Draft EIS **Appendix S – Conceptual Mine Closure Plan** provides a list of research and knowledge gaps to be filled and the programs required to fill them. The Supplementary EIS also provides a number of work programs to be executed through coming years of operation (refer Supplementary EIS **Appendices W** to **AA**).

Section 43 of the *Mining Management Act* provides the Northern Territory Government with the necessary protection for rehabilitation costs or to prevent, minimise or rectify environmental harm. McArthur River Mining is only permitted to undertake activities authorised pursuant to its Authorisation. A security is required to be provided by McArthur River Mining which corresponds to those authorised activities. There are no other security bond funding mechanisms in place.

ATTACHMENT A – NTEPA CORRESPONDENCE RELATING TO ADEQUACY OF INDEPENDENT REVIEW

Dave Moss

From: Roderick Johnson <Roderick.Johnson@nt.gov.au>
Sent: Friday, 6 October 2017 11:55 AM
To: gary.taylor.2@glencore.com.au
Cc: Dave Moss; Lisa Bradley; Paul Purdon
Subject: RE: Follow up on independent review

Hi Gary,

Following a discussion with the NT EPA this week, it was determined that the peer review of the draft EIS conducted by EcoMetrix would suffice as a surrogate for the independent verification, despite some of the requests in the NT EPA's submission not being satisfied.

With respect to the pit void modelling, the determination by the NT EPA was chiefly based on the relatively long lead time for decision making on closure options for the pit void and, consequently, the high uncertainty associated with inputs into the geochemical model for the pit void.

While it is understood that the NOEF Independent Review Board did not, strictly speaking, verify the modelling for the NOEF in its peer review, it is considered that updated modelling of the NOEF by Klohn Crippen Berger using the TOUGH2 package in conjunction with the peer review of modelling outputs / interpretation in the draft EIS should help to inform the NT EPA's assessment of the proposed NOEF, without the need for additional independent verification of the modelling conducted for the draft EIS.

Kind regards

Rod Johnson
Assessment Officer | Environmental Assessment
Environment Division | Department of Environment and Natural Resources

Providing services for the
Northern Territory Environment Protection Authority
ntepa Northern Territory Environment Protection Authority
www.ntepa.nt.gov.au

Level 1, Arnhemica House, 16 Parap Road, Parap NT 0820
GPO Box 3675, Darwin NT 0801
p: 0409 897 145 | f: (08) 8942 6554
e: roderick.johnson@nt.gov.au | www.nt.gov.au

Our Vision: Creating a public sector that provides the highest quality service to Territorians
Our Values: Commitment to Service | Ethical Practice | Respect | Accountability | Impartiality | Diversity

From: gary.taylor.2@glencore.com.au [mailto:gary.taylor.2@glencore.com.au]
Sent: Friday, 6 October 2017 10:37 AM
To: Roderick Johnson
Subject: Follow up on independent review

Good morning Rod,
Thank you for the meeting the other day between yourselves the board and MRM. I think it was a productive meeting and proved to be a good forum to specifically address the current status of the NOEF and updates on the base case.

I notice that early this week you received a reply from Ron Nicholson at Ecometrix and I was just following up on whether or not that you believed this to be satisfactory as per your original concerns on an independent review for aspects of the EIS.

Cheers

Gary Taylor
Environmental Projects Manager
McArthur River Mine, Glencore
gary.taylor.2@glencore.com.au
0447041376

ATTACHMENT B - LETTER FROM GREG ASHE TO PROFESSOR GAVIN MUDD OFFERING A SITE TOUR AND BRIEFING ON THE EIS FOLLOWING THE RELEASE OF HIS REPORT ON OPEN CUT CLOSURE OPTIONS

GLENCORE

31 August 2016

Dr Gavin M Mudd
Chair of the Mineral Policy Institute
Department of Civil Engineering
23 College Walk
Monash University
VICTORIA 3800

via Gavin.Mudd@monash.edu

Dear Dr Mudd

RE: ***THE MACARTHUR RIVER PROJECT: The Environmental Case for Complete Pit Backfill***

I am writing to you in relation to the above report released by the Minerals Policy Institute (MPI) under your name.

We are concerned that a number of comments made in the report are inaccurate and are a public misrepresentation of the environmental issues at the McArthur River Mine (MRM) and how our business is addressing these issues.

We were disappointed that there was no effort to engage or consult with MRM prior to the release of the Report. As you are aware MRM was not requested to provide information in preparation of the Report nor was it provided an opportunity to comment on its conclusions.

The Report makes a number of suggestions, assumptions and claims which are incorrect.

The suggestion that limited environmental information about MRM is released to the public. This is incorrect as all available environmental data is provided on an annual basis to the Independent Monitor, who then conducts a thorough review and releases a detailed report that is publicly available.

A key assumption contained in the report about MRM's expected approach to closure and rehabilitation (i.e. to leave tailings and waste rock above ground) is incorrect.

The Report's key assumption that 91% of waste rock is Potentially Acid Forming (PAF) is incorrect. MRM classifies waste into five material classes and the distinction between these categories is critical, as they have different environmental risk profiles. Approximately 34% of waste rock at the mine is classified as PAF.

The Report also suggests that the Environmental Impact Statement (EIS) process currently underway does not allow for a public assessment. The EIS process is subject to public consultation and the report will be publicly available.

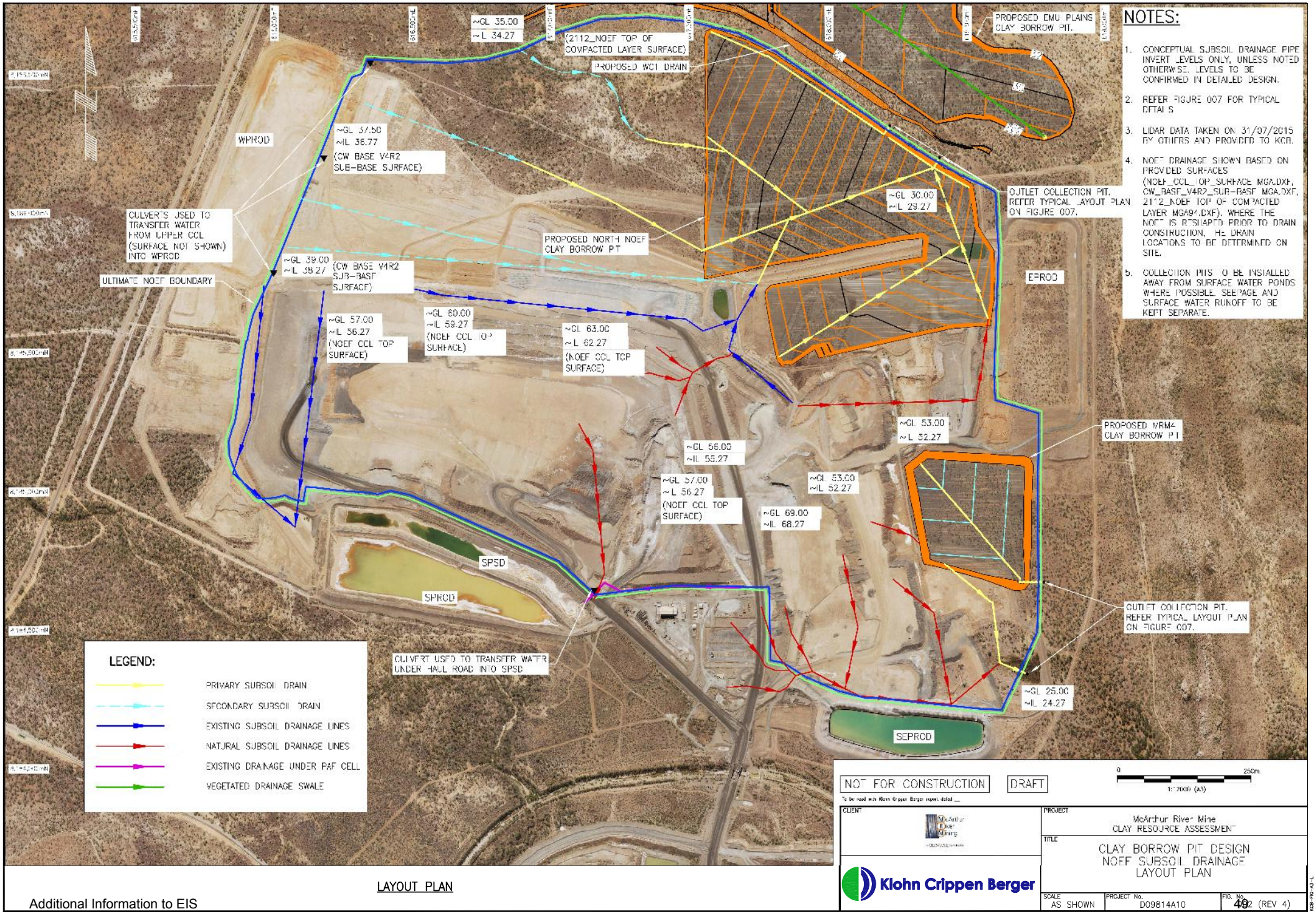
We remain willing to meet with you at a mutually convenient time to discuss the Report and provide you with a full briefing in relation to our operations at MRM, including our community engagement programs at Borroloola.

Yours sincerely,

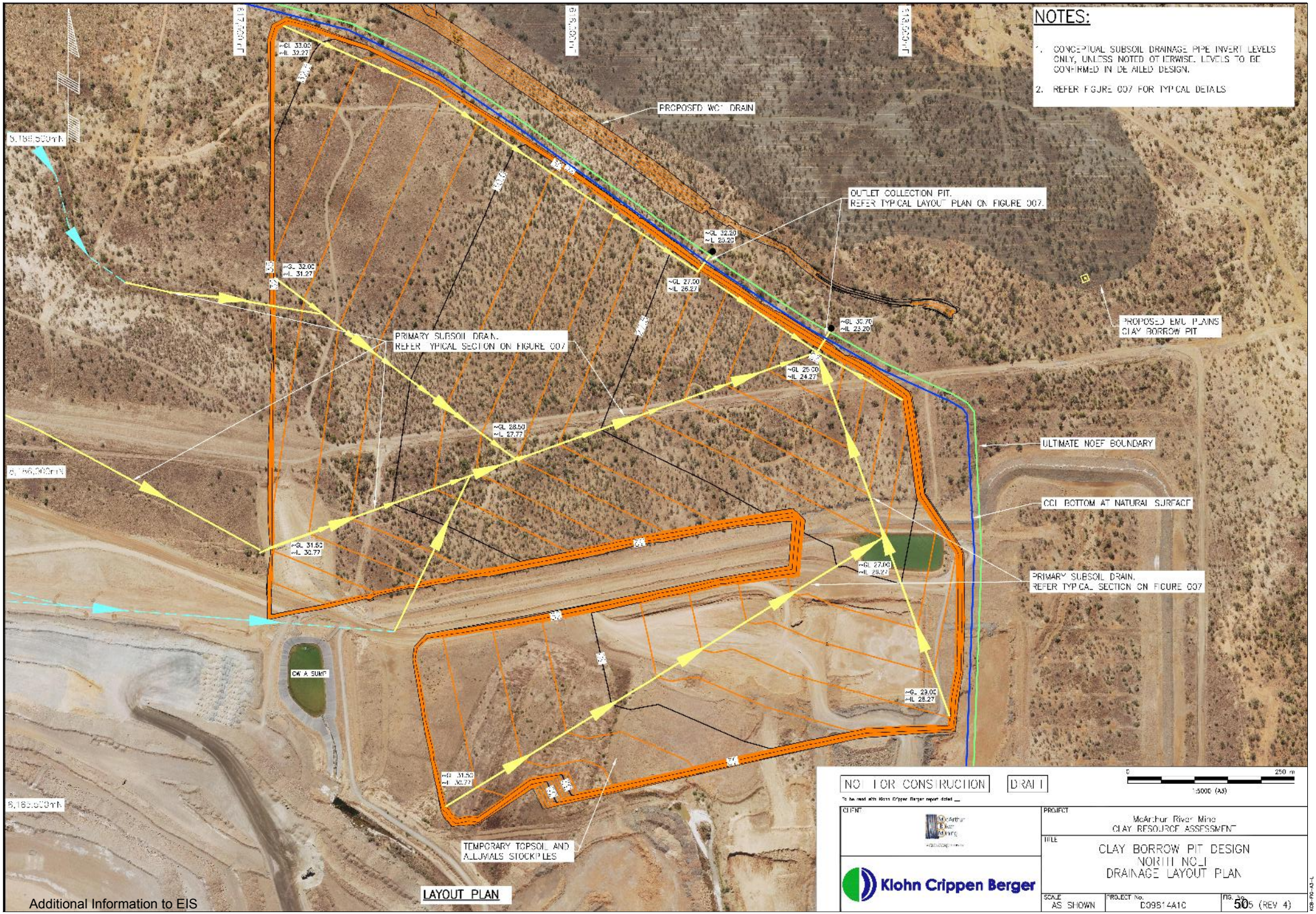
G Ashe

Greg Ashe
Chief Operating Officer
Glencore – Zinc Assets Australia

ATTACHMENT C - CONCEPTUAL DRAINAGE DESIGN DIAGRAMS FOR THE NOEF BASE


NOTES:
1. CONCEPTUAL SUBSOIL DRAINAGE PIPE INVERT LEVELS ONLY, UNLESS NOTED OTHERWISE. LEVELS TO BE CONFIRMED IN DETAILED DESIGN.
2. REFER FIGURE 007 FOR TYPICAL DETAILS
3. LIDAR DATA TAKEN ON 31/07/2015 BY OTHERS AND PROVIDED TO KCB.
4. NOEF DRAINAGE SHOWN BASED ON PROVIDED SURFACES (NOEF_CCL_OP_SURFACE MGA.DXF, CW_BASE_V4R2_SUB-BASE MGA.DXF, 2112_NOEF TOP OF COMPACTED LAYER MGA94.DXF). WHERE THE NOEF IS RESHAPED PRIOR TO DRAIN CONSTRUCTION, THE DRAIN LOCATIONS TO BE DETERMINED ON SITE.
5. COLLECTION PITS TO BE INSTALLED AWAY FROM SURFACE WATER PONDS WHERE POSSIBLE. SEEPAGE AND SURFACE WATER RUNOFF TO BE KEPT SEPARATE.
~GL 35.00
~L 34.27
(2112_NOEF TOP OF COMPACTED LAYER SURFACE)
PROPOSED WCI DRAIN
PROPOSED EMU PLAINS CLAY BORROW PIT.
WPROD
~GL 37.50
~IL 36.77
(CW BASE V4R2 SUB-BASE SURFACE)
CULVERTS USED TO TRANSFER WATER FROM UPPER CCL (SURFACE NOT SHOWN) INTO WPROD
~GL 39.00
~L 38.27
(CW BASE V4R2 SUB-BASE SURFACE)
ULTIMATE NOEF BOUNDARY
PROPOSED NORTH NOEF CLAY BORROW PIT
~GL 30.00
~L 29.27
OUTLET COLLECTION PIT. REFER TYPICAL LAYOUT PLAN ON FIGURE 007.
EPROD
~GL 57.00
~L 56.27
(NOEF CCL TOP SURFACE)
~GL 60.00
~L 59.27
(NOEF CCL TOP SURFACE)
~GL 63.00
~L 62.27
(NOEF CCL TOP SURFACE)
~GL 53.00
~L 52.27
PROPOSED WRM4 CLAY BORROW PIT
~GL 56.00
~IL 55.27
~GL 57.00
~L 56.27
(NOEF CCL TOP SURFACE)
~GL 53.00
~IL 52.27
~GL 69.00
~IL 68.27
SPSD
SPROD
OUTLET COLLECTION PIT. REFER TYPICAL LAYOUT PLAN ON FIGURE 007.
CULVERT USED TO TRANSFER WATER UNDER HAUL ROAD INTO SPSD
~GL 25.00
~IL 24.27
SEPROD
LEGEND:
PRIMARY SUBSOIL DRAIN
SECONDARY SUBSOIL DRAIN
EXISTING SUBSOIL DRAINAGE LINES
NATURAL SUBSOIL DRAINAGE LINES
EXISTING DRAINAGE UNDER PAF CELL
VEGETATED DRAINAGE SWALE
NOT FOR CONSTRUCTION
DRAFT
0
250m
1:2000 (A3)
CLIENT
PROJECT
McArthur River Mine
CLAY RESOURCE ASSESSMENT
TITLE
CLAY BORROW PIT DESIGN
NOEF SUBSOIL DRAINAGE
LAYOUT PLAN
Klohn Crippen Berger
SCALE
AS SHOWN
PROJECT No.
D09814A10
FIG. No.
002 (REV 4)

LAYOUT PLAN



Additional Information to EIS

ATTACHMENT D – EXTRACT FROM MRM/ NTEPA MEETING MINUTES ADDRESSING SCOPE OF ADAPTIVE MANAGEMENT FRAMEWORK

Adaptive Management

DM read text from comment clarification letter:

NT EPA/ DPIR Submission (Page 2 of 22):

Adaptive Management - the NTEPA is concerned that the EIS proposes to apply adaptive management to many of the operational and closure strategies of the project but in many cases does not include the key elements of adaptive management. Adaptive management is a planned and structured process, not "see how we go" contingency planning. Where adaptive management is applied, it should include clear objectives, identification of uncertainties, quantitative triggers for implementation, monitoring, and action plans in the event that triggers are exceeded.

MET Serve/ MRM Query:

MRM acknowledges NTEPA's comments on what an adaptive management process should include, and acknowledges concerns raised by both NTEPA and the Northern Land Council (NLC). MRM proposes that the Supplementary EIS presents greater clarity on the adaptive management framework, including:

- *the outline of a risk-based process aligning with the outcomes from MRM's Project risk assessment;*
- *clarification of those aspects of MRM's activities which will be subject to an adaptive management approach;*
- *relevant parameters (performance indicators) to be monitored, monitoring proposals, and triggers values (where available). Where trigger values are not yet available, a work program would be provided to outline the process and timing for the development of those trigger levels;*
- *identification of associated responses to triggers, distinguishing between short-term and long-term response scenarios; and*
- *an overview (including specific examples where available) of how MRM's adaptive management response process would be implemented, including examples of decision trees developed which would guide responses (and how early warning systems are developed and acted upon).*

The above proposed approach is considered to be achievable within the EIS process. Should the NTEPA require specific trigger levels for all nominated parameters to be presented in the Supplementary EIS, MRM would have great concerns for the timely conclusion of the approvals process and the associated impacts on commencement of the Project. Can the NTEPA confirm the approach presented above, particularly in relation to development of trigger levels, is acceptable?

Subsequent discussion:

- *RJ: The NTEPA thinks this is a reasonable way to approach the management of the site. In terms of a risk based process there is a concern about the levels of uncertainty, ERIAS talked about monitoring the parameters around potential failure modes and likely contaminants and problems that may arise. In terms of specific trigger levels, we have had comments provided to us that state by now we should be in a position to identify site specific trigger levels. There is an argument that there isn't enough information and that triggers aren't required for all parameters. We understand that you have a Waste Discharge Licence so monitoring to cater for that makes sense. We also understand that it is impractical to be asking for trigger levels for everything. With the adaptive management approach however you will need to identify the important aspects.*
- *DM: we need to provide the NTEPA with comfort that we understand issues and need to build in the uncertainty factor. We have given this some thought and it will be considered in the adaptive management framework proposed.*
- *RJ: We're comfortable with that approach.*
- *PP: yes, agree, re trigger levels. Adaptive management is the key for me; so much about what has been proposed has inherent uncertainty and the EPA has a tricky assessment to make as information is*

limited for some parts and therefore we aren't confident that this is the most appropriate approach. At the same time, EPA wants to look at how to set up the right framework that is robust and facilitates future management action. We believe that you understand where we are coming from based on your response (written letter to EPA). The EPA is interested in getting MRM's views on where the issues are and are likely to be in the future, and how or what you will be bringing to the table to manage those issues. The environmental objectives aren't clear, looking at the long term adaptive management. If you want us to have some input or review what you are doing, we're happy to maintain the discussion around this.

- *PP: do you have any experience in putting this adaptive management framework either internal or external as it's not straight forward to put together. How are you feeling about it?*
- *RP: the EIS Team or MRM in general?*
- *GT: directed to MRM in general.*
- *RJ: preferable that MRM Ops are involved rather than just the EIS team as you would want to incorporate adaptive management into the operation moving forward.*
- *RP: currently developing a range of operational plans. Provided an overview of how we are applying adaptive management at a site level, siting the Air Quality Management Plan as a collaborative approach taken between MRM and Government based on monitoring results.*
- *DM: we have given the framework some thought and will discuss further with the NTEPA to confirm we're going to meet expectations in the supplementary.*

Outcome summary:

MRM acknowledges that providing further clarity on the Adaptive Management framework in the Supplementary EIS is very important. The NTEPA are supportive of the approach proposed in the response letter and acknowledge that the approach is on the right track. The Environment Division of DENR has advised that the Adaptive Management framework needs to provide the NTEPA with comfort that the uncertainty associated with the future of the site can be managed. MRM and the Environment Division of DENR agree that it is important to maintain an open line of communication as this part of the Supplementary EIS is developed.

The NT EPA would like to see the evidence that the current advection barrier strategy is working to reduce heating of PAF(RE) in NOEF.

Response

The placement of a low air permeability advection barrier on the NOEF is one part of the overall strategy to reduce sulphide oxidation rates and eliminate spontaneous combustion of PAF(RE) on the NOEF. Remediation of NOEF PAF cell spontaneous combustion has been ongoing since 2014, and the placement of the advection barrier constitutes the latest step in the overall strategy implemented by MRM. The effectiveness of the advection barrier is therefore difficult to evaluate in isolation of all the other measures implemented. The resultant effectiveness of the overall remediation strategy is more significant than quantifying the relative contributions of each element.

The strategy for the reduction of sulphide oxidation rates, reduction of internal temperatures and elimination of spontaneous combustion relies on the successful implementation of several key measures:

1. Excavation, cooling and rehandling of actively combusting material on the NOEF. This was largely completed in 2014.
2. Removal of the batter and berm configuration and shallowing of the outer batter slopes to remove preferential air pathways and limit advection of air into the stockpile through a more resilient geometry. This was completed along the higher priority NOEF Northern Batter in September 2017.
3. Placement of PAF(HC) and PAF(RE) waste rock in 2m lifts to limit air permeability. This was implemented for the West D stage and is currently used for the Central West stage.
4. Placement of a low air permeability barrier on the batters and plateau of the NOEF to further reduce bulk air transport into the stockpile.

Evidence that the strategy is working is based on two key observations:

1. **Elimination of spontaneous combustion:**
   The flattening of the outer batters combined with the placement of the alluvial covers has successfully eliminated spontaneous combustion on the NOEF. The new geometry and the placement of a fine grained cover have successfully reduced oxidation rates in the shallow material, resulting in the complete elimination of spontaneous combustion. This is apparent in both the historical NOEF and the currently active Central West stage, where the systematic use of alluvial barriers has resulted in the absence of spontaneous combustion even though the stage contains a high proportion of PAF (RE).

2. Reduction of internal NOEF temperatures

The remediation strategy undertaken since 2014 has resulted in significant temperature decreases within the NOEF. Figure 1 presents the average temperatures for 10 monitoring wells through the NOEF PAF cell from October 2016 to April 2018.

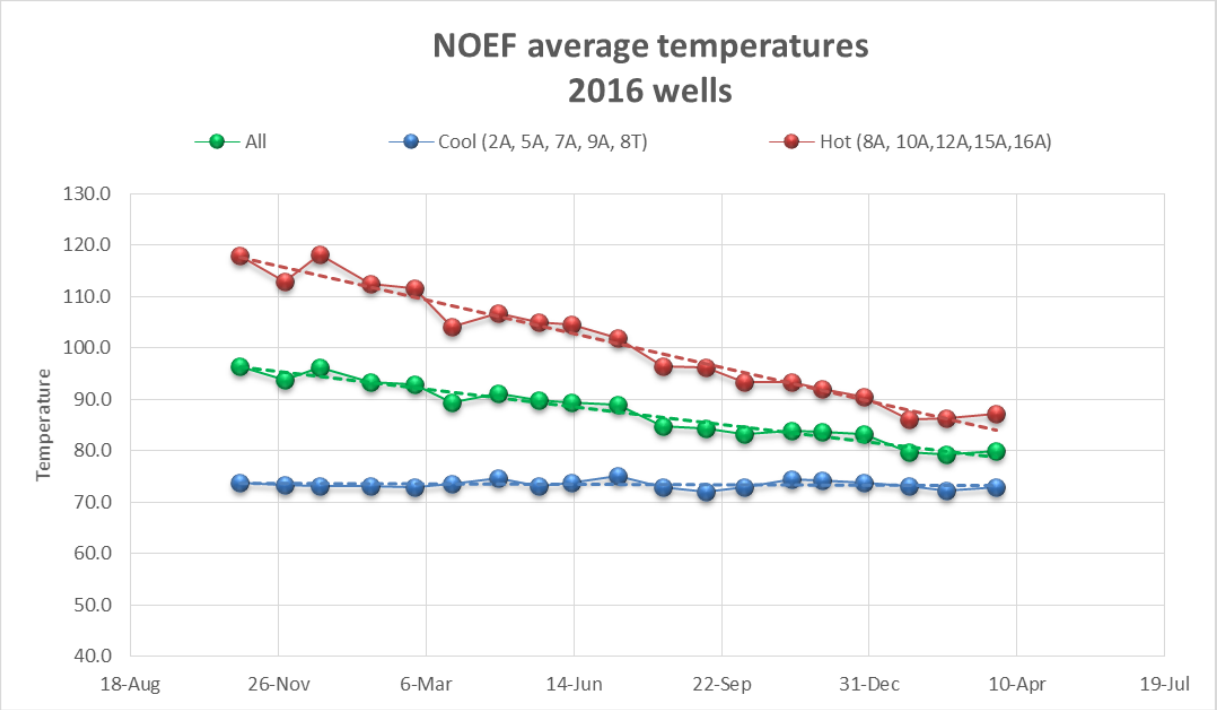


Figure 1: Average monthly temperatures for 10 temperature wells installed in 2016

The key trends are:

- Temperature wells where elevated temperatures are present are showing an overall significant cooling trend with a 30°C reduction in their average temperatures over the 18 month period.
- Temperature wells with background temperatures are showing stable and relatively invariant temperatures.
- The overall average measured temperature shows a cooling trend of in the order of 16°C over the 18 month period.

