APPENDIX D
SURFACE WATER ASSESSMENT

Manager - Project Development and Approvals
Wilpinjong Coal Pty Ltd.
1434 Ulan – Wollar Road,
Wilpinjong NSW 2850

Attention Mr Jamie Lees

Dear Jamie,

RE: Surface Water Assessment - Wilpinjong Coal Mine Modification 6

Introduction

Wilpinjong Coal Pty Ltd (WCPL) is seeking to modify its current Project Approval (05-0021) to permit a higher run-of-mine (ROM) coal production rate (up to approximately 16 million tonnes per annum [Mtpa]) at the existing Wilpinjong Coal Mine (WCM). This modification does not include any changes to the extent of mining or the approved life of the mine and is referred to as Modification 6.

WCPL has requested that Gilbert & Associates assess the potential impacts of Modification 6 on surface water resources.

Background

The WCM was originally approved in 2006. The WCM approval has been modified several times since the original consent - the most recent (Modification 5) being approved by the NSW Planning Assessment Commission in February 2014. Modification 5 included extensions to the open cut pits by approximately 70 hectares and the recovery of an additional 3 million tonnes (Mt) of ROM coal, amendments to the waste emplacement strategy, upgrade of the Coal Handling and Preparation Plant (CHPP) with installation of a tailings belt filter press [BFP]) and an increase in the rate of ROM coal beneficiation in the CHPP.

Description of local surface water hydrology and the existing water management system of the WCM and a comprehensive surface water assessment was undertaken for Modification 5[1]. The principal conclusions of that assessment were as follows.

1 Gilbert & Associates Pty Ltd 'Wilpinjong Coal Mine Modification – Surface Water Assessment', July 2013.

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Water Users

There are no known water access licences on privately-owned land bordering Wilpinjong and Wollar Creeks downstream of the WCM area. Therefore there would continue to be no impacts on private water users on these creeks from the WCM, including Modification 5.

Water Quality

On the basis of available recorded data, there did not appear to be any discernible change in Wilpinjong Creek, Cumbo Creek or Wollar Creek pH, electrical conductivity and sulphate concentrations since the commencement of mining.

Flow Regime in Wilpinjong and Cumbo Creeks

The incremental effect of the maximum change to catchment area associated with the Modification 5 open cut extensions was considered to be negligible in relation to streamflow in both Wilpinjong and Cumbo Creeks. In terms of reduced baseflow in Wilpinjong Creek, HydroSimulations (2013)[2] predicted a negligible difference between predicted baseflow reductions with and without the Modification.

In terms of reduced baseflow in Cumbo Creek, HydroSimulations (2013) predicted a maximum reduction of 0.08 megalitres per day (ML/d) in 2017, with a negligible difference between predicted baseflow reductions with and without the Modification. Assuming the same flow per unit catchment area in Cumbo Creek[3] as in Wilpinjong Creek, the mean annual flow in Cumbo Creek just upstream of Wilpinjong Creek is estimated to be 1,240 megalitres (ML). The reduction of baseflow in Cumbo Creek is therefore likely to have a negligible effect on mean creek flow.

Water Containment Security

Water balance modelling results conducted for Modification 5 indicated a low (negligible) risk of spill from the water management system except from Ed's Lake[4] which was simulated as spilling in the model under exceptionally high rainfall conditions.

[2] HydroSimulations (2013) 'Wilpinjong Coal Mine Modification Groundwater Assessment'.

[3] With a catchment area of 65.9 square kilometres (km^2) – for maximum extents of mine with modification.

[4] Ed's Lake is a small storage dam within the mined out northern end of Pit 1 that receives runoff from the partially rehabilitated waste rock emplacement and other active mining areas.

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Water Supply Reliability

Water balance modelling results conducted for Modification 5 indicated the water supply requirement for the mine would reduce with the commissioning of a tailings BFP. This would improve mine water supply reliability and reduce the rate that water would need to be sourced from the licensed borefield.

