Vickery Extension Project Surface Water Assessment Independent Review

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1 Introduction

BMT was commissioned by the NSW Department of Environment and Planning to complete an independent review of the surface water assessment completed by Advisian as part of the Environmental Impact Statement for the Vickery Extension Project. The review was conducted by Martin Giles, a Senior Principal with BMT.

The review primarily considered the information provided in Appendix B (Surface Water Assessment) of the Vickery Extension Project Environmental Impact Statement, namely the Advisian report *Vickery Extension Project, Surface Water Assessment* (August 2018). The report is referenced in this review as the **Surface Water Assessment**, with page and section references provided as appropriate to the sections of the report being considered.

To provide information to assist in the review, the following documents were also considered:

- Whitehaven Coal, 2018. Vickery Extension Project, Environmental Impact Statement, *Executive Summary.*
- Geo-Environmental Management, 2018. *Vickery Extension Project, Geochemistry Assessment of Overburden, Interburden and Coal Rejects*, April (Appendix M, Geochemistry Assessment of the Vickery Extension Project Environmental Impact Statement) (hereafter referred to as the **Geochemistry Assessment**).
- Attachment 4, Peer Review Letters, *Vickery Extension Project, Environmental Impact Statement*
- Environmental Protection Licences issued to Maules Creek Coal Mine, Tarrawonga Coal Mine, and Boggabri Coal.
- WRM, 2018. *Vickery Extension Project, Flood Assessment,* August (Appendix C, Flood Assessment of the Vickery Extension Project Environmental Impact Statement) (hereafter referred to as the **Flood Assessment**).
- Australian and New Zealand Environment and Conservation Council, 2000, *Australian and New Zealand Guidelines for Fresh and Marine Water Quality, Volume 1, The Guidelines (Chapters 1-7)*, October (hereafter referred to as **ANZECC 2000**).
- Australian and New Zealand Governments and Australian state and territory governments, 2018. *Australian and New Zealand Guidelines for Fresh and Marine Water Quality*, www.waterquality.gov.au/anz-guidelines (accessed 19 November 2018) (hereafter referred to as **ANZG 2018**).

Although ANZG 2018 represents the most recent information available in relation to water quality, only a limited amount of data, most of which refers to the previous ANZECC 2000 guidelines, is currently included in the guidelines. For example, no guideline data is yet available for inland waters in New South Wales and new livestock drinking guidelines are not expected to be released until 2019. Given this, the text refers to parameters nominated in the ANZECC 2000 guidelines unless a specific value is included in the ANZG 2018.

Based on the review, it is considered that the parameters and methodology adopted for the modelling of surface water are appropriate. The results obtained from the modelling can be used to consider the water balance of the mine and the likelihood of discharges occurring from the mine to receiving downstream watercourses.

However, the assessment is considered to be deficient in relation to its consideration of existing water quality, and the potential for discharge from the site to adversely impact on local water quality.

The review has identified a number of concerns that need to be addressed in order to confirm that the mine will not adversely impact on downstream watercourses.

2 Surface Water Quality

2.1 Watercourse Water Quality Data

Table 6.1 of the Surface Water Assessment provides a summary of regional average water quality data for the area, including the Namoi River and Maules Creek. The table presents data for 6 sites:

- Namoi River: Gunnedah (419001);
- Namoi River: Barbers Lagoon (downstream of Bollol Creek) (41910214);
- Namoi River: Driggle Draggle Creek at Boggabri (419032);
- Namoi River: Coxs Creek at Boggabri (419032);
- Maules Creek: Damsite (419044); and
- Maules Creek: Avoca East (419051).

The table lists water quality results for pH, Electrical Conductivity, Alkalinity, Turbidity, Total Nitrogen, and Total Phosphorus, although data for all of the parameters is not available for most of the sites.

Table 6.3 of the Surface Water Assessment presents a summary of the results obtained at a number of other sites, with the results obtained at each site listed in Appendix A of the Surface Water Assessment. At these other sites, the set of water quality parameters tested was more limited, with Appendix A containing results for pH, Electrical Conductivity, Total Suspended Solids, Total Organic Carbon, and Grease and Oil.

