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From: I Epari

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cc:

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Project No. 623.030340.00002

RE: Millennium Mine Groundwater Technical Support Document for an EA Amendment

Introduction

The Millennium Coal Mine is located approximately 20 kilometres (km) south-east of the township of Moranbah, within the Isaac Regional Council Local Government Area (LGA) in Queensland.

The Millennium Mine consists of two mining areas with six contiguous mining leases (ML): the Mavis Downs area (ML 70457, ML 70483 and ML 70485); and the Millennium area (ML 70313, ML 70401, ML 70344). Together these MLs form a single operational project, the Millennium Mine. Millennium Mine operates under Environmental Authority (EA) EPML00819213. Millennium Mine is seeking an Environmental Authority (EA amendment) for EPML00819213, dated 12 June 2023.

In February 2024, SLR undertook the first Annual Hydrogeological Review under the new EA conditions (SLR, 2024). The review identified two items that should be resolved with an EA amendment:

- Streamlining the water quality trigger limit approach; and
- Change the trigger limit for EC for bore MB10B due to an error in the original derivation process identified after recent exceedances.

This memo provides context to these proposed changes and forms an amendment to the trigger limit derivation report (SLR, 2023).

Assessment of trigger limit methodology

SLR undertook a groundwater quality trigger limit derivation in 2023 in accordance with the DESI's guideline "*Using monitoring data to assess groundwater quality and potential environmental impacts* (DES, 2021). This work was documented in a report (SLR, 2023).

Following the DESI guideline to derive the triggers, a statistical summary of the monitoring data was created, and the resulting percentile concentrations were compared against the regional Water Quality Objectives (WQO) (Fitzroy Groundwater Chemistry Zone 34, shallow and deep) as well as the Default Toxicant Guidelines (ANZG, 2018).

DES, 2021 Section 6.1 states: *The compliance approaches recommended in this guideline for groundwater quality assessment are based on comparing a number of consecutive sample tests at compliance bores to a limit based on percentile calculations. This approach is aimed at reducing the probability of a false positive, or what is referred to as a false non-compliance in regards to regulation while ensure approaches are sufficiently sensitive to detect potential impacts.*

The DESI guidelines propose two compliances approaches for defining groundwater quality trigger levels:

- *Single Limit (95th percentile) – 3 consecutive test samples exceed the limit. If a toxicant default guideline (ANZG 2018) is adopted, this can be applied as the limit.*

- *Limit A (80th percentile) and Limit B (95th percentile) – 5 consecutive test samples exceed the Limit A and 3 consecutive test samples exceed the Limit B. If toxicant default guideline (ANZG 2018) is adopted, it should be applied as a Limit B not Limit A.*

For many of the analytes (particularly metals) no site-specific limits could be derived for Millennium Mine due to the percentage of values below LOR. Therefore, it was proposed to use a Limit B only approach to defining the trigger limits, i.e. three consecutive sampling events show concentrations above the relevant Limit are required to constitute a Limit exceedance in the EA.

DESI proposed EA conditions in line with the proposed derived limits. However, one deviation from the trigger limit derivation report (SLR, 2023) is Condition D4.0, which states:

Groundwater contaminant levels measured for monitoring bores identified in Table D1 – Groundwater monitoring locations and frequency for contaminant levels defined in Table D2: Groundwater contaminant trigger levels must not be exceeded on:

- a) Three (3) consecutive occasions for values derived from site specific data;*
- b) Any single occasion for values derived from ANZG (2018) or other guideline values;*
- c) Two (2) consecutive occasions for values derived from Fitzroy Water Plan WQO values.*

In SLR's opinion, the deviation from the compliance approach (that followed DES' guidelines) has the potential of creating compliance notifications and investigations based on a false-positive (an exceedance where there is none). A false positive reading could be related to an incorrect sampling technique, a laboratory error or a genuine outlier in water quality. Subsequent sampling rounds can then show if the reading above a limit persists, in which case a notification and investigation is warranted.

According to the DES guidelines, the risk of a false positive reduces with every consecutive exceedance, in the case of Limit B from 5% for one single event, to 0.25% for two consecutive events and finally to 0.0125% for three consecutive events.

It is recommended to harmonise the compliance approach to a Limit B limit with three consecutive exceedances for all water quality parameters, independent on how they were derived.