Salinity in Wilpinjong Creek Due to Licensed Discharge

No change to the approved maximum licensed daily discharge rate of 5 ML/d was proposed as part of Modification 5. However, the average volume of licensed discharge from the Reverse Osmosis (RO) Plant for the remaining mine life was anticipated to rise as a result of Modification 5. Based on the duration that the RO Plant was in use, it was concluded that there would not be any significant effect on salinity in Wilpinjong Creek as a result of licensed discharges.

Flooding

Consistent with previous surface water assessments, flood bunds were identified as being potentially required to mitigate against pit inflows from major flooding in Wilpinjong Creek and backwater flooding in tributary drainages. A flood study was subsequently undertaken (separate to Modification 5) and recommendations for flood levees/bunds made in accordance with flood model predictions.

Final Void and Post Mine Landform

The post mining landform plan (at the completion of mining), remained largely unchanged from that proposed in the Wilpinjong Coal Project Environmental Impact Statement (WCPL, 2005[5]), albeit Modification 5 did include some increased elevation in-pit landforms. Under Modification 5 there was no change to the catchment area reporting to the final voids and hence no change to the final void water balance.

[5] WCPL (2005) 'Wilpinjong Coal Project Environmental Impact Statement'. Wilpinjong Coal Pty Limited, May.

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Summary of Modification 6

Since transitioning to an owner-operator mine in 2013, WCPL has been implementing a continuous improvement programme for materials handling/mining. The outcomes of this programme indicate a higher ROM coal production rate could be achieved with only minor changes to the existing mining fleet. An increased rate of annual ROM coal production would provide operational flexibility to maintain WCPL's competitive advantage as a low cost thermal coal producer.

WCPL has determined that a number of minor alterations to the approved WCM are therefore required, including:

- An increase in the upper rate of ROM coal production (from 15 Mtpa to approximately 16 Mtpa).
- A minor increase in the upper annual rate of waste rock production (from approximately 33.3 million bank cubic metres [Mbcm] to approximately 34.1 Mbcm).
- Mine sequencing revisions associated with updated geological modelling/mine planning and the accelerated re-mining of a temporary waste rock emplacement.

There would be no change arising from the Modification to the following aspects of the approved WCM:

- open cut and contained infrastructure area;
- mine life;
- saleable coal transport off-site (12.5 Mtpa) or associated average or maximum rail movements; and
- operational workforce (up to approximately 550 people).

As Modification 6 does not include any changes to the extent of mining (i.e. disturbance to natural catchment areas associated with mining would be unchanged from the approved WCM) or the approved life of the mine, potential surface water impacts are generally limited to the water balance implications of alterations to the planned sequence of mining and the projected rates of coal processing and production. The design objectives of the water management system would be unchanged.

The differences in mining and processing rates between the approved WCM (Modification 5) and Modification 6 are summarised in Table 1 below.

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Gilbert & Associates Pty Ltd