The number of samples collected at each of the other sites can be summarised as follows:

- *SW2 (Nagero Creek, sourced from Boggabri Coal Mine):* 6 samples (2008-2012);
- *BCU (Bollol Creek, sourced from Tarrawonga Coal Mine):* 13 samples (2007-2016);
- *WW11 (Driggle Draggle Creek, sourced from Canyon Coal Mine):* 29 samples (2006-2015);
- *SD7 (Stratford Creek Catchment, sourced from Rocglen Coal Mine):* 28 samples (2010-2016);
- *BR (Project Monitoring Site):* 10 samples (2011-2016);
- *JR (Project Monitoring Site):* 12 samples (2011-2016);
- *VUD (Project Monitoring Site):* 14 samples (2011-2016);
- *VUD-OR (Project Monitoring Site):* 19 samples (2011-2016);
- *VUS (Project Monitoring Site):* 20 samples (2011-2016);
- *1986 EIS Monitoring:* 1 sample summary at each of 11 sites (1986);

The location of each sampling sites referenced in the table is shown in Figure 5-1 of the Surface Water Assessment. Figure 5-1 is reproduced in .

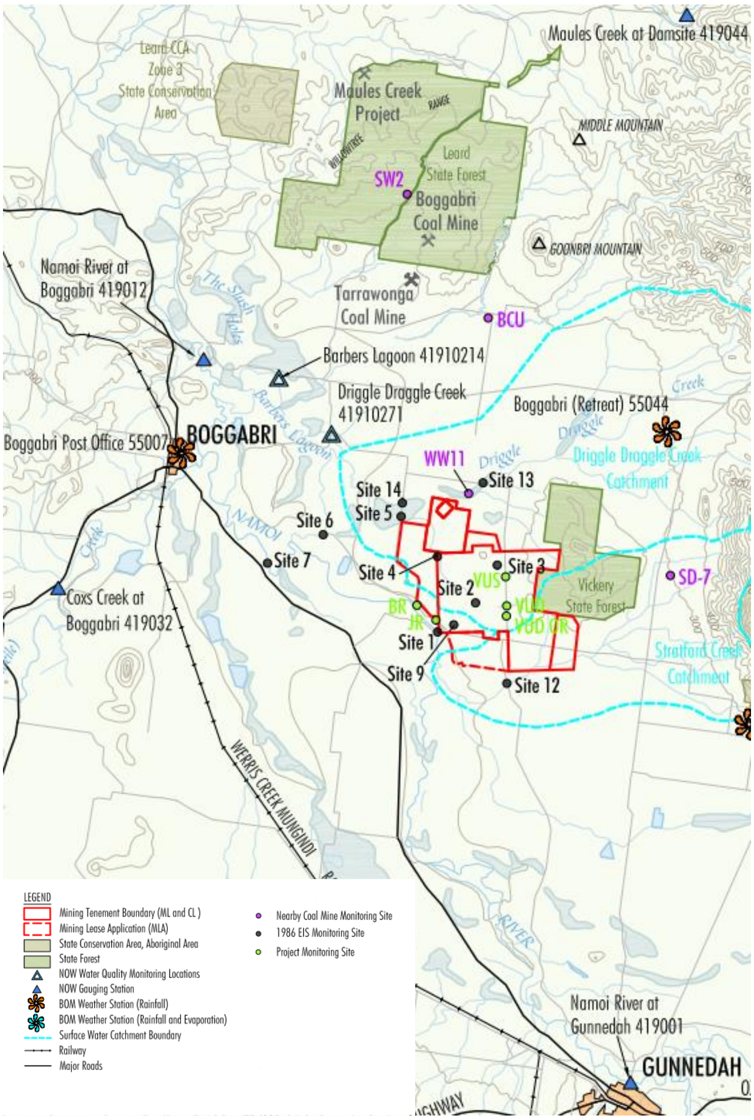

Figure 2-1 Water Quality Sampling Locations (Figure 5-1 of Surface Water Assessment)

The average data presented in Table 6.1 and Table 6.3 of the Surface Water Assessment are summarised in . The table also lists the ANZECC 2000 trigger values for ecosystem protection of upland rivers in south-eastern Australia, irrigation water, and stock water.

