WERRIS CREEK COAL MINE

2017 ANNUAL REVIEW

Table 1 - Annual Review Title Block

Name of Operation	Werris Creek No. 2 Coal Mine
Name of Operator	Werris Creek Coal Pty Limited
Development consent / Project Approval #	Project Approval 10_0059 Modification 2
Name of holder of development consent/project approval	Werris Creek Coal Pty Limited
Mining lease # (Leaseholder)	ML1563 (Creek Resources Pty Ltd & Betalpha Pty Ltd); ML1671, ML1672 (Werris Creek Coal Pty Limited)
Water Licence # (Licence Holder)	WAL29506 (Betalpha Pty Ltd); WAL32224 (Werris Creek Coal Pty Ltd)
MOP Commencement Date	14 January 2016
MOP Completion Date	30 November 2022
Annual Review Commencement Date	1 January 2017
Annual Review Completion Date	31 December 2017
I, Nigel Wood, certify that this audit report is a true and accurate record of the compliance status of Werris Creek Coal Mine for the period 1st January 2017 to 31st December 2017, and that I am authorised to make this statement on behalf of Werris Creek Coal Pty Ltd. Note. a) The Annual Review is an 'environmental audit' for the purposes of section 122B (2) of the Environmental Planning and Assessment Act 1979. Section 122E provides that a person must not include false or misleading information (or provide information for inclusion in) an audit report produced to the Minister in connection with an environmental audit if the person knows that the information is false or misleading in a material respect. The maximum penalty is, in the case of a corporation, \$1 million and for an individual, \$250,000. b) The Crimes Act 1900 contains other offences relating to false and misleading information: section 192G (Intention to defraud by false or misleading statement—maximum penalty 5 years imprisonment); sections 307A, 307B and 307C (False or misleading applications/information/documents—maximum penalty 2 years imprisonment or \$22,000, or both).	
Name of Authorised Reporting Officer	**Nigel Wood**
Title of Authorised Reporting Officer	**General Manager – Open Cut Operations**
Signature	NWood
Date	30 / 8 / 2018

Revision	Comments	Date
0	Submitted for approval	29 March 2018
1	Revised to include DP&E comments	30 August 2018

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Appendix 1 Determination of Groundwater Interception 2017

1 STATEMENT OF COMPLIANCE

This Annual Review has been prepared to provide a summary of the environmental performance of the Werris Creek Coal Mine (WCC) over the reporting period. The compliance status of the WCC against relevant approvals during the reporting period was assessed as at the end of the reporting period (i.e. 31 December 2016) and is summarised in **Table 1**. References to the Environment Protection Licence (EPL) are limited to those that relate to the Project Approval conditions, specifically: Schedule 3 Condition 20(b), 22, 23(a) and Schedule 5 Condition 8(c).

Table 1 – Statement of Compliance

Where all the conditions of the relevant approvals complied with?	Yes/No
Project Approval 10_0059 Modification 2	No
Mining Operations Plan (MOP)	Yes
Mining Lease ML 1563	Yes
Mining Lease ML 1671	Yes
Mining Lease ML 1672	Yes
EPL12290	No
WAL29506	Yes
WAL32224	Yes

Any non-compliances during the reporting period are detailed in **Table 3** and ranked according to the compliance status key in **Table 2**. **Section 11** provides further details of any non-compliance and actions undertaken or proposed for the following reporting period to prevent re-occurrence and mitigate any potential adverse effects, as well as other compliance triggers that were investigated.

Table 2 – Compliance Status Key

Risk Level	Colour Code	Description
High	Non–compliant	Non-compliance with potential for significant environmental consequences, regardless of the likelihood of occurrence
Medium	Non–compliant	Non-compliance with: • potential for serious environmental consequences, but is unlikely to occur; or • potential for moderate environmental consequences, but is likely to occur
Low	Non–compliant	Non-compliance with: • potential for moderate environmental consequences, but is unlikely to occur; or • potential for low environmental consequences, but is likely to occur
Administrative non-compliance	Non–compliant	Only to be applied where the non-compliance does not result in any risk of environmental harm (e.g. submitting a report to government later than required under approval conditions)

Table 3 – Non-Compliances

Relevant Approval	Cond. #	Condition Description (Summary)	Compliance Status	Comment	Where addressed in Annual Review
PA 10_0059 MOD 2	Schedule 3, #1	The Proponent shall ensure that the noise generated by the project (including noise generated on the Werris Creek Rail Spur) does not exceed the criteria in Table 1 at any residence on privately-owned land.	Non-compliant	Attended noise monitoring at the R98 Kyooma location during the evening of the 23rd May 2017 measured Werris Creek Mine noise at 37 dB(A) Leq, however after a low frequency penalty adjustment of 5dB, using the Industrial Noise Policy methodology, levels were 42 dB(A) Leq. WCC undertook an investigation into the incident, with appropriate notifications to the DP&E.	6.1.2 Environmental Performance

2 INTRODUCTION

This is the twelfth Annual Review produced for the Werris Creek No. 2 Coal Mine (WCC) and has been prepared in accordance with the NSW Department of Planning and Environment's (DPE) Integrated Mining Policy – Annual Review Guideline, October 2015. This document has been prepared to satisfy the following requirements:

- The Annual Review requirements of the DPE under the Project Approval PA 10_0059 (Condition 3 Schedule 5);
- Environmental Management Report requirements of the Division of Resources & Energy (DRE) under the WCC Mining Leases; and
- The routine reporting expectations of DPI Water.

This report covers the period between 1st January 2017 to 31st December 2017.

2.1 PROJECT BACKGROUND

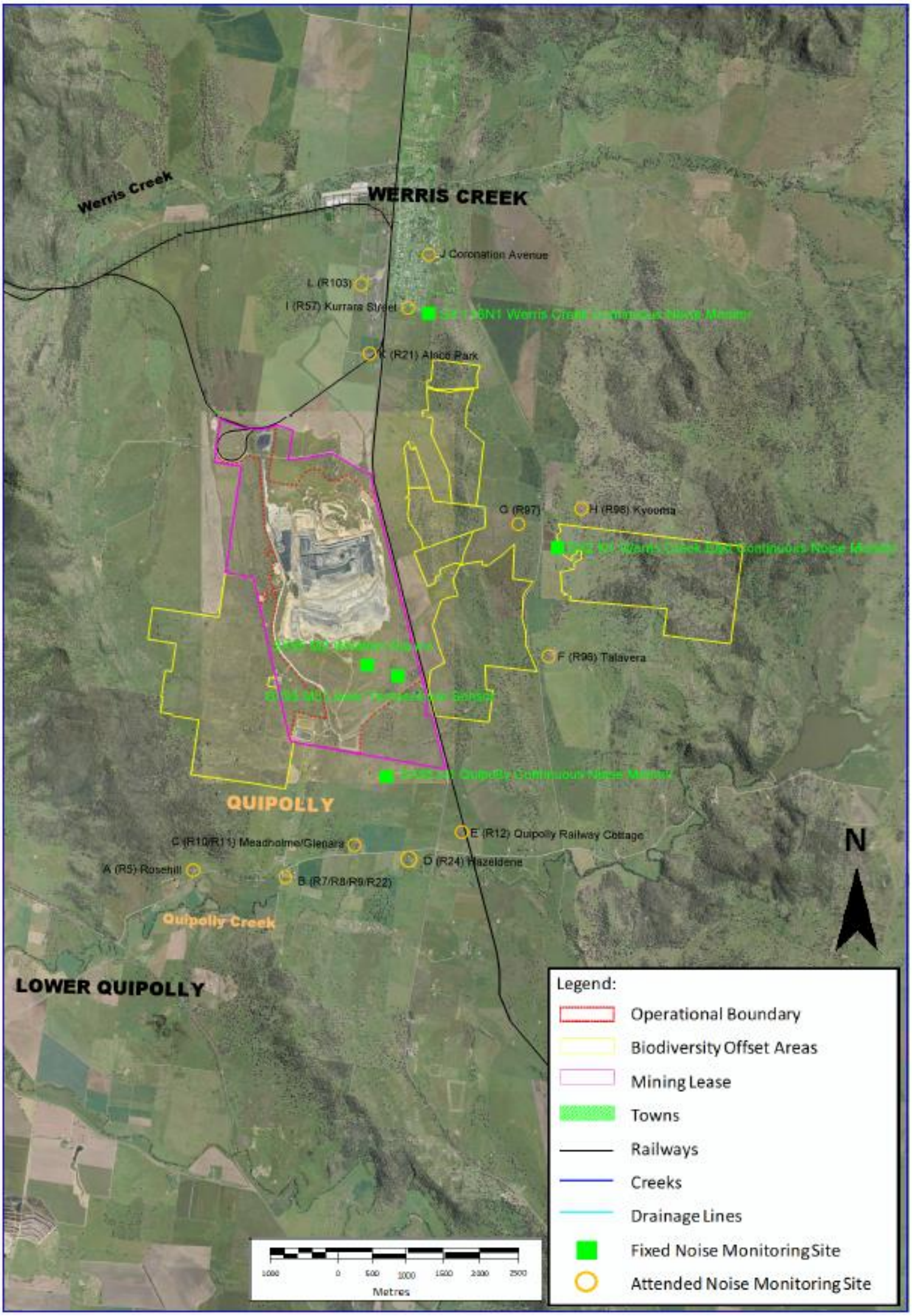
WCC is located approximately 4 km south of Werris Creek and 11 km north-northwest of Quirindi in northwest slopes and plains region of New South Wales (**Figure 1**) and lies within a 910 ha area covered by Mining Lease (ML) 1563, ML1671 and ML1672. The current Project Approval (PA) 10_0059 Modification 2 limits mining until 31st December 2032. The Mining Operations Plan (MOP) covers a 7-year period from the 14th January 2016 to the 30th November 2022. WCC has approval to mine in full the Werris Creek coal measures.

WCC is owned and operated by Werris Creek Coal Pty Limited (WCC), a wholly owned subsidiary of Whitehaven Coal Limited (WHC). The key operational personnel responsible for environmental management at WCC are listed in **Table 4**.

Table 4 – Key Personnel at WCC

Name	Title	Contact
Mr Lynden Cini	WCC Environmental Officer	02 6763 6000
Mr Rod Hicks	WCC Operations Manager	02 6763 6000
Mr Nigel Wood	General Manager – Open Cut Operations	02 6741 9300

Figure 1 – WCC Locality Map and Noise Monitoring Sites



3 APPROVALS

Table 5 provides a summary of the key current licences, leases and approvals that have been obtained for the operation of WCC.

Table 5 – Licences, Leases and Approvals

Authority	Approval	Number	Issue	Expiry	Comments
Department of Planning and Environment (DP&E)	Project Approval	PA10_0059	25/10/2011	31/12/2032	Life of Mine Project allows northerly continuation for entire coal deposit mining up to 2.5Mtpa and 24 hours 7 days per week.
		PA10_0059 MOD1	30/08/2012	31/12/2032	Modification of Biodiversity Offset Area to allow for augmentation of VWD1 to 250ML.
		PA10_0059 MOD2	3/11/2015	31/12/2032	Modification of overburden emplacement design, enabling of a dry processing plant, and to allow void water for agricultural use.
Department of Primary Industries – Division of Resources and Energy (DRE)	Mining Lease	ML 1563	23/03/2005	23/03/2026	Mining Lease granted for 21 years.
		ML 1671	9/03/2012	9/03/2032	Mining Lease granted for 21 years.
		ML 1672	9/03/2012	9/03/2032	Mining Lease granted for 21 years.
	Mining Operations Plan	None	14/01/2016	30/11/2022	MOP approved on 14th January 2016
Environment Protection Authority	Environment Protection Licence	12290	18/04/2005	Anniversary date: 1 April Review Date: 14/07/2020	Last variation 6th May 2016
Department of Primary Industries – Water	Water Access Licence (Water Management Act 2000)	WAL29506	21/02/2013	Perpetuity	Aquifer – 50ML annual allocation. DPI-Water reference number 90AL822531. Formerly 90BL252588
		WAL32224	19/06/2013	Perpetuity	Aquifer – 211ML annual allocation. DPI-Water reference number 90AL828344. Formerly 90BL255087
	Water Works Approval	90WA822532	21/02/2013	15/01/2025	Linked to WAL29506. Bore. Formerly 90PT982801
		90WA828345	19/06/2013	25/06/2017	Linked to WAL32224. Excavation. Formerly 90PT982872
Commonwealth Department of Sustainability, Environment, Water, Population and Communities	Environment Protection and Biodiversity Conservation Act Approval	2010/5571	21/12/2011	31/12/2032	Authorises impacts on EPBC listed threatened species and communities and listed migratory species
Dam Safety Committee	Prescribed Dams	Werris VWD1 Werris VWD3 Werris VWD4	18/10/2012 13/12/2012 13/12/2012	Perpetuity Perpetuity Perpetuity	Significant Sunny Day and Flood Consequence

4 OPERATIONS SUMMARY

4.1 EXPLORATION ACTIVITIES

The WCC drilling programs were undertaken during the first half of the reporting period, year and achieving a total meterage of 2,649m focussed in front of the highwall. Thirty open holes and three cored holes were drilled for a total of 2,649m, including redrills. All boreholes were geologically logged, and geophysically logged.

4.2 MINING OPERATIONS

Table 6 presents the production summary for the previous and current reporting periods and the anticipated production schedule for the next reporting period. ROM coal production is summarised by calendar year to align with PA_0059 conditions. All units are in tonnes unless otherwise stated.

Table 6 – Production Summary

Material	Approved limit	Previous reporting period (actual)	This reporting period (actual)	Next Reporting period (forecast)
Waste Rock / Overburden (bcm)	N/A	12,812,659	14,254,064	14,637,887
ROM Coal (t) (calendar year)	2,500,000 (PA 10_0059)	1,859,793	1,867,752	2,123,951
Coarse reject (t)	N/A	0	0	0
Fine reject (t)	N/A	0	0	0
Saleable Product (t)	5,000,000 (EPL12290)	1,369,269	1,838,375	2,086,543

4.3 COAL HANDLING AND PROCESSING

During the reporting period, coal processing operated Monday to Friday 6:00am to 2:40am with the occasional weekend shift. Train loading operations occurred 24 hours per day, 7 days per week dependent on train scheduling. Coal is segregated at the ROM coal stockpile based on the expected ash content of the coal. The higher ash coal products are processed through the fixed plant crusher and subsequently processed through the secondary crusher. Low ash coal products are processed by the mobile crushers and then screened.

Product coal is transported by road trucks from the coal processing area to the product coal stockpile area at the train load out facility via the private coal haul road. The despatch of product coal from WCC is either railed to the Port of Newcastle or by road to domestic customers. Product movements by month for both rail and domestic road haulage can be found on the Whitehaven Coal website. WCC complied with Schedule 2, Conditions 7 and 8, of PA_0059. The maximum quantity of product coal stockpiled on site during the reporting period was 249,498 tonnes, which occurred during July 2017 and the total quantity of domestic coal transported from site on public roads was 743.13 tonnes for the period. Domestic coal transport data is available on the WHC website.

4.4 OTHER OPERATIONS

4.4.1 Hours of Operation

Mining operations are permitted to be conducted up to 24 hours per day, seven days per week, except for blasting, which is restricted to 9:00am – 5:00pm Monday to Saturday. During the reporting period, mining operations maintained reduced hours of 20.6 hours per day (6:00am – 2:40am) 5 days per week (Monday to Friday), and a 10.5 hour day shift on both Saturday and Sunday. Other ancillary tasks and maintenance activities continued 24 hours per day, seven days per week.

4.5 NEXT REPORTING PERIOD

4.5.1 Exploration

No exploration drilling has been planned at WCC in the next reporting period, however maybe undertaken if required.

4.5.2 Mine Operations

The mine production rates are planned to continue at much the same level as in the current reporting period, although the position in the strip and pit allow for more coal tonnes to be mined offset by lower overburden, as shown in **Table 6**. Vegetation clearing activities in mining areas over the next reporting period will be conducted in accordance with the approved Biodiversity Management Plan and MOP.

4.5.3 Rehabilitation progress

As per MOP commitments, WCC plans to undertake rehabilitation works on 22 hectares of the overburden emplacement in the 2018 reporting period. The focus for the period will be on the finalisation of decommissioned areas, landform development and growth medium development. Maintenance works and supplementary planting will continue on existing rehabilitation areas to encourage success.

5 ACTIONS REQUIRED FROM PREVIOUS ANNUAL REVIEW

There were no outstanding actions carried over from the 2016 Annual Review.

6 ENVIRONMENTAL PERFORMANCE

6.1 NOISE

6.1.1 Environmental Management

During the reporting period various controls were implemented to reduce noise generation including:

- Annual testing of maximum sound power levels;
- Stage 1 or 2 Noise Attenuation fitted on all trucks;
- Use of enclosed conveyors; and
- Use of Silent Horns by excavator operators during the night periods.

WCC have implemented a number of mitigation strategies to minimise the effects of noise on the community, including:

- Property acquisitions;
- Private agreements;
- Installation and maintenance of an acoustic and visual amenity bund; and
- Installation and maintenance of a mine infrastructure area bund.

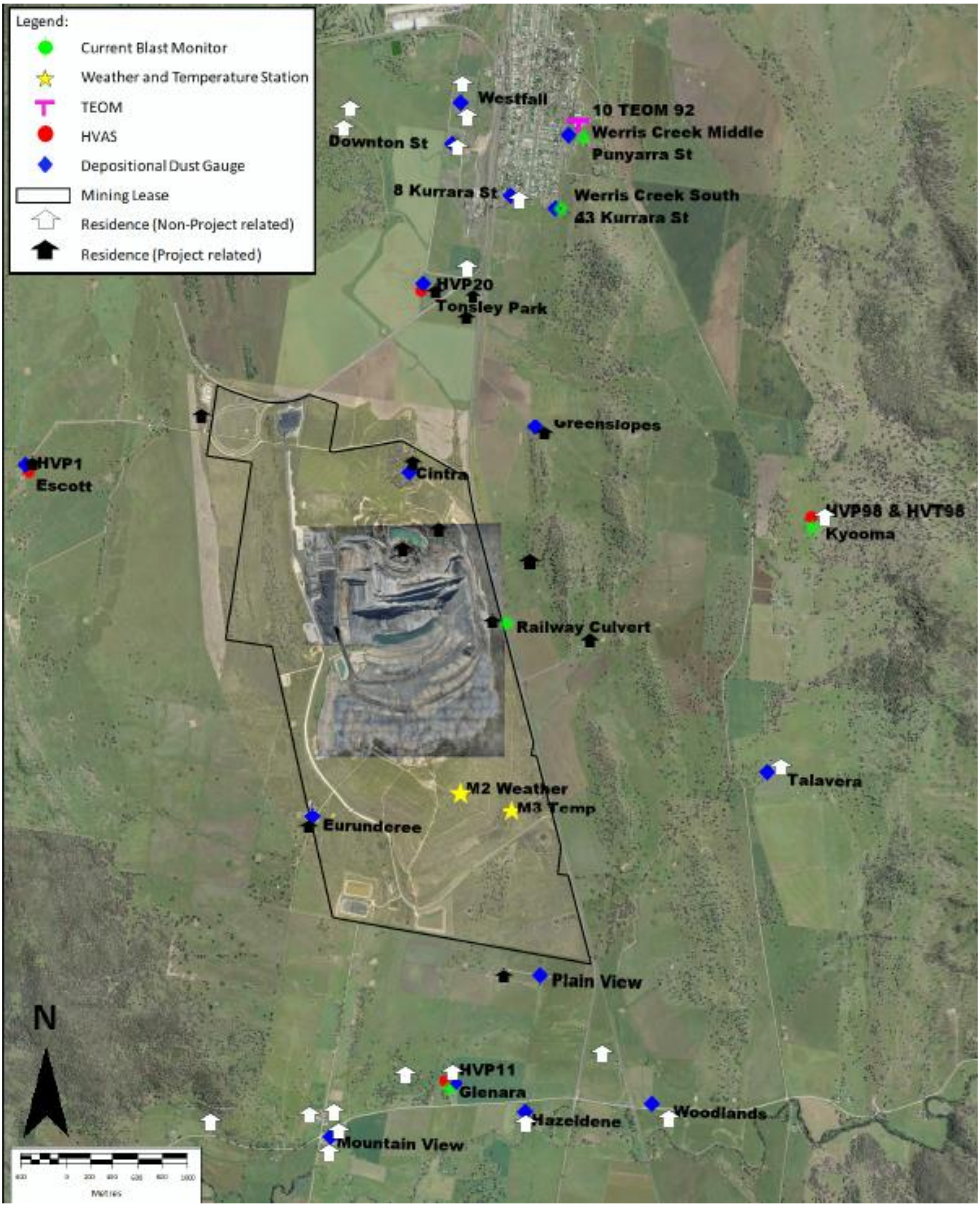
During the reporting period a number of operational strategies were in place to respond to potential noise impacts from mining operations including:

- Continuous noise monitoring;
- Attended noise monitoring;
- Noise control operators engaged;
- Sound filtering and interpretation to isolate the masking effects of extraneous noise sources from birds, insects, and other environmental noise sources during monitoring.