Figure 2 presents the spatial distribution of 16 monitoring wells on the NOEF, together with the mean temperature for April 2018 and the temperature variation over the record. It is important to note that wells numbered 2A to 16A have been in place for 18 months, while the wells numbered 17A to 25A have only been in place for 6 months, hence the differences in measured temperature variations. The April 2018 average temperature for the well is indicated in black, while the red value indicates the temperature variation.

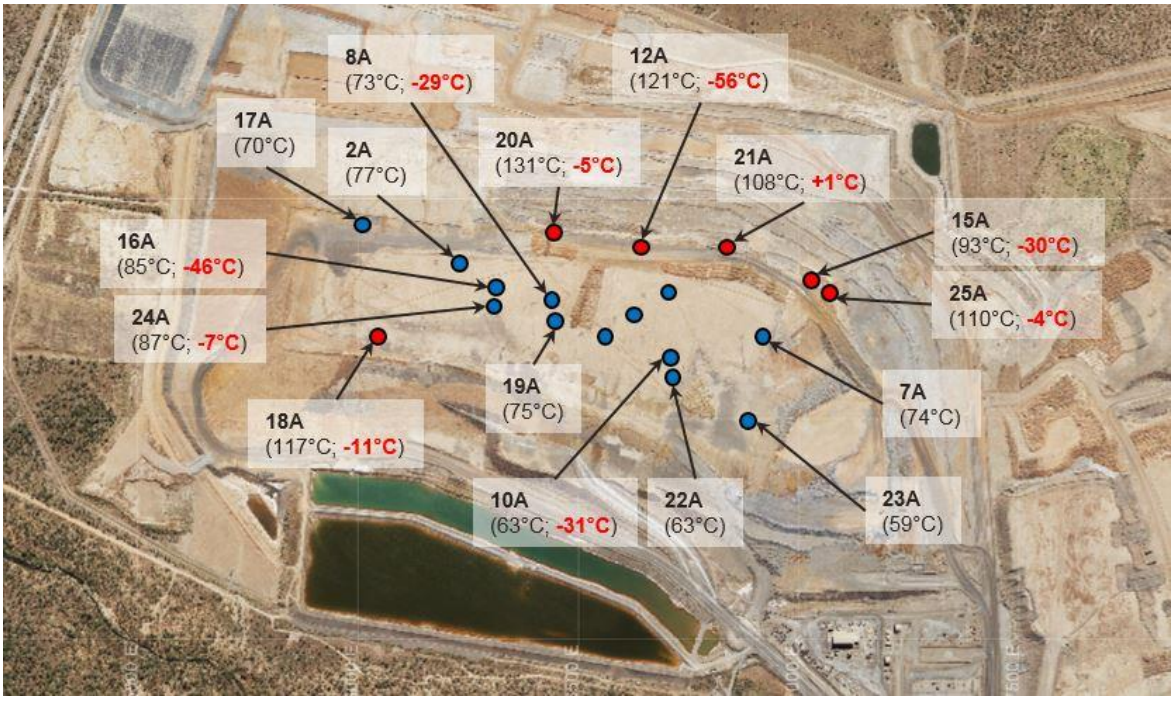


Figure 2: Spatial distribution of 16 monitoring wells on the NOEF.

The key trends are:

- Remnant elevated temperatures are largely restricted to the eastern half of the northern batter. The area shows significant cooling since 2016, in particular in wells 12A and 15A. Wells 20A, 21A and 25A have only been in operation for 6 months, hence the more modest temperature decreases observed. The presence of elevated temperatures in this part of the NOEF (immediately behind the batter) is likely due to internal heat transfer mechanisms resulting from oxidation along the batter, and therefore cooling is expected to occur over a period of time given the thermal inertia of the rock.
- The core of the NOEF PAF cell appears at background temperature, and significant cooling has also been observed (eg. 10A and 16A).

Overall, the measured temperature trends in the NOEF indicate that the current strategy to reduce sulphide oxidation rates and eliminate spontaneous combustion of PAF(RE) on the NOEF are effective. Given the recent placement of the advection barrier, ongoing monitoring will be undertaken to validate the anticipated continuation of the trend observed over the last 18 months.

Has there been any approach to the NIRB to seek a view on the Geosynthetic liner (GSL) as cover for the NOEF?

Response

Ron Nicholson, from the NIRB has been engaged to review the GSL Cover System works and is expected to deliver his review findings within the next few weeks. MRM will provide the NT EPA with a summary of Ron's review findings.

The NT EPA expects that eventually Barney and Surprise Creeks would recover, but does MRM have any predictions on when?

Response

Introduction

Before considering 'recovery' timeframes, it is important to understand the context of Barney and Surprise Creeks, their current environmental status and the significance of the anticipated future influence of McArthur River Mine. A summary of these is provided below with further information provided in the Draft and Supplementary EIS's.

Context

Barney and Surprise Creeks are highly ephemeral with flows extending intermittently throughout the wet season until approximately April each year. Water qualities generally deteriorate as the dry season progresses due to evapo-concentration of small remnant pools.

As part of the Supplementary EIS, Indo-Pacific Environmental undertook a comparative assessment of the Barney and Surprise Creek catchments, to provide context within the McArthur River catchment (refer Indo-Pacific Figure 1 below). This was completed for the dry season of 2015. The total surface area of the McArthur River catchment was found to be 19764 km2, of which the Barney Creek sub-catchment accounted for 2.73% and the Surprise Creek sub-catchment accounted for 0.69%. In terms of aquatic habitat, a total of 40.66 km2 of surface water was identified throughout the entire McArthur River Catchment in the late dry season of 2015. A majority of the Barney Creek sub-catchment was found to be dry at this time with only 0.0009 km2 of surface water identified, all of which occurred within the constructed Barney Creek diversion. This area represents 0.002% of all surface water identified within the McArthur River Catchment at this time. Similarly, with the Surprise Creek sub-catchment, the majority was found to be dry with only a single isolated pool on the north western side of the NOEF identified. The water body measured approximately 0.0001 km2 and accounted for 0.0002% of all surface water identified within the McArthur River Catchment at this time.

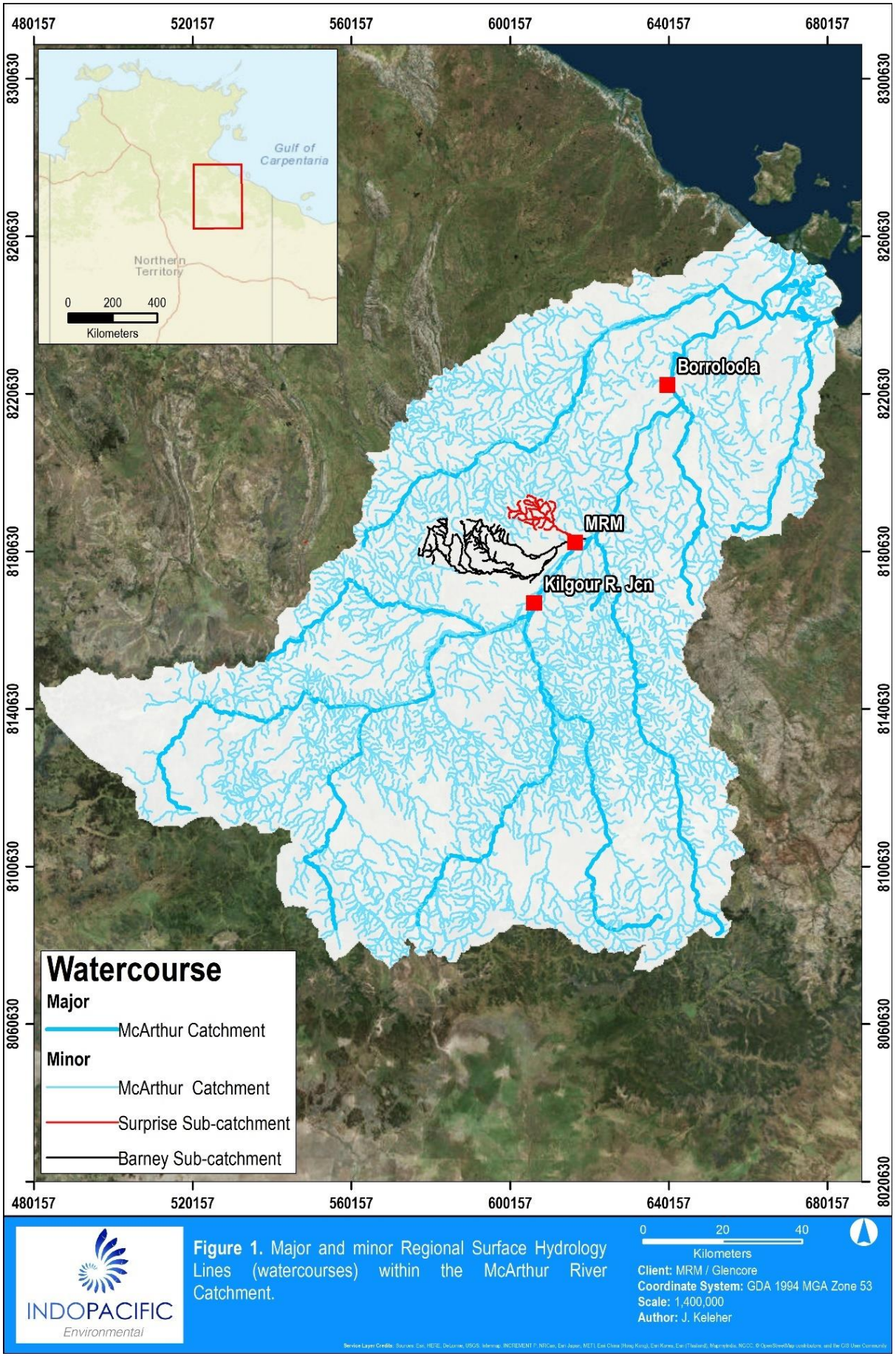


Figure 1. Major and minor Regional Surface Hydrology Lines (watercourses) within the McArthur River Catchment.

From the results above it can be seen that the Barney Creek and Surprise Creek sub-catchments represent a very small portion of the McArthur River catchment and as both are highly ephemeral, a vast majority of each catchment dries out during the dry season. This highlights the fact that fauna remaining in these systems after peak flows subside become stranded before succumbing to the natural drying of their habitat.

Current Status

This discussion is provided in the context of sulphate and zinc concentrations and the relationship with aquatic ecology.

Sampling within Barney and Surprise Creek in recent years has revealed a similar species composition to sites upstream of mining activities within the main McArthur River. However, as detailed within the draft EIS document (particularly Appendix U and Appendix W), this composition exists across a spectrum of water qualities. As discussed, Barney and Surprise Creeks are ephemeral and the vast majority of biota occupation occurs during relatively short wet season flow periods that allow recruitment from the main channel of the McArthur River. Flow and connectivity to the main river within these two creeks generally ceases by late April. Barney Creek upstream of SW18 (i.e. to SW28) (See Draft EIS Figure 8-14 for locations) dries within a matter of a few weeks after cessation of rain and as a result all aquatic biota in this section of the creek perish through natural drying regardless of water quality. Likewise, within that section of Surprise Creek where sulphate concentrations are present, water retracts to the only two locations deep enough to hold permanent water being a small rock hole adjacent the tailings storage facility (TSF) and SW24. Both these pools support diverse and abundant fish fauna throughout the year and which are heavily vegetated to the water's edge. Sulphate concentrations in these pools are known to be above 2000 mg/L for much of the dry season and no observable health effects on biota or riparian vegetation have been recorded. In some years, water persists for several months in Surprise Creek between SW1 and SW33. Although shallow, this section has been found to contain an abundance of fish despite elevated electrical conductivity (EC).

Within the rechannelled section of Barney Creek (i.e. downstream of the confluence of Barney and Surprise Creek), small pools generally persist for several months after rain. These artificially created pools support a wide variety of aquatic biota including fish, macroinvertebrates and higher vertebrates such as the Freshwater Crocodile *Crocodylous johnstoni* and Worrells Turtle *Emydura worrelli*. These reaches generally experience comparatively high sulphate concentrations of up to and beyond 2000 mg/L, particularly in the dry season. Given current sulphate levels within this small section of Barney Creek and the fact biota is not resident (i.e. they have not 'acclimatised' to tolerate these levels), this indicates that the suite of fish species within the wider region can persist in waters of elevated EC which is primarily driven by sulphate based salts. The fact that biota captured from these have not displayed signs of ill-health or poor physical condition also implies that

food for these species (for example, invertebrates, algae or plants) also persists in these environments.

Aquatic fauna captured within Barney and Surprise Creeks has not been recorded to show clinical signs of damage or disease which may be attributed to elevated zinc concentrations. The presence of these mobile aquatic fauna indicates that the aquatic environmental conditions are within the tolerance levels of a range of species and which are sufficient to maintain ecosystem function.

Significance of modelled future conditions

A large portion of the Barney Creek and Surprise Creek catchments will continue to remain upstream of and unaffected by MRM for the remainder of the Project.

Increased sulphate concentrations are predicted to occur downstream of SW4 (in the case of Barney Creek) and downstream of SW1 (in the case of Surprise Creek). However, proposed mitigation measures aim to limit this, including the installation of a trench and recovery bores opposite the TSF and two recovery sumps (BCS1 at SW19 and BCS2 downstream of SW6). It can be seen from the EIS that modelled sulphate levels at the sumps are unlikely to prevent the survival of the species that currently occupy those sections of Barney Creek based on the concentrations currently present.

Published observations of the effects of total salinity on Australian riparian vegetation are limited and therefore are unlikely to provide a clear indication of what may occur in systems such as Barney and Surprise which have vastly different ionic ratios (Jolly et al. 2008). Current field observations of naturally vegetated sections of Surprise Creek adjacent the NOEF, TSF and upstream indicate numerous plant species are present through the area which are common to the wider McArthur River catchment. Despite sulphate being elevated at some of these locations, and salt being physically present on the creek banks, riparian vegetation, including long lived species such as members of the Myrtaceae family, persist apparently unaffected. Health data collected from the area indicated assessed trees were comparable to those located away from MRM (Indo-Pacific Environmental 2016; 2017).

Dissolved zinc concentrations within Barney and Surprise creeks are modelled to be similar to concentrations currently observed in Barney or Surprise Creeks and as such, dissolved zinc is not expected to cause adverse effects on aquatic fauna or riparian vegetation.

Overall very little of Surprise or Barney Creeks sustain aquatic biota year round. The locations that do sustain biota year round are likely the result of local creek bed topography combined with anthropogenic groundwater seepage. Aquatic biota will continue to recruit into these creek systems from the main channel of the McArthur River during periods of high flow and persist until water levels naturally retract.

From the information presented above, it is suggested that modelled sulphate levels are less than half that known to produce chronic effects in most freshwater teleost species and, based on field observations, are also unlikely to have a measurable effect on riparian vegetation density. Species recorded from Barney and Surprise Creeks are found throughout the McArthur River catchment and greater Gulf of Carpentaria. Based on this, and the fact Barney Creek does not represent critical habitat for any species, it is unlikely that any loss of aquatic habitat will result in a population level effect. The capture of affected water from Barney Creek is however considered an important process to avoid adverse effects on the main McArthur River channel. As discussed in Supplementary EIS Appendix W, further assessment and evaluation of the ecotoxicological characteristics of the Barney and Surprise Creek aquatic environment is proposed.

Recovery timeframes

Water quality in Surprise Creek will start to improve from 20-30 years after TSF removal and remediation (to be completed in 2052). The influence of TSF removal will also be apparent in Little Barney Creek and Barney Creek however to a lesser extent due to the enduring influence of localised naturally mineralised zones on groundwater baseflow to these reaches. The constructed Barney Creek diversion channel sits at the bottom of the catchment between the open cut and the NOEF. As the influence of the TSF removal becomes apparent in the Barney Creek diversion channel water qualities, the influence of NOEF seepage will start to be seen. Dry season Sulphate and Zinc concentrations in the Barney Creek diversion are anticipated to increase at this time. These dry season concentrations are likely to endure in this locality in the longer term however as discussed above, the water in the lower diversion will be managed through the Barney Creek sumps to limit the influence on the broader McArthur River system. Furthermore, modelled water qualities at the sumps are unlikely to prevent the survival of the species that currently occupy those sections of Barney Creek.

A GLENCORE COMPANY

20 June 2018

Dr Paul Vogel
Chairman
Northern Territory Environment Protection Authority
Arnhemica House
Level 1, 16 Parap Road
Parap NT 0820

Dear Paul,

RE: MCARTHUR RIVER MINE – HISTORICAL MONITORING AND ENVIRONMENTAL PERFORMANCE SUMMARY

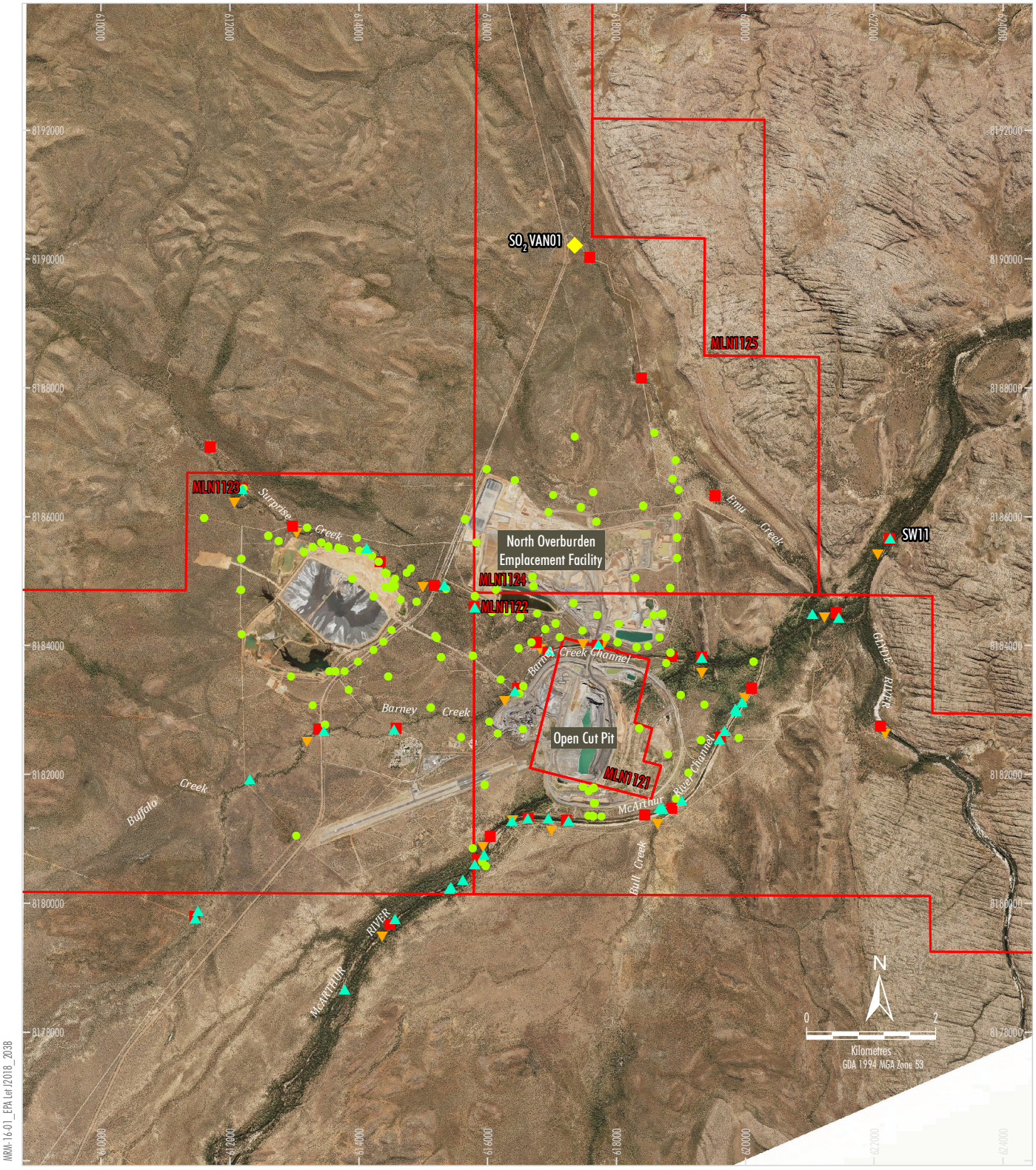
Further to our letter dated 15 May 2018, McArthur River Mining Pty Ltd (MRM) has commissioned a comprehensive review of the historical monitoring dataset outlined in the letter by external expert specialists. The dataset reviewed covers the following key monitoring programs relevant to the environmental performance of the North Overburden Emplacement Facility, which is the subject of the Overburden Management Project Environmental Impact Statement (OMP EIS):

- Artificial Surface Water Quality (for on-site water storages).
- Surface Water Quality.
- Groundwater.
- Macroinvertebrates.
- Aquatic Fauna Abundance and Diversity.
- Metals in Fish.
- Air Quality (sulphur dioxide).

Based on the specialists' expert review of the data from monitoring locations shown on Figure 1, it is concluded the Mine's operations are not resulting in material adverse downstream or off-site impacts. A summary of the experts' opinions relating to the protection of downstream beneficial uses/environmental values and off-site sensitive receivers is provided in Table 1.

These results are of particular relevance to the OMP EIS. The management strategies for the handling of non-benign waste material outlined in the OMP EIS will allow MRM to continue to prevent potential downstream and off-site impacts.

The comprehensive environmental management and monitoring strategies employed at the Mine and described in this letter will continue to be implemented to confirm downstream beneficial uses/environmental values are being maintained and off-site sensitive receivers are not impacted.



LEGEND

- Mineral Lease
- Aquatic Fauna Monitoring Site
- Groundwater Monitoring Site
- Macroinvertebrate Monitoring Site
- SO_2 Monitor
- Surface Water and Fluvial Sediment Monitoring Site

Source: Orthophoto MRM (2017); Department of Environment and Natural Resources (2016)

McARTHUR RIVER MINE

Figure 1

Table 1: Management and Monitoring to Protect Downstream Beneficial Uses/Environmental Values and Off-site Sensitive Receivers

	Component	Tier	Management/ Monitoring Program	Expert Reviewer	Performance Review Conclusions
Aquatic Ecology	*ON-SITE*				
	On-site Preventative Management	1	Water Management Strategy	**WRM Water & Environment** – Julian Orth	- *"Based on the water quality and storage monitoring information between the period of May 2016 and April 2018 that I have reviewed:* o *The Mine water management system has operated successfully to prevent uncontrolled releases of poor quality water to the downstream receiving waters* o *Water storages are designed in accordance with relevant agreed and recognised standards* o *The performance of the Mine water management system to achieving environmental values downstream of the Mine has been demonstrated"*
	On-site Performance Identification	2	Artificial Water Quality	**MRM**	- *Water quality monitoring in key on-site storages allows MRM to understand and contain runoff and seepage from the NOEF.*
			Groundwater	**Klohn Crippen Berger** – Dr Brent Usher – Dr James Tuff	- *"The groundwater monitoring network at MRM is extensive and the approach followed is adequate to identify any adverse and unexpected trends in groundwater quality"*
	DOWNSTREAM				
	Downstream Performance Identification	3	Fluvial Sediments	**Eco Logical Australia** – Garry Straughton – Dr Richard Cresswell	- *"There was no evidence of the influence of the mining operations on metal concentrations in the McArthur River, with sites near to and downstream of the mine having concentrations similar to control and other sites upstream"*
			Surface Water Quality	**Klohn Crippen Berger** – Dr Brent Usher – Dr James Tuff	- *"The overwhelming majority of monitoring records indicate the water quality at SW11 remains within compliance limits as defined by MRM's Waste Discharge Licence"* - *"A key element of MRM's management strategy is to maintain non-acid forming conditions, and groundwater and surface water monitoring shows neutral to slightly alkaline pH across the Mine and downstream"* - *"No exceedances for the key metals of concern (zinc, lead, cadmium, arsenic) have been experienced at SW11 over the period 2008 to 2018. Historically sulphate concentrations occasionally exceeded the SSTVs, but in recent years the records have shown an improvement in performance, with no exceedances in the most recent April 2017 to April 2018 monitoring period"*
		4	Macroinvertebrates	**Environmental Management Services** – Paul Barden	- *"There have been no significant declines or changes in freshwater macroinvertebrate populations as a result of MRM mining and processing operations detected at downstream reference sites during monitoring conducted between 2008 and 2017"*
	Downstream Performance Confirmation	5	Aquatic Fauna Abundance and Diversity Metals in Fish	**IndoPacific Environmental** – Dr Dean Thorburn	- *"there has been no observable decline in species diversity in waters upstream and downstream of the mineral lease"* - *"Data to date indicates there is an extremely low risk to human health from consuming the monitored fish species caught in the McArthur River catchment downstream or upstream of the mineral lease based on the reviewed monitoring data"*
Air Quality	*ON-SITE PREVENTION AND OFF-SITE SENSITIVE RECEIVERS*				
	Sensitive Receiver Performance Confirmation		Air Quality	**Todoroski Air Sciences** – Aleks Todoroski	- *"The available information, including on-site monitoring data shows improved performance over time with respect to the prevention of SO_2 emissions"* - *"Review of air quality monitoring data shows MRM's operations have not resulted in adverse impacts at the closest off-site sensitive receivers"*

Julian Orth **Dr Brent Usher** **Paul Barden** **Dr Dean Thorburn** **Aleks Todoroski**





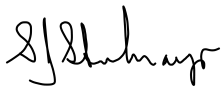
Further information concerning the review of the performance data follows, including letter reports from the expert specialists.

Please note Northern Territory Environment Protection Authority's (NT EPA) feedback to date about the need to clearly describe and review potential off-site and downstream impacts has been considered by MRM and will be implemented in future Operational Performance Reports, copies of which can be provided to the NT EPA when available.

We would be happy to meet with the NT EPA, along with any relevant specialists, to discuss and further explain the outcomes of the analyses.

Should you wish to discuss this letter, please do not hesitate to contact Ryan Pascoe, Manager – Environment, Safety & People, on 08 8975 8287 or ryan.pascoe@glencore.com.au.