Table 1
Modification 5 and 6 Mining and Production Schedule

Year		Waste Rock (Mbcm)		ROM Coal (Mt)		CHPP Feed (Mt)		Product Coal (Mt)				Total Product* (Mt)		Rejects (Mt)			
		Mod 5	Mod 6	Mod 5	Mod 6	Mod 5	Mod 6	Mod 5		Mod 6		Mod 5	Mod 6	Mod 5		Mod 6	
								Bypass	Processed	Bypass	Processed			Coarse	Tailings	Coarse	Tailings#
2014	9	31.9	31.6	14.9	15.8	9.0	9.2	6.5	5.7	6.3	6.3	12.2	12.6*	2.8	0.5	2.3	0.6
2015	10	29.3	34.1	15.0	16.0	8.5	9.2	7.1	5.4	6.3	6.2	12.5	12.5	2.6	0.5	3.1	0.0
2016	11	28.0	32.4	15.0	15.9	8.5	9.0	6.5	5.4	6.6	5.9	11.9	12.5	2.6	0.5	3.1	0.0
2017	12	27.0	32.2	15.0	14.5	8.5	6.0	6.5	4.8	8.7	3.8	11.3	12.5	3.2	0.5	2.2	0.0
2018	13	33.3	24.2	14.7	12.5	8.3	2.3	6.4	4.7	10.8	1.5	11.0	12.2	3.2	0.5	0.9	0.0
2019	14	18.4	18.2	7.8	7.7	4.4	0.9	3.4	2.5	7.8	0.5	5.9	8.2	1.7	0.3	0.4	0.0
2020	15	17.4	19.1	7.3	6.5	4.1	0.7	3.2	2.3	6.0	0.3	5.5	6.2	1.6	0.2	0.4	0.0
2021	16	18.6	20.0	7.6	6.6	4.3	0.7	3.3	2.4	6.0	0.3	5.7	6.3	1.6	0.3	0.4	0.0
2022	17	21.0	18.7	8.0	5.6	4.5	0.7	3.5	2.3	5.0	0.3	5.8	5.3	1.9	0.3	0.4	0.0
2023	18	20.7	16.9	7.2	7.1	4.1	0.7	3.1	2.0	6.4	0.3	5.2	6.7	1.8	0.2	0.4	0.0
2024	19	20.2	12.5	7.1	6.7	4.0	0.6	3.1	2.0	6.1	0.3	5.1	6.4	1.8	0.2	0.3	0.0
2025	20	10.1	7.6	4.7	2.4	2.7	0.4	2.0	1.3	2.1	0.1	3.4	2.2	1.2	0.2	0.3	0.0
2026	21	4.7	3.7	3.2	3.1	1.8	0.7	1.4	0.9	2.4	0.4	2.3	2.8	0.8	0.1	0.3	0.0

* Note some product coal would report to on-site stockpiles and would not increase calendar year product railings above 12.5 Mtpa.

\# Under Modification 6, from 2015 on tailings from the BFP would be added to coarse rejects bin. Under Modification 5, cases with and without the BFP were assessed.

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Changes in catchment area within the water management system over the mine life are shown in Figure 1.