- Modification of operations, including shutting down plant items, to reduce offsite impacts.
- Night time surface operations and dump locations planned to minimise noise where possible; and

Figure 2 – WCC identifies the monitoring locations for both continuous and attended noise monitoring locations.

Figure 2 – WCC Blast Monitoring Sites and Werris Creek Mine Air Quality Monitoring Network



6.1.2 Environmental Performance

Attended Monitoring

Attended monitoring is undertaken on a monthly basis by an independent consultant and is used to assess compliance with licence and approval limits for mine contributed noise. Attended noise monitoring identified one exceedance of the noise criteria during the reporting period, at the R98 Kyooma monitoring site during the evening of the 23rd May 2017. On this occasion, the measured Werris Creek Mine noise was 37 dB(A) Leq however after a low frequency penalty adjustment of 5dB was applied using the Industrial Noise Policy (2000) methodology, levels were above the criteria of 38 dB(A) Leq. However, should the exceedance have been reviewed against the recently released Noise Policy for Industry (October 2017), it is expected that low frequency penalty adjustment would have been applied at 2 dB(A) above measured noise, giving a total exceedance of 39 dB(A).

WCC undertook an investigation into the incident, with appropriate notifications to the EPA and DP&E. There were no exceedances of the $L_{A1\ (1min)}$ criteria during the reporting period. With the exception of the above, attended noise monitoring continued to be generally in accordance with EA predictions.

Table 7 below shows the historical exceedances from attended noise monitoring over the current and previous two reporting periods.

Table 7 – Historical Attended Noise Monitoring Exceedances

Reporting Period	Date	Location	Criteria (dB(A))	Exceedance (dB(A))
2017	23 May 2017	R98 – Kyooma	38	37 (42[a], 39[b])
2016	27 Sep 2016	R98 – Kyooma	38	39
2015-2016	No exceedances			

a) Includes 5 dB penalty using INP (2000) methodology
b) Includes 5 dB penalty using NPI (2017) methodology

6.1.3 Proposed Improvement Measures

WCC plans to construct the remainder of the visual and acoustic bund, prior to mining through Old Colliery Hill, to minimise noise impacts on Werris Creek residents.

6.2 BLASTING

6.2.1 Environmental Management

Best practice blast management measures are implemented at WCC to achieve acceptable outcomes in terms of blast overpressure and vibration, fume generation, and dust impacts.

During the reporting period a number of controls were applied to reduce the potential for impacts, including:

- buffer management through acquisition of a number of adjacent properties thorough private negotiation;
- blasts designed with consideration of the predicted vibration of the shot, geology, ground conditions, explosives selection, initiation sequence/timing, powder factor, history/experience, and the sleeping time of the shot;
- maintenance of the predicted blast vibration objective for Werris Creek of 0.8 mm/s;

- explosive product selection and loading, to reduce the risk of auto-ignition and/or blast fume generation;
- stemming height and quality monitored by, the shot-firer to minimise the risk of elevated air overpressure from rifling;
- initiation sequence strategies are used to minimise vibration and air overpressure impacts;
- sleeping shots minimised to avoid potential deterioration of product;
- WCC aims to fire all blasts in the middle of the day generally between 12:00pm and 2:00pm, when atmospheric mixing is generally highest;
- blast notification prior to every blast;
- pre-blast weather assessment conducted;
- road closures of the Werris Creek Road when proximity of blasts occurred within 200 meters;
- blast fume rating recorded; and
- structural inspections - In response to claims of property damage due to blasting operations.

Air blast overpressure and ground vibration monitoring are undertaken at four monitoring locations illustrated in **Figure 2**, with vibration and air overpressure also measured adjacent to a railway culvert for blasts within 500 metres of this structure. All blast monitors were operational during the period.

6.2.2 Environmental Performance

Vibration/ Air Overpressure Performance

There were 133 blasts undertaken during the reporting period. All blast events have been within the applicable airblast overpressure and ground vibration limits set out in PA 10_0059 MOD2.

There have been no exceedances of airblast overpressure or ground vibration limits during 2017 and the previous reporting period.

6.3 AIR QUALITY

6.3.1 Environmental Management

The air quality criterion applicable to WCC is specified in Condition 16, Schedule 3 of PA10_0059 MOD2 and is managed through the implementation of the Air Quality and Greenhouse Gas Management Plan (AQGHGMP). During the reporting period, various controls were implemented to manage dust including:

- Use of water carts across the site with an additional contractor water cart also utilised during rehabilitation activities;
- Overburden, coal and soil loading activities are not undertaken during periods of adverse weather (high winds or dry conditions), with SMS triggers employed to provide a near-real time operational response;
- Blasting activities restricted to suitable weather conditions and include notification to key stakeholders and residents;
- All personnel are instructed that all vehicles must utilise existing tracks on-site and must be driven to the conditions to minimize trafficable dust generation;
- The extent of disturbed areas (pre-strip clearing and rehabilitation) are minimized to that required for mining operations, with these areas stabilized and revegetated as soon as practicable once no longer required for ongoing operations;
- Water sprays are used on the coal feed hopper, crusher and at all conveyor transfer and discharge points;
- A designated pump and sprinkler installed during the reporting period to minimize dust entrainment off the SAIL stockpile in adverse weather conditions;
- Water Sprinklers added to the TLO to aid in dust suppression;

- Modification of operations, including shutting down plant items, to reduce offsite impacts;
- A depositional dust gauge audit was undertaken to ensure compliance with *AS/NSS 3580.10.1:2003: Methods for Sampling and Analysis of Ambient Air – Determination of Particulate Matter – Deposited Dust – Gravimetric Method*; and
- Installed bird deterrents were maintained on depositional dust gauges to reduce contamination.

The above management measures will continue to be implemented into the next reporting period to continually improve air quality performance.

The WCC Air Quality Monitoring network is illustrated in **Figure 2** and includes:

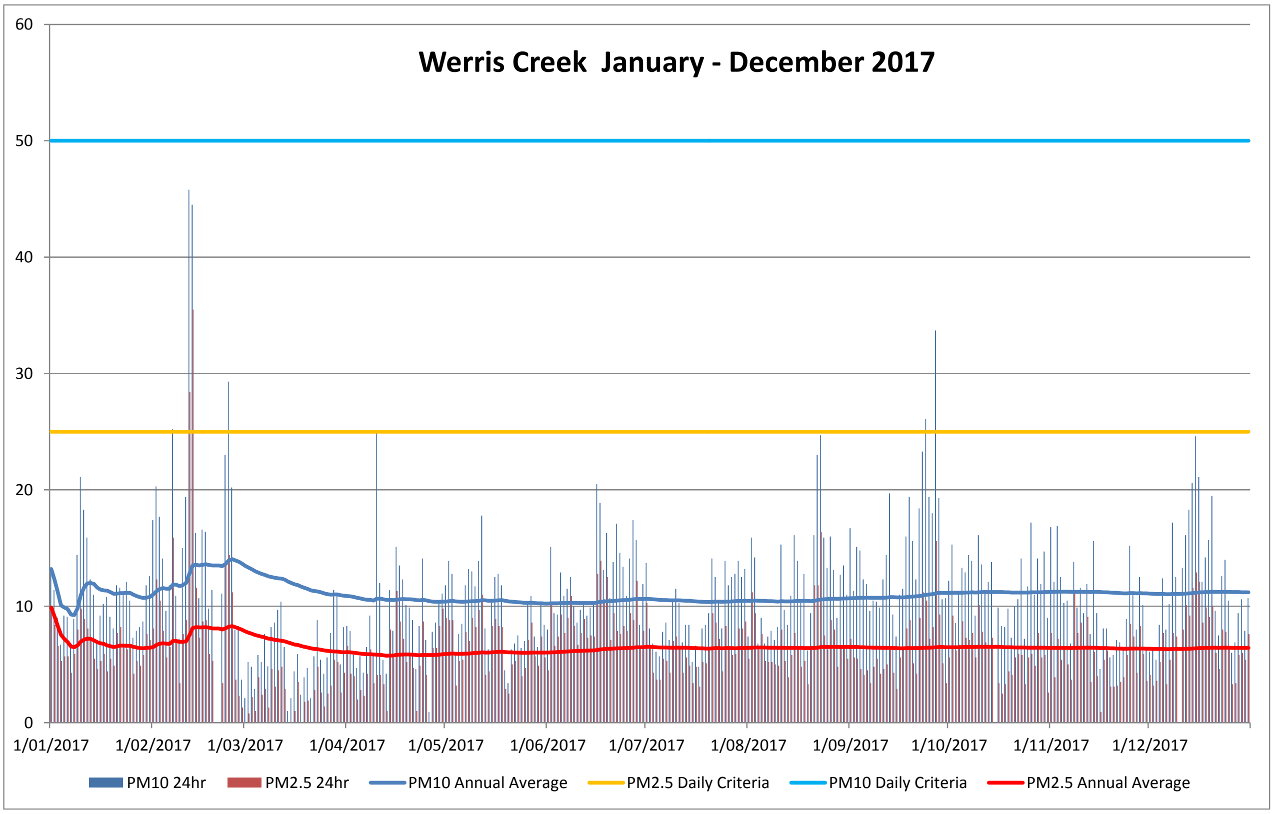
- Continuous monitoring of $PM_{2.5}$ and PM_{10} levels at the Werris Creek TEOM;
- PM_{10} levels are measured at four High Volume Air Samplers (HVAS) distributed across neighbouring properties surrounding WCC. The HVAS run for twenty-four hours every six days. Total Suspended Particulate Matter (TSP) is also measured at a separate HVAS unit located at Kyooma;
- A network of 20 dust deposition gauges surrounding WCC, measuring deposited dust and particulates collected monthly; and
- Six depositional dust gauges located in Quirindi to measure deposited dust adjacent to the railway line. The dust gauges are located in a linear fashion on either side of the railway line, in order to determine the contribution of coal dust to the overall figure.

6.3.2 Environmental Performance

Monitoring conducted at the Werris Creek TEOM indicates the PM_{10} annual average remained well below the applicable criteria of 30 µg/m^3, while the daily maximum PM_{10} criteria of 50 µg/m^3 was not exceeded during the reporting period.

Figure 3 below shows continuous results for PM_{10} (24hr) and $PM_{2.5}$ (24hr) for the reporting period, as well as a running annual average throughout the reporting year.

Figure 3 – Werris Creek TEOM summary for January – December 2017

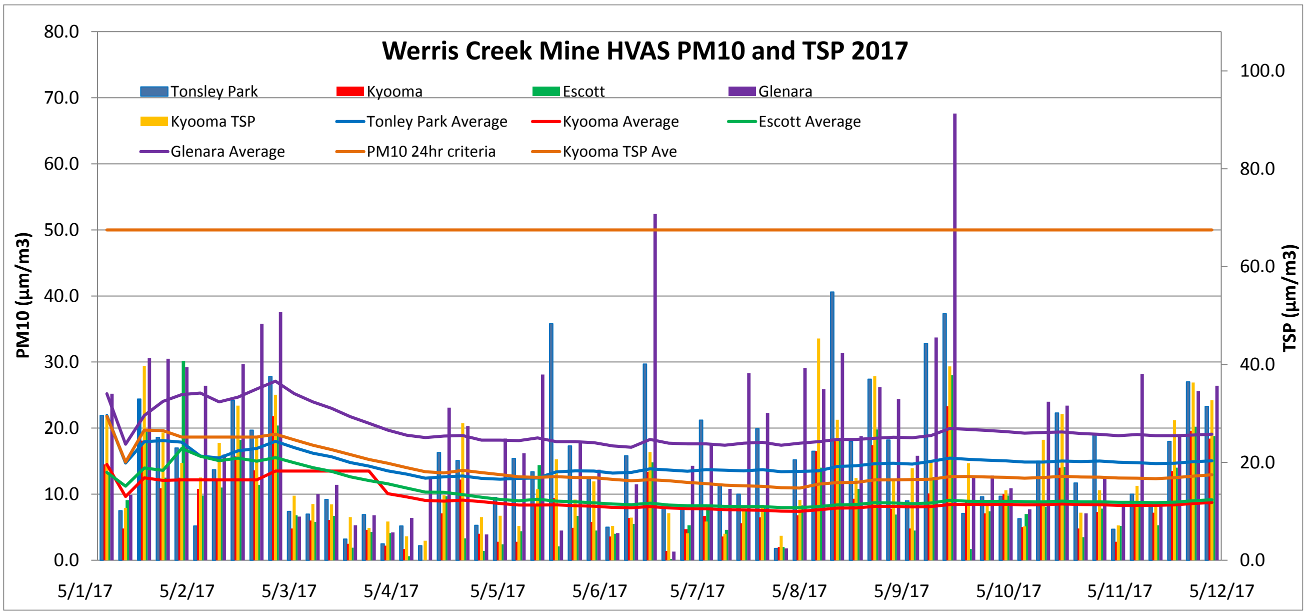


Monitoring conducted across the HVAS PM_{10} network has shown the running annual average PM_{10} concentrations to be well below the criteria of 30 µg/m^3 at all monitoring stations across the network during the reporting period (**Figure 4**). The majority of 24 hour measurements of PM_{10} remained below the daily criteria of 50 µg/m^3 with the exception of two monitoring results at Glenara on the 23rd June 2017, with a PM_{10} concentration of 52.4 µg/m^3 and on the 27th September 2017 with a PM_{10} concentration of 67.6 µg/m^3.

Notification regarding the elevated results was provided to the Department of Planning and Environment following receipt of the monitoring results. Subsequent investigations demonstrated that WCC was not the cause of the elevated PM_{10} levels on both occasions, with WCC operations identified downwind of the monitor and therefore the elevated results were not non-compliances.

All other PM_{10} measurements were within criteria as shown in **Figure 4**.

Figure 4 – Werris Creek Mine HVAS PM10 and TSP results for January – December 2017



A summary of current and historical HVAS and TEOM data can be viewed in **Table 8.**

Table 8 – TEOM and HVAS Averages

Location	2015-2016	*2016	2017
	µg/m^3		
10TEOM92 – Werris Creek	7.8	9.3	**10.8**
HVP20 – Tonsley Park	13.6	13.0	**15.0**
HVP98 – Kyooma	8.2	7.9	**8.7**
HVP1 – Escott	10.6	7.5	**9.2**
HVP11 – Glenara	18.2	16.4	**19.1**

*Shorter reporting period 1st April – 31st December 2016

Analysis of January – December 2017 monitoring results from depositional dust gauges shows all monitoring sites met AQGHGMP criteria, a number of sites were affected by extraneous dust sources, including contamination with excessive organic matter.

Table 8 outlines results which have been excluded either due to direct contamination of the sample or upon investigation of elevated results, the investigation found that the result was attributed to localised dust sources and not WCC operations. External conditions such as, dry conditions, agricultural activities, organic matter (insects, bird droppings), and fire have influenced results at various localised monitors.

Of the five sites with elevated monthly dust measurements, all of the sites (Cintra, Plain View, Mountain View, 8 Kurrara Street and Werris Creek Centre) recorded annual depositional dust averages below the criteria (without the contaminated results).

An investigation of the results at dust gauge site DG34 (8 Kurrara street) which exceeded the AQGHGMP criteria on multiple occasions throughout the reporting period showed consistently high results and low deposited dust levels at nearby gauges indicating a localised source of dust generation or contamination, unrelated to activities at WCC. A summary of deposited dust monitoring results can be found in **Table 9** below.

Table 9 – Deposited Dust Summary for 2017

EPL# 12290	ID	Property	Annual Average	Average - Excluded	Minimum	Maximum	AQGHGMP Criteria	EA MOD2 Predicted	# Results Excluded
-	DG1	Escott^	0.6	-	0.2	1.2	4.0	-	0
-	DG2	Cintra^	3.1	3.0	1.5	5.0	4.0	-	1
-	DG3	Eurunderee^	1.6	-	0.4	3.2	4.0	-	0
-	DG5	Railway View^	2.3	-	1.2	3.6	4.0	-	0
-	DG9	Marengo^	1.0	-	0.1	2.5	4.0	-	0
#29	DG11	Glenara	1.1	-	0.3	1.6	4.0	0.7	0
-	DG14	Greenslopes^	0.9	-	0.3	2.4	4.0	1.3	0
-	DG15	Plain View^	2.6	1.5	0.2	6.0	4.0	0.8	2
-	DG17	Woodlands	1.6	1.3	0.3	3.0	4.0	0.7	1
-	DG20	Tonsley Park^	1.0	-	0.2	3.0	4.0	1.1	0
-	DG22	Mountain View	1.8	1.2	0.3	8.8@	4.0	0.6	1
-	DG24	Hazeldene	1.3	1.3	0.6	3.3	4.0	0.7	1
-	DG34	8 Kurrara Street	7.1	0.6	0.3	19.5@	4.0	-	6
-	DG62	Werris Creek South	1.0	-	0.3	2.1	4.0	-	0
#30	DG92	Werris Creek Centre	1.1	0.6	0.2	6.8@	4.0	-	0
-	DG96	Talavera+	NS	-	NS	NS	4.0	0.8	0
#28	DG98	Kyooma	0.7	-	0.2	1.8	4.0	0.7	0
-	DG101	Westfall	0.9	-	0.2	2.6	4.0	-	0
-	DG103	West Street	0.7	-	0.3	1.5	4.0	-	0

^ Properties owned by Werris Creek Coal;

*Sample contaminated with organic matter from non-mining source (i.e. bird droppings and insects)

@ Sample contaminated from local dust source non-mining related (i.e. fire, farming activities)

Bold = elevated result

NS = Not Sampled

+ = Dust gauge removed temporarily by landowner

6.4 BIODIVERSITY

6.4.1 Environmental Management

Biodiversity was managed in accordance with:

- Schedule 3 Conditions 28 of the PA 10_0059;
- EPBC 2010 / 5571 Condition 1; and
- The WCC Biodiversity Offset Management Plan (BOMP).

6.4.2 Environmental Performance

WCCM Biodiversity Offset Management Plan (BOMP) was approved by DPE on 30th August 2013. The WCCM Biodiversity Offset Strategy is required to offset 1317ha of native woodland to achieve a 'like for like or better' biodiversity outcome across five properties (Biodiversity Offset Areas – BOAs) adjacent to the WCCM for the purpose of restoring vegetated corridors across WCC land holdings and Quipolly Creek Catchment linking with sub-regional habitat corridors.