Yours sincerely,



Sam Strohmayr
General Manager
McArthur River Mining Pty Ltd

BACKGROUND

INTRODUCTION

McArthur River Mining Pty Ltd (MRM) is a wholly owned subsidiary of Glencore and the operator of the McArthur River Mine (the Mine). MRM currently operates the Mine in accordance with the *Phase 3 Development Project Environmental Impact Statement* (MRM, 2012) and *Sustainable Development Mining Management Plan 2013-2015* (and associated amendments). On-site mining and processing activities are conducted within Mineral Lease (MLN) 1121, MLN 1122, MLN 1123, MLN 1124 and MLN 1125 (Figure 1).

MRM is currently seeking approval for the Overburden Management Project Environmental Impact Statement (OMP EIS), which includes the redesign of the North Overburden Emplacement Facility (NOEF) to manage non-benign waste rock.

This environmental performance summary:

- identifies beneficial uses and environmental values relevant to appropriate management of the NOEF (the key beneficial uses/environmental values being associated with the protection of downstream water quality and aquatic ecology);
- provides an overview of MRM's comprehensive environmental monitoring programs relevant to protection of downstream beneficial uses/environmental values and off-site sensitive receivers;
- identifies the closest off-site sensitive receivers and provides an overview of the on-site diagnostic monitoring relevant to sulphur dioxide (SO_2) emissions; and
- provides analysis of monitoring data by expert specialists to confirm that the Mine's operations are not resulting in material adverse downstream impacts or adverse impacts to off-site receivers (**Enclosure 1**).

DOWNSTREAM MONITORING

Beneficial Uses/Environmental Values

MRM's Waste Discharge Licence 174-10 lists the following beneficial uses declared under the *Water Act (NT)* that are relevant to the environment downstream of the Mine site:

  - *McArthur River Area: Aquatic ecosystem protection, recreational water quality and aesthetics; and*
  - *McArthur River Catchment Area: environment, cultural and riparian.*

In addition, and in accordance with the *National Water Quality Management Strategy: Implementation Guidelines* (NWQMS, 1998) and the *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (ANZECC & ARMCANZ, 2000), the following environmental values for the receiving waters downstream of the Mine have been identified:

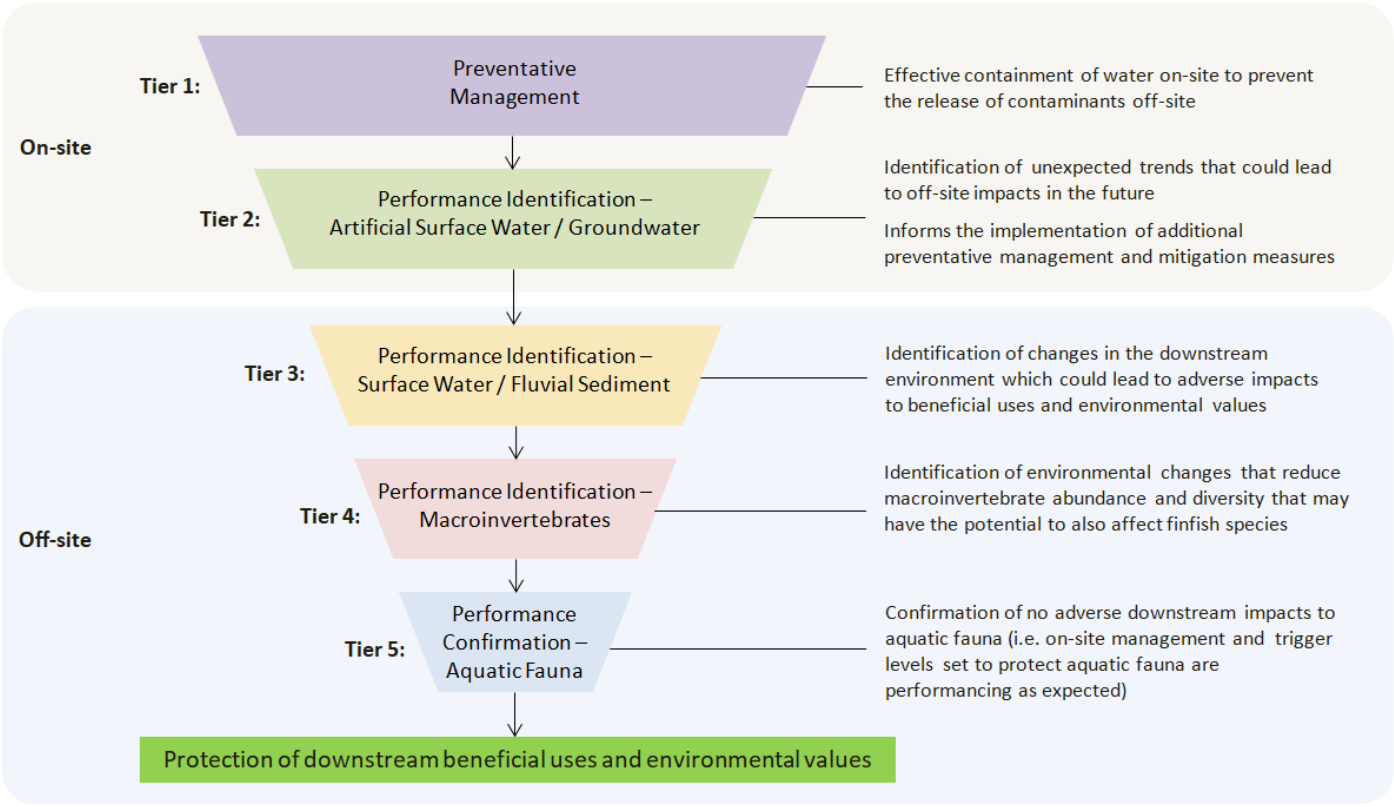
- aquatic ecosystems;
- primary industries including stock drinking water, irrigation and general water uses;
- recreation and aesthetics; and
- cultural and spiritual values.

Typically, the most stringent water quality objectives are associated with the protection of aquatic ecosystems, and so MRM's environmental management and monitoring program targets the protection of downstream aquatic ecosystem values.

Environmental Management and Monitoring Programs

MRM has a comprehensive environmental monitoring program as shown on Figure 1. This program operates across five tiers of protection to mitigate the potential for environmental harm and to identify performance related trends in a timely manner to ensure no adverse impacts to downstream aquatic ecology values, as shown on Plate 1.

Plate 1: Environmental Management and Monitoring Tiers



AIR QUALITY MONITORING

A key objective of the Air Quality Monitoring Program is to demonstrate air quality related impacts due to the Mine's operations are being minimised. Relevant to this objective, the nearest sensitive receiver locations are the townships of Devils Spring and Borroloola, located approximately 25 and 45 kilometres from the mining operations, respectively.

SO_2 monitoring is carried out to the north of the NOEF within the mineral leases at monitoring site SO_2 VAN01 (Figure 1) which is located between the Mine and the townships. The SO_2 concentrations at the townships due to mining activities would be significantly lower than those measured at SO_2 VAN01 (Figure 1) and, therefore, elevated concentrations at SO_2 VAN01 can be used to inform preventative impact management measures, if required, to ensure there are no air quality impacts on the sensitive receivers.

CONCLUSION

The letter provided to the Northern Territory Environment Protection Authority (NT EPA) on 15 May 2018 provided data collected as part of MRM's environmental monitoring network (Figure 1). At the request of the NT EPA, a comprehensive review of the historical data, including recent 2017/2018 data, has been undertaken by MRM, including additional analysis by key specialists. The specialists reviewed on-site and off-site data to inform the conclusions made about the Mine's performance with respect to potential impacts on downstream aquatic ecology and off-site sensitive receivers.

The expert opinions of the specialists that have reviewed the environmental monitoring data are summarised in Table 1 and reports prepared by the specialists to support this letter are provided in **Enclosure 1**. Figure 1 shows the monitoring locations from which data has been analysed by the specialists.

Based on the specialists' expert opinions, it is concluded the Mine's operations are not resulting in material adverse downstream or off-site impacts. The OMP EIS proposes to implement improved preventative management measures which will allow MRM to continue to prevent potential downstream and off-site impacts.

Enclosure 1: Performance Review Letters

0790-47-D2

Ryan Pascoe
Manager – Environment, Safety and People
McArthur River Mine
PO Box 36821
Winnellie NT 0821

15 June 2018

Subject: Summary of historical monitoring and performance relevant to maintaining environmental values in the McArthur River downstream of the Mine site

Dear Ryan,

In response to your request, this letter provides a summary of surface water quality monitored downstream of the Mine site at SW11 in the McArthur River and the performance of the Mine water management system between May 2016 and April 2018. This summary is based on:

- Surface water quality sampling data collected at the Mine provided by MRM personnel; and
- Water monitoring information collected on Mine water storage volumes.

My qualifications and involvement at McArthur River Mine

I am a Senior Engineer with WRM Water & Environment Pty Ltd. My professional qualifications include a Batchelor of Engineering (Civil) and a Master of Engineering (Engineering Science) from the University of Queensland. I am also:

- a Member of the Institution of Engineers;
- a Chartered (Civil and Environmental) member of Engineers Australia;
- on the National Engineering Register of Engineers Australia;
- an Associate Member of Australian National Committee on Large Dams; and
- a Registered Professional Engineer of Queensland (Civil and Environmental).

I have been preparing surface water impact assessments, water balance assessments, mine water dam Trigger Action Response Plans, and on-site water management plans for the Mine since 2011. As part of these investigations, I have monitored the performance of the Mine water management system based on data collected from the artificial surface water monitoring program, the natural surface water monitoring program and the on-site water monitoring program.

Summary of historical monitoring data downstream of the Mine

Table 1 shows a statistical summary of the water quality recorded at SW11 for parameters defined in the McArthur River Mining (MRM) Waste Discharge Licence 174-10 (the WDL) between May 2016 and April 2018. Table 1 also shows the site-

specific trigger value (SSTV) for each of the 20 parameters defined in the WDL. Between the period May 2016 and April 2018, 95 water quality samples have been collected at SW11. Samples have been collected at least once a week during periods of flow at the monitoring point.

The recorded water quality monitoring statistics at SW11 show:

- The minimum, 5th percentile and 20th percentile values are within the SSTV limits defined in the WDL for all water quality parameters except for dissolved oxygen.
- The median and mean values are within the SSTV limits defined in the WDL for all water quality parameters.
- The 80th percentile values are within the SSTV limits defined in the WDL for all water quality parameters except aluminium.
- The 95th percentile values are within the SSTV limits defined in the WDL for all water quality parameters except for electrical conductivity and aluminium.
- The maximum values are within the SSTV limits defined in the WDL for all water quality parameters except for pH, electrical conductivity, dissolved oxygen, aluminium, iron and nitrate.

Figure 1 to Figure 9 compare the historical water quality monitoring information for key parameters defined in the WDL between May 2016 and April 2018 for:

- the McArthur River authorised monitoring point (SW11);
- the McArthur River upstream (background) monitoring site (SW21); and
- the Glyde River upstream (background) monitoring site (SW09).

The figures show parameters that have values that exceeded the SSTV limits defined in the WDL between May 2016 and April 2018 (see Table 1) as well as other parameters of historical significance including sulphate, zinc and lead. Other parameters are not shown as they were well within the respective SSTV limits defined in the WDL.

Note that the SW09 water quality monitoring site is potentially affected by McArthur River backwater flooding during significant flow events. No attempt has been made to account for McArthur River influences in this review.

The results show that, in general the measured surface water quality at the authorised monitoring point (SW11) is within the SSTVs defined in the WDL. Where there are measured SSTV exceedances at SW11, they remain within the range of values measured at background monitoring sites in the McArthur River and the Glyde River. The following is of note:

- pH, electrical conductivity, dissolved oxygen, aluminium and lead levels measured at SW11 are closely related to background water quality measured at SW21. Elevated levels at SW11 up to and exceeding the SSTVs are generally within the range of values measured upstream of the Mine.
- Iron and nitrate levels measured at SW11 are closely related to background water quality measured at both SW09 and SW21. Elevated levels at SW11 up to and exceeding the SSTVs are generally within the range of values measured upstream of the Mine. Measured iron and nitrate levels in the Glyde River during some periods are higher than the McArthur River at both SW21 and SW11.
- Sulphate and zinc levels measured at SW11 can be elevated when compared to background water quality measured at SW21 and SW09. This is likely due

to a combination of managed releases during the wet season (November to April) and mine affected groundwater during the dry season (May to October). Notwithstanding this, the on-site water management system has been operated in a way that ensured that sulphate and zinc levels measured at SW11 remained within the SSTV limits defined in the WDL.

Further details of surface water monitoring data can be found in MRM's 2017 and 2018 Operational Performance Reports.

Summary of the Mine water management system performance

The Mine water management system has been operated in a way that minimises the risk of uncontrolled releases of poor quality water to the receiving waters since my involvement with water management at the Mine site in 2011. Based on the monitoring information I have reviewed:

- Despite some significant wet seasons since 2011, there were no uncontrolled releases (spills) to the downstream receiving waters from any of the key mine water storages since 2011 including:
    - the Tailings Storage Facility (TSF) Cell 2 decant pond;
    - the TSF Water Management Dam (TSF WMD);
    - the North Overburden Emplacement Facility (NOEF) Perimeter Runoff Dams (PRODs):
        - South-east perimeter runoff dam (NOEF SEPROD);
        - South Perimeter Sediment Dam (NOEF SPSD);
        - South Perimeter Runoff Dam (NOEF SPROD);
        - West Perimeter Runoff Dam (NOEF WPROD); and
    - The Anti-pollution pond (Mill APP).
- Mine water storages are operated in accordance with the MRM's mine water storage Trigger Action Response Plan to limit the risk of uncontrolled releases (spills) to agreed and recognised standards;
- In 2011, 2012, 2014, 2017 and 2018 the Mine used the open pit as a mine water storage to avoid uncontrolled releases (spills) of poor quality water into the receiving waters; and
- There are no known non-compliances at the authorised monitoring point (SW11) due to uncontrolled releases (spills) from mine water storages.

Further details of the Mine water management system performance can be found in MRM's 2017 and 2018 Operational Performance Reports.

Summary

The water monitoring data shows that the Mine water management system has been operated in a way that prevents uncontrolled release of poor quality water and maintains environmental values downstream of the Mine site. There have been no uncontrolled releases from key mine water storages (TSF Cell 2 decant pond, TSF WMD, PRODs and Mill APP) since 2011.

Based on the water quality and storage monitoring information between the period of May 2016 and April 2018 that I have reviewed:

- The Mine water management system has been operated successfully to prevent uncontrolled releases of poor quality water to the downstream receiving waters.
- Water storages are designed in accordance with relevant agreed and recognised standards.
- The performance of the Mine water management system to achieving environmental values downstream of the Mine site has been demonstrated.

For and on behalf of

WRM Water & Environment Pty Ltd

Julian Orth BE (Hons) ME (Eng Sc) MIEAust CPEng RPEQ

Associate/Senior Engineer

Table 1 – Summary statistics for selected water quality parameter recorded at SW11 with SSTVs defined in the WDL – May 2016 to April 2018

Parameter	Abbreviation	Units	WDL SSTV	min	5%ile	20%ile	median	80%ile	95%ile	max	mean	no. samples
pH	pH	pH units	6.0-8.5	6.19	6.69	7.48	8.07	8.28	8.48	8.65	7.88	95
Electrical Conductivity	EC	µS/cm	1,000	25.0	58.8	213	633	816	1,040	1,210	563	95
Dissolved Oxygen	DO	% saturation	85-120	44.6	66.5	79.6	89.5	101	113	147	89	92
Metals and metalloids (filtered)												
Aluminium	Al	µg/l	55	1.30	1.88	2.90	6.55	69	193	341	36	94
Arsenic	As		24	0.15	0.43	0.75	1.05	1.30	2.01	3.50	1.10	94
Cadmium	Cd		1.73	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	95
Copper	Cu		10.97	0.15	0.35	0.48	0.70	1.01	2.60	4.26	0.91	95
Iron	Fe		300	2.00	8.00	16.0	32.0	150	252	370	76.0	95
Lead	Pb		16.6	<0.01	<0.01	0.03	0.09	0.16	0.36	0.64	0.11	95
Manganese	Mg		1900	0.60	0.97	2.38	20.8	51.4	111	611	41.0	95
Mercury	Hg		0.6	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.04	<0.02	95
Nickel	Ni		11	0.21	0.28	0.44	0.58	0.83	1.44	2.02	0.67	95
Zinc	Zn		62.68	0.10	0.30	1.02	2.80	8.36	24	37	5.4	95
Total Petroleum Hydrocarbons (TPH)												
TPH Fraction C_6-C_9	NA	µg/l		<20	<20	<20	<20	<20	<20	<20	<20	91
Benzene	NA		950	<1	<1	<1	<1	<1	<1	<1	<1	91
TPH Fraction C_{10}-C_{14}	NA		600	<50	<50	<50	<50	<50	<50	240	52.6	91
TPH Fraction C_{15}-C_{28}	NA			<100	<100	<100	<100	<100	214	320	110	91
TPH Fraction C_{29}-C_{36}	NA			<50	<50	<50	<50	<50	68.0	200	55.1	91
Other												
Sulphate	SO_4	mg/L	341	0.30	1.38	7.44	35.8	90.2	158	233	52.5	95
Nitrate [a]	NO_3	mg/L	0.7	<0.02	<0.02	<0.02	0.10	0.20	0.67	2.94	0.20	95

[a] Water quality records prior to March 2017 were provided as nitrate as N. For the purposes of this assessment, nitrate as N values were converted to nitrate values by multiplying by 4.43

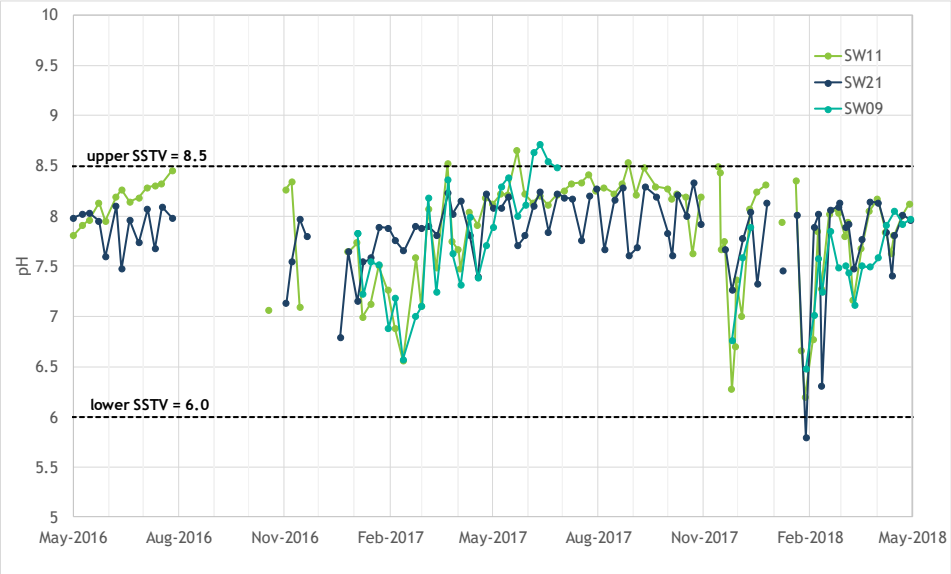


Figure 1 – Comparison of measured pH - SW11, SW21 and SW09

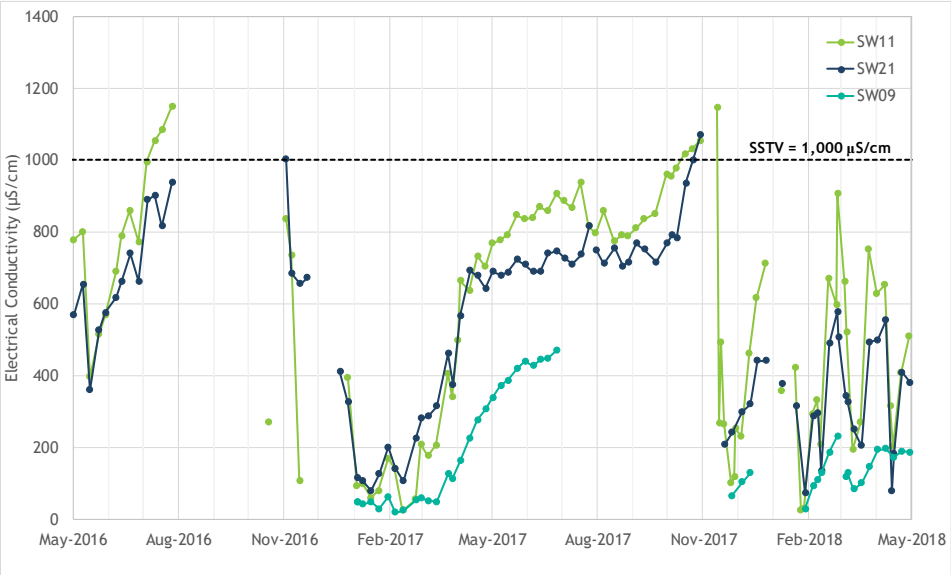


Figure 2 – Comparison of measured electrical conductivity - SW11, SW21 and SW09

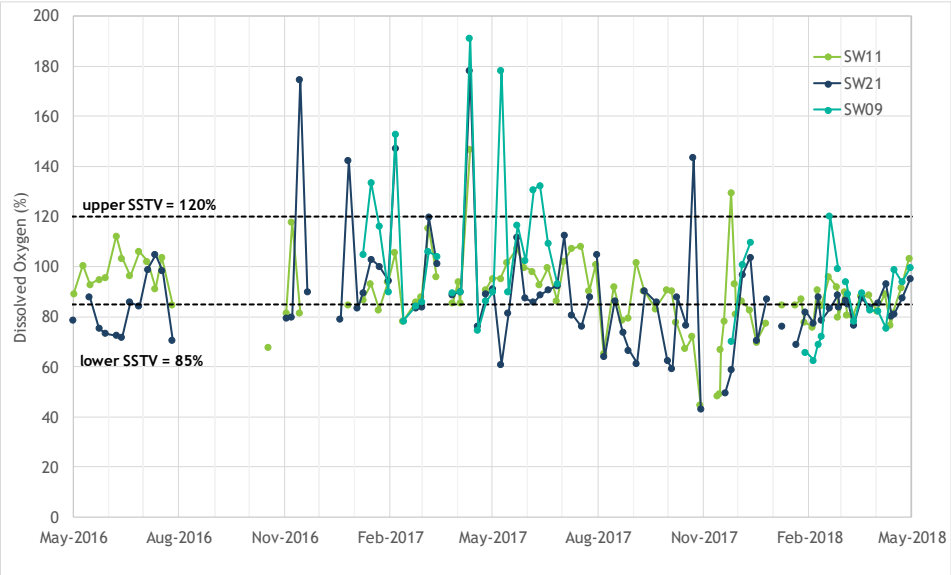


Figure 3 - Comparison of measured dissolved oxygen - SW11, SW21 and SW09

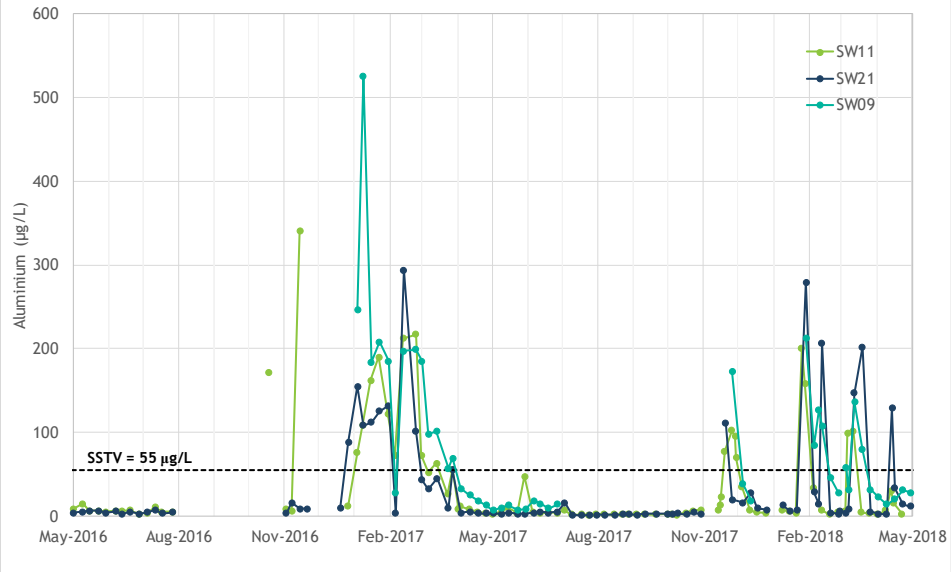


Figure 4 - Comparison of measured aluminium (filtered) concentrations - SW11, SW21 and SW09

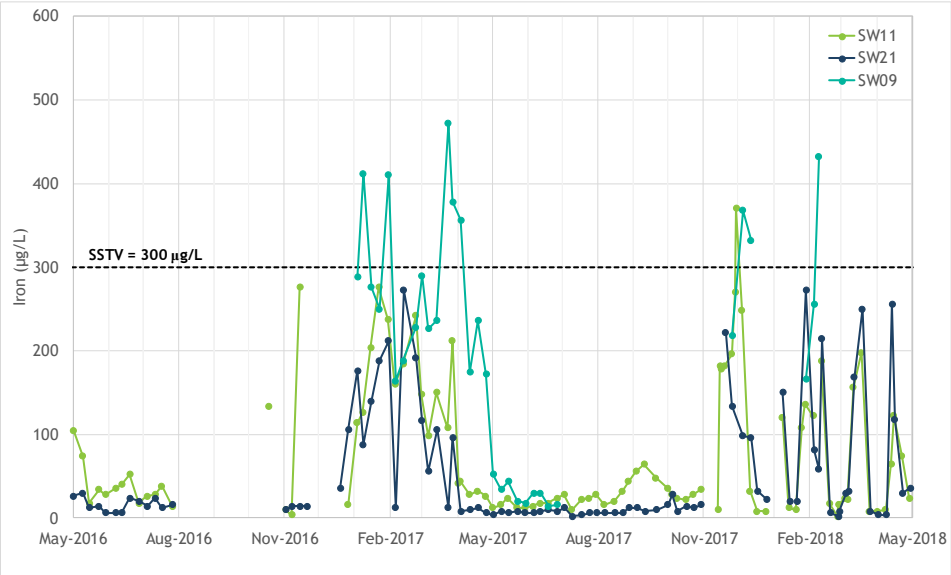


Figure 5 - Comparison of measured iron (filtered) concentrations - SW11, SW21 and SW09

