POTENTIAL IMPACTS OF SEEPAGE FROM WODGINA TSF3-EXT

Prepared for

MINERAL RESOURCES LIMITED

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EXECUTIVE SUMMARY

The key summary outcomes of the overall assessment are as follows:

- During the initial months of TSF3-EXT operation there was lower recycle pumping and higher seepage than is the case now, as the tailings circuit is still ramping up to design operation. This is typical for the start-up of any new processing and TSF facility.
- The current observed impacts of this seepage (rising water levels in some monitoring bores) are not unexpected and consistent with standard hydraulic models. It is also noted that the water level rise in the TSF3-EXT bores are also partly due to seasonal rainfall recharge.
- The predicted net impacts of "worst-case" seepage from TSF3-EXT over the life of the TSF on downstream groundwater are as follows:
    - Continued water level rises in TSX3-EXT bores, but still well below ground surface;
    - Negligible to no impact on groundwater levels downstream of TSF3; and
    - Travel time for seepage from TSF3-EXT to the toe of TSF3 of 5 to 10 years.
- The travel time of any seepage from TSF3-EXT and TSF3 to the main receptor (Turner River, 12km downstream of TSF3) is over 150 years.
- There are four "barriers of protection" for any possible impact on the Turner River:
    - Operation of the TSF3-EXT decant (re-cycle) pumping system:
    - Operation of the TSF3 recovery bores;
    - Very slow groundwater travel time from TSF3 to the Turner River and the hydro-geochemical solute attenuation process that will occur along the travel path; and
    - Operation of the Old Borefield.
- In conclusion:
    - Any groundwater (originating from TSF3) that discharges to the Turner River would be indistinguishable from any natural groundwater discharge; and
    - TSF3-EXT is operating in a manner that is not adversely impacting the environment and is moving towards a state that is consistent with its long term design expectations.

TABLE OF CONTENTS

1 BACKGROUND

Relevant background information, which provides some context for this assessment is as follows:

- Tailings deposition to the existing TSF3 commenced in 2001, by Sons of Gwalia and later Global Advanced Metals, and ceased in 2011.
- Mineral Resources Limited (MRL) acquired the Wodgina mine in 2017 and developed TSF3-EXT to facilitate renewed mining and ore processing.
- TSF3-EXT is a partially lined facility and was commissioned in April 2019.
- As with any new processing operation, the initial period of operation involves ramping up to design production, tailings discharge and tailing recycle water recovery. The tailings circuit typically does not operate in the initial commissioning phase as per the long-term (or steady state) design. This typically takes in the order of months.
- During the first three months of operation (April to June) various components of the tailings circuit operated outside of steady state design conditions. The solids content of the discharged tailings was lower (i.e. the water content higher), recycle pumping was lower, the volume of water ponding in the TSF was higher and seepage from the TSF was higher than the steady state design. As outlined above, this is not an unexpected outcome.
- Since the end of June, the tailings circuit has approached design operating conditions and the water balance model for TSF3-EXT shows a significant reduction in the volume of water ponded and seeping from the TSF.
- The water balance model, which was reviewed by Water, Waste and Land (WWL) Consulting Engineers and Scientists, also shows that ponded water and seepage should continue to decline in the coming months as recycle pumping increases, and that the TSF can continue to operate over the life of the facility as designed. It is noted that rainfall runoff to the TSF is a key component of the water balance, and the water balance has been run for average and above average rainfall conditions, including an additional 400mm cyclone event.

2 SEEPAGE CONDITIONS AND IMPACTS – PRE TSF3-EXT

The potential impacts of TSF3-EXT on downstream water resources (hydro-environment) cannot be considered in isolation, as the existing TSF3 (which ceased operation in 2011) also exerts some influence on the downstream hydro-environment.

Conditions prior to the commissioning of TSF3-EXT can be summarised as follows:

- There is a water table mound beneath TSF3 which is as a combination of a residual mound from previous tailings deposition (and seepage to groundwater beneath the TSF) and annual recharge by the infiltration of rainfall to the surface of the TSF.
- Groundwater flow from beneath TSF3 is largely to the north, following topographic gradient down the creek valley on which the TSF was constructed.
- Monitoring bores immediately downstream of TSF3 show groundwater levels ranging from 5m to 20m below ground level and show seasonal fluctuations of up to 10m in response to wet season rainfall recharge and post-wet season recovery.
- Monitoring bores downstream of the existing TSF3 typically show water quality characterised by brackish salinity (around 4,000 to 5,000mg/L total dissolved salts), sulphate concentrations of around 2,000mg/L and lithium concentrations of around 10 to 15mg/L.
- There are four existing seepage recovery bores immediately downstream of TSF3, which operate at low to moderate pumping rates, and pump water back to the plant.
- Groundwater from TSF3 will eventually move down-gradient to the north and then northeast following natural gradients and eventually reach the Turner River West some 18km downstream, where it may discharge to the Turner River as baseflow in the dry season.
- The estimated travel time for any groundwater to reach the Turner River (using a Darcy groundwater velocity model) is in excess of 150 years and could be over 1,000 years.
- Over the 12km seepage travel pathway and with the slow travel time, any residual seepage in the groundwater would be subjected to a number of hydro-chemical processes (dilution, dispersion, cation exchange and adsorption) that will result in the significant reduction in the concentrations of all solutes present.
- Operation of the existing Old Borefield (located along the groundwater/seepage pathway from TSF to the Turner River) would also intercept much of the groundwater/seepage flow originating at TSF3.
- Any groundwater originating from TSF3 that may eventually discharge to the Turner River would be indistinguishable from any natural groundwater discharge.