Proposed Trigger limit change EC at MB10B

Review of EC at Bore MB10A/B

The Annual Review (SLR, 2024) showed that the electrical conductivity (EC) at MB10B is increasing, and will be likely triggering the three consecutive exceedances in the next monitoring round. The EC is a measure of the salinity of the groundwater, which can naturally vary.

Potential causes for this change in EC at the bore are either natural (response to recharge or evaporation) or mining related (which could be change in flow patterns that bring different types of groundwater into the location around a bore in question).

The comparison of the water levels at MB10A and water levels in the deeper nested bore MB10B (**Figure 1**) shows that water levels in both bores respond to the overall climatic trends, with the water levels decreasing during drier times (decreasing slope in the CRD) and increasing during wetter periods.



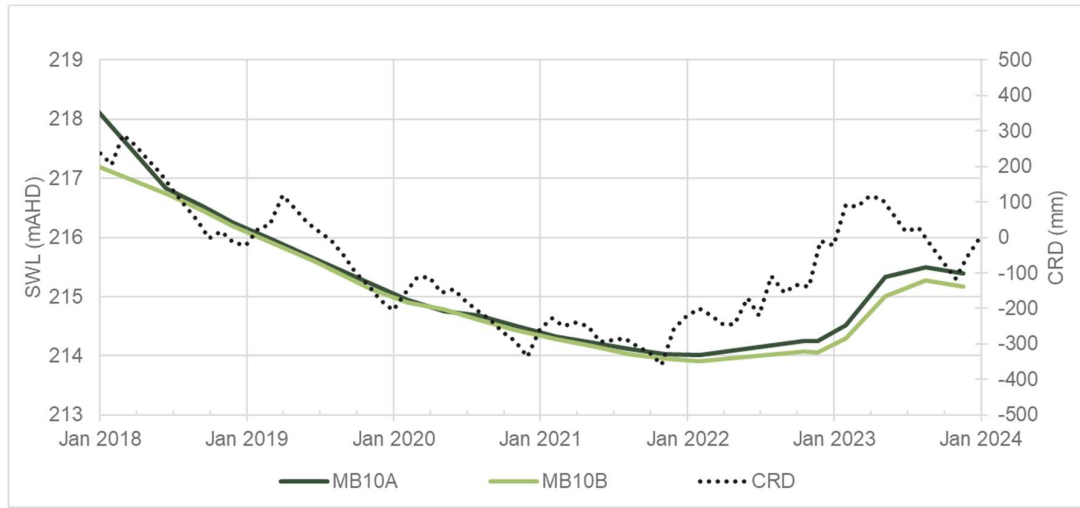


Figure 1 Water Levels at MB10A and MB10B against CRD

A comparison of the EC at the two bores MB10A and MB10B (**Figure 2**) showed that EC at the shallower bore MB10A had generally lower levels, likely due to a better connection to a potential rainfall recharge zone. The EC is relatively stable at the shallow bore, showing a slight increase in EC during the dryer period up to January 2022 and a slight reduction in EC following rainfall recharge following January 2022. Rainfall recharge is diluting the groundwater after a wetter period such as 2022.

The EC at the deeper MB10B also experienced a small EC increase between 2018 and 2022 and has since 2022 increased and stabilised at a new higher level. From the available data set it cannot be concluded what caused the change in EC. However, the value is well below the regional water quality objectives (WQO) of 16,000 $\mu\text{S}/\text{cm}$ (DEHP, 2011) at this location, which means that regional WQO are maintained and the observed increase in EC does not pose a risk of harm to the environment.