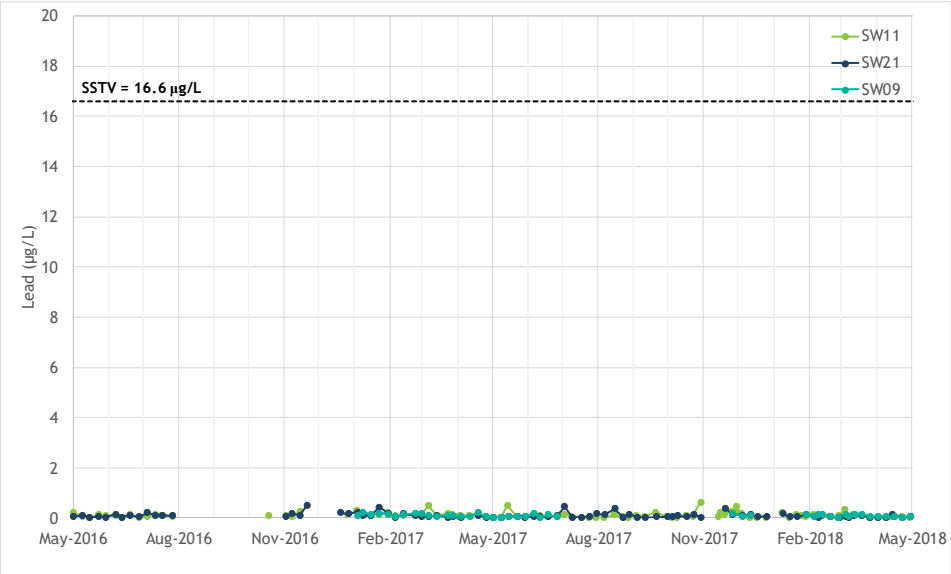


Figure 6 - Comparison of measured lead (filtered) concentrations - SW11, SW21 and SW09

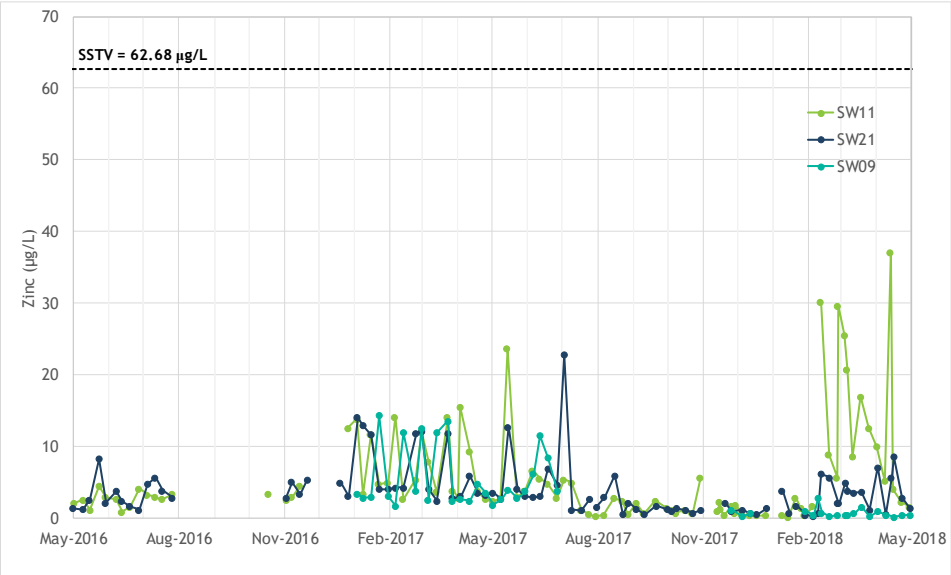


Figure 7 - Comparison of measured zinc (filtered) concentrations - SW11, SW21 and SW09

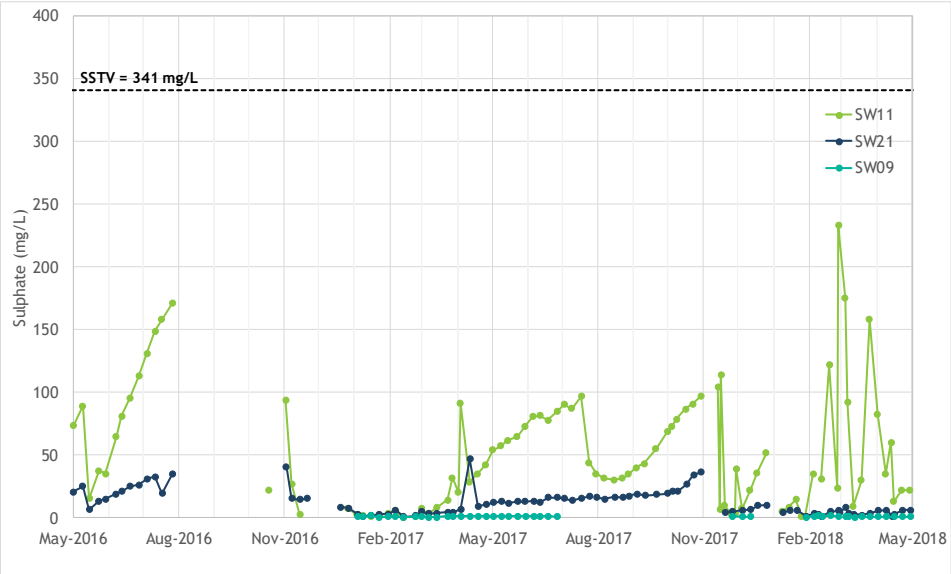


Figure 8 - Comparison of measured sulphate concentrations - SW11, SW21 and SW09

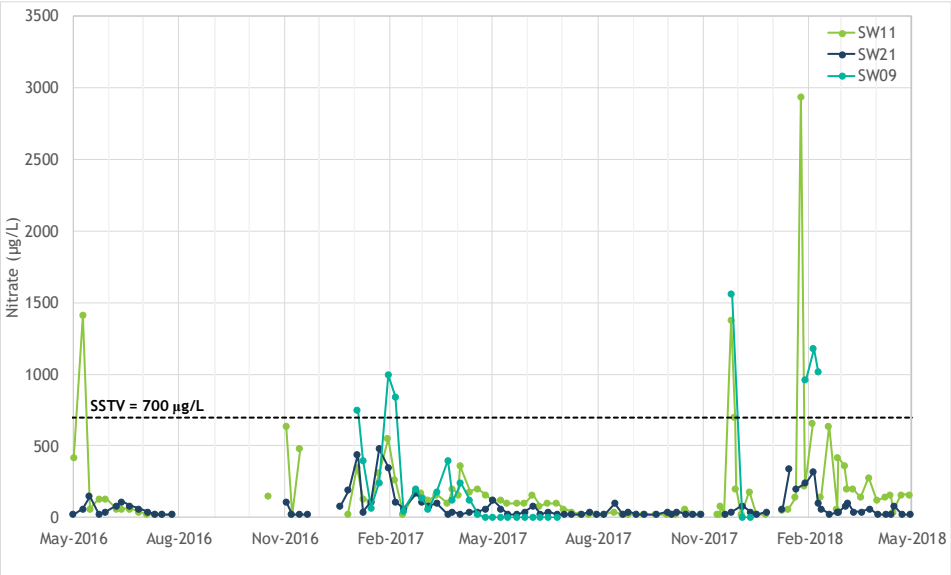


Figure 9 – Comparison of measured nitrate concentration - SW11, SW21 and SW09

June 11, 2018

McArthur River Mine
Via email

Ryan Pascoe
Manager – Environment, Safety and People

Dear Mr Pascoe:

Annual Groundwater and Surface Water Monitoring

1 INTRODUCTION

Klohn Crippen Berger (KCB) was engaged by McArthur River Mine (MRM) in 2018 to assess the groundwater and surface water monitoring data for MRM in the 2017/2018 reporting period (having previously undertaken the assessment of the monitoring data for the period 2014/2016). KCB has also assisted MRM with the recent NOEF EIS and NOEF Supplementary EIS.
This letter provides a high-level summary of the findings from the 2017/18 period specifically; further information is provided in the detailed groundwater and surface water monitoring reports (KCB, 2018), as well as in the technical appendices to the NOEF EIS and EIS Supplementary (KCB 2018).

2 KCB TEAM FOR THE ASSESSMENT

The monitoring assessment for the 2017/2018 reporting period was completed by the following team:

- Dr Brent Usher, Manager Geosciences, Senior Hydrogeochemist and Associate. Brent has more than 21 years of experience, holds a PhD in Hydrogeochemistry, MSc in Hydrogeology, BSc (Hons) in Chemistry and BSc in Geology/Chemistry. He has undertaken water quality/groundwater and mine water assessments at more than 100 mines worldwide. Brent has lead KCB's technical contributions to the NOEF EIS and more recently oversaw the completion of the monitoring assessment.
- Dr James Tuff, Senior Geochemist. James has 15 years' experience and holds a PhD in Geochemistry (Cambridge) and has undertaken geochemical and mine water assessments at a variety of mine sites across the world. James was the project manager for the 2017/18 monitoring assessment.
- Supporting team members included:
    - Nathan Turner, Environmental Scientist. Nathan holds a BSc in Environmental Sciences has more than 11 years' experience in Australia and the United Kingdom.
    - Dr William Nash, Geochemist, holds a PhD in geochemistry from Oxford University and has been involved with mine water quality at several mine sites in Australia and internationally since joining KCB in 2018.

Klohn Crippen Berger Ltd. • Level 5, 43 Peel St • South Brisbane QLD 4101 • Australia
T 617.3004.0244 f • T 617.3004.0299 f • www.klohn.com

- Dr Wesley Burrows has more than 15 years' experience in Australia and Canada in particular. Wesley's specialty is groundwater modelling and he holds a PhD in Numerical Modelling and MSc in GIS as well as a BSc in Physics and Natural Sciences.

3 OVERVIEW

3.1 Contaminants of concern and analytes included in monitoring

Associated with MRM's site geology and mineralisation, several contaminants of concern have been identified for monitoring. These have been reported in several MRM reports, including more recent reporting for the NOEF EIS, and further parameters are also included in the Mine's approved Waste Discharge Licence.

Maintaining non-acid conditions is an important part of MRM's water and waste management strategy, and pH is a key indicator of performance, in conjunction with the other indicator parameters of concern (sulphate, Zn, Pb, As and Cd).

MRM's compliance point is Site SW11 on the McArthur River. The Mine has a set of Site Specific Trigger Values (SSTVs) based on MRM's approved Waste Discharge Licence which is used to evaluate efficacy of the Mine's water and waste management plans in meeting compliance and protecting the water quality downstream of the Mine.

The WDL includes further metals such as Al, Fe, Mn, Hg and Ni as well as field based measures of water quality such as electrical conductivity and dissolved oxygen. MRM's routine analytical suite for monitoring purposes includes all of these parameters, as well as a full suite of major elements, and an extended list of dissolved and total metals.

3.2 Monitoring network

The current MRM surface water monitoring network consists of:

- Natural Surface Water (NSW) sites – 32 sites sampled weekly.
- Artificial Surface Water (ASW) sites – 47 sites sampled either weekly or monthly.

The NSW monitoring network includes sites along the McArthur River, Barney Creek, Surprise Creek, Emu Creek, Bull Creek and the Glyde River. Upstream control sites and downstream impact sites are located along all local creeks and rivers except for Bull Creek and Glyde River, which are considered removed from potential mine impacts. Monitoring sites are also located along diverted sections of Barney Creek and the McArthur River.

ASW sites are located at major Mine infrastructure locations, and have been classified into common domains. The domains are Tailings Storage Facility (TSF) Open Pit (OP), Northern Overburden Emplacement Facility (NOEF) and Concentrator (Mill). Sites consist of ponds, dams and/or sediment traps.

The current monitoring network includes 247 bores covering the mining, mining waste management and background areas across site. MRM currently has no SSTVs for groundwater

and the focus of the groundwater monitoring and management is to protect the quality of the receiving surface water receptors.

4 GENERAL WATER QUALITY OBSERVATIONS

The overwhelming majority of monitoring records indicate the water quality at SW11 remains within compliance limits as defined by MRM's Waste Discharge Licence (WDL), particularly for the latest reporting period. Extending the assessment to previous periods, MRM has implemented water management plans that have allowed the Mine to remain within general compliance at SW11; in instances where potential water impacts have been noted at the downstream site or where exceedances of the SSTV's or WDL have been detected, MRM have notified the Northern Territory (NT DENR as required under the water discharge license WDL174-10) and assessed reasons for these occurrences.

It is noteworthy that to date groundwater and surface water monitoring locations report neutral pH to slightly alkaline pH across the Mine and downstream.

With the prevalence of sulphide minerals, sulphate is parameter of concern. Recent monitoring results (in the last monitoring period particularly) have shown that despite this, the surface water monitoring records show no sulphate exceedances at SW11 or downstream. In broad terms, MRM's water management over the latest reporting period has been implemented in a manner that reduces exceedances at SW11, with discharge volumes managed such that acceptable sulphate concentrations downstream of the operations have been maintained. Historically sulphate has some exceedances during the dry season when stream flow is low, however, the overall trend for sulphate over recent monitoring shows an improvement in performance with no sulphate exceedances in the most recent April 2017 to April 2018 monitoring period.

Filtered metal concentrations are consistently reported at low values on site (consistent with the neutral pH); monitoring stations located at relatively short distances from possible high-metal sources (e.g., the TSF and the NOEF) also report consistently low filtered metal concentrations and indicate the potential for strong attenuation away from such sources.

In line with the above observations, the Mine's water and waste management has allowed MRM to generally stay within compliance and material impacts from mining activities on measured water quality downstream of MRM appear to be limited. Recent data indicates that where exceedances of the SSTVs occur, these are minor and are not of significant concern. Exceedances occur seasonally for dissolved aluminium and iron, corresponding to periods of high background concentrations from surface water flows upstream of MRM. Where pH does not meet the SSTV values, the exceedances are because the surface water pH is marginally too alkaline rather than acidic, while variable dissolved oxygen values are measured during the high flow periods.

For groundwater, the data similarly indicates that the operations are within compliance. The Djirrimini waterhole is the most important Environmental Value for groundwater on site. During the reporting period, the water quality in the series of bores around this water hole was stable and consistent with historical values, indicating that no measurable water quality impact has occurred in the area around this waterhole. While the Phase 3 EIS and MRM's groundwater management plan anticipate that there will be a small decrease in water levels around the water

hole due to open pit dewatering activities, the current monitoring record indicates that groundwater levels to date have been stable and that during the reporting period the groundwater levels around the waterhole respond to climatic factors in a manner consistent with the historic record.

A degree of deterioration of groundwater quality around the Mine waste facilities is an expected outcome, based on the Phase 3 EIS for MRM, and on similar facilities in Australia and internationally. The groundwater monitoring network at MRM is extensive and the approach followed is adequate to identify any adverse and unexpected trends in groundwater quality.

For the most recent monitoring period (April 2017 to April 2018), the site shows an improvement in performance across all monitored surface water parameters, and the results indicate a strong commitment by MRM to maintain water quality to meet compliance even during, and subsequent to, periods of extreme rainfall such as experienced by the site in January 2018.

4.1 Water Management Overview in Reporting Period

MRM's water management over the reporting period has been implemented in a manner that reduces exceedances at SW11, with discharge volumes limited to result in acceptable sulphate concentrations downstream. Over the reporting period, the volume of discharge has been greater than reported in previous years. This has allowed MRM to manage surface water volumes on site while maintaining water quality at SW11 within compliance limits.

In January 2018, MRM experienced a week of extreme rainfall (the highest reported 7-day total on record). It is significant that during this event no Mine-derived water quality exceedances were recorded at SW11. This indicates that the water management was acceptable and discharges were adequately maintained and controlled.

4.2 Summary

The overarching summary from the monitoring assessment includes:

- The overwhelming majority of monitoring records indicate the water quality at SW11 remains within compliance limits as defined by MRM's Waste Discharge Licence.
- A key element of MRM's management strategy is to maintain non-acid forming conditions, and groundwater and surface water monitoring shows neutral to slightly alkaline pH across the Mine and downstream.
- No exceedances for the key metals of concern (zinc, lead, cadmium, arsenic) have been experienced at SW11 over the period 2008 to 2018. Historically sulphate concentrations occasionally exceeded the SSTVs, but in recent years the records have shown an improvement in performance, with no exceedances in the most recent April 2017 to April 2018 monitoring period.
- The groundwater monitoring network is extensive and the approach followed is adequate to identify adverse and unexpected trends in groundwater quality. The Djirrimini waterhole is the most important Environmental Value for groundwater on site. Groundwater levels around the waterhole respond to climatic influences and to date dewatering impacts have not impacted on the long-term groundwater trends around the waterhole. The water quality in the series of bores around this water hole is stable and

consistent with historical values, indicating that no measurable water quality impact has occurred in the area around this waterhole.

5 CLOSURE

We trust this letter report, together with KCB's reports on the groundwater and surface water meet your current requirements.

This report is an instrument of service of Klohn Crippen Berger Ltd. The report has been prepared for the exclusive use of McArthur River Mine (Client) for the specific application to the 2017/18 Water Monitoring assessment (although earlier assessments undertaken by KCB have been considered). The report's contents may not be relied upon by any other party without the express written permission of Klohn Crippen Berger. In this report, Klohn Crippen Berger has endeavoured to comply with generally-accepted professional practice common to the local area. Klohn Crippen Berger makes no warranty, express or implied.

If you have any questions or would like to discuss this submission, please contact Brent Usher at busher@klohn.com or by phone on 07 3004 0244.

Yours truly,

KLOHN CRIPPEN BERGER LTD.

Brent Usher, PhD, PrSciNat
Senior Hydrogeochemist, Manager Geosciences & Associate

BU:BU

Date: 6 June 2018
To: Ryan Pascoe
McArthur River Mining
Manager – Environment, Safety & People
From: Paul Barden

Subject: Request for Comment on Downstream Impacts – MRM Freshwater Macroinvertebrate Program

This memorandum has been prepared in response to a request for comment on historical monitoring and performance relevant to maintaining environmental values downstream of the MRM mineral leases (i.e. downstream impacts in the McArthur River). Ecological Management Services (P. Barden) commenced aquatic macroinvertebrate monitoring at the McArthur River mine in 2002 and has undertaken an annual macroinvertebrate monitoring program at in excess of 30 sites within the MRM leases and reference sites, commencing in 2008.

Statistical analysis of freshwater edge habitat macroinvertebrate diversity and composition at reference sites located on the McArthur River upstream of the MRM mine operations and sites on the main McArthur River channel below mining operations (commencing from approximately 2.5 km below the Barney Creek-McArthur River confluence) indicate that there were no statistically significant differences (p >0.05) for these site treatments for the 2017 sampling period (p = 0.785, p (mc) = 0.69) (Table 1). This indicates that for edge habitat macroinvertebrate assemblages in the McArthur River, there is no detectible impact of mining operations on macroinvertebrate taxa diversity/assemblage composition at sites commencing 2.5 km below the MRM mining operations. There have been no significant declines or changes in freshwater macroinvertebrate populations as a result of MRM mining and processing operations detected at downstream reference sites during monitoring conducted between 2008 and 2017.

Regards

Paul Barden, MSc Environmental Management
Director, Ecological Management Services Pty Ltd
7 June 2018

Table 1. PERMANOVA (Permutational MANOVA) Pairwise Tests Comparing Sites on the McArthur River Upstream and Downstream of MRM Operations, 2017 Aquatic Macroinvertebrate Edge Habitat

Groups	T statistic	P	perms	P(MC)
Reference Upstream, Reference Downstream	0.78512	0.9868	70	0.667

Aquatic macroinvertebrate edge habitat taxa data generated in Primer 6/PERMANOVA+, PRIMER-e, Plymouth Marine Laboratories.

Resemblance: S17 Bray-Curtis similarity

Sums of squares type: Type III (partial)

Fixed effects sum to zero for mixed terms

Permutation method: Unrestricted permutation of raw data

Number of permutations: 9999

Indo-Pacific Environmental Pty Ltd
PO Box 191
Duncraig East, Western Australia, 6023

13th June 2018

Ryan Pascoe
Manager – Environment, Safety and People
McArthur River Mine
PO Box 36821
Winnellie, Northern Territory, 0821

Dear Ryan

Aquatic Fauna Monitoring and Environmental Performance

In an email dated 7th of June 2018, McArthur River Mining (MRM) requested a summary of the historical monitoring of aquatic fauna and performance relevant to maintaining the environmental values downstream and upstream of the mineral lease. Indo-Pacific Environmental specialises in studies of aquatic fauna and ecosystem assessment. Personally I have worked on aquatic fauna throughout northern Australia for close to two decades and have conducted aquatic fauna surveys in most of the major rivers from the Queensland Border to the Fitzroy River, Western Australia. I first surveyed the McArthur River and adjacent catchments in 2001 as the lead scientist in a Commonwealth Scientific and Industrial Research Organisation (CSIRO) funded project investigating euryhaline elasmobranchs and information from that study (and several others after) have been used to inform both State and Federal Government management documents relating to the status of *Pristis* species. Post-graduate and professional studies of habitat utilisation of native fishes has provided me with a sound understanding of assessing fauna habitat requirements which are subsequently used as a basis for rehabilitation strategies in modified and degraded waterways. My PhD focused on euryhaline elasmobranchs, including that of the EPBC listed *Pristis pristis* (Largetooth Sawfish), and I remain one of the most published authors on the subject in Australia with continued contribution in research in advisory roles. My PhD thesis also investigated energy flows and trophic interactions in a monsoonal riverine habitat of north Western Australia which included dietary and stable isotope investigations of all fish species present. This provided a solid understanding of species interactions including metal uptake and bioaccumulation through aquatic food chains which is particularly relevant to studies currently managed for MRM. Based on this experience, and that of other Indo-Pacific Environmental staff, we have managed a number of aquatic fauna monitoring programs for MRM since 2006. This includes a biannual

survey of species diversity and abundance (2006-present), investigation of metals in aquatic fauna tissues and food safety (2009-present), and monitoring movement of migratory species including *P. pristis* (2006-present).

Monitoring Aquatic Fauna Abundance and Diversity

The abundance and diversity of fish and other aquatic vertebrates in permanent and semi-permanent pools of the McArthur River, Surprise Creek and Barney Creek have been monitored biannually (early and late dry season) since 2006. Currently, monitoring is undertaken at 32 sites, located as far upstream as Top Crossing (~50 km upstream of the mineral lease), and as far downstream as the town of Borroloola. Survey techniques include fyke nets, seine nets, gill nets, electrofishing transects, line fishing and visual surveys. Figures 1 and 2 provide a visual comparison of diversity and abundance of various aquatic faunas in each year since 2011. Aquatic fauna monitoring shows that overall diversity and abundance of fish and crustaceans is statistically similar between sites directly below and above the mineral lease in most years, indicating MRM operations have had no measurable impact on aquatic fauna communities. Furthermore, there has been no observable decline in species diversity in waters upstream and downstream of the mineral lease, outside of that which would be considered to be natural variation or as a result of variable seasonal flows or changes in river bed morphology.

The movements of *L. calcarifer* (Barramundi) and *P. pristis* within the McArthur River, and through the mineral lease, are monitored using a variety of tagging techniques and by observing the presence of these migratory species in waters upstream of MRM. Juvenile *P. pristis* up to 2800 mm are regularly captured downstream, within and upstream of the mineral lease, indicating the McArthur River continues to provide an environment which is conducive to the growth and survival of this *EPBC Act* listed species. In relation to *L. calcarifer*, conventional tagging recaptures from the public and acoustic movement data shows the species to regularly move through the mineral lease.

Monitoring Metals in Aquatic Fauna

Aquatic fauna tissue sampling and analysis has occurred since 2006 to identify whether metals associated with MRM activities have entered the aquatic food chain. More recently, emphasis has been placed on the analysis of species which are considered to be commonly consumed in order to determine whether a risk to human health existed. Species were identified as being regularly caught and consumed throughout the freshwater sections of the McArthur River and neighboring catchments through community consultations (Indo Pacific Environmental 2016a). As a result, monitoring includes the collection and analysis of tissues from *L. calcarifer*, *Hephaestus fuliginosus* (Sooty Grunter), *Toxotes chatareus* (Archer Fish), *Macrobrachium spinipes* (Cherabin) and *Velesunio angasi* (Freshwater Mussel).

Data collected to date demonstrates that the concentrations of metals within *L. calcarifer*, *H. fuliginosus*, *T. chatareus* and *M. spinipes* caught throughout the McArthur River catchment, including those collected from sites within the mineral lease, do not represent a risk to human health. From this standpoint these species are considered safe for human consumption. The concentrations of lead in finfish and crustaceans have been found to be well below the applicable Maximum Permissible Concentration (MPC) of 0.5 mg/kg and vastly larger consumption amounts than the current FSANZ Australia wide recommendation of 2-3 servings of fish per week could be safely ingested. Furthermore, the vast majority of consumption amounts calculated using the FSANZ methodology and presented throughout Indo-Pacific Environmental reports from 2014 to 2018 are considered unrealistic for even the most eager

fisher to regularly catch and physically consume. Tables 1 to 8 and Figures 3 to 6 provide an indication of mean tissues concentrations by species and amounts of each which are considered safe for consumption per day. Data to date indicates there is an extremely low risk to human health from consuming the monitored fish species caught in the McArthur River catchment downstream or upstream of the mineral lease.

Monitoring has shown that *V. angasi* consistently have greater concentrations of all analytes in comparison to the other commonly consumed species sampled (Table 7). Several *V. angasi* samples have exceeded the MPC of 2.0 mg/kg for lead, however all of these samples were collected from locations within the mineral lease which are inaccessible to the public (Figure 6). Considering this species is present in very low densities at these sites and that current literature indicates that individual *V. angasi* do not generally move more than ~50 m throughout their life, it is unlikely that *V. angasi* on the mineral lease would be consumed. The fact that very high concentrations of numerous analytes including aluminium, manganese, iron and total arsenic have been consistently recorded in *V. angasi* collected from several river catchments throughout the region and numerous sites away from the mineral lease indicates that intake of *V. angasi* should be limited irrespective of their site of collection.