3 SEEPAGE CONDITIONS AND POTENTIAL IMPACTS – POST TSF3-EXT

The following presents a summary of the outcome of our assessment in relation to the net impacts of the operation of TSF3-EXT. It is noted that the following assessment assumes seepage at recent rates and reflects a worst-case scenario. As outlined in Section 1, the TSF3-EXT tailings circuit is approaching design steady state operating conditions and seepage will be much less than has been experienced over the last few months.

Key outcomes of our (conservative) assessment are:

- Groundwater levels in a geotechnical piezometer (in the downstream embankment of TSF3-EXT) and a monitoring bore (200m downstream of TSF3-EXT and installed into old tailings and foundation soils in TSF3) showed water level rises following the commissioning of TSF3-EXT.
- The water level rise in the geotechnical piezometer (around 8m compared with a 10m rise in the TSF3-EXT pond water level) is largely due to initial seepage from TSF3-EXT, although some component of water level rise is also likely due to wet season recharge to the old TSF tailings. The water level in this piezometer is around 35m below the bore collar at the crest of TSF3-EXT).
- The water level rise in the monitoring bore (around 5m) is due to a combination of seepage from TSF3-EXT and rainfall recharge to the old tailings. The water level in this bore is around 20m below the bore collar and top surface of the old TSF3 tailings.
- The water level rises in these bores reflect the transmission of hydraulic head from the TSF3-EXT pond and not the physical arrival of seepage. It is predicted (using a Darcy groundwater velocity model) that groundwater particles (i.e. seepage) from TSF3-EXT may have travelled around 75m downstream of TSF3-EXT since the start of tailings discharge and that it would take around 6 months to reach the monitoring bore.
- Comparison of water quality data from the pond (tailings decant) and the bore, confirms that the bore water quality is typical of in-situ water within TSF3 and not affected by the lower salinity pond water in TSF3-EXT.
- Predicted travel time for groundwater/seepage from TSF3-EXT to the downstream toe of TSF3 is around 5 to 10 years.
- The predicted worst-case rise in bore water levels near TSF3-EXT, assuming a pond water level at the emergency spillway level and using a Theis groundwater drawdown/mounding model), is around 30m in the geotechnical piezometer (15m below surface) and around 10m in the monitoring bore (10m below surface).
- The predicted net impact of the worst-case scenario described above on groundwater levels downstream at the downstream toe of TSF3 (some 1.5km to the north) ranges from a nil to around a 0.2m groundwater level rise.

4 REVIEWER

The lead reviewer and author of this report was Jon Hall, Consulting Hydrogeologist.

Jon has over 35 years' experience in mine water management consulting. He has local, national and international experience in all aspects of mine water management including mine dewatering/depressurisation, water supply, seepage management and integrated water management. He has worked on projects throughout Australia, in Asia, Africa, Europe and North America at all levels from field supervision, specialist technical input and project management and direction. Over the last 15 years he has also been commissioned by many international mining companies to provide high level technical and due diligence reviews relating to all facets of mine water management.

Jon has specific experience in the conceptualization, monitoring and management of seepage (to groundwater and surface water) from mine processing and waste facilities including mine water ponds, heap leach system, TSFs and waste rock dumps. Notable projects include the Boddington Gold Mine, Argyle Diamond Mine, Paraburdoo Iron Ore Mine and numerous gold mines in the Goldfields (WA); Ranger and Nabarlek Uranium Mines, Cosmo Howley and Pine Creek Gold Mines (NT); Rossing Uranium Mine (Namibia); Geita Gold Mine (Tanzania); Salamanca Uranium Project (Spain); and the BKM Copper Project (Indonesia).

Prior to joining AQ2 in August 2018, Jon was a founding director of Aquaterra, an international consultancy formed in 1998, which grew to over 100 professional staff operating from offices in Australia, Asia and Europe, before it became part of the RPS Group in 2010. He continued with RPS as Technical Director- Mining until leaving to join AQ2. His early career included a brief period as a mine geologist in South Australia and then four years as a hydrogeologist with the Geological Survey of WA before starting his consulting career with Australian Groundwater Consultants in 1983.

This report was reviewed internally by a senior hydrogeological consultant.