Offset Security Management

WHC and DPE have concluded negotiation and agreed on the wording of positive and negative covenants to be registered on individual land titles that make up the WCCM BOA. It is anticipated that the s88E covenant instruments will be signed by WHC and DPE and submitted to NSW Land and Property Information for registration during 2018.

Infrastructure Management

During the reporting period, a total of 1.8km of new fencing (fauna friendly) was constructed along the perimeter of the Marengo BOA replacing the previous fence that was in poor conditions to restrict inadvertent livestock grazing of the BOA. Also during the reporting period, a further 2.5km of redundant fences were deconstructed across the WCCM BOA.

Seed Management

Four routine seed assessments were completed across the WCCM BOA as well as including the mine site vegetation in February (prior to the annual clearing program), March, August and November 2017 designed to identify on a seasonal basis the life cycle stage and development of native plants to identify what, where, when and how to target appropriate resources to collect seed for future revegetation programs. The seed assessments resulted in timely and prioritised seed collection with the spatial information directly given to seed collection contractors to undertake the targeted seed collection. Seed collection programs during the reporting period targeted overstorey species in the Werris Creek locality and collected in accordance with the Florabank guidelines.

As part of the WHC group wide revegetation planning; the onsite collected seed was supplemented with commercially sourced local and regional provident seed by reputable seed collectors. A local revegetation provider was engaged to propagate the seed to produce Box Gum Woodland overstorey species seedlings required for the FY17 and FY18 revegetation programs for the WCCM Rehabilitation and Eurunderee BOA.

Revegetation Management

During the reporting period, an overstorey revegetation program was undertaken for the Eurunderee BOA and WCCM Rehabilitation in June 2017 with 5134 and 3454 hiko seedlings of Eucalyptus albens, Eucalyptus blakelyi, Eucalyptus melliodora and Angophora floribunda planted across 87ha and 118ha respectively. Despite a very dry July to September period; tree watering and maintenance tree planting activities between September and December 2017 have been successful to ensure that a better than minimum survival (aim for >20 trees per hectare) is achieved commensurate with the target open Box Gum Woodland vegetation structure of the WCCM BOAs.

Weed Management

WHC coordinated routine formal weed monitoring/inspections undertaken across WCCM BOAs in February, April, August and November 2017. The priority weeds for control were noted as general broadleaf weeds (noxious and environmental species) in areas proposed for revegetation as well as legacy noxious weeds such as St Johns Wort. During the reporting period, WHC implemented a comprehensive weed control program across the WCCM BOA including 669ha treated between January and December 2017 targeting broadleaf weeds and thistles, Johnsons Grass and St Johns Wort. Only appropriately qualified and experienced weed contractors (AQF3 accreditation or higher for use of herbicide) were engaged to undertake weed control works for WHC.

Feral Animals Management

During the reporting period, WHC implemented a comprehensive feral animal control program across the WCCM BOAs with fox baiting and pig trapping undertaken in March (32 Foxes baited from 112 baits presented and no pigs trapped), June (30 Foxes baited from 112 baits presented and no pigs trapped), August (17 Foxes baited out of 112 baits presented and no pigs trapped) and November 2017 (28 Foxes baited from 112 baits presented and no pigs trapped). The record wet weather during winter and early spring limited the success of control programs during this period. Only appropriately qualified and experienced feral animal contractors were engaged to undertake feral animal control works for WHC.

Bushfire Management

During the reporting period, WHC organised for fuel load monitoring to be undertaken in October 2017 with the average fuel load rating for the WCCM BOA being moderate in accordance with “Overall Fuel Assessment Guide” (July 2010). In accordance with the BOMP, WHC undertook maintenance and upgrade of fire breaks and tracks across the WCCM BOAs with 78.3km of fire breaks completed in March and April 2017.

Monitoring Program

During the 2017 reporting period, annual flora and fauna monitoring of the WCC Rehabilitation Area and BOAs was undertaken between 3rd and 8th October 2017, the following findings were observed:

Despite the prevailing dry conditions, the vegetation monitoring found that the majority of the monitoring sites held or gained condition in the key woodland attributes of native species richness and native overstorey cover. Of the three monitoring sites that decreased in native overstorey cover in 2017; those sites were all Class 4 (good) condition vegetation and could be attributable to either relatively dry conditions.
Ten out of the 30 monitoring sites (20m x 20m plots) have reach or exceeded the minimum vegetation benchmark and completion criteria for native species richness (i.e. White Box Grassy Woodland native species richness benchmark is 23). Of the nine monitoring sites that decreased in native species richness in 2017, four were Class 4 (good) condition sites and three are highly disturbed sites (previous agricultural practices or mine rehab) that are reflecting the prevailing dry conditions impacting on the growth of native annual species.

Vegetation monitoring of Rehabilitation Area sites found that four out of the five monitoring sites held or gained condition in native species richness and native overstorey cover.

A total of 68 bird species were surveyed during the 2017 spring monitoring; which is a slight increase from the 2016 period that identified 61 diurnal avian fauna species. A total of 16 reptile and frog species were surveyed which is a decrease from the 2016 period that identified 20 herpeto fauna species possibly reflecting the prevailing dry conditions during 2017.

6.4.3 Proposed Improvement Measures

- Monitoring programs such as quarterly weed inspections and quarterly seed assessments will continue to be implemented into the next period.

6.5 HERITAGE

6.5.1 Environmental Management

The LOM Environmental Assessment determined that the project would not result in any future adverse impacts on Aboriginal cultural heritage. The impact associated with the removal of the remnant features of the former Werris Creek Colliery is considered to be minor, as the historic sites do not meet the NSW Heritage Office (2001) criteria for high significance sites (even at a local level) (Landskape, 2010). WCC previously undertook quarterly inspections of the only known significant Aboriginal heritage item onsite – the "Narrawolga" Axe Grinding Grooves. No previously unknown Aboriginal sites or artefacts were discovered during the period.

The Heritage Management Plan outlines additional heritage management actions related to items associated with the former underground and these have been completed.

6.5.2 Environmental Performance

As described in the updated Heritage Management Plan, The Narrawolga Axe Grinding Groove Rocks were relocated from the temporary storage facility at WCC to the Willow Tree Visitor Information Centre on 15th April 2015. The relocation project included the relocation of ten sandstone boulders with 43 axe grinding grooves originally relocated from the mining footprint at WCC in 2007. The project involved detailed consultation with the Liverpool Plains Shire Council and Nungaroo Local Aboriginal Lands Council, with assistance provided by a geotechnical engineer and archaeologists to minimise the risk of damage to the Groove Rocks and meet regulatory and documentation requirements. Going forward, heritage management will be focused on items potentially discovered through the mining of the former Werris Creek Colliery, underground workings. Should heritage items be uncovered, processes identified within the Heritage Management Plan will undertake.

6.6 WASTE

6.6.1 Environmental Management

WCC continued to engage a total waste management service provider during 2017. This practice has ensured WCC is positioned to adopt industry standard waste management practices and to maintain regulatory compliance with regard to offsite disposal at licenced facilities and on-site storage requirements.

6.6.2 Environmental Performance

Waste generation quantities are tracked as summarised in **Table 10** for the 2017 period. The current reporting period demonstrates benefits seen from improvements to waste management practices at WCC employed in December 2014. The reduction has been driven by waste minimisation measures such as the introduction of separate recyclable waste and general waste bins as well as educational posters identifying waste streams with appropriate bins. These improvements have led to a significant reduction in general waste volumes, while seeing an ongoing increase in recycling.

Table 10 – Approximate Quantities of Waste Generated for 2017

Waste Stream	2015-2016	^2016	2017
*Waste Oil (kL)	**168**	**120**	**103.8**
*Scrap Metal (kg)	**99,430**	**59,090**	**76, 200**
General Waste (m3)	**1,269**	**852**	**1,051**
*Co-Mingled Recycling (m3)	**177**	**139**	**159.1**
Septic (L)	**10,000**	**0**	**0**
*Empty IBCs (kg)	**4,020**	**1920**	**2020**
Oily Rags (kg)	**16,080**	**16,320**	**13,200**
Hydraulic Hoses (kg)	**15,000**	**15,000**	**34,100**
*Batteries (kg)	**3,165**	**2,042**	**2944**

*Recycled waste stream ^Shorter reporting period 1st April – 31st December 2016

6.7 ENVIRONMENTAL PERFORMANCE SUMMARY

An environmental performance summary is presented in **Table 11** below.

Table 11 – Environmental Performance

Aspect	Approval Criteria / EIS Prediction	Performance during the reporting period	Trend / Key Management Implications	Implemented / proposed management actions
Noise	Refer s6.1	One exceedance of noise criteria at Kyooma on 23rd May 2017	Monthly attended noise monitoring identified an exceedance after a low frequency noise penalty was applied	EPA and DP&E advised via email on 28th July. WCC undertook a review of real-time noise processes as part of the investigation, which resulted in an upgrade of monitoring equipment near the property.
Blasting	Refer s6.2	Approval criteria has been met	NA	NA
Air Quality	Refer s6.3	Two exceedances of dust criteria at Glenara PM10 HVAS on 23rd June 2017 and 27th September 2017	Monthly HVAS sampling identified the daily maximum criteria of 50 µg/m3 was exceeded on two occasions	DP&E were advised via email on 14th July and 13th November 2017 respectively. Subsequent investigations demonstrated that WCC was not the cause of the elevated PM10 levels on both days, with WCC downwind of the monitor.
Biodiversity	Refer s6.4	Approval criteria has been met	NA	NA
Heritage	Refer s6.5	Approval criteria has been met	NA	NA

7 WATER MANAGEMENT

7.1 WATER TAKE

WCC currently holds two Water Access Licences, with the water taken under these licences for the 2017 Jan - Dec reporting year summarised in **Table 12**.

Table 12 - Water Take 2017 January - December (ML)

Water Licence #	Water Sharing Plan	Water Source and Management Zone	Entitlement	Passive Take / Inflows	Active Pumping by WCC	Total
WAL 32224	NSW Murray Darling Basin Porous Rock Groundwater Sources	Gunnedah – Oxley Basin Mdb Groundwater Source	211	68.2	0	68.2
WAL 29506	NSW Murray Darling Basin Porous Rock Groundwater Sources	Gunnedah – Oxley Basin Mdb Groundwater Source	50	0	0	0

7.2 SURFACE WATER MANAGEMENT

7.2.1 Environmental Management

The management of surface water aims to prevent surface water pollution both within onsite dams and offsite water courses. The overall water management strategy is to segregate different water streams onsite based on the potential pollutant in each stream.

- Void Water – the void water catchment area is comprised of the active mining area and overburden emplacement which collects both rainfall runoff and groundwater in the base of the open cut void and needs to be dewatered by pumping to the surface to allow mining of the basal coal seam;
- Dirty Water – the dirty water catchment area is comprised of areas previously disturbed by mining such as rehabilitation and soil stockpile areas, with the focus on the reduction of suspended solids and subsequent discharge of treated water;
- Clean Water – the clean water catchment area is undisturbed by mining activities and allowed to flow offsite without active management; and
- Contaminated Water – includes potentially hydrocarbon contaminated water runoff from the workshop and fuel farm areas which is treated through an oil-water separator, as well as water from ablutions which is treated through a septic system onsite.

Void Water Management

Void Water is stored in one of six designated void water dams (VWD's) comprising the void water management system at WCC. VWD's 1, 3 and 4 are long term water storage structures, while VWD's 2, 5, and 6 are temporary structures, designed for the transfer of void water for use around the project. Construction of two additional storages began during the period, VWD 7 (long-term storage) and VWD 8 (short term, temporary transfer storage). In addition, VWD 5 was decommissioned and mined through. Routine checks and photo-inspections of VWD's were undertaken throughout the reporting period. An annual inspection of the prescribed dams (VWD's 1, 3 and 4) was undertaken by a structural engineer on the 2-3rd May 2017 (SLR, 2017) which identified that all prescribed dams were being managed appropriately with minor maintenance works required. Major works were undertaken on VWD 6, with the north western dam wall excavated and rebuilt with a new compacted clay core in September 2017, due to an ongoing minor surface seepage issue (water retained onsite and reports back to the pit). Post completion of the works no further seepage has been identified.

Void water is predominantly used for dust suppression purposes on site. Water carts engaged in watering haul roads and other areas of the mining excavation are the predominant user of water for dust suppression purposes, with water also used to control dust at conveyor loading points and on coal stockpiles. Void water use is monitored and calculated monthly using water meters on key pipelines and water fill points, supplemented by surveyed volumes of water stored in dams and the void on site. This data is used to update the Water Balance Model for site.

Dirty Water Management and Erosion and Sediment Control Measures

During the period, dirty water dams remained in place to capture surface runoff from disturbed areas of the mine site. There were no discharge events during the reporting period from these dams.

Various measures were maintained and improved during the reporting period to minimise erosion and sediment transport at WCC. Minor maintenance of existing sediment dams SB4, SB17 and SB18 occurred during the period, requiring de-silted, maintenance of flow paths and minor erosion control.

Regular checks of the dirty water management system were undertaken as required dependent on rainfall volume.

Contaminated Water Management

WCC undertook regular maintenance of the key contaminated water infrastructure during the reporting period, with the servicing of both the workshop sump and the oil water separator occurring on a fortnightly basis throughout the reporting period. Waste from these facilities is relocated to the onsite bioremediation area for treatment of residual hydrocarbons within the material.

7.2.2 Environmental Performance

Surface Water Quality

Quarterly sampling of water stored within the clean, dirty and void water dams and within Quipolly and Werris Creeks' (**Figure 5**) was undertaken by WCC. **Table 13** presents the average results recorded at each location for the 2017 reporting period.

Table 13 – Quarterly Surface Water Quality for Dams and Offsite Creeks'

Dam/ Creek	Monitoring Site (EPA No)	Number of Samples	pH	Electrical Conductivity (µS/cm)	Total Suspended Solids (mg/L)	Oil & Grease (mg/L)
EPL 100% Limit			6.5-8.5	1600	50	10
VWD1	16	4	8.04	1508	8	<5
VWD2	27	4	8.03	1588	5	<5
VWD3	-	4	8.23	1273	20	<5
VWD4	-	1*	8.08	1590	10	<5
SB2	10	0*	Dry	Dry	Dry	Dry
SB9	12	0*	Dry	Dry	Dry	Dry
SB10	14	0*	Dry	Dry	Dry	Dry
SB18	32	0*	Dry	Dry	Dry	Dry
QCU	25	0*	Dry	Dry	Dry	Dry
QCD	26	4	8.09	994	11	<5
WCU	23	1*	7.86	444	5	<5
WCD	24	4	8.26	1305	20	2

* Sample location was dry during some or all of the quarterly monitoring periods.

The quarterly water quality shown in **Table 13** was generally consistent with the previous reporting period, with the exception of EC within the VWD's. An increase of approximately 300 µS/cm has been observed. WCC are currently investigating potential causes for the minor change. There were no discharge events from onsite sediment basins.

Figure 5 – Offsite and Discharge Water Quality Monitoring Sites at WCC

7.3 GROUNDWATER MANAGEMENT

7.3.1 Environmental Management

The management of groundwater at WCC is undertaken to achieve two goals, namely:

- Monitoring and measuring potential impacts from mining operations on adjacent aquifers and privately owned bores: and
- Dewatering and use of void water (rainfall runoff and groundwater) that is intercepted by mining operations.

WCC currently monitors 42 groundwater bores, located on the mine site and neighbouring properties, to measure potential impacts on groundwater quality and groundwater availability.

WCC monitors groundwater quality and levels across a range of bores as shown in **Table 14** and **Figure 6**. Monitoring bores in the Werrie Basalt are separated into those close to WCC and those further away, with select bores in both the Werrie Basalt and Quipolly Alluvium nominated as background monitoring bores, due to their location far upstream from WCC when considering the dominant groundwater flow contours. In addition, ten bores also contain logging piezometers, providing a higher resolution water level dataset to enhance the understanding gained from the bimonthly groundwater level sampling of the monitoring network. These piezometers have been placed to target certain zones, including the Werrie Basalt northwest, south and east of WCC, and the upper, middle and lower reaches of the Quipolly Alluvium aquifer in the vicinity of WCC.

Table 14 – WCC Groundwater Monitoring Program

Precinct	Bores
Werrie Basalt near WCC	MW1*, MW2, MW3, MW4B, MW5, MW6*, MW27, MW36A*, MW36B
Werrie Basalt	MW8#, MW10, MW14, MW17B, MW19A, MW20, MW38A, MW38B, MW38C, MW38E, MW41* and MW43*
Quipolly Alluvium	MW7*, MW12, MW13*, MW13B, MW13D, MW15, MW16, MW17A, MW18A, MW21A, MW22A, MW22B, MW23A, MW23B, MW26B, MW28A#*, MW32, MW40* and MW42*
Others	MW24A, MW29 (both Werrie Basalt in the Black Soil Gully valley) MW34 (minor alluvium associated with Werris Creek)
Monitoring Frequency	**Parameters**
Bimonthly	Standing Water Level
Quarterly^	MW7 - Standing Water Level, Total Nitrogen, Nitrate, Total Phosphorus, Reactive Phosphorus, Electrical Conductivity, pH, Chloride, Sulfate, Alkalinity, Calcium, Magnesium, Sodium, Potassium, Arsenic, Barium, Beryllium, Cadmium, Cobalt, Chromium, Copper, Manganese, Nickel, Lead, Vanadium, Zinc, Mercury, Ammonium, Nitrite, Nitrite+Nitrate, TKN, Anions, Cations, Ion Balance, TPH
6 Monthly≥	Total Nitrogen, Nitrate, Total Phosphorus, Reactive Phosphorus, Electrical Conductivity, pH
Annually	Chloride, Sulfate, Alkalinity, Calcium, Magnesium, Sodium, Potassium, Arsenic, Barium, Beryllium, Cadmium, Cobalt, Chromium, Copper, Manganese, Nickel, Lead, Vanadium, Zinc, Mercury, Ammonium, Nitrite, Nitrite+Nitrate, TKN, Anions, Cations, Ion Balance, TPH
# Background monitoring bore * Groundwater logger installed in bore for all or part of reporting period (land owner will not grant access) ^Applies to MW7 bore only ≥Applies to MW1, MW2, MW3, MW4B, MW5, MW6 in conjunction with bimontly depth monitoring	

The Water Balance Model for WCC was updated as part of this Annual Review, with this model used to verify model assumptions in relation to groundwater interception in the mining void. A cusum analysis was undertaken on all monitoring bores at the end of the reporting period to assess whether any bores show changes in water level outside of natural variability. To provide further clarity on the interaction between the Quipolly Alluvium Aquifer and the Werris Basalt Aquifer, four additional monitoring wells were installed during the reporting period (two in each aquifer), and fitted with standing water level loggers.

Figure 6 – Groundwater Monitoring Network

7.3.2 Environmental Performance

Performance with respect to groundwater management, the prevention of pollution and the assessment of impacts on groundwater availability to other surrounding users, is assessed through groundwater level and chemistry monitoring. Monitoring focuses on the Werrie Basalt and Quipolly Alluvium aquifers.

Table 15 presents the groundwater level monitoring data for January to December in the Werrie Basalt and Quipolly Alluvium aquifers. For Quipolly Creek Alluvium, MW28A and MW23A are representative of upstream and downstream aquifer conditions respectively. For Werrie Basalt, MW5 and MW14 are representative of aquifer conditions either side of the watershed between Quipolly Creek in the south and Werris Creek in the north. All groundwater sampling and analyses were undertaken by a NATA accredited laboratory.