Further Information

If you require additional information please email or phone me on (08) 9444 1422 or 0439 694262 to discuss.

Yours sincerely,

Indo-Pacific Environmental Pty Ltd

Dean Thorburn

Director / Principal Scientist

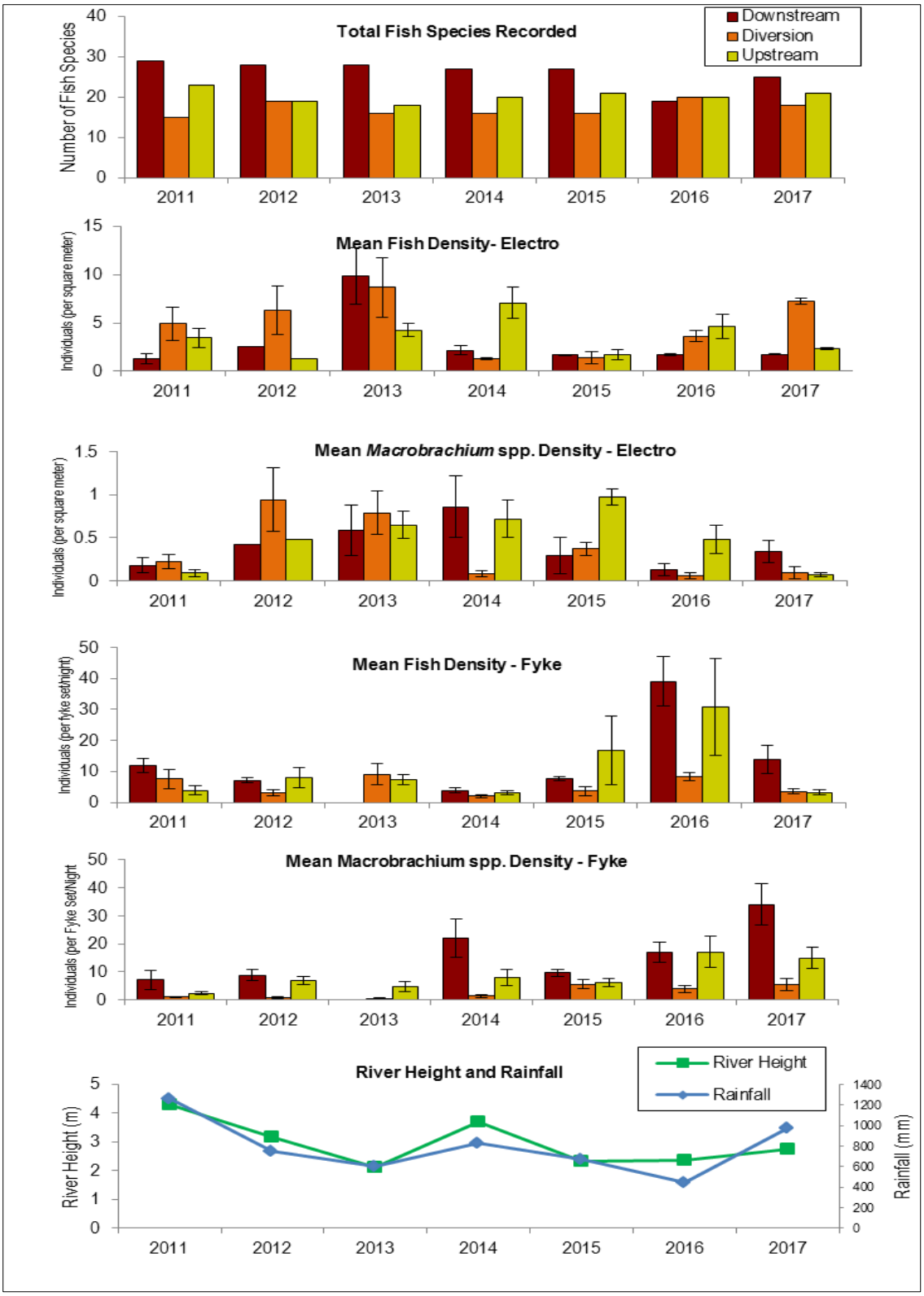
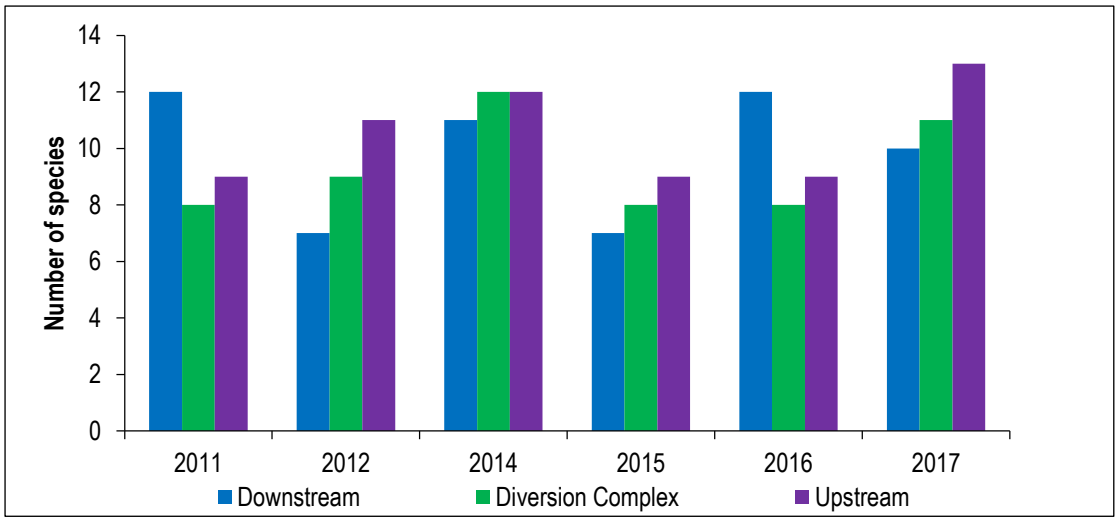
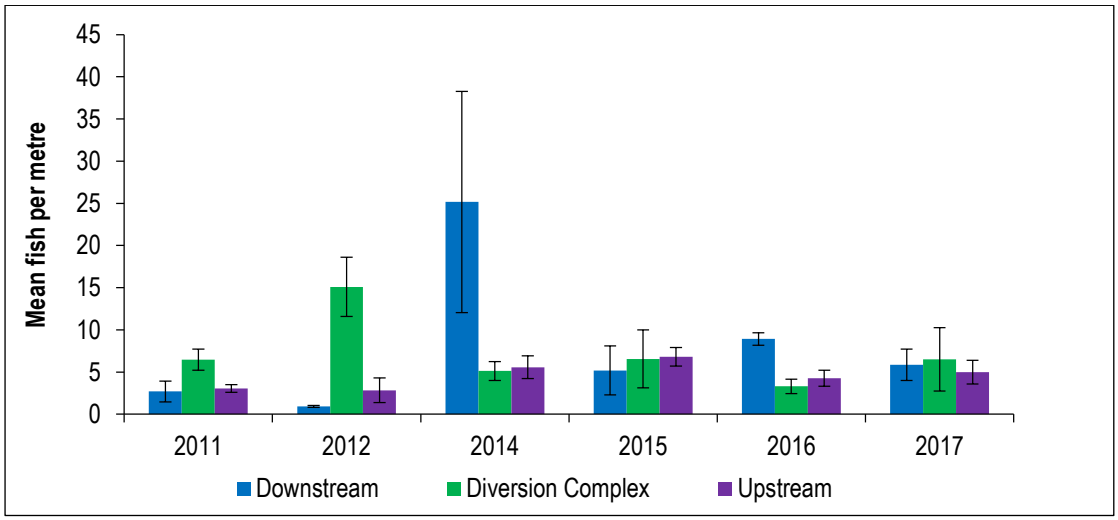


Figure 1. Total number of fish species, mean (± SE) number of fish and *Macrobrachium* spp. captured per metre whilst electrofishing and per fyke net site per 24 hours at sites downstream, within and upstream the diversion during the early dry of 2011 to 2017. River stage height alongside total wet season (December to March) rainfall is also indicated.





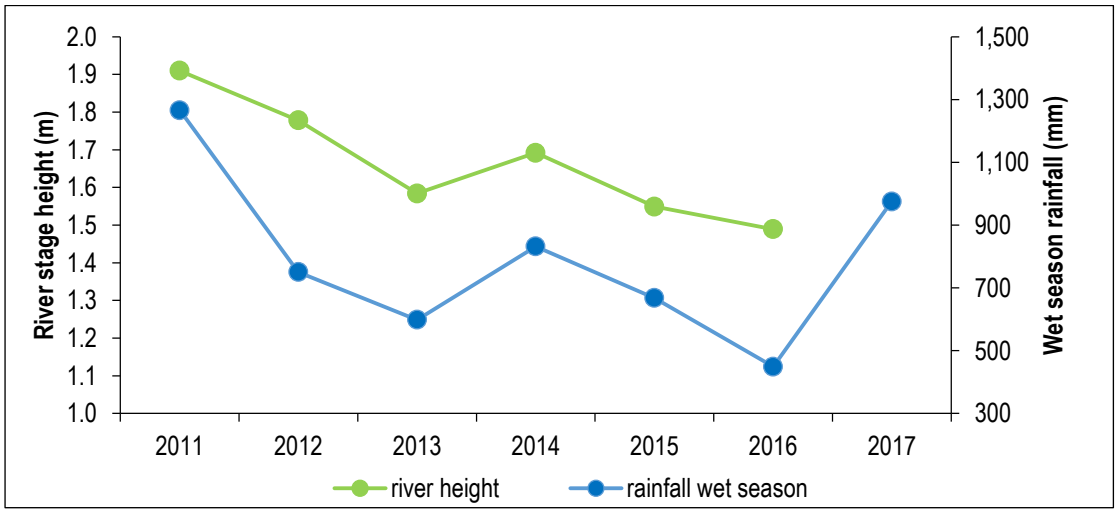


Figure 2. Total number of fish species, mean (± SE) density per metre captured whilst electrofishing at sites directly downstream, within and upstream of the mineral lease during the late dry of 2011 to 2017; river stage height alongside previous total wet season rainfall (December to March).

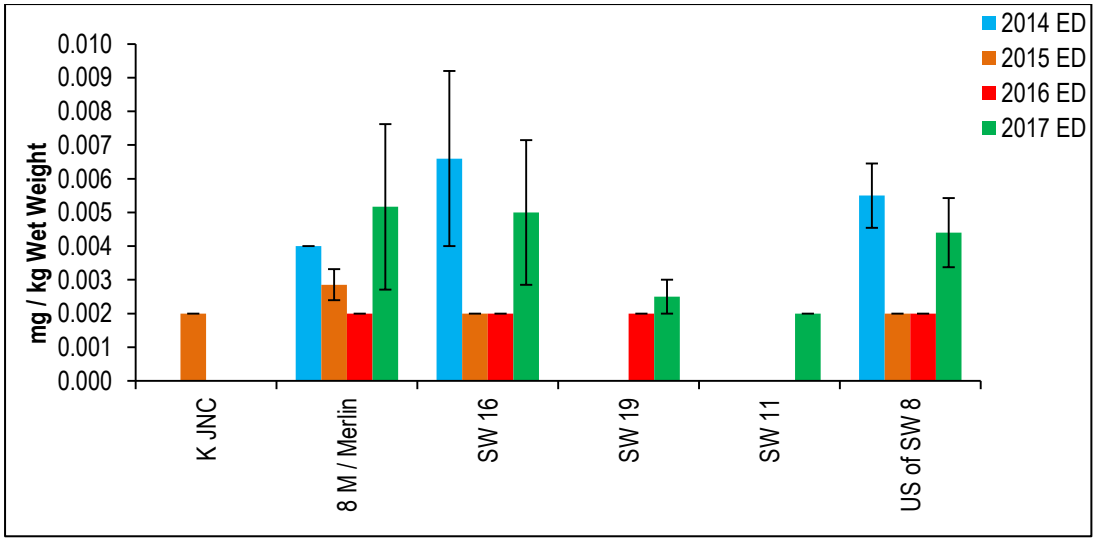


Figure 3. Comparison of mean lead concentrations (mg/kg wet weight) in muscle tissue of *Lates calcarifer* collected throughout the survey area during early dry season sampling between 2014 and 2017.

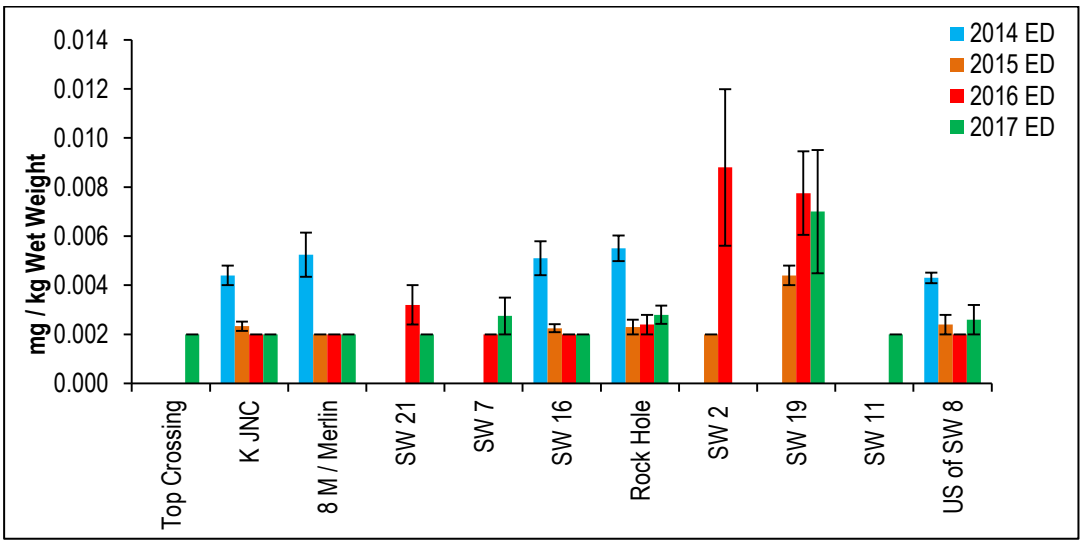


Figure 4. Comparison of mean lead concentrations (mg/kg wet weight) in muscle tissue of *Hephaestus fuliginosus* collected throughout the survey area during early dry season sampling between 2014 and 2017.

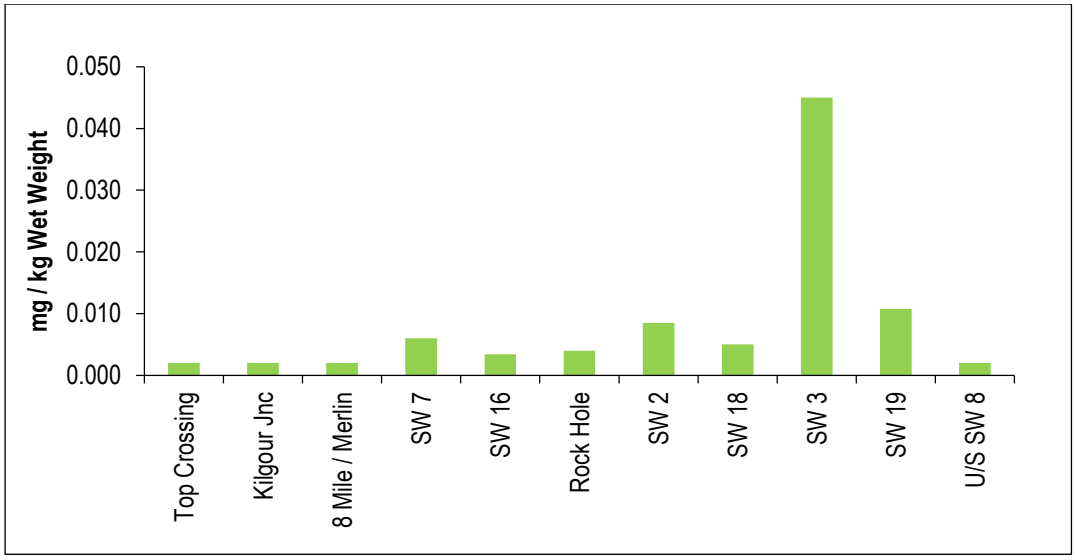


Figure 5. Comparison of mean lead concentrations (mg/kg wet weight) in muscle tissue of *Toxotes chatareus* collected throughout the survey area during early dry season sampling in 2017.

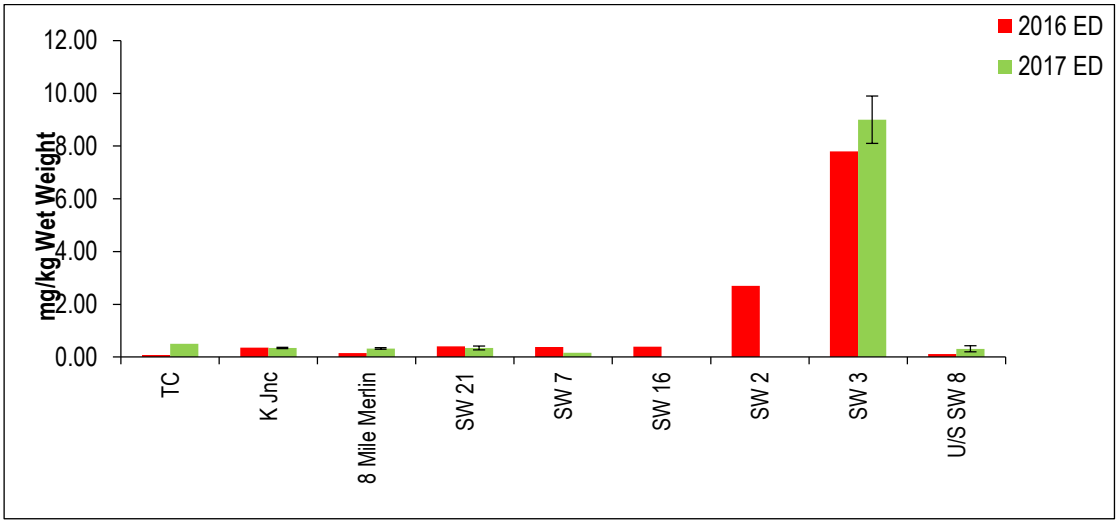


Figure 6. Comparison of mean lead concentrations (mg/kg wet weight) in muscle tissue of *Velesunio angasi* collected throughout the survey area during early dry season sampling in 2016 and 2017.

Table 1. Mean (±SE) metal and metalloid concentrations (mg/kg) found in *Lates calcarifer* muscle from the McArthur River catchment in the early dry season 2017.

Location	n	Al		Mn		Fe		Cu		Zn		As		Se		Cd		Hg		Pb	
Reporting Limit		<0.5		<0.04		<0.2		<0.03		<0.2		<0.005		<0.01		<0.001		<0.002		<0.002	
MPC												2								0.5	
		Mean	±SE	Mean	±SE	Mean	±SE	Mean	±SE	Mean	±SE	Mean	±SE	Mean	±SE	Mean	±SE	Mean	±SE	Mean	±SE
8 Mile / Merlin	6	0.9	0.22	0.16	0.04	2.6	0.30	0.13	0.01	2.9	0.09	0.014	0.00	0.44	0.04	0.001	0.00	0.375	0.06	0.005	0.00
SW 16	5	0.5	0.00	0.17	0.02	1.6	0.28	0.13	0.00	3.0	0.20	0.027	0.02	0.39	0.03	0.001	0.00	0.170	0.06	0.005	0.00
SW 19	2	0.5	0.00	0.08	0.01	0.9	0.10	0.14	0.00	3.2	0.10	0.047	0.03	0.41	0.03	0.001	0.00	0.098	0.00	0.003	0.00
SW 11	2	0.5	0.00	0.13	0.02	1.2	0.50	0.18	0.05	3.3	0.60	0.031	0.02	0.37	0.08	0.001	0.00	0.068	0.03	0.002	0.00
U/S SW 8	5	1.2	0.66	0.13	0.01	1.4	0.21	0.13	0.01	2.9	0.12	0.021	0.00	0.43	0.02	0.001	0.00	0.292	0.08	0.004	0.00
SW 8	4	0.5	0.00	0.11	0.01	1.8	0.10	0.13	0.01	3.2	0.09	0.375	0.12	0.51	0.07	0.001	0.00	0.333	0.09	0.005	0.00

Table 2. Calculated maximum daily consumption (grams) for *Lates calcarifer* muscle collected in early dry season sampling 2017.

Location	Lead		Zinc		Copper	
	Adult	*Child*	*Adult*	*Child*	*Adult*	*Child*
8 Mile / Merlin	15836	12312	22313	8898	288600	128758
SW 16	15836	12312	21817	8700	276396	123313
SW 19	26393	20520	20453	8156	264550	118029
SW 11	39590	30780	19833	7909	211640	94423
U/S SW 8	19795	15390	22262	8878	284900	127108
SW 8	15836	12312	20295	8093	279525	124709

These amounts are based on the mean metal concentrations attained from corresponding sites and relate to a 74kg adult and and 36kg child. Calculations assume dietary background intake levels as provided by the 23rd ATDS ND=LOR. Health Based Guidance Values used in calculations are those provided in 23rd ATDS (FSANZ 2011). The recommended meal portion size by FSANZ is 150 grams for an adult and 75 grams for a child.

Table 3. Mean (±SE) metal and metalloid concentrations (mg/kg) found in *Hephaestus fuliginosus* muscle from the McArthur River catchment in the early dry season 2017.

Location	n	Al		Mn		Fe		Cu		Zn		As		Se		Cd		Hg		Pb	
Reporting Limit		<0.5		<0.04		<0.2		<0.03		<0.2		<0.005		<0.01		<0.001		<0.002		<0.002	
MPC												2								0.5	
		Mean	±SE	Mean	±SE	Mean	±SE	Mean	±SE	Mean	±SE	Mean	±SE	Mean	±SE	Mean	±SE	Mean	±SE	Mean	±SE
Top Crossing	3	0.5	0.00	0.20	0.01	1.6	0.06	0.15	0.01	4.7	0.31	0.013	0.00	0.58	0.09	0.001	0.00	0.058	0.01	0.002	0.00
Kilgour Jnc	5	0.8	0.20	0.21	0.03	2.4	0.42	0.13	0.01	3.8	0.27	0.009	0.00	0.52	0.02	0.001	0.00	0.095	0.00	0.002	0.00
8 Mile / Merlin	4	0.5	0.00	0.21	0.02	2.0	0.30	0.17	0.01	5.4	0.62	0.016	0.00	0.57	0.04	0.001	0.00	0.197	0.06	0.002	0.00
SW 21	5	0.5	0.00	0.31	0.08	1.8	0.28	0.14	0.01	5.2	0.60	0.012	0.00	0.51	0.03	0.001	0.00	0.071	0.01	0.002	0.00
SW 7	4	0.5	0.00	0.24	0.06	1.4	0.08	0.11	0.01	3.7	0.21	0.008	0.00	0.53	0.06	0.001	0.00	0.144	0.05	0.003	0.00
SW 16	5	0.5	0.00	0.23	0.03	1.4	0.18	0.14	0.01	3.7	0.17	0.008	0.00	0.62	0.05	0.001	0.00	0.102	0.02	0.002	0.00
Rock Hole	5	0.5	0.00	0.20	0.02	1.5	0.27	0.13	0.03	5.6	0.43	0.016	0.00	0.39	0.04	0.001	0.00	0.099	0.01	0.003	0.00
SW 19	3	0.5	0.00	0.27	0.03	1.5	0.30	0.15	0.01	5.2	0.53	0.014	0.00	0.47	0.04	0.001	0.00	0.107	0.02	0.007	0.00
SW 11	5	0.5	0.00	0.23	0.02	2.2	0.43	0.21	0.06	4.8	0.89	0.016	0.00	0.53	0.04	0.001	0.00	0.065	0.01	0.002	0.00
U/S SW 8	5	0.5	0.00	0.21	0.01	1.3	0.14	0.15	0.03	4.9	0.38	0.029	0.00	0.43	0.03	0.001	0.00	0.069	0.00	0.003	0.00

Table 4. Calculated maximum daily consumption (grams) for *Hephaestus fuliginosus* muscle collected in early dry season sampling 2017.

Location	Lead		Zinc		Copper	
	Adult	*Child*	*Adult*	*Child*	*Adult*	*Child*
McArthur catchment						
Top Crossing	39590	30780	13926	5553	241546	107765
Kilgour Jnc	39590	30780	17134	6832	289352	129094
8 Mile / Merlin	39590	30780	12065	4811	217865	97200
SW 21	39590	30780	12635	5039	260824	116366
SW 7	28793	22385	17932	7151	336700	150218
SW 16	39590	30780	17785	7092	264550	118029
Rock Hole	28279	21986	11729	4677	276396	123313
SW 19	11311	8794	12587	5019	241546	107765
SW 11	39590	30780	13579	5415	173070	77215
U/S SW 8	30454	23677	13467	5370	243664	108711

These amounts are based on the mean metal concentrations attained from corresponding sites and relate to a 74kg adult and and 36kg child. Calculations assume dietary background intake levels as provided by the 23rd ATDS ND=LOR. Health Based Guidance Values used in calculations are those provided in 23rd ATDS (FSANZ 2011). The recommended meal portion size by FSANZ is 150 grams for an adult and 75 grams for a child.

Table 5. Mean (±SE) metal and metalloid concentrations (mg/kg) found in *Toxotes chatareus* muscle from the McArthur River catchments in the early dry season 2017.