Table 2-1 Surface Water Assessment- Water Quality Summary

Station	pH	EC (µS/cm)	Alkalinity (mg/L)	Turbidity (NTU)	Total Nitrogen (mg/L)	Total Phosphorus (mg/L)	Total Suspended Solids (mg/L)
Namoi River							
Gunnedah (419001)	8.06	497	204	67.3	0.72	0.14	-
Barbers Lagoon (41910214)	7.70	348	-	304	-	-	-
Driggle Draggle Ck, Boggabri (41910271)	6.99	117	-	-	-	-	-
Coxs Creek at Boggabri (419032)	-	495	-	98.7	-	-	-
Maules Creek							
Damsite (419044)	7.70	537	-	21	-	-	-
Avoca East (419051)	7.56	351	141	13.5	0.43	0.15	-
Other Sites							
SW2-Nagero Creek	7.1 (7.0-7.4)	98 (56-160)	-	-	-	-	95 (42-110)
BCU-Bollol Creek	7.0 (6.8-7.3)	169 (124-192)	-	-	-	-	164 (39-210)
WW11- Driggle Draggle Creek	7.1 (6.7-7.3)	96 (67-122)	-	-	-	-	109 (31-134)
SD7	8.0 (7.5-8.4)	220 (154-231)	-	-	-	-	52 (14-74)
Project Monitoring Data (BR,JR,VUD,VUD-OR,VUS)	7.0 (6.9-7.2)	73 (39-96)	-	-	-	-	42 (10-43)
1986 EIS	8.1 (7.7-8.5)	456 (151-511)	-	-	-	-	77 (36-116)
ANZECC 2000							
Default trigger values	6.5-7.5	30-350	-	2	0.25	0.02	-
Limit for irrigation	6-8.5	<1,100	-	-	-	-	-
Limit for Stock Water	-	<3,700	-	-	-	-	-

Notes: Location of sites shown on Figure 2-1.
Figures for other sites shown as average value, with 20th and 80th percentiles shown in brackets).
Figures taken from Table 6.1 and Table 6.3 of the Surface Water Assessment.

The water quality sampling data presented in the Surface Water Assessment is of limited value, only providing an overview of regional stream characteristics for a narrow range of parameters and very limited data for the watercourses that could receive runoff from mining activities.

For example, the values quoted from the 1986 are over 30 years old. Although it is beneficial to have records for a long period, an isolated set of data of such age is of limited use.

Further, it would appear that the values presented in the Surface Water Assessment reflect the arithmetic average of the results rather than median values. When considering water quality data, it is preferable to use median data to avoid outlier values. In the case of the 1986 data, the use of arithmetic averaging results in the high Electrical Conductivity value recorded at the 11 sites being skewed by the 2,489 µS/cm value recorded at Site 9. In comparison, the second largest reading was 517 µS/cm. The median value for the 11 sites is 185 µS/cm rather than the 456 µS/cm nominated in the assessment. Based on the median value, the Electrical Conductivity at the sites sampled in 1986 is typically within the ANZECC trigger value.

In addition, many of the sites for which data is presented (for example BCU, SW2, Maules Creek at Damsite) are located well outside the catchments that drain through the site. While they provide an indication of the general quality of water in the region, the results cannot be used to assess the quality of the water in the watercourses downstream of the mine.

The value of data collected at other sites is also questionable as some of the project monitoring sites will ultimately be removed by mining activities.

The status of receiving waters with respect to heavy metals is also not discussed in the Surface Water Assessment as no base line monitoring results for heavy metals are presented in the assessment.

The Surface Water Assessment notes that the trigger values presented in ANZECC 2000 are conservative assessment levels and that local conditions vary naturally between waterways (p53). Given this, it is agreed that it is necessary to tailor trigger values to local conditions. It is also agreed that the limited data presented with respect to regional water quality suggests that the existing quality of water exceeds the trigger levels.

Consequently, it would not be appropriate to apply discharge standards to the sediment dams based on the trigger values nominated in ANZECC 2000.

The Surface Water Assessment notes that *'trigger values for receiving watercourses will be prepared as part of the Water Management Plan for the Project'* (p53). To define trigger values it is necessary to collect sufficient samples at representative locations over a reasonable length of time in order that seasonal and climatic variations are included in the data set.