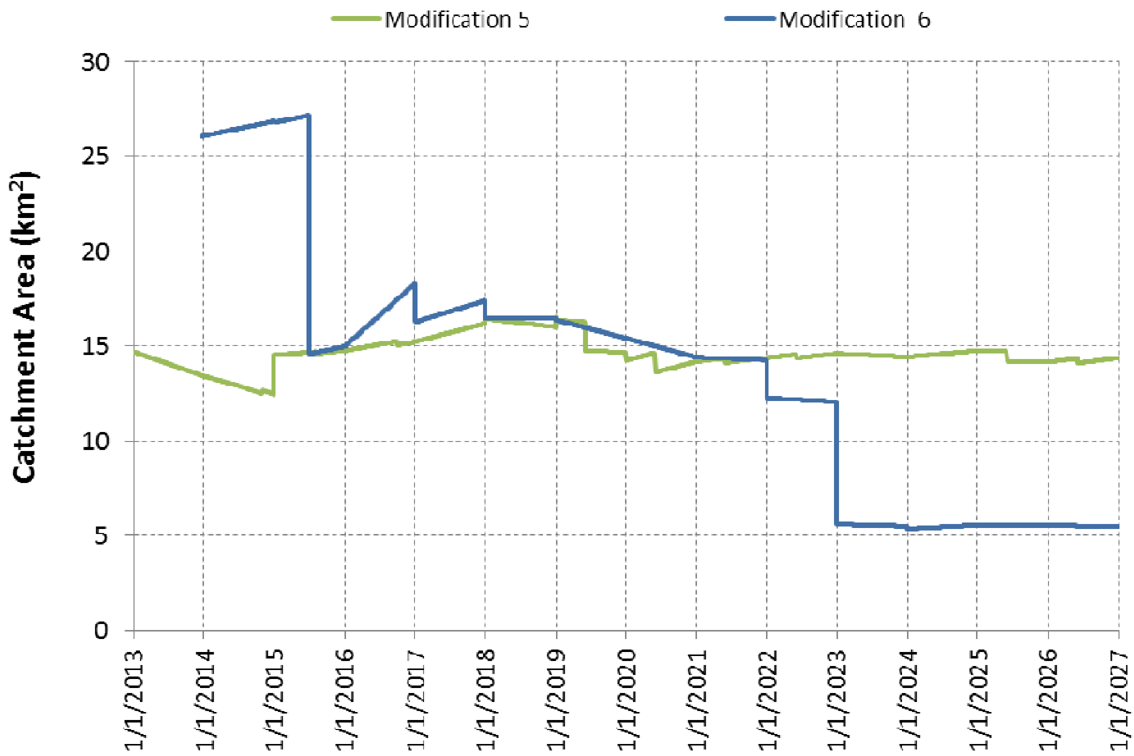

Figure 1 Total Mine Water Management System Catchment Area – Modifications 5 and 6

The main differences can be seen as a significantly higher contributing catchment area currently and until 2015 after which it was assumed under Modification 6 that comprehensive upslope diversions would be in place. The catchment areas would then remain similar to those estimated under Modification 5 through until about 2022. Based on the current indicative mining sequence from 2022, the contributing catchment under Modification 6 would be less than under Modification 5 particularly as a result of the earlier completion of mining in Pit 5. Figure 2 shows the assessed catchments under the Modification 6 mine layout.

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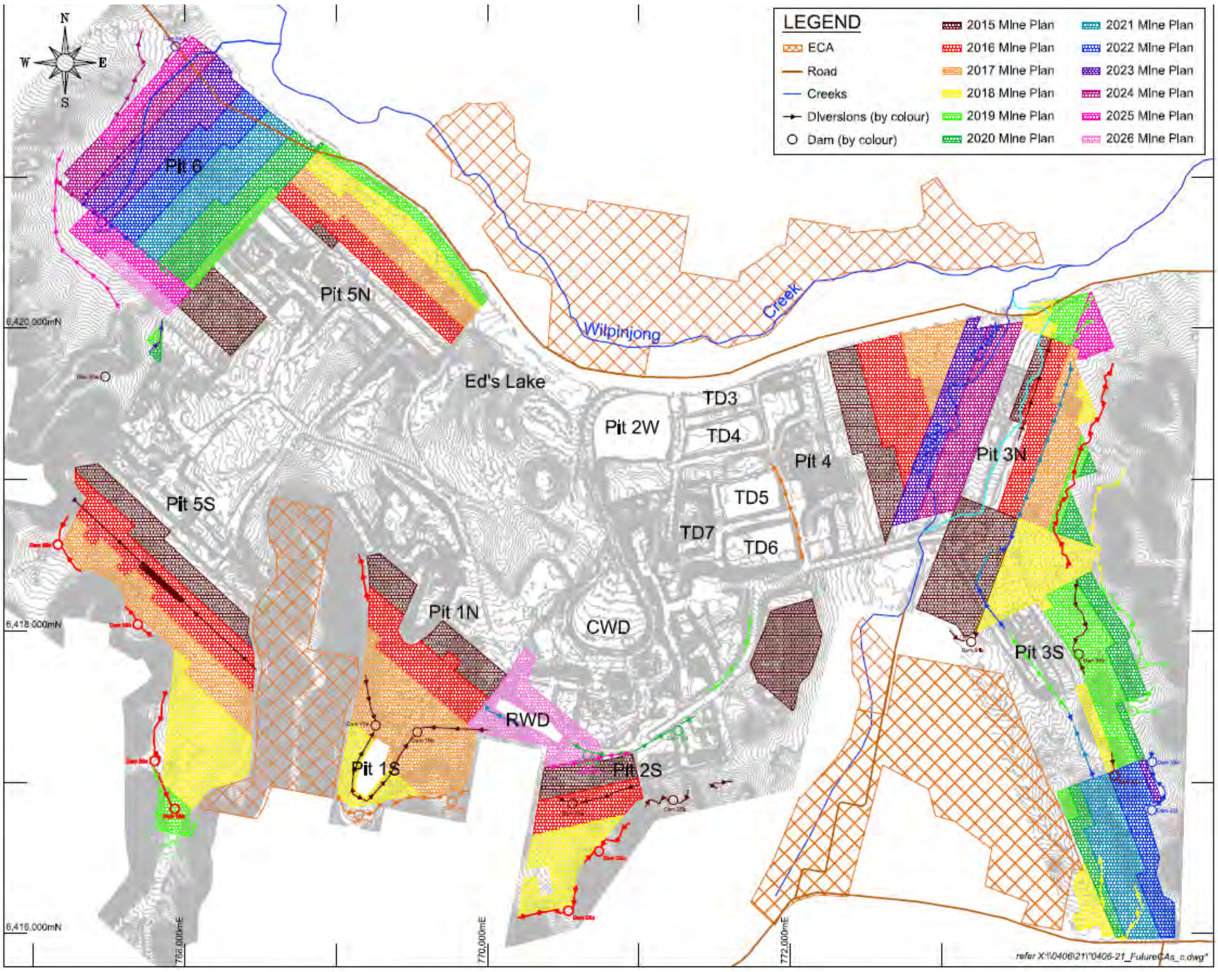