Location	**n**	**Al**		**Mn**		**Fe**		**Cu**		**Zn**		**As**		**Se**		**Cd**		**Hg**		**Pb**	
Reporting Limit		<0.5		<0.04		<0.2		<0.03		<0.2		<0.005		<0.01		<0.001		<0.002		<0.002	
MPC												2								0.5	
		Mean	±SE	Mean	±SE	Mean	±SE	Mean	±SE	Mean	±SE	Mean	±SE	Mean	±SE	Mean	±SE	Mean	±SE	Mean	±SE
Top Crossing	1	0.5		0.12		1.3		0.11		3.8		0.005		0.91		0.001		0.110		0.002	
Kilgour Jnc	1	0.5		0.27		1.8		0.18		4.3		0.007		0.57		0.001		0.056		0.002	
8 Mile / Merlin	2	0.5	0.00	0.11	0.01	1.4	0.25	0.23	0.03	5.1	0.50	0.011	0.00	0.47	0.04	0.001	0.00	0.068	0.02	0.002	0.00
SW 7	2	0.5	0.00	0.13	0.02	2.6	1.50	0.23	0.08	4.8	0.75	0.006	0.00	0.55		0.001	0.00	0.065		0.006	0.00
SW 16	5	0.5	0.00	0.20	0.02	2.5	0.31	0.29	0.02	4.8	0.37	0.008	0.00	0.33	0.01	0.001	0.00	0.056	0.01	0.003	0.00
Rock Hole	4	0.5	0.00	0.18	0.02	3.1	0.39	0.40	0.05	5.0	0.35	0.011	0.00	0.30	0.01	0.002	0.00	0.094	0.01	0.004	0.00
SW 2	2	0.5	0.00	0.39	0.03	2.6	0.10	0.35	0.03	5.5	0.20	0.011	0.00	0.37	0.06	0.002	0.00	0.080	0.01	0.009	0.00
SW 3	2	0.5	0.00	0.42	0.09	4.4	0.20	0.50	0.01	8.3	0.45	0.031	0.00	0.45	0.02	0.006	0.00			0.045	0.01
SW 18	1	0.5		0.17		3.0		0.36		7.0		0.011		0.49		0.002		0.061		0.005	
SW 19	5	0.5	0.00	0.17	0.04	2.8	0.13	0.40	0.03	6.2	0.18	0.012	0.00	0.39	0.01	0.003	0.00	0.052	0.01	0.011	0.00
U/S SW 8	3	0.5	0.00	0.21	0.05	2.9	1.17	0.41	0.12	5.7	0.52	0.077	0.05	0.45	0.06	0.001	0.00	0.090	0.02	0.002	0.00

Table 6. Calculated maximum daily consumption (grams) for *Toxotes chatareus* muscle collected in early dry season sampling 2017.

Location	Lead		Zinc		Copper	
	Adult	*Child*	*Adult*	*Child*	*Adult*	*Child*
Top Crossing	39590	30780	17224	6868	336700	150218
Kilgour Jnc	39590	30780	15221	6070	205761	91800
8 Mile / Merlin	39590	30780	12833	5118	161030	71843
SW 7	13197	10260	13779	5495	164609	73440
SW 16	23288	18106	13692	5460	127714	56979
Rock Hole	19795	15390	13025	5194	92017	41053
SW 2	9315	7242	11900	4745	105820	47211
SW 18	15836	12312	9350	3729	102881	45900
SW 3	1760	1368	7933	3164	74074	33048
SW 19	7331	5700	10556	4210	93528	41727
U/S SW 8	39590	30780	11550	4606	89606	39977

These amounts are based on the mean metal concentrations attained from corresponding sites and relate to a 74kg adult and and 36kg child. Calculations assume dietary background intake levels as provided by the 23rd ATDS ND=LOR. Health Based Guidance Values used in calculations are those provided in 23rd ATDS (FSANZ 2011). The recommended meal portion size by FSANZ is 150 grams for an adult and 75 grams for a child.

Table 7. Mean (±SE) metal and metalloid concentrations (mg/kg) found in *Velesunio angasi* collected from the Limmen River, McArthur River, Glyde River and Robinson River catchments in the early dry season 2017. Shading indicates a value over the maximum permitted concentration outlined by FSANZ (2017).

Location	n	Al		Mn		Fe		Cu		Zn		As		Se		Cd		Hg		Pb	
Reporting Limit		<0.5		<0.04		<0.2		<0.03		<0.2		<0.005		<0.01		<0.001		<0.002		<0.002	
MPC												1				2				2	
		Mean	±SE	Mean	±SE	Mean	±SE	Mean	±SE	Mean	±SE	Mean	±SE	Mean	±SE	Mean	±SE	Mean	±SE	Mean	±SE
Limmen catchment																					
Upstream	2	42	16	970	30	1700	200	1.50	0.30	28	4.0	0.735	0.13	0.23	0.01	0.047	0.03	0.108	0.09	0.205	0.02
Downstream	5	40	24	1340	103	1550	302	1.25	0.11	36	3.3	0.868	0.08	0.22	0.01	0.019	0.00	0.021	0.00	0.376	0.07
McArthur catchment																					
Top Crossing	1	110		1600		1800		2.00		84		1.400		0.26		0.110		0.054		0.500	
Kilgour Jnc	3	87	18	737	113	783	52	2.47	0.67	34	4.0	1.300	0.12	0.31	0.03	0.169	0.08	0.026	0.01	0.343	0.02
8 Mile / Merlin	5	61	11	566	82	794	91	1.78	0.23	25	1.0	0.792	0.02	0.24	0.01	0.043	0.01	0.025	0.00	0.324	0.03
SW 21	3	30	11	507	87	593	59	1.27	0.27	31	4.4	0.970	0.12	0.29	0.03	0.037	0.01	0.022	0.00	0.343	0.07
SW 16	1	14		140		150		0.59		20		0.960		0.36		0.045		0.005		0.160	
SW 3	2	122	38	930	70	345	25	2.15	0.15	92	18.5	0.900	0.10	0.22	0.02	0.112	0.03	0.009	0.00	9.000	0.90
SW 20	2	200	171	660	260	1570	730	1.27	0.54	205	45	1.335	0.47	0.35	0.03	0.375	0.23	0.080	0.04	10.900	6.10
U/S SW 8	5	16	2	678	191	1238	368	0.98	0.12	30	3.3	1.020	0.04	0.20	0.01	0.040	0.01	0.020	0.00	0.312	0.11
Glyde catchment																					
Upper Glyde	5	8	3	740	123	1248	201	0.55	0.08	34	2.0	0.514	0.04	0.14	0.01	0.013	0.00	0.035	0.00	0.096	0.01
Lower Glyde	4	12	3	470	68	1360	352	1.40	0.04	20	1.1	0.708	0.04	0.15	0.00	0.025	0.01	0.024	0.00	0.195	0.03
Robinson catchment																					
Upstream	5	93	44	1104	204	1346	268	1.14	0.16	36	4.7	1.212	0.25	0.20	0.01	0.031	0.01	0.034	0.00	0.206	0.04
Downstream	5	43	15	1052	242	1526	345	1.34	0.11	33	1.3	0.818	0.03	0.25	0.01	0.036	0.01	0.027	0.00	0.285	0.16

Table 8. Calculated maximum daily consumption (grams) for in *Velesunio angasi* collected in early dry season sampling 2017.

Location	Lead		Zinc		Copper	
	Adult	*Child*	*Adult*	*Child*	*Adult*	*Child*
Limmen catchment						
Upstream	386	300	2338	932	24691	11016
Downstream	211	164	1838	733	29582	13198
McArthur catchment						
Top Crossing	158	123	779	311	18519	8262
Kilgour Jnc	231	179	1925	768	15015	6699
8 Mile / Merlin	244	190	2618	1044	20807	9283
SW 21	231	179	2089	833	29240	13045
SW 16	495	385	3273	1305	62775	28007
SW 3	9	7	715	285	17227	7686
SW 20	7	6	319	127	29278	13062
U/S SW 8	254	197	2182	870	37870	16896
Glyde catchment						
Upper Glyde	821	639	1936	772	67586	30153
Lower Glyde	406	316	3272	1305	26455	11803
Robinson catchment						
Upstream	384	299	1798	717	32489	14495
Downstream	278	216	2008	801	27640	12331

These amounts are based on the mean metal concentrations attained from corresponding sites and relate to a 74kg adult and and 36kg child. Calculations assume dietary background intake levels as provided by the 23rd ATDS ND=LOR. Health Based Guidance Values used in calculations are those provided in 23rd ATDS (FSANZ 2011). The recommended meal portion size by FSANZ is 150 grams for an adult and 75 grams for a child.

REFERENCES

FSANZ (2011). *The 23rd Australian Total Diet Study*. Food Standards Australia New Zealand, Canberra.

Indo-Pacific Environmental (2014). *Monitoring of Metals and Lead Isotope Ratios in Fish, Crustaceans and Molluscs of the McArthur River, 2014*. Report to McArthur River Mining. Indo-Pacific Environmental, Perth.

Indo-Pacific Environmental (2015). *Monitoring of Metals and Lead Isotope Ratios in Fish, Crustaceans and Molluscs of the McArthur River, 2015*. Report to McArthur River Mining. Indo-Pacific Environmental, Perth.

Indo-Pacific Environmental (2016a). Fish Consumption Survey and Community Engagement Plan 2016. Report to McArthur River Mining. Indo-Pacific Environmental, Perth

Indo-Pacific Environmental (2016b). *Interim Report on the Monitoring of Metals and Lead Isotope Ratios in Fish, Crustaceans and Molluscs of the McArthur River, 2016*. Report to McArthur River Mining. Indo-Pacific Environmental, Perth.

Indo-Pacific Environmental (2017). *Report on the Monitoring of Metals and Lead Isotope Ratios in Fish, Crustaceans and Molluscs of the Limmen, McArthur and Robinson Rivers - Late Dry Season 2016*. Report to McArthur River Mining. Indo-Pacific Environmental, Perth.

Indo-Pacific Environmental (2018). *Monitoring of Metals and Lead Isotope Ratios in Fish, Crustaceans and Molluscs of the McArthur River, 2017*. Report to McArthur River Mining. Indo-Pacific Environmental, Perth.

TODOROSKI AIR SCIENCES
Suite 2B, 14 Glen Street Eastwood, NSW 2122
Phone: 02 9874 2123
Fax: 02 9874 2125
Email: info@airsciences.com.au
Web: www.airsciences.com.au
ACN: 151 202 765 | ABN: 74 955 076 914

19 June 2018

Ryan Pascoe

Manager – Environment, Safety & People

McArthur River Mine

Via email: Ryan.Pascoe@glencore.com.au

RE: McArthur River Mine SO_2 monitoring and performance summary

Dear Ryan,

I have prepared this performance summary of the SO_2 monitoring for the McArthur River Mine (MRM).

Overview

Aleks has qualifications in mechanical engineering and over 25 years of experience in air quality both in consulting and in government. Aleks has been principal Australasia for a large international environmental consultancy, and was principal and manager in specialist roles for 10 years at NSW EPA. Aleks is a director of Todoroski Air Sciences.

Since becoming involved at the MRM site in early 2015, there has been a significant reduction in the emissions of SO_2 from the site. There has been continuous monitoring of SO_2 in the nearby communities of Borroloola and Devils Spring (i.e. the closest sensitive receivers to the MRM site), and no instance of air emissions above ambient air quality limits was recorded in any of the off-site residential areas.

Presently, a continuous monitor is stationed near the mine to intercept any air emissions that may travel towards the communities of Borroloola and Devils Spring. This monitor ensures that no air quality issues due to the mine would arise in these communities.

Review of SO_2 performance

MRM conducts SO_2 monitoring as part of its environmental monitoring network. The (SO_2) NEPM[1] standards apply to locations representative of air quality likely to be experienced by the general population in the region or sub-region, and not to the data recorded on the MRM site. Therefore to assess the level of SO_2 impact at the nearest population centres SO_2 monitoring was conducted continuously at Borroloola and

[1] National Environmental Protection (Ambient Air Quality) Measure

the community of Devils Spring, located approximately 45km and 25km from MRM respectively, between June 2015 and August 2016.

The Borroloola and Devils Spring SO_2 monitoring results are presented in **Figure 1** and show that the recorded SO_2 concentrations were very low. The recorded levels were well below the 1-hour average, 24-hour average and annual average NEPM standards at both monitoring sites in the monitoring period.

Due to the low levels, monitoring stopped at the communities, and a monitor was set up at the Caravan site which is adjacent to the NOEF, (i.e. the source of the SO_2 emissions). Several internal action trigger levels were used to identify sources of SO_2, so that the mine could extinguish them. However, this monitor was not between the MRM site and the nearest communities. Therefore, on 19 July 2017, the monitor was moved to the Van location, directly between the MRM activities and the nearest settlements, at Devils Spring and Borroloola.

The predicted SO_2 concentrations at the nearest sensitive receivers (i.e. Borroloola and Devils Spring) due to MRM's operations under the Overburden Management Project Environmental Impact Statement are negligible even under adverse weather conditions. The SO_2 concentrations at the nearest communities/ townships due to mining activities would be significantly lower than those measured at the nearby Van monitor and, therefore, elevated concentrations at Van monitor can be used to inform preventative impact management measures, if required, to ensure there are no air quality impacts on the sensitive receivers.

Figure 2 presents the SO_2 monitoring data recorded at the on-site Caravan NOEF and Van monitors, for the period September 2016 and March 2018. Please note that the Caravan site is on the mine site, adjacent to the source of emissions, and the ambient air quality criteria do not apply to the Caravan measurements.

Ongoing modelling/ data interpolation studies conducted using the validated SO_2 monitoring data recorded at both the Caravan NOEF and Van monitoring sites indicate that the SO_2 levels from the MRM site continue to remain well below the NEPM standard level at Borroloola and Devils Spring.

In summary:

- The available information, including on-site monitoring data shows improved performance over time with respect to the prevention of SO_2 emissions.
- Review of air quality monitoring data shows MRM's operations have not resulted in adverse impacts at the closest off-site sensitive receivers.

Yours faithfully,

Todoroski Air Sciences

Aleks Todoroski

References

MRM (2017)

"Air Quality Management Plan", McArthur River Mine, September 2017.

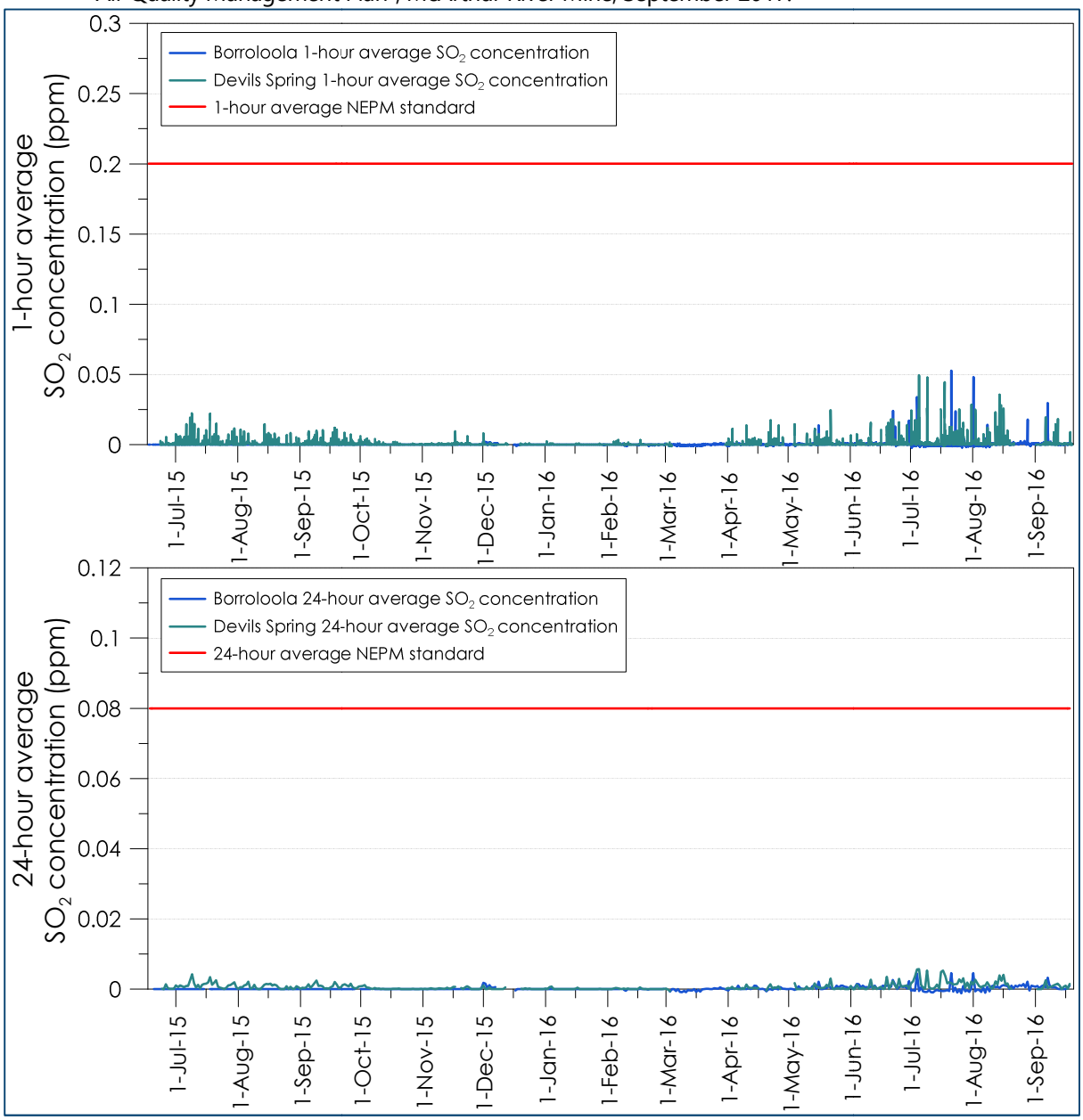


Figure 1: Borroloola and Devils Spring SO_2 monitoring data

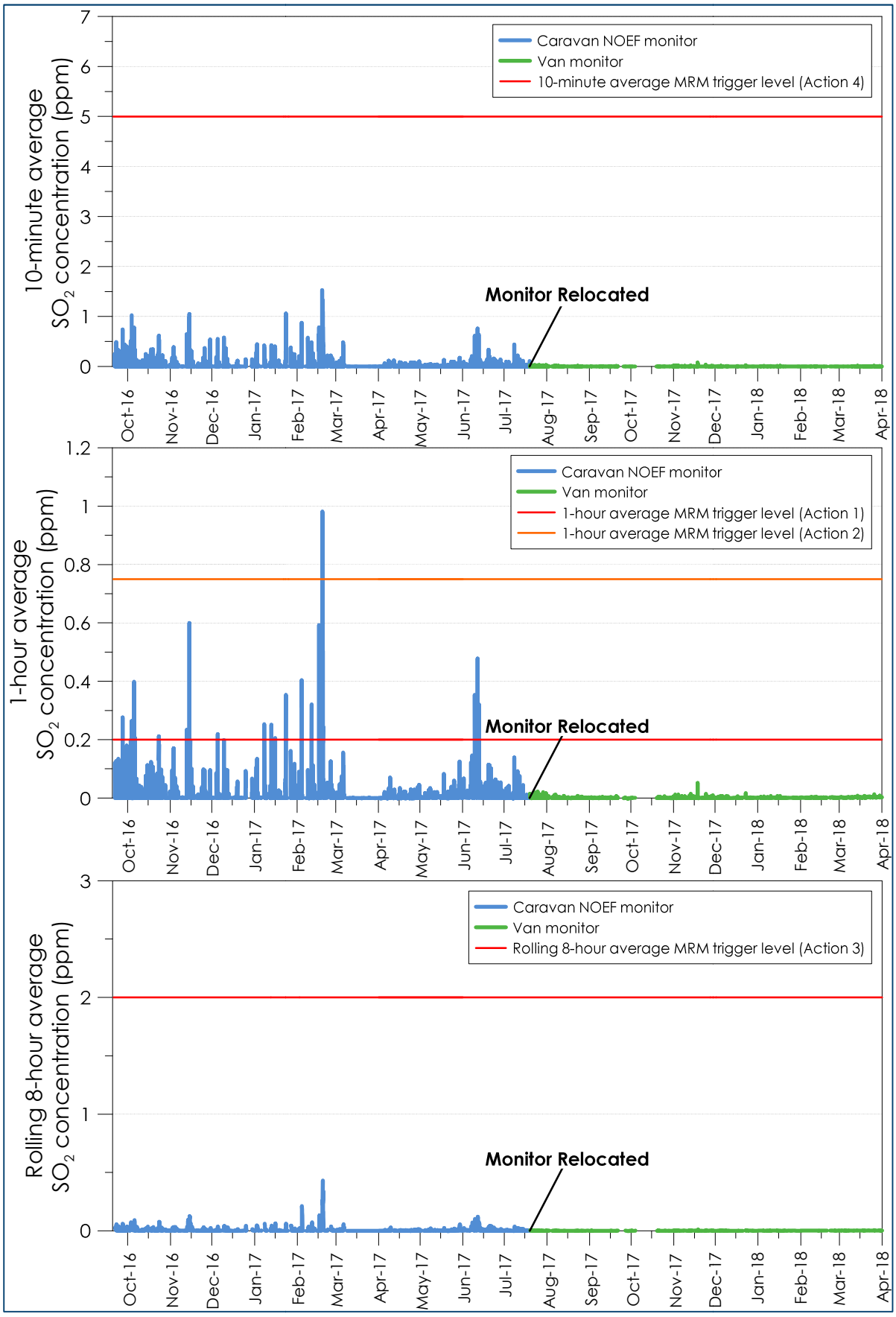


Figure 2: MRM on-site SO_2 monitoring data

Groundwater and Waterways model interaction response:

Please detail how the results of groundwater flows and loads modelling have been incorporated into the waterways model, particularly in terms of predicted total (background + mine-derived) loads and concentrations of CoCs in surface waterways. This could be presented in the form of a table. Alternatively, if the information is already presented in the EIS documentation, please provide a reference to its location

Incorporation of groundwater into the waterways model

The groundwater flow and CoC dissolved load contribution (natural and mine derived) delivered to the waterways during the operational and closure periods were generated by Klohn Crippen Berger (KCB) (**Draft EIS Appendix T – Groundwater Impact Assessment**) and were supplied to WRM Water and Environment (WRM) to be incorporated as inputs to the water balance and waterways models (**Draft EIS Appendix U Surface Water Impact Assessment**, and **Supplementary EIS Appendix N – Updated Water Balance and Waterways Modelling**).

The waterways model divides the surface water environment into separate reaches (refer **Figure 9.1** – Waterways model configuration, of **Draft EIS Appendix U Surface Water Impact Assessment**). **Section 9.2** of **Draft EIS Appendix U Surface Water Impact Assessment** discusses each of the model inputs (including groundwater inflows). Each reach was assigned site specific characteristics (refer Table 9.1 – Adopted waterways model reach characteristics, of **Draft EIS Appendix U Surface Water Impact Assessment).** The reaches were replicated in the various groundwater models (KCB) such that interaction between the surface water and groundwater models could be simulated on a reach by reach basis (i.e. groundwater model outputs could be used as surface water inputs and vice versa)(**Draft EIS Appendix T – Groundwater Impact Assessment)**. Section 9.2.7 - Surface Water and Groundwater Interaction, of **Draft EIS Appendix U Surface Water Impact Assessment,** explains this interaction. The waters model included a 'bank storage' function along each reach. This model attribute facilitated the transfer of flows and loads between the surface water and groundwater systems.

Groundwater flows

Estimated groundwater flows delivered to each reach within the waterways model were generated by KCB (from outputs from their NOEF, TSF and site-wide groundwater models). Section 9 of **Draft EIS Appendix T – Groundwater Impact Assessment,** presents the monthly baseflow estimates from the groundwater system to creeks and rivers through operations and into closure.

This included groundwater delivered to the waterways that would be potentially impacted by the following sources:

- the NOEF domain including residual basal seepage from the NOEF and PRODs that is not intercepted and contained in the site water management system;
- the TSF domain including residual basal seepage from TSF PWD, TSF WMD and TSF Cell1/2 that is not intercepted and contained in the site water management system;
- the Open Cut domain including residual basal seepage from the WOEF, SOEF, EOEF and mine water dams that is not intercepted and contained in the site water management system; and
- natural mineralised zones.

Groundwater COC inputs

KCB generated the estimated groundwater flow and loads delivered to each reach within the waterways model. Section 9 of **Draft EIS Appendix T – Groundwater Impact Assessment,** presents the monthly load estimates from the groundwater system to creeks and rivers through operations and into closure.

As outlined in Section 8.3.4 of **Draft EIS Appendix U Surface Water Impact Assessment**, **e**ach of the five CoCs (SO_4, Zn, Pb, Cd, As) were modelled as a conservative species within the model, and a solids balance has been maintained in each storage. Representative concentrations for each of the CoCs have been applied to all of the inputs to the water balance and waterways models. These representative concentrations have been compiled from various sources, including:

- Historical water quality sampling data;
- Previously calibrated values;
- Unsaturated flow and groundwater model outputs (KCB).

A summary of the source of the adopted representative CoC concentrations is provided in Table 8.6 (Contaminants of concern (CoCs) – source of adopted concentrations), of **Draft EIS Appendix U Surface Water Impact Assessment**. The adopted CoC concentrations for each of the model inputs are provided in Section 5 of **Draft EIS Appendix U Surface Water Impact Assessment**.

Results

The simulation results of the assessment period (2018-2047) are provided in Section 9.7 of **Draft EIS Appendix U Surface Water Impact Assessment**.