Table 15 – Groundwater Monitoring Bore Level Summary – January to December 2017

Site		January-17		February-17		March-17		May-17	
		mbgl	%	**mbgl**	%	**mbgl**	%	**mbgl**	%
Werrie Basalt near WCC	**MW1**	Dry		Dry		Dry		Dry	
	MW2	31.91	1%	32.08	-1%	32.82	-2%	35.18	-7%
	MW3	19.18	0%	19.14	0%	19.15	0%	19.16	0%
	MW4B	14.67	1%	14.94	-2%	14.45	3%	15.87	-9%
	MW5	11.89	0%	11.86	0%	11.89	0%	11.96	-1%
	MW6	16.2	0%	16.2	0%	16.37	-1%	15.43	6%
	MW27*	54.79	0%	54.55	0%	54.46	0%	52.09	5%
	MW36A	21.14	-2%	21.4	-1%	21.3	0%	21.62	-1%
	MW36B	21.12	-2%	21.36	-1%	21.15	1%	21.6	-2%
Werrie Basalt	**MW8***	14.22	-2%	14.61	-3%	15.08	-3%	15.89	-5%
	MW10	13.35	1%	13.33	0%	13.36	0%	13.25	1%
	MW14	16.88	-1%	17.23	-2%	17.89	-2%	18.04	-1%
	MW17B*	11.70	1%	11.72	0%	11.79	-1%	11.98	-2%
	MW19A*	9.07	-6%	10.44	-13%	9.73	7%	10.48	-7%
	MW20*	21.33	0%	21.62	-1%	21.54	0%	21.54	0%
	MW38A	12.43	-3%	12.71	-2%	12.43	2%	12.96	-4%
	MW38B*	9.38	0%	9.44	-1%	9.49	-1%	9.58	-1%
	MW38C*	22.14	-1%	22.21	0%	22.46	-1%	22.45	0%
	MW38E*	9.15	0%	9.27	-1%	9.47	-2%	9.67	-2%
#[1]	**MW24A***	14.32	-1%	14.48	-1%	14.39	1%	14.49	-1%
	MW29*	11.13	4%	11.26	-1%	11.59	-3%	12.16	-5%
Quipolly Alluvium	**MW12***	9.7	-5%	10.17	-5%	10.48	-3%	11.2	-6%
	MW13*	5.73	-3%	5.84	-2%	5.98	-2%	6.13	-2%
	MW13B*	3.95	-6%	4.13	-4%	4.47	-8%	4.53	-1%
	MW13D*	4.63	-3%	4.89	-5%	4.88	0%	4.8	2%
	MW15*	5.26	-2%	5.42	-3%	5.56	-3%	5.69	-2%
	MW16*	6.04	-1%	6.18	-2%	6.33	-2%	6.59	-4%
	MW17A*	5.34	-5%	5.31	1%	5.43	-2%	5.68	-4%
	MW18A*	5.01	-1%	5.07	-1%	5.27	-4%	5.46	-3%
	MW21A*	8.6	-1%	8.81	-2%	9.02	-2%	9.35	-4%
	MW22A*	6.15	-1%	6.30	-2%	6.49	-3%	6.75	-4%
	MW22B*	6.32	-2%	6.49	-3%	6.78	-4%	6.98	-3%
	MW23A*	3.93	-5%	3.92	0%	3.92	0%	3.84	2%
	MW23B*	4.02	-1%	4.68	-14%	4.35	8%	5.05	-14%
	MW26B*	7.38	-1%	7.52	-2%	7.71	-2%	8.56	-10%
	MW28A*	9.97	-10%	10.61	-6%	11.29	-6%	12.28	-8%
	MW32*	3.92	-5%	3.97	-1%	4.02	-1%	3.98	1%
#[2]	**MW34***	9.74	-5%	10.52	-7%	10.6	-1%	10.77	-2%

Site		July-17		September-17		November-17	
		mbgl	%	**mbgl**	%	**mbgl**	%
Werrie Basalt near WCC	**MW1**	Dry		Dry		Dry	
	MW2	37.89	-7%	40.84	-7%	44.53	-8%
	MW3	19.21	0%	19.29	0%	19.35	0%
	MW4B	16.07	-1%	16.27	-1%	16.42	-1%
	MW5	12.00	0%	12.09	-1%	12.18	-1%
	MW6	15.37	0%	15.46	-1%	15.81	-2%
	MW27*	49.95	4%	49.43	1%	49.88	-1%
	MW36A	22.39	-3%	23.18	-3%	23.69	-2%
	MW36B	22.37	-3%	23.15	-3%	23.65	-2%
Werrie Basalt	**MW8***	16.42	-3%	17.28	-5%	17.66	-2%
	MW10	13	2%	13.12	-1%	12.31	7%
	MW14	18.51	-3%	19.09	-3%	19.51	-2%
	MW17B*	12.29	-3%	12.45	-1%	12.76	-2%
	MW19A*	10.63	-1%	12.45	-15%	12.77	-3%
	MW20*	21.57	0%	21.61	0%	21.8	-1%
	MW38A	13.49	-4%	13.94	-3%	14.33	-3%
	MW38B*	9.72	-1%	9.80	-1%	9.86	-1%
	MW38C*	22.66	-1%	22.40	1%	22.81	-2%
	MW38E*	9.84	-2%	9.97	-1%	10.20	-2%
	MW41	8.05		8.22	-2%	8.49	-3%
	MW43	6.91		7.07	-2%	7.34	-4%
#[1]	**MW24A***	14.61	-1%	10.77	36%	15.1	-29%
	MW29*	12.50	-3%	12.77	-2%	13.02	-2%
Quipolly Alluvium	**MW12***	11.61	-4%	11.96	-3%	12.19	-2%
	MW13*	6.3	-3%	6.53	-4%	6.79	-4%
	MW13B*	4.69	-3%	4.87	-4%	5.12	-5%
	MW13D*	4.85	-1%	4.89	-1%	5.1	-4%
	MW15*	5.89	-3%	6.06	-3%	6.26	-3%
	MW16*	6.8	-3%	7.11	-4%	7.35	-3%
	MW17A*	5.97	-5%	6.21	-4%	6.44	-4%
	MW18A*	5.84	-7%	6.05	-3%	6.25	-3%
	MW21A*	9.64	-3%	9.91	-3%	10.15	-2%
	MW22A*	7.01	-4%	7.20	-3%	7.48	-4%
	MW22B*	7.29	-4%	7.52	-3%	7.79	-3%
	MW23A*	3.82	1%	3.92	-3%	4.07	-4%
	MW23B*	No access		4.09	23%	4.25	-4%
	MW26B*	8.3	3%	8.68	-4%	8.96	-3%
	MW28A*	12.57	-2%	13.23	-5%	13.94	-5%
	MW32*	3.86	3%	4.01	-4%	4.03	0%
	MW40	8.06		8.25	-2%	8.58	-4%
	MW42	6.80		6.96	-2%	7.23	-4%
#[2]	**MW34***	10.7	1%	10.8	-1%	11.06	-2%

mbgl – meters below ground level, the distance from top of bore to groundwater surface.

Bold –lowest recorded groundwater level measured during the reporting period.

Orange – Change decrease

Green – Change increase or no change

* - Bore is used for water extraction unrelated to WCC (i.e. stock and domestic or irrigation).

#[1] – Werrie Basalt in the Black Soil Gully valley to east of Werris Creek Mine.

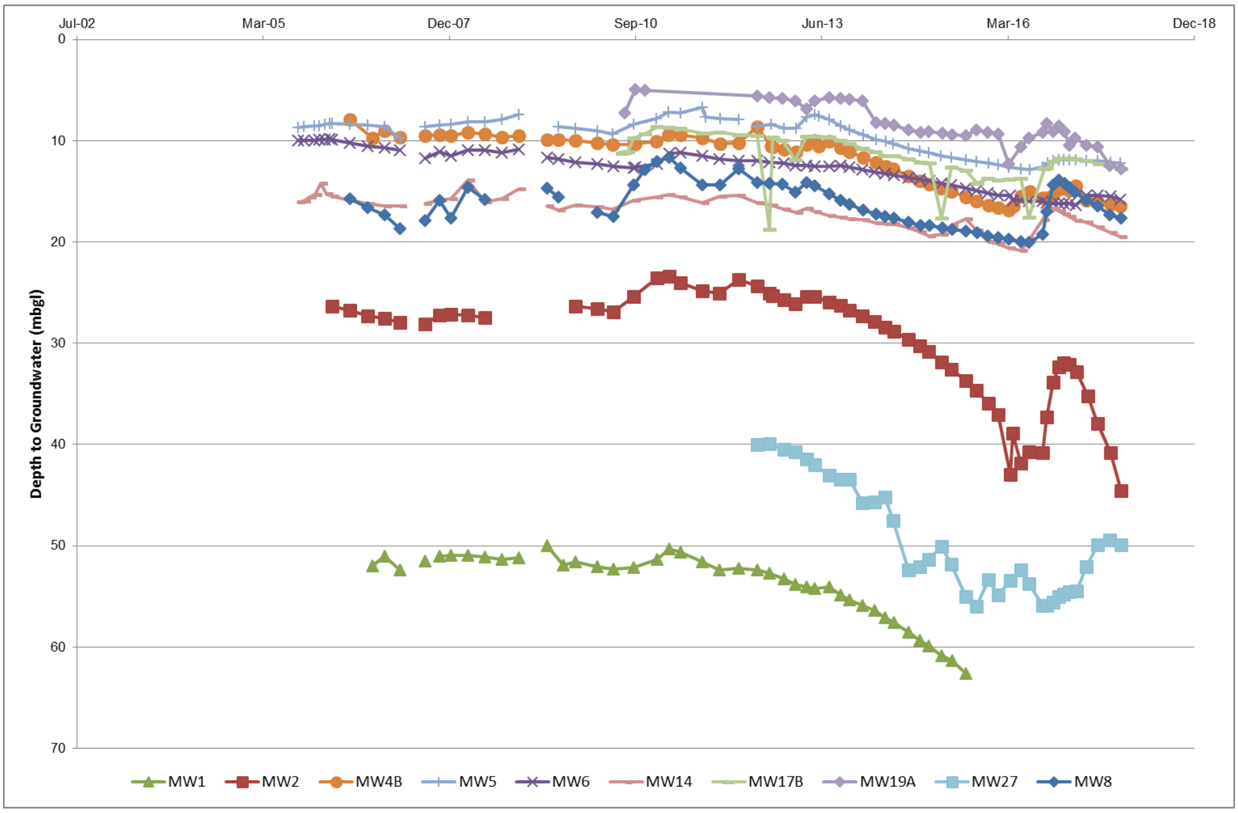
#[2] - Werris Creek Alluvium.

The groundwater level monitoring results have shown generally low water levels throughout 2017, which is representative of the prolonged dry seasons and mirrors historic Annual Review data sets during dry periods.

WCC specialist Groundwater Consultant Ramboll undertook the annual groundwater review for 2017 (Ramboll 2018). The following findings were identified.

All monitoring wells (MW) were reviewed using a CUSUM statistical analysis. Of the 42 wells reviewed, nine were identified as reaching trigger levels, requiring further investigation. These wells were MW 1, 2, 4B, 5, 6, 14, 17B, 19A & 27 and are located within the Werrie Basalt aquifer. No wells located within the Quipolly aquifer trigged the requirement for further investigation. Ramboll (2018) found that these MW displayed trends generally consistent with background MW8 and cumulative rainfall data for the period. **Figure 7** identifies these findings inclusive of the background monitoring well MW8.

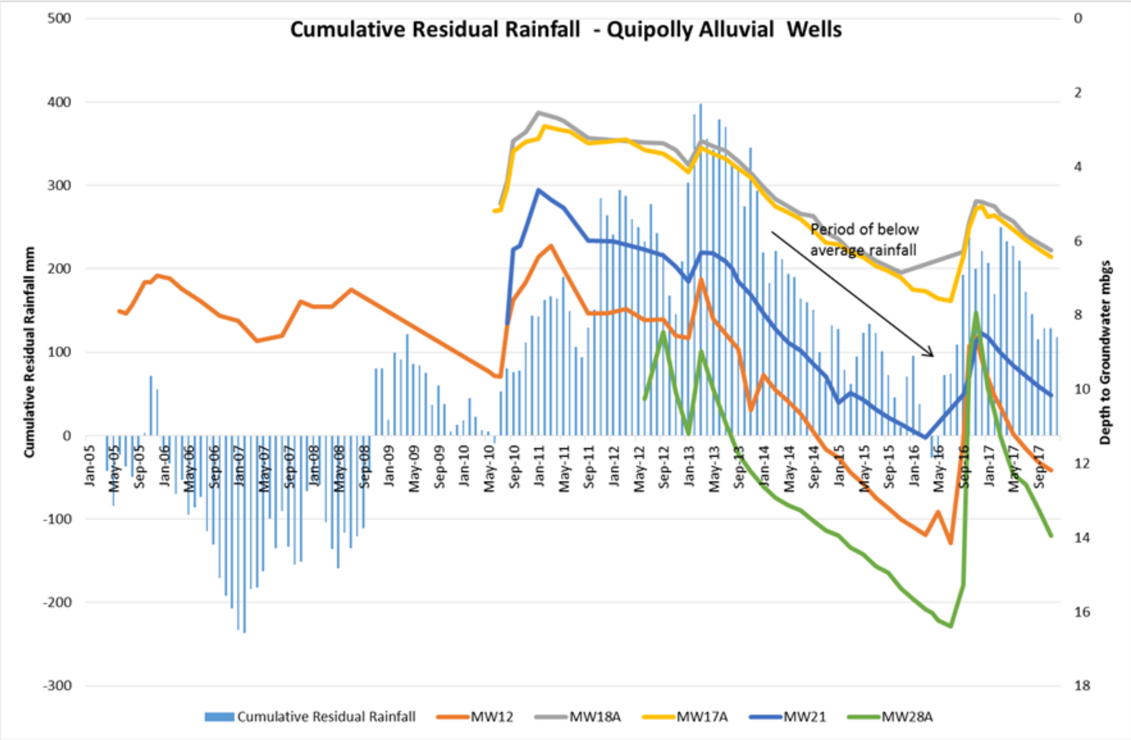
Figure 7 - Comparison of groundwater trends in trigged monitoring wells.



Quipolly Alluvium Aquifer

In aquifer systems that are recharged by rainfall, groundwater levels closely follow the cumulative residual rainfall patterns. The Quipolly alluvial aquifer is a system reliant on rainfall recharge and flooding and it is expected that this correlation would be apparent in wells monitoring the Quipolly Alluvium. Groundwater level data from wells within the Quipolly alluvium aquifer system, monitored by WCCM, and compared to cumulative residual rainfall is presented in **Figure 8** and show a close correlation between groundwater level and cumulative residual rainfall

Figure 8 – Cumulative residual rainfall and monitoring wells within the Quipolly Alluvium



Groundwater well MW28A, located to the south of the project site is considered to be up-gradient and representative of fluctuation in the aquifer in response to factors other than mining. The fluctuations observed in MW28A were found to be consistent with those observed in the other Quipolly aquifer wells.

The steep increase in groundwater level within the Quipolly alluvium aquifer in September 2016 was likely attributed to the overflow of Quipolly Dam, upstream of the wells. Quipolly Dam was upgraded by State and Local Government, in early 2013 as part of a program to improve dam safety and increase the storage capacity. The dam overflowed in September 2016 for the first time since augmentation works had been completed. Over the monitoring period of January 2017 to December 2017, a decline in groundwater levels is observed, consistent with the lower than average rainfall shown by the cumulative residual rainfall plot.

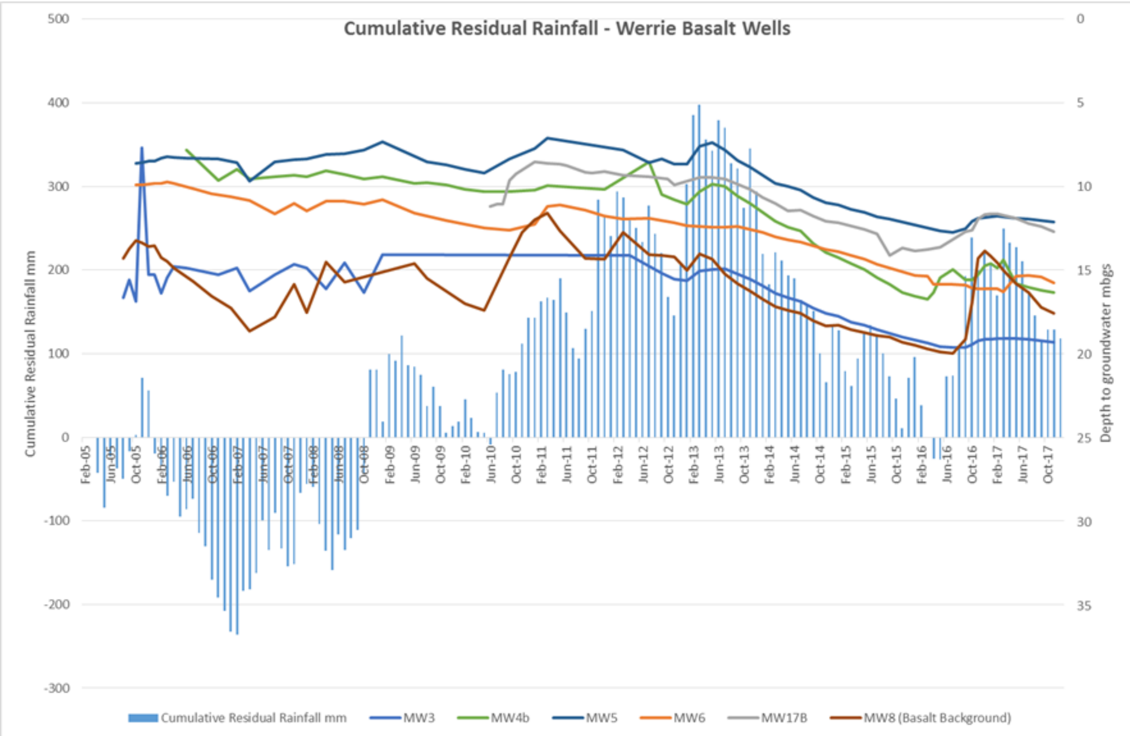
Werrie Basalt Aquifer

Wells monitored within the Werrie Basalt are known to be in an area of low permeability overlying clays, resulting in less noticeable recharge due to cumulative rainfall.

The Werrie Basalt aquifer is monitored on all sides of the mine workings. Monitoring location MW8, located remotely to the south of the site and to the south of Quipolly Creek, is considered a representative background well for comparison of groundwater levels around the south of the site. A comparison of observed groundwater levels in MW8 and Werrie Basalt aquifer monitoring wells located directly south of the mine workings, with cumulative residual rainfall is presented in

Figure 9 Some correlation to cumulative residual rainfall is observed, however locations directly south of the mine do not demonstrate a response of the same magnitude as the background well MW8.

Figure 9 – Cumulative residual rainfall and groundwater levels in the basalt aquifer south of the mine.



As part of the 2016 review, (Ramboll Environ February 2017), it was noted that wells MW4b and MW6 had not demonstrated the same recovery response to the late 2016 increased rainfall (compared to the background well MW8), and it was considered that this was potentially due to slower recovery rates or a lag effect. Continued monitoring in 2017 confirmed a delayed water level recovery in both MW4b and MW6 with a subsequent decline further into 2017 consistent with the background well and the rainfall conditions.

Ramboll, 2018, conducted an assessment of groundwater flow directions and rates, which indicated that rates are consistent with pre-mining conditions and show flow to be directed towards the creek systems with consistent hydraulic gradients.

Ramboll, 2018, undertook a review of water quality data within both the Quipolly and Werrie Aquifers, in line with requirements outlined in **Table 13**.

