BHP

Mt Arthur Coal

Annual Review FY19

26 September 2019

Amended on 12 November 2019 following Department of Planning, Industry and Environment review

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Table 1: Annual Review title block

Document Details	
Name of Operation	Mt Arthur Coal
Name of Operator	Hunter Valley Energy Coal Pty Ltd
Project Approvals	PA 09_0062 (MOD 1) PA 06_0091
Name of holder of project approvals	Hunter Valley Energy Coal Pty Ltd
Mining Leases	CCL 744, CL 396, ML 1358, ML 1487, ML 1548, ML1593, ML1655, ML 1739, ML 1757, MPL 263
Name of holder of mining leases	Hunter Valley Energy Coal Pty Ltd; Mt Arthur Coal Pty Limited
Water Licences	WAL 917, WAL 918, WAL 1296, WAL 18141, WAL 18247, WAL 41495, WAL 41556
Name of holder of water licences	Hunter Valley Energy Coal Pty Ltd
Mining Operations Plan Commencement Date	1 July 2017 (v1.2 as approved 26 Sep 2018)
Mining Operations Plan Completion Date	30 June 2020
Annual Review Commencement Date	1 July 2018
Annual Review Completion Date	30 June 2019
I, Kris Sheehan, certify that this audit report is a true and accurate record of the compliance status of Mt Arthur Coal for the period 1 July 2018 to 30 June 2019 and that I am authorised to make this statement on behalf of Hunter Valley Energy 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	Kris Sheehan
Title of authorised reporting officer	HSE Superintendent – Mt Arthur Coal
Signature of authorised reporting officer	
Date	12/11/2019

1. Statement of Compliance

A statement of Mt Arthur Coal's compliance with its project approvals and mining leases is presented in Table 2 with eight identified non-compliances (six issues) during the reporting period being discussed in Table 3.

Table 2: Statement of compliance

Were all conditions of the relevant approval(s) complied with?	
PA 09_0062	NO
EPL 11457	NO
EPBC 2011/5866	NO
EPBC 2014/7377	YES
ML	YES

Table 3: Non-compliance summary

Relevant approval	Condition	Description Summary	Compliance Status	Comment	Report Reference
PA 09_0062	10 (Schedule 3)	Blast monitoring	Non-compliant (Low)	Blast overpressure exceedance	Section 11
PA 09_0062	10 (Schedule 3)	Blast monitoring	Non-compliant (Low)	Missing blast results	Section 11
PA 09_0062	24 (Schedule 3)	Air quality monitoring	Non-compliant (Low)	Air quality exceedance notification not undertaken in accordance with the approved Plan	Section 11
PA 09_0062	29 (Schedule 3)	Groundwater monitoring	Non-compliant (Low)	Groundwater monitoring not undertaken in accordance with the approved Plan	Section 11
EPL 11457	L6.3	Blast monitoring	Non-compliant (Low)	Blast overpressure exceedance	Section 11
EPL 11457	M9.1	Blast monitoring	Non-compliant (Low)	Missing blast results	Section 11
EPL 11457	O3.2	Dust emissions	Non-compliant (Low)	Dust emissions from site over Denman Road	Section 11
EPBC 2011/5866	17	Website documents	Non-compliant (Administrative)	Incorrect version of Biodiversity Management Plan published on website	Section 11

Note: Compliance Status key for Table 3

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

Risk Level	Colour code	Description
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)

Acronyms

Acronyms	
AHMP	Aboriginal Heritage Management Plan
ARA	Annual rapid assessment
BioMP	Biodiversity Management Plan
BMP	Blast Management Plan
CASA	Civil Aviation Safety Authority
CCC	Community Consultative Committee
CCL	Consolidated coal lease
CHPP	Coal handling and preparation plant
CL	Coal lease
CRD	Cumulative rainfall departure
DoEE	Federal Department of the Environment and Energy
DP&E	Former NSW Department of Planning and Environment
DPIE	NSW Department of Planning, Industry and Environment. The change occurred on 1 July 2019
DRE	Former Division of Resources and Energy
DRG	Former Division of Resources and Geoscience
EA	Environmental assessment
EIS	Environmental impact statement
EL	Exploration licence
EMS	Environmental management system
EPA	NSW Environment Protection Authority
EPBC	Environment Protection and Biodiversity Conservation Act 1999
EPL	Environment Protection Licence
FY	Financial year
HRSTS	Hunter River Salinity Trading Scheme
HSE	Health, Safety and Environment
HVAS	High volume air sampler

Acronyms	
HVEC	Hunter Valley Energy Coal (Mt Arthur Coal)
IROC	Integrated Remote Operations Centre
MAC	Mt Arthur Coal
ML	Mining lease
MOP	Mining Operations Plan
MSC	Muswellbrook Shire Council
NGER	*National Greenhouse and Energy Reporting Act 2007*
NSW	New South Wales
OEH	NSW Office of Environment and Heritage
PA	Project Approval
RACI	Responsibility, Accountability, Consult and Inform
RBGS	Royal Botanic Gardens Sydney
ROM	Run of mine
UAV	Unmanned Aerial Vehicle
VPA	Voluntary Planning Agreement
VWP	Vibrating wire piezometers

2. Introduction

The Mt Arthur Coal Complex, located approximately five kilometres south west of Muswellbrook in the Upper Hunter Valley in New South Wales (NSW) includes the Mt Arthur Coal Open Cut, the Mt Arthur Coal Underground Project (no underground operations are currently taking place), Coal Handling and Preparation Plant (CHPP), rail loop and rail load out. The Mt Arthur Coal Complex, offset areas and surrounding region is shown in Figure 1 and Figure 2.

This Annual Review details the environmental and community performance for the period from 1 July 2018 to 30 June 2019 for operations at the Mt Arthur Coal Complex.

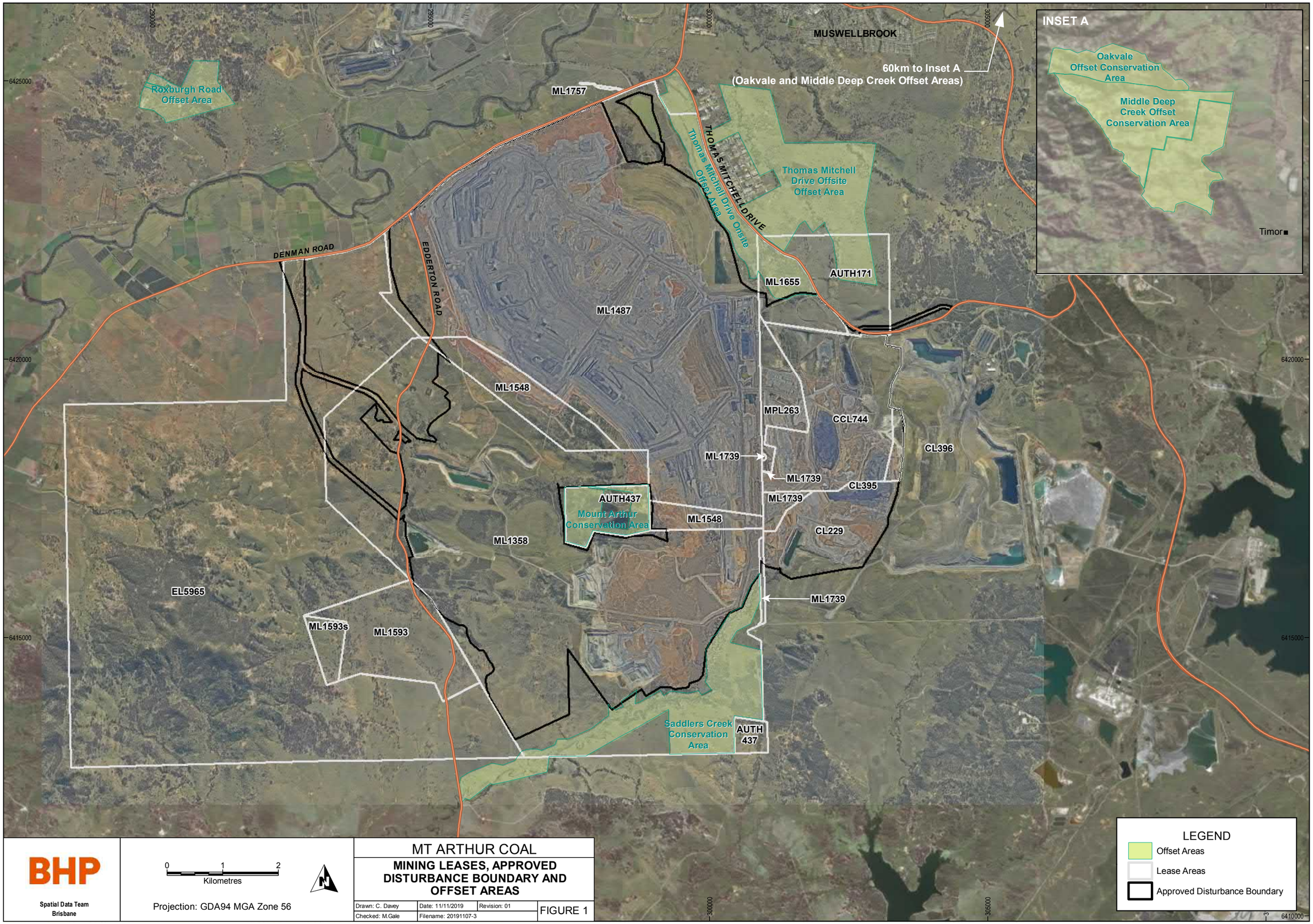
This document has been prepared in accordance with the Annual Review guidelines issued in by the former NSW Department of Planning and Environment (DP&E) in October 2015 and fulfils statutory reporting requirements required in mining leases and Schedule 5 Condition 3 of the Mt Arthur Coal Mine Open Cut Consolidation Project Approval Modification 1 (09_0062 MOD 1).

This report was prepared in consultation with the NSW Resources Regulator, the former DP&E, Muswellbrook Shire Council (MSC), NSW Environment Protection Authority (EPA) and the former NSW Department of Primary Industries – Water (DPI – Water). The report is distributed to a range of external stakeholders and is available on the BHP website at www.bhp.com.

Contact details for personnel associated with environmental management at Mt Arthur Coal can be found in Table 4.

Table 4: Mt Arthur Coal management contact details

Name and role	Phone contact details
Dawid Boshoff, General Manager, BHP Mt Arthur Coal	(02) 6544 5800
Kris Sheehan, Superintendent Health, Safety and Environment Business Partner, Mt Arthur Coal	(02) 6544 5800
Michael Gale, Principal Environment Analysis and Improvement, BHP Minerals Australia	(02) 6544 5800



BHP

Spatial Data Team
Brisbane

0 1 2
Kilometres

Projection: GDA94 MGA Zone 56

MT ARTHUR COAL

MINING LEASES, APPROVED DISTURBANCE BOUNDARY AND OFFSET AREAS

Drawn: C. Davey	Date: 11/11/2019	Revision: 01	FIGURE 1
Checked: M.Gale	Filename: 20191107-3		

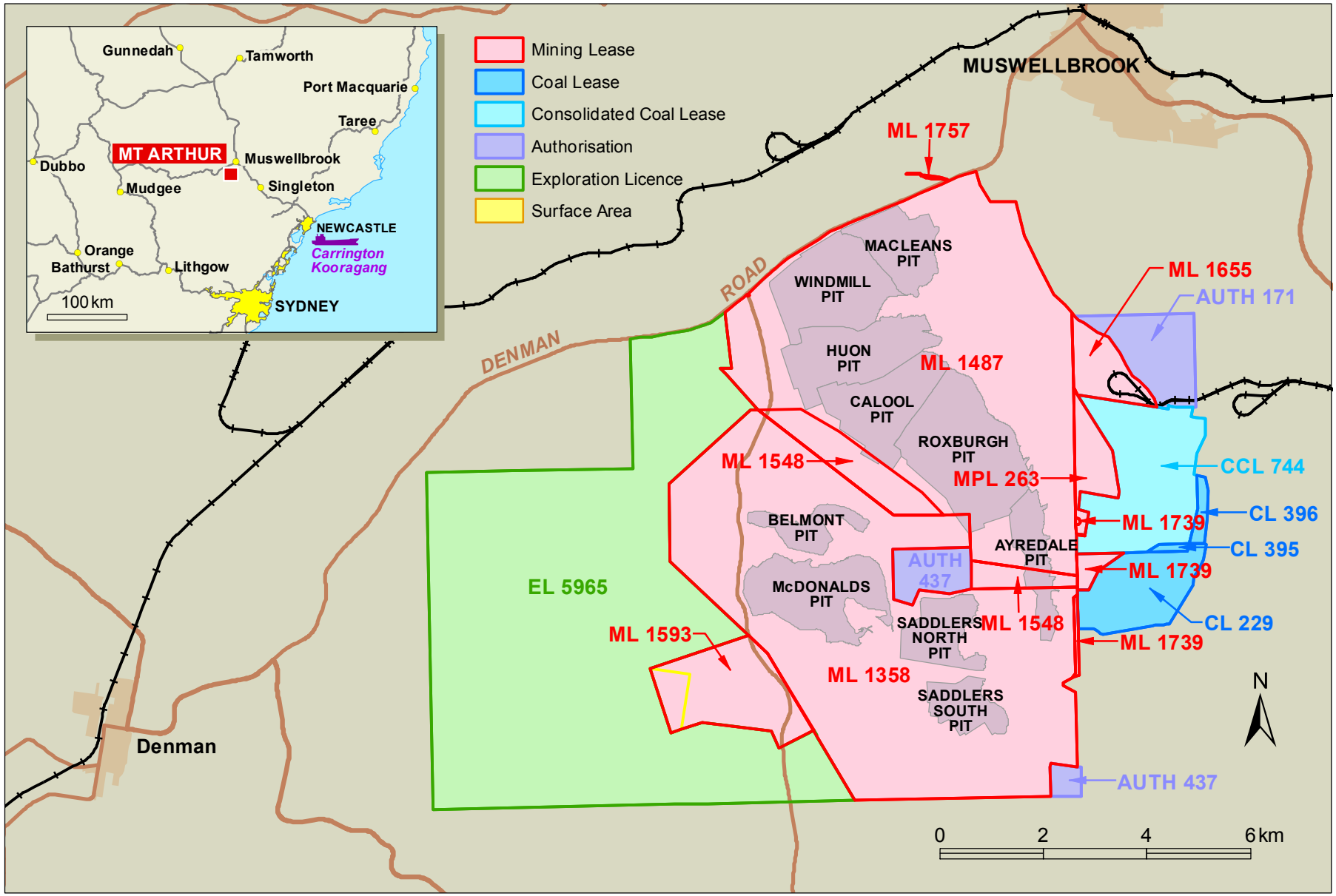


Figure 2: Mt Arthur Coal Locality Plan

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3. Approvals

Mt Arthur Coal has a number of statutory approvals, leases and licences that regulate activities on site. During the reporting period, the following approval modifications occurred:

- An amended Mining Operations Plan (MOP) was approved by DRG on 26 September 2018 for FY18-FY20 mining operations; and
- EPL 11457 was varied on 17 October 2018 to include a condition requiring the calculation of the hourly discharge volume limit prior to discharging water under the Hunter River Salinity Trading Scheme (HRSTS). The EPA has also updated the description used for the HRSTS discharge points to match the terminology used in the new condition.

Table 5 shows Mt Arthur Coal's existing statutory approvals as at 30 June 2019.

Table 5: Mt Arthur Coal's existing statutory approvals as at 30 June 2019

Description	Issue date	Expiry date
Project approvals issued by the DP&E		
Mt Arthur Coal Mine Open Cut Consolidation Project Modification 1 (09_0062 MOD 1)	26/09/2014	30/06/2026
Mt Arthur Coal Mine Underground Project (06_0091)	02/12/2008	31/12/2030
Mining leases and exploration licences issued by the DRG		
CCL 744	03/07/1989	21/01/2028
CL 396	23/06/1992	03/02/2024
ML 1358	21/09/1994	21/09/2036
ML 1487	13/06/2001	12/06/2022
ML 1548	31/05/2004	30/05/2025
ML 1593	30/04/2007	29/04/2028
ML 1655	03/03/2011	03/03/2032
ML 1739	25/07/2016	25/07/2037
ML1757	07/07/2017	07/07/2038
MPL 263	17/10/1990	17/10/2032
A 171	18/10/2004	18/10/2020
A 437	04/03/1991	04/03/2020
EL 5965	14/07/2007	*
Drayton sublease CL 395	13/04/2006 (registered 14/06/2013)	21/01/2029
Drayton sublease CL 229	13/04/2006 (registered 14/06/2013)	02/02/2024

Description	Issue date	Expiry date
EPL issued by the EPA		
EPL 11457	09/10/2001 (varied on 17/10/2018)	Not specified
EPBC approval issued by the DoEE		
EPBC 2011/5866	30/04/2012 (varied on 29/06/2017)	30/06/2022
EPBC 2014/7377	05/12/2016	30/06/2026

* Application for renewal lodged with the DRG and renewal is currently pending.

4. Operations Summary

4.1 Mining Operations

Mining and processing operations at Mt Arthur Coal continued 24 hours a day, seven days a week during the reporting period. Mining continued within the Ayredale, Calool, Huon, Roxburgh, Saddlers and Windmill open cut pits. Overburden and interburden material was removed by excavator / shovel and transported via rear dump truck to overburden emplacements, including visual dumps 4 to 5 (VD4 to VD5), contingency dumps 1 to 5 (CD1 to CD5), conveyor corridor dump (CC1) and Drayton dump. Raw coal was extracted by excavator and transported to the CHPP by rear dump truck.

Raw coal was processed at the CHPP, with approximately 17 million tonnes of product coal being railed to the port of Newcastle for export and approximately two million tonnes of product coal being transported to the Bayswater power station via overland conveyor, as shown in Appendix 6 – Annual Coal Transport Report FY19. Coarse coal waste (rejects) was co-disposed within overburden emplacements and fine coal waste (tailings) was pumped to the tailings storage emplacement in East Pit. Production figures for raw, product and waste materials produced during the reporting period are summarised in Table 6.

Table 6: Production summary

Material	Unit	Approved limit	Previous reporting period (actual)	This reporting period (actual)	Next reporting period (estimate)
Overburden	bank cubic meters	N/A	113,514,000	128,723,000	144,508,000
Run-of-mine coal	tonnes	32,000,000	23,679,000	24,969,000	24,888,000
Coarse and fine reject	tonnes	N/A	3,116,000	4,599,000	3,909,000
Tailings	tonnes	N/A	2,137,000	1,978,000	2,826,000
Product (saleable) coal	tonnes	27,000,000 (by rail)	18,541,000	18,257,000	17,029,000

4.2 Other Operations

Other operations at Mt Arthur Coal during the Reporting period included:

- *Exploration*: 51 boreholes (totalling 18,421 metres) were drilled in ML1358, ML1487 and ML 1548 to further define coal seam geology and geotechnical parameters of the resource. Rehabilitation and sealing of 38 boreholes was completed. 45.6 square kilometres of electromagnetic data (totalling approximately 870 line-kilometres) were flown by helicopter (SKYTEM) in ML 1358, ML 1487, ML 1548, ML 1593, EL 5965 and A437. The survey is intended to inform structural analysis and hydrogeological studies, map limit of oxidation lines and map coked coal boundaries. An additional 1.6 square kilometres of the electromagnetic data were flown off-lease, north of Denman Road, to inform geotechnical analysis and hydrological studies. No land clearance or ground disturbance was associated with the airborne electromagnetic survey.
- *Land Preparation*: During the reporting period approximately 184,000 cubic metres of topsoil was recovered from 132 hectares of clearing ahead of mining and for additional dump space using excavators, dozers and trucks. Material was either stockpiled, or placed directly onto reshaped areas to be rehabilitated where able to, with the remaining topsoil being stockpiled. Between 100 to 300 millimetres of topsoil was recovered during stripping.
- *Infrastructure Construction and Management*: The following major projects were commenced, progressed or completed during the reporting period:

- The first phase of the Tailings Dam Stage 2 raise project involving the downstream raising of an existing embankment by 10 meters to provide ongoing tailings storage capacity;
- Relocation of infrastructure to facilitate the approved extension of Windmill Pit, including detailed planning and design work for the realignment of Edderton Road in accordance with alignment Option 2 presented in PA 09_0062 originally granted in 2010;
- Increasing the fill rate of the existing northern fill stand and construction of an additional water fill point for the Windmill Pit to reduce the turnaround time for water carts and increase dust suppression coverage;
- Installation of a skid mounted communications hut and antenna at Windmill Pit and replacement of the communications tower on Mount Arthur (subject to final approval by DPI Crown Lands and Water) to improve communications coverage;
- Relocation of powerlines to facilitate the forward mine plan;
- Installation of sediment control structures downstream of the southern conveyor corridor overburden emplacement area prior to dump construction;
- Construction of a temporary deployment facility including carparks, bathhouse and ablutions and office buildings on the north western side of the main pit; and
- Refurbishment of existing maintenance and office facilities in the Bayswater mine infrastructure area.

During the reporting period there were no variations from the current MOP related to construction works on site.

4.3 Employment Details

As at 30 June 2019, Mt Arthur Coal employed 993 permanent and fixed-term contract employees and approximately 922 contractors on a full-time equivalent basis. Approximately 64 per cent of Mt Arthur Coal's employees resided in the local government areas of Muswellbrook, Upper Hunter and Singleton as at 30 June 2019.

4.4 Next Reporting Period

Forecast operations for the next reporting period, in particular significant changes in the mine, include:

- Increased intensity in Ayredale Pit with new area prepped for mining, 'Ayredale Upper';
- Relocation of infrastructure to facilitate the approved extension of Windmill Pit, including detailed planning and design work for the realignment of Edderton Road in accordance with alignment Option 2 presented in PA 09_0062 originally granted in 2010;
- Relocation of infrastructure to facilitate pit progression – EME Pad and Orica facilities;
- New explosives and magazine facility north of Belmont pit – involves a new semi-modular explosive facility and relocate magazine;
- Monocline will have significant impact on dump height for a few hundred metres, due to steeply dipping floor;
- Establish a large out of pit dump (OP1N) to cater for insufficient dump capacity on low wall over five year plan, particularly with impact of monocline;
- Relocation of powerlines to facilitate the forward mine plan;
- 15 new boreholes – involves installation of monitoring bores and vibrating wire piezometers (VWP) at 15 new locations;
- Installation of sediment control structures downstream of the southern conveyor corridor and OP1N overburden emplacement areas prior to dump construction;
- Permanent Sediment Dam near Saddlers Creek – involves construction of a new approximately 105 ML sediment dam, including pump and pipeline to Drayton Void;
- OP1N Pit Dump Water Management – three new sediment dams including pump, pipeline to McDonald's pit;

- Installation of additional water pipelines and associated pumps to support ongoing water management strategies;
- Drayton Void pumping and pipeline upgrade works – involves approximately 16 kilometres of pipeline, two150 l/s electric pontoon pumps and associated heavy vehicle / light vehicle electrical works;
- Continue Tailings Dam Stage 2 raise project involving the downstream raising of an existing embankment by 10 meters to provide ongoing tailings storage capacity; and
- Commence rehabilitation of Main Dam 4 / Tailings Storage Facility to final landform.

5. Actions Required from Previous Annual Review

The NSW Resources Regulator conducted a site inspection 12 February 2019 and notified Hunter Valley Energy Coal (HVEC) by letter dated 11 April 2019 that the FY18 Annual Review satisfied the Minister for Resources and Secretary for the DP&E.

The DP&E notified HVEC by letter dated 21 December 2018 that the amended FY18 Annual Review was considered by the Department to generally meet the requirements of the Project Approval.

Regulator feedback following review of the FY18 Annual Review is summarised in Table 7. Feedback from the Department of Planning, Industry and Environment (DPIE) following the initial submission of the FY19 Annual Review is also summarised in Table 7. The FY19 Annual Review was amended and resubmitted on 12 November 2019.

Table 7: Actions required from FY18 Annual Review and initial submission of FY19 Annual Review

Action required	Requested by	Action taken by HVEC	FY19 Annual Review section
Regulator Feedback from FY18 Annual Review			
Include Rehabilitation Maintenance and Improvement Program	NSW Resources Regulator	Rehabilitation Maintenance and Improvement Program has been incorporated.	Section 8.5 (Table 31)
Include details and progress report on the formal rehabilitation process (NSW Resources Regulator directed) in future Annual Reviews	DP&E		
Regulator Feedback from Initial Submission of FY19 Annual Review			
Entire Annual Review – Section numbering to be consistent with the guideline	DPIE	Section numbering adjusted	All sections
Section 3 – as per Section 2 of the guideline, provide a map showing offset areas as applicable	DPIE	Figure 1 revised to include offset areas	Section 2 (Figure 1)
Table 1 and Section 8, Table 23 – water license numbers to not match	DPIE	Table 1 and Table 23 revised to both reference WAL numbers on the licences	Table 1 and Section 7.1 (Table 23)
Section 8, Table 23 – Table 23 should be amended to match Table 7 of the guideline	DPIE	Table 23 revised and it now includes all relevant water licences (alluvial and groundwater licences were added). Table 1 list of licences also revised	Table 1 and Section 7.1 (Table 23)
Section 10 – as per Section 9 of the guideline, provide additional commentary around increasing complaint trends, and any actions undertaken or proposed as an outcome of the complaints	DPIE	Complaint trends and actions undertaken were previously discussed within the relevant section i.e. blast complaints were discussed in Blasting. The complaints commentary has been moved from each individual section and consolidated into Section 9.1. One additional action to address the overall increasing trend in lighting complaints has also been included in the discussion.	Section 9.1

Action required	Requested by	Action taken by HVEC	FY19 Annual Review section
Section 13 – as per Section 12 of the guideline, provide a timeline for measures to be implemented in the next reporting period, and commentary on revision of any management plans as a result of these measures	DPIE	The six actions in Section 12 have all been assigned a completion date of 30 June 2020. No changes to any management plans will be required as a result of the assigned actions. Text to indicate this has been added to Section 12.	Section 12

6. Environmental Performance

6.1 Noise

Environmental Management

Noise management at Mt Arthur Coal is managed in accordance with:

- MAC-ENC-MTP-032 Noise Management Plan; and
- MAC-ENC-PRO-056 Noise Monitoring Program.

The Noise Management Plan was prepared to fulfil the requirements of project approval, meet conditions of Environmental Protection Licence (EPL) 11457, as well as manage and minimise mine noise impact on the community and environment.

Mt Arthur Coal has eight statutory monitoring locations as detailed in the Noise Monitoring Program and four real-time monitoring locations utilised for internal use. Noise monitoring locations are shown in Figure 3.

A revised Noise Management Plan was submitted to the DP&E in June 2019 and approval of this Plan is anticipated for FY20.

Environmental Performance

An analysis of monthly attended noise monitoring results indicates Mt Arthur Coal's operations did not exceed the $L_{Aeq(15min)}$ during the reporting period. There were also no valid exceedances of the $L_{A1\ (1min)}$ statutory limit (noise level exceeded for one per cent of the time). The $L_{A1(1min)}$ statutory limit was exceeded at NP04 in July 2018, however this confirmatory retest result did not apply due to adverse weather conditions, hence was not valid. The next highest $L_{A1(1min)}$ result during the reporting period for NP04 was 33 dBA, which is below the statutory limit. A summary of results from Mt Arthur Coal's attended noise monitoring in the reporting period is provided in Table 8. Where a remeasure was required on the same night to determine the sustained noise level, only the remeasure result has been used to calculate tabulated results.

A comparison of FY19 noise monitoring results to previous reporting years is presented in Table 9. FY19 $L_{Aeq(15\ min)}$ noise levels are generally consistent with or below historical results, with only the maximum $L_{Aeq(15min)}$ at NP04 being slightly higher than for previous years. Data capture was 100 per cent at all attended noise monitoring sites. On seven occasions noise levels from Mt Arthur Coal were audible but too low to measure at a particular site.

$L_{Aeq(15min)}$ noise level predictions modelled for 2016 in the 2013 noise impact assessment were used for comparison with monitoring results for this reporting period, as shown in Table 8. Maximum $L_{Aeq(15min)}$ noise results are all below modelled predictions.

The additional impact of low frequency noise was assessed in accordance with the EPA's 2017 Noise Policy for Industry. None of the noise measurements recorded during the reporting period satisfied the conditions outlined in the Noise Policy for Industry to require assessment of low-frequency noise.

Complaints and Reportable Incidents

During the reporting period, 16 noise complaints were received from three complainants. These complaints are discussed further in Section 9.

Mt Arthur Coal did not receive any government fines or penalties related to noise during the reporting period and there were no related reportable incidents.

Proposed Improvements

Operational noise will continue to be managed and monitored in accordance with the Noise Management Plan and associated procedures.

Table 8: Monthly attended noise monitoring results in decibels

Noise Monitoring Location	$L_{Aeq(15min)}$ dB			$L_{A1(1min)}$ dB		Trend / key management implications	Implemented / proposed management actions
	Approval criteria	2016 prediction	Reporting period performance (min/log ave/max^)	Approval criteria	Reporting period performance (min/log ave/max^)		
NP04	38	38	20/33/37*	45	25/42/47*	No valid exceedances	Continuation of management and monitoring in accordance with Noise Management Plan
NP07	39	38	30/31/33	45	30/34/37*		
NP10	39	38	30/30/30*	45	30/32/35*		
NP12	39	41	35*/35/35*	45	42*/42/42*		
NP13	35	N/A	20/27/30*	45	20/28/31		
NP14	35	35	20/28/32*	45	22/31/34*		
NP15	35	36	25/28/31*	45	25/30/34*		
NP16	37	38	30/31/32*	45	30*/34/35		

^ Measurable noise levels only – does not include *inaudible* or *not measurable* results
* Noise emission limits do not apply due to winds greater than three metres per second (at a height of 10 metres), or temperature inversion conditions greater than or equal to four degrees Celsius per 100 metres.

Table 9: Attended noise monitoring results in decibels in comparison to previous years

Monitoring Site	FY19		FY18		FY17	
	Min	Max	Min	Max	Min	Max
$L_{Aeq(15\ min)}$ dB						
NP04	IA	37*	IA	35*	IA	35*
NP07	IA	33	IA	34	IA	34*
NP10	IA	<30*	IA	39*	IA	44*
NP12	IA	35*	IA	36	IA	33*
NP13	IA	<30*	IA	30*	IA	22*
NP14	IA	32*	IA	34*	IA	28*
NP15	IA	31*	IA	34*	IA	28*
NP16	IA	32*	IA	32	IA	36*
$L_{Aeq(1\ min)}$ dB						
NP04	IA	47*	IA	50*	IA	37*
NP07	IA	37*	IA	45	IA	37*
NP10	IA	35*	IA	43*	IA	38*
NP12	IA	42*	IA	40	IA	38*

Monitoring Site	FY19		FY18		FY17	
	Min	Max	Min	Max	Min	Max
NP13	IA	31	IA	32*	IA	27*
NP14	IA	34*	IA	41*	IA	32*
NP15	IA	34*	IA	44*	IA	31*
NP16	IA	35	IA	42	IA	42*

* Noise emission limits do not apply due to winds greater than three metres per second (at a height of 10 metres), or temperature inversion conditions greater than or equal to four degrees Celsius per 100 metres.
IA – Mt Arthur Coal's operations were inaudible.
NM – Mt Arthur Coal's operations were audible but not measurable.

BHP

Spatial Data Team
Brisbane

1:53,000

0 1 2
Kilometres

Projection: GDA94 MGA Zone 56

MT ARTHUR MINE

MONITORING LOCATIONS
AIR QUALITY, BLASTING, NOISE & METEOROLOGICAL

Drawn: K.Reedy	Date: 12/08/2019	Revision: 1	FIGURE 3
Checked: M.Gale	Filename: 20190812-1a.mxd		

BENGALLA
MUSWELLBROOK
MT ARTHUR
DRAYTON
MAC EWU

Bengalla Road
Denman Road
Roxburgh Road
Mangoola Road
Thomas Mitchell Drive
New England Highway
Hebden Road
Edderton Road
Orica Road
Mt Arthur Access Road

HUNTER RIVER
Muscle Creek
Ramrod Creek
Hollys Creek
Quarry Creek
Saddlers Creek
Swamp Creek

DD14 DC05 DF05
NP14
NP15 WS10 NC05 DC09
BP09 DD15
DC11
DC08 DD16 BP08
WS11
DC10
NP07 NC02 WS08 DD19 DF06 BP07 DC02 DP16
BP10 DD22
WS05 NC04 NP10 BP04 DF07 DD21 DC04
DC07 NC07 WS12 BP11 NP04
NP12 DD04
DD01
DD03
WS09
DD12
DD10
DC06
DD08
DC12
DD05
DC13

ML1757
ML1487
ML1655
ML1548
ML1358
ML1593
ML1739
MPL263
AUTH171
AUTH437
AUTH 437
CCL744
CL396
CL395
CL229
EL5965

6425000
6420000
6415000
280000
285000
290000
295000
300000
305000

LEGEND

- Authorisation
- Mining Lease
- Coal Lease
- Consolidated Coal Lease
- Exploration Lease
- Surface Area
- Approved Disturbance Boundary
- High Volume Air Sampler (decommissioned in FY19)
- Depositional Dust Gauge (decommissioned in FY19)
- Depositional Dust Gauge (current)
- Blast Monitoring Site
- TEOM Sensor Site
- Noise Monitoring Site
- Weather Station

6.2 Blasting

Environmental Management

Blasting at Mt Arthur Coal is managed in accordance with:

- MAC-ENC-MTP-015 Blast Management Plan; and
- MAC-ENC-MTP-024 Road Closure Management Plan (internal document).

The Blast Management Plan details the relevant blast overpressure and vibration impact assessment criteria and compliance procedures and controls related to open cut blasting activities. It includes the blast monitoring program, as well as public infrastructure monitoring requirements. It also includes the blast fume management strategy, which aims to minimise visible blast fume and reduce potential for offsite fume migration.

Mt Arthur Coal has five statutory blast monitors:

- BP04 (South Muswellbrook);
- BP07 (Sheppard Avenue);
- BP09 (Denman Road West);
- BP10 (Yammanie North); and
- BP11 (Balmoral Road).

Blast monitoring locations are shown in Figure 3.

The modification project approval states a ground vibration limit for public infrastructure of 50 millimetres per second (mm/s), unless Mt Arthur Coal has a written agreement with the relevant owner of the public infrastructure to exceed these criteria and advised the former DP&E in writing of the terms of the agreement. Written agreements with Roads and Maritime Services (RMS), Telstra and Ausgrid are in place allowing increases in the ground vibration blast impact assessment criteria as follows:

- 150 mm/s with no allowable exceedances (RMS, Ausgrid);
- 10 per cent of the total number of blasts over a period of 12 months are allowed to exceed 100 mm/s (Telstra, Ausgrid); and
- Notification prior to blasting for blasts predicted to exceed 100 mm/s at Denman Road (RMS).

Environmental Performance

During the reporting period 154 blasts were undertaken. With the exception of BP09 and BP10, blast data capture rates for the reporting period were 100 per cent at all statutory sites. On 12 February and 5 March 2019 airblast overpressure and ground vibration results were not recorded at BP09 or BP10 for two blast events, as detailed in Section 11.

Blasting was undertaken between 8 am and 5 pm Monday to Saturday, with no blasts being undertaken on Sundays or public holidays. No blast ground vibration monitoring results above the maximum 10 mm/s limit were recorded at any of the statutory blast monitors during the reporting period. One blast recorded an airblast overpressure result above the maximum 120 dBL limit on 24 December 2018 at 2:15 pm, recording 120.6 dBL at the Denman Road West monitor (BP09), which resulted in two complaints.

Of the 154 blast events fired during the reporting period, five (3.2 per cent) exceeded the airblast overpressure criteria of 115 dBL and two (1.3 per cent) exceeded the ground vibration criteria of 5 mm/s, hence remaining below the five per cent allowable exceedance limits.

One reportable blast fume event occurred during the reporting period on 17 April 2019 at 10.37 am. This event was rated as a level 4C with no fume from the blast leaving site. One complaint was received in relation to the blast fume event. An investigation was completed and information has been provided to the DPIE and the EPA.

Results reflect predictions made in the modification environmental assessment and do not show a significant difference in average or maximum results compared to previous reporting periods. A comparison of FY19 blast monitoring results with previous years is provided in Table 10.

In accordance with the Blast Management Plan, potential impacts to public infrastructure were calculated for blasts in Windmill and Roxburgh pits with all blasts meeting the agreed criteria.

Table 10: Summary of statutory blast monitoring results

Parameter	Statistic	FY19	FY18	FY17
Ground vibration (mm/s)	Average	0.27	0.25	0.26
	Maximum valid result	5.51 (at BP09)	9.78 (at BP09)	3.23 (at BP09)
	Valid blasts above 5 mm/s threshold	2	2	0
Airblast overpressure (dBL)	Average	95.1	97.2	95.6
	Maximum valid result	120.6 (at BP09)	118.4 (at BP09)	118.4 (at BP09)
	Valid blasts above 115 dBL threshold	5	6	3

Complaints and Reportable Incidents

During the reporting period, 17 blast complaints were recorded. These complaints are discussed further in Section 9. Reportable blast incidents are discussed in Section 11.

Proposed Improvements

Continued updates on the Site Law database and improvements to the predictive model, which is periodically audited externally, will be undertaken in FY20, allowing for increased accuracy in determining the vibration and overpressure at the design stage. Furthermore, flyrock modelling will be undertaken in FY20 to assist in reducing the probability and impact of overpressure events.

Improvements to the site's current predictive meteorological model will also be undertaken in FY20.

6.3 Meteorological Data

Environmental Management

Meteorological monitoring at Mt Arthur Coal is managed in accordance with:

- MAC-ENC-MTP-040 Air Quality and Greenhouse Gas Management Plan. This document was updated and approved by DP&E on 25 January 2019 and renamed to Air Quality Management Plan (AQMP); and
- MAC-ENC-PRO-057 Air Quality Monitoring Program up to and including 25 January 2019 due to approval of the AQMP.

Mt Arthur Coal's primary statutory real-time meteorological station located at the mine's industrial area (WS09) is an essential component of the operation's environmental monitoring system. Wind speed, wind direction, temperature, rainfall, solar radiation and humidity data is collected at 15 minute intervals and relayed using radio telemetry.

A secondary statutory real-time meteorological station, located off site to the north west of the mine at Wellbrook (WS10), also provides representative weather data for the mine site, including prevailing wind conditions, and is used in conjunction with WS09 to determine the presence and strength of temperature inversions in the local atmosphere as part of the pre-blast environmental assessment. These meteorological stations are shown on Figure 3.

Both statutory meteorological stations comply with the Australian Standard 2923-1987 *Ambient Air – Guide for measurement of horizontal wind for air quality applications* and the EPA's 2017 Noise Policy for Industry.

Mt Arthur Coal installed four new additional wind speed and wind direction monitors during the reporting period in order to enhance monitoring of meteorological conditions in the vicinity of the mine.

Environmental Performance

Meteorological data capture rate for the reporting period was 100 per cent at both WS09 and WS10.

Total rainfall for the reporting period was 416 mm, which is approximately 30 per cent lower than the long-term average of 619 mm. Wind direction at Mt Arthur Coal (WS09) during the reporting period was predominantly from the north-west (Winter/Spring) and south-east (Summer/Autumn).

Proposed Improvements

Mt Arthur Coal will continue to record and utilise meteorological data from its two statutory monitors during the next reporting period.

6.4 Air Quality

Environmental Management

Air quality at Mt Arthur Coal is managed in accordance with:

- MAC-ENC-MTP-040 Air Quality and Greenhouse Gas Management Plan. This document was updated and approved by DP&E on 25 January 2019 and renamed to Air Quality Management Plan (AQMP); and
- MAC-ENC-PRO-057 Air Quality Monitoring Program up to and including 25 January 2019 due to approval of the AQMP.

Mt Arthur Coal operates an air quality monitoring network consisting of:

- Six statutory dust deposition gauges recording dust fallout, which are derived from mining or non-mining activities. These provide a measure of changing air quality. As part of the update of the AQMP, four of these gauges were decommissioned. Two deposited dust gauges remained from 25 January 2019;
- Three statutory high volume air samplers (HVAS) monitoring fine dust particles (PM_{10}) for 24-hours every six days. As part of the updated AQMP these samplers were removed from the monitoring network. Data from these decommissioned samplers has been reported up until 25 January 2019;
- Six statutory real-time dust monitors, referred to as tapered element oscillating microbalance samplers (TEOMs), which record PM_{10} levels on a continuous basis;
- Five additional TEOMs, which also record continuous PM_{10} levels are included in the monitoring network. These are non-statutory and are used for proactive internal management purposes; and
- A real-time short message service (SMS) alarm system that provides notifications to operational staff, in response to air quality monitoring measurements at real-time monitors, enabling dust-generating activities to be reviewed. This system was discontinued during the reporting period and replaced by the Mt Arthur Coal Dust Control System, which is monitored 24 hours a day, seven days a week by the Integrated Remote Operations Centre (IROC) in Brisbane who contact site Operations to activate the Dust Trigger Action Response Plan (TARP) when dust trigger levels are exceeded. Operational responses are recorded in the Dust Control System.

Air Quality monitoring locations are shown in Figure 3.

Mt Arthur Coal utilises a predictive dust model that predicts meteorological conditions and PM_{10} concentrations up to 72 hours in advance. This tool is used for operational dust management planning and notification of mining supervisors when adverse weather conditions are predicted.

Environmental Performance

Air dispersion modelling completed for the 2016 representative mining scenario, as part of the 2013 environmental assessment, has been used to evaluate monitoring results for the reporting period.

Depositional Dust Gauges

The results from the statutory depositional dust monitoring results are summarised in Table 11. Depositional dust gauge data capture rates for the reporting period were 100 per cent at all statutory sites.

For the reporting period, no statutory depositional dust gauges exceeded the annual average assessment criteria, as shown in Table 11. Annual average depositional dust results were higher than in FY18 for both remaining statutory sites DD08 and DD14.

Monitoring results for the reporting period were also generally higher than predictions modelled for 2016 in the 2013 air quality assessment, indicating that the dry conditions experienced throughout the reporting period and other local dust producing sources have had an influence on monitoring results.

Table 11: Comparison of annual average deposited dust results

Monitor Location	Approval criteria (annual average)	Annual average depositional dust (g/m^2/month)			Trend / key management implications	Implemented / proposed management actions
		FY19	FY18	FY17		
Antiene (DD04)	4 g/m^2/ month	-^	2.5	2.1	No exceedances	Continue dust management in accordance with AQMP
Edderton Homestead (DD08)		2.0	1.4	1.4		
Roxburgh Road (DD14)		2.6	2.3	1.6		
Denman Road West (DD15)		-^	4.7*	4.0		
Sheppard Avenue (DD19)		-^	4.6**	2.7		
South Muswellbrook (DD21)		-^	2.3	1.7		

^ An annual average cannot be calculated as data was only recorded for the period 1 July 2018 to 25 January 2019; monitoring was discontinued at this site after this date as per the new AQMP.
* During the FY18 reporting period, the wind was from the direction of Mt Arthur Coal for 47 per cent of the time. If all the deposited dust from this direction originated from Mt Arthur Coal, the contribution to the total from Mt Arthur Coal would be 2.2 g/m^2/month. Sampling comments were included for DD15 as follows: Jan 2018: dusty cattle track next to gauge; May 2018: Recent harvesting and ploughing in the area.
** During the FY18 reporting period, the wind was from the direction of Mt Arthur Coal for 10 per cent of the time. If all the deposited dust from this direction originated from Mt Arthur Coal, the contribution to the total from Mt Arthur Coal would be 0.45 g/m^2/month. There were no sampling comments for DD19. Sources in the immediate area include unsealed roads, agricultural activities and horse paddocks.

High Volume Air Samplers

A summary of results from the statutory HVAS PM_{10} monitoring sites for the reporting period is provided in Table 12 and further results can be found in Appendix 1 – Air Quality Monitoring Results.

With the exception of one missed result at DF05 on 4 October 2018 due to equipment failure, the data capture rate for all other statutory HVAS monitoring sites was 100 per cent for the reporting period up to the date of decommissioning.

The short term 24-hour impact assessment criteria was exceeded four times at HVAS monitoring site DF05 and nine times at DF06. Investigations calculated Mt Arthur Coal's contribution to be less than 50 µg/m^3 for each exceedance recorded from July to November 2018, allocated on the proportion that wind direction was from the mining operation to receptor. Regional air quality trends at the time and localised influences and events were also considered during the investigations. 24-hour PM_{10} results and calculated Mt Arthur Coal contributions are summarised in Table 13. HVAS exceedance results from December 2018 were not individually investigated and reported to the DP&E. The reason for not reporting was based on the ongoing liaison with DP&E regarding the planned removal of HVAS equipment from the AQMP. The AQMP was submitted to the DP&E for initial review in September 2018. The AQMP was approved in January 2019 with endorsement by DP&E for the removal of HVAS equipment.

Air dispersion modelling predictions based on the cumulative annual average PM_{10} for the 2016 mining scenario have been used to evaluate HVAS results, as summarised in Table 12.

Table 12: Summary of HVAS PM_{10} results

Monitor Location	Approval criteria (µg/m³)	2016 – predicted cumulative µg/m³	Monitoring results (µg/m³)						Trend / key management implications	Implemented / proposed management actions
			FY19		FY18		FY17			
			Max 24-hr result	Ann Ave	Max 24-hr result	Ann Ave	Max 24-hr result	Ann Ave		
Roxburgh Road (DF05)	Short term 24-hr average: 50 Long term annual average: 30	25	81#	-^	91*	24	56*	17	No valid exceedances	HVAS monitoring discontinued from 25 January 2019
Sheppard Avenue (DF06)		26	89*	-^	103*	40**	47#	23		
South Muswellbrook (DF07)		24	40	-^	87*#	24	43	19		

^ An annual average cannot be calculated as data was only recorded for the period 1 July 2018 to 25 January 2019; monitoring was discontinued at this site after this date as per the new AQMP.

* This result, which includes air emissions from all sources, was investigated as it exceeded the 24-hour impact assessment criterion of 50 µg/m³. Investigations found that Mt Arthur Coal's contribution to this result was less than the criterion.