Modelled daily flows along with modelled daily sulphate and zinc concentrations and are expressed graphically in the following sequence of figures in **Draft EIS Appendix U Surface Water Impact Assessment**:

- **Figure 9.19** – Modelled daily flows and sulphate concentrations through the MRM waterways at SW21, SW28, SW24, SW19, SW06 and SW11 during the operational period (2018 to 2047)
- **Figure 9.20** – Modelled daily flows and sulphate concentrations through the MRM waterways at SW21, SW28, SW24, SW19, SW06 and SW11 during Stage 8 (2047 to 2060)
- **Figure 9.21** – Modelled monthly flows and sulphate concentrations through the MRM waterways at SW21, SW28, SW24, SW19, SW06 and SW11 during Stage 9 and Stage 10 (2060 to 2100)
- **Figure 9.22** – Modelled daily flows and sulphate concentrations through the MRM waterways at SW21, SW28, SW24, SW19, SW06 and SW11 during Stage 11 and Stage 12 (2100 to 2500)
- **Figure 9.23** – Modelled daily flows and sulphate concentrations through the MRM waterways at SW21, SW28, SW24, SW19, SW06 and SW11 during Stage 13 (2500 to 3018)
- **Figure 9.24** – Modelled daily flows and zinc concentrations through the MRM waterways at SW21, SW28, SW24, SW19, SW06 and SW11 during the operational period (2018 to 2047)

- **Figure 9.25** – Modelled daily flows and zinc concentrations through the MRM waterways at SW21, SW28, SW24, SW19, SW06 and SW11 during Stage 8 (2047 to 2060)
- **Figure 9.26** – Modelled daily flows and zinc concentrations through the MRM waterways at SW21, SW28, SW24, SW19, SW06 and SW11 during Stage 9 and Stage 10 (2060 to 2100)
- **Figure 9.27** – Modelled daily flows and zinc concentrations through the MRM waterways at SW21, SW28, SW24, SW19, SW06 and SW11 during Stage 11 and Stage 12 (2100 to 2500)
- **Figure 9.28** – Modelled daily flows and zinc concentrations through the MRM waterways at SW21, SW28, SW24, SW19, SW06 and SW11 during Stage 13 (2500 to 3018)

Appendix F of **Draft EIS Appendix U Surface Water Impact Assessment** shows the predicted monthly statistics of daily flow as well as SO_4, Zn, Pb, Cd and As concentrations during the operational period (2018 to 2047), 2047 to 2060, 2060 to 2100, 2100 to 2500 and 2500 to 3018.

From:
Sent: Saturday, 19 May 2018 1:40 PM
To:
Cc:
Subject: RE: Summary of questions from the MRM briefing to the NT EPA board
Attachments: 20180519 NTEPA - MRM Employment data.pdf

Dear

We'll endeavour to get responses back on these queries as promptly as we can. If ok with you I'd like to get these back to you as we have them to hand rather than waiting for the complete set of responses?

Please find attached employment data back to 2007 showing MRM employees, contractors, and indigenous participation. Our record of local and NT based staff numbers has only been a recent addition to our reporting suite so we don't have data going back in time on this.

Generally our % of Territory based staff has followed the wider trends in the Territory, with cost of living pressures in Darwin driving people to commute interstate. With recent house and rental price easing were seeing anecdotal evidence of more MRM staff relocating from interstate so perhaps we'll see an increase in the locally based staff through this year. We're specifically targeting locally based staff and trying to attract interstate based staff with relocation assistance packages and roster options that are attractive to locally based staff.

Regards,

McArthur River Mine

Tel. +61
Mob. +61
Facsimile +61 8 8975 8120
Email:
www.mcarthurrivermine.com.au

McArthur River Mining

McARTHUR RIVER MINE
COMMUNITY BENEFITS TRUST
Program partner

From:
Sent: Thursday, 17 May 2018 7:38 PM
To:
Cc:
Subject: FW: Summary of questions from the MRM briefing to the NT EPA board

Hi

Apologies for the late response to this, it got a bit lost. Please see below regarding the questions from the NT EPA meeting and some further information requests regarding the socio-economic aspects of the Proposal.

The following three points are additional queries that I recorded in my notes during the NT EPA meeting that were not included in the attachment from MRM:

- The NT EPA would like to see the evidence that the current advection barrier strategy is working to reduce heating of PAF(RE) in NOEF.
- Has there been any approach to the NIRB to seek a view on the Geosynthetic liner (GSL) as cover for the NOEF?
- The NT EPA expects that eventually Barney and Surprise Creeks would recover, but does MRM have any predictions on when?

Additionally, the following is an information request relating to socio-economic aspects of the Proposal. This information would help build the story that MRM has made a positive economic contribution, particularly locally and regionally (NT), and that this economic contribution is likely to increase if the proposal proceeds. It may also show that there has been improvement in local economic contributions; for example, the proportion of Indigenous employees and local employees has risen.

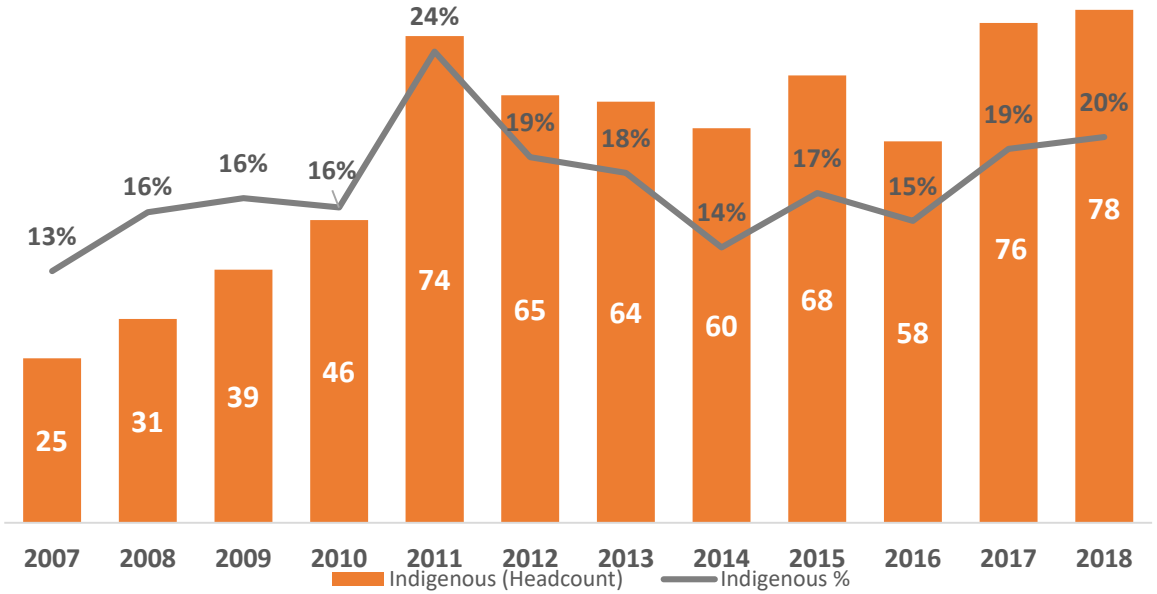
- Confirmation of current employment statistics:
    - 420 staff
    - 19% of staff are Indigenous
    - 40 – 50 staff (~10%) are local (i.e. live in Borroloola or Robinson River or a nearby outstation)
    - 55% of current staff reside in the NT
- Historical staff numbers (direct, MRM employees). Perhaps once a year over the life of the mine, or as far back as possible.
- Historical proportion of Indigenous employees, and local employees.
- Current number of contractor employees, if available. Historical number of contractor employees, if available.
- Are local (Borroloola) companies/rangers currently contracted by MRM? (e.g. Carpentaria Shipping Services). If so, please provide details – which companies, what are their services, how many employees are involved?
- What goods and services are sourced from local businesses by (i) MRM, and (ii) its non-local employees? (as referred to on page 12-32 of draft EIS)
- How many times have royalties been paid to the NT Government so far during the life of the mine? We are aware that Royalties were first paid in 2007 (sourced from MRM press release).
- Does MRM have an estimate of how much they have contributed to the Gross State Product in recent years?

I look forward to your responses on these matters.

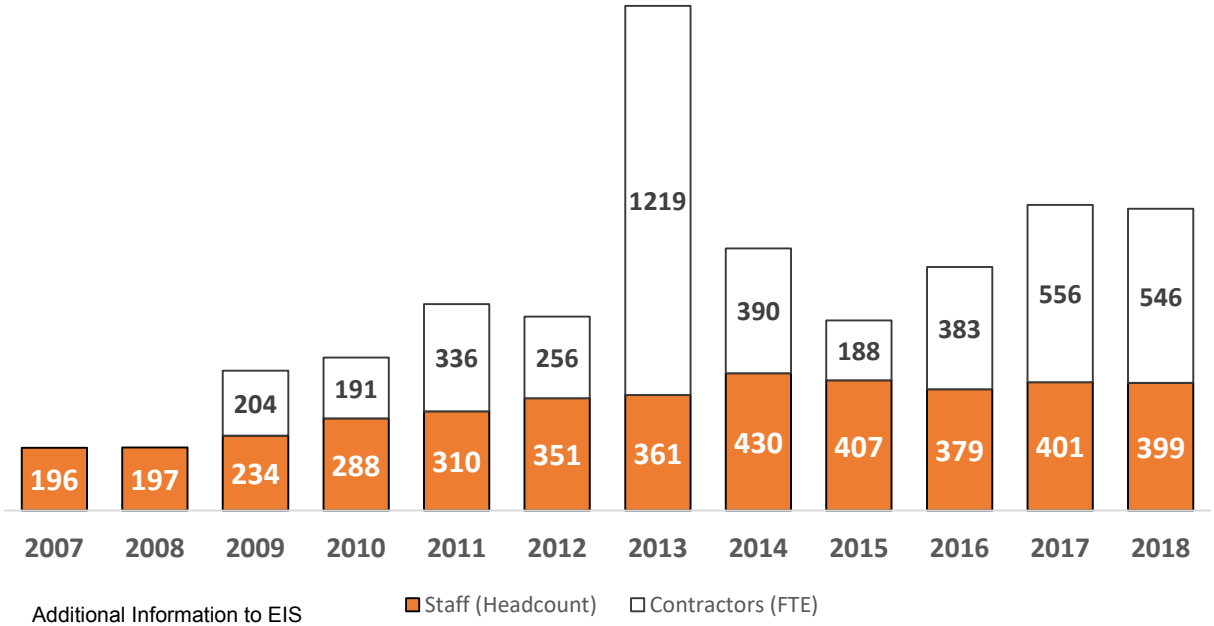
Kind regards

Assessment Officer | Environmental Assessment
Environment Division | Department of Environment and Natural Resources
Providing services for the
Northern Territory Environment Protection Authority
ntepa Northern Territory Environment Protection Authority
www.ntepa.nt.gov.au

Level 1, Arnhemica House, 16 Parap Road, Parap NT 0820
GPO Box 3675, Darwin NT 0801
p: | f: (08) 8942 6554
e: | www.nt.gov.au



Indigenous employment rate has followed the growth in headcount, and in 2018 MRM is employing more indigenous people than any time during the last decade



MRM Current Workforce Profile	
Staff	*399*
Indigenous #	*78*
Indigenous %	*20%*
Local (Borroloola)	*37*
NT Residency %	*54%*

From:
Sent: Saturday, 19 May 2018 2:01 PM
To:
Cc:
Subject: RE: Summary of questions from the MRM briefing to the NT EPA board
Attachments: 20171102_SportsCourts.pdf; 20180513_LegacyFund.pdf

,

Regarding the socio-economic contribution to the local community please find attached two recent press releases regarding the MRM Community Benefits Trust and the link to the recently updated website. This provides a comprehensive summary of the projects that the trust has funded during the last 10 years.

http://www.mrmcommunitytrust.com/

Regards,

McArthur River Mine

Tel. +61
Mob. +61
Facsimile +61
Email:
www.mcarthurrivermine.com.au

$1.5m sports facility to support youth activities in Borroloola

A $1.5 million sporting facility will be built in Borroloola with a grant from the McArthur River Mine (MRM) Community Benefits Trust.

Built on the site of the old town basketball courts, the new facility will include covered multi-purpose sports courts, seating, lighting, electronic scoreboard, car parking and pedestrian access.

Roper Gulf Regional Council applied for the funding to provide a much-needed facility for youth in Borroloola. It is the largest single grant ever awarded by the MRM Community Benefits Trust.

MRM Community Benefits Trust Chair Greg Ashe said the provision of facilities for youth in Borroloola was a consistent need identified in Trust community consultations.

"We know there is a big need for a facility such as this to engage young people in healthy activities," Mr Ashe said.

"This is a perfect example of how the Community Benefits Trust can make a difference to the lives of people in Borroloola and the Gulf region."

Roper Gulf Regional Council Mayor Judy MacFarlane thanked McArthur River Mine for its contribution to the betterment of Borroloola, adding that delivering infrastructure that met community expectation required a strong partnership between Local Government, residents and key stakeholders like MRM.

"Borroloola has been identified as one of the fastest-growing towns in the 186,000 square kilometre Roper Gulf Local Government Area," Mayor MacFarlane said.

"To ensure the wants of residents are met, Council needs to form solidified relationships with funding partners who have a vested interest in the social and economic development of the town, whether that is a Government entity or an enterprise like McArthur River Mine.

"The youth here are the future of Borroloola, so I thank MRM for having the long-term vision and commitment to provide the funding needed, through its Community Benefits Trust, for Council to build infrastructure that will promote health and physical activity in this town."

The grant comes as the Trust celebrates 10 years of operations as a joint initiative of McArthur River Mining, the Northern Territory Government and the local community. Over this time, the Trust has contributed $14.8 million to 83 separate programs.

NT Government representative on the Trust Board Jake Quinlivan said he was pleased the Trust was able to fast track the project given its importance to Borroloola.

"From the funding application being considered by the Board to reaching an agreement with Roper Gulf, the process has taken a matter of weeks – that's great news for the community," he said.

Construction is expected to begin early in the new year.

For comment from the MRM Community Benefits Trust, contact Tracy Jones on 0407 727 813 or tracy@creativeterritory.com

For comment from Roper Gulf Regional Council, contact the Communications Coordinator on 0427 674 212 or roper.governance@ropergulf.nt.gov.au

About the MRM Community Benefits Trust

Established in 2007, the MRM Community Benefits Trust is a partnership between McArthur River Mining, the Northern Territory Government and the local community. It commits $1.25 million a year to projects that support culture and art, enterprise and job creation, social and community development, education, health and the environment. In its 10 years of operations it has contributed $14.8 million to 83 programs and projects in the region.

MEDIA RELEASE

McArthur River Mine Community Benefits Trust establishes a Legacy Fund for Gulf region

13 May 2018

The McArthur River Mine Community Benefits Trust has established a Legacy Fund to continue the long-term funding of community projects in the Gulf region after mining ends at MRM in 2036.

The Trust is a joint initiative of the Northern Territory Government, MRM and the people of the Gulf region centred on Borroloola.

MRM contributes $1.25 million a year to the Community Benefits Trust, which is administered by an independent board comprising five community members and two directors each appointed by the Northern Territory Government and MRM.

The Trust Board's decision means that $250,000 of the annual MRM contribution will now be set aside in the Legacy Fund, with the remaining $1 million available for grants for community programs.

Announcing the initiative today, Trust chair Mike Reed said the fund would provide a lasting community benefit long after mining is due to finish in 20 years' time.

"The Board recognises that its current funding stream only lasts while mining continues, which is currently through until 2036," Mr Reed said.

"If we start setting aside money now, we can secure a long-term funding stream for the development of the Gulf region."

The MRM Community Benefits Trust has granted more than $14 million to 93 local projects since its inception in 2007. Grants are focussed on six areas of community development – Culture and Arts, Enterprise and Job Creation, Social and Community Development, Education, Health and Environment.

In 2017, the Trust awarded its largest grant to date, with $1.5 million awarded to Roper Gulf Regional Council to build a multi-purpose sports facility in Borroloola. Other major projects funded include $1 million towards the construction of a crèche, a trade training centre at Borroloola School, a regional health study, dugong and dolphin conservation study, rock art protection and school breakfast programs.

It is anticipated the Legacy Fund could become self-sustaining by end of mining, which would generate enough interest for the ongoing support of community programs for the region.

Media enquiries: Tracy Jones on 0418 251 774

From:
Sent: Thursday, 7 June 2018 12:55 PM
To:
Cc:
Subject: RE: Paragraph from Appendix L

Hi

In answer to your query, please note that the Supplementary EIS includes an updated TSF LOM Plan (refer Appendix I of the Supplementary EIS), which includes details on proposed TSF seepage management measures (including source control) in Section 11.1 (TSF Seepage and Groundwater Management Strategy).

The entire section has been reproduced below for your reference, with yellow highlighted sections of note.

"Groundwater management is a key issue to be resolved as part of the LoM TSF plan. Previous and ongoing impact from sulphate contamination to Surprise Creek has been monitored by MRM and various attempts made to reduce seepage. In addition, recent review of TSF water quality suggests that high sulphate levels and metal contamination in the TSF appears to originate from process water rather than by oxidation of the tailings beach which is a less significant contributor than originally thought.

Significant factors in past failure to adequately control seepage impacts are:

- *Poor quality water in the Decant Pond from process water;*
- *Ongoing high water levels in the TSF;*
- *Relatively high permeability of foundations;*
- *Past perimeter polymer curtain barrier wall proven to be ineffective (i.e. no head-loss across barrier, design flawed);*
- *Shallow depth and insufficient number of groundwater recovery bores, perceived extent of collection of "non-seepage" groundwater and failure to maintain consistent retrieval.*

For groundwater management from MRM TSF it is proposed to initiate an improved system involving management of source, implementation of barriers (where feasible) and a final level of extraction, as shown diagrammatically in Figure 35.

The primary method of seepage impact reduction is control of the source from both quality and quantity perspectives. Control of quality will be undertaken by strict management of tailings beaching to reduce oxidation, additionally MRM have made improvements to the management of PbOx bleed water as described earlier. Subject to further assessment and possible trials, GHD considers there to be a good opportunity for further "tailings improvement" by using economical methods to promote additional drying and densification of the tailings to remove additional pore water at the surface and therefore further reduce potential for seepage.

A potential secondary method of seepage control will comprise the construction of engineered barriers (if necessary) to seepage currently reporting to critical areas such as Surprise Creek. Specifically, it is recognised that structural features (i.e. faults) in the foundation of the TSF may act as preferential pathways for seepage. Any such highly permeable bedrock to depth may be suitable for conventional cement grouting. Specifications and requirements for this type of treatment will be determined during the detailed design phase based on the results of additional geophysical survey and drilling investigations carried out by MRM in 2016. Any such controls would also be included within the next stage of groundwater modelling.

As a final level of seepage control, it is intended to recover groundwater at locations where impact is being caused. This includes Surprise Creek. Detailed TSF groundwater modelling has been completed by consultants Klohn Crippen Berger (KCB) to validate this concept as presented in their report entitled "TSF Seepage & Mitigation Modelling", November 2016 (KCB 2016b).

Groundwater recovery along Surprise Creek will comprise the excavation of a deep trench to below the invert level of Surprise Creek. At the base of the excavation a gravel filled trench with slotted pipe and appropriate pump-out wells will be installed. The drain would be located to allow drainage of the water table to a level below the level of Surprise Creek. This would allow generation of a slight negative hydraulic gradient to the creek and capture of seepage from the TSF impacting on creek water. The drain would be designed in sections to allow an appropriate drainage level, relative to the various pools along the creek. In the future, this type of recovery system could be extended around the eastern and southern sides.

A preliminary design for the Surprise Creek Seepage Interception Trench is provided in the Design Drawings attached as Appendix A.

Detailed designs will involve the further development of a groundwater and surface water monitoring regime, which will be established to measure and monitor the success of the proposed TSF strategy in line with the MRM EIS environmental objectives. This will also allow for further adaptation of mitigation systems in the future.

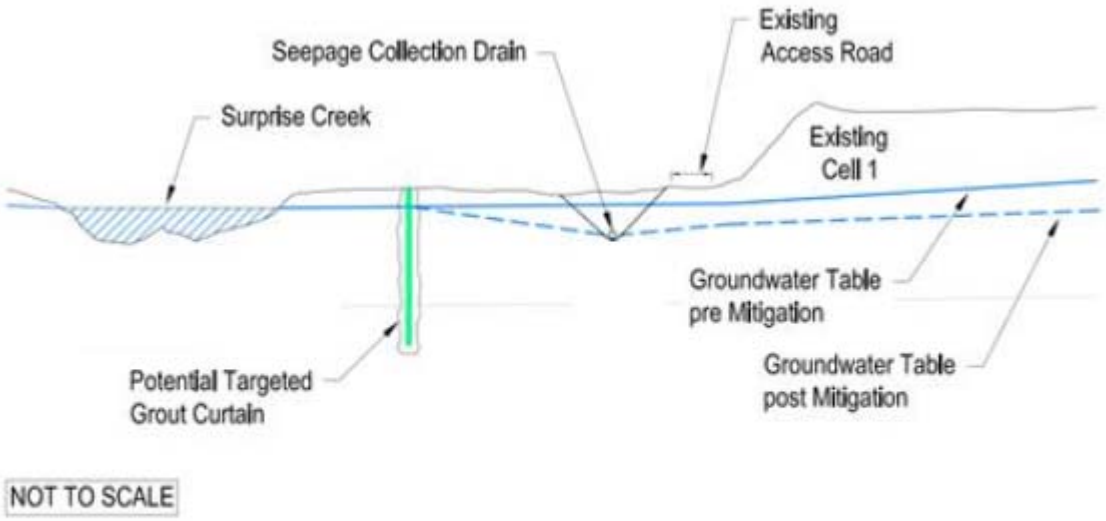


Figure 35 Foundation Seepage Mitigation Measures

In addition, Appendix C (Risk Register) of the TSF LOM Plan includes two risk events that provide some detail as follows:

- Risk R003
  - Hazard identified as *Seepage from TSF above threshold contaminant levels impacting receptors, or not compliant with operational objectives. Caused either by inappropriate tailings management, unsuitable investigation and design of controls, or inappropriate monitoring".*
  - Mitigation measures to date identified as:
    - Design minimises source by restricting decant pond size, promote tailings drying and consolidation, higher density and lower permeability.
    - Minimise oxidisation (therefore improving quality of seepage) by managing tailings beach with sufficient level of saturation (>80%) by completing routine deposition cycles. Insitu tailings testing for moisture and saturation.
    - Tailings settlement, drying and consolidation modelling undertaken by GHD to predict seepage flux through the TSF.
    - Groundwater and contaminant transport modelling undertaken by KCB to demonstrate the effectiveness of groundwater capture particularly along Surprise Creek.
  - Future mitigation measures identified as:
    - *Seepage interception system designed to restrict contaminated groundwater plume.*
    - *Ongoing surface/groundwater monitoring programme.*

    - *Ongoing review of design assumptions using the "observational approach".*
    - *Opportunity to capture additional seepage using PWD underdrainage.*
- Risk 036
    - Hazard identified as *Increased seepage recovery requirements within footprint of TSF to manage existing contaminated groundwater and increased recharge resulting from removal of tailings, post completion of remining tailings.*
    - Mitigation measures to date identified as:
        - *Risk identified*
        - *Seepage recovery system may need to be supplemented for this phase with additional recovery bores*
    - Future mitigation measures identified as *"to be reviewed during detailed design"*.

Cheers

METSERVE
Mining & Energy Technical Services Pty Ltd
PO Box 306
Fortitude Valley Qld 4006
Phone: 1300 078 518
Email:

From:
Sent: Wednesday, 6 June 2018 1:46 PM
To:
Subject: Paragraph from Appendix L

Hi ,

As discussed, see the highlighted last line, which is the source of my query, of the following paragraph from page 121 of Appendix L (which I've included for context):

There is an increase in sulphate load reporting to Surprise Creek during the life of mine. This increase is associated with tailings seepage migrating a short distance north towards Surprise Creek, in spite of the proposed interception trench put in place to capture the majority of the load. This sulphate load diminishes during closure as the tailings is removed and placed in-pit. After approximately 100 years the sulphate load in Surprise Creek is reduced from 2,000 kg/day back to <500 kg/day. An alternative and more effective mitigation plan is currently in the design phase and this should act to limit the loads to Surprise Creek further.

Can you please shed some general light on the mitigation plan that is being designed? Source controls?

Thanks

Assessment Officer | Environmental Assessment
Environment Division | Department of Environment and Natural Resources

Providing services for the
Northern Territory Environment Protection Authority
ntepa Northern Territory Environment Protection Authority
www.ntepa.nt.gov.au

From:
Sent: Thursday, 21 June 2018 4:03 PM
To:
Cc: '

Subject: FW: Rapid fill of pit void

Hi

I have discussed this with WRM and they have confirmed that the adopted pumping regime is conceptual to assess the potential flow and volume impacts on McArthur River and to estimate the likely range of Mine Pit Lake fill times based on the adopted pump rate and minimum river flow trigger.

For modelling purposes, when the river flow rate is 10 m^3/s or greater, water is pumped from the river at up to 500 ML/d. For example:

- when the river flow rate is below 10 m^3/s (say 9.9 m^3/s) at the mine, the pumps are switched off and the McArthur River flows downstream of the pump would match upstream flows.
- when the river flow rate is 10 m^3/s at the mine, 5m^3/s is pumped into the Mine Pit Lake and McArthur River flows immediately downstream of the pump are reduced to 5 m^3/s.
- when the river flow rate is 1000 m^3/s at the mine, 5.8 m^3/s is pumped into the Mine Pit Lake and McArthur River flows immediately downstream of the pump are reduced to 994.2 m^3/s.

It is expected that the rules regarding the pumping regime would be further refined once the arrangement of the pumps for filling the Mine Pit Lake has been finalised. This would include a refined assessment of the potential flow and volume impacts.

Cheers

From:
Sent: Wednesday, 20 June 2018 4:21 PM
To:
Subject: Rapid fill of pit void

Hi ,

Hope you are well. I'm just reading through Issue No 245 in Section 7.13 and trying to understand the flow duration curves and explanation for why extraction of water during rapid filling is not likely to be a problem.

If, as suggested in Section 9.2.5 of draft EIS Appendix U, a minimum river flow of 864 ML/day is assumed before up to 500 ML/day is pumped from it, can you please explain why river flows greater than 430 ML/day would be affected as shown in the FDC and stated in the following paragraph in Section 7.13?

The Rapid Fill period has a minor effect on McArthur River flows for flows greater than 430 ML/d (5 m3/s). The greatest effects occur when McArthur River flows at SW16 are approximately 860 ML/d (10 m3/s), where flow duration exceedance probabilities are reduced by between -1.5% and -4% for the periods assessed. For flows above and below about 860 ML/d, the effects are less. For flows above 2000 ML/d, the effect on flow duration is less than 1%.

Thanks

From:
Sent: Friday, 22 June 2018 3:34 PM
To:
Cc:

Subject: RE: MRM query - Supplement Appendix J

Hi

Some desktop assessment/ literature review work has been completed, primarily looking for known tolerances of aquatic species to the water qualities predicted at MRM into the future. As discussed Thursday morning there are gaps in the available information, however the forward work program presented in the SEIS aims to resolve these. As discussed, the available information identified is presented throughout a number of different sections within the SEIS and it's appendices. Those relevant to Appendix J are provided below.