Groundwater Quality

Monitoring of groundwater quality during the period identified pH and EC values generally in line with past results, with minor increases noted in some stock and domestic bores. Total Phosphorus and Total Nitrogen results were all reported below the historic maximum concentrations. A number of bores associated with agricultural land have continued to display generally high Total Phosphorus and Total Nitrogen levels. These levels have been consistent with historic monitoring and are a reflection of the agricultural land use and fertiliser inputs rather than impacts from mining operations.

7.3.3 Proposed Improvement Measures

The Groundwater monitoring program described above will continue to be implemented during the next reporting period.

7.4 SITE WATER BALANCE MODEL VALIDATION

The WCC Water Balance Model is focused on accounting for all water entering and leaving the open cut pit to allow a verification of groundwater interception during the reporting year (**Table 16**). The key inputs to the water balance model are:

- Direct rainfall and runoff – Generally the largest input due to the large pit catchment, this item relates to rainfall that falls directly in the void water catchment. During any rainfall event, runoff is significant due to the large catchment and hard, compacted surfaces.
- Recharge from underground workings – Considerable volumes of water are used to manage spontaneous combustion within the former underground workings at WCC. Sprinklers and other drenching sprays are used to reduce the heating of coal that can lead to underground fires, with the majority of this water returning to and collecting in the void.
- Evaporators recharge – Since September 2015, large evaporator sprays have been installed at WCC to reduce the volume of void water stored on site. A large portion of this water will not evaporate, but instead percolate through the accumulated spoil until it collects in the void.
- Dust Suppression – To minimise the generation of dust from vehicle movements, water is applied directly to haul roads and dumps. Furthermore, water may be applied to excavator loading faces and production drills to minimise the generation of dust at these points.
- Groundwater – Located within the Coal Measures sequence, the enclosed basin contains various small-scale water bearing zones generally associated with the coal seam. In addition, water is also stored in the former workings of the previous underground colliery and is also present in the overburden spoil. A small proportion of groundwater may also be derived from the Werrie Basalt aquifer.

The key outputs to the model include:

- Pit dewatering – Includes all water pumped from the pit during the year, which is the principle pathway for water leaving the void.
- Direct evaporation – Includes the volume of water directly evaporated from the pit and other locations within the void water cycle.

Table 16 – Water Balance Inputs and Outputs.

Source	Estimated Mean Average Volume (ML)	Notes
INPUTS TO PIT		
Rainfall and Runoff	444.2	Calculated from WBM-31 based on rainfall, area and characteristics of catchments areas which report back to the pit.
Evaporators and Dust Suppression	591.2	Volume of water estimated to flow back into the pit from use of evaporators and dust suppression. The final volume returning to the pit is derived from runoff/infiltration/storage calculations in WBM-31.
Pumped into Void	3.4	Volume of water pumped into the Void via meter 10.
Water Pumped to Old Workings	32	Volume of water pumped into the old workings for spontaneous combustion control.
TOTAL INPUT	**1,070.8**	
OUTPUTS FROM PIT		
Out of Pit Pumping	904.0	Volume based on metered pumping.
Direct Evaporation	157.6	Estimated volume directly evaporated from the surface of the pit, based on climatic data (from daily evaporation measured at Gunnedah Resource Station).
Groundwater and Underground Workings	31	Pro-rata amount derived from the hydrogeological model.
TOTAL OUTPUT	**1,092.6**	
Change in Storage	116.0	The difference between the estimated volume of water in the pit void between January 2017 and September 2017, based on surveyed levels and the established relationship between height and pit volume. Over this period this volume had increased so must be balanced against inputs and outputs from modelling.
NET WATER	**137.8**	Difference in input/output. See comments about relative errors (section 2.4).

The results of the above Water Balance were found to correlate well with the hydrogeological model predictions for groundwater inflow for the WCC pit and generally with predictions made in the Water Management Plan. A surplus of water obtained during an above average rainfall during 2016 has carried water stocks over into 2017. Increased storage within the void has seen an out flow from the void into the underground workings. Compared to 2016 (23ML inflow) 2017 has identified 31ML outflow. A detailed report on the water balance can be found in Appendix A.

8 REHABILITATION

The Rehabilitation Objectives for WCC are described in Section 4 of the WCC MOP. The post mining land use goal for WCC is to reinstate certain areas of the mine to Class III capable agricultural land, and to ensure rehabilitation and revegetation is self-sustaining.

8.1 REHABILITATION PERFORMANCE DURING THE REPORTING PERIOD

During the reporting period, mining operations progressed in line with the Mining Operations Plan. Minimal advancements in the earlier rehabilitation categories (Landform Establishment and Growth Medium Development) were made during the reporting period. However, areas of decommissioning were advanced during the period, with the majority of the 27.4 ha of this area being shaped to final landform requirements, awaiting subsoil and topsoil placement. This additional rehabilitation has advanced the MOP requirements for rehabilitation by 4 ha above the targeted 29 ha at WCC for the period. The MOP identified 29 ha would be achieved for this period, a total of 33 ha has been undertaken for the period. All infrastructure continued to be in use during the period, and as such no areas of infrastructure were rehabilitated during the period.

Rehabilitation processes for the 2017 reporting year focused on the maintenance and advancement of current vegetation areas, this included the planting of approximately 6000 native tube stock, ongoing maintenance to exiting trees and watering newly planted stock (see Section 6.4.2 Environmental Performance, Revegetation).

Weed control was completed across all areas of rehabilitation during the reporting period to control a number of broadleaf weeds persistent in regeneration areas. Inspections of rehabilitation structures following heavy rainfall identified that all areas are structurally sound, with only minimal maintenance required. A description of rehabilitation monitoring and other initiatives to boost rehabilitation success have been described in **Section 6.4 Biodiversity**.

8.2 REHABILITATION TRIALS

WHC is supporting research into arboreal habitat augmentation of woodland rehabilitation by installing previously cleared timber back on the post mining landform to replicate habitat provided by stag trees that occur naturally in woodland communities. Motion sensor cameras have predominantly captured images of birds at 8 control sites (no stag trees) and 16 treatment sites (augmented stag trees) on the mine rehabilitation area and 16 reference sites (natural stag trees) within the adjacent biodiversity offset area at WCC. This research will continue into the next reporting period.

Table 17 presents a summary of the disturbance classes for the end of the previous reporting period, the end of the current reporting period, and a forecast as at the end of the next reporting period. Error! Reference source not found. identifies the rehabilitation categories as at December 2017.

Table 17 – Rehabilitation Status

Mine Area Type[1]	Previous Reporting Period April – Dec 2016 (Actual)	This Reporting Period 2017 (Actual)	Next Reporting Period 2018 (Forecast)
	April – Dec 2016 (ha)	2017 (ha)	2018 (ha)
A. Total mine footprint	559	556	556
B. Total active disturbance	392	387	403
C. Land being prepared for rehabilitation	16*	33	22
D. Land under active rehabilitation	151	151	151
E. Completed rehabilitation	0	0	0

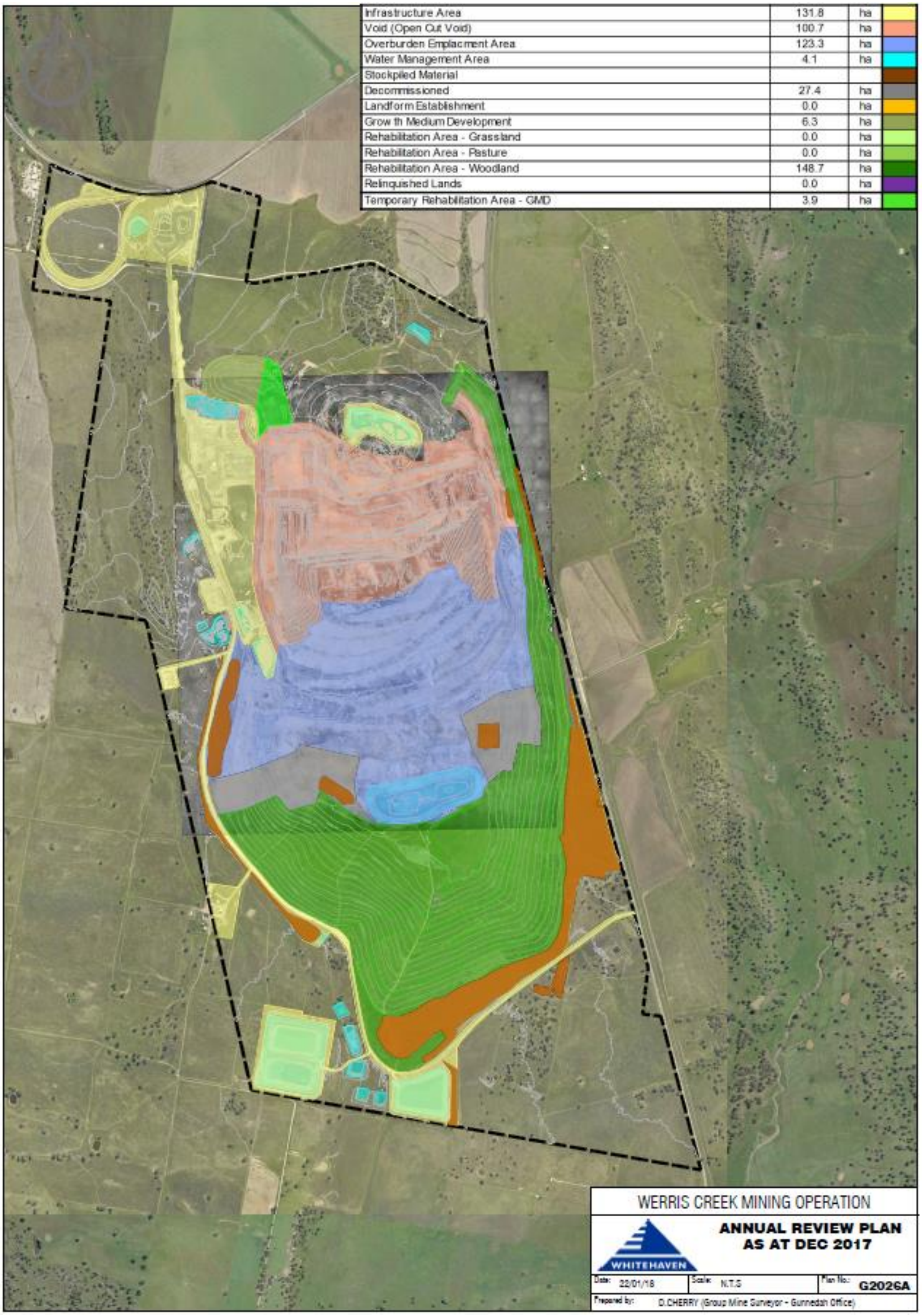
[1] Refer Annual Review Guideline (p.11) for description of mine area types.

** Comprises areas seeded with a cover crop only, and those waiting on final native grass seeding*

No areas of rehabilitation at WCC have received formal signoff for completion; however, areas under active rehabilitation as listed in item D above are trending well towards completion.

A minor reduction in total mine footprint 2017 has been associated with continuous improvements in survey determinations.

Figure 10 – Rehabilitation Categories December 2017



8.3 REHABILITATION WORKS PROPOSED FOR NEXT REPORTING PERIOD

WCC aims to continue rehabilitation efforts during the 2018 reporting period largely in accordance with the projections under Year 2/3 of the current MOP. These actions will focus on finalisation of decommissioned areas, landform development and growth medium development of the next section of the outer western batter, upper plateau and eastern batter. Works will also focus on the in-fill planting of tube stock on all rehabilitation areas.

In addition to the progression of the rehabilitated landform, WCC will manage the existing areas of rehabilitation to ensure a continued trend towards the rehabilitation objectives described at the start of this section.

8.4 KEY ISSUES TO ACHIEVING SUCCESSFUL REHABILITATION

There are four key issues in achieving successful rehabilitation, including:

- Poor vegetation establishment and growth due to poor soils/lack or nutrient;
- Weed and feral animal infestation;
- Excessive erosion and sedimentation resulting in land stability and vegetation growth issues; and
- Harsh weather conditions limiting growth, i.e. extended periods of drought.

In cases where the performance is sub-optimal, additional management measures will be implemented (e.g. replanting, repairing landform and water management features, application of mulch/fertilisers, feral animal and weed control etc.).

9 COMMUNITY

WCC is located approximately 2.0km south-southwest of the residential area of Werris Creek and 1.5km north of the rural community of Quipolly, and as such works closely with these communities to provide beneficial outcomes resulting from coal mining activities at WCC.

9.1 COMMUNITY ENGAGEMENT ACTIVITIES

WCC uses a variety of community engagement and consultation methods including the WCC Community Consultative Committee (CCC), regular updates to the Whitehaven Coal website, designated community telephone complaints lines, local media updates, local school visits, sponsorship of local community events and groups, and meetings as required with neighbours and a range of stakeholders including government and non-government agencies.

In addition there were four CCC meetings held during the reporting period.

9.2 COMMUNITY CONTRIBUTIONS & INITIATIVES

WHC, which includes WCC contributes financially to the economy at both state and federal level and to the communities in which we operate. Employees and contractors also add a significant economic contribution to townships in the Liverpool Plains Shire Council (LPSC) through their purchases from local businesses. Whitehaven Coal has contributed in excess of $1 billion to the North West NSW region since 2012.

Community Enhancement Fund (CEF)

As part of the Life of Mine Project, WCC established the Community Enhancement Fund (CEF) to provide support for community projects in the Liverpool Plain Shire and in particular the Werris Creek township.

Whitehaven has pledged more than $1m in payments to the Liverpool Plains Shire Council for community projects. Projects funded to date by Whitehaven in the Liverpool Plains LGA include:

- $100k for projects at Australian Railway Museum, Werris Creek;
- $70k for playground improvements in Werris Creek;
- $65k for skate park, Werris Creek;
- $50k for projects in villages in Liverpool Plains Shire; and
- $20k for Royal Theatre, Quirindi.

9.3 COMMUNITY COMPLAINTS

WCC maintains a dedicated community telephone complaints line (02 6768 7001) which is published at the mine entrance, on the Whitehaven Coal website, and in community newsletters. In the event of a complaint or enquiry, details pertaining to the complainant, the complaint and action taken are recorded on the complaints register. The register is available on the Whitehaven website.

Blasting was the dominant cause for complaint in 2017, with 9 blast-related complaints of the 24 received, compared with 12 during the same reporting period. This reduction may in part be attributed to a self-imposed reduction in the maximum targeted vibration prediction for the southern end of Werris Creek Township, which was reduced from 1.0mm/s to 0.8mm/s during the last reporting period. This is further supported by the reduction in blast related complaints and an ongoing reduction overall in complaints when 2017 is compared to earlier reporting periods, as shown in **Table 18**.

For specific complaint details and actions taken, refer to the Complaint Database for 2017 located on the Whitehaven Coal website.

Table 18 – WCC Complaints 2017

Issue	2015-2016	^2016	2017
Blast - Vibration/Overpressure	23	12	9
Blast - Dust/Fume	6	1	1
Blast/Other	0	7	0
Noise – Train Load Out	1	0	0
Noise – Mine	0	1	3
Lights – Mine	2	0	0
Lights - Train Load Out	2	0	0
Dust – Mine	2	4	4
Dust - Train Load Out	1	0	0
Groundwater Level	4	0	0
Surface Water	0	2	0
Road	0	0	0
Clearing	0	0	0
Odour	0	3	7
Heritage	0	0	0
Number of Issues Raised*	**41**	**30**	**24**

* Number of complaints does not equal the number of issues raised as one complaint can raised multiple issues

^Shorter reporting period 1st April – 31st December 2016

10 INDEPENDENT AUDITS

An Independent Environmental Audit (IEA) was undertaken at WCC on the 14th and 15th of June-2017. The full IEA report and Action Plans can be found on the Whitehaven Coal website.

- The remaining issues outstanding at the completion of the reporting period are summarised in **Table 19 and**
- **Table** 20, all other actions not listed below have been closed out.

Table 19 – Status of the Implementation of the 2014 IEA Action Plan

Condition	Recommendations	Actions taken
PA 10_0059 MOD2 Schedule 3 Condition 27	SLR recommends that WCC progress consultation with the DP&E in order to close out this condition regarding long term security for the offset area.	Draft NSW Conveyancing Act 1919 Section 88E Instruments are being negotiated by NSW Department of Planning and Environment with Whitehaven Coal's legal representatives as at March 2018. Accordingly, the Department of Environment and Energy (DoEE) approved a variation extending the time for registering of offset security until 31st December 2018.
PA 10_0059 MOD2 Schedule 3 Condition 37	Finalise the construction of the visual bund and revegetate the visual bund.	The eastern visual bund has progressed to a point where by current WCC operations are not in view of the public, reducing potential visual and noise impacts. Finalisation of the visual bund will occur in subsequent reporting periods, pending mining schedule commitments.

Table 20– Status of the Implementation of the 2017 IEA Action Plan

Condition	Recommendations	Actions taken
PA 10_0059 MOD2 Schedule 3 Condition 23 EPL 12290 O1.1, M3.2, E1.1 EA Statement of Commitments 3.1, 3.2, 3.4	There have been audits from the EPA and DPE, with outcomes and proposed actions currently being finalised. Implement the agreed outcomes from this audit.	Outcomes from the multi-agency audit to be implemented as per Action Plans previously submitted to the relevant Departments. There is one outstanding action still current.
PA 10_0059 MOD2 Schedule 3 Condition 43	For the next MOP update, send the key sections of the MOP document to these agencies for review/comment.	WCC will ensure appropriate consultation will be undertaken during the next MOP revision.
EPL 12290 M9.1	It is unclear to the auditor as to why the EPL requires 60 minute noise monitoring surveys to assess compliance with the criteria which is LAeq15minute.	WCC will consider applying for modification to EPL 12290.

11 INCIDENTS AND NON-COMPLIANCES DURING THE REPORTING PERIOD

11.1 REPORTABLE INCIDENTS

WCC reported two incidents during the reporting period:

- Dust exceedances on 23rd June and 27th September 2017, refer to section 6.3.2
- Noise exceedance on the 23rd May 2017, refer to section 6.1.2

11.2 NON-COMPLIANCES

The compliance status of WCC against relevant approvals during the reporting period was assessed in Section 1 as at the end of the reporting period. Details on each non-compliance have been identified in Sections 6.3.2 & 6.1.2.

11.3 REGULATORY ACTIONS

WCC did not receive any regulatory actions during the reporting period.

12 ACTIVITIES TO BE COMPLETED IN THE NEXT REPORTING PERIOD

Activities to be completed in the next reporting period to improve the environmental or community performance of WCC have been included in **Table 21**.

Table 21 – Activities to be completed in the next reporting period

Activity	Timeframe
Completion of review and, if necessary, revision of Environmental Management Plans	In accordance with PA 10_0059
Progression of remaining actions from the IEA	Ongoing
Continued community liaison and engagement with local stakeholders	Ongoing

APPENDIX A

Intended for
Whitehaven Coal Pty Ltd

Document type
Report

Date
March 2018

Project Number
318000386

DETERMINATION OF GROUNDWATER INTERCEPTION 2017

WERRIS CREEK COAL MINE

DETERMINATION OF GROUNDWATER INTERCEPTION 2017 WERRIS CREEK COAL MINE

Revision	**2**
Date	**23/03/2018**
Made by	**Simon Gaskell**
Checked by	**Stephen Cadman**
Approved by	**Fiona Robinson**
Description	**Report**

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EXECUTIVE SUMMARY

Werris Creek Coal Mine (WCCM) is situated in the northwest slopes and plains of New South Wales and is located 4km south of Werris Creek. The mine operates under project approval PA 10_0059 MOD 2, approved in 2015.