As the original mine was approved in 2014, there has been ample opportunity (both before and subsequent to the approval) to define recording sites and to complete an appropriate sampling program to establish base line conditions in the streams upstream and downstream of the site. While it is recognised that the streams are ephemeral, the time available for sampling would have allowed multiple rounds of sampling to be undertaken. This sampling would have considered conditions both in the various streams that could receive direct discharge from the dam and the Namoi River. Given the scale of the project, if a comprehensive sampling project was not pro-actively commenced following the 2014 approval and to inform the current project extension application, there is a concern whether an appropriate program will be undertaken and base line data obtained if an approval were to be issued for the extension.

If a suitable data set were to be collected, the data could be used to define appropriate trigger levels for key parameters (including heavy metals) in order for existing conditions and the potential impact of discharges from the dam to be reliably assessed.

However, rather than defining appropriate long-term stations and collecting a comprehensive data set, limited information has been collected for a small number of project monitoring sites. Although the Surface Water Assessment provides an undertaking to define trigger values and suggests sites for the completion of sampling (Section 11.1.3, page 121), the necessary sampling required to underpin the definition of trigger values has not been completed and an insufficient number of parameters are proposed for sampling.

To allow trigger values to be defined, it will be necessary for the proponent to:

- Identify water quality sampling sites, both upstream (where practicable) and downstream of points of discharge from sediment basins, and further downstream to the Namoi River (potentially more sites than identified in the report);
- Define a water quality monitoring program (including at least pH, Electrical Conductivity, Total Suspended Solids, Total alkalinity/acidity, Sulphate, Aluminium, Arsenic, Molybdenum, and Selenium);
- Complete regular monitoring; and
- Define existing water quality and appropriate trigger values based on accepted methodologies.

Although the Surface Water Assessment could be amended to include the requirements of the water quality sampling program, it is expected that insufficient time will be available for the collection of a reasonable data set. Given the uncertainty and the consequent need to adopt the precautionary principle, it is necessary to consider reducing the potential for discharge from the site from sediment basins (either by pumping to restore storage capacity or by overtopping in floods) by increasing the volume of storage provided for the mine.

2.2 Likely Water Quality of Runoff Discharged from Mine

As mining activities are yet to commence on site, site-specific data in relation to the quality of runoff from the site is not available. Table 4.7 of the Surface Water Assessment presents the results of sampling undertaken at the nearby coal mines of Rocglen, Canyon, and Tarrawonga Coal Mines.

A summary of Table 4.7, which also lists the relevant ANZECC 2000 limits for irrigation and livestock and the NHMRC guideline values for human health, is presented in . Table 2-2 lists the trigger levels nominated in Table 3.4.1 of ANZECC 2000 with respect to 95 percent protection of slightly to moderately disturbed systems and the (low reliability) trigger level nominated in ANZG 2018 with respect to Molybdenum.

The following comments are made with respect to the results summarised in Table 2-2.

- ***Aluminium***

  While the concentration of Aluminium is below the limit nominated in ANZECC for irrigation and livestock, it is well in excess of the default trigger value for the protection of ecosystems.

- ***Arsenic***

  While the concentration of Arsenic is generally below the limit nominated in ANZECC for irrigation and livestock (with the highest concentrations at the Tarrawonga coal mine exceeding the irrigation limit), the higher of the recorded values are in excess of both the human health guideline and the default trigger value for the protection of ecosystems.

- ***Molybdenum***

  Some of the recorded concentrations of Molybdenum exceed the ANZECC irrigation and livestock limits, the ANZG 2018 trigger level for Molybdenum, and the NHMRC human health guideline.

- ***Selenium***

  Selenium levels all appear to be within ANZECC and NHMRC guideline limits.