** This result, which includes air emissions from all sources, was investigated as it exceeded the annual impact assessment criterion of 30 µg/m³. Investigations found that Mt Arthur Coal's contribution to this result was less than the criterion.

This maximum result does not include results for DF05 on 4 October 2018 (in FY19), for DF07 from 26 December 2017 to 7 January 2018 (in FY18) and for DF06 from 12 January 2017 to 23 February 2017 (in FY17), due to equipment failure during these times.

Table 13: 24-hour PM_{10} results and calculated Mt Arthur Coal contributions for HVAS

Date of event	Monitor location	24-hour PM_{10} result (µg/m³)	Mt Arthur Coal contribution (µg/m³)	Summary of investigation findings
18/07/2018	DF06	70	0	This monitor was located downwind of Mt Arthur Coal's operations for zero per cent of the day. Calculated based on the HVAS 24-hour PM_{10} result and wind direction, it is inferred that Mt Arthur Coal made a contribution of 0 µg/m³.
24/07/2018	DF06	89	0	This monitor was located downwind of Mt Arthur Coal's operations for zero per cent of the day. Calculated based on the HVAS 24-hour PM_{10} result and wind direction, it is inferred that Mt Arthur Coal made a contribution of 0 µg/m³.
22/09/2019	DF06	63	2	This monitor was located downwind of Mt Arthur Coal's operations for 3.1 per cent of the day. Calculated based on the HVAS 24-hour PM_{10} result and wind direction, it is inferred that Mt Arthur Coal made a contribution of 2 µg/m³.
15/11/2018	DF06	76	6	This monitor was located downwind of Mt Arthur Coal's operations for 7.3 per cent of the day. Calculated based on the HVAS 24-hour PM_{10} result and wind direction, it is inferred that Mt Arthur Coal made a contribution of 6 µg/m³.
3/12/2018	DF06	52	*	*
9/12/2018	DF05 DF06	58 55	* *	* *
27/12/2018	DF05 DF06	63 59	* *	* *
2/01/2019	DF05 DF06	81 53	* *	* *

Date of event	Monitor location	24-hour PM_{10} result ($\mu g/m^3$)	Mt Arthur Coal contribution ($\mu g/m^3$)	Summary of investigation findings
8/01/2019	DF06	52	*	*
14/01/2019	DF05	54	*	*

* Mt Arthur Coal contribution not calculated due to planned removal of HVAS equipment from sampling program and proactive implementation of the new AQMP. Exceedance was not individually investigated and reported to DP&E.

Tapered Element Oscillating Microbalance Samplers

A summary of the non-validated results from the statutory real-time TEOM PM_{10} monitoring sites for the reporting period is provided in Table 14 and validated (reviewed by the monitoring contractor) results are provided in Appendix 1 – Air Quality Monitoring Results. Appendix 1A – Example Air Quality Exceedance Report contains an example of the report that is provided to the regulator for each air quality exceedance, along with a how to interpret guide, outlining calculation methods.

Data capture for the reporting period is summarised below:

- DC02 – 93 per cent;
- DC04 – 93 per cent;
- DC05 – 93 per cent;
- DC06 – 89 per cent;
- DC07 – 91 per cent; and
- DC09 – 85 per cent.

The Wellbrook monitor (DC09) had a data capture rate of 85 per cent due to a firmware upgrade in March 2019 that resulted in data loss and the installation of a related corrupted data storage card in April 2019.

During the reporting period, based on validated data, the short term 24-hour impact assessment criteria was exceeded 68 times at statutory TEOM monitoring sites. Exceedances as reported to the DP&E, based on non-validated data, are recorded in Table 15. On the 22 November 2018 at DC07 and 19 February 2019 at DC02, the 24-hour impact assessment criteria of 50 $\mu g/m^3$ was exceeded due to extraordinary weather events as agreed by the Secretary, therefore these results are excluded from application of the criterion. For the remaining recorded exceedances it was determined that the incremental increase in concentrations due to the Mt Arthur Coal project was less than 50 $\mu g/m^3$. Exceedance investigations for each elevated result have been based on assessment of regional air quality influences and proportional mine-to-receptor wind direction.

During the reporting period Mt Arthur Coal's statutory TEOM monitoring sites remained below the long-term annual impact assessment criteria. All statutory TEOMs experienced a rise in the average when compared with FY18 and FY17 results, which is consistent with the dry conditions experienced throughout this reporting period. An extended drought, high temperatures, regional dust episodes and particulates from bushfires have been associated with the particularly dry conditions.

Air dispersion modelling predictions for the 2016 mining scenario have been used to evaluate annual average TEOM PM_{10} results for the reporting period, as summarised in Table 14.

Table 14: Summary of TEOM PM_{10} monitoring results using validated data

Monitor location	Approval criteria (µg/m³)	2016 – predicted cumulative (µg/m³)	TEOM PM_{10} monitoring results (µg/m³)						Trend / key management implications	Implemented / proposed management actions
			FY19		FY18		FY17			
			Max 24-hour result	Ann Ave µg/m³	Max 24-hour result	Ann Ave µg/m³	Max 24-hour result	Ann Ave µg/m³		
Sheppard Avenue (DC02)	Short term 24-hour average: 50 Long term annual average: 30	26	223#	30	92*	29	76*	18	No valid exceedances of the incremental impact assessment criteria due to the Mt Arthur Coal project. All TEOMs experienced a rise in the average, consistent with the dry conditions experienced in FY19	Continue dust management in accordance with AQMP
South Muswellbrook (DC04)		24	163*	25	65*	22	53*	19		
Roxburgh Road (DC05)		25	124*	21	68*	19	40	10		
Edderton Homestead (DC06)		22	107*	19	46	14	38	13		
Antiene (DC07)		20	146#	20	67*	18	42	14		
Wellbrook (DC09)		21	168*	25	78*	21	65*	14		

* This result, which includes air emissions from all sources, was investigated as it exceeded the short term 24-hour impact assessment criterion of 50 µg/m³. Investigations found the incremental increase in concentrations due to the Mt Arthur Coal project was less than the criterion.
# The 24-hour impact assessment criteria of 50 µg/m³ was exceeded due to an extraordinary weather event as agreed by the Secretary, therefore this result is excluded from application of the criterion.

Table 15: 24-hour PM_{10} exceedances and calculated Mt Arthur Coal incremental impact for statutory TEOMs

Date of event	Monitor location	24-hour PM_{10} result ($\mu g/m^3$)	Mt Arthur Coal contribution ($\mu g/m^3$) (incremental impact)
18/07/2018	DC02	65	0
20/07/2018	DC02	65	0
24/07/2018	DC02	77	0
28/07/2018	DC09	61	1
4/08/2018	DC09	54	0
18/08/2018	DC02	62	0
15/09/2018	DC02	59	2
	DC04	52	2
19/09/2018	DC02	55	2
6/11/2018	DC02	62	5
22/11/2018*	DC02	171	0
	DC04	187	0
	DC05	185	8
	DC06	109	0
	DC07	155	107
	DC09	179	1
23/11/2018*	DC02	148	0
	DC04	136	0
	DC05	99	0
	DC06	85	0
	DC07	116	38
	DC09	124	0
2/12/2018	DC02	61	2
	DC09	54	3
4/12/2018	DC02	51	2
9/12/2018	DC09	52	31
27/12/2018	DC05	54	14
	DC09	53	17
3/01/2019	DC09	55	28
16/01/2019	DC02	67	12
	DC07	50	3
	DC09	52	18
17/01/2019	DC02	52	6
	DC09	57	8
26/01/2019	DC02	66	21
27/01/2019	DC02	60	23
10/02/2019	DC04	61	14
	DC05	57	6
	DC07	55	4
12/02/2019	DC02	57	15
13/02/2019	DC02	103	22
	DC04	86	15
	DC05	73	3
	DC06	61	3
	DC07	76	3

Date of event	Monitor location	24-hour PM_{10} result ($\mu g/m^3$)	Mt Arthur Coal contribution ($\mu g/m^3$) (incremental impact)
15/02/2019	DC02	50	19
18/02/2019	DC02	54	10
	DC04	41	6
	DC09	51	11
19/02/2019*	DC02	224	132
	DC04	60	13
	DC07	55	4
	DC09	66	8
5/03/2019	DC02	51	16
6/03/2019	DC02	70	7
	DC04	58	11
	DC05	67	15
	DC06	63	6
	DC09	83	22
13/03/2019	DC02	61	24
31/03/2019	DC02	54	6
	DC04	71	11
	DC05	68	6
	DC07	62	3
	DC09	70	10
8/04/2019	DC02	54	18
9/04/2019	DC02	56	20
25/04/2019	DC02	61	0
26/04/2019	DC02	62	0
27/04/2019	DC02	51	0
4/05/2019	DC02	60	1
16/06/2019	DC02	60	0

Note: The results reported in this table are based on non-validated data, as reported to regulators.
* This day was an extraordinary event as agreed by the Secretary, as per Note d of Schedule 3, Condition 20 of PA 09_0062.

Total Suspended Particulates

TEOM PM_{10} monitoring data is used to calculate annual average total suspended particulate (TSP) levels. TSP results were calculated by multiplying the validated annual average PM_{10} results by 2.5, in accordance with the approved AQMP. During the reporting period, TSP remained below the long-term annual impact assessment criteria at all statutory sites, as shown in Table 16. TSP at each of the monitoring locations were above the reported values for FY18 and FY17, which can primarily be attributed to the dry conditions experienced throughout this reporting period.

Table 16: Summary of total suspended particulate results

Site name	Approval criteria	TSP annual average monitoring results (µg/m^3)			Trend / key management implications	Implemented / proposed management actions
		FY19	FY18	FY17		
Sheppard Avenue (DC02)	Long term annual average: 90 µg/m^3	75	71	44	No exceedances	Continue dust management in accordance with AQMP
South Muswellbrook (DC04)		61	55	46		
Roxburgh Road (DC05)		53	47	26		
Edderton Homestead (DC06)		46	35	33		
Antiene (DC07)		51	44	35		
Wellbrook (DC09)		61	51	35		

Complaints and Reportable Incidents

During the reporting period, 21 dust-related complaints were received from eight complainants. These complaints are discussed further in Section 9.

The dust complaint received through the EPA on 26 October 2018 is further detailed in Section 11. There were no other dust-related reportable incidents in the reporting period.

Proposed Improvements

In line with the principles of continuous improvement that are integral to the site Environmental Management System, Mt Arthur Coal will continue upgrades to the Dust Control System, including the air quality monitoring network and real time monitoring system in the next reporting period to improve system accuracy and reliability. Dust emissions at source will be further controlled by the implementation of mobile equipment dust emission mitigation and silica exposure reduction programmes.

6.5 Biodiversity

Environmental Management

Flora and fauna at Mt Arthur Coal is managed in accordance with:

- MAC-ENC-MTP-047 Rehabilitation Strategy;
- MAC-ENC-MTP-050 Biodiversity Management Plan (BioMP);
- MAC-ENC-PRO-012 Land Management (internal document);
- MAC-ENC-PRO-080 Rehabilitation and Ecological Monitoring Procedure (internal document); and
- MAC-HSE-PRO-002 Pest Animal Management Procedure (internal document).

The BioMP outlines Mt Arthur Coal's biodiversity management and monitoring approach, addressing both State and Commonwealth approval conditions in relation to biodiversity management. The BioMP was revised and approved during the reporting period by both the DP&E, on 22 May 2019, and the federal Department of the Environment and Energy, on 5 June 2019. The revised BioMP includes provisions from the former MAC-ENC-PRG-007 Onsite and Near Offsite Offset Management Program and MAC-ENC-PRG-008 Offset Management Program – Middle Deep Creek Offset Area, making these former management programs obsolete.

The biodiversity offset areas managed by Mt Arthur Coal, as per the BioMP, are as follows:

- Mt Arthur Conservation Area (99 hectares);
- Saddlers Creek Conservation Area (431.3 hectares);
- Thomas Mitchell Drive Offset Area (on-site) (219.4 hectares);
- Thomas Mitchell Drive Offset Area (off-site) (495 hectares);

- Roxburgh Road 'Constable' Offset Area (109 hectares); and
- Middle Deep Creek Offset Area (1245.5 hectares).

In accordance with the modification project approval, long-term security for the Mt Arthur Coal biodiversity offset areas is provided through conservation agreements, which were formally registered on title in FY18.

Mt Arthur Coal undertakes annual flora and fauna monitoring to track progress against the BioMP and MOP objectives. The monitoring program tracks the condition of habitat areas over time and ensures that the BioMP's established performance indicators and project approval requirements are being met. The program includes 24 active monitoring sites throughout site woodland rehabilitation areas and remnant vegetation areas onsite and within offset areas. Remnant vegetation monitoring sites are used to assess mine impact and natural regeneration, as well providing reference data for comparative assessment of rehabilitation monitoring sites.

During the reporting period Mt Arthur Coal also developed the MAC-HSE-PRO-002 Pest Animal Management Procedure, primarily to manage kangaroo harvesting at the operation.

During the reporting period the FY18 planting work that had been deferred due to extended drought conditions in the Hunter region was completed at the Middle Deep Creek Offset in June 2019. A total of 8,520 tubestock was planted over 14.8 hectares. Wherever possible tubestock used were developed using seed collected from the conservation and offset areas.

The Thomas Mitchell Drive Onsite Offset planting did not proceed due to ongoing drought conditions and low soil moisture. As per the Indicative Revegetation Schedule for the Thomas Mitchell Drive Onsite Offset shown in the BioMP, this area is due for revegetation in 'Year 4" – nominally 28 April 2020 to 27 April 2021.

Weed Assessment and Treatment

Mt Arthur Coal conducted an annual weed assessment in FY19. This included a whole of site weed survey and a weed assessment conducted through the Rehabilitation and Ecological Monitoring Program.

Mt Arthur Coal's weed treatment programs are guided by the *Hunter Regional Strategic Weed Management Plan 2017 – 2022* (Hunter Local Land Services, 2017). Mt Arthur Coal primarily targets Weeds of National Significance, as well as State Priority weeds and Regional Priority weeds for the Hunter Region, declared under the *Biosecurity Act 2015*.

Pest Animal Control

Feral animal presence is continually monitored through scheduled inspections and workforce feedback. Information from these sources is used to plan the feral animal control programs across the mine site and all biodiversity offset and conservation areas.

The vertebrate pest management program continued during the reporting period, with the annual campaign utilising 1080 baiting to target wild dogs (*Canis lupus familiaris*) and foxes (*Vulpes vulpes*). A particular focus was also placed on rabbit population control in FY19. Additional programs introduced and conducted in FY19 included:

- Kangaroo harvesting in operational areas;
- A shooting program targeting wild dogs (*Canis lupus familiaris*), foxes (*Vulpes vulpes*), feral cats (*Felis catus*), rabbits (*Oryctolagus cuniculu*) and hares (*Leporidae lepus*);
- Rabbit and hare baiting program;
- Fumigation of rabbit burrows; and
- Live rabbit trapping using traps and ferrets.

Environmental Performance

The annual ecological development monitoring program, consisting of vegetation community assessment and fauna surveys, was undertaken in November/December 2018 by independent consultants. The annual survey assessed diversity and habitat condition across nine sites in accordance with the rotational schedule of the monitoring program. Those sites consisted of:

- Three rehabilitation sites in the mine site woodland corridor (VB2, CD1 and MCV2);
- Five remnant revegetation reference sites in both onsite and offsite offsets (MTA1, SAD1, TMDOFF1, MDC1 and MDC2); and

- One natural regeneration site at the Middle Deep Creek Offset Area (MDC3).

Four nest box monitoring locations were also monitored (MACT, TMD Onsite, Saddlers Creek and Mt Arthur).

Biodiversity Monitoring Results

Results of flora and vertebrate fauna species for the monitoring sites are provided in Table 17, along with a condition assessment score, which indicates ecological health based on condition attributes such as dieback, canopy health, erosion, vegetation patch shape, epicormic growth, weed invasion, mid strata native density, ground strata native density and connectivity of vegetation.

Results for the three rehabilitation sites monitored during this reporting period are discussed in more detail below.

Table 17: Flora and fauna species recorded and condition assessment scores

Parameter	Rehabilitation Site			Reference Site					Regeneration Site
	VB2	CD1	MCV2	MTA1	SAD1	TMDOFF1	MDC1	MDC2	MDC3
Flora									
Native flora species (No.)	15	26	23	55	59	34	44	51	29
Native flora species (% of total)	53.6	60.5	67.6	96.5	77.6	89.5	83.0	86.4	54.7
Introduced flora species (No.)	13	17	11	2	17	4	9	8	24
Introduced flora species (% of total)	46.4	39.5	32.4	3.5	22.4	10.5	17.0	13.6	45.3
Total flora species	28	43	34	57	76	38	53	59	53
Total condition score out of 32	27	26	26	29	28	28	30	30	25
Fauna									
Native amphibians	0	0	0	0	1	4	0	0	0
Native birds	10	6	17	14	18	17	28	26	16
Native mammals	3	4	12	7	9	1	13	19	4
Native reptiles	0	1	2	2	3	2	6	5	4
Total native fauna species	13	11	31	23	31	24	47	50	24
Introduced fauna species*	2	2	0	1	0	0	2	0	0
Total fauna species	15	13	31	24	31	24	49	50	24
Threatened fauna species^	1	0	5	1	1	0	5	6	0

* All introduced fauna species recorded in FY19 were mammals.
^ Does not include migratory- or marine-listed species declared under the *EPBC Ac 1999t*.

VB2

The rehabilitation site VB2 was first monitored in 2004 and has now been monitored in six subsequent periods. VB2 is located within the Box Gum Woodland Establishment Area. The cumulative dataset indicates that the attributes of the VB2 rehabilitation site in FY19 are generally consistent with the previous five monitoring periods, notwithstanding minor variations in diversity and abundance values.

One observable change in the rehabilitation at VB2 appears to be the overall decline in introduced species present since the commencement of monitoring in 2004. Although introduced species diversity has increased slightly from 2012, the introduced species diversity is nearly half of what it was in its first year of monitoring in 2004. The total number of introduced flora species is similar between VB2 and its reference site TMDON1.

A second observable change in the rehabilitation at VB2 is the progressive development of the canopy, mid- and

understorey layers. In 2016, the canopy layer measured 6-8 metres and no small tree layer was present. In FY19, the canopy layer measured between 10-13 metres and a small tree layer is now present.

The FY19 flora species diversity recorded at VB2 (28 species) is considerably lower than what was recorded at TMDON1 in FY18 (63 species). Vegetation at VB2 comprises a belt of establishing canopy trees over grassy groundcover dominated by introduced pasture grasses. The canopy consists entirely of juvenile Spotted Gum, which is not recorded at TMDON1. The sub-canopy consists of shorter Spotted Gum and *Acacia implexa* and the shrub layer consists of predominately *Acacia salicina* and *Acacia implexa*. The ground layer is moderately vegetated with mixed grasses and broad-leaved weeds, dominated by introduced grass species. Native grasses and forbs are present, though not dominant.

In terms of flora species composition and diversity, VB2 is not considered to be trending towards levels recorded at its reference site TMDON1, primarily due to the lack of native species diversity present and incorrect canopy species present. The floristic assemblage at VB2 (with the exception of a few native grass species) does not include the Box Gum Woodland seed mix species listed in Table 10 of the MOP for rehabilitation sites within areas to be established as Box Gum Woodland.

The VB2 site is considered to provide poor quality habitat for fauna as it supplies limited foraging resources and very limited refugia sites. The age of the existing canopy vegetation is currently very young and, as a result, there are no tree hollow resources or mistletoes.

The diversity of fauna species recorded at VB2 is comparable to what was recorded at the site's initial year of monitoring in 2009. However, fauna diversity has decreased by more than 50 per cent since the site was last monitored in FY16. Nevertheless, the fauna diversity recorded in FY19 is still comparable to the fauna species diversity recorded at TMDON1 in 2007.

Only one threatened species was recorded at VB2 in FY19, the Eastern Bentwing-bat. In comparison, in FY16 three threatened bat species were recorded at VB2. Two introduced species were recorded at VB2 in FY19, the European Rabbit and Wild Dog.

CD1

The rehabilitation site CD1 was first monitored in 2009 and has been monitored again in 2010, 2012, FY16 and FY19. CD1 is located within the Rehabilitation Woodland Corridor. The cumulative dataset indicates that the attributes of the CD1 rehabilitation site in FY19 are generally consistent with previous monitoring, notwithstanding minor variations in species diversity and abundance values.

One observable change in the rehabilitation at CD1 appears to be the overall increase in native species present. Although native species diversity decreased significantly from 2009 to 2010, native species diversity has steadily increased since and FY19 marked the highest native species diversity recorded to date. During this time introduced species diversity has remained steady with only minor variations between monitoring periods. The total number of introduced flora species is similar between CD1 and its reference site TMDON1.

A second observable change in the rehabilitation at CD1 appears to be the progressive development of the canopy, mid- and understorey layers. In 2016, the canopy layer measured 8-10 m and in FY19 the canopy layer measured between 9-13 m.

The FY19 flora species diversity recorded at CD1 (43 species) is lower than what was recorded at TMDON1 in FY18 (63 species). Vegetation at site CD1 comprises a multilayered belt of juvenile canopy trees and shrubs over grassy groundcover that is dominated by native grasses. The canopy consists of a mix of Spotted Gum, Blakely's Red Gum and White Box tree species. White Box – Grey Box intergrade and Blakely's Red Gum were recorded at reference site TMDON1 in FY18; however Spotted Gum was not. The sub-canopy layer is comprised of Narrow-leaved Ironbark, *Acacia implexa* and White Box and the shrub layer consists of *Acacia salicina* as well as some introduced species. The ground layer is dominated by mixed, native grasses and forbs, predominately the native Hairy Panic. Overall, the canopy, mid-storey and ground layers are relatively similar between CD1 and TMDON1.

With consideration of the data collected to date, in terms of flora species composition and diversity, CD1 is considered to be generally trending towards levels recorded at its reference site TMDON1. The floristic assemblage at CD1 is generally consistent with the species composition and structure criteria for both Central Hunter Box – Ironbark Woodland and Central Hunter Ironbark – Spotted Gum – Grey Box Forest as outlined in Table 11 of the MOP.

The CD1 site is considered to provide poor quality habitat for fauna as it supplies limited foraging resources and very limited refugia sites. The age of the existing canopy vegetation is currently young and for this reason, there are no tree hollow resources or mistletoes.

The diversity of fauna species recorded at CD1 has decreased slightly since the most recent monitoring period in FY16, but increased since the initial monitoring period in 2009. The decrease in native fauna species diversity from

the previous monitoring period is a result of the reduction of reptiles, mammals and bird species recorded. The average native species diversity at CD1 is significantly lower and the introduced species diversity is slightly higher than the TMDON1 reference site. No threatened species were recorded at CD1 in FY19.

MCV2

The MCV2 rehabilitation site was established in 2003 and first monitored in FY15. It has now been monitored five times. The cumulative dataset indicates that in many ways, the attributes of the MCV2 rehabilitation site in FY19 are consistent with previous monitoring, notwithstanding minor variations in diversity and abundance values.

An observable change in the rehabilitation at MCV2 appears to be the progressive development of the canopy, mid- and understorey layers. A regenerating lower shrub layer of eucalypts and Acacia species was also recorded; these plants were likely to be the result of natural regeneration of the canopy species. In FY18 and FY19, the separation of the eucalypts and taller Acacia species into more obvious canopy and midstorey layers has become apparent.

Of the 34 flora species recorded at MCV2 in FY19, 12 species were also recorded at reference site Mt Arthur NE Slopes in FY15 (the most recent monitoring event at the reference site). Canopy vegetation at MCV2 is dominated entirely by Spotted Gum. The mid-storey layer comprises Acacia species that are in senescence and largely remain as stags; a natural process in the development of the vegetation. The mid-storey and shrub layer are comprised of Spotted Gum, *Acacia implexa* and *Acacia salicina*. The ground layer continues to be well vegetated with mixed grasses and forbs, dominated by native grass species. It is expected that over time as the rehabilitation at MCV2 progresses, the native flora species assemblage will become more similar to the open forest vegetation at reference site Mt Arthur NE Slopes.

At this point in time there is no discernible trend for flora diversity, however the rehabilitation appears to be progressing well as there is no major dieback of vegetation in any stratum that would indicate failure of establishment or serious problems with the rehabilitation. There are no major outbreaks of invasive weeds or indications of native species suppression due to competition with introduced species. Regeneration of native canopy species indicates natural recruitment is taking place, which is desirable and negates the need for supplementary planting at this stage.

The floristic assemblage at MCV2 is generally consistent with the species composition and structure criteria for *Central Hunter Ironbark – Spotted Gum – Grey Box Forest* as outlined in Table 13 of the MOP. However, supplementary planting with respect to introducing target shrub species would address the target species criteria outlined in Table 11 of the MOP and planting of additional ground cover species would increase the number of target species in the understorey.

MCV2 is considered to provide moderately good quality habitat for fauna as it supplies blossom and insect foraging resources and refugia sites. Salvaged logs, woody debris and stags have been identified throughout the site.

The diversity of fauna species at MCV2 in FY19 is slightly higher than fauna diversity recorded in FY18 and the greatest species diversity recorded on the site since monitoring began. Overall fauna diversity is comparable between MCV2 and its reference site Mt Arthur NE Slopes, with both sites being dominated by common bird and microbat species that are known from the general locality.

The highest number of threatened species were recorded (five total) in FY19 since monitoring of the site. Threatened species recorded included the Speckled Warbler, Yellow-bellied Sheathtail-bat, Large-eared Pied Bat, Eastern Bentwing-bat and Eastern Cave Bat. The Speckled Warbler has been recorded all five years of monitoring while the Eastern Bentwing-bat has been recorded over the past four years of monitoring.

Nest Box Monitoring Results

Nest box occupancy rates during the reporting period are shown in Table 18. The results of the FY19 nest box monitoring were broadly comparable with the previous year of monitoring. Fluctuations in fauna diversity and abundance are considered to be natural variations and/or a result of the current condition of the nest boxes, and not attributable to mining-related activities.

Mt Arthur continues to have the highest occupancy rates over time compared with the other nest box sites. This is attributed to the site having connectivity to larger patches of suitable habitat. Occupancy rates have steadily increased each year since FY15, with the exception of FY18, which remained unchanged from FY17. This is the first time since FY14 that Squirrel Gliders have been recorded at Mt Arthur and the first time they have ever been recorded at MACT. The presence of the Squirrel Gliders recorded in the Mt Arthur Conservation Area and MACT nest boxes is a positive sign for the areas.

MACT nest box occupancy rates decreased slightly from the two previous monitoring years but are still considered comparable. The relatively high occupation rate is attributed to the site having connectivity to larger patches of suitable habitat.

The continued low occupancy rates at TMD Onsite is generally likely to be due to the small degree of north-south connectivity from the site and also potentially due to the installation of a high fence bounding the Thomas Mitchell Drive Onsite Offset Area. Connectivity in this area will increase with time as the Rehabilitation Woodland Corridor to the west of this area develops.

The continued low occupancy rates at Saddlers Creek may potentially be related to the heights of the nest boxes. It could also be related to the number of hollow bearing trees present in the area, which provide more suitable habitat than nest boxes. This theory is supported by the high numbers of Common Brushtail Possums recorded during nocturnal surveys of the site, which shows arboreal fauna are present, but not utilising the nest boxes present.

Table 18: Nest box occupancy rates and species

Nest box site	FY19 occupancy rate (%)	Number of nest boxes occupied	Number of nest boxes	Nest box occupants species	FY18 occupancy rate (%)	FY17 occupancy rate (%)
Mt Arthur	52	13	25	10 x Common Brushtail Possums 2 x Squirrel Gliders 1 x Sugar Glider	48	48
MACT	29	4	14	2 x Common Brushtail Possums 1 x Squirrel Glider 1 x Sugar Glider	43	38
TMD Onsite	0	0	7	-	14	14
Saddlers Creek	0	0	9	-	0	0

Assessment against MOP Completion Criteria

Rehabilitation at the MCV2 is located within Domain D Rehabilitation – Native Woodland. Vegetation at this site is currently 16 years old. CD1 is also located within Domain D Rehabilitation – Native Woodland and is currently 11 years old. VB2 is located within the Box Gum Woodland Establishment Area and so is located within Domain E Rehabilitation – Box Gum Woodland. Vegetation at this site is currently 16 years old. The canopy stratum is represented by Spotted Gum. As such, the site does not contain suitable mid-storey and canopy species to be considered representative of Box Gum Woodland and rectification works in the form of tubestock planting is recommended for this site.

An assessment of the rehabilitation sites against specific performance and completion criteria for their relevant Domains (D and E) is provided in Table 19. It is considered that rehabilitation at these sites is now at Phase 4 Ecosystem and Landuse Establishment. Given the progress of MCV2 rehabilitation, an assessment against Phase 5 Ecosystem and Landuse Sustainability MOP criteria is also presented in Table 19.

The remnant vegetation monitoring sites established in the conservation and offset areas are also used as reference sites against which rehabilitation sites can be measured.

Performance indicators relevant to the first four years of management of the conservation and offset areas are provided in the MOP under Domain F - Onsite Conservation and Offset Areas. Compliance with these performance indicators and the relevant management actions in the BioMP is evaluated in Table 20. Compliance with the broader scope and requirements of the BioMP will be evaluated through the Independent Environmental Audit and/or Biodiversity Audit process.

Table 19: Status of rehabilitation sites against MOP completion criteria

Relinquishment Criteria	MCV2 (Domain D)	CD1 (Domain D)	VB2 (Domain E)
Phase – 4. Ecosystem and Landuse Establishment			
All areas shown as Native Woodland vegetation community in Plan 4, planted with a native species mix (seed or tubestock) targeted at establishing an open grassy woodland vegetation community.	Compliant for isolated stand of woodland at this monitoring site. On a whole of site basis, this criterion will not be fully compliant until all rehabilitation has been undertaken in the woodland corridor.	Compliant for isolated stand of woodland at this monitoring site. On a whole of site basis, this criterion will not be fully compliant until all rehabilitation has been undertaken in the woodland corridor.	N/A
Rehabilitation species composition (seed mix or tubestock) drawn from the species list in Section 7.2 for Central Hunter Box – Ironbark Woodland or Central Hunter Ironbark - Spotted Gum – Grey Box Forest.	Partially compliant with Central Hunter Ironbark - Spotted Gum – Grey Box Forest. Canopy species are compliant but shrub layer missing except for *Acacia salicina* and ground layer contains low diversity of target species (only two target grasses and two target herbs).	Partially compliant with Central Hunter Ironbark - Spotted Gum – Grey Box Forest and Central Hunter Box – Ironbark Woodland. Canopy species are compliant but shrub layer is missing and ground layer contains low diversity of target species (only one target grass and three target herbs).	N/A
All structural dominant species represented compared with analogue site.	Partially compliant	Partially compliant	Partially compliant
The diversity, percentage and density of shrubs and juvenile trees with a stem diameter <5cm is comparable to that of the local remnant vegetation.	Compliant	Not compliant	Not compliant
The total number of live native plant species is greater than or comparable to the local remnant vegetation.	Not compliant	Not compliant	Not compliant
The number of tree, shrub and sub-shrub species is comparable to that of the local remnant vegetation.	Compliant	Not compliant	Not compliant
Species composition for revegetation will be aimed at establishing a complex community structure consisting of groundcover, understory and canopy.	Compliant	Partially compliant	Partially compliant
Nesting boxes (various bird, squirrel glider, possum and bat) and natural habitat features (including large rocks, logs/coarse woody debris, hollow bearing timber) are placed in established native woodland rehabilitation.	Compliant. Large logs have been placed in clumps within the stand of woodland.	Not compliant	Not compliant
Number of weed species and surface area comparable to reference sites.	Compliant	Compliant	Compliant
Program implemented for fuel load assessment and reduction, with advice from NSW Rural Fire Service.	Compliant	Compliant	Compliant

Relinquishment Criteria	MCV2 (Domain D)	CD1 (Domain D)	VB2 (Domain E)
Pest animal infestation comparable to reference sites, with ongoing control program in place.	Compliant	Compliant	Not compliant
Where adjacent to selected grazing or operational mining land, adequate fencing and signage is installed and maintained to prevent unintentional vehicle and livestock access.	Not compliant	Not compliant	N/A
Rehabilitated native vegetation distribution will link areas of onsite and near-site native vegetation, and be consistent with the biodiversity corridors consistent with the latest version of the DRE Synoptic Plan.	Compliant	Compliant	N/A
The Box-Gum reestablishment area based on the north-eastern slope of Visual Dump 1, and shown on Plan 4, will be established with a species mix (seed or tubestock) drawn from the species list presented in Section 7.2 for Central Hunter Box - Ironbark Woodland or Central Hunter Ironbark - Spotted Gum – Grey Box Forest.	N/A	N/A	Not compliant for Central Hunter Box – Ironbark Woodland. Partially compliant for Central Hunter Ironbark – Spotted Gum – Grey Box Forest:- Canopy - Corymbia maculate present, but only 5% cover. Understorey - not compliant. Ground - not compliant. Central Hunter Ironbark – Spotted Gum – Grey Box Forest is not considered to be appropriate for the Box Gum Woodland Establishment Area for the purposes of compliance with the EPBC Approval because it does not conform to White Box – Yellow Box – Blakely's Red Gum Grassy Woodland.
Phase – 5. Ecosystem and Landuse Sustainability			
All areas shown as Native Woodland vegetation community in Plan 4, planted with a native species mix (seed or tubestock) targeted at establishing an open grassy woodland vegetation community have been established.	Compliant for isolated stand of woodland at this monitoring site. On a whole of site basis, this criterion will not be fully compliant until all rehabilitation has been undertaken in the woodland corridor.	N/A	N/A
The developing vegetation community will include key species listed in Section 7.2 for Central Hunter Box - Ironbark Woodland or Central Hunter Ironbark – Spotted Gum – Grey Box Forest.	Partially compliant with Central Hunter Ironbark - Spotted Gum – Grey Box Forest. Canopy and ground strata species are compliant but shrub layer missing except for *Acacia salicina*.	N/A	N/A

Relinquishment Criteria	MCV2 (Domain D)	CD1 (Domain D)	VB2 (Domain E)
The development of a multilayered community structure is evident, and (for communities > 10 years) consists of canopy, understory and groundcover comparable with reference sites.	Compliant	N/A	N/A
Density and diversity of developing tree and shrub species within rehabilitated community is comparable to that of reference sites.	Compliant	N/A	N/A
Vegetation health: Age < 5 years - survival of 75% of key species and no evidence of significant vegetation stress (i.e. weed dominance, disease, water stress, premature die-back); Age > 5 years – vegetation health indicators comparable to that of reference sites.	Compliant	N/A	N/A
Observations indicating reproduction (seeding, flowering or second generation plants) recorded at multiple locations within rehabilitated vegetation area.	Compliant	N/A	N/A
Observations indicating nutrient recycling (development of consistent litter layer, litter layer decomposition and cryptogam presence) recorded at multiple locations within rehabilitated vegetation area.	Compliant	N/A	N/A
Fauna monitoring of natural and introduced habitat features (i.e. nesting boxes large rocks, logs/coarse woody debris, hollow bearing timber) indicates colonisation by native species.	Compliant	N/A	N/A
Weeds control, feral animal control and fuel load monitoring and reduction programs are implemented, with no significant weed infestations, and overall weed trends comparable to reference sites.	Compliant	N/A	N/A
Where adjacent to selected grazing or operational mining land, adequate fencing and signage is installed and maintained to prevent unintentional vehicle and livestock access.	Not compliant	N/A	N/A
Rehabilitated native vegetation distribution will link areas of onsite and near-site native vegetation, and be consistent with the biodiversity corridors consistent with the latest version of the DRE Synoptic Plan.	Compliant	N/A	N/A

Table 20: Status of remnant vegetation sites against MOP completion criteria and BioMP management actions

Criteria	MTA1	SAD1	TMDOFF1	MDC1	MDC2	MDC3
MOP Relinquishment Criteria for Phase – 5. Ecosystem and Landuse Sustainability (for Domain F – Onsite Conservation and Offset Areas)						
Compliance with management actions presented in the site Biodiversity Management Plan, as evidenced through the most recent Independent Environmental Audit and/or Biodiversity Audit.	Compliant	Compliant	Compliant	Compliant	Compliant	Compliant
BioMP Section 5.1 – Offset Area Revegetation/Regeneration Works						
Natural regeneration encouraged and facilitated through livestock exclusion, fencing and access control, weed and pest management and bushfire management.	Compliant (natural regeneration phase)	Compliant (natural regeneration phase)	Partially Compliant (natural regeneration phase), however livestock was not entirely excluded*	Compliant (natural regeneration phase)	Compliant (natural regeneration phase)	Compliant (natural regeneration phase)
All active revegetation works will be designed with structural and floristic diversity suitable to meet the benchmark vegetation community targets.	N/A – no active revegetation required at this stage at any of these sites.					
All active revegetation will involve use of local provenance seed.	N/A – no active revegetation required at this stage at any of these sites.					
Revegetation areas will be subject to a monitoring program developed.	N/A – no active revegetation required at this stage at any of these sites.					
BioMP Section 5.2 – General Offset Area Management Measures						
Fencing will only be used within the offset and conservation areas to replace existing fencing, or where potential vegetation disturbance by land use impacts warrants additional protection.	Compliant	Compliant	Compliant	Compliant	Compliant	Compliant
Identification of areas with potential for impact on ecological values from human, vehicle or stock access.	Compliant	Compliant	Compliant	Compliant	Compliant	Compliant
Fencing will be used to delineate those areas that are being actively regenerated, to exclude grazing impacts and allow vegetation to regenerate naturally.	Compliant	Compliant	Compliant	Compliant	Compliant	Compliant
Appropriate signage will be used at key access points to the offset and conservation area to identify that the areas are of high ecological significance.	Compliant	Compliant	Compliant	Compliant	Compliant	Compliant
A weed control program has been implemented to limit the spread and colonisation of noxious and environmental weeds at the Mt Arthur Coal Complex.	Compliant. However, additional focus recommended for Common	Compliant. However, additional focus recommended for Fireweed, Common Prickly	Compliant. However, additional focus for Fireweed and Common Prickly Pear.	Compliant. However presence of St John's Wort and Sweet Briar	Compliant. However presence of Common Prickly Pear and St	Compliant. However presence of Tiger Pear and Common

Criteria	MTA1	SAD1	TMDOFF1	MDC1	MDC2	MDC3
	Prickly Pear and Coolatai Grass.	Pear, African Boxthorn and Mother-of-millions.		noted but not currently present in problematic numbers.	John's Wort noted but not currently present in problematic numbers.	Prickly Pear noted but not currently present in problematic numbers.
The ongoing fauna and flora monitoring program will include surveys for the presence of significant populations of feral fauna species.	Compliant	Compliant	Compliant	Compliant	Compliant	Compliant
Feral animal control programs will be completed at least annually and more frequently if required.	Compliant	Compliant	Compliant	Compliant	Compliant	Compliant
Strategic grazing – grazing is currently excluded from offset and conservation areas.	Compliant	Compliant	Compliant	Compliant	Compliant	Compliant

* Presence of livestock was observed within TMDOFF1. Exclusion fencing is installed and the livestock appeared to have accessed the site through a damaged gate. Evidence of livestock access to the area was minimal and the broken gate was likely to have been damaged recently from the neighbouring property.

Weed Control

Annual weed assessments were conducted by land management consultants on the Mt Arthur Coal site in November 2018, and the Roxburgh and Thomas Mitchell Drive Onsite biodiversity offset and conservation areas generally between February and May 2019. Further guidance on weed treatment was obtained from the Rehabilitation and Ecological Monitoring Program.

Two key weed species were targeted during the reporting period:

- African boxthorn (*Lycium ferocissimum*); and
- Prickly Pear (*Cylindropuntia* species).

These species were targeted due in part to the aerial weed assessment and due to the time of year that weed treatment was undertaken (Autumn and Winter). Mt Arthur Coal targeted over 392 hectares of land for weed treatment during the reporting period. The treatment focused in the north eastern portion of the site, including the VD1 rehabilitation area, operational area surrounding the Environmental Dam and the Thomas Mitchel Drive Onsite Offset Area. This area was selected to target high value locations and with strong linkages between existing woodland and rehabilitation areas. This was to drive toward achieving closure criteria. Weed control methods included chemical spraying, cutting and pasting and manual removal.

In addition approximately 100 hectares of weed spraying was completed at the Roxburgh offset, also targeting African boxthorn (*Lycium ferocissimum*) and Prickly Pear (*Cylindropuntia* species). Routine inspections of other offset areas did not identify any priority weed treatment during the reporting period.

Pest Animal Control

During June 2019 a wild dog and fox baiting campaign was completed across the Mt Arthur Coal mine site and adjacent conservation areas. During the campaign 150 baits were laid across 50 locations, with 15 wild dog takes and 25 fox takes. At Middle Deep Creek and Roxburgh Road Offset Areas 177 baits were laid across 59 locations, with 34 wild dog takes and 58 fox takes.

Additional rabbit control programs were undertaken in FY19, targeting the VD1 rehabilitation area. The results of these programs are presented in Table 21. Mt Arthur Coal has commenced a trial into the use of ferrets in the trapping of rabbits. In FY19 there was limited success, however improvements are targeted in FY20.

Table 21: Rabbit control program results for FY19

Methodology	Count
Baiting	Estimated 100
Fumigation	Unknown
Trapping	3
Shooting	9

Kangaroo harvesting commenced at Mt Arthur Coal in FY19 within operational areas. This was due to recommendations in reports assessing rehabilitation areas (Highlands Environmental, 2018 and Future Harvest, 2019) recommending reduction in kangaroo numbers due to predation on targeted flora species in rehabilitation areas. Harvesting of kangaroos for human consumption was considered to have the highest net gain, providing control in kangaroo numbers and beneficial reuse of the carcasses. The program humanely destroyed 104 kangaroos, providing over 3,000 kilograms of consumable meat.

Other animals humanely destroyed by shooting during the reporting period included one wild dog, one feral cat and four hares.

Complaints and Reportable Incidents

One complaint was received through the DP&E on 22 November 2018 regarding a road closure on Thomas Mitchell Drive and interaction with traffic from a mine access track adjoining Thomas Mitchell Drive. This complaint is discussed further in Section 9.

Mt Arthur Coal did not receive any government fines or penalties related to flora and fauna during the reporting period and there were no related reportable incidents.

Proposed Improvements

Mt Arthur Coal will continue to implement the Ecological Development Monitoring Program during the next reporting period, with monitoring of woodland rehabilitation, remnant woodland community sites and revegetation/regeneration areas within conservation areas. Mt Arthur Coal will also continue to implement annual landform stability assessments of existing rehabilitation in the next reporting period.

Mt Arthur Coal will continue removing waste items and repairing sections of fence that require maintenance in conservation and biodiversity offset areas during the next reporting period.

During the next reporting period Mt Arthur Coal will continue to execute a three year plan that includes an annual weed assessment, weed strategy and weed management review. Weed management priorities will be revised based on the outcomes of the reviews with the aim of improving strategies for weed control across the site with particular focus on newly established rehabilitation. Mt Arthur Coal is trialling weed survey using Unmanned Aerial Vehicle (UAV) and high resolution aerial imagery. The intent of the UAV survey is to more cost effectively target invasive species and to create a better measure of success in weed treatment. The work involves high resolution aerial imagery taken in a series of passes to give a transect. The images are then processed using image recognition to automatically pull out individual species and give accurate weed load and species count per hectare. This process is still in draft with additional species yet to be individually identified. The improvements to weed assessment form part of a three year plan to improve weed management on site.

During the next reporting period, Mt Arthur Coal will also implement another vertebrate pest management program on site and across all conservation and offset areas. Improvements in the management of rabbits will be a particular focus, with expanded shooting, trapping and baiting programs to be completed.

6.6 Visual Amenity and Lighting

Environmental Management

Visual amenity and lighting management at Mt Arthur Coal is managed in accordance with:

- MAC-ENC-PRO-071 Visual Assessment Procedure;
- MAC-PRD-PRO-073 Procedure for Lighting Plant Movement and Setup; and
- MAC-ENC-PRO-077 Light Management Procedure.

Mt Arthur Coal's visual assessment procedure ensures overburden emplacement development is monitored and assessed against modelled predictions in the environmental assessment.

Management measures presented in the Light Management Procedure aim to control and reduce the impact of lighting on the surrounding area. The procedure is used in conjunction with the procedure for lighting plant movement and setup, which advises operational staff on correct alignment of lights to avoid offsite impact.

Environmental Performance

Visual impact inspections were completed in August 2018 and April 2019. Inspections indicated that locations to the east of Mt Arthur Coal have extensive views of rehabilitated overburden dumps, with reduced visual contrast to surrounding non-mined landforms and peripheral visual impact from active mining activities. From locations to the north and west, a distinct visual contrast between mining activity and the surrounding non-mined landscape is evident due to exposure to low wall overburden dumps. For all locations the shape and size of the overburden dumps are within the predicted model shown in the environmental assessment.

Complaints and Reportable Incidents

During the reporting period, 23 lighting complaints were received from seven complainants. One complaint was received through DP&E on 12 July 2018 in relation to dump heights. These complaints are discussed further in Section 9.

Mt Arthur Coal did not receive any government fines or penalties related to lighting or visual amenity during the reporting period and there were no related reportable incidents.

Proposed Improvements

During the reporting period Mt Arthur Coal continued to incorporate fluvial geomorphic principles into the design of overburden emplacements. Rehabilitated landforms were reshaped to facilitate natural surface flow processes, resulting in a final shape that more closely mimics the adjacent non-mined landscape and reduces visual impact. This process will be developed further in subsequent reporting periods.

Lighting from Mt Arthur Coal will continue to be implemented in accordance with the Light Management Procedure and managed to minimise impacts on the local community whilst maintaining the minimum level necessary for operational and safety needs.

6.7 Aboriginal Cultural Heritage

Environmental Management

Aboriginal cultural heritage at Mt Arthur Coal is managed in accordance with:

- MAC-ENC-MTP-042 Aboriginal Heritage Management Plan.

Mt Arthur Coal has implemented a management plan that provides the framework to identify, assess, monitor, conserve and manage Aboriginal cultural heritage. The management plan assists Mt Arthur Coal to mitigate the impacts of its operations on Aboriginal cultural heritage, comply with the requirements of the *National Parks and Wildlife Act 1974*, *Environmental Planning and Assessment Act 1979* and the modification project approval and continue its active partnership with the Aboriginal community.