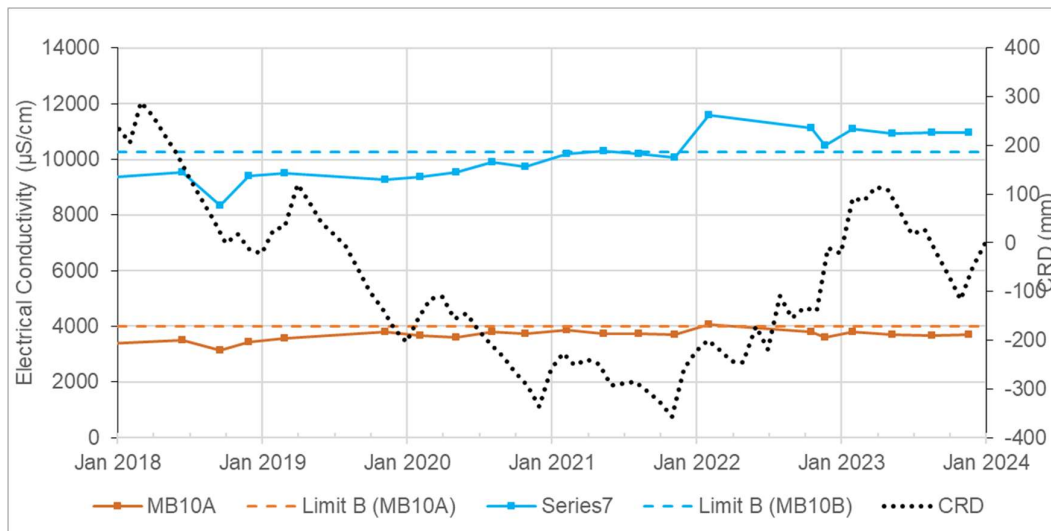


Figure 2 Field EC at MB10A and MB10B against CRD



Review of the trigger limit at MB10B

When undertaking the trigger limit review (SLR, 2023), the trigger limit for Field EC at MB10B was mistakenly based on site-specific data. As can be seen on the trigger limit derivation table reproduced in **Appendix A**, Field EC at MB10B had shown an increasing trend, which – based on the guidelines – makes the dataset unsuitable for deriving a site-specific trigger limit and a suitable and relevant guideline value should be used instead. As an example for a correct application of the methodology, the same increasing trend was identified for chloride, for which a guideline value was applied (refer to **Appendix A**).

The 80th percentile for EC for MB10B was 9,957 $\mu\text{S}/\text{cm}$, and the 95th percentile was 10,265 $\mu\text{S}/\text{cm}$ (SLR, 2023 and **Appendix A**). Both values are well below the Fitzroy WQ1310 WQO (Zone 34) value of 16,000 $\mu\text{S}/\text{cm}$ (DEHP, 2011). To account for the increasing trend and maintaining regional water quality objectives, the Fitzroy WQOs is deemed suitable and relevant to be applied to EC at this bore. It is recommended to change the trigger limit at EC10B from 10,265 $\mu\text{S}/\text{cm}$ to 16,000 $\mu\text{S}/\text{cm}$.

Recommendations

The following groundwater related changes of the EA are proposed for this EA amendment:

- Harmonise the compliance approach to a Limit B limit with three consecutive exceedances for all water quality parameters, independent on how they were derived (Condition D4.0).
- In EA table D2, change the trigger limit for EC from the site specific 95th percentile (10,265 $\mu\text{S}/\text{cm}$) to a guideline value (16,000 $\mu\text{S}/\text{cm}$, Fitzroy WQO, Zone 34 deep).

Minor editorial amendments:

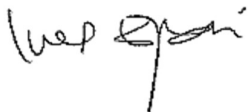
- In EA table D2, replace Lab EC with Field EC, as the site-specific trigger limits were derived based on the Field EC, not the Lab EC.
- In EA table D2, replace “(dissolved *)” with “(dissolved)”, i.e. replace the star with a closed bracket.

Closure

This memo was written to support an EA amendment for condition 4.0 of Millennium’s EA (EPML00819213) as well as a change of the trigger limit for Field EC at MB10B.

Regards,

SLR Consulting Australia



Ines Epari
Principal Consultant



References

ANZG, 2018. *Australian and New Zealand Guidelines (ANZG) for Fresh and Marine Water Quality. (2018)*. Canberra, ACT, Australia: Australian and New Zealand Governments and Australian state and territory governments.

Department of Environment and Heritage Protection (DEHP), 2011. *Environmental Protection (Water) Policy 2009 Fitzroy River Sub-basin Environmental Values and Water Quality Objectives Basin No. 130 (part), including all waters of the Fitzroy River Sub-basin* September 2011

Department of Environment and Science (DES), 2021. *Using monitoring data to assess groundwater quality and potential environmental impacts*, version 2.

SLR, 2023: *Millennium Mine Groundwater Network Review and Trigger Assessment*, SLR Ref: 620.30802.00000-R02, Version No: -v3.0, February 2023

SLR, 2024: *Millennium Mine Groundwater Monitoring 2023 Annual Review*, dated 29 February 2024, report number 623.030340.00001 -R01, v2.0.