Table 2-2 Summary of Mine Water Storage Monitoring

Location	Parameter (mg/L)			
	Aluminium	Arsenic	Molybdenum	Selenium
Coal Mines				
Canyon Coal Mine	0.50 (0.25-0.85)	0.005 (0.003-0.006)	0.003 (0.003-0.005)	<0.01 (<0.01-<0.01)
Rocglen Coal Mine	0.79 (0.27-2.18)	0.009 (<0.001-0.042)	0.020 (<0.001-0.195)	<0.01 (<0.01-<0.01)
Tarrawonga Coal Mine	N/A	0.006 (<0.001-0.20)	0.011 (<0.001-0.101)	<0.01 (<0.01-<0.01)
ANZECC 2000, ANZG 2018 and NHMRC Guidelines				
ANZECC/ANZG- Default Trigger Values	0.055	0.037	0.034	0.011
ANZECC- Irrigation	5	0.1	0.01	0.02
ANZECC- Livestock	5	0.5	0.15	0.02
Guideline- Human Health (NHMRC)	-	0.01	0.05	0.01

Note: Values from Table 4.7 of the Surface Water Assessment
Values presented for coal mines reflect average value, with minimum and maximum shown in brackets.

The Surface Water Assessment notes that *'comparison to the aquatic ecosystem guideline is not considered warranted given measured concentrations of key water quality indicators for the Namoi River are already elevated relative to these values'* (p35).

The key water indicators referred to in the assessment are pH, Electrical Conductivity, Turbidity, Total Nitrogen, and Total Phosphorus (refer Section 2.1). The exceedance of trigger values for these indicators is not necessarily of any relevance to the existing concentrations of heavy metals in the downstream watercourses. While it is accepted that past agricultural practices could cause elevated turbidity and nutrient levels, the same argument is not necessarily applicable to heavy metals.

As discussed in Section 2.1, no evidence is presented in the Surface Water Assessment with respect to existing heavy metal concentrations in downstream watercourses.

The Surface Water Assessment also notes that the recorded high Molybdenum levels (refer Table 2-2) generally occurred during extended dry periods. On the basis that releases from sediment dams during extended dry periods are unlikely, the assessment argues that runoff with elevated Molybdenum levels would be '*unlikely to impact the receiving environment*' (p35).

This argument does not take into account the potential for flood flows to fill the sediment dams and cause them to overtop. Although it is reasonable to expect that some level of dilution could occur as a result of the mixing of runoff entering the sediment basin and water already contained in the basin, it is still possible that water could be discharged from the site with elevated concentrations of heavy metal. Similarly, while the rainfall over the remainder of the catchment could result in significant flow in the receiving watercourses, it is also possible that the rainfall could be localised and not sufficient to cause a major flow from the remainder of the catchment. Again, it is possible that flow in the creek could contain elevated levels of heavy metals.

2.3 Proposed Monitoring

The Geochemistry Assessment (p32) recommends that water quality monitoring for sediment dams capturing runoff from the waste rock emplacement include pH, Electrical Conductivity, Total Suspended Solids, Total alkalinity/acidity, Sulphate, Aluminium, Arsenic, Molybdenum, and Selenium.

In comparison, the Surface Water Assessment makes an insufficient commitment to sampling. While in Section 7.6 it is noted that discharge will be permitted *'once the suspended solids concentration (and other relevant parameters) has reduced to a level suitable for controlled discharge in accordance with an EPL'* (p69), Section 7.9 states that '*controlled discharge would only occur once the water was of appropriate sediment concentration (TSS typically 50 mg/L) in accordance with the EPL requirements'* (p70). Section 9.4 of the Surface Water Assessment states that *'in the event that controlled discharge of water from a sediment dam is required,…the water would be allowed to settle…in order to ensure that any discharge had a suspended solids concentration of less than 50 mg/L*' (p112). A similar statement is made in Section 10.5 of the Surface Water Assessment.

The latter statements are consistent with the Environmental Protection Licences issued for nearby mines:

- Maules Creek Coal Mine (EPL 20221);
- Tarrawonga Coal Mine (EPL 12365); and
- Boggabri Coal (Forest View Quarry) (EPL 20404).

All of these licences define the following discharge limits:

- Oil and grease: 10 mg/L;
- pH: 6.5-8.5; and
- Total suspended solids: 50 mg/L.

In addition to the above, the licences also note that the conditions do *'not authorise the pollution of waters by any pollutant other than those specified.'*

Given this, although the Surface Water Assessment anticipates that the licencing of discharges will be based on oil and grease, pH and Total Suspended Solids, it is necessary to ensure that the concentration of other contaminants is also acceptable.