Environmental Performance

During January and February 2019, salvage works were undertaken to relocate the 'Fairford 1' grinding groove site from the Roxburgh pit area in collaboration with RPS archaeologists and with the assistance of the registered Aboriginal parties. This was a major piece of work and the grinding groove was successfully salvaged and recorded in accordance with the methodology detailed in the Aboriginal Heritage Management Plan. The artefact is now located in a temporary keeping place, determined in consultation with the registered Aboriginal parties.

Minor survey and / or salvage activities were also successfully completed and recorded during the reporting period for the following site works in accordance with the methodology detailed in the Aboriginal Heritage Management Plan:

- Edderton Road upgrade;
- Powerpole upgrades;
- Closure of North Cut Tailings Storage Facility and Main Dam;
- Installation of fibre optic cable route at Denman Road;
- Saddlers rehabilitation sediment control;
- Edderton Road (Windmill extension); and
- Site water pipeline upgrade.

Complaints and Reportable Incidents

Mt Arthur Coal did not receive any complaints, government fines or penalties related to Aboriginal cultural heritage during the reporting period and there were no related reportable incidents.

Proposed Improvements

A major review of the Mt Arthur Coal cultural heritage management plan will be undertaken in FY20, as agreed in consultation with the DPIE, to update the disturbance boundary, cultural heritage site data as well as information about the grinding groove relocation. Visual inspections of the other grinding grooves will be undertaken.

6.8 European Cultural Heritage

Environmental Management

European cultural heritage at Mt Arthur Coal is managed in accordance with the:

- MAC-ENC-MTP-046 European Heritage Management Plan;
- MAC-ENC-MTP-048 Edinglassie and Rous Lench Conservation Management Plan - Volume 1;
- MAC-ENC-MTP-049 Edinglassie and Rous Lench Conservation Management Plan - Volume 2; and
- MAC-ENC-PRG-004 Edinglassie and Rous Lench Heritage Management Program.

Mt Arthur Coal has implemented several management plans that provide the framework to identify, assess, monitor, conserve and manage European cultural heritage. Mt Arthur Coal owns and manages five heritage-listed homesteads as follows:

- Edinglassie Homestead (state significance);
- Rous Lench Homestead (state significance);
- Edderton Homestead Complex (local significance);
- Belmont Homestead Complex (local significance); and
- Balmoral Homestead (local significance).

The two State-significant historic heritage items with possible impacts from the Mt Arthur Coal operation are the Edinglassie and Rous Lench homesteads.

The European heritage management plan assists Mt Arthur Coal to coordinate and manage the European heritage items affected or potentially affected by its operations, comply with the requirements of the *Heritage Act 1977* and the modification project approval and mitigate impacts of its operations on European cultural heritage.

Environmental Performance

During the reporting period, Mt Arthur Coal inspected all of its historic homesteads and related buildings located on freehold land to ensure properties were maintained to an acceptable standard.

Complaints and Reportable Incidents

Mt Arthur Coal did not receive any complaints, government fines or penalties related to European cultural heritage during the reporting period and there were no related reportable incidents.

Proposed Improvements

All heritage structures are planned to remain in situ during the next reporting period with no impacts predicted from the current mine plan. Inspections and maintenance measures will continue to be implemented during the next reporting period to conserve all historic homesteads and related buildings owned by Mt Arthur Coal.

6.9 Contaminated Land and Hydrocarbon Contamination

Environmental Management

Contaminated land at Mt Arthur Coal is managed in accordance with the following internal documents:

- MAC-ENC-PRO-028 Storage of Fuels and Chemicals;
- MAC-ENC-PRO-029 Spill Response;
- MAC-ENC-PRO-074 Contaminated Land Management; and
- MAC-STE-PRO-013 Hazardous Materials Management Procedure.

Hydrocarbons and other hazardous substances are kept in designated storage compounds designed and managed in accordance with relevant standards and procedures. Monitoring and inspection programs are maintained for these facilities to ensure hazardous materials and wastes are being adequately stored and disposed of and that any spills or leaks are promptly reported and managed.

Environmental Performance

During the reporting period, all spills were controlled and contained immediately using emergency spill kits or earthmoving equipment to form a temporary bund. Small spills were disposed of offsite by Mt Arthur Coal's waste contractor. Mt Arthur Coal is considering options regarding management of larger scale contaminated soils on site.

Complaints and Reportable Incidents

Mt Arthur Coal did not receive any complaints, government fines or penalties related to contaminated land or hydrocarbon contamination during the reporting period and there were no related reportable incidents.

Proposed Improvements

Mt Arthur Coal will continue to manage contaminated land and hydrocarbon contamination in accordance with project approval and legislative requirements.

6.10 Spontaneous Combustion

Environmental Management

Spontaneous combustion at Mt Arthur Coal is managed in accordance with:

- MAC-ENC-PRG-002 Spontaneous Combustion Control Program.

Mt Arthur Coal has implemented a spontaneous combustion control program to prevent, monitor, control and report outbreaks of spontaneous combustion.

Environmental Performance

Spontaneous combustion at Mt Arthur Coal is predominantly confined to old mining areas at Bayswater No. 2 and the Drayton sublease area. This is a result of the higher levels of carbon and sulphuric material in the coal seams mined in these Greta measures in comparison to those mined in current active mining areas.

During the reporting period there was an increase in the area recorded as being affected by spontaneous combustion at Mt Arthur Coal. A total of 353 m² of land was treated for spontaneous combustion in the reporting period. A summary of spontaneous combustion in the reporting period is shown in Table 22.

To validate areas of spontaneous combustion on site, Mt Arthur Coal, in conjunction with neighbouring mining company Malabar Coal, commissioned a thermal imagery scan flight. The flight was undertaken pre-dawn on 22 September 2018. Results showed monthly visual inspections had accurately picked up most areas of spontaneous combustion, with a couple of exceptions in hard to access areas.

Figure 4 shows locations of spontaneous combustion at Mt Arthur Coal at start and end of reporting period.

Table 22: Summary of spontaneous combustion at Mt Arthur Coal in FY19

Month	Area affected at start of month (m^2)	Area naturally extinguished (m^2)	Area treated (m^2)	New or recurring areas (m^2)	Area affected at end of month (m^2)
July	1771	0	0	66	1837
August*/September	1837	0	45	125	1917
October	1917	0	0	0	1917
November	1917	0	32	0	1885
December	1885	0	0	7	1892
January	1892	0	10	16	1898
February	1898	0	115	534	2317
March	2317	0	27	0	2290
April	2290	0	94	76	2272
May/June*	2272	0	30	43	2285
Total		**0**	**353**	**867**	

* Surveys were not undertaken in August 2018 and June 2019 due to limited resources being available on site.

Complaints and Reportable Incidents

During the reporting period, one complaint was received regarding odour from spontaneous combustion on 6 October 2018. This complaint is discussed further in Section 9.

Mt Arthur Coal did not receive any government fines or penalties related to spontaneous combustion during the reporting period.

Proposed Improvements

Mt Arthur Coal will continue to monitor spontaneous combustion during the next reporting period, and cap readily accessible areas.

In accordance with the approved mine operations plan, overburden material will continue to be emplaced over current emplacement areas at Bayswater No. 2. This will be carried out in alignment with the design of the extension of the existing tailings storage facility, which is planned to encompass most of this area, and will ultimately treat a significant portion of identified spontaneous combustion areas.

BHP

Mapping Services, Brisbane

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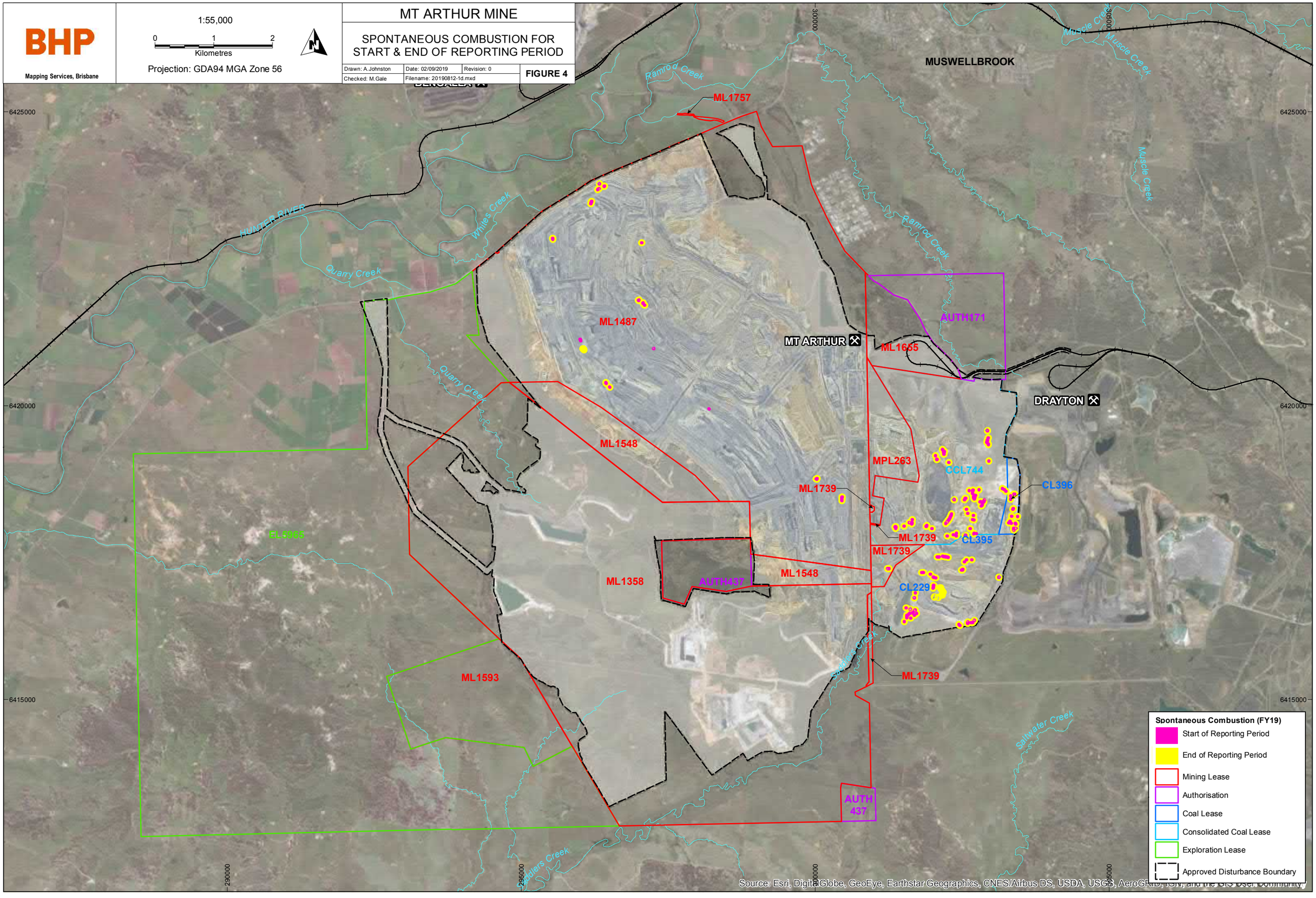
Kilometres

Projection: GDA94 MGA Zone 56

MT ARTHUR MINE

SPONTANEOUS COMBUSTION FOR START & END OF REPORTING PERIOD

Drawn: A.Johnston	Date: 02/09/2019	Revision: 0	**FIGURE 4**
Checked: M.Gale	Filename: 20190812-1d.mxd		



6.11 Bushfire

Environmental Management and Performance

Bushfire at Mt Arthur Coal is managed in accordance with:

- MAC-ENC-PRO-076 Bushfire Prevention Procedure (internal document); and
- MAC-STE-PRO-010 Emergency Procedure – Bushfires (internal document).

Specific prevention and fire suppression control measures are implemented in order to protect remnant vegetation communities as well as Mt Arthur Coal infrastructure. Preventative measures include fuel load assessment and reduction programs, the establishment and maintenance of fire breaks and the prevention of ignition sources. Fire suppression and control is achieved through on-site fire-fighting equipment, including a rescue truck and water carts, facilitated by a network of roads and vehicle access trails, which provide access to all areas of Mt Arthur Coal owned land. Mt Arthur Coal also maintained a trained emergency response team on each shift, and fire extinguishers are fitted in vehicles and buildings.

No grass or bushfires occurred on site or at the conservation or offset areas during the reporting period.

Complaints and Reportable Incidents

Mt Arthur Coal did not receive any complaints, government fines or penalties related to bushfire during the reporting period and there were no related reportable incidents.

Proposed Improvements

During the next reporting period Mt Arthur Coal will continue to manage bushfire risk in accordance with relevant procedures.

6.12 Greenhouse Gas and Energy

Environmental Management

Greenhouse gas and energy at Mt Arthur Coal are managed in accordance with the:

- MAC-ENC-MTP-040 Air Quality and Greenhouse Gas Management Plan. This document was updated and approved by DP&E on 25 January 2019 and renamed to Air Quality Management Plan (AQMP).

The new AQMP includes greenhouse gas and energy management measures. Mt Arthur Coal undertakes regular reviews and monitoring of greenhouse gas emissions and energy efficiency initiatives to ensure that greenhouse gas emissions per tonne of product coal are kept to the minimum practicable level. During the reporting period Mt Arthur Coal continued greenhouse gas and energy consumption monitoring with the use of a centralised database to assist with monthly tracking and reporting of key emission sources. A key focus during the reporting period was to ensure the operation complied with the regulations under the *National Greenhouse and Energy Reporting* (NGER) *Act 2007*.

Environmental Performance

Total emissions were 609 kt CO_2-e in the FY19 reporting period, of which direct (scope 1) emissions accounted for 85 per cent, and scope 2 emissions from the use of grid-based electricity accounted for the remaining 15 per cent. As in the previous reporting period, Mt Arthur Coal used NGER Method 2 measurement of its open fugitive emissions, which increased in absolute terms (to 42 kt CO_2-e) and as a proportion of total scope 1 emissions (eight per cent). Fugitive emissions are expected to continue increasing over time as mining progresses into areas with higher in-situ methane contents.

Fuel combustion will continue to constitute the bulk of emissions from Mt Arthur Coal, accounting for 92 per cent of scope 1 emissions and almost 78 per cent of total emissions in the reporting period. Energy use was similarly dominated by diesel fuel (93 per cent), with other fuels accounting for two per cent and electricity making up the balance.

Complaints and Reportable Incidents

Mt Arthur Coal did not receive any complaints, government fines or penalties related to greenhouse gas or energy during the reporting period and there were no related reportable incidents.

Proposed Improvements

Mt Arthur Coal will continue to investigate and, where feasible, implement projects to reduce fossil fuel energy consumption and greenhouse gas emissions in accordance with BHP's sustainability commitments, including the company's greenhouse gas emission targets.

6.13 Waste Management

Environmental Management

Waste at Mt Arthur Coal is managed in accordance with:

- MAC-ENC-PRO-033 Waste Handling and Disposal (internal document).

Environmental Performance

During the reporting period Mt Arthur Coal's activities, generated approximately 5,444 tonnes of both recycled and non-recycled waste sent off site for management. This is an increase of approximately 13 per cent on the FY18 total of 4,821 tonnes. Approximately 4,457 tonnes (82 per cent) of the total waste produced and sent off site for management was recycled during the reporting period, as shown in Figure 5. This is consistent with the FY18 recycled off site total of 3,910 tonnes (81 per cent).

In addition, Mt Arthur Coal captured and recycled approximately 2,323 tonnes of effluent water in an on-site sewerage treatment system to reuse this water in site operations.

Complaints and Reportable Incidents

Mt Arthur Coal did not receive any complaints, government fines or penalties related to waste during the reporting period and there were no related reportable incidents.

Proposed Improvements

During the next reporting period Mt Arthur Coal will continue to manage waste in accordance with relevant procedures.

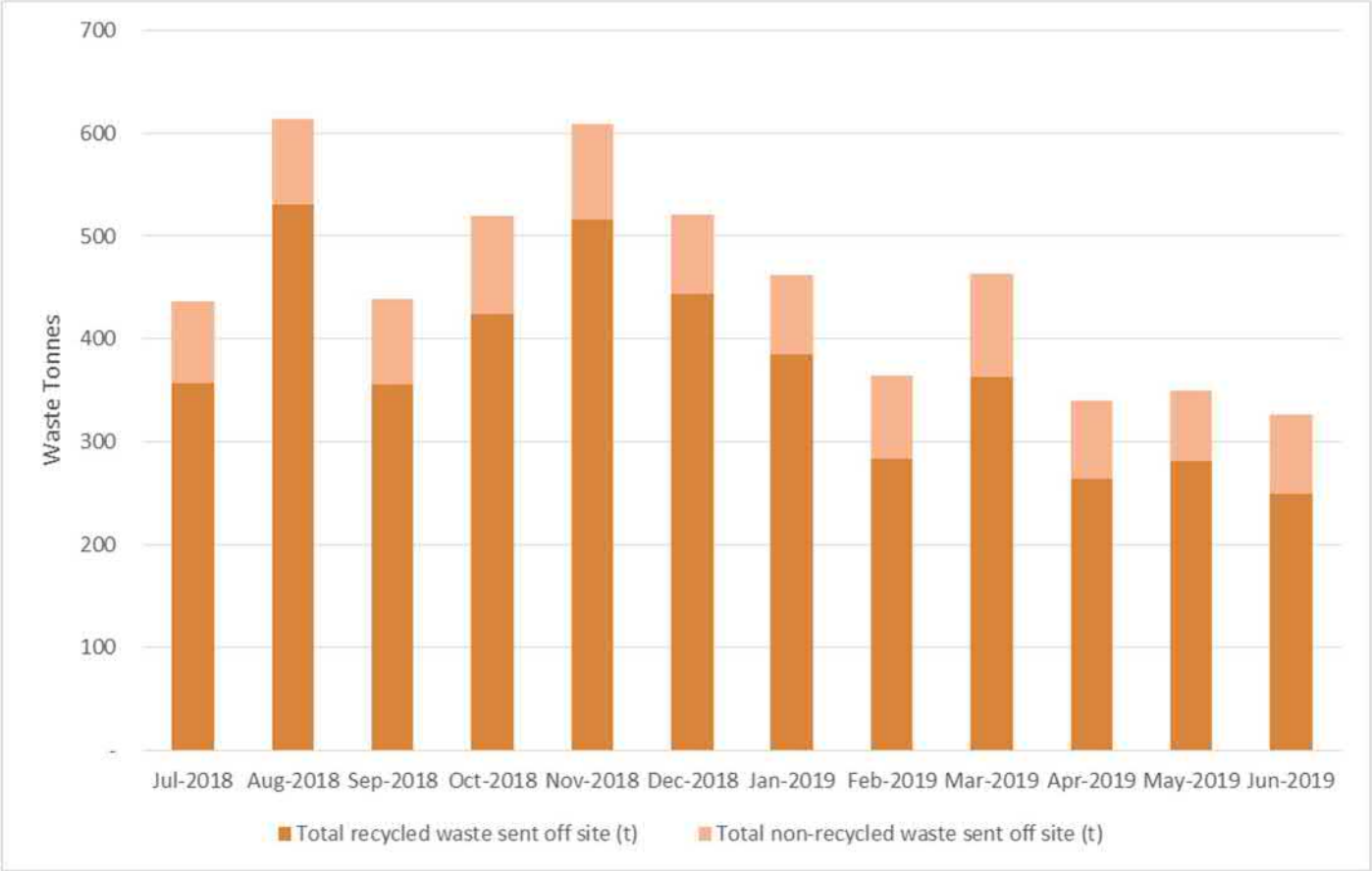


Figure 5: Waste disposal from Mt Arthur Coal

6.14 Public Safety

Environmental Management / Performance

During the reporting period Mt Arthur Coal maintained a boundary security fence around much of the perimeter of its site to ensure no unauthorised access to mining areas. A number of boom gates also exist to restrict unauthorised or unintentional access to the active mining and infrastructure areas. Routine patrols of these boundaries and access points are conducted through the engagement of third party security specialists and by internal statutory compliance personnel with no identified security or access breaches occurring during the reporting period.

During the reporting period Mt Arthur Coal implemented a permanent emergency response team consisting of BHP Emergency Services Officers and Paramedics. These personnel, along with the existing volunteer emergency response team, provide a professional emergency response service to site. The team are dedicated to ongoing continuous improvement, standardisation and preventative work.

Complaints and Reportable Incidents

Mt Arthur Coal did not receive any complaints, government fines or penalties related to public safety during the reporting period and there were no related reportable public safety incidents.

Proposed Improvements

Mt Arthur Coal will continue to maintain and monitor site security and ensure public safety during the next reporting period.

7. Water Management

7.1 Water Balance

Mt Arthur Coal maintains a site water balance model incorporating surface and groundwater inputs and outputs. The model is used to interpret current conditions and forecast future mine water inventories and use. The model build generally aligns to the Minerals Council of Australia Water Accounting Framework.

Mt Arthur Coal did not discharge water into the Hunter River from its licensed discharge point under the Hunter River Salinity Trading Scheme (HRSTS) during the reporting period.

Water use totaled 6,940 ML during the reporting period. The use is a total of model outputs including evaporation, product entrainment and task loss. This is a minor increase in water usage compared to the 6,879 ML used in FY18.

The largest input to site is typically rainfall as outlined in the modification project environmental assessment, however this was not the case during the reporting period due to ongoing drought conditions and rainfall below fifth percentile. The largest input to the site was licensed extraction from the Hunter River of approximately 2,980 ML, as shown in Table 23.

Mt Arthur Coal continued to source water from the Muswellbrook Shire Council treated effluent scheme to reduce the demand from other external sources. An estimated 660 ML of recycled effluent was brought onto site for reuse in site operations. This supply contract renewal is in negotiation and planned to continue in FY20.

Table 23: Water take for FY19

Water Licence number	Water sharing plan, source and management zone	Entitlement (Unit Shares)	Passive take / inflows (ML)	Active pumping (ML)	Total (ML)
WAL 917	Hunter Regulated River Water Source (High Security), Zone 1A Management Zone	2,197	-	0	0
WAL 918	Hunter Regulated River Water Source (General Security), Zone 1A Management Zone	3,564	-	2,980	2,980
WAL 1296	Hunter Regulated River Water Source (Supplementary), Zone 1A Management Zone	301	-	0	0
WAL 18141	Hunter Regulated River Alluvial Water Source, U/S Glennies Creek Management Zone	104	50*	-	50*
WAL 18247	Hunter Regulated River Alluvial Water Source, U/S Glennies Creek Management Zone	247	191*	-	191*
WAL 41495	Sydney Basin-North Coast Groundwater Source	750	750^	-	750^
WAL 41556	Sydney Basin-North Coast Groundwater Source	250	58^	-	58^

* Alluvial inflow has been calculated, based on predicted flux to and from alluvium (ML/day) as reported in the EIS, to be a total of 241 ML, which has been allocated across the two alluvial licences.

^ Groundwater seepage has been calculated, based on predicated average inflow to the pits (ML/day) as reported in the EIS, to be a total of 808 ML, which has been allocated across the two groundwater licences.

7.2 Erosion and Sediment

Environmental Management

Erosion and sediment at Mt Arthur Coal is managed in accordance with:

- MAC-ENC-PRO-060 Erosion and Sediment Control Plan;
- MAC-ENC-PRO-061 Surface Water Monitoring Program; and
- MAC-ENC-PRO-063 Surface and Ground Water Response Plan.

Environmental Performance

Total suspended solids (TSS) results remained low during the reporting period at the majority of statutory sites with below average rainfall limiting the number of samples collected as monitoring points were recorded as dry or water level was too low to sample. However, one reportable exceedance for TSS was recorded at SW03. This exceedance was the result of the below average rainfall causing Saddlers Creek to become a series of isolated ponds and was not a result of mine operations. The TSS results were mostly consistent compared with results from previous financial years. TSS results are summarised in Table 25, with further results presented in Appendix 2 – Surface Water Quality Monitoring Results. Water management structures were also routinely inspected after rain events > 25mm and maintained to ensure they are performing to design and prevent impacts on downstream waters.

During the reporting period monitoring of riparian vegetation was undertaken as part of the annual riparian vegetation and channel stability assessment, in accordance with the Surface Water Monitoring Program. Table 24 summarises the results of the riparian vegetation assessment undertaken at the monitoring sites. The results of the FY19 channel stability assessment are generally consistent with previous monitoring years' findings. Most sites showed increased or consistent native species despite current drought conditions and all sites showed improved or consistent condition scores. This indicates that Saddlers Creek, Quarry Creek, Ramrod Creek and White's Creek Diversion are generally stable and/or stabilising with regenerating riparian vegetation and ground cover.

Table 24: Riparian vegetation assessment - species diversity and total condition scores for FY19

Site	SW03 (Saddlers Creek)			SW04 (Quarry Creek)			SW12 (Ramrod Creek)			SW15 (White's Creek Diversion)		
	FY19	FY18	FY17	FY19	FY18	FY17	FY19	FY18	FY17	FY19	FY18	FY17
Number of native species (% of total)	46 (68)	59 (76)	40 (65)	15 (47)	15 (56)	14 (38)	30 (65)	17 (46)	22 (56)	16 (41)	8 (31)	10 (31)
Number of introduced species (% of total)	22 (32)	19 (24)	22 (35)	17 (53)	12 (44)	23 (62)	16 (35)	20 (54)	17 (44)	20 (59)	18 (69)	22 (69)
Total number of species	68	78	62	32	27	37	46	37	39	36	26	32
Total condition score (% of 32)	27 (84)	26 (81)	26 (81)	25 (81)	25 (81)	24 (75)	25 (81)	25 (81)	24 (75)	24 (75)	24 (75)	24 (75)

Improvements that occurred during the reporting period include:

- The amelioration of dispersive soils were made as part of the FY19 rehabilitation program;
- New sediment controls including sediment control ponds; and
- Erosion and sediment controls are implemented as part of the Permit to Disturb process and inspected on an as needed basis.

Complaints and Reportable Incidents

Mt Arthur Coal did not record any water release incidents during the reporting period.

Proposed Improvements

New sediment dams constructed for expanded overburden emplacements in the conveyor corridor and upper Saddlers Creek catchment will be designed in accordance with the provisions for sediment retention basins in the Managing Urban Stormwater – Soil and Construction Volume 2E – Mines and Quarries Guidelines (DECC, 2008).

Areas prone to erosion with exposed dispersive soils are focused in freshly established rehabilitation areas. These areas undergo annual landform stability assessments as per MAC-ENC-PRO-080 Rehabilitation and Ecological Monitoring Procedure. Plans for improvements to soil amelioration as per the response to the NSW Resources Regulator will be developed during the next reporting period, following more detailed sampling and independent advice. Plans include the more detailed assessments of soil characteristics to target ameliorants and investigation of the use of temporary stabilisation of freshly established rehabilitation whilst ground cover establishes.

7.3 Surface Water

Environmental Management

Surface water at Mt Arthur Coal is managed in accordance with:

- MAC-ENC-MTP-034 Site Water Management Plan;
- MAC-ENC-PRO-061 Surface Water Monitoring Program;
- MAC-ENC-PRO-059 Site Water Balance;
- MAC-ENC-PRO-063 Surface and Ground Water Response Plan (SWMP); and
- MAC-ENC-PRO-032 Water Management (internal document).

Water quality downstream of Mt Arthur Coal's operation is currently monitored by an independent consultant at five statutory monitoring sites, plus Mt Arthur Coal's licensed discharge point and Saddlers Creek flow monitoring gauge.

Mt Arthur Coal's Site Water Management Plan outlines measures for managing water on site, while the Surface Water Monitoring Program establishes impact assessment criteria against which monitoring results are compared. Impact assessment criteria are presented as trigger values which, if exceeded, lead to a response such as more intensive monitoring, investigation and if required, remedial action.

The rating curve for the SWGS1 monitoring station in Saddlers Creek was reviewed and updated during the reporting period.

Environmental Performance

A summary of the surface water quality data for statutory sites during the reporting period is provided in Table 25, with further results provided in Appendix 2 – Surface Water Quality Monitoring Results.

Water quality parameters in natural watercourses surrounding the mine including Saddlers Creek (SW02 and SW03), Quarry Creek (SW04), Ramrod Creek (SW12) and Whites Creek (SW15) were subject to normal variations in response to the ephemeral nature of the creeks, local geology and weather conditions. Water quality parameters are only recorded at the HRSTS discharge point (SW28) during discharge, and no HRSTS discharge occurred during the reporting period.

Surface water pH measured at individual statutory sites remained relatively constant during the reporting period and within the impact assessment trigger levels of 6.5-9.0 at all times. Surface water EC and TSS measured at individual statutory sites remained below impact assessment trigger levels during the reporting period at SW15, however six reportable exceedances were recorded at SW03, SW04 and SW12, as summarised in Table 25.

SW02 was dry during the reporting period, giving a capture rate of zero percent. SW03 was too low to sample in two months, giving a capture rate of 83 percent. SW04 was either dry or too low to sample in nine months, giving a capture rate of 25 percent. Data capture during the reporting period was 100 per cent for SW12. SW15 was dry for eight months giving a data capture of 33 percent.

Surface water monitoring results were also recorded for flow, EC and turbidity at the SWGS1 monitoring station in Saddlers Creek. As it is an ephemeral creek, Saddlers Creek was mostly dry over the reporting period, with one flow event recorded on 30 March 2019. This rainfall event produced corresponding peaks in turbidity and EC results. The peak EC results on 12 July 2018 and 4 March 2019 correspond to calibrations of the EC probe, not flow events. Flow, EC and turbidity results for SWGS1 for the reporting period are summarised in Table 26, with reporting period results presented as plots in Appendix 2 – Surface Water Quality Monitoring Results.

Surface water monitoring locations are shown in Figure 6.

BHP

Spatial Data Team
Brisbane

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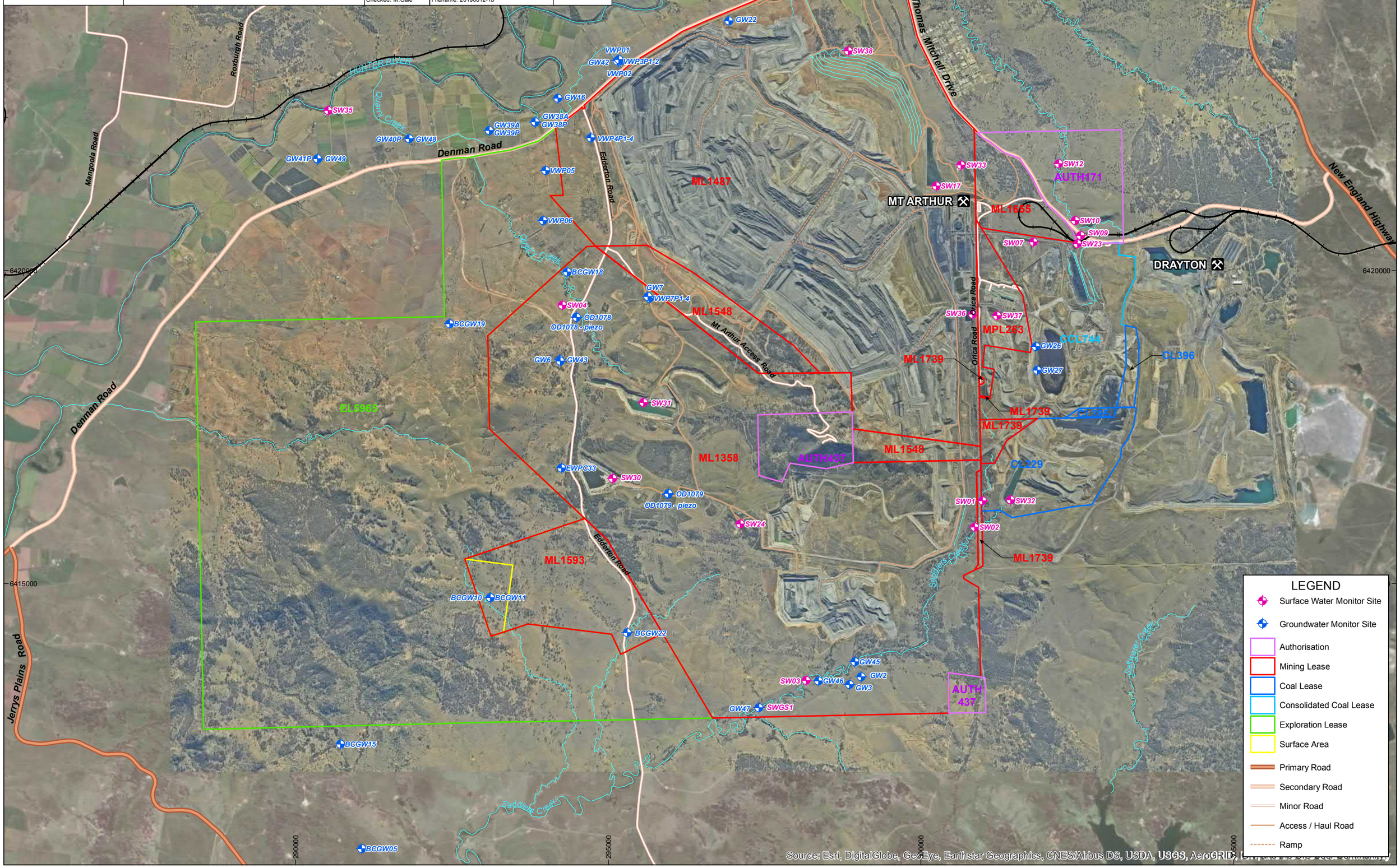
Kilometres

Projection: GDA94 MGA Zone 56

MT ARTHUR MINE

GROUNDWATER AND SURFACE WATER MONITORING LOCATIONS

Drawn: K.Reedy	Date: 12/08/2019	Revision: 0	**FIGURE 6**
Checked: M.Gale	Filename: 20190812-1b		



LEGEND

- Surface Water Monitor Site
- Groundwater Monitor Site
- Authorisation
- Mining Lease
- Coal Lease
- Consolidated Coal Lease
- Exploration Lease
- Surface Area
- Primary Road
- Secondary Road
- Minor Road
- Access / Haul Road
- Ramp

Table 25: Summary of statutory surface water quality monitoring results

Site	Impact Assessment Criteria Trigger Values			Monitoring Results			Trend/ key management implications	Implemented / proposed management actions
				min	ave	max		
SW02	pH	6.5 – 9.0		-	-	-	No assessment criteria triggered. Dry during the reporting period	Continue managing surface water in accordance with site WMP
	EC (µS/cm)	Stage 1	12,365	-	-	-		
		Stage 2	13,900					
	TSS (mg/L)	Stage 1	219	-	-	-		
		Stage 2	277					
SW03	pH	6.5 – 9.0		7.1	8.0	8.5	No assessment criteria triggered	
	EC (µS/cm)	Stage 1	10,133	1,303	6,799	10,400	Stage 1 criteria exceeded on one occasion (not a reportable exceedance)	
		Stage 2	11,402					
	TSS (mg/L)	Stage 1	37	8	35.4	136	Stage 1 criteria exceeded on one occasion (not a reportable exceedance). Stage 2 criteria exceeded on one occasion on 17/9/2018 as a result of below average rainfall not mine activity. SW03 was an isolated pond at the time of sampling and the upstream site (SW02) was dry	
		Stage 2	46					
SW04	pH	6.5 – 9.0		8.5	8.6	8.6	No assessment criteria triggered	
	EC (µS/cm)	Stage 1	13,959	4,090	10,763	21,000	Stage 2 criteria exceeded on one occasion on 11/12/2018 as a result of below average rainfall not mine activity. SW04 was an isolated pond during sampling	
		Stage 2	15,509					
	TSS (mg/L)	Stage 1	82	11	35.7	61	No assessment criteria triggered	
		Stage 2	104					
SW12	pH	6.5 – 9.0		7.1	7.7	8.7	No assessment criteria triggered	
	EC (µS/cm)	Stage 1	6,659	1,180	6,203	12,600	Stage 1 criteria exceeded consecutively on three occasions (resulting in one reportable exceedance on 17/9/2018) as a result of below average rainfall not mine activity. SW12 was an isolated pond at the time of sampling and the upstream site (SW09) was dry. Stage 2 criteria exceeded on three occasions (21/11/2018, 11/12/2018 and 19/3/2019), as a result of below average rainfall not mine activity. SW12 was an isolated pond at the time of sampling and the upstream site (SW09) was dry. On 19/3/2019 the water at SW12 was green in colour indicating that an algal bloom was present. The upstream site (SW09) remained dry and has been reported as dry since September 2017	
		Stage 2	7,153					
	TSS (mg/L)	Stage 1	555	<5	54.1	340	No assessment criteria triggered	
		Stage 2	708					
SW15	pH	6.5 – 9.0		7.2	7.5	7.6	No assessment criteria triggered	
	EC (µS/cm)	Stage 1	7,128	614	1,021	1,690		
		Stage 2	8,262					
	TSS (mg/L)	Stage 1	103	<5	8.3	12		
		Stage 2	130					

Table 26: Summary of SWGS1 surface water gauging station monitoring results on Saddlers Creek

FY19	Flow (ML/day)	Average daily EC (µS/cm)	Average daily turbidity (NTU)
Minimum	0	0	5.1
Maximum	85	508.5*	173.3
Average	0.7	3.08	8.6

* This maximum result of 508.5 µS/cm corresponds to calibration of the EC probe, not a flow event. The maximum average daily EC corresponding to the flow event on 30 March 2019 was 346.8 µS/cm.

Complaints and Reportable Incidents

Mt Arthur Coal did not have any complaints or reportable incidents relating to surface water and did not receive any government fines or penalties related to surface water during the reporting period.

Proposed Improvements

Mt Arthur Coal will continue to use site water collected in both in-pit and out-of-pit storages prior to the use of water from the Hunter River. Where plans indicate that there would be sufficient water stored on site, water allocations for the Hunter River will continue to be offered to leaseholders and near neighbours as a temporary transfer.

Due to the ongoing below average rainfall Mt Arthur Coal is currently undertaking a water security program aimed at increasing enhancing efficiencies in site water use.

Mt Arthur Coal plans to update the site Water Management Plan during the next reporting period.

7.4 Ground Water

Environmental Management

Ground water at Mt Arthur Coal is managed in accordance with:

- MAC-ENC-MTP-034 Site Water Management Plan;
- MAC-ENC-PRO-062 Ground Water Monitoring Program (GWMP); and
- MAC-ENC-PRO-063 Surface and Ground Water Response Plan.

Mt Arthur Coal's Site Water Management Plan aims to minimise any adverse impacts on aquifers in proximity to the operation, including the two major aquifer areas, the hard rock coal measures and the shallow alluvial deposits associated with the Hunter River.

The Ground Water Monitoring Program outlines program requirements for monitoring of potential groundwater impacts from mining operations. A program to upgrade ground water monitoring bores, and improve monitoring accuracy, was completed during the FY16 reporting period. Following this a two year interim monitoring program as outlined in Appendix 3 of the GWMP was undertaken, concluding during the FY18 reporting period.

An assessment and analysis of interim monitoring program data was undertaken during the reporting period by an independent consultant in order to determine if a sufficient reference dataset had been collected to revise and set new groundwater triggers. Following review of the interim monitoring program Mt Arthur Coal plans to revise the groundwater monitoring program with a quarterly sampling schedule (increased from biannual) and revised trigger values, as well as observations and other recommendations from the review. This will form part of the update of the site Water Management Plan, which is currently being undertaken. The revised site Water Management Plan should be submitted to DPIE for approval during the next reporting period.

Although the FY18 Annual Review stated that groundwater trigger values were revised following the completion of the interim monitoring program and would be applied for the FY19 monitoring period, instead the currently approved GWMP dated 28 April 2015 is applicable for the FY19 monitoring period. The revised triggers will not be applied until further review and subsequent approval by the DPIE.

In anticipation of moving to the revised site Water Management Plan in FY19, Mt Arthur Coal adjusted the sampling frequency to quarterly instead of bi-monthly (which is beyond the requirements of the currently approved GWMP) and also adjusted the sampling requirements at some of the sites as recommended by the independent consultant. This proactive implementation of the revised site Water Management Plan did result in the following non-compliances with requirements in the currently approved Groundwater Monitoring Program:

- Manual water level data was not collected at all monitoring sites every two months as required. Water level data was collected in July 2018 but then reverted to quarterly for the remainder of the reporting period, with manual water level data being collected in September and December 2018 and March and June 2019;
- Water level data was collected for GW26 and GW27 in July 2018 only, then these sites were prematurely removed from the monitoring program;
- Water quality samples were collected for total phosphorus and the full suite of metals (aluminium, antimony, arsenic, barium, boron, cadmium, chromium, copper, lead, mercury, molybdenum, selenium and zinc) only once rather than twice during the reporting period. They were collected in June 2019 but not December 2018; and
- Water quality data was not collected at all during the reporting period at sites GW6, GW7, GW26, GW42 and GW43 as required.

The Surface and Ground Water Response Plan outlines the response actions to be implemented, should ground water monitoring trigger values be exceeded. Management measures associated with the alluvial ground water cut-off wall and flood levee constructed parallel to Denman Road along the northern boundary of the site to prevent both surface and subsurface migration from the Hunter River to the active pit, have also been incorporated into the Surface and Ground Water Response Plan.

Environmental Performance

Drawdown and cut off wall performance

Piezometric pressure head, or drawdown, for each statutory bore was calculated for both the total monitoring period and for the reporting period. Drawdown contours and tabulated data for the reporting period are presented in Appendix 3 – Groundwater Monitoring Results. Drawdown in the Permian sequence is evident around the main open cut pit, and extends southwest in the vicinity of the Bayswater mine area.

During 2013 and 2014, a bentonite wall was installed along Denman Road to minimise groundwater level drawdown in the alluvium due to seepage through the alluvium/regolith from the Hunter River alluvium toward the mine. Groundwater levels within the Edinglassie and Ramrod Creek coal seams and the F4 Fault have declined 72 metres in the F4 Fault, 83 metres in the Edinglassie Seam and 85 metres in the Ramrod Creek Seam since installation. In contrast, nearby Hunter River alluvial aquifer monitoring bores GW16 and GW21, have recorded water level changes of 0.69 and 1.08 metres, respectively. GW42 is located adjacent to the VWP installations and has also remained relatively stable with no detected drawdown. Instead, its groundwater level oscillates simultaneously with the level of the Hunter River.

This relatively stable trend of groundwater levels within the alluvium if compared with the Permian seams indicates that the depressurisation observed in the underlying Permian coal seam has not significantly impacted upon groundwater levels within the alluvium in the vicinity of GW16 and GW21, and the water level changes are expected to be largely a response to seasonal conditions.

The groundwater level predicted by the 2013 project numerical model for FY19 was extracted and compared to measured June 2019 data. A figure showing the comparative results is presented in Appendix 3 – Groundwater Monitoring Results. Negative values show where the model over-predicts impacts (depicted by red, orange and yellow markers on the figure) and under-predicts drawdown (green markers).

A recent review of the AGE 2013 groundwater model identified that when the data is ordered by model layer, the prediction discrepancies generally fall in order of model layers from top to bottom. The model over-predicts drawdown in the shallower model layers and under-predicts in the deeper layers. This is also a reflection of the observation that the deeper coal seams depressurise to a greater distance from the highwall compared to shallower coal seams. This discrepancy occurs because the numerical model represents the Permian sequence with a limited number of model layers. Additional layers may better represent the coal seams in more detail through the sequence and the intervening aquitards to better replicate the observed drawdown. The groundwater model is currently under review to improve the model's predictive capability. Throughout 2019 the site conceptual model has been reassessed to better inform the groundwater model.

Groundwater Quality

A summary of the ground water quality data for each key aquifer during the reporting period is provided in Table 27. Plots of ground water quality data during the reporting period for all statutory sites are provided in Appendix 3 – Ground Water Monitoring Results and Groundwater Level Drawdown Analysis.

Assessment criteria for groundwater monitoring results consists of a two stage trigger process for EC, and pH results outside the trigger range of 6.5 to 9.0 over three consecutive readings.

Table 27: Summary of ground water monitoring results by aquifer

Aquifer	Sites	pH			EC (µS/cm)			Depth to water from top of casing (m)		
FY19	**Site references**	**Min**	**Max**	**Avg**	**Min**	**Max**	**Avg**	**Min**	**Max**	**Avg**
Saddlers Creek Alluvial	GW45, GW46, GW47	6.6	7.2	6.9	2,312	8,050	5,687	7.6	12.2	9.5
Saddlers Creek tributary alluvium	BCGW22A	6.8	6.8	6.8	9,200	11,900	10,805	4.3	4.7	4.5
Hunter River Alluvial	GW16, GW21,GW25, GW38A,GW39A, GW40A,GW41A, GW42	6.7	7.5	7.2	932	7,340	4,038	7.5	11.0	9.6
Permian	GW2,GW3,GW6, GW7,GW23, GW38P,GW39P, GW43,GW44, GW48,GW49, BCGW18,BCGW19, BCGW22,EWPC33	6.7	11.7	7.6	2,086	13,000	5,032	4.8	100.6	27.2
FY18	**Site references**	**Min**	**Max**	**Avg**	**Min**	**Max**	**Avg**	**Min**	**Max**	**Avg**
Saddlers Creek Alluvial	GW45, GW46, GW47	6.9	7.6	7.1	734	8,220	3,987	6.9	11.4	8.8
Saddlers Creek tributary alluvium	BCGW22A	6.8	7.1	7.0	10,850	11,810	11,347	3.5	4.1	3.8
Hunter River Alluvial	GW16, GW21,GW25, GW38A,GW39A, GW40A,GW41A, GW42	6.2	8.0	7.2	764	7,700	4,362	7.2	11.0	9.4
Permian	GW2,GW3,GW6, GW7,GW23, GW38P,GW39P, GW43,GW48, GW49,BCGW18, BCGW19,BCGW22, EWPC33	6.0	11.9	7.6	2,230	10,680	4,796	3.7	83.7	26.4
West Cut Groundwater	GW26,GW27	6.6	6.9	6.7	5,610	6,070	5,852	51.3	52.8	52.2

Aquifer	Sites	pH			EC (µS/cm)			Depth to water from top of casing (m)		
FY17	**Site references**	**Min**	**Max**	**Avg**	**Min**	**Max**	**Avg**	**Min**	**Max**	**Avg**
Saddlers Creek Alluvial	GW45, GW46, GW47	6.5	8	7.2	638	6,360	3,995	6.5	10.5	8
Hunter River Alluvial	GW16, GW21,GW25, GW38A,GW39A, GW40A,GW41A	6.7	8.6	7.3	737	7,770	4,001	7.2	10.2	9.0
Permian	GW2,GW3,GW6, GW7,GW23, GW38P,GW39P, OD1078, OD1078-Piezo, OD1079-Piezo, BCGW05, BCGW10, BCGW11,BCGW12, BCGW15,BCGW18, BCGW19,EWPC33	6.9	12.5	8	2,130	12,480	5,263	3.2	55.8	21.6
West Cut Groundwater	GW26,GW27	6.4	6.7	6.5	4,980	6,730	5,601	50.1	51.3	51.8

There were 15 reportable exceedances of currently approved groundwater level triggers during the reporting period at five fractured rock bores (GW2, GW3, GW23, GW39P and OD1078-Peizo), as discussed in Table 28. Notably, only one of these sites (OD1078-Peizo) would have still recorded exceedances using the revised groundwater level trigger values following the completion of the Interim Groundwater Monitoring Program.