Figure 2 Mine Site Catchments Modification 6

Surface Water Assessment

The proposed changes associated with Modification 6 have the potential to affect the water balance and associated water management requirements of the WCM. These changes and their implications for site water management have been assessed by simulating the changes using the site water balance model.

The ability of the water management system to achieve its operational objectives was assessed by simulating the dynamic behaviour of its water balance over the entire remaining mine life under the variable climatic conditions that may be encountered. The water balance model developed for the WCM simulates all the inflows, outflows, transfers and changes in storage of water on-site on a continuous basis from early 2014 through to the end of 2026 (the end of mining).

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The model simulates the water (mass) balance of all existing and proposed storages on a sub-daily time interval. The model was set up to run over a large number of different climatic sequences compiled from the historical regional record obtained from the Data Drill[6] from 1889 onwards. Each sequence comprised a 13-year period (2014 to 2026 inclusive). The sequences were formed by "moving" along the historical record one year at a time with the first sequence comprising the first 13 years in the record. The second sequence comprised years 2 to 14 in the record while the third sequence comprised years 3 to 15 and so on. The start and end of the historical record was 'linked' so that additional sequences which included years from both the beginning and end of the historical record were combined to generate additional climate sequences.

Using this methodology 125, 13-year sequences of daily rainfall and evaporation were formulated for use in the model simulations. The results from all sequences were used to generate water storage volume estimates and other relevant water balance statistics. This method effectively includes all recorded historical climatic events in the water balance model, including high, low and median rainfall periods.

The model assumes commissioning of the tailings BFP at the end of 2014, with a consequent reduction in CHPP water demand.

The model included simulation of licensed discharge (including RO Plant permeate) to Wilpinjong Creek. It was assumed that a discharge daily volume of 0.43 ML/d could be discharged until the discharge rate is upgraded with the approved water treatment plant to enable 3.5 ML/day of mine water to be discharged within 6 months of the total water inventory on site increasing to 3,200 megalitres (ML) at any time after mid-2014. It was further assumed that if the total volume of water held on site in all storages and open cut pits fell below 2,500 ML, the RO Plant and licensed discharge would cease operation and not recommence until the total volume of water held in all storages rose above 3,200 ML. It was also assumed that the RO Plant would operate for at least one month per year (assumed to be June) to maintain serviceability of the plant.

Groundwater inflows to open cut pits were included in the water balance model. Predicted groundwater inflows varying with time were provided by HydroSimulations[7] – refer Table 2. Given rates were assumed to apply as constant rates over the given year and to change at the beginning of the year.