Appendix A – MB10B trigger derivation table (from SLR, 2023)

MB10B

	Field pH	Field EC	Sulfate as SO4	Chloride	Aluminium Dissolved	Antimony Dissolved	Arsenic Dissolved	Copper - Dissolved	Iron Dissolved	Mercury Dissolved	Molybdenum Dissolved	Selenium Dissolved	Silver Dissolved	Zinc Dissolved	C6 - C10 Fraction	C10 - C40 Fraction
	pH Unit	(µS/cm)	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	(µg/L)	(µg/L)
Water quality Guidelines																
ANZECC Aquatic Ecosystem (95%) Protection Guideline (ANZIS 2018)	6.0-7.5	250	-		0.055	0.009	0.013	0.0014	-	0.0006	0.034	0.011	0.00001	0.008		
ANZECC Stock watering Guidelines	6.0 - 8.5	7500	1000		5	-	0.5	0.4	-	0.002	0.15	0.02	-	20		
ANZECC Guidelines – Irrigation ST	6.0 - 8.5				20		2	5	10	0.002	0.05	0.05		5		
ANZECC Guidelines – Irrigation LT	6.0 - 8.5				5		0.1	0.2	0.2	0.002	0.01	0.02		2		
Fitzroy WQ1310 WQO Zone 34 (shallow)	7.1-8.1	8910	318	3185	-		-	0.03	0.14	-	-	-		0.06		
Fitzroy WQ1310 WQO Zone 34 (deep)	7.4-8.0	16000	398	5905				0.03	0.246					0.317		
DES, 2013															20	100
Statistics																
Count	30	28	30	25	25	27	25	3	30	29	24	24	29	3	26	27
% of values below LOR	0	0	0	0	100	100	100	100	40	100	83	100	100	67	8	100
Minimum Date	30/01/2014	30/01/2014	30/01/2014	13/08/2014	30/01/2014	30/04/2014	14/10/2014	30/01/2014	30/01/2014	30/01/2014	30/04/2014	30/01/2014	30/01/2014	30/01/2014	30/04/2014	30/01/2014
Maximum Date	19/10/2022	19/10/2022	19/10/2022	19/10/2022	08/11/2021	19/10/2022	19/10/2022	13/08/2014	19/10/2022	19/10/2022	19/10/2022	27/10/2020	19/10/2022	13/08/2014	19/10/2022	19/10/2022
Minimum	6.4	7700	42	2520	0.0025	0.0005	0.0005	0.0005	0.025	0.00005	0.0005	0.0025	0.0005	0.00125	10	50
5th percentile	6.7	7973	46	2764	0.0025	0.0005	0.0005	0.0005	0.025	0.00005	0.0005	0.0025	0.0005	0.00125	15	50
20th Percentile	6.9	8792	59	3030	0.0025	0.0005	0.0005	0.0005	0.025	0.00005	0.0005	0.0025	0.0005	0.00125	40	50
Median	7.0	9390	97	3150	0.0025	0.0005	0.0005	0.0005	0.465	0.00005	0.0005	0.0025	0.0005	0.00125	60	50
80th Percentile	7.4	9957	127	3382	0.0025	0.0005	0.0005	0.0005	0.87	0.00005	0.0005	0.0025	0.0005	0.00047	80	50
95th Percentile	7.7	10265	174	3682	0.005	0.0005	0.0005	0.0005	1.03	0.00005	0.001	0.0025	0.0005	0.006425	107.5	50
Maximum	7.8	11129	196	3710	0.005	0.0005	0.0005	0.0005	1.14	0.00005	0.001	0.0025	0.0005	0.007	120	50
Trigger derivation considerations																
Trigger Development not possible due less than 8 samples																
Trigger Development not possible due to more than 15% of values <LOR					x	x	x	x	x	x	x	x	x	x		x
Mann Kendall trend	decreasing	increasing	decreasing	increasing	increasing				increasing		decreasing				decreasing	
Proposed Trigger limits																
Limit A (80th Percentile)		9957	127													
Limit B (95th Percentile) or applicable guideline	6.0-7.5	10265	174	5905	0.055	0.009	0.013	0.0014	0.246	0.0006	0.034	0.011	below LOR	0.008	20	100