Three reportable exceedances of currently approved Stage 2 assessment criteria for groundwater EC were recorded at GW2 and GW40A, as discussed in Table 28. Notably, neither of these sites would have recorded exceedances using the revised groundwater EC Stage 2 triggers following the completion of the Interim Groundwater Monitoring Program. There were no reportable exceedances of currently approved pH or Stage 1 assessment criteria for groundwater EC in FY19.

Table 28: Groundwater level and quality exceedances

Site	Parameter	Elevated months	Investigation results
GW2	Water level	Jul 2018, Sep 2018, Dec 2018, Mar 2019, Jun 2019	GW2 exceeded the currently approved groundwater level trigger in every month, resulting in three reportable exceedances, with a maximum depth to water of 11.73 metres. The groundwater levels and the cumulative rainfall departure (CRD) in this area show a strong correlation. Therefore, it is considered likely that the current drought (sharp decreasing trend in the CRD curve since 2017/2018 until present) is the dominant cause of the trigger exceedance within this bore. The groundwater level trigger value was revised following the completion of the Interim Groundwater Monitoring Program and will be applied once the revised monitoring program has been approved by the DPIE. Further updates to trigger values may be required following the update to the groundwater model. Notably GW2 did not exceed the revised groundwater level trigger at all in FY19.

Site	Parameter	Elevated months	Investigation results
GW3	Water level	Jul 2018, Sep 2018, Dec 2018, Mar 2019, Jun 2019	GW3 exceeded the currently approved groundwater level trigger in every month, resulting in three reportable exceedances, with a maximum depth to water of 12.05 metres. The groundwater levels and the CRD in this area show a strong correlation. Therefore, it is considered likely that the current drought (sharp decreasing trend in the CRD curve since 2017/2018 until present) is the dominant cause of the trigger exceedance within this bore. The groundwater level trigger value was revised following the completion of the Interim Groundwater Monitoring Program and will be applied once the revised monitoring program has been approved by the DPIE. Further updates to trigger values may be required following the update to the groundwater model. Notably GW3 did not exceed the revised groundwater level trigger at all in FY19.
GW23	Water level	Jul 2018, Sep 2018, Dec 2018, Mar 2019, Jun 2019	GW23 exceeded the currently approved groundwater level trigger in every month, resulting in three reportable exceedances, with a maximum depth to water of 49.87 metres. Investigations revealed that the change in groundwater level was likely due to the mining related fractured rock aquifer depressurisation of the coal seam and was consistent with modelled predictions in the environmental assessment. The groundwater level trigger value was removed following the completion of the Interim Groundwater Monitoring Program and hence no trigger value will be applied once the revised monitoring program has been approved by the DPIE.
GW39P	Water level	Jul 2018, Sep 2018, Dec 2018, Mar 2019, Jun 2019	GW39P exceeded the currently approved groundwater level trigger in every month, resulting in three reportable exceedances, with a maximum depth to water of 10.55 metres. Investigations revealed that the depressurisation of the coal seams within the open cut mine was the likely cause of the decreasing water level in GW39P and the drawdown was within the predicted order of magnitude, which was comparable to model predictions. The groundwater level trigger value was revised following the completion of the Interim Groundwater Monitoring Program and will be applied once the revised monitoring program has been approved by the DPIE. Further updates to trigger values may be required following the update to the groundwater model. Notably GW39P did not exceed the revised groundwater level trigger at all in FY19.
OD1078-Piezo	Water level	Jul 2018, Sep 2018, Dec 2018, Mar 2019, Jun 2019	OD1078-Piezo exceeded the currently approved groundwater level trigger in every month, resulting in three reportable exceedances, with a maximum depth to water of 49.40 metres. The trigger level in this bore has been exceeded since its initial monitoring records at the end of 2017. Its groundwater level displays a downward trend for the duration of the data series. Since there are no baseline monitoring records, it is not possible to establish accurately the cause of the downward trend, but it could possibly be attributed to the current drought as there is some correlation with the CRD curve. The groundwater level trigger value was revised following the completion of the Interim Groundwater Monitoring Program and will be applied once the revised monitoring program has been approved by the DPIE. Further updates to trigger values may be required following the update to the groundwater model. OD1078-Piezo also exceeded the revised groundwater level trigger in every month in FY19.
GW2	EC	Mar 2019, Jun 2019	GW2 exceeded the currently approved groundwater EC Stage 2 trigger in March 2019 (5,030 µS/cm) and June 2019 (4,900 µS/cm). Investigations revealed that the bore did not appear to be impacted by mining activities. Historically, EC values show a correlation with both rainfall trends and groundwater elevations and during FY19, the site received less than average rainfall. The groundwater EC trigger values were revised following the completion of the Interim Groundwater Monitoring Program and will be applied once the revised monitoring program has been approved by the DPIE. Notably GW2 did not exceed the revised groundwater EC Stage 2 trigger at all in FY19 and did not have any reportable revised Stage 1 trigger exceedances either.

Site	Parameter	Elevated months	Investigation results
GW40A	EC	Jun 2019	GW40A exceeded the currently approved groundwater EC Stage 2 trigger in June 2019 (4,790 µS/cm). The salinity level in this bore was relatively stable between 2008 and 2019, with no long term increasing or decreasing trends. The stable value oscillates between 3,200 and 5,200 µS/cm, but the trigger is set at 4,777 µS/cm, so it has been exceeded on seasonal fluctuations. The FY19 exceedance seems to be a regular seasonal fluctuation instead of a long term rising trend. The groundwater EC trigger values were revised following the completion of the Interim Groundwater Monitoring Program and will be applied once the revised monitoring program has been approved by the DPIE. Notably GW40A did not exceed the revised groundwater EC Stage 2 trigger at all in FY19 and did not have any reportable revised Stage 1 trigger exceedances either.

With the exception of the non-compliances to the Groundwater Monitoring Program discussed above and the ten sites discussed below, data capture for manual sampling was 100 per cent at all remaining monitoring sites:

- GW8: This bore was mined out in July 2017 (data capture for FY19 not applicable);
- GW22: This bore was mined out in February 2016 (data capture for FY19 not applicable);
- GW23: This bore was no longer sampled for water quality from April 2016 due to poor recharge at this bore affecting sample quality. Water level monitoring only continued at this bore from April 2016. This bore has run dry due to mining related fractured rock aquifer depressurisation;
- GW25: Water quality samples were unable to be collected from GW25 in March 2019 as tree roots were blocking the bore; however level measurements were able to be taken in March 2019;
- BCGW05, BCGW10, BCGW11 and BCGW15: Issues with the landholder prevented access to these four bores for the entire reporting period, so no water level or quality data was obtained for these bores. Following review of the interim monitoring program, it has been determined that these bores do not need to be monitored as sufficient background data can be obtained via the accessible bores, so these bores will be removed from the revised groundwater monitoring program;
- BCGW18: Water level and quality data could not be obtained from this site in July and September 2018 and March 2019 as the monitoring site was dry. Only water level data, not quality data was able to be obtained in December 2018 and June 2019 as the water level was too low to collect water quality samples; and
- GW44: No water quality data was able to be obtained from this site for the entire reporting period as this new bore is very deep and low flow sampling methodologies have not been effective at this site thus far. GW44 will be removed from the revised water quality monitoring program in favour of collecting level data only at this site, following review of the interim monitoring program.

Several monitoring bores also have data gaps in water level logger data during the reporting period, primarily due to issues with logger battery life. This issue will be further addressed in FY20.

Complaints and Reportable Incidents

Mt Arthur Coal did not receive any complaints, government fines or penalties related to ground water during the reporting period.

Proposed Improvements

During the next reporting period Mt Arthur Coal will continue to monitor hydro-geomorphological conditions and evidence of any ground water ingress as operations progress towards the Hunter River alluvials, including monitoring of the alluvial cut-off wall.

Following review of the Interim Groundwater Monitoring Program Mt Arthur Coal has revised the groundwater monitoring program. This revision will form part of the update of the site Water Management Plan planned for FY20. There is planned work on reviewing the Mt Arthur Coal groundwater model in FY20. This may result in further revision of groundwater assessment trigger values.

An increase to the monitoring network is proposed for the next reporting period. This will include a number of new monitoring locations ahead of mining. Part of this work will include the installation of telemetry with groundwater level and conductivity loggers. The telemetry improvement will be investigated for roll out across the entire network, focussing on loggers that need replacement. This will improve data capture and reduce sampling requirements.

8. Rehabilitation

8.1 Buildings and Infrastructure

The former Bayswater maintenance sheds and office buildings were decommissioned this reporting period. The area now forms part of the Mt Arthur South deployment area. In October 2018, BHP awarded Thiess a mining services contract to complete end-to-end mining services in the Ayredale and Roxburgh pits (referred to as Mt Arthur South) over five years. BHP will remain mine and lease holder of Mt Arthur South.

8.2 Topsoil

Topsoil management at Mt Arthur Coal focuses on maintaining the quality of the topsoil resource as a rehabilitation growth medium. Activities undertaken during the reporting period included:

- Prioritising direct placement of topsoil;
- Testing topsoil to determine appropriate depths for stripping and recovery as well as ameliorant requirements;
- Felling and mulching trees in situ on disturbance areas to increase organic content within the topsoil that was used directly on rehabilitation areas; and
- Reusing felled trees from disturbance areas on new rehabilitation areas to provide habitat.

Additional measures generally undertaken when stockpiling topsoil include:

- Restricting stockpile height to generally three metres or less, consistent with the MOP, to minimise compaction and anaerobic conditions within topsoil stockpiles;
- Locating stockpiles so as to reduce the requirement for re-handling and establishing cover crops; and
- Spraying topsoil stockpiles to manage weeds.

Topsoil was placed and spread to an approximate depth of 200 to 300 millimetres on rehabilitation areas. The newly spread topsoil surface was contour cultivated prior to sowing to provide a suitable environment that encourages water infiltration in the soil.

8.3 Landform Design

Mt Arthur Coal aims to create rehabilitation that is safe, stable and non-polluting, that is self-sustaining and comparable to the surrounding natural landscape. Landform and rehabilitation incorporates natural micro-relief and natural drainage lines for landforms designed and constructed post the current modification project approval. The proposed design methodology chosen is an adaptation of the Geofluv™ approach (geomorphic design). The geomorphic design uses the characteristics of stable natural alluvial landforms in the local environment as an analogue on which to base the design of overburden landforms. Importantly, the approach does not replicate existing landforms, but rather uses the key characteristics that make these landforms stable in a new design. Natural landforms in alluvial materials are characterised by an integrated network of drainage channel, typically with slopes initially convex close to ridge lines, becoming concave and progressively flattening with increasing catchment area. The aim is to establish landforms consistent with the erosion rate of natural features in the area.

Future use of areas disturbed by active mining is closely linked to landform design and general vegetation strategies found in the Synoptic Plan. The Environmental Assessment states ‘the conceptual final landform provides an integrated landscape that is consistent with the Synoptic Plan and aims to link existing vegetation communities with mine rehabilitation areas to provide fauna movement corridors for the movement of fauna’. These proposed corridors are consistent with, and will further complement, both the Synoptic Plan and the final landforms of surrounding areas.

Management measures designed to reduce the visual impact created by the overburden emplacement have been incorporated into the mine plan. Such measures include:

- The integration of tree corridors on overburden emplacements as part of progressive rehabilitation;

- The retention of the eastern flank of MacLean's Hill to assist in creating landscape diversity at the foot of overburden emplacements;
- Modifying final void high walls and low wall slopes to minimise final disturbance;
- Incorporating micro relief features (stag trees, ripping, rock features and habitat trees) throughout overburden emplacements to provide an enhanced naturally appearing landform and fauna habitat;
- The practical consideration of 'Geofluv type' designs on emplacements to sustainably manage water and create a natural looking and stable landform;
- The strategic design and rehabilitation of overburden emplacements for increased visual shielding of operations;
- Establishing visual and ecological planting patterns of native trees to achieve landscape patterns that complement the existing spatial distribution of tree and grass cover in a grazing landscape; and
- Minimising exposure of work areas to sensitive receivers where possible, largely through the timely rehabilitation of visible overburden emplacements.

The final landform design can be seen in Figure 7 and Figure 8. Figure 7 shows bulk shaping prior to topsoil placement. Although this geomorphic design has been implemented on other sites within NSW and also worldwide there are many defining characteristics that restrict its use such as space, waste characterisation, rainfall, availability of suitable rock, availability of mulch, final landuse, landform height and steepness of the landform. Mt Arthur Coal has larger higher landforms than other sites in the Hunter Valley, and is also space constrained for emplacement area. The resultant design aligns with industry best practice, but will be monitored over the coming years to ensure further natural landform design incorporates learnings and improvement from the current work.

The current geomorphic work has been completed as a trial to understand time, cost, stability and volume constraints. The MAC-ENC-MTP-047 Rehabilitation Strategy with updated designs was submitted to the former DP&E and former DRG in 2018 with updated information in regards to the design use and void management. Furthermore the revised Rehabilitation Management Plan has been submitted to the NSW Resources Regulator in 2019 with updated landform designs and areas to be rehabilitated to 2026.

Figure 7: Rehabilitation at VD5 emplacement using natural landform design

Figure 8: Re-worked contour drains on VD5

8.4 Disturbed Land

Rehabilitation of land is carried out in accordance with:

- Mt Arthur Coal FY16-FY20 Mining Operations Plan;
- MAC-ENC-MTP-047 Rehabilitation Strategy;
- MAC-ENC-MTP-050 Biodiversity Management Plan; and
- MAC-ENC-PRO-012 Land Management Procedure.

Rehabilitation is designed to achieve a stable final landform compatible with the surrounding environment and to meet the landform commitments presented in the MOP.

During the reporting period Mt Arthur Coal completed (achieved Phase 4 – Ecosystem and Landuse Establishment) 17.5 hectares of rehabilitation across two areas. An additional 32.4 hectares entered Phase 3 – Growing Media Development with topsoil being spread. This was below the MOP target of 90 hectares to Phase 4 – Ecosystem and Landuse Establishment, as shown in Table 29. Areas of rehabilitation undertaken during the reporting period are shown in Appendix 5 – Rehabilitation Plan.

A meeting was held with the NSW Resources Regulator on 4 April 2019 to discuss potential shortfalls in areas available for rehabilitation. In this meeting it was highlighted that 50 hectares of the FY19 target fell into a project to close the Main Dam and the North Cut tailings storage facility. Delays to the project to ensure that work can be completed safely and to a high quality pushed the projected finish date out to FY22. To attempt to make up this shortfall Mt Arthur Coal identified and prioritised dumping into areas that would achieve final heights. This allowed for an additional 56.6 hectares to enter Phase 2 – Landform Establishment. However, these additional areas would not be available to seed at an ideal time to achieve best results. In the meeting on 4 April 2019 Mt Arthur Coal committed to achieving 40 hectares of rehabilitation reaching Phase 4 – Ecosystem and Landuse Establishment. A summary of the rehabilitation phases is presented in Table 29.

Previously Mt Arthur Coal had committed to the NSW Resources Regulator that hand seeding would be phased out. This was due to a recommendation in the 2018 Highlands Environmental report. Mt Arthur Coal selected aerial seeding by Unmanned Aerial Vehicle (UAV) with the aim of achieving greater and more even coverage and greater accuracy tracking application rates. Other improvements included cost savings and safety improvements. Initially two operators were on-boarded as vendors to Mt Arthur Coal to ensure adequate coverage. Towards the end of the financial year when seeding was scheduled to take place one of the vendors withdrew their services due to issues with their unit and Civil Aviation Safety Authority (CASA) approval. The seeding continued with the single operator attempting to complete the proposed FY19 rehabilitation. Difficulties were experienced with inclement weather, including high winds, fog and rain causing multiple delays. Difficulty was also experienced getting the seed mix to flow through the spreading unit of the UAV. As a result only 17.5 hectares of seed was able to be applied during optimum seed spreading conditions.

Both woodland and pasture seed mixes and rates have been revised in consultation with an independent specialist, as specified in the MOP.

Table 30 provides the Mt Arthur Coal rehabilitation summary for the operation.

Table 29: Mt Arthur Coal rehabilitation claimed for FY19

Rehabilitation phase	FY19 MOP rehabilitation commitments (hectares)	FY19 areas in active rehabilitation phases (hectares)
Phase 2 – Landform Establishment	0	56.6
Phase 3 – Growing Media Development	0	32.4
Phase 4 – Ecosystem and Landuse Establishment	90	17.5
Total	**90**	**106.5**

Note: All areas calculated using GDA1994 Zone 56 coordinate system

Table 30: Mt Arthur Coal rehabilitation summary

Mine area type	Previous reporting period (FY18 actual)	This reporting period (FY19 actual)	Next reporting period (FY20 forecast)
A. Total mine footprint[1]	4,700	5,171	5,418
B. Total active disturbance[2]	3,502	3,871*	4,266
C. Land being prepared for rehabilitation[3]	0	89	54
D. Land under active rehabilitation[4]	1,198	1,211*	1,120**
E. Completed rehabilitation[5]	0	0	0

Note: All areas calculated using GDA1994 Zone 56 coordinate system
* Reconciled via survey from FY19
** FY19 actuals, minus FY20 forecast dehab plus FY20 rehabilitation target
1 Total mine footprint includes all areas within a mining lease that either have at some point in time or continue to pose a rehabilitation liability due to mining and associated activities.
2 Total active disturbance includes all areas ultimately requiring rehabilitation.
3 Land being prepared for rehabilitation includes the sum of mine disturbed land that is under the following rehabilitation phases – decommissioning, landform establishment and growing media development (as defined in DRE MOP/Rehabilitation Management Plan Guidelines).
4 Land under active rehabilitation includes areas under rehabilitation and being managed to achieve relinquishment.
5 Completed rehabilitation requires formal signoff by the NSW Resources Regulator that the area has successfully met the rehabilitation land use objectives and completion criteria.

8.5 Other Activities

During the reporting period other rehabilitation related activities undertaken included:

- Collection of approximately five kilograms of seed from remnant native vegetation located on Mt Arthur Coal owned land in the vicinity of the operation within conservation and offset areas for use in rehabilitation. Due to poor weather conditions no supplementary planting occurred during the reporting period;
- Rehabilitation maintenance activities, including weed spraying, soil management, minor earthworks repairs and feral animal control;
- Approximately five hectares of rehabilitation was re-worked on the VD5 to improve the rock lined drains (see Figure 8); and
- Approximately 1,700 tubestock was planted along the Denman Road visual bund. Species were selected in general accordance with targeted ecological communities as wells as to provide visual amenity to the adjacent communities.

Further improvement works can be found in Table 31, as recommended in various consultant reports for the site.

Table 31: Mt Arthur Coal rehabilitation maintenance and improvement program

Area	Item		Notes	Results	Follow up monitoring
1. All areas	1.1	Kangaroo management	Kangaroo harvesting commenced in operational areas in FY20, focusing on VD1 and surrounding area. A Kangaroo harvesting risk assessment was completed and the harvesting program commenced in March 2019 in the area surrounding VD1. The program experienced early success with over three tonnes of meat harvested (totalling 104 kangaroos). However, kangaroos have moved into inaccessible areas based on risk assessments. This program has also been put on hold due to the need to continue the program in the Thomas Mitchell Drive Onsite Offset area. When approval has been gained the program will be recommenced.	104 kangaroos harvested in FY19.	Recording of animals taken and as part of the annual ecological development monitoring.
	1.2	Rabbit management	Rabbit management commenced in FY19. The following key activities have been undertaken as part of the rabbit management program: 1. A round of fumigation of rabbit burrows was conducted across the site in FY19. This work will not be repeated due to the inherent safety risks associated with the activity; 2. Rabbit baiting using 1080 poison was conducted in the VD1 and enviro dam area. The program estimated to remove 100 rabbits. Following consultation with Local Land Services 1080 will be substituted with Pindone to allow for broader use across the site; 3. Rabbit trapping was carried out in the VD1 area. This program was not successful and will not be repeated; and 4. Opportunistic shooting of pest species was conducted as part of the kangaroo harvesting program. Targeted pest species shooting will occur in FY20. Rabbit control using ferrets will be carried out in FY20 with results reported in the next Annual Review. A combination of broad baiting in spring and summer are planned in combination with ferrets in winter. Excavation of burrows will not be pursued as the majority of burrows are located in sensitive locations and would result in land disturbance	FY19 rabbit cull: - 100 from baiting - 9 from shooting - 3 from trapping	Annual ecological development monitoring.
	1.3	Replace hand sowing	Trials in the use of UAVs in spreading of seed were completed during the reporting period in order to provide greater efficiency, safety improvements and accuracy of application. Initially, arrangements were made for two operators to provide this capability. Towards the end of the reporting period when seeding was scheduled to take place one of the vendors withdrew their services due to equipment reliability issues and CASA requirements. The seeding trial continued with the single operator. Disruptions were experienced due to inclement weather and issues with the flow of the seed mix through the spreading unit of the UAV. The traditional method of hand seeding was conducted in some areas to apply seed during unfavourable flying conditions. Trials will continue during the next reporting period to further develop the use of UAVs in rehabilitation seeding.	See Section 8	Annual ecological development monitoring.
	1.4	Characterisation of rehabilitation materials be completed prior to use	Topsoil used FY19 was characterised and independent advice was gained on ameliorants to be used. Some existing topsoil stockpiles (TSS043, TSS056, TSS078 and TSS081) have been sampled and analysed, with further work to be completed in the next reporting period. A selection of waste rock and topsoil spread throughout the reporting period was sampled and ameliorant developed by an independent soil scientist was applied. A program of test pitting in older rehab areas in VD1 and CD1 was completed during the reporting period.	Soil sampling results and report can be supplied on request.	Ongoing sampling of stockpiles and directly placed topsoil.

Area	Item		Notes	Results	Follow up monitoring
			Results of that work are discussed below (see 2.4). Additional soil sampling was also conducted on VD5. An update to the Land Management Procedure is scheduled to be completed by December 2019. Future erosion and sediment control works will revolve around the update and approval of Mt Arthur Coal's Erosion and Sediment Control Plan by DPIE.		
1. All areas	1.5	Use successful examples of rehabilitation success from around site and develop standard practice	Work to date has focussed on centralising data to establish previous methodologies. Work on a new spatial tracking system incorporating graphical representation commenced in June 2019. This work has been incorporated into the recently submitted Forward Program and is part of a broader project covering all of BHPs Australian operations. Routine monitoring (such as Annual Rapid Assessments) will be spatially represented to improve tracking of maintenance and improvement requirements. Improvements to the Rehabilitation Management Plan have been submitted with the Forward Program, including the incorporation of more quantitative closure criteria.	N/A	Continual improvement and updating GIS database.
	1.6	Weed treatment	Weed assessment completed and weed works commenced for the reporting period. More advanced weed assessment methodologies are being investigated. A report into the use of high resolution aerial imagery is currently being drafted. Mt Arthur will investigate using this methodology as well as the existing methodologies (e.g. as part of the Rehabilitation and Ecological Development monitoring to better track weed treatment across the site). The focus of weed treatment during the reporting period was in the VD1 and TMD Onsite Offset area. The species targeted were African Boxthorn and Prickly Pear. See 2.5 for more information on weed treatment trials.	See Section 6.5	Annual ecological development monitoring.
	1.7	Mulching	Initial application of mulch or equivalent scheduled for end of August 2019 has not yet been undertaken due to delays with the UAV seeding trial. The first application of mulch is scheduled to be completed during the next reporting period. Remedial works are dependent on ongoing soil sampling and update of the Erosion and Sediment Control Plan.	N/A	Landform stability monitoring – Annual Rapid Assessment
	1.8	Contour drain removal	Removal of contour drains is dependent on design assessment and scope completion as well as review of VD1 contour drain removal (see 2.6). This will allow lessons learned to be effectively implemented.	N/A	To be confirmed
	1.9	Translocation of key species	Identify key species in pre-strip areas and commence trials in translocating them. This work is scheduled to be undertaken in Autumn 2021, however there is opportunity to trial some work in Autumn 2020. This work will be reviewed to ensure that the levels of success are commensurate with effort and cost. Success of this program is dependent on controlling pest species (rabbit, hare and kangaroo). Measure of success to be confirmed.	N/A	Monitoring of the health of translocated plants.
	1.10	Review QA/QC procedures	Initial assignments of QA/QC processes were completed during the reporting period with the development of a RACI (Responsibility, Accountability, Consult and Inform) table for rehabilitation at Mt Arthur Coal. An audit into final landform was conducted in June 2019 which identified an opportunity to improve formal review of design execution which is expected to be included in an update to the rehabilitation RACI.	N/A	To be confirmed

Area	Item		Notes	Results	Follow up monitoring
2. VD1	2.1	Excavate soil from the sediment dam at VD1 to re-establish its design functionality	Rock drains were re-worked to improve erosion outcomes during the reporting period. Further review of the rock-lined drains and their performance will be undertaken in the next reporting period.	N/A	Landform stability monitoring – Annual Rapid Assessment
	2.2	Fill erosion gullies at VD1 (FY17 rehabilitation) to the landform design surface	Erosion fill to be determined following soil sampling results for calculation of ameliorant quantities. Sampling was conducted in February 2019 and the report has been finalised. The remedial work is scheduled for December 2019, however may be delayed due to the need to apply gypsum across the area to mitigate the dispersive nature of the soils and may better align with the broader VD1 re-contouring project.	N/A	Landform stability monitoring – Annual Rapid Assessment
	2.3	Construct rock lined waterways at VD1 (FY17 rehabilitation) with trapezoidal cross-sections	See 1.8	N/A	Landform stability monitoring – Annual Rapid Assessment
	2.4	Soil assessment	Complete. Topsoil depth and characteristics were tested in areas with no woodland cover. Detailed soil assessment of topsoil and subsoils on CD1 and VD1 were also completed. Amelioration recommendations from the report are being compiled and scoped. Scoping to be completed by the end of September 2020, which will be dependent on assessing risks associated with aerial application. Further soil assessments will be undertaken during the next reporting period.	Report available on request.	Landform stability monitoring – Annual Rapid Assessment
	2.5	Weed treatment Trial Area 1 identified in the Future Harvest 2019 report	Weed treatment on Trial Area 1 was scheduled for September 2019, this has been delayed until September 2020 to allow for integration with the Royal Botanic Gardens Sydney (RBGS) collaboration work. The scope includes: 1. Slashing 2. Rip contours 3. Spray emergent weeds early Spring 4. Re-seed 5. Spot treatment for weeds	N/A	Will form part of the annual ecological development monitoring, however additional monitoring may come from the RBGS collaboration.
		Weed treatment Trial Area 2 identified in the Future Harvest 2019 report	Revegetation treatment on Trial Area 2 was scheduled for September 2019, this has been delayed until September 2020 to allow for integration with the RBGS collaboration work and to conduct a thorough risk assessment into a controlled burn occurring in operational areas. The scope includes:	N/A	Will form part of the annual ecological development monitoring, however

Area	Item		Notes	Results	Follow up monitoring
			1. Secure area and conduct burn in early Spring 2019 2. Rip contours 3. Spray emergent weeds early Spring 4. Re-seed 5. Spot treatment for weeds (Autumn 2020) 6. Tube stock planting Note that tube stock planting in recent years has had a low success rate due to drought and predation. Any planting will require the controls listed in 1.1 and 1.2 as well as an assessment on weather conditions and the efficacy of irrigation.		additional monitoring may come from the RBGS collaboration.
	2.6	Contour drain removal	Design requirements assessment for this has commenced and will be completed in 2020. Following this, scoping is scheduled to be completed in 2021.	N/A	To be confirmed
	2.7	Habitat and water availability	Schedule of this work will be determined by removal of contour drains (see 2.6). The final design will also include all weather access and removal of contour drains. The Cumberland Ecology 2019 report recommended nest boxes. Mt Arthur Coal will focus on bringing more stag trees, larger felled timber and rock piles to the rehabilitation areas in the interim.	N/A	N/A
	2.8	All weather road access			
	2.9	Stem density reduction	This work was due to be packaged with weed control Trials 1 and 2. Due to delays in the trials it will be completed as a separate scope of work, scheduled to be completed during the next reporting period.	N/A	Annual ecological development monitoring.
	2.10	Water areas if winter rainfall is not sufficient	General irrigation of rehabilitation not considered practical. Targeted watering of tube stock planting will be investigated. Dependent on tube stock planting.	N/A	Annual ecological development monitoring.
	2.12	Ground cover diversity seeding	Scheduled to commence in Autumn 2020. Undertake increased ground cover diversity seeding projects in native grassland areas.	N/A	Annual ecological development monitoring.
	2.13	Translocate key species from pre-clearance areas	See 1.9	N/A	Annual ecological development monitoring.
	2.14	Review weed treatment trials	Review of Trial Areas 1 and 2. Determine if slashing or controlled burn is more effective. Scheduled for Autumn 2021 but is dependent on a risk assessment of burning on site.	N/A	Will form part of the annual ecological development monitoring, however additional monitoring may come from the

Area	Item		Notes	Results	Follow up monitoring
					RBGS collaboration.
	2.15	Application of ameliorants	A significant amount of fertiliser and gypsum is to be applied to VD1 based on the soil assessment (see 2.4). This work is to be scoped to determine the most efficient means of application. Scoping to be completed by September 2020.	N/A	Annual ecological development monitoring.
	2.16	Tube stock planting	FY19 ecological development monitoring recommended planting of characteristic canopy, shrub and groundcover species identified in Table 10 of the MOP. Note that tube stock planting in recent years has had a low success rate due to drought and predation. Any planting will require the controls listed in 1.1 and 1.2 as well as an assessment on weather conditions and the efficacy of irrigation.	N/A	Annual ecological development monitoring.
3. VD5	3.1	Construct rock lined waterways at VD5 with trapezoidal cross-sections that capture water flows	Work commenced in relining the rock lined drains in February 2019 and was completed in March 2019.	See Figure 8	Landform stability monitoring – Annual Rapid Assessment
	3.2	Re-rip, seed and fertilise FY17 rehabilitation	Based on industry advice, best practice is to spray the weeds of the most recent rehabilitation prior to ripping and fertilising to reduce the seed bank for weeds in the topsoil. See 1.6 regarding weed control works. Spraying works across all rehabilitation has been delayed due to on-boarding of new service providers. The steeper slopes in some areas require specialist equipment. Review of the species present include saltbush. While this is not a target species, its presence can help to ameliorate salts present in soils. Further review of the areas in question will be included in the FY20 annual Rehabilitation and Ecological Development Monitoring. Any ripping work will be determined following the vegetation assessment and be re-scheduled for FY20.	N/A	Landform stability monitoring – Annual Rapid Assessment
	3.3				
4. CD1	4.1	Application of ameliorants	A significant amount of fertiliser and gypsum is to be applied to CD1 based on the soil assessment (see 2.4). This work is to be scoped to determine the most efficient means of application. Scoping to be completed by the end of September 2020, dependent on risk assessment into aerial application.	N/A	Landform stability monitoring and ecological development monitoring.
	4.2	Stem density reduction	To be completed following 2.9. Focus is currently on VD1 improvements. Estimated to commence in Autumn 2021.	N/A	Annual ecological development monitoring.
	4.3	Habitat and water availability	To be completed following 4.2. Focus is currently on VD1 improvements. Estimated to commence in Autumn 2021.	N/A	N/A

Area	Item		Notes	Results	Follow up monitoring
	4.4	Understory planting	To be completed following 4.2. Focus is currently on VD1 improvements. Species to include *Notelaea microcarpa var. microcarpa* (Native Olive), *Bursaria spinosa* (Blackthorn), *Acacia falcata* (Hickory Wattle) and *Acacia paradoxa* (Kangaroo Thorn). Note that tube stock planting in recent years has had a low success rate due to drought and predation. Any planting will require the controls listed in 1.1 and 1.2 as well as an assessment on weather conditions and the efficacy of irrigation. Estimated to commence in Autumn 2021.	N/A	Annual ecological development monitoring.
5. Macdonalds and Belmont area	5.1	Rip, seed and fertilise FY17 rehabilitation	This work is to be re-assessed based on the longer term plan as some of the areas will be required for further dumping.	N/A	N/A
	5.2	Fill erosion gullies at MacDonald's to the landform design surface			
	5.3	Remove contour drains			
	5.4	Fill erosion gullies at MacDonald's Void (2000 rehabilitation) to the landform design surface			
	5.5	Translocate key species from pre-clearance areas	Vegetation here should be suitable for species to be relocated. To be commenced in FY20.	N/A	Annual ecological development monitoring.

8.6 Rehabilitation Activities for Next Reporting Period

The FY19-FY21 Forward Program was submitted to the NSW Resources Regulator (formerly DRG) for the period 1 July 2019 to 30 June 2022. Performance indicators and completion criteria were developed for the MOP and are representative of current site techniques and information derived from monitoring data. This will be dynamic over the life of the mine, in consultation with the NSW Resources Regulator, progressing towards rehabilitation being self-sustaining on site.

Rehabilitation activities for the FY20 reporting period include the continuation of natural landform design rehabilitation techniques and the inclusion of habitat in new areas as they become available. Rehabilitation targets will align with those in the FY18 and FY19 MOP with an annual rehabilitation area target of 80 hectares.

New rehabilitation of land will be carried out in accordance with:

- Mt Arthur Coal's FY19-FY21 Forward Program;
- Mt Arthur Coal's Rehabilitation Management Plan;
- MAC-ENC-MTP-047 Rehabilitation Strategy;
- MAC-ENC-MTP-050 Biodiversity Management Plan; and
- MAC-ENC-PRO-012 Land Management Procedure.

Additional focus on improving the quality of rehabilitation of VD1 will continue in FY20 with the aim of establishing self-sustaining Box Gum woodland based vegetation community as described in the MOP. Potential expansion of the grazing trial to other rehabilitation areas will be investigated if weather conditions are favourable.

Further assessment of the rehabilitation at VD1 and CD1 was conducted as part of an ecological development program and soil evaluation work. This assessment, combined with the annual Ecological Development Monitoring have formed the Mt Arthur Coal Rehabilitation Maintenance and Improvement Program presented in Table 31.

Mt Arthur Coal will investigate the further use of UAVs to assess vegetation health and ecological development. This will potentially provide a more detailed assessment of ecological development at Mt Arthur Coal and help guide improvement practices.

During the next reporting period Mt Arthur Coal will appoint a dedicated Rehabilitation Specialist role, which will be responsible for collaborating with and influencing mine planning to achieve MOP rehabilitation targets using industry best practice methods, as well as implementing the rehabilitation maintenance and improvement program of works presented in Table 31.

9. Community

9.1 Community Interaction

Mt Arthur Coal invites feedback about its activities through a free-call 24-hour Community Response Line (1800 882 044), which is advertised in the local newspapers and at www.bhp.com.

During the reporting period, Mt Arthur Coal received 85 complaints from community members and near neighbours. A comparison of complaints received during the reporting period against previous financial years is shown in Figure 9 and a complete register of complaints is presented in Appendix 4 – Community Complaints.

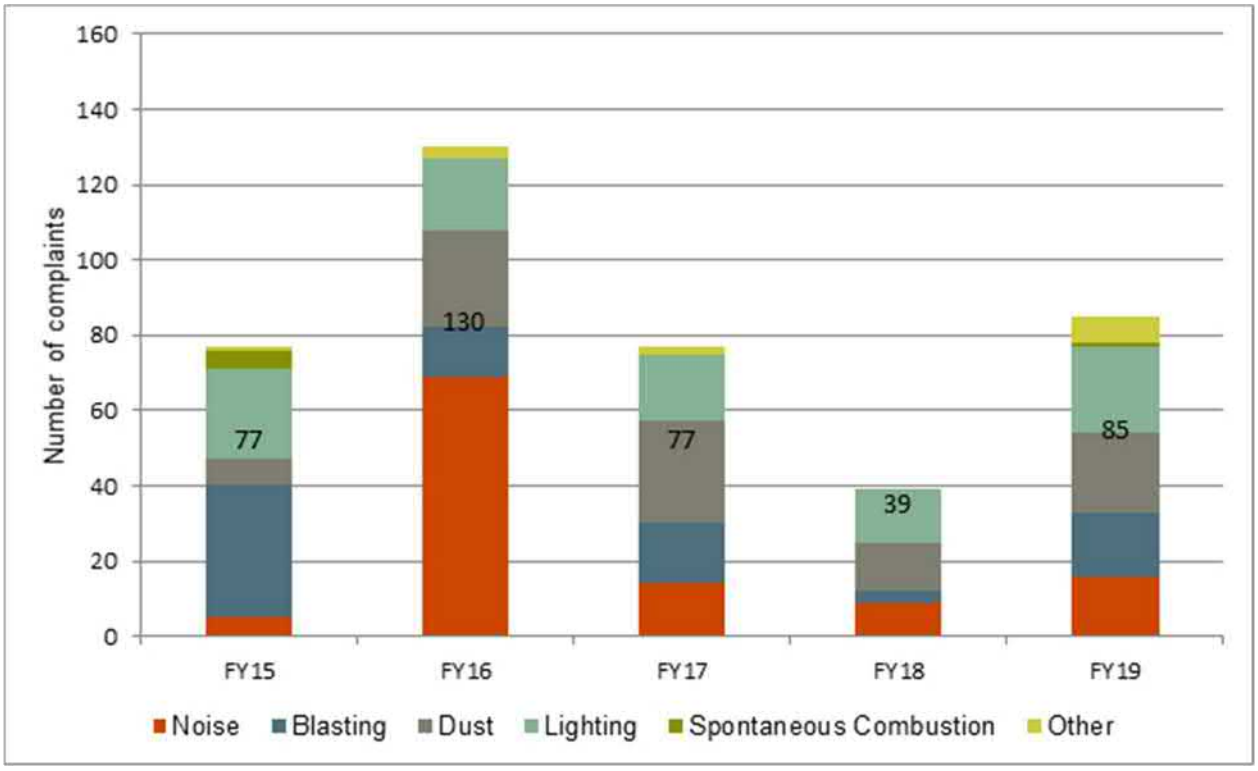


Figure 9: Comparison of complaints received during current and previous financial years

Noise Complaints

During the reporting period, 16 noise complaints were received from three complainants, including 10 operational noise complaints, five low frequency noise complaints and one train noise complaint. This is higher than FY18 (9 noise complaints) and FY17 (14 noise complaints). All complaints were investigated, with noise levels generated by Mt Arthur Coal being measured within internal management benchmarks at the nearest real-time monitor, whenever noise data was available. One complaint was received in relation to train noise, however investigation revealed that no trains were operating at the time of the complaint.

Blasting Complaints

During the reporting period, 17 blast complaints were recorded (12 blast vibration, four blast fume and one blast dust). This is an increase from three complaints in FY18, but comparable to 16 complaints in FY17. With the exception of one blast on 24 December 2018 at 2:15 pm, which recorded a blast overpressure exceedance of 120.6 at the Denman Road West monitor and resulted in two complaints, all blast vibration and airblast overpressure results were within maximum regulatory criteria on dates when the remaining blast vibration complaints were received.

One blast fume complaint was lodged through a third party in relation to the blast fume event on 17 April 2019. Two blast fume complaints were received on 4 July 2018 in relation to the same blast and the fourth blast fume complaint was received on 31 July 2018. On 4 and 31 July 2018 investigation revealed weather conditions were suitable for blasting at the time. Results indicated fume levels were below reportable criteria and the callers were advised of investigation results.

In addition, three complaints were also received relating to road safety management during blasting activities (recorded as complaint type 'Other' in complaints register). As part of its blasting procedures, Mt Arthur Coal places reduced speed signs along a public road approximately one hour before the anticipated time of the blast event. These signs are put in place for the safety of both the general public and company personnel who are located along the roadway in preparation for a blast. Investigation revealed that speed limit signs were erected within the timeframe set out in Mt Arthur Coal's blasting procedures, which aim to ensure the safety of Mt Arthur Coal personnel and community members, hence no further action was required.

Air Quality Complaints

During the reporting period, 21 dust-related complaints were received from eight complainants, which is higher than FY18 (13 complaints) but lower than FY17 (27 complaints). With the exception of four dust complaints, complaint investigations indicated that real-time dust levels and 24-hour averages remained within regulatory limits at the monitoring location nearest to the complainant. Two complaints received on 19 September 2018 were from the Racecourse Road area. At the time of these complaints results were elevated, however Mt Arthur Coal's contribution to the 24-hour PM_{10} result was minimal, as shown in Table 15. On 22 and 23 November 2018 Mt Arthur Coal received two complaints over the two days regarding dust in the Muswellbrook area. The DP&E declared an extraordinary regional event over these two days and throughout the period Mt Arthur Coal continued to implement all reasonable and feasible measures to minimise dust generation on site.

The dust complaint received through the EPA on 26 October 2018 is further detailed in Section 11.

Biodiversity Complaints

One complaint was received through the DP&E on 22 November 2018 regarding a road closure on Thomas Mitchell Drive and interaction with traffic from a mine access track adjoining Thomas Mitchell Drive. The DP&E was provided with further information relating to the use of the access track and its intersection with Thomas Mitchell Drive.

Visual Amenity and Lighting Complaints

During the reporting period, 23 lighting complaints were received from seven complainants, which is higher than FY18 (14 complaints) and FY17 (18 complaints). Where complaints were received at night, immediate action was taken to locate and redirect the offending light, to address the complainant's concerns. In addition, to address the increasing trend in complaints throughout the reporting year, Mt Arthur Coal's Overburden team completed training in May 2019 in relation to lighting plant movement and set-up procedure.

One complaint was received through DP&E on 12 July 2018 in relation to dump heights. The investigation revealed dump heights were well under their maximum limits. The DP&E was advised of these findings.

Spontaneous Combustion Complaints

During the reporting period, one complaint was received regarding odour from spontaneous combustion on 6 October 2018. Investigation revealed spontaneous combustion activity at the time of the complaint on 6 October 2018. Mining operations were altered to reduce spontaneous combustion related activity in response to the complaint. No spontaneous combustion complaints were received in FY18 or FY17.

Website and Media

Mt Arthur Coal provides information about the operation through the BHP website at www.bhp.com, including project approval documents, blast schedules, coal transport information, Community Consultative Committee (CCC) meeting minutes, community complaint records, environmental monitoring information, independent environmental audits, environmental management plans, EPBC compliance reports and Annual Reviews. Note that the Annual Coal Transport Report is now provided as part of this Annual Review in Appendix 6 – Annual Coal Transport Report FY19.

Community Consultative Committee

During the reporting period, Mt Arthur Coal coordinated four CCC meetings in accordance with the former DP&E Guidelines for Community Consultative Committees. CCC meetings were held on:

- 13 August 2018;
- 12 November 2018;
- 11 February 2019; and
- 13 May 2019.

Mt Arthur Coal also participated in two Joint CCC meetings with Maxwell Infrastructure Malabar Coal held on:

- 19 December 2018; and
- 12 June 2019.

9.2 Community Investment

During the reporting period Mt Arthur Coal contributed $642,100 to the local community. Central to Mt Arthur Coal's commitment to the local community is its Voluntary Planning Agreement (VPA) with MSC, of which $500,000 is provided annually toward the Mt Arthur Coal Community Fund. Established under the *Environmental Planning and Assessment Act 1979*, the VPA contributes to public amenities and services that may be impacted by the growth in mining operations.

10. Independent Audit

An independent environmental audit was undertaken at Mt Arthur Coal in June 2017, covering the audit period between 1 July 2014 and 30 June 2017. The audit was undertaken by an audit team led by Peter Horn from Jacobs, approved by the former DP&E. The audit assessed the environmental performance of the project and compliance with the conditions of the project approval, EPL and mining leases including associated assessments, plans or programs. It also reviewed the adequacy of strategies, plans or programs required under these approvals.

The following summary of the audit results was provided in the audit report (Jacobs, April 2018):

"A total of 1,446 conditions and commitments were assessed as part of this audit. 41 issues resulted in 46 non-compliances, of which 33 of the non-compliances were administrative.

A basic risk assessment was conducted for all non-compliances with Low/Medium/High risk levels provided as results. For the non-compliances that were not administrative, there were 8 Low and 5 Medium results. No High risk non-compliances were identified in the audit.

Complaints have reduced over the previous few years results (apart from a spike in complaints in 2015-16). Reportable incidents totalled 7 in the audit period, with the incidents closed out adequately."

The audit report together with Mt Arthur Coal's response to audit issues resulting in non-compliances and audit recommendations is available on the BHP website. Audit actions completed during the reporting period are presented in Table 32. Progress on audit actions that are still outstanding is presented in Table 33. Audit actions reported as completed in the FY18 Annual Review have not been included in this report.

Of the 32 actions agreed with the DP&E 17 of them have been completed. The remaining actions will be completed in FY20.

The next Independent Environmental Audit will be commissioned in FY20 for the period between 1 July 2017 and 30 June 2020.