Project Approval 10_0059 relates to the LOM project and Schedule 3 condition (23) of the project approval refers to the development of a Water Management Plan. The Water Management Plan includes requirements for surface water and groundwater monitoring and outlines trigger conditions and contingency responses. This report addresses the following requirement of the water management plan:

1. *Completion of an annual pit water balance to determine the groundwater interception;*

In late 2016, a change in reporting schedule was implemented by Werris Creek, to cover a calendar year from the previously evaluated April to March reporting period.

This report is the first full calendar year evaluation and covers the period, January 2017 to December 2017.

In order to verify the groundwater modelling estimates for the annual inflow of groundwater into the Void, a comparison with observed water levels in the Void accounting for other inputs and outputs to the water balance has been carried out. This has been done through the construction of a water balance model (WBM) for the Void. The scope of the WBM was follows:

- Simulate water balance processes likely to influence the level of standing water in the Void;
- Make a suitable allowance for potential error in monitoring data used in the model;
- Undertake a sensitivity check on key assumptions, e.g. runoff coefficients for different land-use types;
- Carry out a full-year simulation with a daily time-step for the calendar year of 2017;
- Compare the results of the WBM with observations of water levels in the Void for 2017; and
- Using the WBM to assess differing groundwater inflow scenarios, above and below the predicted flow (from the groundwater model) to provide a best fit to match the observed water levels.

The WBM created for this report has been revised in comparison with previous years of reporting groundwater interception. This WBM is also distinct from previous opportunities to use water balance modelling to provide a tool for predicting potential future impacts on water use. In particular, the WBM used in this report does not fully replicate water storages and water use outside of the Void. This is not necessary for the objectives of this modelling work as described in further detail within this report.

In addition, a peer review of the previous water balance modelling work (Arup 2016) had made a series of recommendations for additional explanation and clarification in the water balance report. These recommendations have been addressed within this report.

The findings of the 2017 Review conducted as a requirement of the Project Approval have resulted in the following conclusions:

- Groundwater inflows to the mining operations were initially predicted using a calibrated model which were tested by incorporation into a water balance for the mine pit over a discrete period.
- The results of the pit WBM for January 2017 to December 2017, using water management data from the site including, metered volume measurements from pit dewatering, evaporator use and dust suppression usage, was found to correlate well with the hydrogeological model predictions for groundwater inflow to the pit.
- This process has further validated the groundwater model developed for the LOM project, which was refined in 2012. At the time of the LOM impact assessment, this model benefitted from real time calibration data recorded during the initial mining scenarios and was therefore

considered to be a robust representation of the groundwater system. Minor modification of the boundary conditions adopted in the model was undertaken in 2012 following changes to the management of groundwater within the former mine workings.

- On the basis of the WBM validation the predictions of impacts to the groundwater levels in the basalt aquifer are considered to remain valid.
- Therefore, the results indicate that Werris Creek Coal Mine has complied with its Water Access Licence (WAL) conditions for the period January 2017 to December 2017.

1. INTRODUCTION

Werris Creek Coal Mine (WCCM) is situated in the northwest slopes and plains of New South Wales and is located 4km south of Werris Creek. The mine operates under project approval PA 10_0059 MOD 2, approved in 2015.

1.1 Background

In 2005, Werris Creek Coal Mine (WCCM) commenced mining of the Greta Coal Measures – Werris Creek outlier, situated within the Werrie Basin. The coal measures overlie Werrie Basalt, which is directly beneath and surrounds the coal measures in all directions. The upper layers of the basalt have been shown to be highly weathered to form a clay aquitard providing confinement or semi-confinement between aquifers within the coal measures and underlying basalt hard rock.

Underground mining of part of the coal seam was undertaken prior to the commencement of open cut mining in 2005. The open cut operations are currently mining through the former underground mine workings. Underground mine workings were known to be saturated prior to commencement of operations. The mine plan intended to dewater these workings prior to encroachment and excavation, however due to the risk of spontaneous combustion the mine workings have been maintained saturated through the recirculation of water from the open cut.

Planning approval for the open cut mining operations was sought in two stages, representing the initial project and the Life of Mine (LOM) Project. Each stage was subject to a groundwater impact assessment which involved three dimensional modelling of the aquifer systems to assess impacts from the proposed operations. Modelling was based on measured groundwater levels for the project site and known or assumed geological parameters. Modelling for the second project approval, the LOM project, also included calibration of the initial model to observed site conditions.

Project Approval 10_0059 relates to the LOM project and Schedule 3 condition (23) of the project approval refers to the development of a Water Management Plan. The Water Management Plan includes requirements for surface water and groundwater monitoring and outlines trigger conditions and contingency responses. This report addresses the following requirement of the water management plan:

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In late 2016, a change in reporting schedule was implemented by Werris Creek, to cover a calendar year from the previously evaluated April to March reporting period.

This report is the first full calendar year evaluation and covers the period, January 2017 to December 2017.

1.2 Study Objective

Mining operations occur within the coal measures of the Werrie Basin. Whilst not mining the surrounding basalt aquifer, the removal of groundwater from the coal measures can cause groundwater flow from the basalt aquifer to the coal measures to occur resulting in an incidental interception of groundwater from the basalt aquifer.

Objective 1 of this study is to determine the volume of groundwater intercepted from the basalt aquifer by the mining operations for the period 1 January 2017 to 31 December 2017.

The principal mechanism whereby local groundwater could be affected by mine operations would be via the open cut void (the Void). Where excavations in the Void intersect with groundwater, this would result in a standing water level in continuity with local groundwater levels. Standing water within the Void, which includes water derived from multiple sources such as rainfall runoff, reused water returning to the void, pre-existing water from the underground workings and groundwater interception (see **Figure 1**), is collected within a designated area to minimise disruption on operations. This standing water is then subject to evaporation and pumping out for storage and re-use in other parts of the mine.

1.3 Scope of Work

In order to verify the groundwater modelling estimates for the annual inflow of groundwater into the Void, a comparison with observed water levels in the Void accounting for other inputs and outputs to the water balance has been carried out. This has been done through the construction of a water balance model (WBM) for the Void. The scope of the WBM was follows:

- Simulate water balance processes likely to influence the level of standing water in the Void;
- Make a suitable allowance for potential error in monitoring data used in the model;
- Undertake a sensitivity check on key assumptions, e.g. runoff coefficients for different land-use types;
- Carry out a full-year simulation with a daily time-step for the calendar year of 2017;
- Compare the results of the WBM with observations of water levels in the Void for 2017; and
- Using the WBM to assess differing groundwater inflow scenarios, above and below the predicted flow (from the groundwater model) to provide a best fit to match the observed water levels.

The WBM created for this report has been revised in comparison with previous years of reporting groundwater interception. This WBM is also distinct from previous opportunities to use water balance modelling to provide a tool for predicting potential future impacts on water use. In particular, the WBM used in this report does not fully replicate water storages and water use outside of the Void. This is not necessary for the objectives of this modelling work as described in further detail within this report.

1.4 Peer Review

In September 2016, Arup undertook a review of two different WCC WBMs: the 'verification-WBM' used for verifying groundwater interception estimates (i.e. the predecessor of the WBM presented in this report); and the 'predictive-WBM' which was created for the separate purpose of providing a basis for future mine water management. The Arup review comprised consideration of the validity of the assumptions used for the model, in particular rainfall runoff assumptions; and consideration of the validity of the conclusions of the model, in particular the conclusions with respect to the relative contribution of surface and groundwater to the total pit volume.

A number of recommendations were made as a result of this review and Werris Creek Coal has committed to addressing these. Where applicable to the WBM described herein, the recommendations have been implemented as follows:

Arup Recommendation	How and where addressed in this report
"Clear description of the MS Excel water balance model, including the distinction between the 'verification-WBM' and the 'predictive-WBM', along with details of numerical modelling tools employed such as AWBM, and details on how the tools were used (data sources, input parameters, calibration method, boundary conditions, etc.).	The WBM for this project has been created using GoldSim software and replaces the WBM used for the groundwater interception verification report in previous years. As described above, the purpose of the WBM presented here is to assess the groundwater modelling work and estimates of interception. The WBM is therefore tailored to meeting these aims. A full description of all input parameters, data, sensitivity to error/uncertainty etc. is presented in **Sections 2.3 and 2.4**.
"A full conceptual diagram showing the entire water balance for the site (reports currently only show a conceptual model for the verification-WBM but not for the predicted-WBM)."	The conceptual diagram for the WBM presented in this report is applicable to the purpose for which the modelling has been done, i.e. verification of groundwater interception estimates, and is suitable for this purpose.
"Magnitude of selected input parameters and justification for their use. Where parameters are calculated (such as runoff parameters),	A range of input parameters have been used and a full description of how error and uncertainty have

Arup Recommendation	How and where addressed in this report
documentation of how the parameters were calculated and justification for their selection. The uncertainty associated with certain parameters is considered to be relatively large, in particular the estimated losses from the water curtain and the discharge to the void from the pre-strip sprinkler. This uncertainty, and justification for the chosen parameter values, should be discussed in the documentation report."	been accounted for are presented in **Sections 2.3 and 2.4.**
"Model assumptions and evaluation of underlying certainties."	A full description of all input parameters, data, sensitivity to error/uncertainty etc. is presented in **Sections 2.3 and 2.4.**
"In future reports, the reasons for poor calibration between the verification-WBM and site data should be better documented."	Goodness-of-fit between the WBM and site observations are presented in the 'Verification of Predicted Groundwater Interception' section of this report.
"Confidence in the water balance models would be increased by improving the clarity in the descriptions for the parameters used, as well as ensuring that parameters are used consistently in the modelling. The inclusion of consumptive water uses in the reporting tables for the verification-WBM is confusing, particularly when they are not relevant to the verification-WBM."	A range of input parameters have been used and a full description of how error and uncertainty has been accounted for are presented in **Sections 2.3 and 2.4.** The comment on presenting extraneous data has been noted and all extraneous data (not relevant to the development of the WBM) has been excluded from the report.
"The correlation parameter used to quantify the agreement between Werris Creek Post Office rainfall data and site rainfall data (used in the predictive-WBM) should be defined in the water balance documentation report."	Site-specific daily rainfall data suitable for use in the WBM has been used for 2017. On this basis, imported rainfall data from the BoM Werris Creek Post Office monitoring station is no longer needed.
"The water balance documentation report should include a sensitivity analysis on key parameters that can be varied in the verification-WBM."	A full description of all input parameters, data and their sensitivity to error/uncertainty is presented in **Sections 2.3 and 2.4.**
"The water balance documentation report should consider whether the inclusion of daily measurements of evaporation from an on-site location would reduce errors associated with use of offsite monthly evaporation data (BOM Tamworth Airport Station) and the feasibility of measuring daily evaporation on-site. The existing water balance documentation indicates that evaporation data from BOM Tamworth Airport Station has been used as published by BOM, rather than used to derive a site specific estimate."	Sensitivity testing of BoM data from two separate sources has been carried out and is presented in section 2.4.1. Sensitivity analysis has not identified a significant difference between the use of Gunnedah station evaporation rates (which are up-to-date as of 2017) and data from the Quirindi Post Office location (where evaporation data gathering has been discontinued). For evaporation rates in future, water balance reports will use current data for Gunnedah Resource Centre.

2. WATER BALANCE

2.1 Conceptual Water Balance Model

A summary of the WBM used in this report representing flow to the Void (and also including external outputs) is presented in **Figure 1**. The red-dashed line indicates the processes which are incorporated into the WBM. There is no requirement to model water volumes in the Void Water Dams (VWDs) and consumptive uses for this water (dust suppression, agricultural water use) because, for the purposes of the balance in the Void itself, an allowance only has to be made for inputs/outputs via pumping to the VWDs. What happens to this water outside the Void is not applicable to verifying groundwater interception in the Void itself.

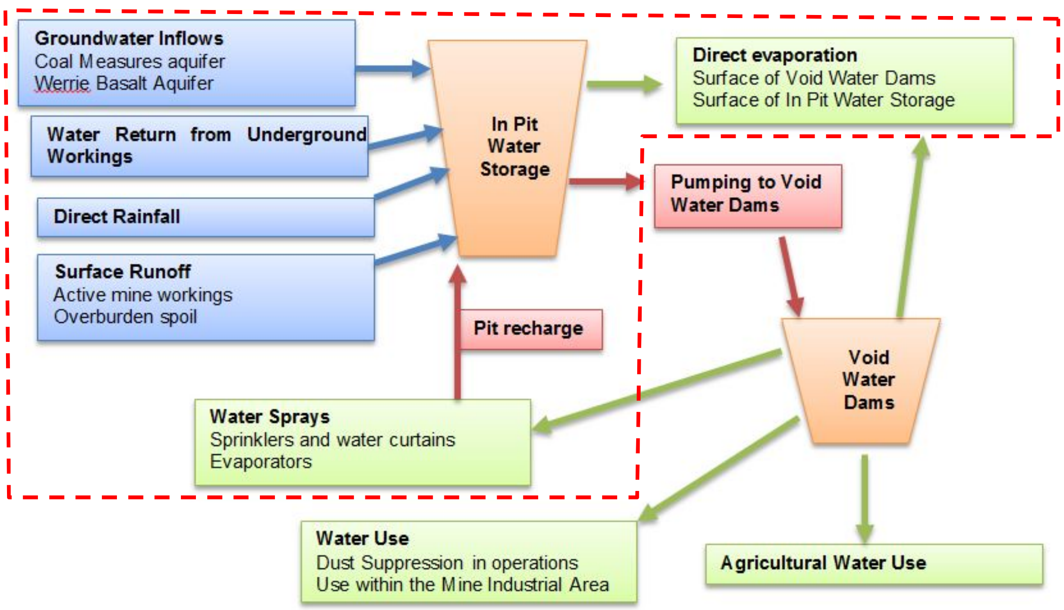

Figure 1 Conceptual Water Balance

2.2 Revised Modelling Package - GoldSim

An MS Excel water balance has previously been prepared for the mine. Based on the comments received from Arup and Ramboll's experience of similar projects, for 2017, GoldSim software has been used for the development of an entirely new WBM.

The main benefits of taking this approach are as follows:

- Linkages between different elements of the model are graphically represented by GoldSim which ensures there is no confusion about broken links or incorrect cell-referencing, ensuring accuracy;
- GoldSim has a near-unlimited capability for adding processes whereas MS Excel has a reduced capacity for the number of inputs possible in each cell;
- Daily or more frequent time-steps can create errors in Excel water balances due to circular references and ordering issues; and
- GoldSim can be used to create dynamic simulations that change during the model run and additional modules to address water quality and probabilistic simulations can be added.

A summary diagram of the WBM created within GoldSim is presented in **Figure 2**. Note that direction arrows do not show the flow direction of water but indicate linkages between separate elements of the model. The GoldSim model created by Ramboll is fully auditable.

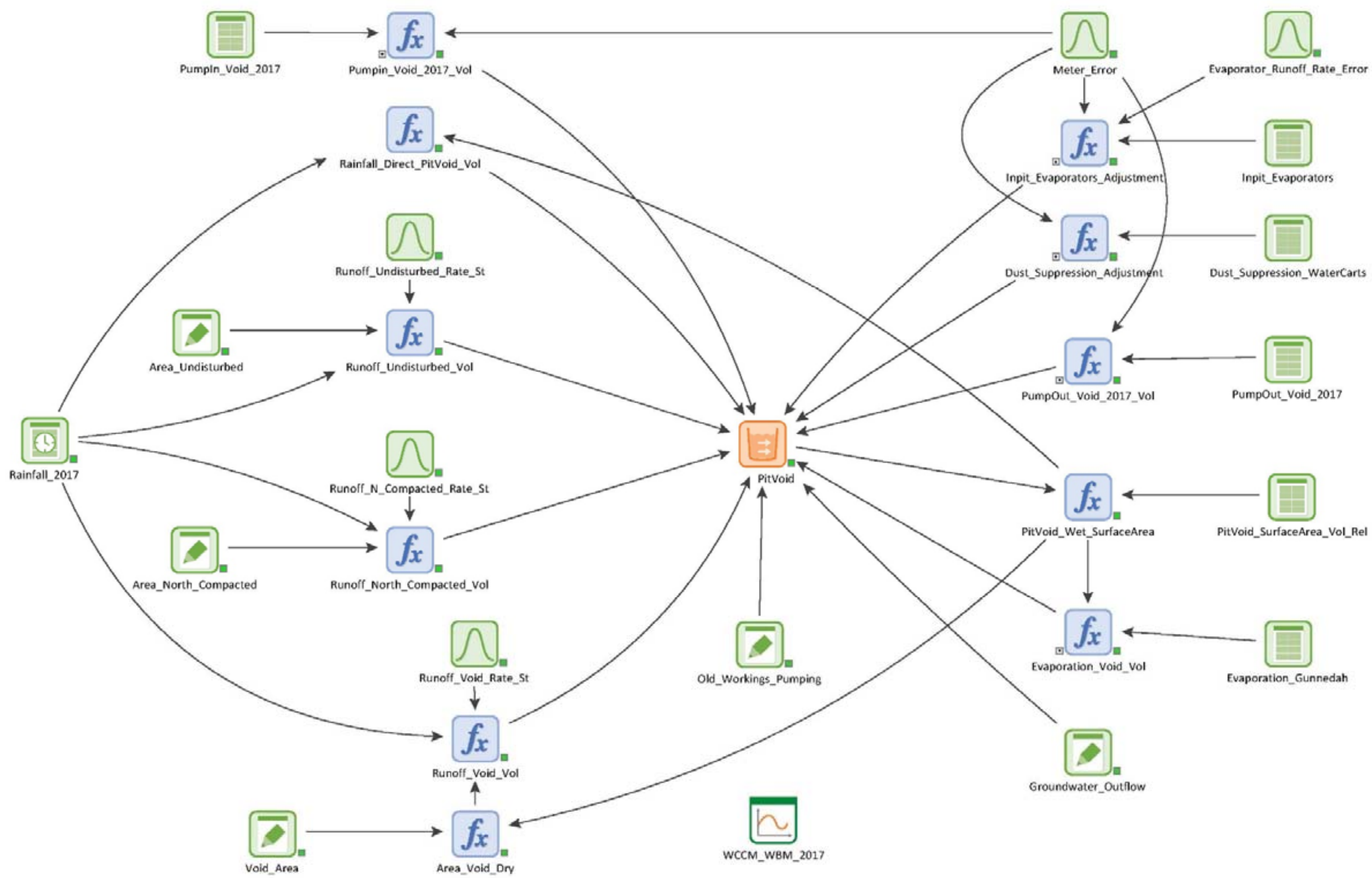

Figure 2 GoldSim Representation of WBM

The GoldSim model was run with a daily time-step for 272 days starting on the 1 January 2017 through to the end of September to compare with observed volumes of water in the pit. Monte Carlo probabilistic simulations were used in each case due to the use of stochastic data which accounts for uncertainty and error. A total of 100 realisations per model run were used.

2.3 Input Data

2.3.1 Groundwater Inflow

Groundwater interception has been estimated through the use of the hydrogeological model and is the contribution from the coal measures, the backfilled overburden and the Werrie Basalt. Water return from underground workings is likewise incorporated within the estimate for annual groundwater interception. The hydrogeological model is described in **Section 3**.

For 2017, a total groundwater input to the model of -31.1 ML was calculated, (ie, a net outflow). This value was converted to a daily flow by dividing the annualised total by 365 days.

In order to sensitivity test the result of the hydrogeological model, two additional scenarios whereby groundwater inflows were 350 ML/year and outflows were 350 ML/year were also simulated.

In addition to groundwater inflow estimations, the mine recorded an estimated total of 32 ML pumped into the old mine workings.

In total, three versions of the WBM were therefore created and are hereafter referred to as WBM(-31), WBM(350) and WBM(-350).