I have also presented some additional information that I have been able to extract from the literature reviewed. This provides some more discussion of the potential effects of various water qualities (focussing on zinc) on aquatic ecology. This is presented in green text below the Appendix J extracts.

Appendix J of the Supplementary EIS includes assessment of the impact of sulphate and zinc (as well as other water quality parameters) as they relate to specific, identified risks in **Section 3.3 Risk Identification and Mitigation**, the accompanying risk assessment table (presented as Table 4 of Appendix J), as well as broader discussion in Sections 3.3, particularly in Section 3.3.1 (Reduction in Water Quality).

Elevated sulphate and zinc and their associated effect on Barney Creek is discussed on page 37 as part of **Section 3.5.2 Effects on Surface and Groundwater** in the context of the NOEF expansion:

"A number of potential pathways exist for waters which have interacted with the NOEF to enter groundwater and surface water. In addition, potential exists for water to seep through the NOEF, including PAF and reactive waste rock, which may ultimately lead to a reduction in groundwater and surface water quality. Indeed, this interaction has the potential to create long- lasting detrimental effects.

The NOEF represents a large catchment area and mass. Consequently, large volumes of surface runoff will occur during rain events. Considering the proximity of Surprise, Barney and Emu Creeks to the NOEF, runoff has the potential to reduce water quality in particular by increasing TSS. The mass of the NOEF also has the potential to cause a groundwater mound which results in rising of the surrounding groundwater level. The subsequent cartage of salts to the surface can influence water electrical conductivities which may exceed fauna tolerances. In addition mounding of groundwater can lead to an alteration of inflow to the creeks in close proximity.

Considering the current design of the NOEF, seepage is most likely to represent the greatest risk to groundwater and subsequently surface water quality. In light of this risk, a GSL as opposed to a CCL will now be included in the cover system to further reduce seepage of water through the NOEF. Current modelling predicts that surface waters in Barney Creek will be high in sulphates and zinc (WRM 2018) which may exceed the tolerance of some fauna. During the operational period this has mainly been attributed to seepage from the TSF. However, post closure and after rehabilitation of the TSF elevated sulphate levels have been directly attributed to the NOEF (WRM 2018). As well as benign material, the NOEF also contains highly reactive and potentially acid forming rock. In consideration of this (and predicted sulphate concentrations) it has been considered vital that interaction of water with these latter waste types is minimised and that any water that has interacted with the NOEF be captured and managed.

Predicted sulphate concentrations (WRM 2018) in Barney Creek, may result in aquatic habitat in the lower part of Barney Creek becoming unfavourable to some aquatic fauna at least for some time each year. This is particularly the case during post-wet periods when flow rates subside resulting in lower dilution and mixing rates and

evapoconcentration. While current modelling predicts concentrations of sulphate will decline at some locations after the closure of the TSF and over time, monthly median sulphate concentrations at SW19 will exceed the SSTVs (~2000 mg/kg) during months of lowest discharge from 2060 onwards (i.e. March to September) (WRM 2018). Upon decommissioning of BCS1 (2060) the predicted mean concentration of sulphate is 2929 mg/L. Furthermore, beyond 2060 predicted mean sulphate concentrations at BCS2 (located in Barney Creek near the confluence with the McArthur River) will continue to increase to 3319 mg/L by 2500.

Sampling in Barney Creek has indicated a number of fish species can persist in waters of high electrical conductivity (EC). Hephaestus fuliginosus*,* Leiopotherapon unicolor*,* Melanotaenia splendida *and* Nematalosa erebi *have been consistently recorded in sulphate affected reaches of Barney Creek up to 2240 mg/L. This implies that not only can these fish species tolerate these concentrations but food for these species (for example, invertebrates, algae or plants) also persists in these environments. In addition* Lates calcarifer *has been recorded from inland waters with sulphate concentrations up 2180 mg/L. Based on this, some resilience exists for aquatic fauna to persist in the lower portion of Barney Creek for some time. At BCS2 within Barney Creek, however, median sulphate concentrations will continue to increase and will exceed the SW11 SSTVs throughout the year by 2168-2500 reaching concentrations of up to ~4000 mg/kg when creek discharge is at its lowest (WRM 2018). This value is beyond the maximum concentrations at which aquatic fauna have been recorded in Barney Creek to date.*

The fish species recorded from Barney and Surprise Creek are found throughout the McArthur River catchment and greater Gulf of Carpentaria. Based on this and the fact Barney Creek does not represent critical habitat for any species, it is unlikely the loss of any aquatic habitat will result in a population-level effect. However, capture of affected water from Barney Creek remains an important process to avoid adverse effects on water and habitat quality in the McArthur River."

It is further discussed in the context of potential TSF impacts on page 42 of Appendix J (**Section 3.6.2 Uncontrolled Release of Tailings through Spill and Seepage**):

"*As discussed in section 3.5.2, modelling predicts that surface waters in Barney Creek will contain high concentrations of sulphates (and zinc) throughout the operational phase and post closure (WRM 2018). These models also predict that a majority of the sulphate will be derived from TSF seepage until its eventual decommissioning. As discussed in Section 3.5.2, highest annual sulphate concentrations (and resulting EC) will be experienced during low flow periods. While Section 3.5.2 also describes fauna that have resilience to these conditions, the recognition that seepage will occur and the nature of the expressed surface water, has resulted in the current Project design incorporating two sumps in Barney Creek. This includes one sump slightly downstream of the confluence with Surprise Creek and the other in the lower part of Barney Creek. While the quality of aquatic habitat will inevitably be degraded in Surprise and Barney Creeks due to the TSF seepage, a primary aim remains the protection of the McArthur River proper. Indeed, if seepage is able to reach the McArthur River this may have long-lasting effects on habitat, water quality and the aquatic fauna present."*

Both of these sections go on to list mitigation and management processes that are used to address these potential impacts.

1. Zinc

2.1 General

Zinc is an essential metal for most aquatic organisms due to its involvement in somatic cell functions including protein synthesis and enzymatic regulation (Bury *et al*. 2003). Waterborne (dissolved) zinc is taken up in teleost fish through chloride cells in the gill epithelium (Marshall 2002; Bury *et al*. 2003). However, in excess, zinc may also compete with uptake of calcium which may disrupt calcium homeostasis (Hogstrand *et al*. 1994; Marshall and Bryson 1998; Marshall 2002; Bury *et al*. 2003). Interestingly, the reverse of this uptake relationship has also been found to be true in waters rich in calcium which can result in zinc deficiencies in aquatic organisms (Hogstrand and Wood 1996) or no toxic effects at levels of zinc above normal LC50s for a particular species (Heijerick *et al*. 2002). The intestine is responsible for the majority of zinc uptake in freshwater fish (as opposed to uptake through gills via water) although Spry *et al*. (1988) reports over 57% of daily zinc requirements can be extracted from water via the

gills when the diet is deficient in zinc. When freshwaters experience increased salinity, the increasing cation concentrations may decrease bioavailability of metals due to competition for binding sites on the gills (Spry and Wood 1989; Hogstrand *et al*. 1994; Alsop *et al*. 1999; Santore *et al*. 2002). Additionally, anions in higher salinity waters may bind to, and change the speciation of zinc, thus altering its affinity for the gill (Santore *et al*. 2002).

In general, the addition of dietary zinc even at high levels, increases growth of aquatic fauna, while excess requirements are efficiently regulated to avoid toxicity (Hogstrand and Wood 1996). For example, many feeding trials over 500 mg/kg have not resulted in reduced growth or abnormal behaviour in freshwater fish species. If anything, high dietary zinc stimulates growth and excess requirements are generally regulated. (see examples such as Knox *et al.* 1984, Wekell *et al*. 1983 and Spry *et al*.1988). Therefore only dissolved zinc is considered a concern due to its competing uptake pathway with calcium. In a review of zinc toxicity in for freshwater species, Spear (1981) reports LC50s of 3 to 20 mg/L in hard water (i.e. over 250 mg/L). While Reed *et al*. (1980) report LC50s of 8 to 11 mg/L for three freshwater teleost species before recommending a comparatively conservative environmental protection concentration of 0.8 mg/L. Several authors have investigated metal interactions in the presence of dissolved zinc and report the addition of zinc decreases the uptake (and toxic effects) of non-essential metals such as cadmium (Hemelraad et al. 1987; McDonald and Wood 1993; Kargın and Çoğun 1999).

In terms of non-lethal but measureable effects, zinc has been shown to impair branchial (gill) calcium uptake in some freshwater teleost species at lower concentrations in the vicinity of 150 µg/L (Hogstrand *et al*. 1994, 1995) although this was subsequently shown to be reversed by increased calcium levels. Kori-Siakpere and Ubogu (2008) found a reduction in haemoglobin and haematocrit to be among the first measurable effects of dissolved zinc. In their study species *Heteroclarias* sp. (catfish) this occurred at dissolved zinc concentrations of above 5 mg/L. Few investigations within the wider Northern Territory region have been conducted, although Baker and Walden (1984) investigated the effect of dissolved zinc on various species of *Melanotaenia* (Rainbow fish), a genera which is widespread in the McArthur River. LC50's were found to range from 4 to 15.9 mg/L which is in agreeance with international teleost studies. Muyssen *et al*. (2005) investigating the effects of zinc toxicity on a range freshwater invertebrate species found a significant positive relationship existed between the mean EC50 and the ambient zinc concentration of the different aquatic systems, suggesting a role of acclimation and/or adaptation. Those authors also reported that no significant correlation existed between the acute zinc tolerance and the body size of the invertebrate organisms tested.

A range of literature has investigated the toxicity of dissolved zinc to freshwater macrophyte species often in conjunction with a range of other non-essential heavy metals such as lead and cadmium. In general dissolved zinc has been found to increase growth rates until concentrations approach a range of 4 to 6 mg/L (Aravind and Prasad 2003; Megateli *et al*. 2009; Basile *et al.* 2012; Chanu and Gupta 2016). These studies also report reductions in the toxicity (uptake) of lead and cadmium when higher concentrations of zinc are present. In reference to riparian vegetation, zinc uptake is highly regulated, with reported toxic thresholds upwards of 60 mg/L and generally well above 100 mg/L (Schützendübel *et al.* 2002; Bittsanszky *et al.* 2005; Castiglione *et al.* 2007; Shanahan *et al.* 2007). It is also know that riparian vegetation obtain water from various water sources throughout the soil profile and as root structure varies between riparian species so does the degree of uptake from particular depths (Dawson and Ehleringer 1991).

2.2 The Current Situation

MRM's current trigger value for zinc under WDL178-08 is 0.063 mg/L measured at the natural surface water monitoring point of SW11. As with sulphate, this concentration was calculated using ANZECC (2000) methodology and accounts for the natural hardness of McArthur River water. Zinc concentrations at which the suite of species within the McArthur River are known to reside in is approximately 0.050 mg/L (i.e. 50 µg/L) . Furthermore aquatic fauna surveys conducted since 2011 within Surprise and Barney Creeks regularly record dissolved zinc levels of 0.03 to 0.048 mg/L. Aquatic fauna captured in this area has not been recorded to show clinical signs of damage or disease which may be attributed to elevated zinc concentrations. The presence of these mobile aquatic fauna indicates that the aquatic environmental conditions are within the tolerance levels of a range of species and which are sufficient to maintain ecosystem function.

2.3 Modelled concentrations, mitigation strategies and probable effects

2.3.1 McArthur main channel

Of greatest risk to biota within the main channel of the McArthur River are zinc concentrations in initial inflows from the open cut lake which are predicted to occur after 2060 under the current closure scenario. Similar to sulphate, dissolved zinc inflows immediately leaving the open cut lake are expected to exceed the SW11 trigger value between the years 2060 and 2100 with a maximum modelled zinc concentration of 0.159 mg/L. However due to the relatively small amount of outflow compared to the dilution provided by flow from the McArthur River at the same time the resultant zinc levels will below the trigger value by the time the water reaches SW11 (0.008 mg/L). After the year 2100, dissolved zinc concentrations in water flows from the open cut pit are predicted be similar to the trigger value specified in WDL178-08. In relation to biota in the section between the open cut outflow and SW11 the maximum concentrations are above that which freshwater communities have been observed in the McArthur River. If modelled concentrations are compared to previously discussed published literature tolerances for a range of tropic levels, and applying the 1/10th precautionary principle, it is likely that biota in the McArthur can tolerate dissolved zinc concentrations of at least double the maximum modelled concentration of 0.159 mg/L.

2.3.2 Barney and Surprise Creeks

Dissolved zinc concentrations within Barney and Surprise creeks are modelled to reach a maximum of 0.043 mg/L at BCS 1 and less than 0.030 mg/L at BSC2 for any given time period to 3018. These predicted dissolved zinc concentrations are no greater than concentrations currently observed in Barney or Surprise Creeks and as such, dissolved zinc is not expected to cause adverse effects on aquatic fauna or riparian vegetation within these ephemeral creeks.

In the context of suitability for human consumption and to reiterate recently provided information, the following may also be of value:

Aquatic fauna tissue sampling and analysis has occurred since 2006 to identify whether metals associated with MRM activities have entered the aquatic food chain. More recently, emphasis has been placed on the analysis of species which are considered to be commonly consumed in order to determine whether a risk to human health existed. Species were identified as being regularly caught and consumed throughout the freshwater sections of the McArthur River and neighbouring catchments through community consultations (Indo Pacific Environmental 2016a). As a result, monitoring includes the collection and analysis of tissues from *L. calcarifer*, *Hephaestus fuliginosus* (Sooty Grunter), *Toxotes chatareus* (Archer Fish), *Macrobrachium spinipes* (Cherabin) and *Velesunio angasi* (Freshwater Mussel).

Data collected to date demonstrates that the concentrations of metals within *L. calcarifer*, *H.fuliginosus*, *T. chatareus* and *M. spinipes* caught throughout the McArthur River catchment, including those collected from sites within the mineral lease, do not represent a risk to human health. From this standpoint these species are considered safe for human consumption. The concentrations of lead in finfish and crustaceans have been found to be well below the applicable Maximum Permissible Concentration (MPC) of 0.5 mg/kg and vastly larger consumption amounts than the current FSANZ Australia wide recommendation of 2-3 servings of fish per week could be safely ingested. Furthermore, the vast majority of consumption amounts calculated using the FSANZ methodology and presented throughout Indo-Pacific Environmental reports from 2014 to 2018 are considered unrealistic for even the most eager fisher to regularly catch and physically consume. Data to date indicates there is an extremely low risk to human health from consuming the monitored fish species caught in the McArthur River catchment downstream or upstream of the mineral lease.

Cheers

From:
Sent: Monday, 18 June 2018 3:31 PM

To:
Subject: MRM query - Supplement Appendix J

Hi ,

A response to issue 242 in Supplement Section 7.13 states: **Supplementary EIS Appendix J – Aquatic Fauna Update Report** also provides an assessment of the long-term effects of elevated sulphates and zinc on aquatic biota and riparian habitats in Barney Creek and McArthur River.

Can you please point out where in Appendix J the answer to the NT EPA's first dot point of issue 242 is?

Thanks

Assessment Officer | Environmental Assessment
Environment Division | Department of Environment and Natural Resources
Providing services for the
Northern Territory Environment Protection Authority
ntepa Northern Territory Environment Protection Authority
www.ntepa.nt.gov.au

Level 1, Arnhemica House, 16 Parap Road, Parap NT 0820
GPO Box 3675, Darwin NT 0801
p: | f: (08) 8942 6554
e: | www.nt.gov.au

Our Vision: Creating a public sector that provides the highest quality service to Territorians
Our Values: Commitment to Service | Ethical Practice | Respect | Accountability | Impartiality | Diversity

From:
Sent: Sunday, 24 June 2018 12:23 PM
To:
Cc:

Subject: Re: MRM 6 ML WTP

Follow Up Flag: Follow up
Flag Status: Flagged

Morning

The WTP is in commissioning now. It's too early to determine its performance and certainly too early to make any comments on upgrading. We have engaged the suppliers of the WTP to operate and maintain it for 12 months while we access the performance/operability/consumables usage rates etc. We need this information before to inform future upgrades.

Regards

Sent from my iPhone

On 24 Jun 2018, at 11:33 am, wrote:

> Good morning ,
>
> In my reviews of water management documentation I've come across some comments about the 6 ML/day water treatment plant proposed to be commissioned in late 2017. I had been under the impression that it was already operational. Is this WTP up and running yet? If so, how is it coping now with the water on site given that it's proposed to be upgraded soon?
>
> Thanks

Assessment Officer | Environmental Assessment
Environment Division | Department of Environment and Natural Resources

Providing services for the
Northern Territory Environment Protection Authority
<image001.png>
www.ntepa.nt.gov.au

Level 1, Arnhemica House, 16 Parap Road, Parap NT 0820
GPO Box 3675, Darwin NT 0801
p: | f: (08) 8942 6554
e: | www.nt.gov.au

Our Vision: Creating a public sector that provides the highest quality service to Territorians
Our Values: Commitment to Service | Ethical Practice | Respect | Accountability | Impartiality | Diversity

Please consider the environment before printing this email.

From:
Sent: Thursday, 28 June 2018 1:15 PM
To:
Cc:
Subject: RE: MRM isolated pit lake elevation scenario

Yes, about that.

Regards

METSERVE
Mining & Energy Technical Services Pty Ltd
PO Box 306
Fortitude Valley Qld 4006
Phone: 1300 078 518
Email:

From:
Sent: Thursday, 28 June 2018 1:42 PM
To:
Cc:
Subject: RE: MRM isolated pit lake elevation scenario

Thanks. So about 100 m below the pit crest at equilibrium in around 350 years?

Regards

Assessment Officer | Environmental Assessment
Environment Division | Department of Environment and Natural Resources

Providing services for the
Northern Territory Environment Protection Authority
ntepa Northern Territory Environment Protection Authority
www.ntepa.nt.gov.au

From:
Sent: Thursday, 28 June 2018 12:53 PM
To:
Cc:
Subject: MRM isolated pit lake elevation scenario

Hi

Further to your query (over the phone) on the mine pit lake level in the unmanaged, isolated mine pit lake scenario, please see below information.

Ground level (pit crest) sits at about 25-30m AHD.

Evaporation is a significant driver for water loss. In the isolated pit scenario the following drivers result in a net losing system:

Inflows:

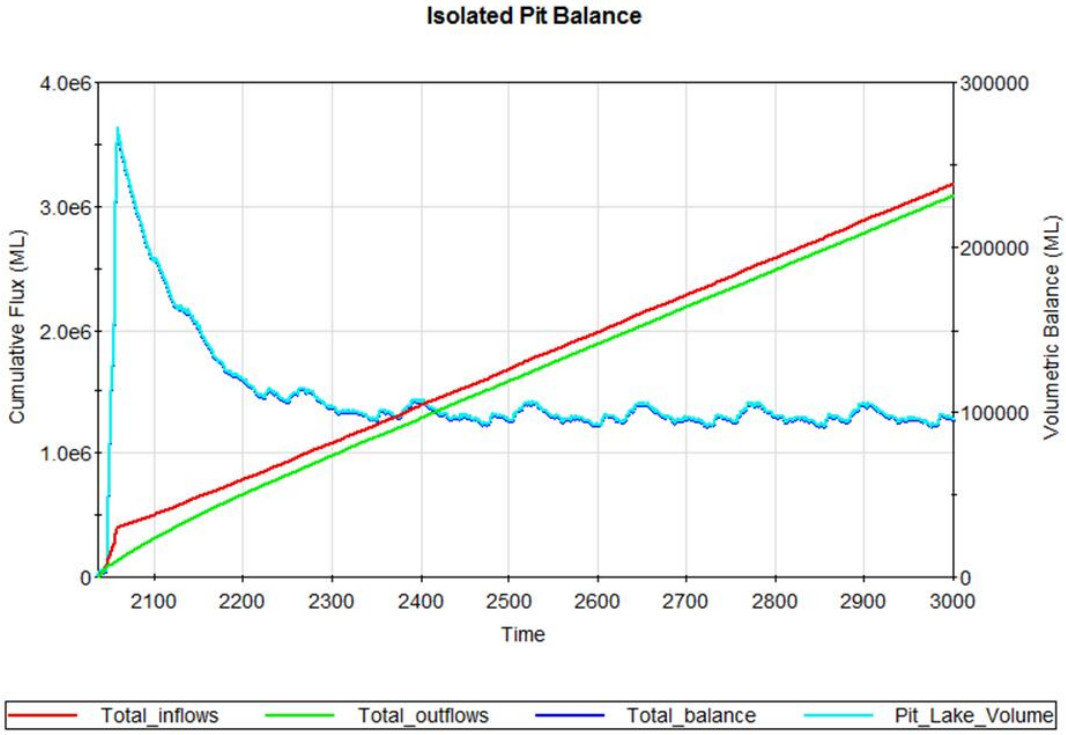
- Limited GW inflows ~800 ML/yr
- Direct RF +runoff per year 251 ha * 716mm/yr = ~1800 ML/yr
- Paleochannel ~400 ML/yr
- Tailings consolidation is a negligible contribution in long term

Losses:

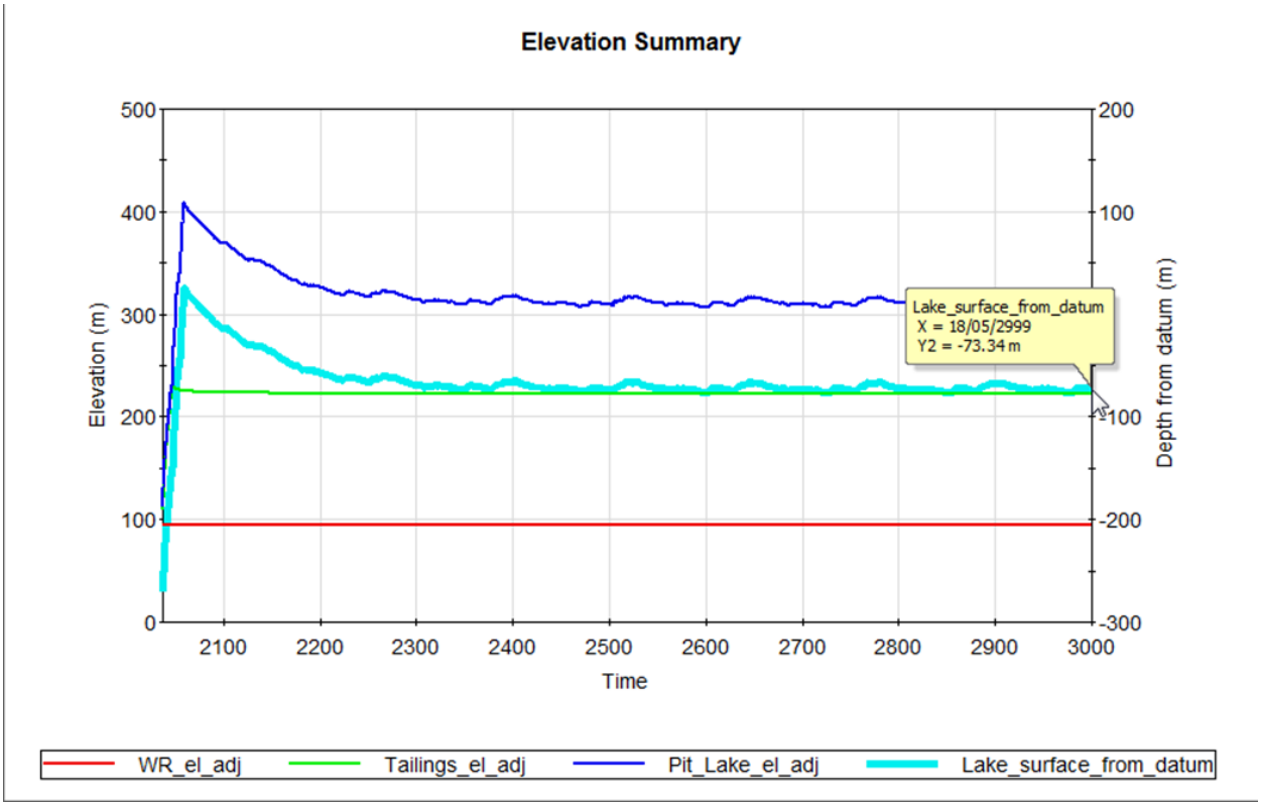
- Lake Evap: 2144mm/yr * 140ha = ~3000ML/yr

In the long term, this is balanced at a pit lake elevation of about -73m AHD.

The figure below plots cumulative inflows, cumulative outflows and the balance (when the red and green lines are parallel, the system is in steady state).



To answer your question – the elevation summary below gives some indication (the light blue line is the relevant prediction). In this simulation below the distance from datum is about -73m at simulation end (see the comment bubble) - but it takes about 350 years or so to stabilise. Also note, the lake level is above 0m AHD until 2080 for this scenario. The system is in a net loss state until the pit lake shrinks enough (and drops enough) that the increasing inflows from GW balance the shrinking losses from evaporation.



Regards

METSERVE
Mining & Energy Technical Services Pty Ltd
PO Box 306
Fortitude Valley Qld 4006
Phone: 1300 078 518
Email:

From:
Sent: Thursday, 26 July 2018 9:33 PM
To:
Cc:

Subject: Re: Requested Gouldian Finch information

Follow Up Flag: Flag for follow up
Flag Status: Flagged

Thanks

From:
Sent: Thursday, July 26, 2018 8:27:34 PM
To:
Cc: **Subject:** Requested Gouldian Finch information

Hi

Further to discussions with METServe, please see potential Gouldian Finch habitat disturbance figures associated with both the approved Phase 3 Development Project and the proposed Overburden Management Project. The Overburden Management Project disturbance figures are now based on the updated disturbance footprints presented in the Supplementary EIS (Figure 6-18).

Gouldian Finch potential habitat type	Area of potential Gouldian Finch habitat approved to be disturbed in Phase 3 Development Project (ha)	Area of potential Gouldian Finch habitat proposed to be disturbed in the Overburden Management Project (ha)	Difference in potential Gouldian Finch habitat proposed to be disturbed between Projects (ha)
Nesting	2.9	7.1	4.2
Feeding	433.8	438.9	5.1

Cheers