Table 32: Completed 2017 Independent Environmental Audit issues

Audit report reference	Issue	Audit finding	Conditions and commitments found not compliant	Status
Section 4.1, Table 5 Item 1 (page 9) / Section 4.2, Table 6 Item 2 (page 12)	Due to an administrative Non-compliance in the Noise Management Plan, the DP&E consider it not implemented.	Not Compliant Administrative	PA 09_0062 Schedule 3 Condition 9	**Complete** The revised Noise Management Plan was submitted to the DP&E for approval in June 2019.
Section 4.1, Table 5 Item 5 (page 9) / Section 4.2, Table 6 Item 5 (page 12)	The site was not able to demonstrate the coordination of air quality management with neighbouring mines Drayton, Mangoola and Bengalla. MAC is involved in the Upper Hunter Mining Dialogue.	Not Compliant Low Risk	PA 09_0062 Schedule 3 Condition 23(g)	**Complete** A protocol to coordinate air quality management was developed in August 2019.
Section 4.1, Table 5 Item 6 (page 10) / Section 4.2, Table 6 Item 6 (page 13)	Due to a Non-compliance in the Air Quality Management Plan, DP&E consider it not implemented.	Not Compliant Low Risk	PA 09_0062 Schedule 3 Condition 24	**Complete** The revised Air Quality Management Plan was approved by the DP&E on 25 January 2019.
Section 4.1, Table 5 Item 9 (page 10) / Section 4.2, Table 6 Item 9 (page 13)	Due to an administrative Non-compliance in the Biodiversity Management Plan, DP&E consider it not implemented.	Not Compliant Administrative	PA 09_0062 Schedule 3 Condition 40	**Complete** The revised Biodiversity Management Plan was approved by the DP&E on 22 May 2019.
Section 4.1, Table 5 Item 5 (page 9) / Section 4.2, Table 6 Item 10 (page 12)	The Biodiversity Management Plan does not include: 1) Details for targeted rehabilitation efforts in creeks and drainage lines. 2) Detail on the proposed landscaping associated with public roads.	Not Compliant Administrative	PA 09_0062 Schedule 3 Condition 40(c)	**Complete** The revised Biodiversity Management Plan was approved by the DP&E on 22 May 2019. The revised Plan includes Section 11.3.2 Management of landscaping to reduce visual impacts and Section 11.3.3 Rehabilitation of creeks and drainage lines following mining.
Section 4.1, Table 5 Item 24 (page 11) / Section 4.22, Table 12 Item 3 (page 21)	Evidence was not provided of the submission of an air quality report with the EPL 11457 Annual return.	Not Compliant Administrative	AQGGMP S5	**Complete** No specific air quality monitoring report is required by the EPA to be submitted with the Annual Return. Any exceedances or non-compliances are detailed in the Annual Return forms. The revised Air Quality Management Plan was approved by the DP&E on 25 January 2019.
Section 4.1, Table 5 Item 25 (page 11) / Section 4.24, Table 13 Item 2 (page 21)	No evidence of the audit of the Blast Management Plan (every 3 years) in the audit period.	Not Compliant Administrative	BMP App 5 S8	**Complete** The Mt Arthur Coal Document Management System records all required reviews of management plans listed in PA 09_0062. The revised Blast Management Plan was approved by the DP&E during the previous reporting period.

Audit report reference	Issue	Audit finding	Conditions and commitments found not compliant	Status
Section 4.1, Table 5 Item 26 (page 11) / Section 4.24, Table 13 Item 1 (page 21)	Contractors engaged in undertaking drill and blast tasks at MAC are required to understand and follow the Blast Management Plan but no evidence of this was able to be provided.	Not Compliant Low Risk	BMP App 5 S7	**Complete** In line with the site's training matrix relevant contractors have been trained in blast procedures relevant to their role in FY19.
Section 4.1, Table 5 Item 30 (page 11) / Section 4.28, Table 15 Item 3 (page 23)	The audit team were not able to determine whether all reviews required by Section 7 of the AHMP had been completed.	Not Compliant Administrative	AHMP S7.0	**Complete** The Mt Arthur Coal Document Management System records all required reviews of management plans listed in PA 09_0062.
Section 4.1, Table 5 Item 31 (page 11) / Section 4.29, Table 16 Item 1 (page 24)	It was not able to be established if all the required reviews of the European Heritage Management plan had taken place.	Not Compliant Administrative	EHMP S6	**Complete** The Mt Arthur Coal Document Management System records all required reviews of management plans listed in PA 09_0062.
Section 4.1, Table 5 Item 34 (page 11) / Section 4.32, Table 18 Item 1 (page 23) / Section 4.45, Table 26 Item 2 (page 30)	The audit team were not able to verify that all of the required reviews of the NMP had taken place.	Not Compliant Administrative	NMP S9.2	**Complete** Mt Arthur Coal submitted the NMP to the DP&E for approval in January 2019. The Mt Arthur Coal Document Management System records all required reviews of management plans listed in PA 09_0062.
		Not Compliant Administrative	EA 2013 S4.10.3	
Section 4.1, Table 5 Item 36 (page 11) / Section 4.36, Table 20 Item 1 (page 26)	The audit team were not able to verify that all of the required reviews of the WMP had taken place.	Not Compliant Administrative	Site WMP S10	**Complete** DPIE requested the management plans be submitted in a controlled manner rather than as a group and Mt Arthur Coal remains in consultation with DPIE for the approval of the Noise Management Plan. The revised Water Management Plan is awaiting submission. The Mt Arthur Coal Document Management System records all required reviews of management plans listed in PA 09_0062.
Section 4.1, Table 5 Item 37 (page 11) / Section 4.37, Table 21 Item 1 (page 27)	Evidence of the annual review of the Surface Water and Groundwater Response Plan was not able to be provided.	Not Compliant Administrative	Surface Water and Ground Water Response Plan S1.2	**Complete** DPIE requested the management plans be submitted in a controlled manner rather than as a group and Mt Arthur Coal remains in consultation with DPIE for the approval of the Noise Management Plan. The revised Water Management Plan, which now incorporates the Surface Water and Groundwater Response Plan, is awaiting submission. The Mt Arthur Coal Document Management System records all required reviews of management plans listed in PA 09_0062.

Audit report reference	Issue	Audit finding	Conditions and commitments found not compliant	Status
Section 4.1, Table 5 Item 38 (page 11) / Section 4.38, Table 22 Item 1 (page 27)	Evidence of the annual review of the Surface Water Monitoring Program was not able to be provided.	Not Compliant Administrative	Surface WMP S1.2	**Complete** DPIE requested the management plans be submitted in a controlled manner rather than as a group and Mt Arthur Coal remains in consultation with DPIE for the approval of the Noise Management Plan. The revised Water Management Plan, which now incorporates the Surface Water Monitoring Program, is awaiting submission. The Mt Arthur Coal Document Management System records all required reviews of management plans listed in PA 09_0062.
Section 4.1, Table 5 Item 39 (page 12) / Section 4.40, Table 23 Item 1 (page 28)	Evidence of the annual review of the Biodiversity MP was not able to be provided.	Not Compliant Administrative	Biodiversity MP S11	**Complete** The revised Biodiversity Management Plan was approved by the DP&E on 22 May 2019.

Table 33: Progress on outstanding 2017 Independent Environmental Audit issues

Audit report reference	Issue	Audit finding	Conditions and commitments found not compliant	Status
Section 4.1, Table 5 Item 1 (page 9) / Section 4.2, Table 6 Item 1 (page 12)	A comprehensive system utilising meteorological monitoring and predictive forecasting for noise management was not in place at the time of the audit.	Not Compliant Low Risk	PA 09_0062 Schedule 3 Condition 8(b)	**In progress** A system was under development during the audit and was finalised in early 2018. The revised Noise Management Plan was submitted to the DP&E in June 2019. Approval of the Plan is anticipated for FY20. The new system will be implemented within one month of approval of the revised Noise Management Plan by the DPIE. **Action assigned** (within one month of approval of the Noise Management Plan by DPIE).
Section 4.1, Table 5 Item 7 (page 10) / Section 4.2, Table 6 Item 7 (page 13)	Due to a Non-compliance in the Water Management Plan, DP&E consider it not implemented	Not Compliant Low Risk	PA 09_0062 Schedule 3 Condition 29	**In progress** A revision of the Water Management Plan (WMP) is in progress, however the DPIE have requested that the revised management plans be submitted sequentially to avoid overloading the reviewers. **Action assigned** (completion of WMP review DPIE dependent).

Audit report reference	Issue	Audit finding	Conditions and commitments found not compliant	Status
Section 4.1, Table 5 Item 12 (page 10) / Section 4.2, Table 6 Item 12 (page 15)	Due to an administrative Non-compliance in the Aboriginal Heritage Management Plan, DP&E consider it not implemented.	Not Compliant Administrative	PA 09_0062 Schedule 3 Condition 45	**In progress** The Aboriginal Heritage Management Plan (AHMP) is currently being reviewed and revised by Mt Arthur Coal, in consultation with OEH, the Aboriginal community, MSC and relevant landowners. The DPIE have requested that the revised management plans for review be submitted sequentially to avoid overloading the reviewers. **Action assigned** (completion of AHMP review DPIE dependent).
Section 4.1, Table 5 Item 13 (page 10) / Section 4.2, Table 6 Item 13 (page 15)	Due to an administrative Non-compliance in the Environmental Management Strategy, DP&E consider it not implemented.	Not Compliant Administrative	PA 09_0062 Schedule 5 Condition 1	**In Progress** The Environmental Management Strategy will be revised following the approval of the revised Air Quality, Noise, Blast and Water Management Plans by DPIE. DPIE requested the Management Plans be submitted in a controlled manner rather than as a group and Mt Arthur Coal remains in consultation with DPIE for the approval of the Noise Management Plan. **Action assigned** (the document has been drafted for completion within one month of approval of the revised Noise and Water Management Plans by DPIE).
Section 4.1, Table 5 Item 16 (page 10) / Section 4.7, Table 8 Items 1 and 5 (page 17) / Section 4.8, Table 9 Items 1 (page 18)	There was no evidence of the approval of flow metering devices by NSW Office of Water (or DPI Water).	Not Compliant Low Risk	Water Licence 20BL171995 C2	**In progress** Further investigation into this groundwater licence condition and Mt Arthur Coal's compliance with it will be undertaken. The Office of Water will be notified of the outcomes of the investigation and any specific actions/due dates that come out of it. **Action assigned** (completion by 30 June 2020).
		Not Compliant Administrative	Water Licence 20BL171995 C8	
		Not Compliant Administrative	Water Licence 20BL168155 C7	
Section 4.1, Table 5 Item 17 (page 10) / Section 4.7, Table 8 Item 2 (page 17)	There was no evidence of the provision of maps or plans showing the location of works associated with water licences.	Not Compliant Administrative	Water Licence 20BL171995 C3	**In progress** Further investigation into this groundwater licence condition and Mt Arthur Coal's compliance with it will be undertaken. The Office of Water will be notified of the outcomes of the investigation and any specific actions/due dates that come out of it. **Action assigned** (completion by 30 June 2020).
Section 4.1, Table 5 Item 18 (page 10) / Section 4.7, Table 8 Item 3 (page 17)	Not all documents developed by the site to address the requirement to minimise ongoing seepage of alluvial groundwater to the mine works were approved by the NSW Office of Water (or DPI Water), specifically the MOP.	Not Compliant Administrative	Water Licence 20BL171995 C5	**In progress** Further investigation into this groundwater licence condition and Mt Arthur Coal's compliance with it will be undertaken. The Office of Water will be notified of the outcomes of the investigation and any specific actions/due dates that come out of it. **Action assigned** (completion by 30 June 2020).

Audit report reference	Issue	Audit finding	Conditions and commitments found not compliant	Status
Section 4.1, Table 5 Item 19 (page 10) / Section 4.7, Table 8 Item 4 (page 17)	Water licence compliance reports were not submitted.	Not Compliant Medium Risk	Water Licence 20BL171995 C7	**In progress** Further investigation into this groundwater licence condition and Mt Arthur Coal's compliance with it will be undertaken. The Office of Water will be notified of the outcomes of the investigation and any specific actions/due dates that come out of it. **Action assigned** (completion by 30 June 2020).
Section 4.1, Table 5 Item 27 (page 11) / Section 4.26, Table 14 Item 1 (page 22)	The EMS needs to be updated as it quotes procedures that were no longer used and could not be found.	Not Compliant Administrative	EMS Table 2	**In Progress** The Environmental Management Strategy will be revised following the approval of the revised Air Quality, Noise, Blast and Water Management Plans by DPIE. DPIE requested the Management Plans be submitted in a controlled manner rather than as a group and Mt Arthur Coal remains in consultation with DPIE for the approval of the Noise Management Plan. **Action assigned** (the document has been drafted for completion within one month of approval of the revised Air Quality, Noise, Blast and Water Management Plans by DPIE).
Section 4.1, Table 5 Item 28 (page 11) / Section 4.28, Table 15 Item 1 (page 22)	The Thomas Mitchell Drive offset area has been fenced in accordance with the AHMP but the access protocols were not determined through consultation with the Indigenous Stakeholders.	Not Compliant Administrative	AHMP S5.1	**In Progress** The Aboriginal Heritage Management Plan (AHMP) is currently being reviewed and revised by Mt Arthur Coal, in consultation with OEH, the Aboriginal community, MSC and relevant landowners. The DPIE have requested that the revised management plans for review be submitted sequentially to avoid overloading the reviewers. **Action assigned** (completion of AHMP review DPIE dependent).
Section 4.1, Table 5 Item 29 (page 11) / Section 4.28, Table 15 Item 2 (page 23)	The commitments from Section 5.8 of the AHMP are not followed through in the site induction package.	Not Compliant Administrative	AHMP S5.8	**In Progress** Mt Arthur Coal is going through the process of updating induction requirements for all of site in a complete overhaul of the induction process. This will include assigning requirements for all levels of staff regarding environmental and cultural heritage awareness. Mt Arthur Coal will update the site induction package accordingly. In the interim a site-wide notice was issued on 22 August 2019 communicating cultural heritage requirements on site, the purpose being to refresh everyone on the commitments outlined in Section 5.8 of the Aboriginal Heritage Management Plan. **Action assigned** (completion by 30 June 2020).
Section 4.1, Table 5 Item 31 (page 11) / Section 4.28, Table 15 Item 4 (page 23)	The offset management plans do not refer to Cultural Heritage issues.	Not Compliant Administrative	AHMP App 4	**In progress** The Aboriginal Heritage Management Plan (AHMP) is currently being reviewed and revised by Mt Arthur Coal, in consultation with OEH, the Aboriginal community, MSC and relevant landowners.

Audit report reference	Issue	Audit finding	Conditions and commitments found not compliant	Status
				The DPIE have requested that the revised management plans for review be submitted sequentially to avoid overloading the reviewers. **Action assigned** (completion of AHMP review DPIE dependent).
Section 4.1, Table 5 Item 33 (page 11) / Section 4.31, Table 17 Item 1 (page 25)	Evidence of an annual review of the Groundwater Monitoring Program was not able to be provided.	Not Compliant Administrative	GMP S1.2	**In Progress** The Mt Arthur Coal Document Management System records all required reviews of management plans listed in PA 09_0062. The Interim Monitoring Program of the upgraded monitoring network concluded February 2018. An assessment and analysis of interim monitoring program data has been completed. Sufficient reference dataset has been collected to revise and set new groundwater triggers and monitoring frequency. The Groundwater Monitoring Program will be revised and submitted with the updated WMP. DPIE have requested that the revised management plans for review be submitted sequentially to avoid overloading the reviewers. **Action assigned** (completion of WMP review DPIE dependent).
Section 4.1, Table 5 Item 35 (page 11) / Section 4.35, Table 19 Item 1 (page 26)	The site water balance requires updating and has not been updated since 2012.	Not Compliant Low Risk	Site Water Balance S2.2.2	**In Progress** The site water balance model was updated and a calibration completed in January 2018. The corresponding Site Water Balance management document will be updated accordingly with the WMP. DPIE have requested that the revised management plans for review be submitted sequentially to avoid overloading the reviewers. **Action assigned** (completion of WMP review DPIE dependent).
Section 4.1, Table 5 Item 41 (page 12) / Section 4.45, Table 26 Item 1 (page 30)	The Aboriginal Heritage Management Plan should have been updated in consultation with the Aboriginal community and the OEH to specify management and mitigation measures relevant to the 2013 Modification area.	Not Compliant Administrative	EA 2013 S4.7.3	**In progress** The Aboriginal Heritage Management Plan (AHMP) is currently being reviewed and revised by Mt Arthur Coal, in consultation with OEH, the Aboriginal community, MSC and relevant landowners. The DPIE have requested that the revised management plans for review be submitted sequentially to avoid overloading the reviewers. **Action assigned** (completion of AHMP review DPIE dependent).

11. Incidents and Non-compliances

Blast Overpressure Exceedance

On 24 December 2018 at 2:15 pm a blast in Windmill pit recorded an airblast overpressure result above the maximum 120 dBL limit. This event recorded an airblast overpressure exceedance of 120.6 dBL at the Denman Road West monitor (BP09) and resulted in two complaints. This exceedance was notified to both the DP&E and the EPA.

An analysis of the video footage confirmed that the exceedance occurred due to a fault in one hole. Information retrieved from blast logic showed that this hole in particular was overloaded. This then resulted in reduced stemming height causing rifling of the hole and subsequently, the overpressure exceedance due to a lack of confinement.

The site's Loading Bulk Explosives Procedure deals with overloaded holes. Following the incident Mt Arthur Coal's Drill and Blast team retrained operators on the importance of following this procedure and the process for dealing with overloaded holes to prevent a reoccurrence of this event.

Missing Blast Results

On 12 February and 5 March 2019 airblast overpressure and ground vibration results were not recorded at the Denman Road West (BP09) or Yammanie North (BP10) monitors for two blast events. The two blast events were RXN2764BB_B2 on 12 February 2019 at 12:36 pm and AYC0086RL232 on 5 March 2019 at 10:58 am.

Neither blast event automatically triggered results as the blasts were relatively small, so Mt Arthur Coal requested the blast monitoring contractor to manually trigger the results. The status of the results for BP09 and BP10 are still 'pending' on the blast monitoring contractor's website, indicating these results did not come through. The most likely cause of the non-compliances are communications issues at the time of manually triggering the two blast events.

Results for blast events RXN2764BB_B2 and AYC0086RL232 at all other blast monitors were below regulatory criteria. No community complaints were received. In order to prevent a recurrence of this non-compliance the manual trigger data capture process will be reviewed and refresher training will be undertaken to ensure that all relevant staff are fully aware of the data capture requirements and processes.

Reporting of HVAS Exceedances

HVAS exceedance results from December 2018 were not individually investigated and reported to the DP&E. The reason for not reporting was based on the ongoing liaison with DP&E regarding the planned removal of HVAS equipment from the AQMP. The AQMP was submitted to the DP&E for initial review in September 2018. The AQMP was approved in January 2019 with endorsement by DP&E for the removal of HVAS equipment.

HVAS exceedance results for December 2018 and January 2019, until 25 January when the new AQMP was approved, have been reported in this Annual Review in Table 13.

Groundwater Management Plan Monitoring Schedule

Although the FY18 Annual Review stated that groundwater trigger values were revised following the completion of the interim monitoring program and would be applied for the FY19 monitoring period, instead the currently approved GWMP dated 28 April 2015 is applicable for the FY19 monitoring period. The revised trigger values will not be applied until further review and subsequent approval by the DPIE.

In anticipation of moving to the revised site Water Management Plan in FY19, Mt Arthur Coal adjusted the sampling frequency to quarterly instead of bi-monthly and also adjusted the sampling requirements at some of the sites as recommended by the independent consultant. This premature implementation of the revised site Water Management Plan resulted in a number of non-compliances with regards to collection of manual water level data and collection of water quality sample data, which is discussed in further detail in Section 7.4.

Dust over Denman and Edderton Roads – 26 October 2018

A report was received by the EPA alleging dust generated from the Mt Arthur Coal mine operation was visible over Denman Road and Edderton Road, Muswellbrook at approximately 6:25 pm on Friday 26 October 2018. The report also alleged that no water carts were observed being used on the premises.

On 29 October 2018 Mt Arthur Coal received a Request for Information from the EPA. On 4 December 2018 Mt Arthur Coal received a Notice to Provide Information and/or Records (Notice Number 1572816) from the EPA, followed by a subsequent Notice to Provide Information and/or Records (Notice Number 1578433) on 2 May 2019.

The EPA alleged that the following conditions in EPL 11457 were breached as a result of the reported incident:

- O1.1 – Licensed activities must be carried out in a competent manner. This includes: a) the processing, handling, movement and storage of materials and substances used to carry out the activity; and b) the treatment, storage, processing, reprocessing, transport and disposal of waste generated by the activity;
- O2.1 – All plant and equipment installed at the premises or used in connection with the licensed activity: a) must be maintained in a proper and efficient condition; and b) must be operated in a proper and efficient manner;
- O3.1 – The premises must be maintained in a condition which minimises or prevents the emission of dust from the premises; and
- O3.2 – Activities occurring in or on the premises must be carried out in a manner that will minimise the generation, or emission from the premises, of wind-blown or traffic generated dust.

Mt Arthur Coal responded to Notices 1572816 and 1578433, detailing how dust management practices were implemented at the time of the alleged EPL breach.

Following receipt of Mt Arthur Coal's response the EPA determined that the following course of action was appropriate:

- To issue Mt Arthur Coal with a Penalty Notice of $15,000 on 23 July 2019 for the alleged contravention of Section 64(1) of the POEO Act, being failure to comply with condition O3.2 of EPL 11457.

Website Publishing of Biodiversity Management Plan

On 12 February 2019 the Federal Department of the Environment and Energy (DoEE) contacted Mt Arthur Coal to advise that a desktop review of compliance for the Mt Arthur Coal Extension Project, EPBC 2011/5866 conducted by the DoEE identified that the published Biodiversity Management Plan (BioMP) on the BHP website was not the most recent BioMP. Mt Arthur Coal updated the version of the BioMP on the Regulatory Information website as required and no further action was taken.

12. Activities during Next Reporting Period

Mt Arthur Coal has established the following targets for the next reporting period:

- Undertake flyrock modelling to assist in reducing the probability and impact of blast overpressure events;
- Undertake improvements to the sites current predictive meteorological model;
- Establish competency of front line leadership and Integrated Remote Operations Centre (IROC) in License to Operate risk management;
- Embed Licence to Operate risk control effectiveness testing;
- Fit for purpose monitoring systems within the Environment Data Monitoring System Project; and
- Drive rehabilitation on trajectory to closure – based on ecological development monitoring.

These targets will be closely monitored and an update on the status of each will be reported in the next Annual Review. The above six actions have all been assigned a completion date of 30 June 2020, although it is noted that the final action in the list is ongoing. No changes to any management plans will be required as a result of the abovementioned actions.

Table 34 outlines a progress summary of Mt Arthur Coal's performance against targets set for the FY19 period.

Table 34: Mt Arthur Coal's performance against targets for FY19

Target	Status	Performance
Upgrade components of the air quality monitoring network and real time monitoring system to improve system accuracy and reliability.	Complete	Mt Arthur Coal's air quality monitoring system was upgraded in FY19 to improve reliability and accuracy. This included infrastructure upgrades along with software improvements.
Execute three year plan that includes an annual weed assessment, weed strategy and weed management review. Weed management priorities will be revised based on the outcomes of the reviews with the aim of improving strategies for weed control across the site with particular focus on newly established rehabilitation.	Ongoing	Refer to Section 6.5.

Appendix 1 – Air Quality Monitoring Results

High Volume Air Sampler (HVAS) PM_{10} Results

Date	DF05	DF06	DF07	Assessment criteria
	24-hour PM_{10} ($\mu g/m^3$)	24-hour PM_{10} ($\mu g/m^3$)	24-hour PM_{10} ($\mu g/m^3$)	Short term (24-hour) ($\mu g/m^3$)
6/07/2018	13.0	31.0	14.0	50
12/07/2018	12.0	30.0	24.0	
18/07/2018	41.0	70.0^	40.0	
24/07/2018	20.0	89.0^	39.0	
30/07/2018	7.0	27.0	15.0	
5/08/2018	22.0	35.0	21.0	
11/08/2018	16.0	37.0	29.0	
17/08/2018	21.0	43.0	25.0	
23/08/2018	33.0	40.0	31.0	
29/08/2018	31.0	32.0	21.0	
4/09/2018	12.0	11.0	10.0	
10/09/2018	22.0	22.0	15.0	
16/09/2018	31.0	35.0	22.0	
22/09/2018	47.0	63.0^	34.0	
28/09/2018	18.0	29.0	16.0	
4/10/2018		32.0	23.0	
10/10/2018	25.0	18.0	14.0	
16/10/2018	23.0	26.0	18.0	
22/10/2018	13.0	34.0	25.0	
28/10/2018	32.0	44.0	23.0	
3/11/2018	8.0	49.0	31.0	
9/11/2018	25.0	27.0	19.0	
15/11/2018	36.0	76.0^	33.0	
21/11/2018	37.0	37.0	32.0	
27/11/2018	27.0	45.0	29.0	
3/12/2018	36.0	52.0	37.0	
9/12/2018	58.0	55.0	35.0	
15/12/2018	41.0	37.0	27.0	
21/12/2018	29.0	31.0	26.0	
27/12/2018	63.0	59.0	33.0	
2/01/2019	81.0	53.0	39.0	
8/01/2019	26.0	52.0	32.0	
14/01/2019	54.0	45.0	36.0	
20/01/2019	34.0	37.0	28.0	

24-hour result exceeding regulatory criteria

Malfunctioning HVAS monitor – results unreliable

^ Investigation deemed Mt Arthur Coal contribution below criteria

Tapered Element Oscillating Microbalance (TEOM) PM_{10} Validated Results

Date	24-hour PM_{10} (µg/m^3)					
	DC02	DC04	DC05	DC06	DC07	DC09
	Sheppard Avenue	South Muswellbrook	Roxburgh Road	Edderton Road	Antiene	Wellbrook
1/07/2018	14	17	15	15	14	8
2/07/2018	12	15	14	13	13	10
3/07/2018	15	15	10	9	12	8
4/07/2018	15	19	17	16	13	14
5/07/2018	14	15	5	7	8	5
6/07/2018	20	15	7	8	14	10
7/07/2018	26	16	7	7	14	15
8/07/2018	12	11	7	5	9	8
9/07/2018	11	11	9	8	7	10
10/07/2018	16	18	18	19	13	17
11/07/2018	22	21	15	19	12	12
12/07/2018	27	27	13	15	17	12
13/07/2018	21	17	6	10	13	10
14/07/2018	19	18	5	19	11	14
15/07/2018	17	16	5	16	12	14
16/07/2018	24	18	8	14	14	22
17/07/2018	29	17	7	13	14	20
18/07/2018	64	49	42	30	44	44
19/07/2018	45	33	28	38	31	41
20/07/2018	61	34	19	17	33	43
21/07/2018	20	18	6	12	13	14
22/07/2018	23	22	19	24	14	29
23/07/2018	35	25	22	25	21	31
24/07/2018	72	44	17	13	42	37
25/07/2018	44	30	17	12	21	36
26/07/2018	41	32	16	15	24	38
27/07/2018	44	34	49	29	31	50
28/07/2018	49	35	34	33	28	68
29/07/2018	26	22	18	17	21	22
30/07/2018	25	18	7	8	15	22
31/07/2018	29	20	10	12	17	24
1/08/2018	38	28	12	9	19	40
2/08/2018	38	34	28	22	29	41
3/08/2018	34	28	22	30	25	26
4/08/2018	48	49	42	40	46	60
5/08/2018	26	24	20	24	19	29
6/08/2018	23	26	18	10	17	19
7/08/2018	28	29	24	19	30	31
8/08/2018	15	13	5		8	6

Date	24-hour PM_{10} (µg/m^3)					
	DC02	DC04	DC05	DC06	DC07	DC09
	Sheppard Avenue	South Muswellbrook	Roxburgh Road	Edderton Road	Antiene	Wellbrook
9/08/2018	12	17	16		7	20
10/08/2018	19	23	9	14	12	20
11/08/2018	28	22	15	14	19	26
12/08/2018	19	12	4		8	7
13/08/2018	16	9	4	8	9	8
14/08/2018	14	10	4	5	8	11
15/08/2018	23	14	9	12	11	19
16/08/2018	33	22	12		18	25
17/08/2018	33	26	11	14	25	24
18/08/2018	59	35	20	16	29	40
19/08/2018	35	29	13	9	23	32
20/08/2018	26	19	7	6	14	16
21/08/2018	28	18	10		15	18
22/08/2018	21	16	9		12	15
23/08/2018	25	22	32	25	20	35
24/08/2018	24	23	32	22	20	33
25/08/2018	19	22	22		18	24
26/08/2018	11	15	9		11	10
27/08/2018	11	15	11	13	10	15
28/08/2018	15	20	13	14	16	18
29/08/2018	20	23	13	15	17	17
30/08/2018	22	21	26	19	17	29
31/08/2018	34	34	29		29	37
1/09/2018	26	25	16		19	22
2/09/2018	13	16	12		11	20
3/09/2018	17	16	15	11	15	19
4/09/2018	6	8	7	5	6	13
5/09/2018	11	13	12	8	11	5
6/09/2018	16	14	21	13	13	28
7/09/2018	11	13	7	10	9	12
8/09/2018	11	14	10	9	10	9
9/09/2018	22	19	6	7	11	11
10/09/2018	16	17	16	15	13	24
11/09/2018	16	19	27	23	14	23
12/09/2018	23	24	21	24	17	26
13/09/2018	46	35	43	28	35	44
14/09/2018	30	25	25	33	22	34
15/09/2018	54	41	28	23	30	41
16/09/2018	29	27	25	16	27	28
17/09/2018	31	26	32	22	24	35
18/09/2018	36	32	25	29	25	33

Date	24-hour PM_{10} (µg/m^3)					
	DC02	DC04	DC05	DC06	DC07	DC09
	Sheppard Avenue	South Muswellbrook	Roxburgh Road	Edderton Road	Antiene	Wellbrook
19/09/2018	51	39	27	24	30	37
20/09/2018	31	24	24	16	21	29
21/09/2018	28	20	22	20	18	33
22/09/2018	46	34	41	20	25	33
23/09/2018	38	27	29	17	24	38
24/09/2018	17	16	16	13	14	19
25/09/2018	14	12	15	11	10	16
26/09/2018	17	15	15	14	11	13
27/09/2018	11	12	12	16	9	12
28/09/2018	22	17	14	14	12	15
29/09/2018	28	22	18	12	17	18
30/09/2018	22	20	23	14	19	20
1/10/2018	20	18	21	15	13	20
2/10/2018	28	20	33	21	19	24
3/10/2018	39	33	39	20	28	32
4/10/2018	28	23	16	11	20	14
5/10/2018	0	3	0	2	0	0
6/10/2018	5	8	10	7	5	6
7/10/2018	10	13	14	8	11	13
8/10/2018	10	10	10	9	7	10
9/10/2018	25	22	17	17	18	14
10/10/2018	14	14	17	13	11	19
11/10/2018	6	9	8	7	6	8
12/10/2018	7	9	13	6	6	9
13/10/2018	12	12	14	8	9	11
14/10/2018	11	14	14	11	10	12
15/10/2018	13	13	18	12	9	14
16/10/2018	16	15	13	11	13	13
17/10/2018	15	16	10	11	10	10
18/10/2018	9	11	6	7	6	7
19/10/2018	12	13	9	13	8	10
20/10/2018	20	16	17	16	15	15
21/10/2018	15	17	17	14	13	15
22/10/2018	23	24	24	18	20	26
23/10/2018	23	19	13	18	16	20
24/10/2018	39	35	37	23	28	33
25/10/2018	24	22	26	19	20	23
26/10/2018	30	28	26	22	22	26
27/10/2018	29	29	18	21	28	26
28/10/2018	34	27	27	19	24	25
29/10/2018	30	26	27	19	23	27

Date	24-hour PM_{10} (µg/m^3)					
	DC02	DC04	DC05	DC06	DC07	DC09
	Sheppard Avenue	South Muswellbrook	Roxburgh Road	Edderton Road	Antiene	Wellbrook
30/10/2018	34	28	25	24	22	29
31/10/2018	45	36	26	29	29	32
1/11/2018	46	33	34	31	28	43
2/11/2018	37	28	21	28	23	35
3/11/2018	40	35	21	21	24	31
4/11/2018	44	37	38	32	32	37
5/11/2018	30	27	21	25	25	22
6/11/2018	62	41	22	36	38	32
7/11/2018	35	25	20	15	19	22
8/11/2018	3	6	7	6	3	8
9/11/2018	17	20	21	17	16	18
10/11/2018	23	23	26	16	18	19
11/11/2018	19	19	25	17	15	23
12/11/2018	21	18	25	13	15	21
13/11/2018	24	21	30	14	16	25
14/11/2018	33	28	29	18	23	27
15/11/2018	43	30	22	17	23	23
16/11/2018	11	12	11	8	10	10
17/11/2018	18	16	24	15	14	19
18/11/2018	20	13	22	11	12	17
19/11/2018	20	19	26	15	17	23
20/11/2018	35	24	32	20	19	32
21/11/2018	41	39	33	36	31	36
22/11/2018	167	163	124	107	146	168
23/11/2018	141	117	98	83	107	113
24/11/2018	41	29	14	9	21	19
25/11/2018	35	25	13	10	23	21
26/11/2018	32	26	30	18	18	23
27/11/2018	37	34	30	25	29	31
28/11/2018	8	10	8	11	7	8
29/11/2018	6	9	6	5	5	9
30/11/2018	24	18	19	15	13	21
1/12/2018	27	24	27	20	21	27
2/12/2018	58	46	48	27	41	49
3/12/2018	44	34	24	21	28	27
4/12/2018	51	35	34	21	34	37
5/12/2018	26	23	26	15	17	20
6/12/2018	18	26	21	14	12	20
7/12/2018	28	23	28	16	20	27
8/12/2018	32	22	40	23	20	40
9/12/2018	40	32	48	31	29	48

Date	24-hour PM_{10} (µg/m^3)					
	DC02	DC04	DC05	DC06	DC07	DC09
	Sheppard Avenue	South Muswellbrook	Roxburgh Road	Edderton Road	Antiene	Wellbrook
10/12/2018	46	35	37	25	30	39
11/12/2018	19	19	15	14	15	13
12/12/2018	12	13	11	12	10	11
13/12/2018	11	12	7	10	9	9
14/12/2018	15	16	12	12	13	11
15/12/2018	32	30	33	27	23	32
16/12/2018	26	29	23	24	24	25
17/12/2018	27	30	16	17	18	19
18/12/2018	31	32	34	26	25	30
19/12/2018	25	24	26	22	19	23
20/12/2018	21	21	23	17	15	17
21/12/2018	18	22	19	14	16	17
22/12/2018	17	19	16	12	12	13
23/12/2018	16	16	17	11	13	14
24/12/2018	18	20	23	14	16	21
25/12/2018	12	12	7	11	8	8
26/12/2018	23	19	24	21	16	24
27/12/2018	41	32	59	38	25	49
28/12/2018	33	24		36	22	41
29/12/2018	40	25		22	23	35
30/12/2018	33	21	20	31	19	30
31/12/2018	48	31	33	41	29	34
1/01/2019	24	25	23	23	21	19
2/01/2019	37	35	45	42	33	46
3/01/2019	41	35	30	32	30	51
4/01/2019	38	35	29	30	28	38
5/01/2019	37	31	22	24	25	29
6/01/2019	13	12	4	7	8	12
7/01/2019	15	13	9	10	9	16
8/01/2019	30	26	12	21	21	19
9/01/2019	48	69	20	17	26	26
10/01/2019	32	29	21	22	23	28
11/01/2019	23	23	16	21	18	23
12/01/2019	24	26	17	22	18	25
13/01/2019	34	33	30	26	27	34
14/01/2019	27	30	30	23	22	40
15/01/2019	44	40		26	35	40
16/01/2019	66	56		47	49	52
17/01/2019	51	48		48	42	58
18/01/2019	47	41		33	33	39
19/01/2019	91	36		30	36	42

Date	24-hour PM_{10} (µg/m^3)					
	DC02	DC04	DC05	DC06	DC07	DC09
	Sheppard Avenue	South Muswellbrook	Roxburgh Road	Edderton Road	Antiene	Wellbrook
20/01/2019	23	18	14	15	14	24
21/01/2019	13	15	7	12	10	12
22/01/2019	33	27	22	27	22	25
23/01/2019	41	32		18	27	21
24/01/2019	36	34	25	25	28	29
25/01/2019	38	35	21	31	25	30
26/01/2019	66	39	31	37	36	42
27/01/2019	59	42	38	35	38	44
28/01/2019	39	36	22	24	29	25
29/01/2019	44	39	29	32	32	35
30/01/2019	59	40	28	28	33	36
31/01/2019	67	37	16	29	37	33
1/02/2019	25	20	10	10	14	14
2/02/2019	12	8	6	8	9	11
3/02/2019	17	21	21	19	15	24
4/02/2019	46	38	28	27	30	35
5/02/2019			29	27	24	30
6/02/2019				14		17
7/02/2019	20	20		15		
8/02/2019	33	29	25	19	21	
9/02/2019	14	22	18	14	17	13
10/02/2019	45	61	57	39	54	48
11/02/2019	37	31	26	20	28	23
12/02/2019	57	40	34	33	36	41
13/02/2019	104	86	73	61	75	52
14/02/2019	32	27	35	23	23	28
15/02/2019	50	30	26	19	24	26
16/02/2019	23	26	22	17	19	21
17/02/2019	28	26	28	27	20	27
18/02/2019	54	41	47	46	34	51
19/02/2019	223	60	50	48	54	66
20/02/2019	31	32	15	13	24	14
21/02/2019	13	16	11	14	11	8
22/02/2019	20	20	15	18	14	14
23/02/2019	9	14	8	13	10	7
24/02/2019	17	24	15	15	17	15
25/02/2019	21	24	25	25	18	25
26/02/2019	26	27	26	25	21	27
27/02/2019	33	22	28	26	16	23
28/02/2019	19	15	25	20	10	26
1/03/2019	36	21	24	12	17	24

Date	24-hour PM_{10} (µg/m^3)					
	DC02	DC04	DC05	DC06	DC07	DC09
	Sheppard Avenue	South Muswellbrook	Roxburgh Road	Edderton Road	Antiene	Wellbrook
2/03/2019	24	20	22	13	15	31
3/03/2019	22	23	23	11	16	25
4/03/2019	37	30	37	17	25	34
5/03/2019	51*	33*	38*	31	47*	33
6/03/2019	70*	57*	67*	63*	24*	83*
7/03/2019	32*	31*	31*	22*	24*	27*
8/03/2019	30*	28*	30*	25*	24*	35*
9/03/2019	36*	28*	22*	29*	11*	27*
10/03/2019	14*	17*	16*	28*	35*	23*
11/03/2019	35*	43*	44*	30*	32*	43*
12/03/2019	41*	41*	29*	27*	33*	30*
13/03/2019	61*	38*	36*	30*	24*	31*
14/03/2019	29*	29*	27*	27*	18*	29*
15/03/2019	34*	26*	0*	12*	12*	18*
16/03/2019	15*	16*	12*	11*	5*	11*
17/03/2019	7*	10*	4*	0*	7*	5*
18/03/2019	5*	8*	4*	9*	7*	4*
19/03/2019	10*	17*	9*	11*	7*	7*
20/03/2019	10*	22*	16*	11*	7*	13*
21/03/2019	13*	17*	0*	3*	7*	9*
22/03/2019	13*	21*	18	0*	7*	17*
23/03/2019	22*	24*	16	0*	7*	11*
24/03/2019	2*	0*	17	10*	17*	14*
25/03/2019	17*	23*	14	17*	33*	13*
26/03/2019	11*	0*	35	20*	0*	32*
27/03/2019	11*	31	32	20*	0*	36*
28/03/2019	18	23	36	27	26*	30
29/03/2019	32	30	28	46	20*	28
30/03/2019	19	27	18		62*	21
31/03/2019	54	71	68	53	47*	70
1/04/2019	9	16	18	14	14	0*
2/04/2019		10	11	19		0*
3/04/2019		16	24	23		0*
4/04/2019	16	20	18	10		0*
5/04/2019	19	17	14	9	15	19*
6/04/2019	17	16	15	17	14	17*
7/04/2019	30	23	19	12	19	30*
8/04/2019	53	43	27	22	33	54*
9/04/2019	58	41	24	19	36	56*
10/04/2019	30	28	29	17	25	30*
11/04/2019	21	20	22	11	18	21*

Date	24-hour PM_{10} (µg/m^3)					
	DC02	DC04	DC05	DC06	DC07	DC09
	Sheppard Avenue	South Muswellbrook	Roxburgh Road	Edderton Road	Antiene	Wellbrook
12/04/2019	20	18	22	11	18	20*
13/04/2019	38	24	24	18	21	39*
14/04/2019	36	32	46	24	29	35*
15/04/2019	31	24	21	13	20	31*
16/04/2019	27	23	23	10	19	27*
17/04/2019	23	16	27	13	15	23*
18/04/2019	26	24	24	16	16	26*
19/04/2019	25	21	24		20	25*
20/04/2019	20	20	22		16	19*
21/04/2019	24	21	26		19	25*
22/04/2019	35	23	41		21	36*
23/04/2019	24	18	26		17	24*
24/04/2019	38	23	19		20	0*
25/04/2019	62	33	27	34	25	61*
26/04/2019	62	38	28	27	36	62*
27/04/2019	52	44	44	32	40	51*
28/04/2019	34	27	24	18	23	35*
29/04/2019	46	32	44	34	33	45*
30/04/2019	42	31	35	26	29	43*
1/05/2019	53	30	35	27	26	29
2/05/2019	60	36	35	28	37	33
3/05/2019	31	20	20	15	17	25
4/05/2019	10	6	5	4	7	7
5/05/2019	12	12	9	5	11	11
6/05/2019	15	11	10	9	9	11
7/05/2019	17	12	8	7	11	12
8/05/2019	35	22	17	13	21	22
9/05/2019	24	15	16	11	14	25
10/05/2019	21	19	21	11	19	20
11/05/2019	17	12	9	5	15	10
12/05/2019	14	14	18	10	12	19
13/05/2019	31	23	21	20	18	20
14/05/2019	26	21	17	15	20	20
15/05/2019	22	20	27	19	24	28
16/05/2019	18	19	21	16	18	25
17/05/2019	34	31	29	23	29	32
18/05/2019	28	25	28	17	25	24
19/05/2019	20	21	28	17	20	27
20/05/2019	30	26	17	19	17	22
21/05/2019	27	20	12	16	15	21
22/05/2019	36	18	19	13	18	29

Date	24-hour PM_{10} (µg/m^3)					
	DC02	DC04	DC05	DC06	DC07	DC09
	Sheppard Avenue	South Muswellbrook	Roxburgh Road	Edderton Road	Antiene	Wellbrook
23/05/2019	40	27	34	29	25	39
24/05/2019	38	29	20	17	24	23
25/05/2019	32	22	16	17	19	24
26/05/2019	39	28	17	13	26	22
27/05/2019	47	27	12	10	32	24
28/05/2019	26	16	12	9	18	15
29/05/2019	36	20	11	9	19	20
30/05/2019	24	15	11	5	14	13
31/05/2019	27	14	13	9	13	24
1/06/2019	34	25	26	20	23	35
2/06/2019	35	30	22	21	27	23
3/06/2019	17	13	6	8	12	10
4/06/2019	14	11	5	3	9	6
5/06/2019	19	16	6	2	10	8
6/06/2019	22	17	14	8	19	10
7/06/2019	38	27	24	16	27	27
8/06/2019	40	34	31	23	27	25
9/06/2019	19	17	8	12	15	13
10/06/2019	20	16	7	10	13	13
11/06/2019	21	16	13	13	13	21
12/06/2019	27	18	18	13	14	15
13/06/2019	38	25	15	15	21	15
14/06/2019	24	19	10	8	15	12
15/06/2019	35	26	27	13	19	20
16/06/2019	60	32	38	23	23	35
17/06/2019	30	20	11	8	19	22
18/06/2019	16	13	7	7	11	10
19/06/2019	18	16	15	9	12	18
20/06/2019	22	21	33	17	16	31
21/06/2019	32	28	18	10	23	17
22/06/2019	24	23	26	16	22	27
23/06/2019	27	19	16	10	17	20
24/06/2019	14	11	7	8	9	8
25/06/2019	9	8	6	4	9	7
26/06/2019	12	11	11	8	12	11
27/06/2019	12	12	13	8	13	13
28/06/2019	14	14	15	11	12	13
29/06/2019	15	14	12	11	10	13
30/06/2019	24	20	13	10	18	15

Date	24-hour PM_{10} (µg/m³)					
	DC02	**DC04**	**DC05**	**DC06**	**DC07**	**DC09**
	Sheppard Avenue	**South Muswellbrook**	**Roxburgh Road**	**Edderton Road**	**Antiene**	**Wellbrook**
Annual Average Regulatory Criteria	30 µg/m³					
Annual Average	30	25	21	19	20	25
Maximum	223	163	124	107	146	168
Data Recovery %	93	93	93	89	91	85
Annual Average TSP Regulatory Criteria	90 µg/m³					
Annual Average TSP	75	61	53	46	51	61

24-hour validated result exceeded regulatory criteria

Results unavailable (for example due to equipment failure, power outage, etc) or results invalid due to being outside of validation criteria

* Non-validated data – due to firmware upgrades, data from the data logger was inadvertently wiped; the data shown is from the daily checks of the data prior to validation occurring

Note: Data summaries (annual average, maximum, data recovery %) exclude non-validated data

Note: Validated data presented here is different to that used for exceedance reporting as per Table 15

Appendix 1A – Example Air Quality Exceedance Report

Mt Arthur Coal

Reporting Date: 17/06/2019
Reported Date: 16/06/2019

Mt Arthur Coal Daily Report - Dust

Figure 1 : PM10 Absolute concentration 24 hour average

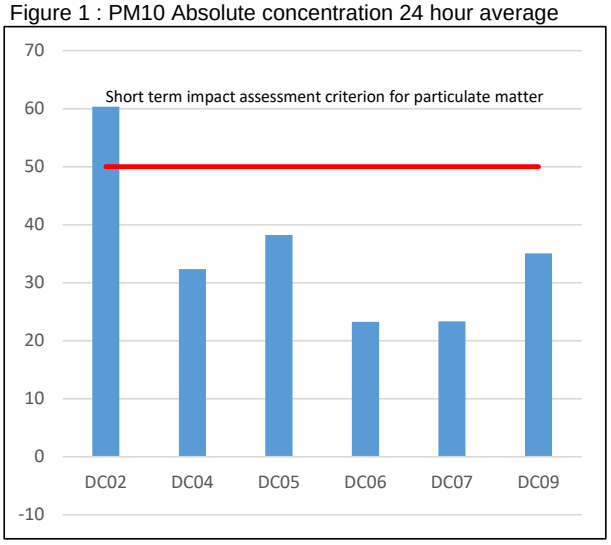


Table 1 : Last 24 hour PM10

	Absolute PM10 (µg/m3)	Incremental PM10 (µg/m3)
DC02	60.4	0.4
DC04	32.3	0.0
DC05	38.2	0.0
DC06	23.2	2.5
DC07	23.3	0.1
DC09	35.1	0.3
Background	32.4	

Absolute Concentration: Incremental increase in concentrations due to the project plus background concentrations due to all other sources. NB: where the Absolute concentration is zero, this is may be as a result of a filter paper change or power failure, as the TEOM resets to zero automatically.

