C&R CONSULTING
Geochemical & Hydrobiological Solutions Pty Ltd
ABN 72 077 518 784

Underground Coal Gasification / Coal Seam Gas Investigations
Mineralogical, Geological, Petrographic and Soils Services
Hydrogeomorphic and Palaeogeomorphic Evaluations
Terrestrial and Aquatic Fauna and Flora Surveys
Climate History and Extreme Events Analysis
Contaminated Site and Mine Water Analysis
Environmental Compliance and Monitoring
Estuarine and Marine Water Assessments
Registered Research and Development
Surface and Groundwater Hydrology

PO Box 1777
Thuringowa, Qld 4817, Australia
Tel: +61 (0) 7 4725 3751
info@candrconsulting.com.au
www.candrconsulting.com.au

13 November 2022

Francis Kuranchie
Environmental Superintendent
Millennium Mine
M Mining Pty Ltd

Dear Mr Kuranchie,

Re: Environmental Authority Table C2 Amendment

M Mining Pty Ltd (M Mining) are in the process of amending the contaminant release limits for turbidity and suspended solids (SS) (in '*Table C2: Mine affected water release limits*') in the Millennium Mine (MM) environmental authority (EA) EPML00819213. Currently, the contaminant release limits within Table C2 for turbidity and SS are listed as '*TBA*' (i.e. 'to be advised'). The footnote below Table C2 within the EA states that M Mining must amend the contaminant release limits for these two quality characteristics prior to 7 December 2022.

Consequently, M Mining requested the assistance of C&R Consulting Pty Ltd (C&R) in determining appropriate site-specific levels of turbidity and SS to ensure the protection of downstream environmental values. The receiving environments of MM are stated within the EA as New Chum Creek, West Creek and North Creek – as well as any connected waterways within 10 km downstream of the release points. Therefore, the receiving environments include the Isaac River.

In a letter dated 23 August 2022, C&R provided M Mining an assessment of background water quality from the Isaac River to meet data requirements for deriving site-specific water quality objectives in accordance with the *Queensland water quality guidelines* (DEHP, 2009[1]), ANZECC and ARMCANZ, 2000[2] and DES, 2021[3]. The letter proposed contaminant release limits for turbidity and SS based on the 80th percentiles of the background data to be submitted to the Department of Environment and Science (the Department).

Subsequently, M Mining has advised C&R that the Department provided feedback on the proposed contaminant release limits, requesting any available background data from New Chum Creek and the

[1] DEHP (2009) *Queensland water quality guidelines*, Version 3. Department of Environment and Heritage Protection, Queensland. ISBN 978-0-9806986-0-2, pp. 184..
[2] ANZECC and ARMCANZ (2000). *Australian and New Zealand guidelines for fresh and marine water quality.* National Water Quality Management Strategy. Australian and New Zealand Environment and Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand, Canberra.
[3] DES (2021). *Using monitoring data to assess groundwater quality and potential environmental impacts. Version 2.* Department of Environment and Science (DES), Queensland Government, Brisbane, pp. 60.

receiving waters contaminant trigger level for SS (258 mg/L) from Table C7 of the EA, be considered when determining the release limits.

Table 1 below provides summary statistics for background (i.e. upstream of M Mining operations) samples collected from New Chum Creek or its tributaries in 2021 and 2022. The validity of the data were questioned and, subsequently not included in the initial assessment undertaken by C&R (detailed in the letter dated 23 August 2022), as many of the results are from rising stage samplers or gauging stations, where samples can sit for long periods before being assessed by the laboratory. Further, many of these samples were collected from tributaries of New Chum Creek and were not sampled from the New Chum Creek reference point designated within the EA (i.e. MP1; Table 1).

Table 1: Summary statistics for background samples collected from New Chum Creek.