Section 11.1.2 of the Surface Water Assessment deals with site surface water monitoring and discharge. Section 11.1.2 states that water quality monitoring during controlled discharges 'could' include conductivity, TSS, pH, oil and grease, and total organic carbon. Consistent with the recommendations of the Geochemistry Assessment, the assessment notes that the monitoring of sediment dams could include pH, Electrical Conductivity, Total Suspended Solids, Total alkalinity/acidity, Sulphate, Aluminium, Arsenic, Molybdenum, and Selenium.

Consequently, it is recommended that the proponent be required to commit to a water quality monitoring program for water collected in sediment basins (in particular) and other mine storages. The program will need to consider the collection of at least the parameters nominated in the Geochemistry Assessment (i.e. pH, Electrical Conductivity, Total Suspended Solids, Total alkalinity/acidity, Sulphate, Aluminium, Arsenic, Molybdenum, and Selenium) at regular intervals and the specification of appropriate limits for each parameter (for inclusion in the Environmental Protection Licence) prior to discharge being considered acceptable.

It is noted that due to the lack of base line data to set local guidelines (refer Section 2.1), it will be necessary to either adopt trigger levels based on ANZECC 2000/ ANZG 2018 guidelines until sufficient data is available to define local guidelines or adopt enlarged sediment basins/ water storages to minimise the need for controlled discharge and the risk of overtopping.

In the event of water quality monitoring indicating that the concentration of key parameters in the sediment basins/ water storages is both consistent and low, then the frequency of water quality monitoring can be reduced.

3 Basin Sizing

3.1 Sediment Dams

Section 7.8 of the Surface Water Assessment notes that the sediment dams have been designed in accordance with the standard *Managing Urban Stormwater: Soils & Construction* (Landcom, 2004). For the site, this equates to storing the runoff produced by a 5-day rainfall depth of 38.4 mm (pp69-70).

While the method of sizing is standard, the detailed water balance modelling reported in Section 8 of the Surface Water Assessment indicates that, even with pumping from a number of dams to assist mine water supply, there is a possibility of significant discharge occurring as a result of either controlled discharge or overflows.

In both cases, the annual volume of discharge/overflow increases with project year.

In the case of controlled discharge, the median climate sequence would be associated with a total discharge volume of 2,313 ML (p85), with a 90th percentile annual volume in excess of 600 ML (p92).

For overflows, the median climate sequence would be associated with a total overflow volume of 3,847 ML (p85), with a 90th percentile annual volume in excess of 1,100 ML.

The Surface Water Assessment does not consider the potential impact of the discharge on the quality of water in downstream watercourses. Although the dam sizing is based on standard criteria, the Surface Water Assessment does not confirm whether discharges (either controlled or overflow) would result in an unacceptable impact.

It is desirable to complete additional modelling to confirm the potential impact of discharge from the dams on water quality in downstream watercourses, taking into account the likely timing of discharge relative to stream flow in receiving watercourses.

However, it is recognised that in the absence of base line water quality data the result of the assessment may not be conclusive. Consequently, to minimise the extent of modelling required, an alternative approach would be to increase the size of the sediment dams in order to sufficiently reduce the volume of water discharged from the site to ensure that discharge will not have a deleterious impact on the environment.

3.2 Other Mine Water Storages

The proposed mine includes a number of water storages, with water pumped between storages to maintain capacity and to cater for the water demand associated with the mine.

As a result of this pumping, the water balance modelling demonstrates that it will be possible to keep levels in the mine water dams and the Blue Vale Void Storage below the full supply level.

While such an approach is acceptable, it is necessary to ensure that failure of the pumping system will not result in unacceptable conditions in the short term. It is therefore necessary for the Surface Water Assessment to consider the potential implications associated with a pump or infrastructure failure scenario and to detail measures proposed (if required) to provide for emergency pumping should it be required.

4 Final Void

Section 8.10 discusses the mine void water balance following mine closure. The water balance determines that the water level in the void would remain well below the point at which overtopping could occur.

The modelling suggests that the salinity of the stored water would increase over time as a result of groundwater inflow. While the increase in salinity would occur over hundreds of years, the level of salinity is of concern.

It is therefore recommended that options for reducing salinity (primarily filling the void) be considered.