6 Silo Data Drill (http://www.longpaddock.qld.gov.au/silo/) for location 32 21'S 149 51'E.
7 HydroSimulations 'Wilpinjong Coal Mine Modification 6 – Groundwater Assessment' May 2014.

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Table 2
Predicted Groundwater Open Cut Pit Inflow Rates (HydroSimulations, 2014)

YEAR	MODIFICATION 5 (ML)	MODIFICATION 6 (ML)
2014	1775	1775
2015	2038	1979
2016	1862	1598
2017	1064	729
2018	908	1067
2019	266	340
2020	24	150
2021	626	1647
2022	797	964
2023	963	1025
2024	1519	824
2025	815	477
2026	0	82
Total	12657	12657
Average	974	974
Maximum	2038	1979

Results of Water Balance Model Simulations

Comparative model results for the remaining mine life for high rainfall (90th percentile), median and low rainfall (10th percentile) sequences were obtained from model results and are summarised in Table 3 below for the approved mine (Modification 5) and Modification 6.

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Table 3
Water Balance Model Results
(Averaged over Mine Life ML/annum)

	10th Percentile Rainfall Sequence (Dry)		Median Rainfall Sequence		90th Percentile Rainfall Sequence (Wet)	
	Modification 5	**Modification 6**	**Modification 5**	**Modification 6**	**Modification 5**	**Modification 6**
Inflows						
Catchment Runoff	1220	761	1332	1061	1543	1423
Groundwater	671	736	673	743	674	743
Tailings Water	16	12	16	12	16	12
Outflows						
CHPP Use	486	452	486	452	486	452
Truckfill (Dust Suppression) Use	663	675	668	655	629	607
Evaporation	442	372	474	430	481	514
Licensed Discharge to Wilpinjong Creek	437	255	394	364	589	736
Spill off site	2	0	0	0	0	0

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Figure 3 shows the model predicted statistical distributions of total volume of water held in all storages (including open cut pits) versus time for the mine life. The 90-percentile plot is that volume that is predicted to have a 10% chance of being exceeded at any point in time (i.e. a 90% chance of non-exceedance). The 10-percentile plot is that volume that is predicted to have a 90% chance of being exceeded at any point in time. The median plot has a 50% chance of being exceeded at any point in time.

Figure 3 Predicted Total Water Storage Volume

Water Supply Reliability

Predicted water supply reliability has been calculated as volume supplied divided by demand volume (averaged over the simulation period) for the CHPP and haul road dust suppression. Average reliability is averaged over all sequences and over the 13 year remaining mine life, maximum reliability refers to the highest reliability in any one 13 year period (averaged over the 13 years) and minimum reliability is the lowest reliability in any 13 year period (also averaged over the 13 years). Table 4 summarises predicted supply reliabilities.

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Table 4
Predicted Water Supply Reliability

	CHPP Supply			Haul Road Dust Suppression Supply		
	Minimum	*Average*	*Maximum*	*Minimum*	*Average*	*Maximum*
Modification 5	96.7%	99.9%	>99.9%*	92.3%	99.7%	>99.9%*
Modification 6	97.7%	>99.9%*	>99.9%*	86.6%	98.8%	>99.9%*

* The inherent uncertainty in the representativeness of low rainfall periods in the historical climate data set used in the model precludes the use of the term "100%".

There is very low predicted risk of CHPP water supply shortfall prior to 2019 – mainly due to the significant volume of water currently stored on site. As stored water volume falls, WCPL may need to implement sourcing of water from licensed water supply bores to maintain a storage "reserve" and supply reliability in line with the above predictions. Ongoing reviews of the mine water balance will provide updated information on future supply reliability, which is inherently highly influenced by site rainfall. It is recommended that such reviews occur annually. Depending on the results of these reviews, WCPL could initiate sourcing of additional water supply from the existing licensed borefield or under agreement with the nearby Ulan Coal Mines (subject to separate environmental assessment and approval).