Date	Sample ID	Turbidity (NTU)	Suspended Solids (mg/L)
17/06/2021	GS_MP_US3_3	362	162
17/06/2021	GS_MP_US3_2	593	396
18/06/2021	RSS1	2,160	1,460
18/06/2021	GS_MP_US3_1	1,190	367
18/06/2021	RSS2	1,450	330
17/06/2021	NCGULLY	1,210	437
6/07/2021	RSS1	1,380	550
3/07/2021	GS_MP1-1	858	435
15/11/2021	GS1_MP1_AS	1,650	1,760
15/11/2021	RSS1	2,350	960
2/07/2022	US Access Road	329	154
Descriptive statistics			
Count		11	11
Minimum		329	154
50th percentile		1,210	435
80th percentile		1,650	960
95th percentile		2,255	1,610
Maximum		2,350	1,760
Mean		1,230	637
Standard deviation		638	506
Coefficient of variance		52%	79%
Outlier identifier		3,782	2,661

The summary statistics reveal that the minimum background SS for New Chum Creek (329 mg/L) is greater than the current receiving waters contaminant trigger level (258 mg/L as outlined in Table C7 of the EA). This suggests that MM is unlikely to meet this downstream objective during natural flow

events (i.e. regardless of undertaking releases), and that the current receiving waters contaminant trigger level (from EA Table C7) may not be suitable. It is not known how the 258 mg/L trigger level detailed for SS in Table C7 of the EA was developed. However, it is highly recommended that this value also be amended to the 80th percentile of reference site(s), equivalent to the proposed release objective.

Table 2 compares the summary statistics for New Chum Creek to those developed for the Isaac River (from the initial C&R letter dated 23 August 2022), while also providing statistics for a pooled dataset of both watercourses. Table 2 shows that there are differences between the median (50th percentile) values of the two watercourses' datasets (for both quality characteristics) but these differences are within the standard deviation range of each dataset. Based on these results an independent samples test was performed on each quality characteristic, comparing the datasets from New Chum Creek and Isaac River. Table 3 shows that while there appears to be a significant difference in the variance of the two datasets for turbidity (i.e. a significant result for Levene's test), there is no significant difference between the means of either dataset for each quality characteristic (i.e. $p > 0.05$ for both t-test results). This suggests that the two datasets are similar and can be combined to develop site-specific objectives. Therefore, if the validity of the New Chum Creek data are ignored, it is appropriate to adopt the 80th percentile of the pooled dataset as the site-specific trigger levels for turbidity and SS within EA Table C2, as well as for SS in Table C7.

Table 2: Summary statistics for background samples collected from New Chum Creek and Isaac River.

Statistic	New Chum Creek	Isaac River	Pooled data
Turbidity (NTU)			
Count	11	25	36
Minimum	329	169	169
50th percentile	1,210	933	1,145
80th percentile	1,650	2,314	2,160
95th percentile	2,255	3,716	3,513
Maximum	2,350	5,210	5,210
Mean	1,230	1,451	1,384
Standard deviation	638	1,322	1,161
Coefficient of variance	52%	91%	84%
Outlier identifier	3,782	6,738	6,028
Suspended solids (mg/L)			
Count	11	24	35
Minimum	154	21	21
50th percentile	435	601	437
80th percentile	960	1,574	1,404
95th percentile	1,610	3,160	2,940
Maximum	1,760	4,780	4,780

Statistic	New Chum Creek	Isaac River	Pooled data
Mean	637	1,023	902
Standard deviation	506	1,188	1,039
Coefficient of variance	79%	116%	115%
Outlier identifier	2,661	5,774	5,058

Table 3: Independent samples test results to determine the significant difference between the two sets of data (i.e. New Chum Creek data and Isaac River data).

Quality characteristic		Levene's Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean diff.	Std. err. diff.	95% CI	
									Lower	Upper
Turbidity	Equal variances assumed	4.812	.035	-.513	34	.611	-220.94	430.57	-1095.97	654.09
	Equal variances not assumed			-.656	33.33	.516	-220.94	336.89	-906.09	464.22
Suspended solids	Equal variances assumed	3.983	.054	-1.004	33	.323	-385.47	383.84	-1166.39	395.45
	Equal variances not assumed			-1.307	32.99	.200	-385.47	294.84	-985.33	214.39

Where:
F = the test statistic of Levene's test.
Sig. = the p-value corresponding to Levene's test statistic (we assume a p-value of <0.05 is a significant relationship).
t = the t-test statistic.
df = degrees of freedom.
Sig. (2-tailed) = p-value corresponding to the given t-test statistic and degrees of freedom.
Mean diff. = difference between the sample means.
Std. err. diff. = standard error of the mean difference estimate.
CI = confidence interval.

If you have any further questions, please do not hesitate to contact me.

Regards,

Matt Knott

Senior Scientist/Manager
C&R Consulting Pty Ltd