Incremental Concentration: Incremental increase in concentrations due to the project on its own. Note that this value is not simply the Absolute concentration minus the Background; the latter is influenced by wind direction and minimum wind speed.

Background Concentration: Calculated concentration in the absence of contributions from the mine. This is the average of all background concentrations for the day.

Figure 2 : Last 24 hour windrose (WS09)

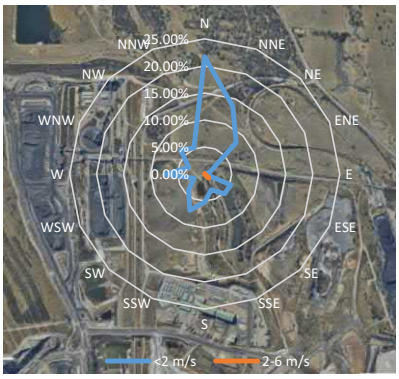
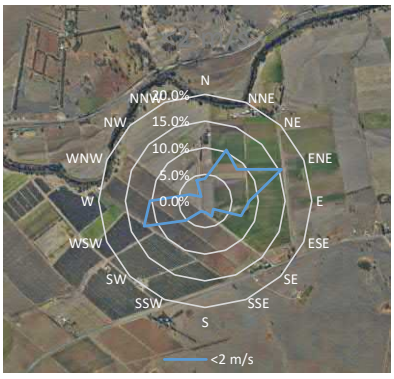


Figure 3 : Last 24 hour windrose (WS10)



Rainfall (mm): 0.0

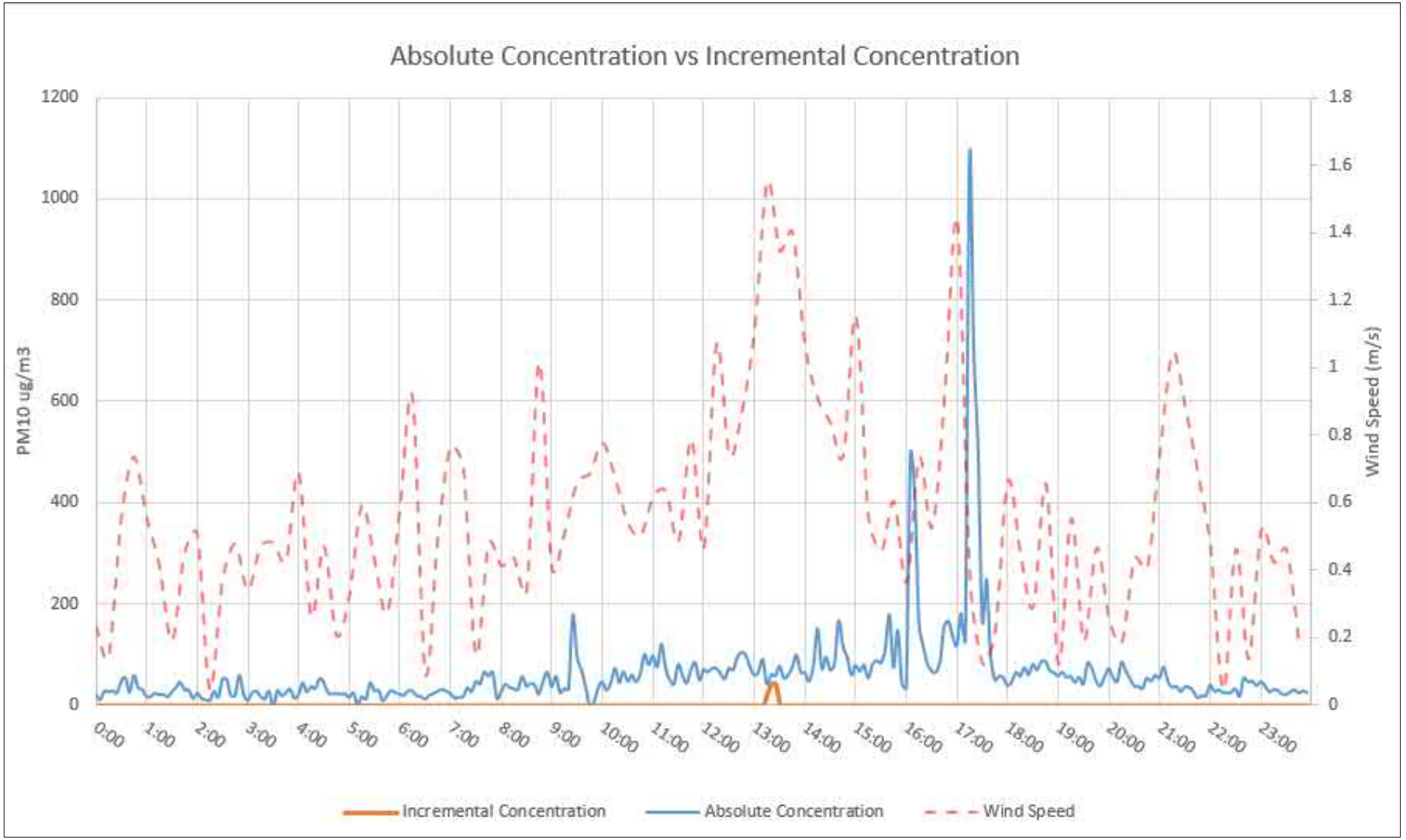
Rainfall (mm): 0.0

Table 2 : Dust TARP

Trigger Action Response Plan
Business as Usual Mining
Standard dust control measures include:
- Watercart scheduling to ensure active haul roads are routinely watered
- Roads are speed limited
- Assessment of weather conditions prior to blasting
- Conveyors shielded
- Water spray fitted at conveyor transfers
- Water sprays on plant feed
- Water sprays on clean coal stockpiles
- Raw coal hopper bins shielded and water sprays fitted

Table 3 : Daily Alarm Report Summary (if blank, no alarms)

Alarm Type	Station	Start Time	Inc PM10 (µg/m3)	Abs PM10 (µg/m3)	Action Details (IROC)	Action Details (THIESS)

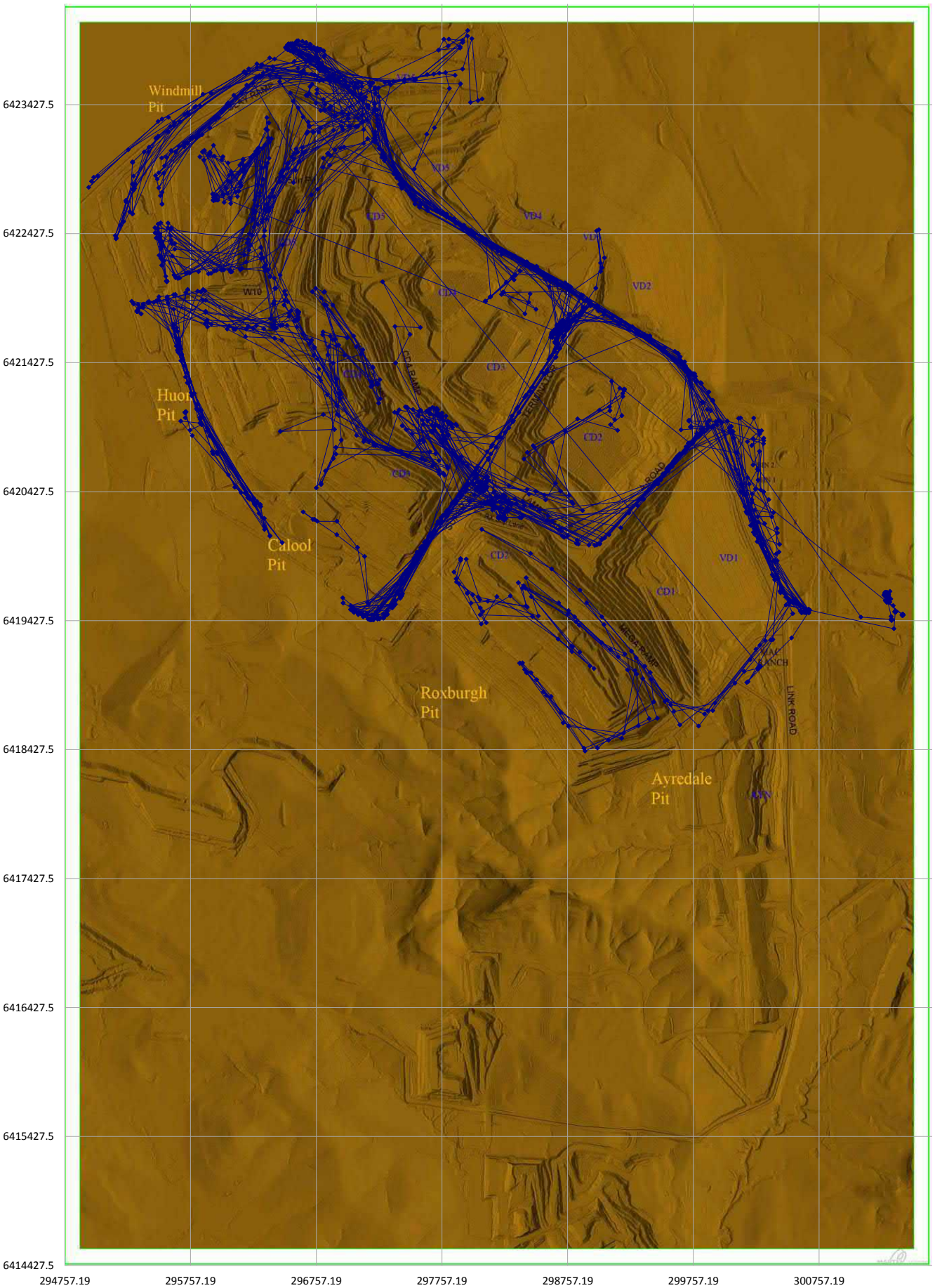

Absolute Concentration vs Incremental Concentration
PM10 ug/m3
Wind Speed (m/s)
1200
1000
800
600
400
200
0
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
0:00
1:00
2:00
3:00
4:00
5:00
6:00
7:00
8:00
9:00
10:00
11:00
12:00
13:00
14:00
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
Incremental Concentration
Absolute Concentration
Wind Speed

Mt Arthur Coal

24 Hour Environmental Summary

Sunday 16-Jun-2019

Watercart GPS Trace - All Watercarts



MinVu

Mt Arthur Coal

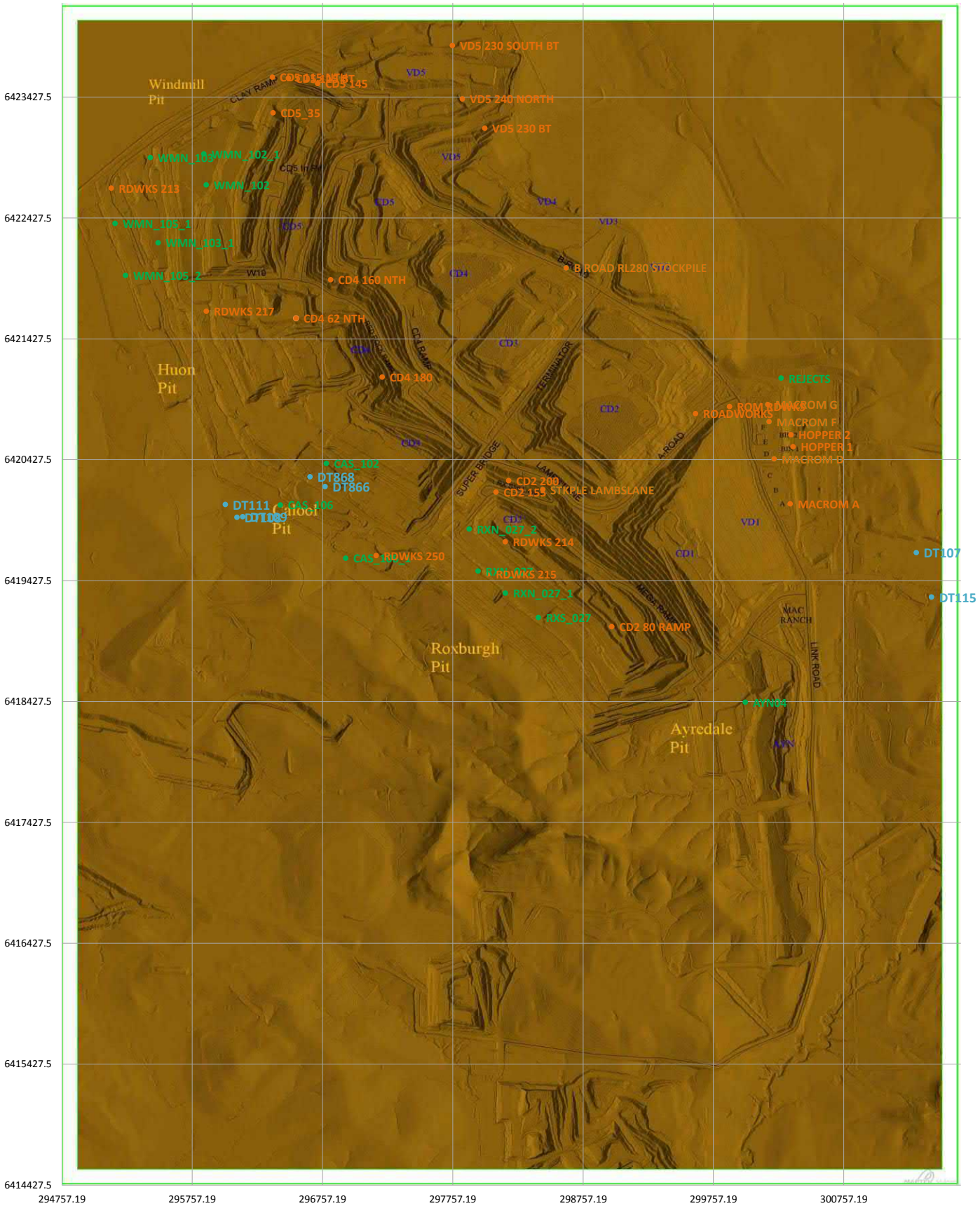
24 Hour Environmental Summary

Sunday 16-Jun-2019

BHP

Mining Activity Locations

Key: Dump Location Load Location Drill Location



Mt Arthur Coal

24 Hour Environmental Summary - Watercarts ONLY

Sunday 16-Jun-2019

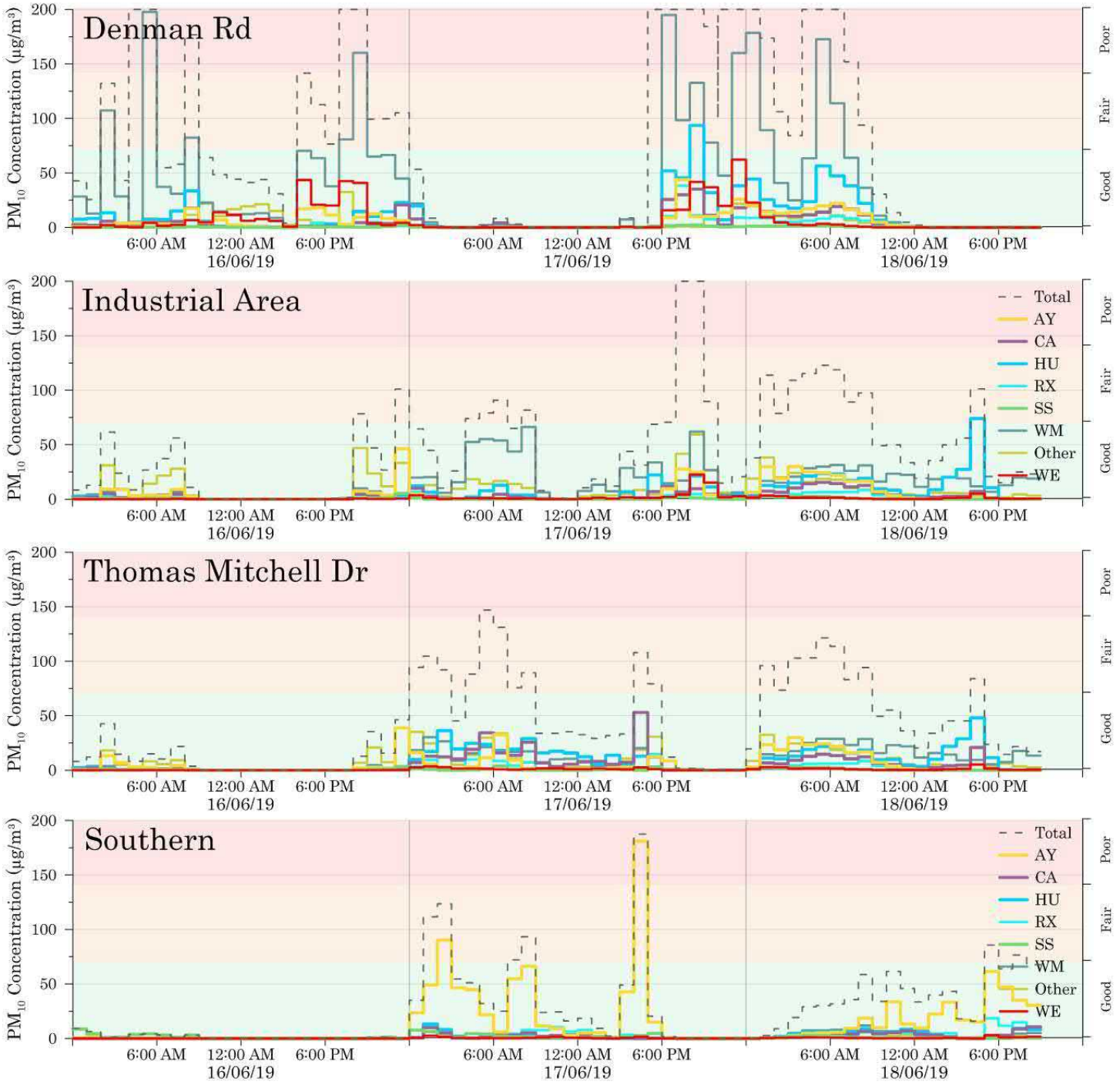
Total Wait on Dust hrs: **0.00**

Equipment	Equipment Type	Production (hours)	Wait on Dust (hours)
WC594	Cat 777WC	21.7	0.0
WC595	Cat 777WC	9.9	0.0
WC596	Cat 777WC	22.1	0.0
WC597	Cat 777WC	24.0	0.0
WC653	Cat 777WC	24.0	0.0
WC654	Cat 777WC	23.5	0.0
WC656	Cat 777WC	23.9	0.0
WC657	Cat 777WC	18.9	0.0
WC658	Cat 777WC	23.8	0.0
		191.8	0.00

16/06/2019																								
	12am	1am	2am	3am	4am	5am	6am	7am	8am	9am	10am	11am		12pm	1pm	2pm	3pm	4pm	5pm	6pm	7pm	8pm	9pm	10pm	11pm
WS	0.6	1.0	1.2	0.9	0.5	1.6	2.1	1.7	2.1	2.6	3.6	3.4	WS	3.0	3.9	3.8	2.9	3.9	4.1	3.4	3.7	2.2	1.3	1.8	2.1
WD	NNW	NW	SSE	SE	SE	SE	SE	SE	SE	SE	SE	SE	WD	SE	SE	SE	SE	SE	SSE	SE	SE	SSE	SE	SE	SSE
Max 1-hour average PM_{10} concentration ($\mu g/m^3$)																									
Denman Rd	43	26	132	43	17	>200	55	58	177	64	48	44	Denman Rd	41	44	31	4	142	113	77	163	>200	99	100	105

17/06/2019														18/06/2019											
	12am	2am	4am	6am	8am	10am	12pm	2pm	4pm	6pm	8pm	10pm		12am	2am	4am	6am	8am	10am	12pm	2pm	4pm	6pm	8pm	
WS	1.3	1.5	1.2	0.3	1.8	1.7	1.9	1.3	1.0	2.3	3.5	3.0	WS	1.5	0.7	1.2	0.3	0.6	1.1	1.1	1.9	2.0	1.4	1.8	
WD	NW	NW	NW	NW	WNW	WNW	WSW	WSW	SSW	SSE	SSE	SE	WD	SE	SE	SE	NNE	NW	WNW	WNW	W	WNW	NW	NW	
Max 2-hour average PM_{10} concentration ($\mu g/m^3$)																									
Denman Rd	31	1	1	6	0	0	0	4	1	>200	>200	>200	Denman Rd	>200	95	>200	190	62	9	1	0	0	0	0	

Forecast Date: 16 Jun 2019 - 18 Jun 2019



BHP

Spatial Data Team
Brisbane

1:53,000

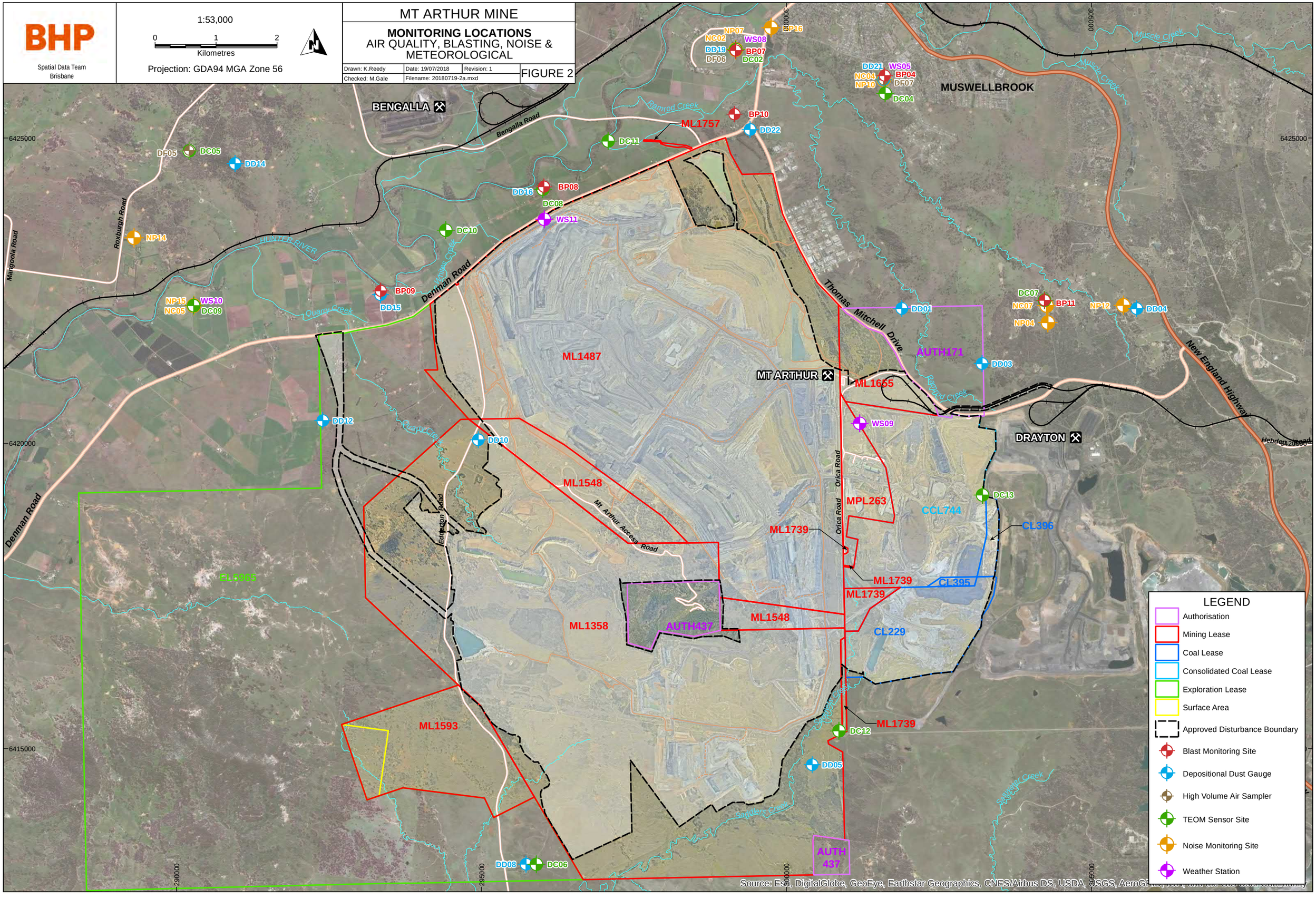
0 1 2
Kilometres

Projection: GDA94 MGA Zone 56

MT ARTHUR MINE

MONITORING LOCATIONS
AIR QUALITY, BLASTING, NOISE & METEOROLOGICAL

Drawn: K.Reedy	Date: 19/07/2018	Revision: 1	FIGURE 2
Checked: M.Gale	Filename: 20180719-2a.mxd		



LEGEND

- Authorisation
- Mining Lease
- Coal Lease
- Consolidated Coal Lease
- Exploration Lease
- Surface Area
- Approved Disturbance Boundary
- Blast Monitoring Site
- Depositional Dust Gauge
- High Volume Air Sampler
- TEOM Sensor Site
- Noise Monitoring Site
- Weather Station

How to Interpret MAC Investigation Reports

Definitions

Table 1 Definitions of terminology

Absolute Concentration (µg/m^3) (Total Impact)	*Incremental increase in concentrations due to the project plus background concentrations due to all other sources* - PA09_0062 Schedule 3 Section 20.
Incremental Concentration (µg/m^3) (Incremental Impact)	*Incremental increase in concentrations due to the project on its own* - PA09_0062 Schedule 3 Section 20.
Background concentration (µg/m^3)	Calculated concentration measured in the absence of contributions from the mine
Arc of Influence	Directional values where MAC has the ability to influence the PM_{10} concentration

Alerts

Table 2 Mt Arthur Coal alert levels

Alert Level 1	1 hour incremental rolling average exceeds 90 µg/m3
Alert Level 2	3 Hour incremental rolling average exceeds 80 µg/m3
Alert Level 3	24 Hour rolling average exceeds 45 µg/m3

Dust Arcs

Table 3 Mt Arthur Coal monitoring stations arc of influence

TEOM monitor	**Wind direction (at TEOM) assigned to Mt Arthur contribution (degrees from north)****
DC02 Sheppard Avenue (Racecourse)	165–230
DC04 South Muswellbrook	185–251
DC05 Constable	93–143
DC06 Edderton Homestead	355–75
DC07 Antiene	209–290
DC08 Edinglassie	82–218
DC09 Wellbrook	74–135
DC10 Edinglassie West	74–160
DC11 Hunter River Pump	139–228
DC12 Conveyor (Drayton Void)	74–160
DC13 Bayswater	139–228

Incremental and Background Calculations

Incremental concentration is calculated as:

$$\text{Incremental Concentration} = \text{Absolute } PM_{10} \text{ Concentration} - \text{Site Background Concentration}$$

Site Background Concentration is calculated as:

Average of concentrations at each monitoring points that fall outside the arc of influence (defined in Table 3).

Every 5 minutes:

- Site Background Concentration is calculated as above;
- Incremental Concentration is calculated as above;

Every 24 hours:

- 24 hour average Absolute Concentrations are reported
- 24 hour average Incremental Concentrations are reported

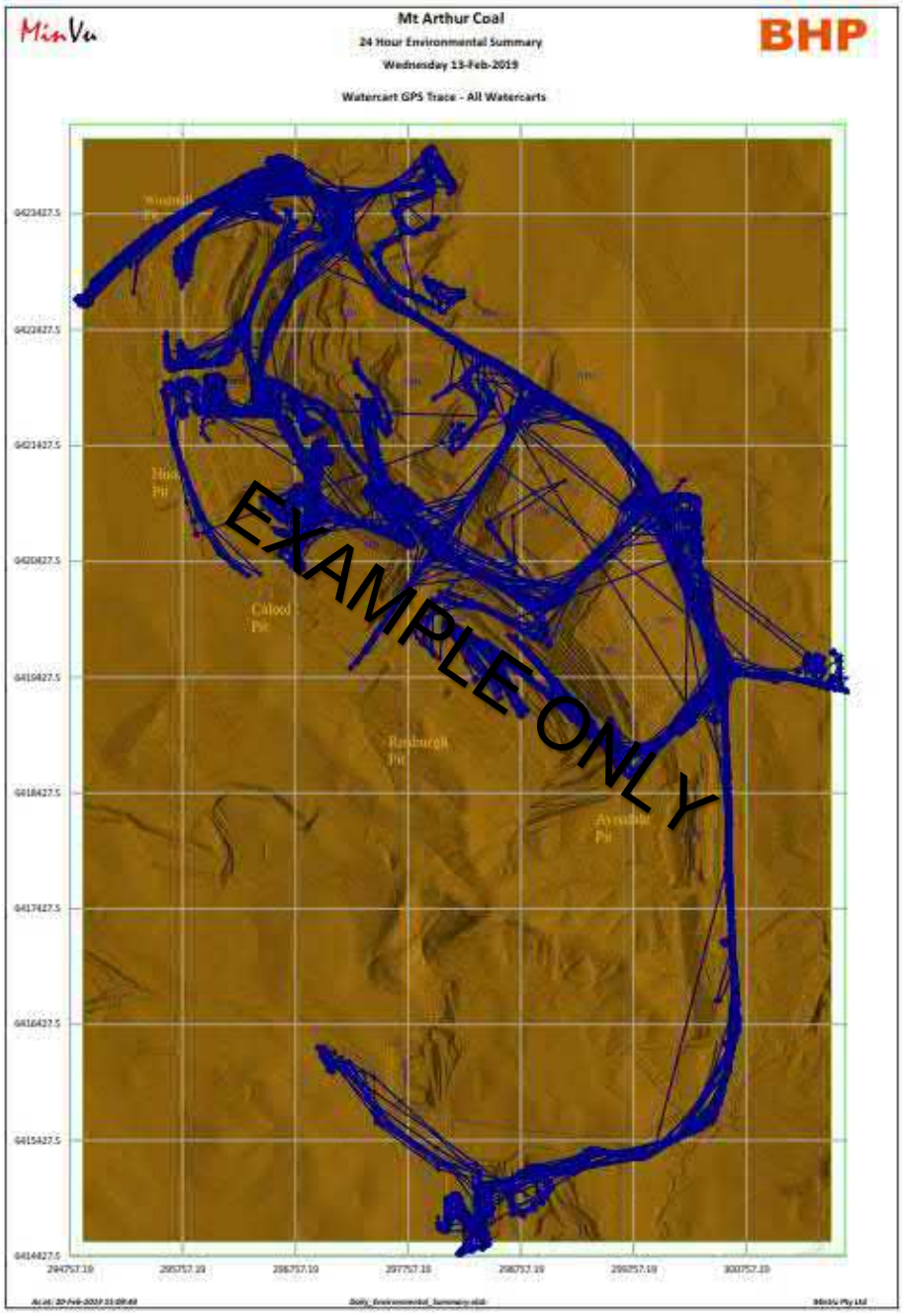
How to interpret Daily Environmental Summary

Contents:

- Watercart GPS trace for 24 hour period
- Mining Activity Locations for 24 hour period
- Number and production hours of watercarts for 24 hour period
- Mt Arthur Daily Meteorological forecast
- Monitoring Locations M

Watercart GPS trace for 24 hour period

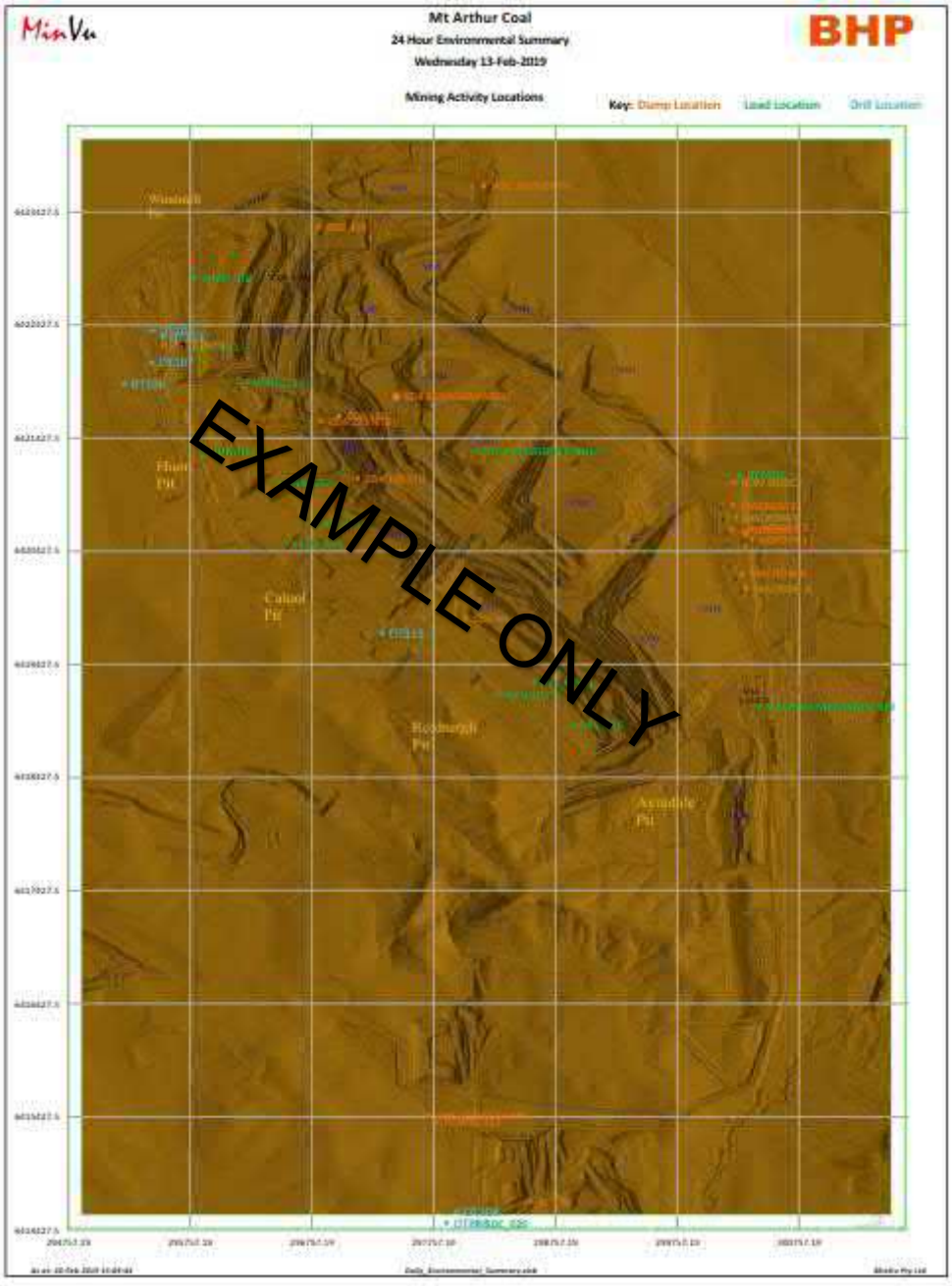
Map of all locations/routes MAC watercarts travelled throughout the period represented by blue lines. Intensity of activity can be seen by thicker and more frequent blue lines.



Mining Activity Locations for 24 hour period

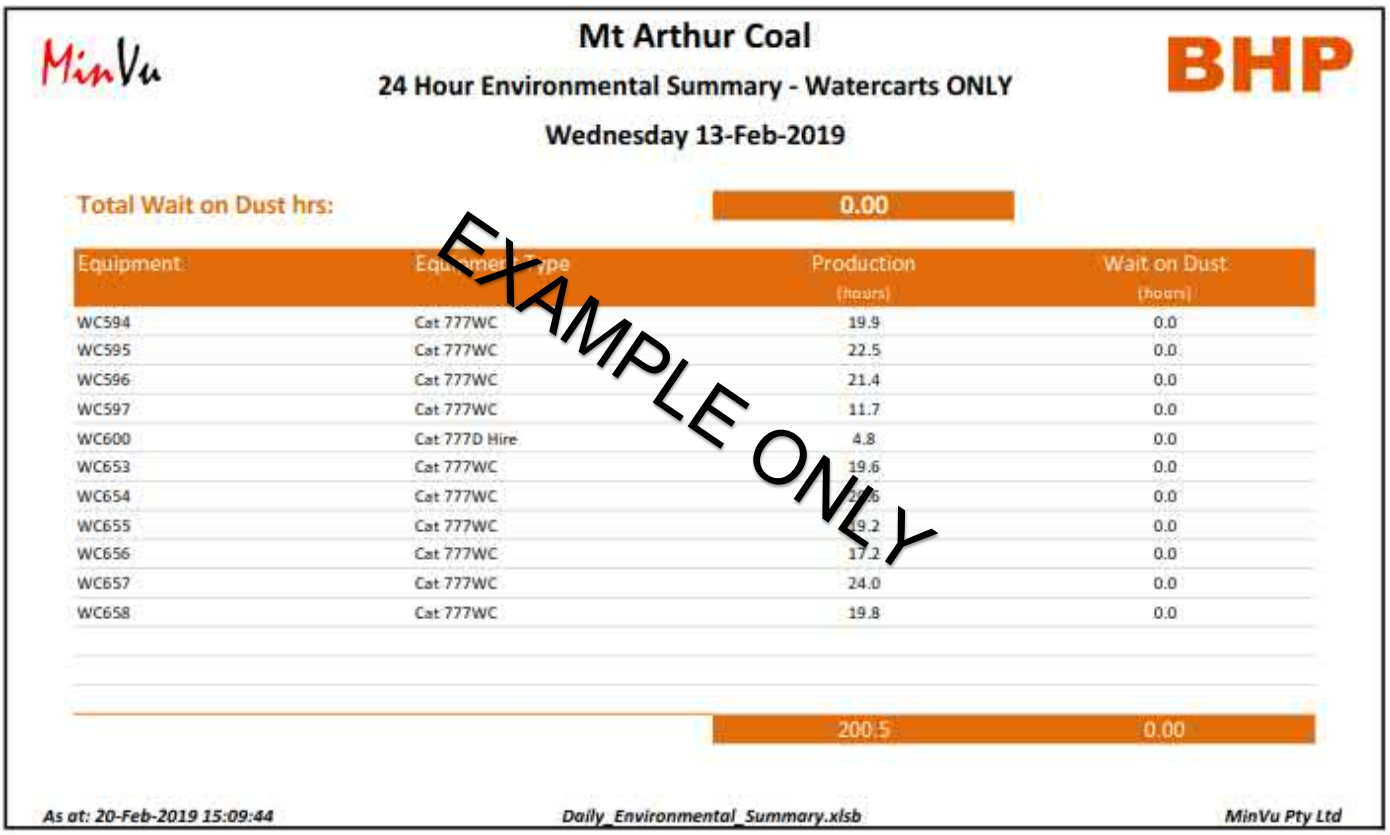
Map of all dumping, loading/digging and drilling locations throughout the period.

Locations are colour coded as per legend.



Number and production hours of watercarts for 24 hour period

List of all watercarts in operation during the period. Production hours represents total operating time/ watercart.