2.3.2 Rainfall

Daily rainfall data in mm has been collected at the mine throughout 2017 as presented in **Figure 3.** No missing data were identified.

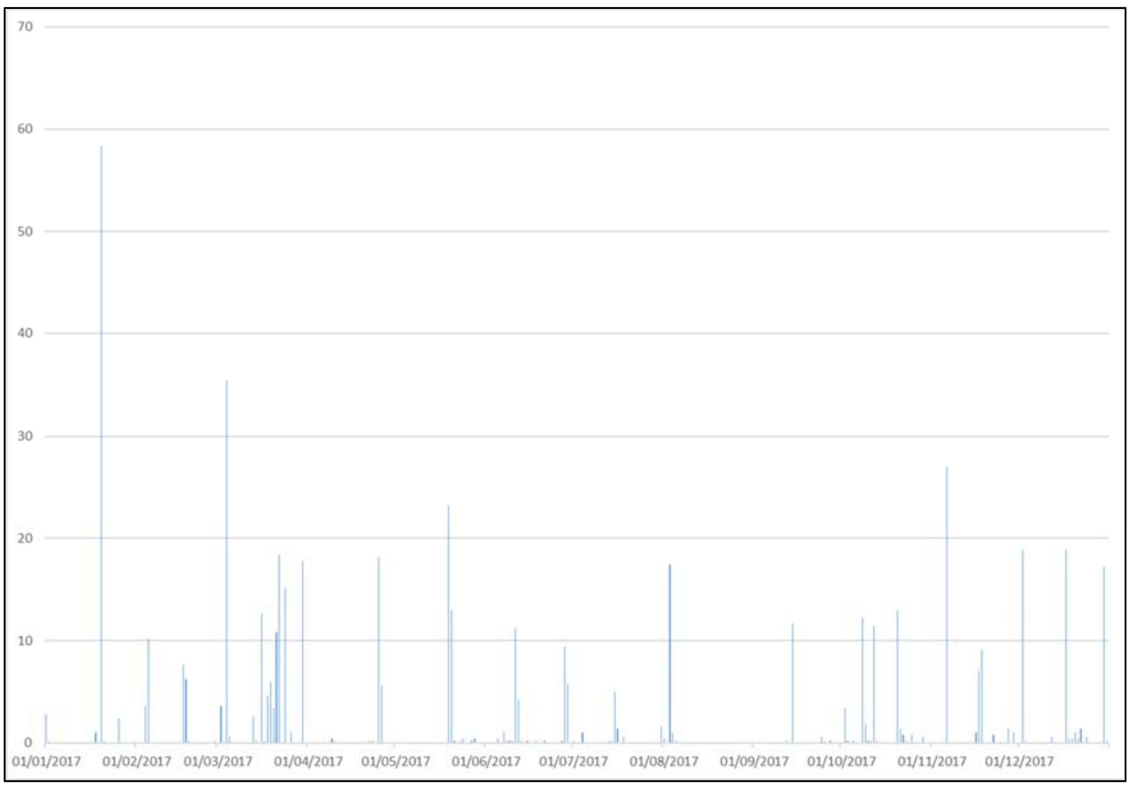

Figure 3 Daily Rainfall (mm) Werris Creek Mine

Direct rainfall inputs to the WBM occur at the surface of the standing water in the Void. This applies only to the surface area of this water therefore an allowance for how this may change over time was made in the WBM. Topographic data was provided by WCC based on a survey completed in December 2017 (**Figure 4**). This was considered to represent the best available information on which to base the geometry of the Void.

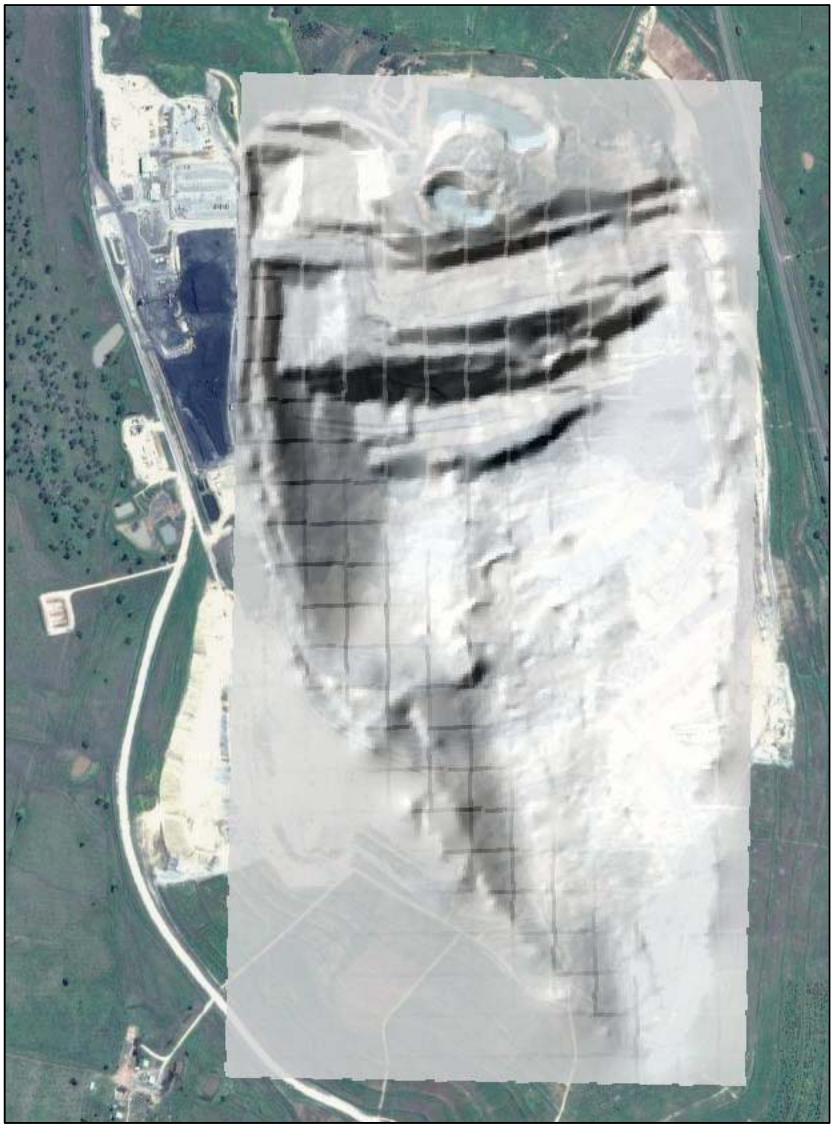

Figure 4 Topographic Survey Data (December 2017)

The topographic survey was used to derive a relationship between the volume of standing water in the Void and the surface area of that water as presented in **Figure 5.** GoldSim interpolates data between points to calculate the surface area for the volume in the pit as it rises and falls.

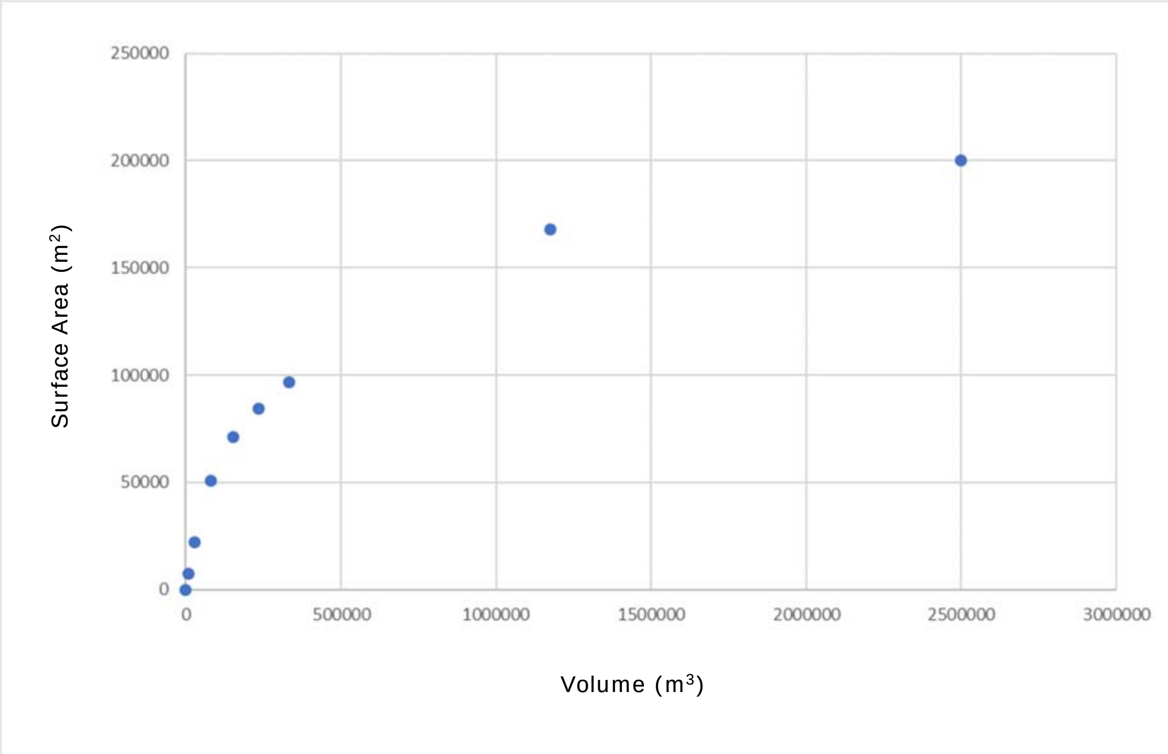

Figure 5 Relationship Between Volume of Water in the Void and Surface Area of Standing Water

2.3.3 Surface Runoff

Three areas, presented in **Figure 6,** were identified to contribute runoff input to the void based on the topographic survey data shown in **Figure 4** and sub-divided based on land use type:

- the active open cut area including Overburden Emplacement (blue area);
- bare/compacted soil area to the north of the active open cut area (red area); and
- undisturbed land to the north of the active open cut area ("old colliery" hill) and rehabilitated land to the south of the open cut area (yellow area).

The areas of each of these land use types were calculated using GIS software mapping on the basis of reviews of the survey data, aerial photography, site knowledge and discussions with WCC staff. The total area of each used in the WBM was as follows:

- Active Mining = 1,852,504 m^2;
- Compacted = 33,786 m^2; and
- Undisturbed/Rehabilitated = 177,305 m^2.

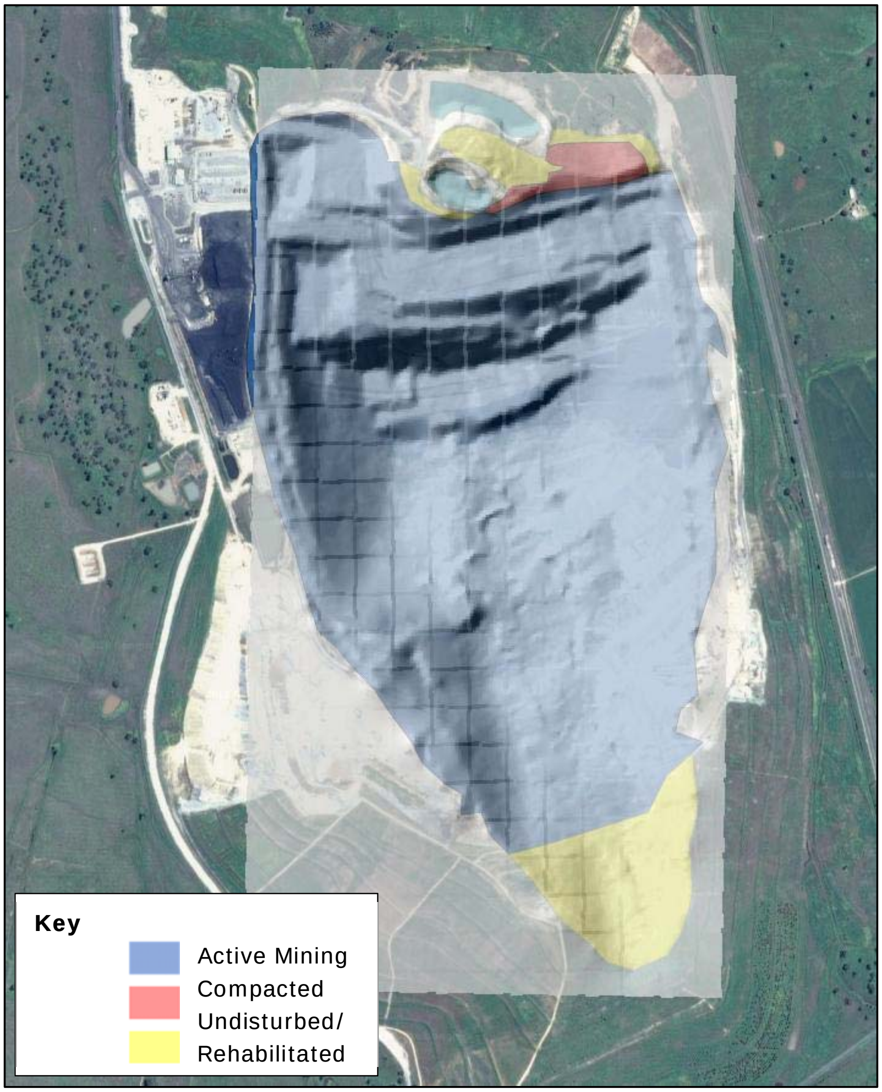

Figure 6 Land Use Types Contributing Runoff to Void

Runoff coefficients were taken from the GSSE surface water assessment[1]. With the exception of the Void standing water area, the effects of evaporation on surface water are incorporated in the runoff coefficients. The blue area was assumed to have a runoff coefficient of 60%, the red area 50% and the yellow area 20%. As the GSSE runoff coefficients have never been tested with field-based monitoring, an allowance was made in the WBM for uncertainty/error as described further below.

2.3.4 Pumping out of the Void

The principal mechanism whereby water is extracted from the Void is via pumping. The balance of water pumped into and out of the Void is recorded by WCC using an inline water pipe meter, (Meter 10) located by the Main Haul Road. WCC has provided monitoring data for 2017 from this meter to be incorporated within the WBM. As there is only one pipeline/pump which enables transfers to/from the Void, the metering of these transfers incorporates the majority of transfers between other parts of the site (principally the VWDs) and the Void. Metering at this point is why

[1] GSSE (2010). Surface Water Assessment, Life of Mine Project.

there is no need to represent the VWDs and transfers between them within the WBM used in this report. How and where water pumped out of the Void is used outside the Void would not impact on the WBM as long as the balance between transfers in and out recorded at Meter 10 are represented. Exceptions to this rule are listed under Water Re-use.

2.3.5 Water Re-use

Water is re-used within areas which could contribute runoff to the Void via the following means:

1. Water curtain to suppress spontaneous combustion fire risk in active mining areas;
2. In-pit evaporators, primarily used on the western end wall and north of the Void;
3. Dust suppression using water carts; and
4. Evaporators in use on the rehabilitation area to the south of the active mining area.

Based on discussions with WCC, in 2017 there was negligible use of a water curtain and there are no records of any water being extracted from any of the VWDs for this purpose in WCC monitoring data. As such, zero input associated with a water curtain has been made in the WBM for 2017.

In-pit trailer evaporators are fed directly from VWDs i.e. not via the pipeline that connects the VWDs to the Void. The mine has observed that runoff from the evaporators occurs such that much of the water used in this way ultimately returns to the Void. An allowance for potential inputs to the Void from this source has therefore been made. Data for the total volume of water used in these evaporators is based on metering carried out by WCC for 2017 (Minetek Evaporators, RL445 and Trailer Evaporators).

Dust suppression water is extracted from the VWDs and used in water carts around the active mine area. The total allowance for dust suppression water flowing back into the Void has been taken from metering carried out by WCC for 2017 (Meter 3). An adjustment for error in the meter volumes and the rate of return to the Void has been made for these inputs.

2.3.6 Evaporation

Evaporative losses from rain and water re-use over active mine areas, compacted areas and undisturbed/rehabilitation areas that potentially contribute flow to the Void are accounted for in the runoff coefficients used (with an allowance for uncertainty). Direct evaporative losses from standing water in the Void are made by subtracting evaporation at a rate of mm/day from the surface area of that water in m^2. The surface area of standing water in the Void is calculated as per the relationship described in **Section 2.3.2** *Rainfall*.

Evaporation data has, in previous years, been obtained from both BoM at Quirindi Post Office, which is the nearest location recording this data, and Gunnedah Resource Centre, approximately 50 km from Werris Creek. Data for Quirindi Post Office appears to no longer be available from BoM. Monthly average evaporation data for Quirindi Post Office, recorded since the late 1960s and understood to be current up to the end of 2015, was previously used in the WBM because, although there is the possibility that monthly averages may have changed since the end of 2015, the use of average data over a period of more than 40 years means that this is unlikely to have been significant in the one year where data has not been obtained. However, as this data appears to no longer be available from BoM, monthly average evaporation data for Gunnedah Resource Centre have therefore been used in the WBM. A check using data for Quirindi has been undertaken in order to establish the difference this would make to WBM totals and is reported below in **Section 2.4**.

2.4 Uncertainty and Error

2.4.1 Rainfall

As presented in **Table 1**, a comparison between monthly rainfall totals for the nearest BoM station (Quirindi Post Office, station number 055049) and readings taken at the site shows no obvious reason why rainfall data are subject to significant error. The differences in monthly totals are considered to be within the range of expectation given that the two stations are over

15 km apart. An allowance for uncertainty in the volumes of runoff (the largest single contributor of water inputs in the WBM) has, in any case, been made as described below.

Table 1 Comparison of Monthly Rainfall Totals at the Site and Nearest BoM Station for 2017

Source	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Werris Creek 2017 (mm)	65	28	132.2	24.8	37.6	33.6	10.2	18	15.2	71.4	66	68	570
Quirrindi PO 2017 (mm)	79.2	16.2	94.2	27	30.2	28.2	7	20.2	7.2	51.8	74.8	96.2	532.2

2.4.2 Surface Runoff

The potential for uncertainty and error in the estimation of runoff coefficients has been made by inputting the data as stochastic elements in the WBM. In each case, the runoff coefficient has been set up with a normal distribution using the GSSE-calculations as the mean average and a standard deviation of 10%. An example is presented in **Figure 7.** The potential for uncertainty is therefore carried over into the volume of runoff from each land use type. In all cases, where stochastic elements are used and the standard deviation could result in negative values, the distribution has been truncated with a minimum of zero.

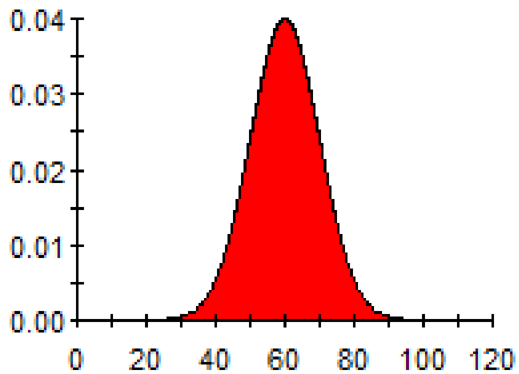

Figure 7 Example of Normal Distribution Fitted to Runoff Coefficient for Active Mining Area

2.4.3 Metering

It is acknowledged by WCC that there is the potential for error associated with on-site metering. For all inputs and outputs which rely on such data (pumping in and out of the void, dust suppression, evaporators), an allowance for error has been made by applying a stochastic element within GoldSim to these data. A mean average of 100% is applied with a standard deviation of 10% as per **Figure 8**.