Water Containment

The daily water balance model predicts that some spill may occur under exceptionally high rainfall events – some spill was predicted to occur in 2 out of 125 simulated climatic sequences. All predicted spills occur from Ed's Lake which has an estimated capacity of 135 ML with a catchment area of approximately 2.2 km^2 (as at late 2013). The majority of the catchment of this dam comprises waste rock emplacement areas that have or are undergoing rehabilitation. Both predicted spills are associated with a particularly high rainfall period in February 1955 (171 millimetres [mm] in one day and 328 mm in 10 days). The predicted spill risk is lower than predicted in the Modification 5 water balance, where spill was predicted to occur in 15% of climatic sequences. Ed's Lake is no longer used as a staging storage for water transfer from Pit 5 North to the Pit 2 West water storage. Therefore the water quality of Ed's Lake during exceptionally high rainfall would be related directly to runoff water quality from its catchment. It is also noted that WCPL has sourced supplementary equipment to upgrade the installed pumping capacity on Ed's Lake.

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Risk of Mining Disruption

The potential risk of disruption to mining has been assessed by tracking the number of days in each climatic sequence where the volume of water held in each active open cut pit exceeded 200 ML (an arbitrary volume chosen to represent conditions which *could* lead to mining disruption). Table 5 shows the simulated days per year that this volume was exceeded for each open cut pit averaged over all years and climatic sequences, while Table 6 shows the highest number of days per year in any one 13-year climatic sequence (averaged over that climatic sequence).

Loss of Baseflow in Wilpinjong and Cumbo Creeks

HydroSimulations (2014) have undertaken an assessment of the implications of the proposed Modification 6 on baseflow in overlying streams - they concluded that:

> *Modification 6 would have no discernible impact on stream baseflow, beyond the effects of approved mining. Only the timing of any baseflow capture would change.*

Based on that conclusion it can be inferred that there would not be no material change to stream baseflow attributable to Modification 6.

Table 5
Predicted Average Days per Year with in Excess of 200 ML Open Cut Pit Water Volume

	Pit 1	Pit 2 South	Pit 3	Pit 4	Pit 5 North	Pit 5 South	Pit 6
Modification 5	5	0	10	0	15	8	7
Modification 6	4	0	18	0	28	14	1

Table 6
Predicted Maximum Average Days per Year (in Any One 13-Year Climatic Sequence) With in Excess of 200 ML Open Cut Pit Water Volume

	Pit 1	Pit 2 South	Pit 3	Pit 4	Pit 5 North	Pit 5 South	Pit 6
Modification 5	43	9	87	0	167	41	94
Modification 6	67	26	165	2	179	130	54

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Conclusions

Modification 6 would involve a change to coal production and processing rates. Mine sequence changes also arise from Modification 6 and from general updates to site geological modelling and mine planning. Modification 6 would not involve a change to the approved disturbance areas or to the mine pit limits and disturbance of natural catchments. There would be no change to the WCM life and no change to the approved final landforms and final mine voids.

From a surface water perspective the principal change would be to the water balance during the remaining active mine life due to changes in contributing catchments and changes in the CHPP feed schedule which would affect mine water supply demand. The implications of these changes have been investigated using the water balance simulation model developed for the WCM.

Results of that modelling show that provided water management measures consistent with the existing design objectives of the water management system are implemented, Modification 6 would not pose any additional environmental risks with respect to surface water management of the approved mine, as:

- there would be no change to the approved disturbance of natural catchments;
- there would continue to be a low risk of water supply shortfalls occurring over the remaining life;
- there would be sufficient containment capacity within existing and proposed water management storages on site to contain mine water and other potentially contaminated water on site with a very low risk of external spill;
- there would be no material change to the rates of licensed discharge to Wilpinjong Creek for the median rainfall sequence;
- there would be no change to the catchment area reporting to the final voids and hence no change to the final void water balance; and
- there would be no additional implications with respect to flood management and mitigation.

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