MinVu

Mt Arthur Coal

24 Hour Environmental Summary - Watercarts ONLY

Wednesday 13-Feb-2019

BHP

Total Wait on Dust hrs: 0.00

EXAMPLE ONLY

Equipment	Equipment Type	Production (hours)	Wait on Dust (hours)
WC594	Cat 777WC	19.9	0.0
WC595	Cat 777WC	22.5	0.0
WC596	Cat 777WC	21.4	0.0
WC597	Cat 777WC	11.7	0.0
WC600	Cat 777D Hire	4.8	0.0
WC653	Cat 777WC	19.6	0.0
WC654	Cat 777WC	22.6	0.0
WC655	Cat 777WC	19.2	0.0
WC656	Cat 777WC	17.2	0.0
WC657	Cat 777WC	24.0	0.0
WC658	Cat 777WC	19.8	0.0
		200.5	0.00

As at: 20-Feb-2019 15:09:44 *Daily_Environmental_Summary.xlsb* *MinVu Pty Ltd*

Appendix 2 – Surface Water Quality Monitoring Results

Surface Water Quality Results

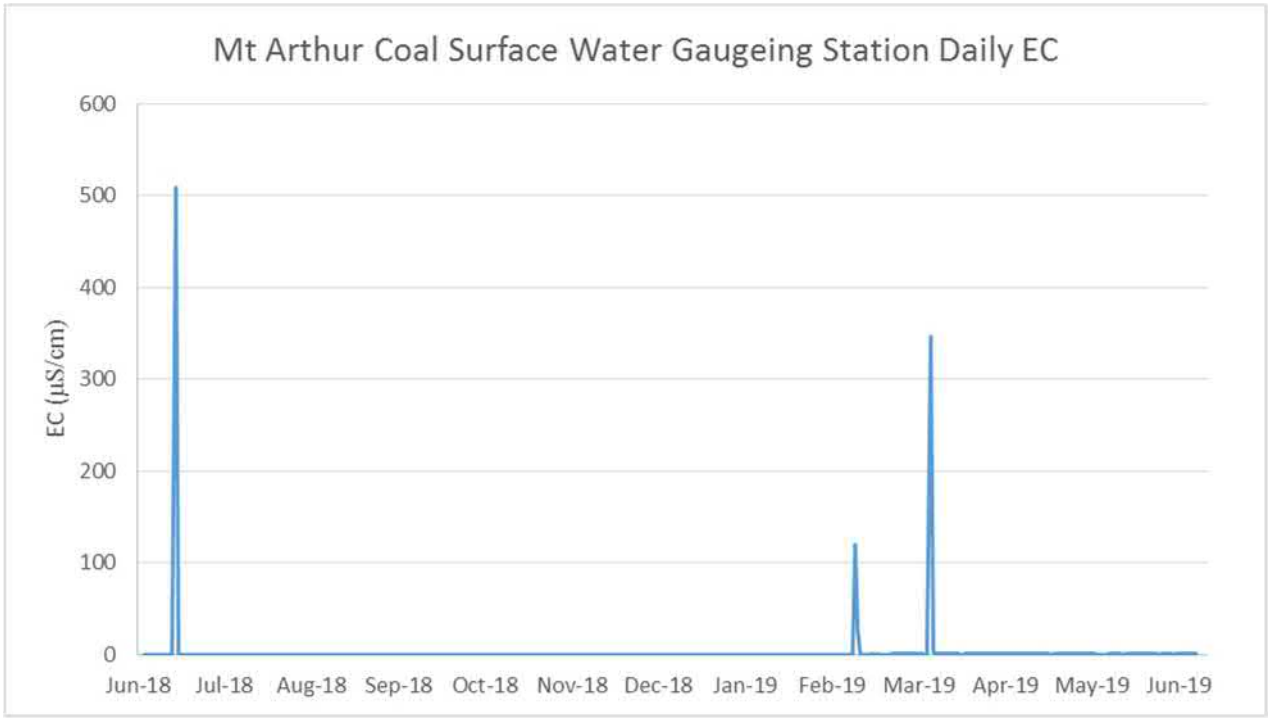
Site	Month	Date sampled	Flow (description)	Field pH	Field EC (uS/cm)	TDS (mg/L)	TSS (mg/L)	Turbidity (NTU)	Sulfate (mg/L)	Dissolved Fe (mg/L)	Total Fe (mg/L)	Nitrate (mg/L)	O&G (mg/L)
SW02	Jul-18	23 & 25/7/2018											
	Aug-18	21 & 22/8/2018											
	Sep-18	17 & 18/9/2018											
	Oct-18	23 & 24/10/2018											
	Nov-18	20 & 21/11/2018											
	Dec-18	11 & 12/12/2018											
	Jan-19	15 & 16/1/2019											
	Feb-19	18 & 22/2/2019											
	Mar-19	19 & 20/3/2019											
	Apr-19	8 & 9/4/2019											
	May-19	14 & 15/5/2019											
	Jun-19	17 & 18/6/2019											
	Impact Assessment Criteria Trigger Values		**Stage 1 Trigger**	**6.5< >9.0**	**12365**		**219**						
			Stage 2 Trigger		**13900**		**277**						
SW03	Jul-18	23 & 25/7/2018	Still	8.36	8010	5610	38	7.7	782	<0.05	0.47	<0.01	<5
	Aug-18	21 & 22/8/2018	Still	8.23	8760	5390	32	10.3	784	<0.05	2.9	<0.01	<5
	Sep-18	17 & 18/9/2018	Still	7.9	7600	4840	136	26.6	736	<0.05	0.74	<0.01	<5
	Oct-18	23 & 24/10/2018	Still	8.11	7330	5690	24	10.5	747	<0.05	0.41	<0.01	<5
	Nov-18	20 & 21/11/2018	Still	8.03	10000	6340	19	1.8	827	0.09	0.24	<0.01	<5
	Dec-18	11 & 12/12/2018	Still	8.09	8680	5830	28	44.1	689	0.06	0.6	0.04	<5
	Jan-19	15 & 16/1/2019	Still	8.54	10400	6170	17	4.4	841	0.07	0.13	<0.01	5
	Feb-19	18 & 22/2/2019											
	Mar-19	19 & 20/3/2019											
	Apr-19	8 & 9/4/2019	Still	7.11	1303	667	8	5.7	318	0.39	0.7	<0.01	<5
	May-19	14 & 15/5/2019	Still	7.42	2711	1750	37	7	662	0.19	3.24	0.01	<5
	Jun-19	17 & 18/6/2019	Still	7.81	3200	1950	15	3.5	702	0.12	0.74	<0.01	<5
	Impact Assessment Criteria Trigger Values		**Stage 1 Trigger**	**6.5< >9.0**	**10133**		**37**						
			Stage 2 Trigger		**11402**		**46**						

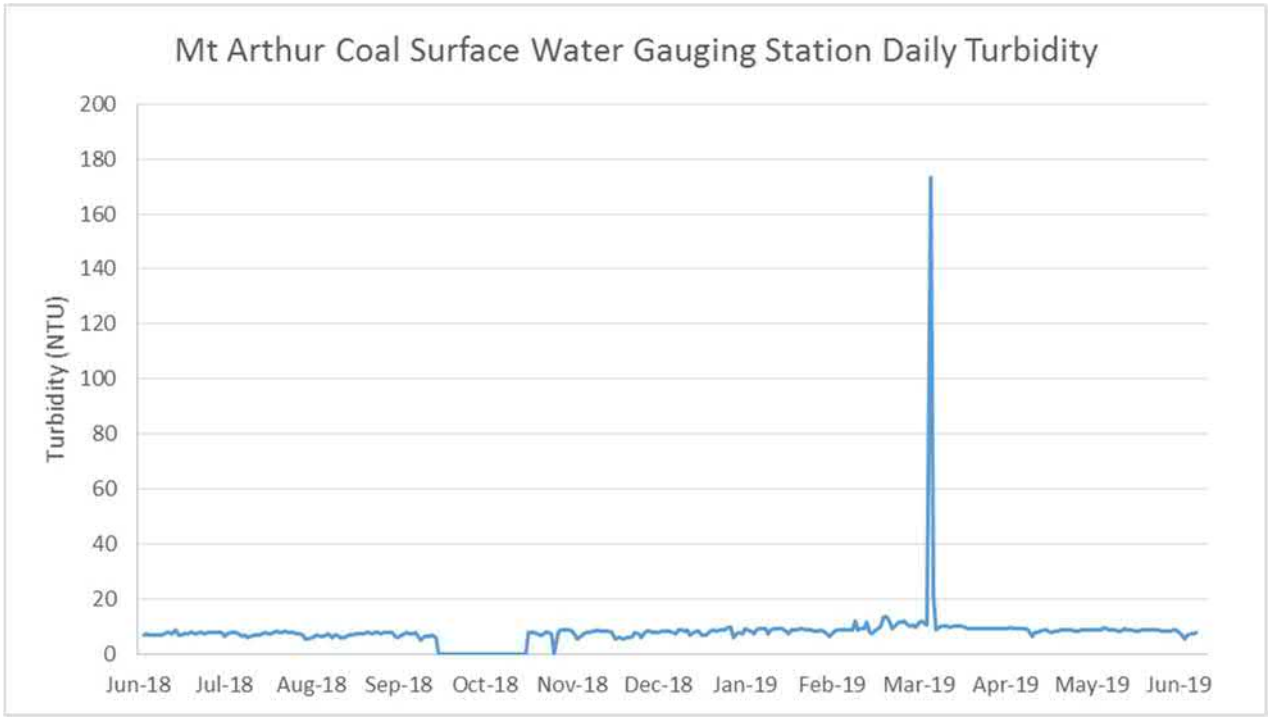
Site	Month	Date sampled	Flow (description)	Field pH	Field EC (uS/cm)	TDS (mg/L)	TSS (mg/L)	Turbidity (NTU)	Sulfate (mg/L)	Dissolved Fe (mg/L)	Total Fe (mg/L)	Nitrate (mg/L)	O&G (mg/L)
SW04	Jul-18	23 & 25/7/2018											
	Aug-18	21 & 22/8/2018											
	Sep-18	17 & 18/9/2018											
	Oct-18	23 & 24/10/2018											
	Nov-18	20 & 21/11/2018											
	Dec-18	11 & 12/12/2018	Still	8.64	21000	17600	61	34.7	4970	0.29	0.86	<0.01	<5
	Jan-19	15 & 16/1/2019											
	Feb-19	18 & 22/2/2019											
	Mar-19	19 & 20/3/2019											
	Apr-19	8 & 9/4/2019	Still	8.57	4090	2350	11	8.2	625	<0.05	0.19	8.23	<5
	May-19	14 & 15/5/2019	Still	8.48	7200	5210	35	17.8	1800	0.21	1.92	<0.01	<5
	Jun-19	17 & 18/6/2019											
	Impact Assessment Criteria Trigger Values		**Stage 1 Trigger**	**6.5< >9.0**	**13959**		**82**						
			Stage 2 Trigger		**15509**		**104**						
SW12	Jul-18	23 & 25/7/2018	Still	7.64	5960	4860	12	10.5	1840	0.07	1.33	0.06	<5
	Aug-18	21 & 22/8/2018	Still	7.75	7030	5240	9	4	2130	<0.05	0.56	<0.01	<5
	Sep-18	17 & 18/9/2018	Still	7.53	6690	5150	6	5	1890	0.09	0.52	0.04	<5
	Oct-18	23 & 24/10/2018	Still	7.57	6810	6310	<5	6.7	2200	0.14	0.66	<0.01	<5
	Nov-18	20 & 21/11/2018	Still	7.81	11900	6150	340	172	2560	<0.05	7.66	<0.01	<5
	Dec-18	11 & 12/12/2018	Still	7.83	12600	9060	8	14.8	3550	0.05	1.52	<0.01	<5
	Jan-19	15 & 16/1/2019	Still	7.32	3230	1900	6	4.4	721	0.16	1.06	<0.01	<5
	Feb-19	18 & 22/2/2019	Still	8.1	6200	3680	39	10.3	1440	0.12	0.95	<0.01	<5
	Mar-19	19 & 20/3/2019	Still	8.65	8140	5970	76	47.6	4950	0.15	2.22	<0.01	<5
	Apr-19	8 & 9/4/2019	Still	7.64	1180	797	50	20.1	342	<0.05	0.41	0.57	<5
	May-19	14 & 15/5/2019	Still	7.08	2226	1650	88	16.9	577	0.21	1.69	0.02	<5
	Jun-19	17 & 18/6/2019	Still	7.4	2470	1790	10	1.4	735	<0.05	0.24	<0.01	<5
	Impact Assessment Criteria Trigger Values		**Stage 1 Trigger**	**6.5< >9.0**	**6659**		**555**						
			Stage 2 Trigger		**7153**		**708**						
SW15	Jul-18	23 & 25/7/2018											
	Aug-18	21 & 22/8/2018											

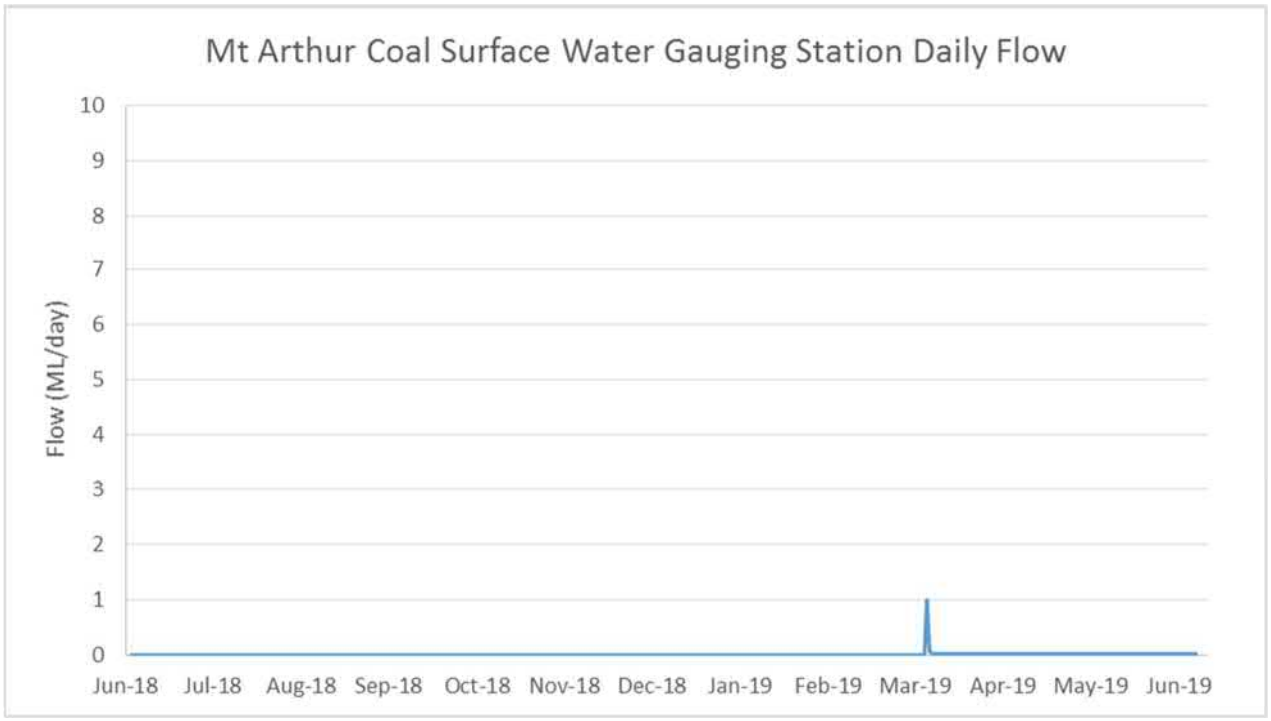
Site	Month	Date sampled	Flow (description)	Field pH	Field EC (uS/cm)	TDS (mg/L)	TSS (mg/L)	Turbidity (NTU)	Sulfate (mg/L)	Dissolved Fe (mg/L)	Total Fe (mg/L)	Nitrate (mg/L)	O&G (mg/L)
	Sep-18	17 & 18/9/2018											
	Oct-18	23 & 24/10/2018											
	Nov-18	20 & 21/11/2018											
	Dec-18	11 & 12/12/2018											
	Jan-19	15 & 16/1/2019	Dam	7.58	1690	1160	<5	18.6	144	0.44	0.53	<0.01	6
	Feb-19	18 & 22/2/2019											
	Mar-19	19 & 20/3/2019											
	Apr-19	8 & 9/4/2019	Dam	7.21	614	390	7	5	111	0.57	1.08	<0.01	<5
	May-19	14 & 15/5/2019	Dam	7.53	887	548	9	13.3	77	1.06	3.38	0.02	<5
	Jun-19	17 & 18/6/2019	Dam	7.5	893	506	12	4.6	92	0.64	1.13	<0.01	<5
	Impact Assessment Criteria Trigger Values		**Stage 1 Trigger**	**6.5< >9.0**	**7128**		**103**						
			Stage 2 Trigger		**8262**		**130**						

Unable to sample due to dry or low water level

Saddlers Creek Surface Water Flow Plots






Mt Arthur Coal Surface Water Gauging Station Daily Flow
Flow (ML/day)
10
9
8
7
6
5
4
3
2
1
0
Jun-18
Jul-18
Aug-18
Sep-18
Oct-18
Nov-18
Dec-18
Jan-19
Feb-19
Mar-19
Apr-19
May-19
Jun-19

Appendix 3 – Ground Water Monitoring Results and Groundwater Level Drawdown Analysis

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JFB,AC/JST:ak
G1936E.MAC drawdown review FY2019
13 September 2019

Attention: Sarah Parton

Mt Arthur Coal/NSW Energy Coal
Thomas Mitchell Drive
MUSWELLBROOK NSW 2333

Dear Sarah,

RE: Mt Arthur Coal Groundwater Annual Review – 2018/2019

1 Introduction

This letter report has been drafted to review MAC groundwater data as a requirement for Mt Arthur Coal's (MAC) 2018/2019 Annual Environmental Management Review (AEMR). Australasian Groundwater and Environmental Consultants Pty Ltd (AGE) have prepared this letter at the request of MAC.

2 Scope of work

The objective of the project was to review groundwater monitoring data collected in the 2018/2019 financial year (FY19) to satisfy the conditions of approval relating to groundwater. To achieve this objective, the scope of services included:

- Drawdown review:
    - reviewing groundwater levels and preparing plots of drawdown for July 2018 to June 2019;
    - comparing monitoring data to drawdown predictions from the sites numerical model prepared for the Mt Arthur Coal Consolidation Project Environmental Assessment[1]; and
    - preparing a summary table of approved impacts compared to measured monitoring results.
- Trigger exceedance review – review of trends in bores that have exceeded the trigger levels for water level and electrical conductivity;
- QA charge balance error:

[1] AGE (2009). Report on Mt Arthur Coal Consolidation Project – Groundwater Impact Assessment. Project G1446, June 2009.

    - undertaking relative percent difference (RPD) calculations on duplicate/triplicate analytical samples to assess potential variability in samples; and
    - calculating statistics (minimum, maximum, average, median and standard deviation) of field parameters and laboratory analyses to assess variability in datasets.
- cut-off wall performance assessment:
    - reviewing vibrating wire piezometer (VWP) data from VWP1, VWP2, VWP3_P1 and VWP3_P2;
    - comparing the VWP data to groundwater levels in adjacent monitoring bores constructed within alluvium; and
    - assessing the potential to mining related depressurisation of coal seams to impact upon alluvial groundwater levels.
- preparing a letter report summarising the findings in line with reporting requirements outlined in the Department of Planning and Environment (DPE) "Annual Review Guidelines for Post-approval requirements for State significant mining developments" date October 2015.

3 Results and discussion

3.1 Water level datasets

A map presenting the groundwater monitoring locations is presented on Figure 3.1 below.

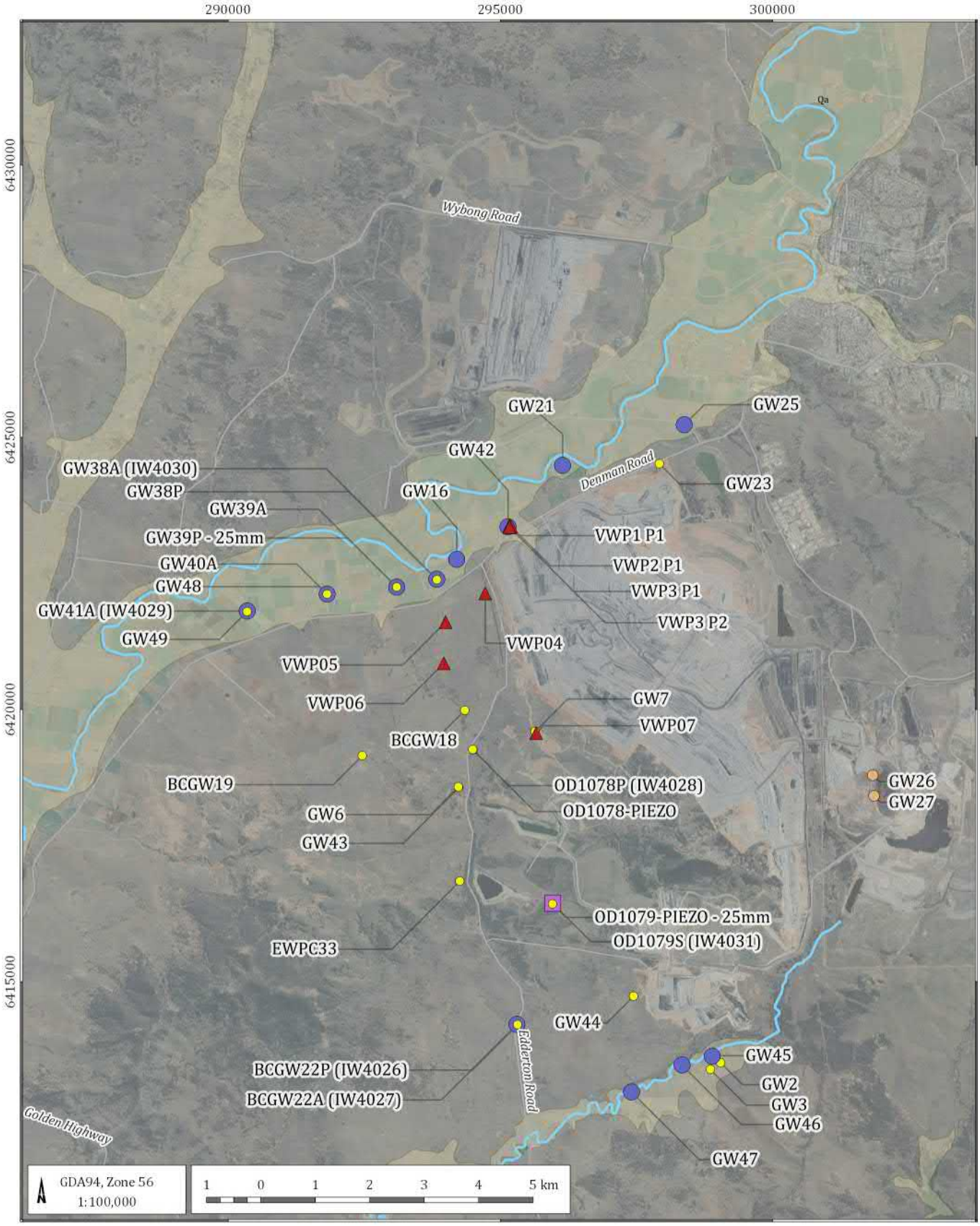
Water levels records from MAC were reviewed and summarised in Attachment A which contains information for the 38 groundwater monitoring sites including:

- bore details – surveyed location, elevation, depth and target formation;
- groundwater levels measured in each bore (initial measurement, July 2018 and June 2019);
- change in groundwater levels since records commenced; and also, for the period July 2018 to June 2019;
- water level thresholds for monitoring bores that if exceeded trigger investigation into the cause;
- monitoring bores where triggers have been exceeded for FY19 (shaded blue and bold text);
- groundwater levels predicted by the numerical model for FY19; and
- difference in groundwater levels predicted by the numerical model and the measured in the monitoring network.

The multiple sections below refer to information within this table.

3.2 Groundwater level changes and trigger events

Figure 3.2 shows the total drawdown calculated at each monitoring bore between the start of the monitoring records and June 2019. The monitoring bores are colour coded based on installation within either the alluvium (yellow label) or Permian strata (purple label). Contours lines of equal drawdown are also shown for the Permian. The drawdown in the Permian layers occurs in a zone west of the active mining areas. The drawdown shown on Figure 3.2 is a function of mining impacts and climatic conditions over the monitoring period. In the case of the Permian layers the measured drawdown change is largely attributed to the mining activities as climatic conditions are not expected to create water level changes of the magnitude observed.



LEGEND

Roads

Watercourses

Groundwter monitoring locations - MAC

- Monitoring bore - alluvium
- Monitoring bore - coal measures
- Monitoring bore - highwall/TSF
- Monitoring bore - spoil
- VWP - coal measures

MAC Annual Review 2018 - 2019 (G1936E)

Groundwater monitoring locations

DATE 03/09/2019

FIGURE No: **3.1**

G:\Projects\G1936E\MAC_annual_review_2018_2019\3_GIS\Workspaces\001_Deliverable1\G1936E_mon_loc_network.qgs

Trigger values for groundwater level monitoring are established in the MACs Site Water Management Plan[2], Groundwater Monitoring Program[3] and Surface and Groundwater Response Plan[4]. The general purpose of these plans is to minimise any adverse impacts on aquifers in proximity to the operation, including the two major aquifer areas, the hard rock coal measures and the shallow alluvial deposits associated with the Hunter River. The Groundwater Monitoring Program includes trigger levels based on predictions from the approved groundwater model for a selection of monitoring bores; a response protocol is also established and it must be followed in case the triggers are exceeded for an established period of time.

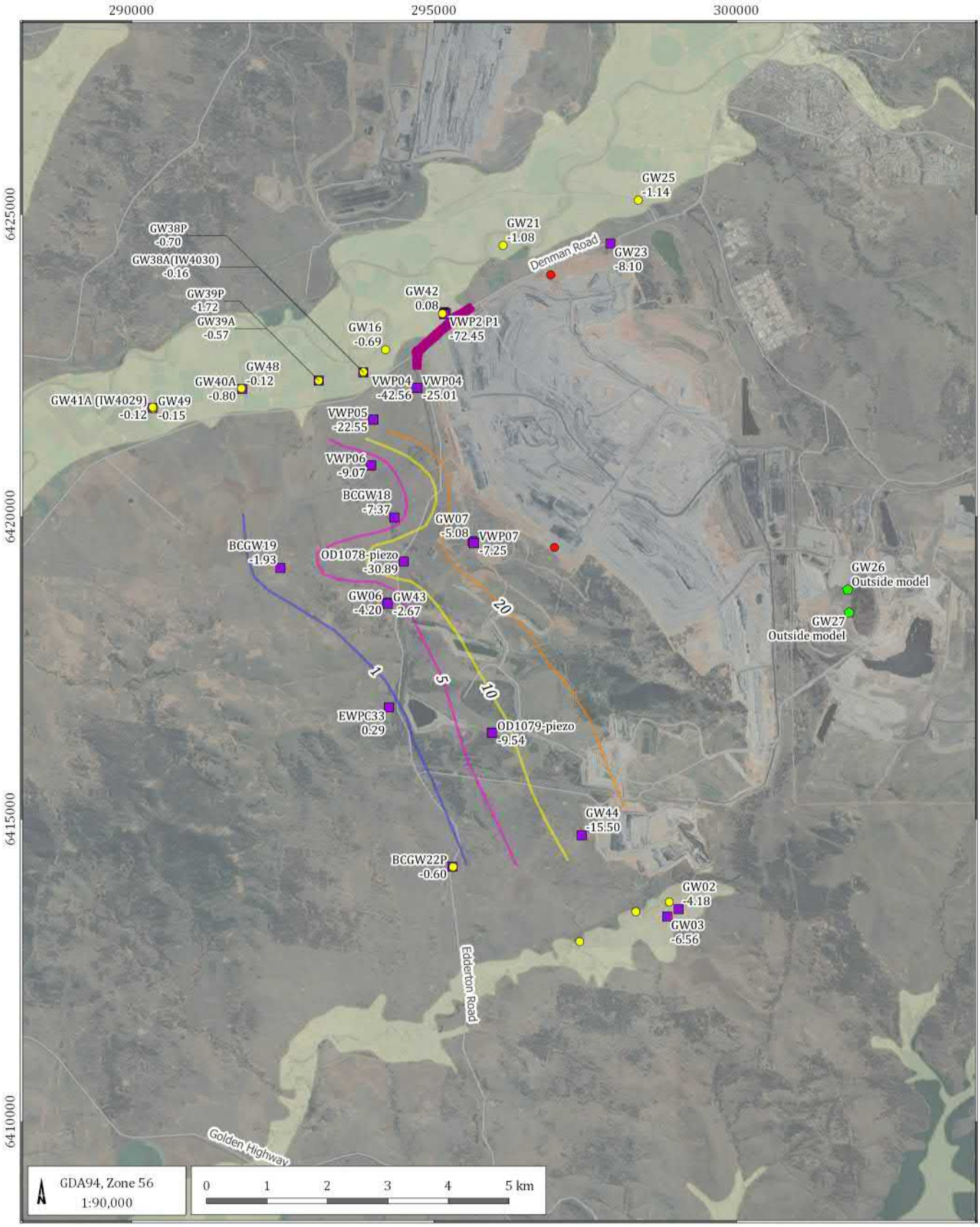
The trigger values are included in Attachment A, and groundwater levels exceeding the triggers (below the trigger) are highlighted on the table. The table indicates that groundwater levels fell below the trigger levels at eight sites during FY19 (GW2, GW3, GW21, GW23, GW39P, OD1078, VWP2, VWP3). Each trigger event was investigated by reviewing water level trends at each site and comparing this to climatic trends indicated by a monthly cumulative rainfall departure graph. Hydrographs for each monitoring site where the trigger was exceeded are provided in Figure 3.3 below. In the set of hydrographs presented in Figure 3.3, the Cumulative Rainfall Departure (CRD) curve is included in each graph to provide a comparison reference to assess if changes in groundwater levels are correlated with climatic conditions. The CRD is a summation of the monthly departure of rainfall from the long-term average monthly rainfall. A rising trend in the CRD plot indicates periods of above long-term average rainfall, whilst a falling slope indicates periods when rainfall is below long-term average.

Table 3.1 discusses the potential reasons for the trigger events at each monitoring site.

[2] BHP (2012). MAC-ENC-MTP-034 Site Water Management Plan.

[3] BHP (2015). MAC-ENC-PRO-062 Ground Water Monitoring Program (GWMP).

[4] BHP (2015). MAC-ENC-PRO-063 Surface and Ground Water Response Plan.



LEGEND

Monitoring locations and drawdowns

- Alluvium
- Coal Measures
- Coal Measures/Highwall
- Mined out

Roads

Bentonite wall

Permian aquifer drawdown (m)

- 1
- 5
- 10
- 20

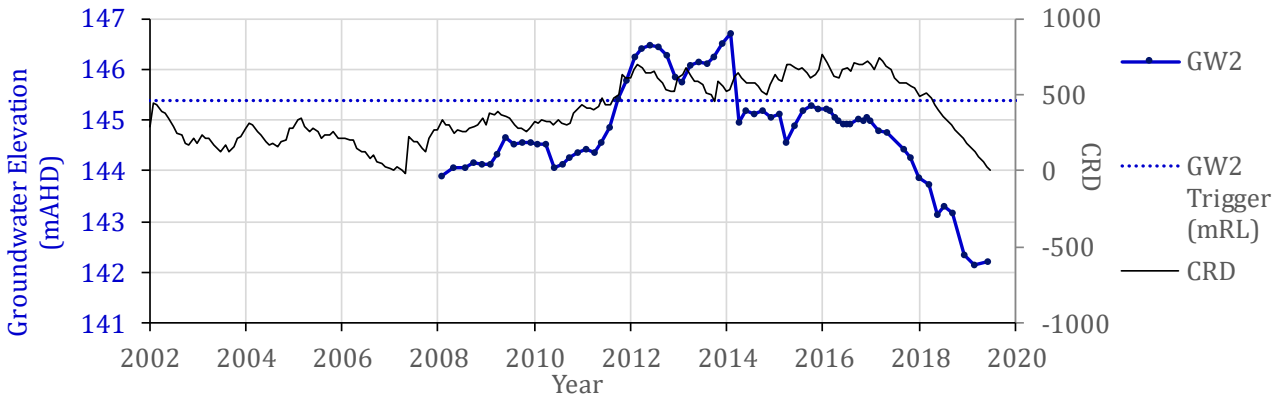
MAC Annual review 2018-19 (1936E)

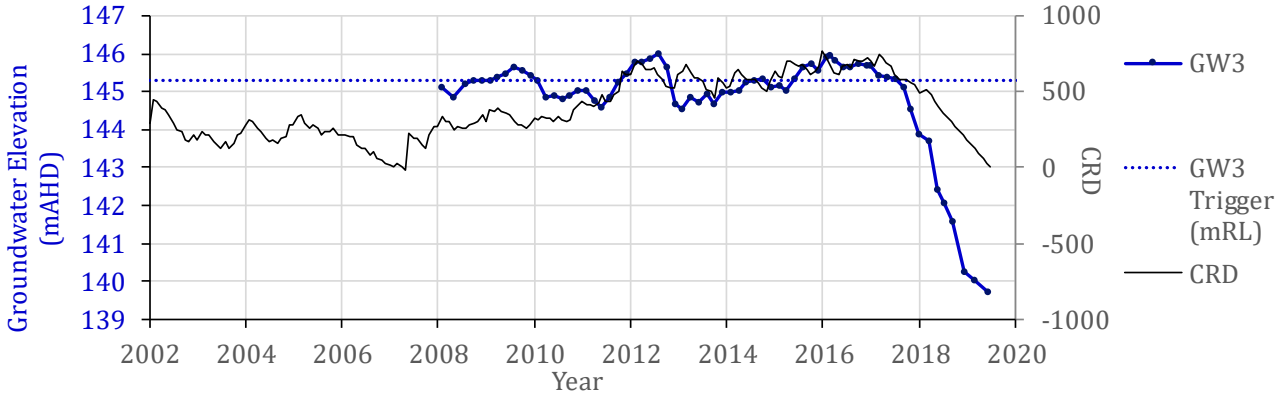
Groundwater drawdown between the start of monitoring and June 2019

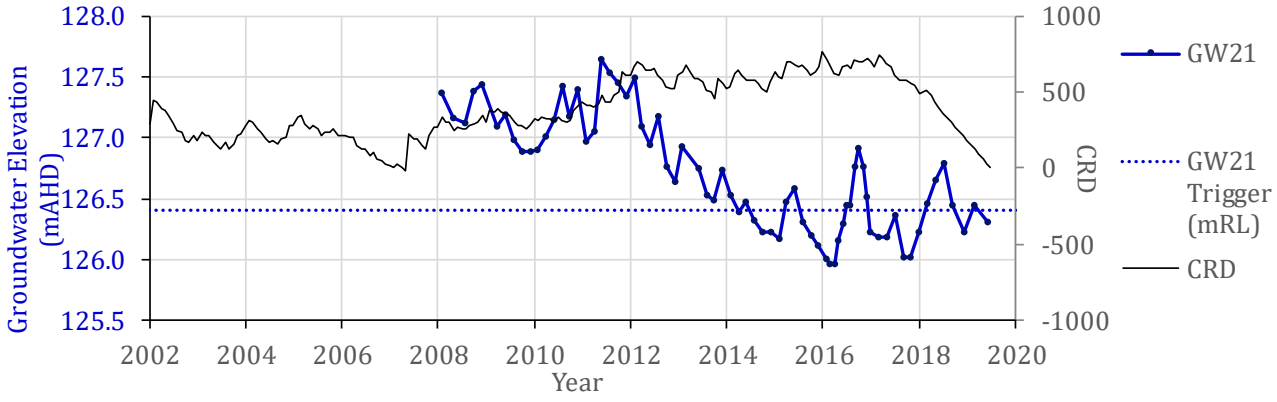
DATE 03/09/2019

FIGURE No: **3.2**

G:\Projects\G1936E\MAC_annual_review_2018_2019\3_GIS\Workspaces\001_Deliverable1\03.01_G1936E_Groundwater drawdown between the start of monitoring and June 2019.qgs


Groundwater Elevation (mAHD)
147
146
145
144
143
142
141
1000
500
0
-500
-1000
CRD
2002
2004
2006
2008
2010
2012
2014
2016
2018
2020
Year
GW2
GW2 Trigger (mRL)
CRD


Groundwater Elevation (mAHD)
147
146
145
144
143
142
141
140
139
1000
500
0
-500
-1000
CRD
2002
2004
2006
2008
2010
2012
2014
2016
2018
2020
Year
GW3
GW3 Trigger (mRL)
CRD


Groundwater Elevation (mAHD)
128.0
127.5
127.0
126.5
126.0
125.5
1000
500
0
-500
-1000
CRD
2002
2004
2006
2008
2010
2012
2014
2016
2018
2020
Year
GW21
GW21 Trigger (mRL)
CRD


Groundwater Elevation (mAHD)
134
132
130
128
126
124
122
1000
500
0
-500
-1000
CRD
2002
2004
2006
2008
2010
2012
2014
2016
2018
2020
Year
GW23
GW23 Trigger (mRL)
CRD

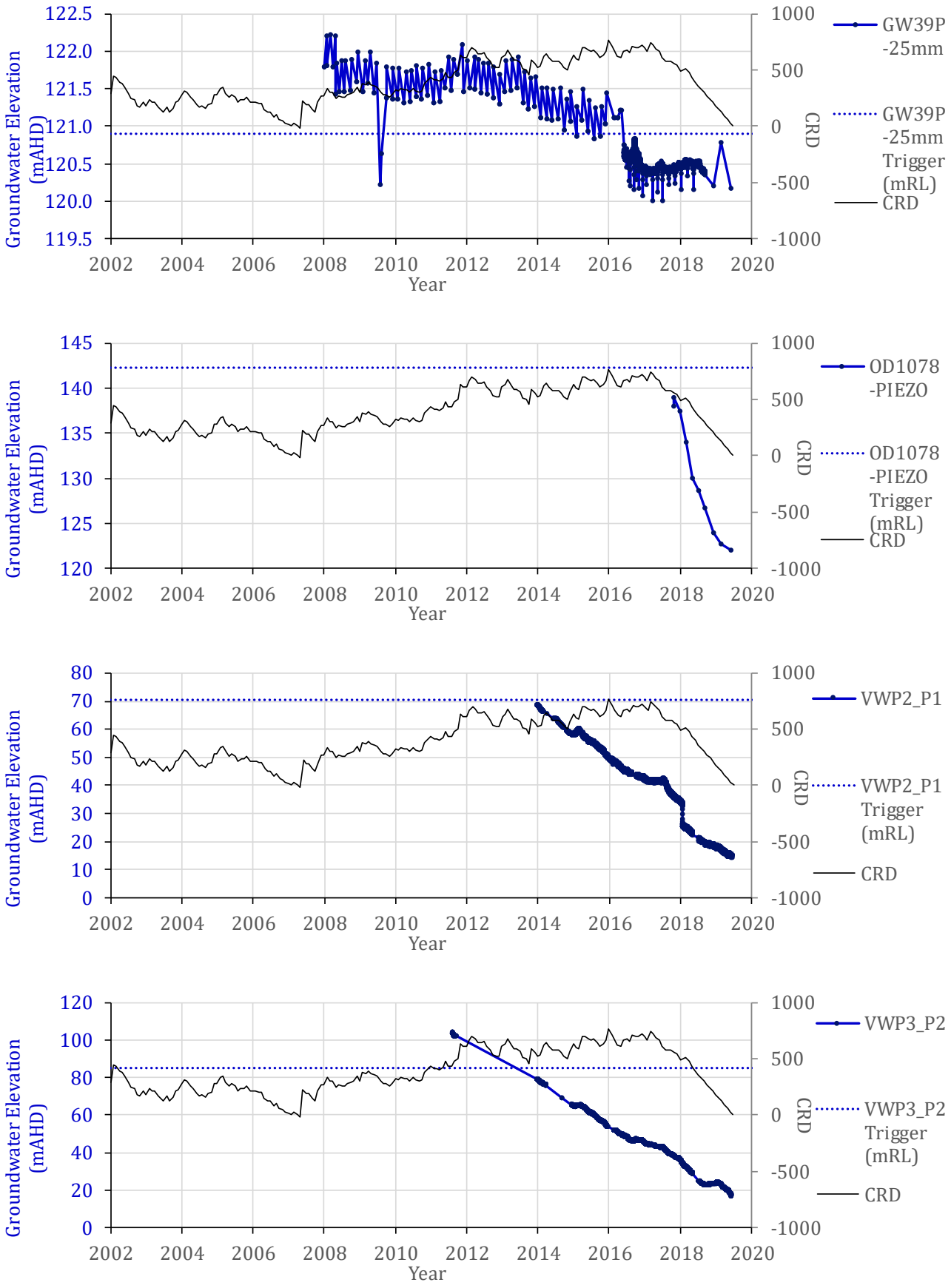
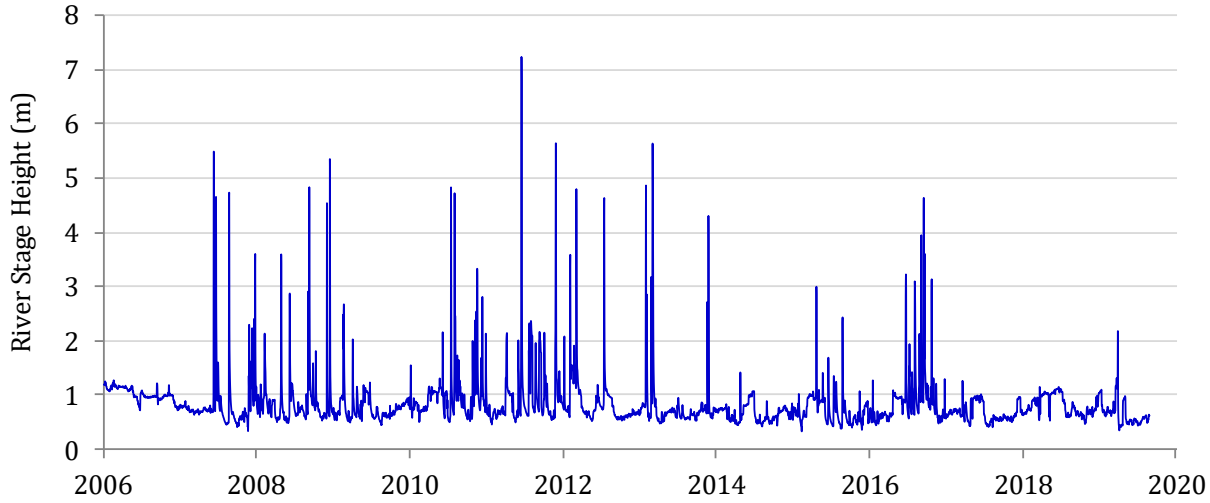


Figure 3.3 Hydrographs of selected groundwater monitoring locations

Table 3.1 Level trigger exceedances

Bore ID	Screened lithology	Located	Comment
GW2 GW3	Woodlands Hill Seam	Saddlers Creek	The groundwater levels and the CRD in this area show a strong correlation. Therefore, it is considered likely that the current 2018 drought (sharp decreasing trend in the CRD curve since 2017/2018 until present) is the dominant cause of the trigger exceedance within these bores.
GW21	Alluvium	Hunter River Alluvium, between Mt Arthur and Bengalla Open Cuts	The trigger level in this bore has been intermittently exceeded since 2014. Its level began declining in 2012 and has oscillated around a relatively stable value (~126.3 mAHD) since 2014. A comparison of the water level within this bore against the Hunter River water level trends (Figure 3.4) does not suggest a correlation with the decline recorded in the bore. The water level trend displays seasonal oscillations correlated with the CRD, but it also displays a long term trend not fully associated with the CRD. Therefore, it is possible this bore has been slightly affected by mining; however there remains some uncertainty in this conclusion given the relatively limited water level change and the magnitude of the natural variability.
GW23	Ramrod Creek Seam	Along the Hunter River, north-east of Mt Arthur Open Cut	The trigger level at this location has been exceeded since its initial monitoring records in 2008. Its level trends are relatively stable, with no downward trend that can be attributed to mining impact. The trigger level should be revised.
GW39P-25mm	Warkworth Seam	Along the Hunter River, west of Mt Arthur Open Cut	The trigger level in this bore has been exceeded since 2016, with a downward trend that does not align with climatic trends and is potentially attributed to mining depressurisation. The trend drops around June 2016 and stabilized at a level approximately 0.5 m lower than 2015/2016 levels. The total drop between mid-2008 and 2019 is approximately 1.3 m. The bore GW38P, upstream from this bore, does not show a similar decreasing trend; instead, it shows a more stable level trend if compared to GW39P-25mm. The bore GW48, downstream from this bore, has been monitored only since 2016 and also displays a relatively stable trend.
OD1078-piezo	Bowfield Seam	West of Mt Arthur Open Cut, besides the drainage coming out of the Belmont Pit	The trigger level in this bore has been exceeded since its initial monitoring records at the end of 2017. Its groundwater level displays a downward trend for the duration of the data series. Since there are no baseline monitoring records, it is not possible to establish accurately the cause of the downward trend, but it could possibly be attributed to the 2018 drought as there is some correlation with the CRD curve.

Bore ID	Screened lithology	Located	Comment
VWP2_P1 VWP3_P1 VWP3_P2	F4 Fault Edinglassie Seam Ramrod Creek Seam	North of Mt Arthur Open Cut, immediately behind the low permeability wall	All the sensors in this VWP location exceeded their trigger values since 2013 or 2014. The levels at this location display a continuous downward trend that can be correlated to mining induced depressurisation, which is expected given the hydrogeological characteristics of MAC. The groundwater model used to set the triggers under estimated the magnitude of depressurisation at these sites.



Source: BOM river station 210002, Hunter River at Muswellbrook Bridge

Figure 3.4 Hunter River stage height

3.3 Cut-off wall performance

During 2013 and 2014 MAC constructed a bentonite wall along Denman Road in the vicinity of the F4 fault to minimise drawdown within the alluvium. To collect baseline data four VWPs were installed in August 2011 into the underlying Permian strata beneath the Hunter River alluvium, northwest of the Mt Arthur main pit and adjacent Denman Road (Figure 3.5).

Figure 3.5 Cut-off wall and HRA monitoring bore locations

Hydrographs of the VWP data and monitoring data from adjacent HRA monitoring bores are presented in Figure 3.6 and Figure 3.7. Since installation, the most reliable VWP data has been captured from the end of December 2013. VWP data for the footwall block of the Edinglassie Seam only extends to January 2017; this issue should be addressed by replacing the datalogger.

Figure 3.6 and Figure 3.7 show groundwater levels within the Edinglassie and Ramrod Creek coal seams and the F4 Fault have declined 72 m in the F4 Fault, 83 m in the Edinglassie Seam and 85 m in the Ramrod Creek Seam since installation. In contrast, nearby Hunter River Alluvial aquifer monitoring bores GW16 and GW21, have recorded water level changes of 0.69 and 1.08 m respectively. GW42 is located adjacent to the VWP installations and has also remained relatively stable with no detected drawdown; instead, its groundwater level oscillates simultaneously with the level of the Hunter River (see Figure **3.8**). The higher levels in GW42 coincide with periods of higher levels in the water level of the Hunter River.

These relatively stable trend of groundwater levels within the alluvium if compared with the Permian seams indicate that the depressurisation observed in the underlying Permian coal seam has not significantly impacted upon groundwater levels within the alluvium in the vicinity of GW16 and GW21, and the water level changes are expected to be largely a response to seasonal conditions.