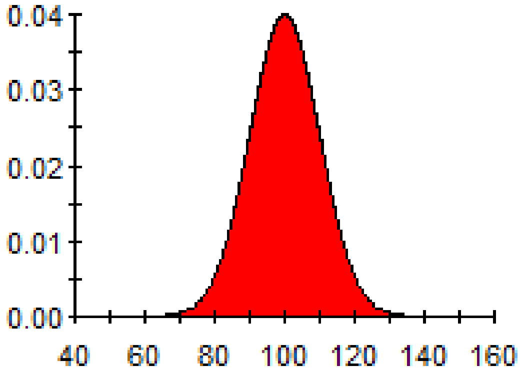

Figure 8 Example of Normal Distribution Fitted to Meter Error

2.4.4 In-pit Evaporators

There is uncertainty about the proportion of evaporator use that ends up running off and what is lost as evaporation. To allow for potential error in this estimate, a stochastic element has been included in the WBM using a normal distribution with mean 25% and standard deviation of 10%.

2.4.1 Evaporation

WBM-31 (the water balance model simulation using the predicted groundwater flow from the Groundwater model), was run with average monthly evaporation data from both Quirindi Post Office and Gunnedah Resource Centre to evaluate the effect.

Running the WBM using the Quirindi data, (in place of that for Gunnedah PO), resulted in less water in the Void throughout the simulation. The implications of this for the results of modelling are discussed in **Section 4**. Essentially, although recording a greater amount of water in the Void using the Gunnedah data, the modelling shows that this variation is not significant for the validation of groundwater inflow.

BOM shows that all three evaporation stations, Quirindi, Gunnedah and Tamworth lie within the total evaporation band of 1800mm to 2000mm per year average pan evaporation. Variability within this range is not found to be significant in the context of the WBM[2].

[2] Bureau of Meterology average pan annual pan evaporation for years 1975 to 2005.

3. PREDICTION OF GROUNDWATER INTERCEPTION

The total groundwater flow for the monitoring period 1 January 2017 to 31 December 2017 was predicted from the hydrogeological model and is the contribution from the coal measures, the backfilled overburden and the Werrie Basalt. The total groundwater flow was predicted to be - 31.1 ML for the period, which actually represents an outflow indicating water flowing out of the void and into the underground workings. These flows are expected due to the increased water storage in the pit by WCC as part of the water management during the year.

This prediction was determined using the calibrated groundwater model developed for the assessment of impacts from the Life of Mine proposal.

The calculated groundwater flows from each groundwater component for the period are tabulated in **Table 2**.

Table 2 Predicted Groundwater Inflow, January 2017- Dec 2017 Monitoring Period

Description	Totals
Total groundwater inflow to void from all sources including overburden and workings	-31.1ML
Contribution from basalt aquifer (i.e. outside of basin)	68.2ML
Inflow from Coal Measures and workings	-48.8ML
Inflow to void from overburden	12.5ML

Table 3 shows the calibrated groundwater model predictions of groundwater movement between the various strata. The total inflow expressed as the total groundwater inflow to the void (or in this case, flow out of the void), is not necessarily the sum of the other components due to effects of storage within the underground workings and the overburden. That is, some water that flows to the coal measures and overburden may not arrive at the pit void. The water access licence for removal from the basalt aquifer refers only to that groundwater predicted to flow from the basalt aquifer.

Mining operations continue to expand the depth of extraction and therefore maintaining reductions in water levels in the basalt aquifer in the proximity of the pit. However this has been offset by reduced rainfall/recharge conditions over the period which has resulted in a net drop in total groundwater inflow from 23ML, in the 2016 modelled period, (May to December), to a 31.1 ML outflow for the current period.

The model predicts that a slight increase in storage within the basin aquifers (overburden and underground workings) occurred for the period. This volume is included in the total basalt aquifer contribution in **Table 2** as it has transitioned from the basalt aquifer to the overburden or underground workings however has not transitioned to the void.

4. VERIFICATION OF PREDICTED GROUNDWATER INTERCEPTION

The WBM was simulated to evaluate the predicted groundwater interception. **Figure 9** to Figure **11** presents the volume of water in the pit void calculated from the WBM simulations between January and December 2017 versus survey estimates of the volume of water in the Void made by WCC through the same period.

Figure 9 to Figure 11 presents, respectively, the water balance model simulations for:

- WBM(-31), the result from the groundwater model (which is requiring verification);
- WBM(350) using a factor of ten times greater than the modeled flow; and
- WBM(-350) using a factor of ten times less than the modeled flow.

It has been estimated by WCC that the reporting error for measurements may be ± 10 ML per month and this is due to factors such as the ongoing changes in the pit floor as mining occurs and the progression of overburden material into the void water storage. High and low bounds to the mine water measurements have been applied for comparison. Results for the WBM are presented with both the mean of all realisations plus the 5% and 95% percentiles.

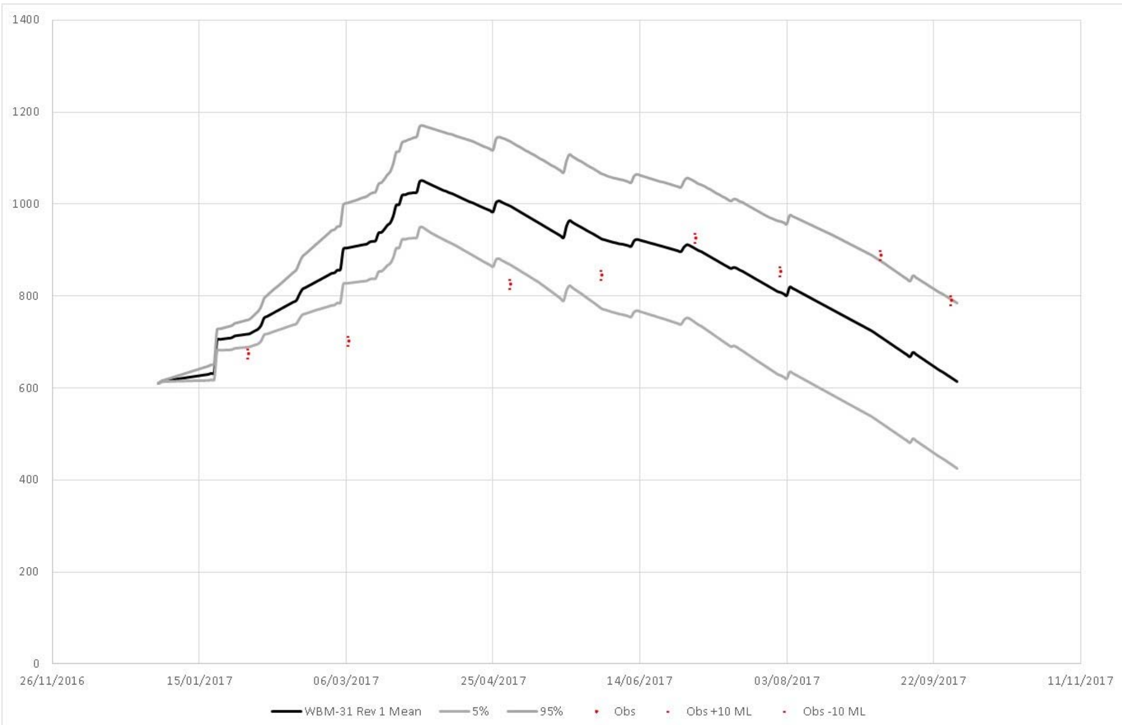

Figure 9 WBM(-31) Versus Observed Volumes

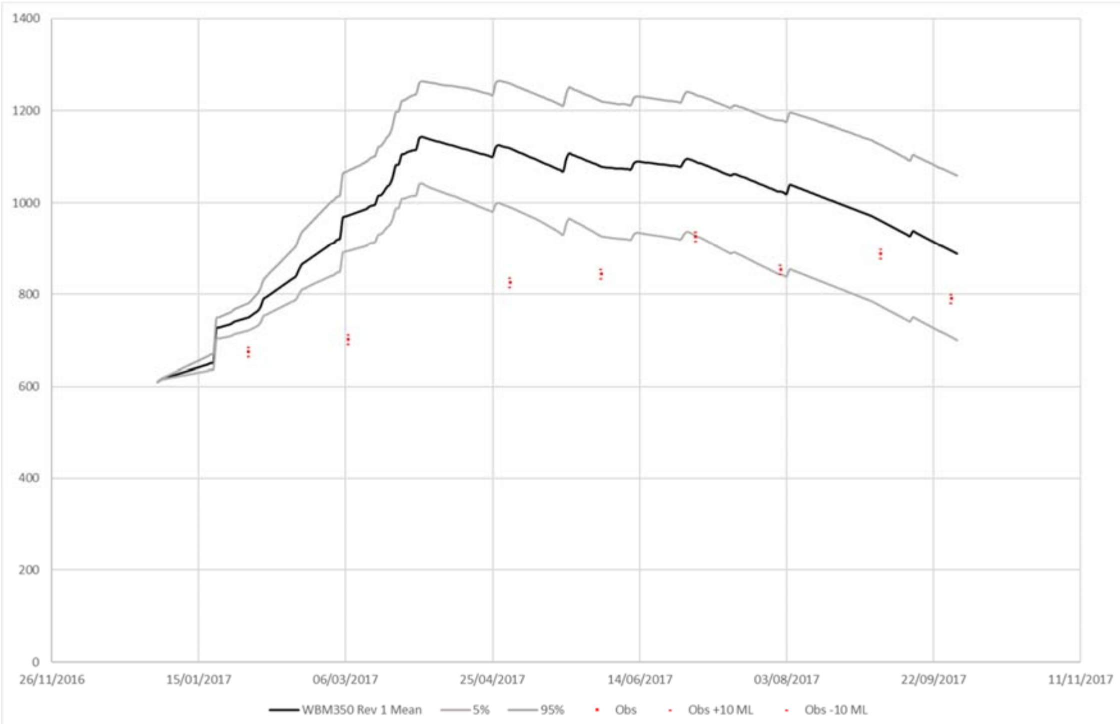

Figure 10 WBM (350) Versus Observed Volumes

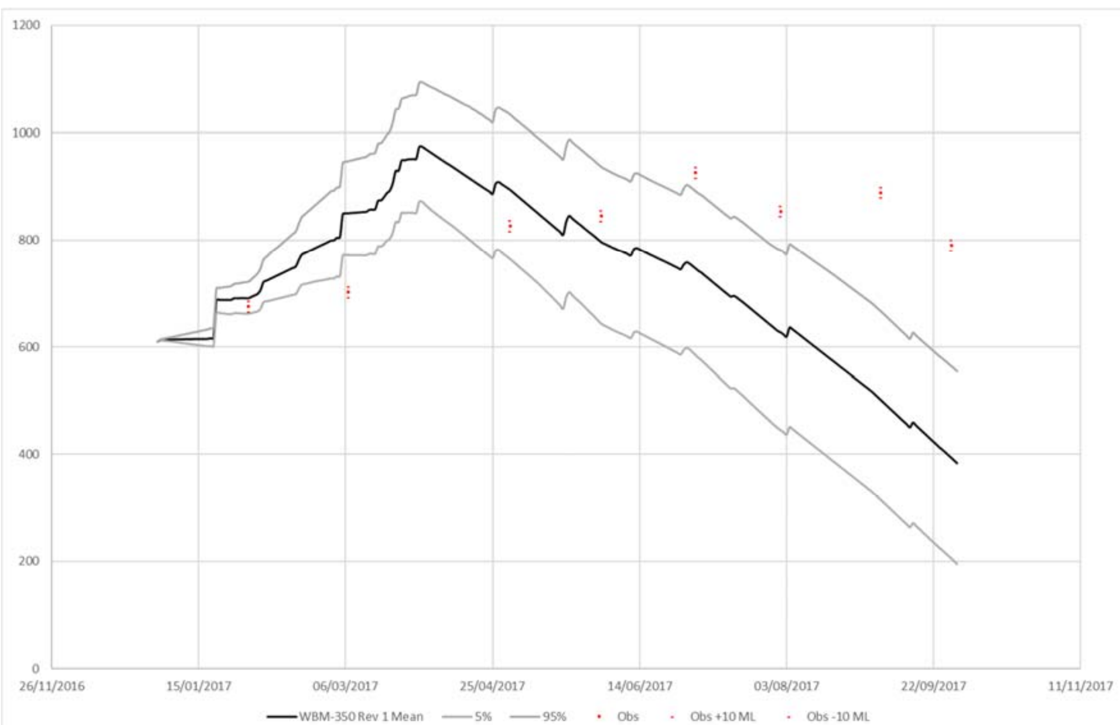

Figure 11 WBM(-350) Versus Observed Volumes

Based on visual analysis of the three scenarios, WBM(-31), which uses the predicted flow from the groundwater model presents the best fit between the model results and site observations. Most of the points fall within the 5% to 95% percentiles and there is relatively even distribution between data above and below the mean. By contrast, the results from WBM(350) are all above observed data and WBM(-350) shows a significant discrepancy by the end of the model run.

The calculated groundwater flows from each groundwater component for the 2017 period are tabulated in **Table 3** which summarises total pit water inputs and outputs for the 2017 reporting period using observations of water volumes in the Void between 1st January 2017 and 28th September 2017 (the final date for which the Void water volume was estimated).

When considering the potential for error associated with evaporation data (the results presented in **Figure 9** to **Figure 11** use Gunnedah data), using evaporation data from Quirindi does not significantly impact on the results. **Figure 12** shows the results of WBM(-31) using Quirindi evaporation data, indicating the WBM is not particularly sensitive to the use of evaporative rate differences between Quirrindi PO meteorology station and Gunnedah station.

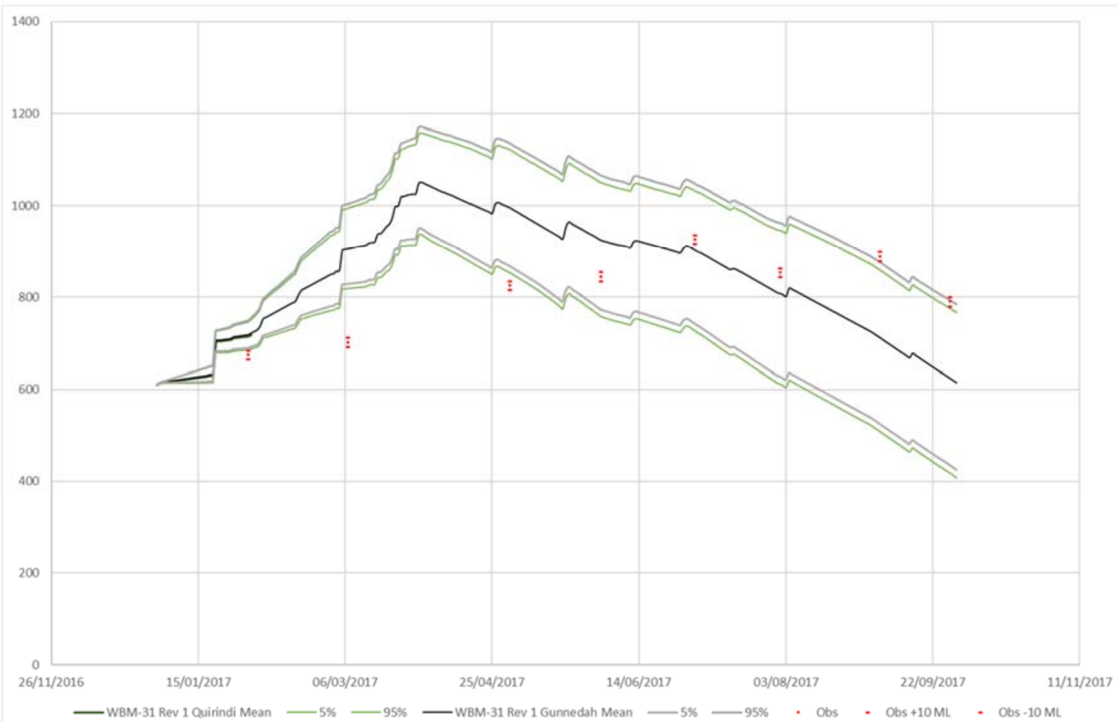

Figure 12 WBM-31 Comparison between Gunnedah and Quirindi Evaporation Data Versus Observed Volumes

The calculated groundwater flows from each groundwater component for the 2017 period are tabulated in **Table 3** which summarises total pit water inputs and outputs for the 2017 reporting period using observations of water volumes in the Void between 1st January 2017 and 25th September 2017 (the final date for which the Void water volume was estimated).

Table 3 WCC Void Water Usage 1st January 2017 to 28th September 2017

Source	Estimated Mean Average Volume (ML)	Notes
INPUTS TO PIT		
Rainfall and Runoff	444.2	Calculated from WBM-31 based on rainfall, area and characteristics of catchments areas which report back to the pit.
Evaporators and Dust Suppression	591.2	Volume of water estimated to flow back into the pit from use of evaporators and dust suppression. The final volume returning to the pit is derived from runoff/infiltration/storage calculations in WBM-31.
Pumped into Void	3.4	Volume of water pumped into the Void via meter 10.
Water Pumped to Old Workings	32	Volume of water pumped into the old workings for spontaneous combustion control.
TOTAL INPUT	**1,070.8**	
OUTPUTS FROM PIT		
Out of Pit Pumping	904.0	Volume based on metered pumping.
Direct Evaporation	157.6	Estimated volume directly evaporated from the surface of the pit, based on climatic data (from daily evaporation measured at Gunnedah Resource Station).
Groundwater and Underground Workings	31	Pro-rata amount derived from the hydrogeological model.
TOTAL OUTPUT	**1,092.6**	
Change in Storage	116.0	The difference between the estimated volume of water in the pit void between January 2017 and September 2017, based on surveyed levels and the established relationship between height and pit volume. Over this period this volume had increased so must be balanced against inputs and outputs from modelling.
NET WATER	**137.8**	Difference in input/output. See comments about relative errors (section 2.4).

As presented in **Table 3**, once inputs, outputs and the observed change in water in the Void are accounted for, the model reflects a net increase in water in the Void of 137.8 ML. The WBM may, in general, over-predict net water (although the results give a reasonable fit in view of the potential recording errors).

5. CONCLUSIONS AND RECOMMENDATIONS

To satisfy the Annual Review requirement of the Project Approval, and to determine compliance with both WAL29506 & WAL32224 of which a total of 261ML is allocated for aquifer interception through inflow, a prediction of inflow volumes to the mine void was completed for the January 2017 to December 2017 period as the first review over a calendar year.

Groundwater inflows to the mining operations were initially predicted using a calibrated model. To test the validity of the predictions, they were then incorporated into a water balance for the mine pit over a discrete period.

The results of the pit WBM for January 2017 to December 2017, using water management data from the site including, metered volume measurements from pit dewatering, evaporator use and dust suppression usage, was found to correlate well with the hydrogeological model predictions for groundwater inflow to the pit.

This process has further validated the groundwater model developed for the LOM project, which was refined in 2012. At the time of the LOM impact assessment, this model benefitted from real time calibration data recorded during the initial mining scenarios and was therefore considered to be a robust representation of the groundwater system. Minor modification of the boundary conditions adopted in the model was undertaken in 2012 following changes to the management of groundwater within the former mine workings. On the basis of the WBM validation the predictions of impacts to the groundwater levels in the basalt aquifer are considered to remain valid.

Therefore, the results indicate that Werris Creek Coal Mine has complied with WAL conditions in terms of interception, for the period January 2017 to December 2017.

6. REFERENCES

Ramboll Australia Pty Ltd, “Assessment of Groundwater Levels – January to December 2017”, February 2018, (in preparation).

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Bureau of Meteorology (http://www.bom.gov.au): Quirindi Post Office

GSSE (2010). “Surface Water Assessment, Life of Mine Project”. 2010.