Further, the water balance suggests that the pit would not overtop. The Flood Assessment includes levees to divert external catchment runoff entering the voids even under the Probable Maximum Flood Event (p38). Provided the levees are appropriately constructed, then the risk of water entering the void from external catchments will have been eliminated.

5 Conclusion and Recommended Additional Work

A desktop review of the surface water assessment included as Appendix B of the Vickery Extension Project Environmental Impact Statement was completed.

The assessment results included the outcome of detailed water balance modelling completed with respect to mine operations. The review determined that the parameters and methodology adopted for the modelling of surface water are appropriate. The results obtained from the modelling can be used to consider the water balance of the mine and the likelihood of discharges occurring from the mine to receiving downstream watercourses.

However, the assessment is considered to be deficient in relation to its consideration of existing water quality, and the potential for discharge from the site to adversely impact on local water quality.

The key findings of the review in terms of aspects where more detail or investigation is required are as follows.

Existing Water Quality

The assessment presents the results of water quality sampling conducted in the region. The available water quality data is considered to be insufficient for the purpose of providing an understanding of existing water quality. Specifically, insufficient data has been collected to define the quality of water in the watercourses downstream of the site. It is recommended that the proponent undertake the following activities:

- Define appropriate sampling points so that conditions at all points of discharge from the site can be assessed (potentially increasing the number of sampling sites from those nominated in Section 11.1.3 of the assessment);
- Define water quality parameters (as a minimum pH, Electrical Conductivity, Total Suspended Solids, Total alkalinity/acidity, Sulphate, Aluminium, Arsenic, Molybdenum, and Selenium) and frequency (noting the ephemeral nature of the streams);
- Commit to completing a comprehensive water quality monitoring program given that limited data has been collected since the approval issued in 2014.
- Complete sampling for a sufficient period that seasonality and climatic factors are included in the water quality data set; and
- Use the collected data to set together with modelling to define appropriate water quality trigger levels for the existing situation and allowable discharge limits for the parameters of concern.

Quality of Water in Sediment Basins

Given the uncertainty associated with the quality of water discharged to the sediment dams, it is necessary to collect water quality samples to confirm the nature of the water that could potentially be discharged from the dam:

- Define a program for the collection of water quality data for the sediment basins (noting that the program can allow for a decreased frequency of sampling in the event of consistent low results being obtained for certain parameters); and

- Define water quality parameters to be sampled (as a minimum pH, Electrical Conductivity, Total Suspended Solids, Total alkalinity/acidity, Sulphate, Aluminium, Arsenic, Molybdenum, and Selenium) and the frequency of sampling.

Discharge from Sediment Basins

The Surface Water Assessment proposes a number of sediment dams to collect runoff, with collected water either used internally or released via controlled discharge to maintain the minimum required runoff storage capacity.

Although the dams have been sized in accordance with standard practice, this does not guarantee that the water discharged from the site (as a result of either controlled discharge or flood overflows) will not be of poor quality and adversely impact on downstream water quality.

It is recommended that the proponent complete additional modelling to determine the potential impact of discharge from the sediment dams on downstream watercourses. Given the lack of suitable base line data and in the event that it is necessary to commence work prior to sufficient data being collected to allow trigger values to be defined for the existing watercourses (which in turn allows discharge limits to be set), it is noted that such modelling may not be definitive.

Consequently, as an alternative to minimise the amount of modelling required and to increase the certainty that discharge from the dams will not result in an adverse environmental impact, it is recommended that the Precautionary Principle be applied and the sediment basins increased in size to minimise the need for controlled discharge and the risk of water quality impacts downstream.

In addition, it may be necessary for the Environmental Protection Licence issued for the mine to include discharge limits for all relevant water quality parameters and not just oil and grease, pH, and Total Suspended Solids.

Operation of Storages

The mine contains a number of storages, with the water balance accounting for the proposed movement of water between dams. It is recommended that the proponent confirm that the failure of any part of the pumping infrastructure will not result in the potential for storages containing contaminated water overtopping within the likely period necessary for repair and to outline backup measures available to ensure that the required transfer of water can occur.

Final Void

Modelling completed in support of the final void has indicated that very high levels of salinity will occur over time as a result of groundwater inflow. It is recommended that the proponent consider alternate treatments for the void in order to avoid the increase in salinity of water stored in the void.

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