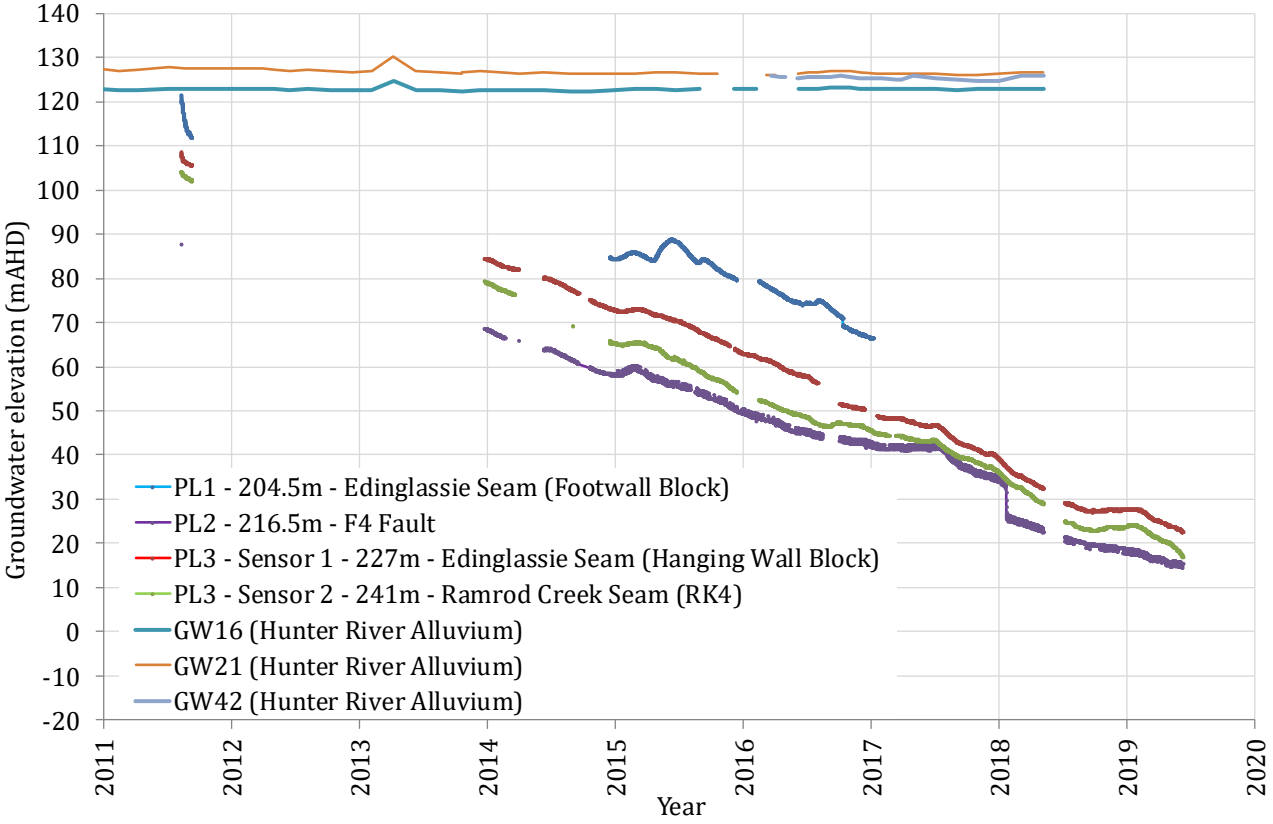


Figure 3.6 Groundwater Hydrograph - PL1, PL2 and PL3 and Hunter River Alluvium

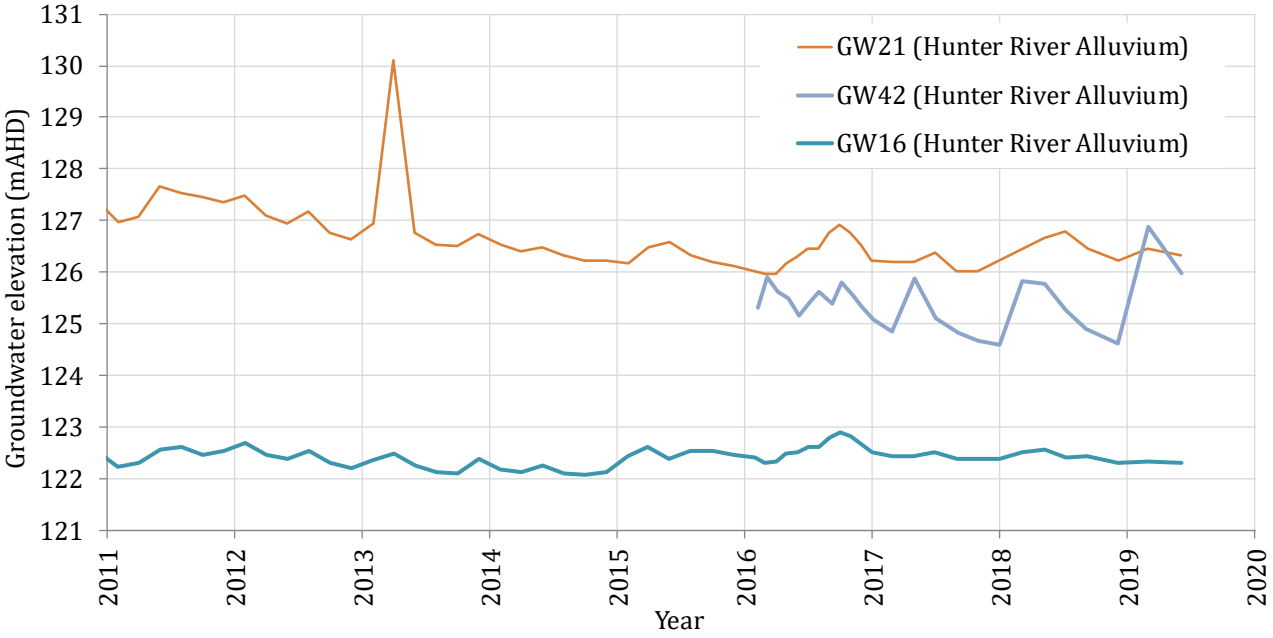
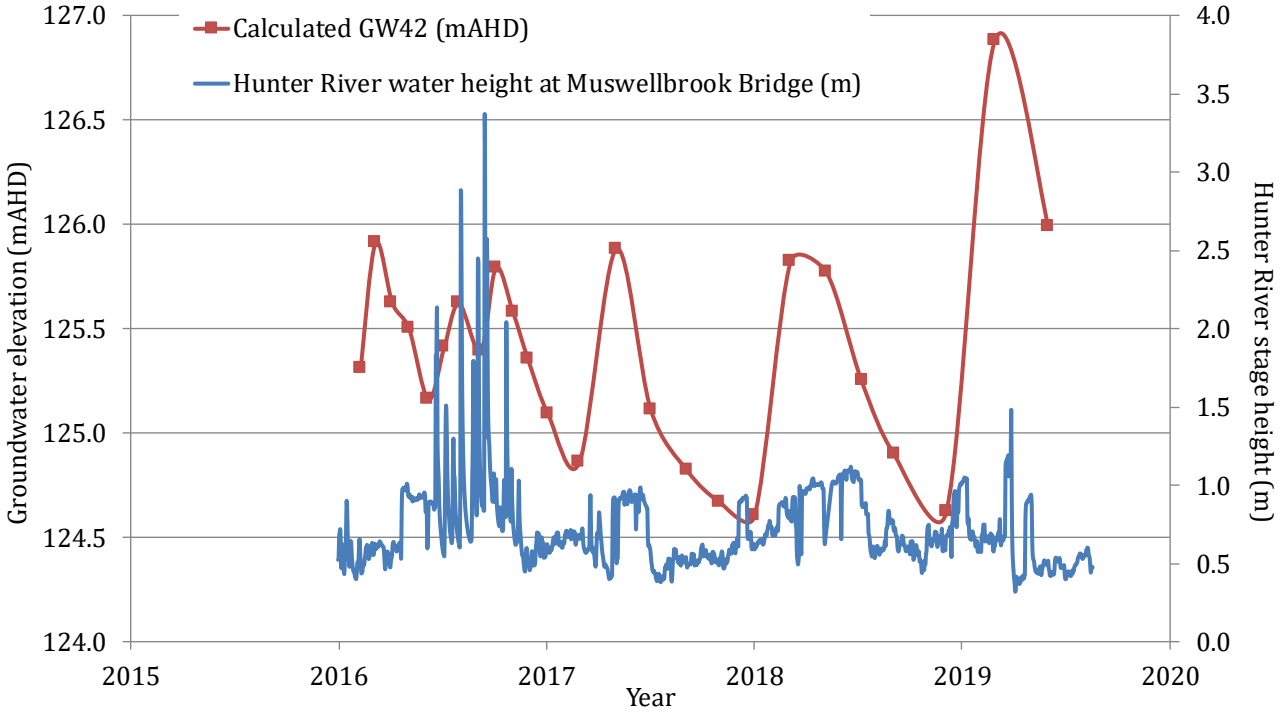


Figure 3.7 Groundwater Hydrograph – alluvial monitoring bores detail



Source: *BOM river station 210002, Hunter River at Muswellbrook Bridge.*

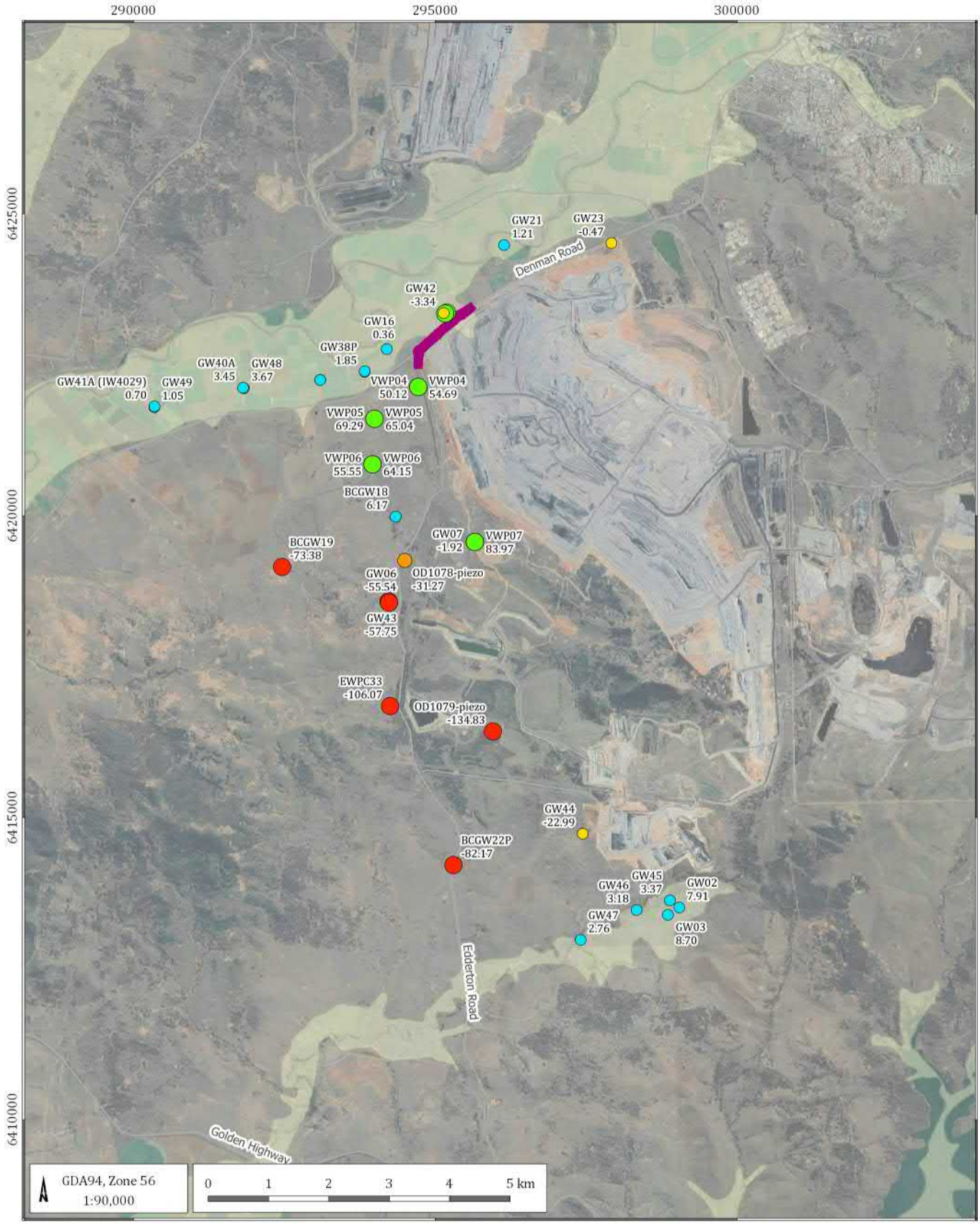
Figure 3.8 GW42 water level and Hunter River stage height

3.4 Review of numerical model predictions

The groundwater level predicted by Consolidation project numerical model for FY19 was extracted and compared to measured June 2019 data. Figure 3.9 shows the difference between the model predictions and the FY19 measurements with negative values indicating where the model over predicts, and green indicating underprediction of drawdown.

This figure shows that the groundwater model predictions close to the north-west of the Mount Arthur Pit and in the Hunter River alluvium are relatively good. Further to the southwest of the pit, the modelled predictions are less accurate. The VWP locations VWP1_P1, VWP2_P1, VWP3_P1 and VWP3_P2, for example, display mining drawdown approximately 100 m lower than modelled. Given the proximity of these VWPs to the mine pit, it is believed the model did not represent the mine drawdown accurately in this area, the same than in other areas and depths.

A recent review of the AGE (2013) groundwater model identified that when the data is ordered by model layer, the prediction discrepancies generally fall in order of model layers from top to bottom. The model over-predicts drawdown in the shallower model layers and underpredicts in the deeper layers. This is also a reflection of the observation that the deeper coal seams depressurise to a greater distance from the highwall compared to shallower coal seams. This discrepancy occurs because the numerical model represents the Permian sequence with a limited number of model layers. Additional layers may better represent the coal seams in more detail through the sequence and the intervening aquitards to better replicate the observed drawdown. The groundwater model is currently under review to improve the model's predictive capability. Throughout 2019 the site conceptual model has been reassessed to better inform the groundwater model.



LEGEND

Modelled versus measured heads (m)

- -150 - -50
- -50 - -25
- -25 - 0
- 0 - 25
- 25 - 50
- 50 - 100

- Roads
- Bentonite wall

MAC Annual review 2018-19 (1936E)

Modelled heads vs. measured heads (June 2019)

DATE 03/09/2019

FIGURE No: **3.9**

G:\Projects\G1936E.MAC_annual_review_2018_2019\3_GIS\Workspaces\001_Deliverable1\03.01_G1936E_Drawdowns.qgs

3.5 Groundwater quality

A summary of the pH and electrical conductivity (EC) and depth to water data for each key aquifer in the project area is presented in Table 3.2.

Table 3.2 Summary of groundwater monitoring results by aquifer - FY19

Aquifer	Sites	pH			EC (µS/cm)			Depth to water from top of casing (m)		
FY17	**Site references**	**Min.**	**Max**	**Avg.**	**Min.**	**Max.**	**Avg.**	**Min.**	**Max.**	**Avg.**
Saddlers Creek alluvium	GW45, GW46, GW47	6.6	7.2	6.9	2312	8050	5687	7.60	12.22	9.52
Saddlers Creek tributary alluvium	BGGW22A (IW4029)	6.8	6.8	6.8	9200	11900	10805	4.28	4.72	4.52
Hunter River alluvium	GW16, GW21, GW25, GW38A, GW38A(IW4030), GW39A, GW40A, GW41A(IW4029), GW42*	6.7	7.5	7.2	932	7340	4038	7.45	11.00	9.59
Permian/ fractured rock	BCGW18*, BCGW22*, EWPC33, GW2, GW6*, GW7*, GW23, GW38P, GW39P, GW43*, GW44*, GW48, GW49	6.7	11.7	7.6	2086	13000	5032	4.84	100.6	27.18

Note: ** bores where only 'depth to water' data was recorded.*

3.5.1 Trigger events

The approved Groundwater Monitoring Program includes trigger thresholds for groundwater salinity as indicated by electrical conductivity (EC). The EC triggers were established based on baseline data, and the 95% or 99%ile values. Measurements exceeding the triggers occurred in samples collected from BCGW22A, GW2, GW40A and GW41A during FY19. Graphs of EC for each of the monitoring locations where the trigger was exceeded are provided in Figure 3.10. An analysis of the trigger events is included in Table 3.1.

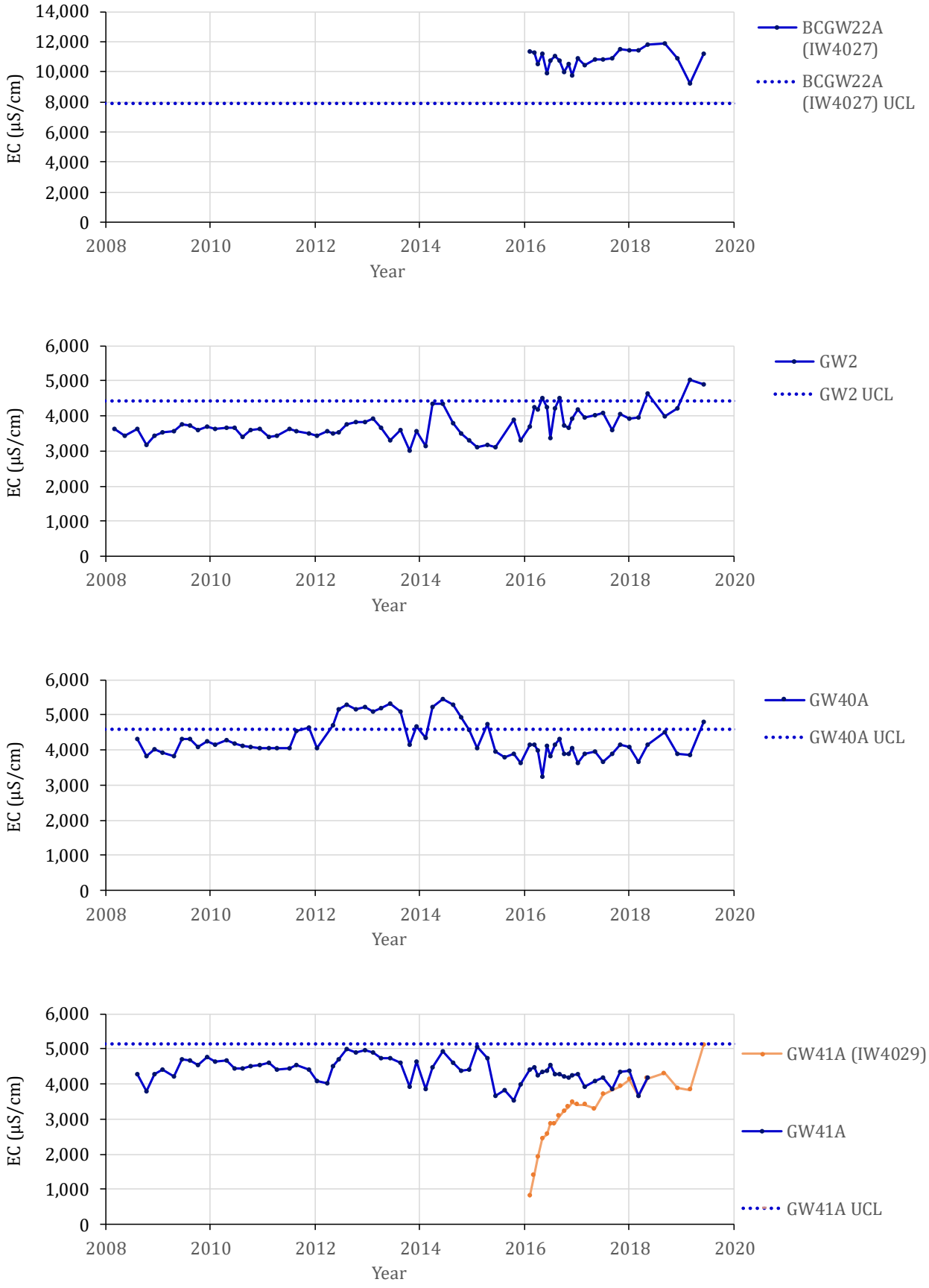


Figure 3.10 Electrical Conductivity (EC) of selected groundwater monitoring locations

Table 3.3 EC trigger exceedances

Bore ID	Screened lithology	Located	Comment
BCGW22A	Alluvium	Alluvium of small channel north of Saddlers Creek, downgradient of McDonalds Pit (south-west of Mt Arthur Open Cut),	The salinity level is relatively stable between 2016 and 2019 (where data is available). The stable value observed during this period is above the trigger, so the baseline calculations and trigger should be reviewed.
GW2	Woodlands Hill Seam	Saddlers Creek	The salinity levels in this bore are relatively stable between 2008 and 2017. Since 2018, a slight rising trend is observed, exceeding the trigger in 2019. The Permian layers in the Saddlers Creek area are believed to be impacted by the 2018 drought. An outcome of this is potentially the salinity trend observed in this bore.
GW40A	Alluvium	Hunter River Alluvium, west of Mt Arthur Open Cut	The salinity level in this bore is relatively stable between 2008 and 2019, with no long term increasing/decreasing trends. The stable value oscillates between 3200 and 5200 uS/cm, but the trigger is set at 4777 uS/cm, so it has been exceeded on seasonal fluctuations. The 2019 exceedance seems to be a regular seasonal fluctuation instead of a long term rising trend.
GW41A	Alluvium	Hunter River Alluvium, west of Mt Arthur Open Cut, west of GW40A	The available salinity records between 2016 and 2019 show a strong rising trend, for the replacement bore, but the original GW41A bore shows a stable trend. A longer monitoring series will be necessary to assess whether the monitored salinities stabilise at a similar value, or if they are monitoring groundwater from slightly different units. If the rising trend continues, a potential connection between the Permian layers and the alluvium can be assessed (including salinities and levels of alluvial and Permian bores in the area), so it can be determined if mining impact is extending from the Permian layers into the alluvium.

3.5.2 Quality assurance review

In addition to the above, MAC require an assessment of the quality assurance (QA) measures implemented by Carbon Based Environmental Pty Ltd (CBE) for the quarterly groundwater sampling to identify potential error with either the CBE sampling methodology or chemical analytical techniques. This review includes:

- comparison of duplicate samples and calculation of Relative Percentage Difference (RPD) for the laboratory analysis results for each sampling event;
- review of the CBE groundwater sampling field sheets for assessment of field parameter stabilisation and purging volume for collection for a representative water sample; and
- review of sample hold times prior to being dispatched to the Australian Laboratory Services Pty Ltd (ALS).

The results of this review are presented in Attachment B and summarised in Table 3.4.

Table 3.4 Summary of quality assurance review

Monitoring round	Field data	Field parameter stabilisation	Frequency of analyses	Analysis parameters	Holding time (days)	Duplicate sample	Relative percentage difference	Comments
Sep-18	WL, T(°C), pH, EC	All samples within parameters.	Quarterly	All samples: pH/EC, TSS/TDS, Cl-, Ca, Mg, K, Na, SO4, Alkalinity. Dissolved Fe.	All samples arrived at lab within holding times, except for pH analysis.	IW4027	Suspended Solids: 40%	All bores purged of >3 bore volumes prior to sampling, except GW16, GW21, GW25, GW38A(IW4030), GW39P, GW48, GW49, BCGW22, GW47, GW39A (hand bailed), GW39P (hand bailed) and BCGW18 (dry). 2 out of 4 sample batches reached lab below specified temperature of 4 degrees Celsius. Not clear in COC documentation whether W-2 metals analysis by ALS is for dissolved or total metals and if samples were field filtered or not. Field calibration sheets provided.

Monitoring round	Field data	Field parameter stabilisation	Frequency of analyses	Analysis parameters	Holding time (days)	Duplicate sample	Relative percentage difference	Comments
Dec-18	WL, T(°C), pH, EC	All samples within parameters.	Quarterly	All samples: pH/EC, TSS/TDS, Cl-, Ca, Mg, K, Na, SO4, Alkalinity. Dissolved Fe. GW16, GW21, GW25, GW38A(IW4030), GW38P, GW39A, GW39P, GW45, GW46 and GW47: additional analysis of Total P and dissolved metals: As, Cd, Cr, Cu, Ni, Pb, Zn, Hg, Al, Sb, Ba, B, Mo, Se.	All samples arrived at lab within holding times for all analysis, except for pH analysis of samples GW40A, GW48, GW41A(IW4029), GW49, EWPC33, GW2 and MCGW22.	GW2	(No RPDs greater than 20%)	All bores purged of >3 bore volumes prior to sampling, except GW39A and GW39P (hand bailed), BCGW22 (dry) and BCGW18 (water level too low to sample). 3 out of 4 sample batches reached lab at or below specified temperature of 4 degrees Celsius. Not clear in COC documentation whether W-2 metals analysis by ALS is for dissolved or total metals and if samples were field filtered or not. Single calibration sheet provided.

Monitoring round	Field data	Field parameter stabilisation	Frequency of analyses	Analysis parameters	Holding time (days)	Duplicate sample	Relative percentage difference	Comments
Mar-19	WL, T(°C), pH, EC	All samples within parameters.	Quarterly	All samples: pH/EC, TSS/TDS, Cl-, Ca, Mg, K, Na, SO4, Alkalinity. Dissolved Fe. BCGW22: additional analysis of Total P and dissolved metals: As, Cd, Cr, Cu, Ni, Pb, Zn, Hg, Al, Sb, Ba, B, Mo, Se.	All samples arrived at lab within holding times, except for pH analysis for all samples excluding BCGW22.	GW21	(No RPDs greater than 20%)	All bores purged of >3 bore volumes prior to sampling, except GW49, BCGW22, IW4027, GW39P, GW41A(IW4029) (hand bailed), GW49 (hand bailed), GW25 (blocked) and BCGW18 (dry). All samples reached lab below specified temperature of 4 degrees Celsius. Not clear in COC documentation whether W-2 metals analysis by ALS is for dissolved or total metals and if samples were field filtered or not. Field calibration sheets provided except for 21 March 2019.

Monitoring round	Field data	Field parameter stabilisation	Frequency of analyses	Analysis parameters	Holding time (days)	Duplicate sample	Relative percentage difference	Comments
Jun-19	WL, T(°C), pH, EC	All samples within parameters.	Quarterly	pH/EC, TSS/TDS, Cl-, Total P, Ca, Mg, K, Na, SO4, Alkalinity. Dissolved metals: As, Cd, Cr, Cu, Ni, Pb, Zn, Hg, Fe, Al, Sb, Ba, B, Mo, Se	All samples arrived at lab within holding times, except for pH analysis.	GW2	Suspended solids: 45.5% Potassium: 33.3% Phosphorus: 33.3% Aluminium: 100%	All bores purged of >3 bore volumes prior to sampling, except GW39P (hand bailed), BCGW22 (dry) and BCGW22 (no recorded of volume purged on day of sampling). 2 out of 5 sample batches reached lab at or below specified temperature of 4 degrees Celsius. Not clear in COC documentation whether W-2 metals analysis by ALS is for dissolved or total metals and if samples were field filtered or not. Field calibration sheets provided.

The results of the QA review can be summarised as follows:

- Duplicate sample – the borehole from which duplicate samples was consistently recorded.
- Field data – field parameters for pH, electrical conductivity (EC), temperature (°C) and depth to groundwater level (WL) were recorded for each duplicate sample.
- Relative Percentage Difference – an exceedance of the RPD greater than 20% was determined for suspended solids (SS), potassium, phosphorus and aluminium. Assuming the duplicate samples were collected at the same time as the original sample, this would suggest there is a slight variation in suspended solids in the field samples. The high RPD in potassium, phosphorus and aluminium occurred on very low values (near the LOR) and have a very small absolute difference in values. That is, RPD calculations can show false positives when values are very low; for example, an RPD evaluation for samples with phosphorus values of 0.02 and 0.03 (GW2/duplicate) present an RPD value of 33.3%. Generally, even with the RPD exceedances, we consider the duplicate analyses to be representative of one another.
- Holding Times – the holding times for all samples ranged from between one and seven days, which is within the specified holding times for the parameters analysed. These range from seven days (calcium hardness, total suspended solids and total dissolved solids) to general 28 days for most of the remaining parameters, exception for general metals, which is six months. The exception to this is pH with only 11 of 72 samples analysed within the 6-hour holding time – this is a normal challenge for all sites remote from laboratories. Field measured pH (using calibrated meters) is generally preferred as a more reliable source of data.
- Field Parameter Stabilisation – CBE provided sample stabilisation data for all sampling events and stabilisation criteria for the field determinations were suitable, with temperature being set at (±0.2°C), pH (±0.1 pH units) and EC (±5%).
- Bore purge Volume – Review of this data indicates that on average three bore volumes were purged for each bore before sampling. Bores where less than three bore volumes of water were purged were most commonly due to dry bores or when hand bailing was implemented. During the sampling period of September 2018 over half of all bores were purged 80% to 99% of three bore volumes of water and was not the result of dry bores, blockages or hand bailing methods, while the rest were purged three bore volumes or more. In each monitoring round the bore were monitored in a consistent manner and the samples are considered representative of the aquifer at each monitoring location.

4 Recommendations

We suggest the following improvements to the MAC groundwater monitoring program:

- Digital field monitoring sheets – currently, the monitoring data is recorded manually on paper for later transcription into the MAC database. The monitoring contractor should consider taking steps towards digital recording of field data. This step will reduce time and cost for the review of field data and reduce potential error being introduced during the transcription phase. This will also enforce more systematic use of standardised bore names, as they can vary slightly between data files, which may cause problems in the data interpretation.
- Barometrically corrected data – the monitoring contractor provided the raw downloaded level logger data and the same raw data exported in CSV files, and also data from a barometric sensor on site. The monitoring contractor should also baro-correct the data and provide it as baro-corrected files; this will allow field staff to do the initial processing of the logger data, which is likely to increase the quality of the data as they may detect first hand any potential data glitches.

- Data for the VWP sensor VWP1_P1 – this sensor stopped producing data in January 2017. It is recommended to check the installation, as a new logger unit might fix the problem. A first assessment with a hand reader for VWP frequency can be made to confirm the integrity of the sensor and cables. If the hand reader can read data from the sensor, it is suggested to replace the VWP logger unit.
- Chilled groundwater lab samples – in the FY19 monitoring campaign some of the groundwater sample batches (eskies) accepted at ALS above the recommended temperature (4 deg C). In the future, an effort should be made to chill all the samples.
- Metals analysis – the groundwater samples were tested by ALS Environmental for dissolved metals; however, there is no mention of the samples being field filtered and preserved for metals analysis. Field filtration is recommended by the laboratories, so the procedure should be performed and clearly described on the field-sheets.
- Three bore volumes – we suggest the field staff is instructed to purge the bores to the required amount (three bore volumes) or more, and avoid stopping short of the required volume, to say 90% or 80%.The field records regarding sampling are of good quality and we encourage the level of detail and accuracy of notes to be maintained.

5 Closure

Thank you for the opportunity to assist MAC with this groundwater review for the FY19 AEMR. If you have any queries, please do not hesitate to call.

Yours faithfully,

Juan Berrio
Hydrogeologist/Groundwater Modeller
Australasian Groundwater and Environmental Consultants Pty Ltd

Attachment A *Statutory bore, groundwater level and drawdown data*
Attachment B *G1936E.MAC.annual review – FY 2018-2019 – RPD review*

Attachment A Statutory bore, groundwater level and drawdown data

	Construction details							Trigger values		Modelled groundwater levels		Measured groundwater levels							Drawdown			
Bore ID	Easting	Northing	TOC Elev 2014 survey (mAHD)	TOC Elev 2018 survey (mAHD)	Total bore depth (m)	Target formation	Model layer (MOD1 FEFLOW model-AGE 2013)	WMP (2015) triggers (mAHD)	2005StartHead	MAC con-solidation project (MOD1) June 2019 modelled head (mbgl)	MAC con-solidation project June 2019 modelled head (mAHD)	Date first GWL record	First record depth to water (mBTOC)	First record GWL (mAHD)	July2018 depth to water (mBTOC)	July2018 GWL (mAHD)	June 2019 depth to water (mBTOC)	June 2019 GWL (mAHD)	Head difference modelled vs. measured June 2019[2] (m)	Measured drawdown - first record vs. measured June 2019[3] (m)	Expected drawdown - first record vs. modelled June 2019[3] (m)	Measured drawdown FY18-19[4] (m)
BCGW05	291052.66	6410763.63	139.91	135.00	16.70	Glen Munro	3	-	137.87	4.12	135.79	Jan-08	13.50	126.40	NM	NM	NM	NM	-	-	-	-
BCGW10	293115.40	6414781.03	185.43	185.47	65.40	Woodlands Hill	4	-	182.01	46.16	139.27	Jan-08	7.10	178.30	NM	NM	NM	NM	-	-	-	-
BCGW11	293117.47	6414779.36	185.80	185.43	39.10	Glen Munro	3	-	182.01	46.28	139.52	Jan-08	7.30	178.50	NM	NM	NM	NM	-	-	-	-
BCGW12	293142.78	6414688.45	182.86	182.70	43.90	Glen Munro	3	-	180.03	56.21	126.65	Jan-08	8.30	174.50	NM	NM	NM	NM	-	-	-	-
BCGW15	290716.63	6412432.49	161.38	154.43	36.70	Glen Munro	3	-	176.61	-	-	Jan-08	14.10	147.20	NM	NM	NM	NM	-	-	-	-
BCGW18	294345.19	6419985.43	158.79	158.97	11.30	Arrowfield	4	142.7	156.68	5.10	153.69	Jan-08	3.90	154.90	10.37	148.60	11.44	147.53	6.17	-7.37	-1.21	1.07
BCGW19	292461.91	6419151.75	187.43	187.00	8.40	Glen Munro	3	174.4	191.41	80.94	106.49	Jan-08	5.60	181.80	7.49	179.51	7.13	179.87	-73.38	-1.93	-75.31	-0.36
BCGW22A	295313.60	6414209.80	143.45	144.04	15.00	Alluvium	1		152.24	5.32	138.72	Feb-16	3.02	141.02	6.43	137.59	NM	NM	-	-	-2.30	-
BCGW22P	295301.50	6414214.69	143.91	144.02	37.90	Glen Munro	3	128.8	147.91	86.89	57.13	Jan-08	4.00	139.90	4.10	139.94	4.72	139.30	-82.17	-0.60	-82.77	0.64
EWPC33	294252.70	6416847.05	230.34	230.04	57.40	Blakefield	2	176.2	222.90	140.12	90.22	Jan-08	34.30	196.00	33.08	196.96	33.75	196.29	-106.07	0.29	-105.78	0.67
GW2	299044.92	6413510.71	153.92	153.87	113.00	Woodlands Hill	4	145.4	144.36	3.79	150.13	Jun-01	7.50	146.40	10.74	143.13	11.65	**142.22**	7.91	-4.18	3.73	0.91
GW3	298855.80	6413389.36	151.56	151.79	120.40	Woodlands Hill	4	145.3	143.65	3.12	148.44	Aug-01	5.30	146.30	9.36	142.43	12.05	**139.74**	8.70	-6.56	2.14	2.69
GW6	294227.05	6418579.22	198.49	198.59	27.10	Glen Munro	3	165.5	189.47	79.53	118.96	Feb-96	19.80	178.70	26.25	172.34	24.09	174.50	-55.54	-4.20	-59.74	-2.16
GW7	295635.41	6419594.54	214.65	214.82	48.80	Woodlands Hill	4	134.1	177.18	47.95	166.70	Jul-99	41.00	173.70	43.03	171.79	46.20	168.62	-1.92	-5.08	-7.00	3.17
GW8	296991.44	6419491.13	207.63	mined out	-	NA	all	118.4	178.51	51.21	156.42	Feb-99	18.00	189.60	NM	NM	NM	NM	-	-	-33.18	-
GW16	294197.18	6422759.34	132.22	131.89	13.30	Alluvium	1	121.8	123.45	9.55	122.67	Feb-99	9.20	123.00	9.34	122.55	9.58	122.31	0.36	-0.69	-0.33	0.24
GW21	296141.35	6424483.01	136.03	135.97	15.80	Alluvium	1	126.4	127.86	8.51	127.52	Feb-99	8.60	127.40	9.30	126.67	9.65	**126.32**	1.21	**-1.08**	0.12	0.35
GW22	296929.99	6423998.39	154.36	mined out	91.20	Ramrod Creek	7	88.2	135.51	33.05	121.31	May-99	15.20	139.20	NM	NM	NM	NM	-	-	-17.89	-
GW23	297919.37	6424514.92	181.70	181.17	54.60	Ramrod Creek	7	132.5	136.23	50.87	130.83	Feb-99	42.30	139.40	49.78	131.39	49.87	**131.30**	-0.47	-8.10	-8.57	0.09
GW25	298375.73	6425230.84	140.43	140.09	13.70	Alluvium	1	120	134.49	-	-	Feb-99	9.60	130.80	10.25	129.84	10.43	129.66	-	-1.14	-	0.18
GW26	301841.28	6418791.94	234.80	234.76	93.10	West Cut Tailings	-	-	-	-	-	Feb-04	69.00	165.80	52.82	181.94	NM	NM	Outside model	Outside model	Outside model	Outside model
GW27	301862.79	6418412.22	236.42	235.91	115.50	West Cut Tailings	-	-	-	-	-	May-04	71.00	165.40	53.33	182.58	NM	NM	Outside model	Outside model	Outside model	Outside model
GW38A	293831.43	6422376.98	131.57	131.50	20.60	Alluvium	1	121.9	123.64	8.35	123.15	Jan-08	8.70	122.90	9.52	121.98	NM	NM	-	-	0.25	-
GW38A(IW4030)	293831.31	6422393.09	131.10	131.75	11.37	Alluvium	1	-	123.58	8.60	123.15	Feb-16	9.60	122.15	9.77	121.98	9.76	121.99	1.16	-0.16	1.00	-0.01
GW38P	293831.70	6422384.09	131.58	131.68	32.60	Warkworth	4	121	123.62	8.43	123.15	Jan-08	9.50	122.00	10.18	121.50	10.38	121.30	1.85	-0.70	1.15	0.20
GW39A	293094.34	6422248.31	130.68	130.64	10.40	Alluvium	1	120.8	123.91	7.07	123.61	Jan-08	8.90	121.80	9.36	121.28	9.41	121.23	2.39	-0.57	1.81	0.05
GW39P-25mm	293094.70	6422250.89	130.40	130.73	42.70	Warkworth	4	120.9	123.91	6.81	123.59	Jan-08	8.50	121.90	10.28	120.45	10.55	**120.18**	3.41	-1.72	1.69	0.27
GW40A	291815.48	6422119.30	129.35	129.28	13.80	Alluvium	1	118.7	122.41	7.01	122.34	Jan-08	9.60	119.70	10.32	118.96	10.38	118.90	3.45	-0.80	2.64	0.06
GW41A	290354.29	6421788.54	126.48	126.42	11.60	Alluvium	1	118.7	119.70	6.70	119.78	Jan-08	6.80	119.70	7.30	119.12	NM	NM	-	-	0.08	-
GW41AR(IW4029)	290347.80	6421809.90	125.91	126.56	8.00	Alluvium	1	-	119.20	6.78	119.78	Feb-16	7.36	119.20	7.45	119.11	7.48	119.08	0.70	-0.12	0.58	0.03
GW42	295138.80	6423356.30	135.08	135.62	11.00	Alluvium/Regolith	1	-	-	12.97	122.65	Feb-16	9.71	125.91	9.85	125.77	9.63	125.99	-3.34	0.08	-3.26	-0.22
GW43	294233.00	6418560.10	196.83	197.33	69.00	Woodlands Hill	4	-	193.65	87.91	109.42	Feb-16	27.49	169.84	28.73	168.60	30.16	167.17	-57.75	-2.67	-60.42	1.43
GW44	297444.50	6414732.60	210.50	211.03	133.00	Woodlands Hill	4	-	181.17	123.63	87.40	Feb-16	85.14	125.89	83.39	127.64	100.64	110.39	-22.99	-15.50	-38.49	17.25
GW45	298889.71	6413629.54	-	152.46	15.00	Alluvium	1	-	143.75	8.85	143.61	Feb-16	8.43	-	11.41	141.05	12.22	140.24	3.37	-	-	0.81
GW46	298336.76	6413469.34	-	144.16	21.00	Alluvium	1	-	138.84	5.89	138.27	Feb-16	6.91	-	8.35	135.81	9.07	135.09	3.18	-	-	0.72
GW47	297408.76	6412974.11	-	137.07	18.00	Alluvium	1	-	129.36	5.03	132.04	Feb-16	6.41	-	7.52	129.55	7.79	129.28	2.76	-	-	0.27
GW48	291829.60	6422110.67	129.07	129.70	36.15	Bowfield	4	-	122.43	7.22	122.47	Feb-16	10.77	118.93	10.58	119.12	10.89	118.81	3.67	-	3.55	0.31
GW49	290345.74	6421797.57	126.02	126.55	36.00	Arrowfield	4	-	119.19	6.88	119.67	Feb-16	7.78	118.77	7.84	118.71	7.93	118.62	1.05	-	0.90	0.09

	Construction details							Trigger values		Modelled groundwater levels		Measured groundwater levels							Drawdown			
Bore ID	Easting	Northing	TOC Elev 2014 survey (mAHD)	TOC Elev 2018 survey (mAHD)	Total bore depth (m)	Target formation	Model layer (MOD1 FEFLOW model-AGE 2013)	WMP (2015) triggers (mAHD)	2005StartHead	MAC con-solidation project (MOD1) June 2019 modelled head (mbgl)	MAC con-solidation project June 2019 modelled head (mAHD)	Date first GWL record	First record depth to water (mBTOC)	First record GWL (mAHD)	July2018 depth to water (mBTOC)	July2018 GWL (mAHD)	June 2019 depth to water (mBTOC)	June 2019 GWL (mAHD)	Head difference modelled vs. measured June 2019[2] (m)	Measured drawdown - first record vs. measured June 2019[3] (m)	Expected drawdown - first record vs. modelled June 2019[3] (m)	Measured drawdown FY18-19[4] (m)
OD1078	294495.47	6419259.28	171.32	171.70	63.00	Arrowfield	4	-	166.24	80.64	90.68	Jan-08	7.30	164.10	29.77	141.93	NM	NM	-	-	-73.42	-
OD1078-piezo	294495.47	6419259.28	171.38	171.41	82.80	Bowfield	4	142.3	166.24	80.64	90.74	Jan-08	18.50	152.90	41.45	129.96	49.40	**122.01**	-31.27	-30.89	-62.16	7.95
OD1079	295956.29	6416426.92	227.20	226.55	NA	NA		-	214.46	195.86	31.34	Oct-14	31.89	195.30	39.34	187.21	NM	NM	-	-	-163.96	-
OD1079-piezo	295956.29	6416426.92	227.34	226.70	87.20	Glen Munro	3	158.7	214.46	196.00	31.34	Jan-08	51.70	175.70	56.51	170.19	60.54	166.16	-134.83	-9.54	-144.36	4.03
VWP1_P1	295166.64	6423380.75	135.46	135.46	204.50	Edinglassie	7	96.1	129.01	26.03	109.43	Sep-11	23.60	111.90	-	-	-	-	-	-	-2.47	-
VWP2_P1	295194.77	6423364.09	135.41	135.41	216.50	F4 Fault	-	70.4	-	-	110.99	Aug-11	47.70	87.70	112.85	22.56	120.16	**15.25**	95.74	-72.45	23.29	7.31
VWP3_P1	295165.89	6423349.36	135.38	135.38	227.00	Edinglassie	7	88.5	129.01	25.08	110.30	Sep-11	29.80	105.60	103.02	32.36	113.00	**22.38**	87.92	-83.22	4.70	9.98
VWP3_P2	295165.89	6423349.36	135.38	135.38	241.00	Ramrod Creek (RK)	7	85	129.01	25.08	110.30	Sep-11	33.30	102.10	106.41	28.97	118.45	**16.93**	93.37	-85.17	8.20	12.04
VWP04_130	294719.20	6422131.70		140.84	-	Vaux (VU)	6	-	132.86	-	106.66	Sep-14	-	77.04	79.05	61.79	84.30	56.54	50.12	-20.50	29.62	5.25
VWP04_161					-	Bayswater (BU)						Oct-14	-	76.98	83.20	57.64	88.87	51.97	54.69	-25.01	29.68	5.67
VWP04_201					-	Edderton (ED)	7	-	133.90	-	127.50	Nov-14	-	75.24	90.32	50.52	97.69	43.15	84.35	-32.09	52.26	7.37
VWP04_262					-	Edinglassie (EG)						Dec-14	-	64.20	105.32	35.52	117.44	23.40	104.10	-40.80	63.30	12.12
VWP04_285					-	Ramrod Creek (RK)						Jan-15	-	61.17	111.12	29.72	122.23	18.61	108.89	-42.56	66.33	11.11
VWP05_164	293993.30	6421605.10		161.40	-	Vaux (VU)	6	-	131.99	-	128.62	Feb-15	-	68.95	88.23	73.17	95.11	66.29	62.33	-2.66	59.67	6.88
VWP05_192					-	Bayswater (BU)						Mar-15	-	86.13	92.77	68.63	97.82	63.58	65.04	-22.55	42.49	5.05
VWP05_227					-	Edderton (ED)	7	-	133.97	-	133.21	Apr-15	-	85.47	91.67	69.73	97.48	63.92	69.29	-21.55	47.74	5.81
VWP05_288					-	Edinglassie (EG)						May-15	-	69.67	122.59	38.81	130.84	30.56	102.65	-39.11	63.54	8.25
VWP05_311					-	Ramrod Creek (RK)						Jun-15	-	63.04	FAULTY	FAULTY	FAULTY	FAULTY	-		70.17	
VWP06_237	293960.30	6420850.40		179.64	-	Vaux (VU)	6	-	142.69	-	144.01	Jul-15	-	92.30	90.61	89.03	91.18	88.46	55.55	-3.84	51.71	0.57
VWP06_269					-	Broonie (BR)						Aug-15	-	89.99	87.20	92.44	87.40	92.24	51.77	2.25	54.02	0.20
VWP06_304					-	Edderton (ED)	7	-	143.51	-	145.11	Sep-15	-	90.08	99.41	80.23	98.68	80.96	64.15	-9.12	55.03	-0.73
VWP06_366					-	Edinglassie (EG)						Oct-15	-	86.33	102.86	76.78	102.38	77.26	67.85	-9.07	58.78	-0.48
VWP06_388					-	Ramrod Creek (RK)						Mar-16	-	82.05	-	-	-	-	-	-	63.06	-
VWP07_223	295656.10	6419564.90		215.95	-	Piercefield	5	-	169.38	-	168.98	Dec-15	-	123.55	104.12	111.83	112.81	103.14	65.84	-20.41	45.43	8.69
VWP07_271					-	Vaux (VU)	6	-	169.38			Dec-15	-	116.15	105.94	110.01	116.02	99.93	69.05	-16.22	52.83	10.08
VWP07_286					-	Bayswater (BU)	7	-	170.37	-	171.22	Dec-15	-	104.89	124.07	91.88	128.70	87.25	83.97	-17.64	66.33	4.63
VWP07_326					-	Edderton (ED)						Dec-15	-	94.78	125.10	90.85	128.42	87.53	83.69	-7.25	76.44	3.32
VWP07_418					-	Ramrod Creek (RK)						Dec-15	-	154.32	68.93	147.02	FAULTY	FAULTY	-	-	16.90	-

Notes: *[1] TOC Elev – Top of Casing elevation; mAHD metres above Australian Height Datum; GWL – groundwater level; mBTOC – metres below top of casing.*

[2] Negative values indicate the measured piezometric level is higher than modelled – this means the model is over-predicting effects at this site for FY17.

[3] Negative values indicate drawdown.

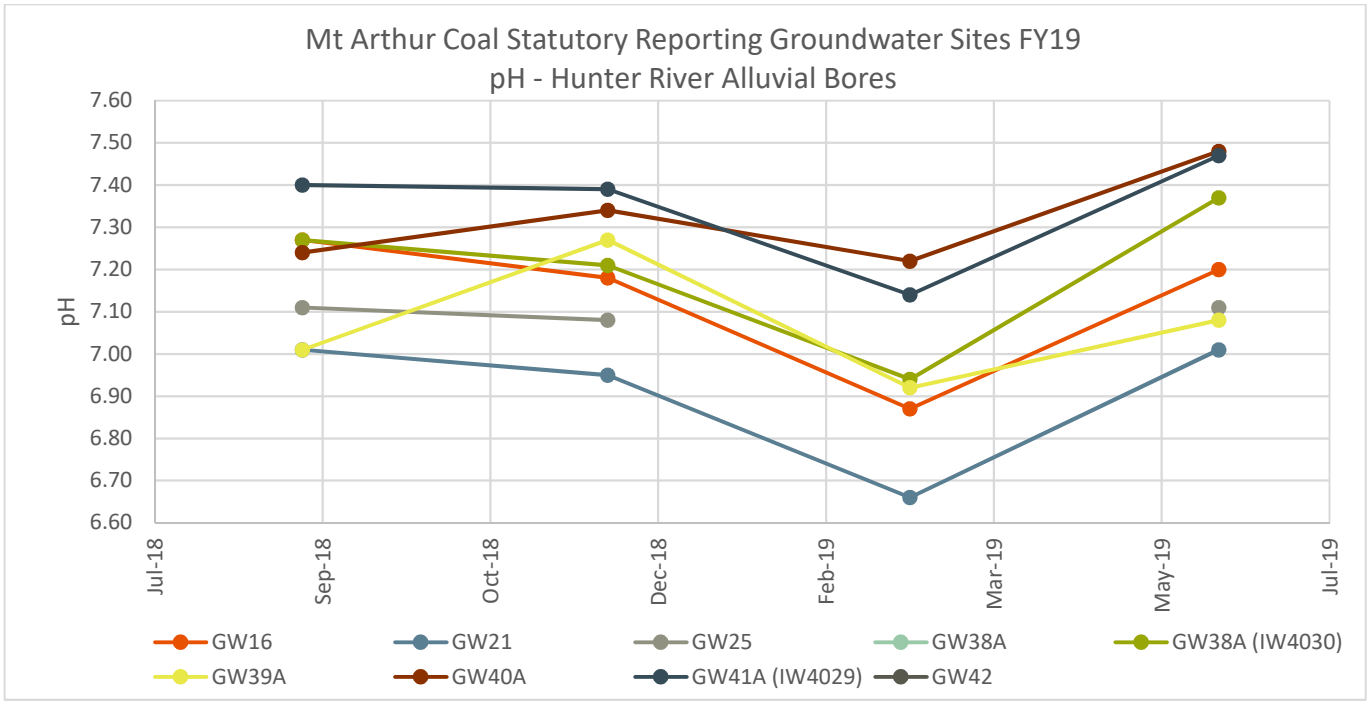
[4] Negative values indicate drawdown over the last year.

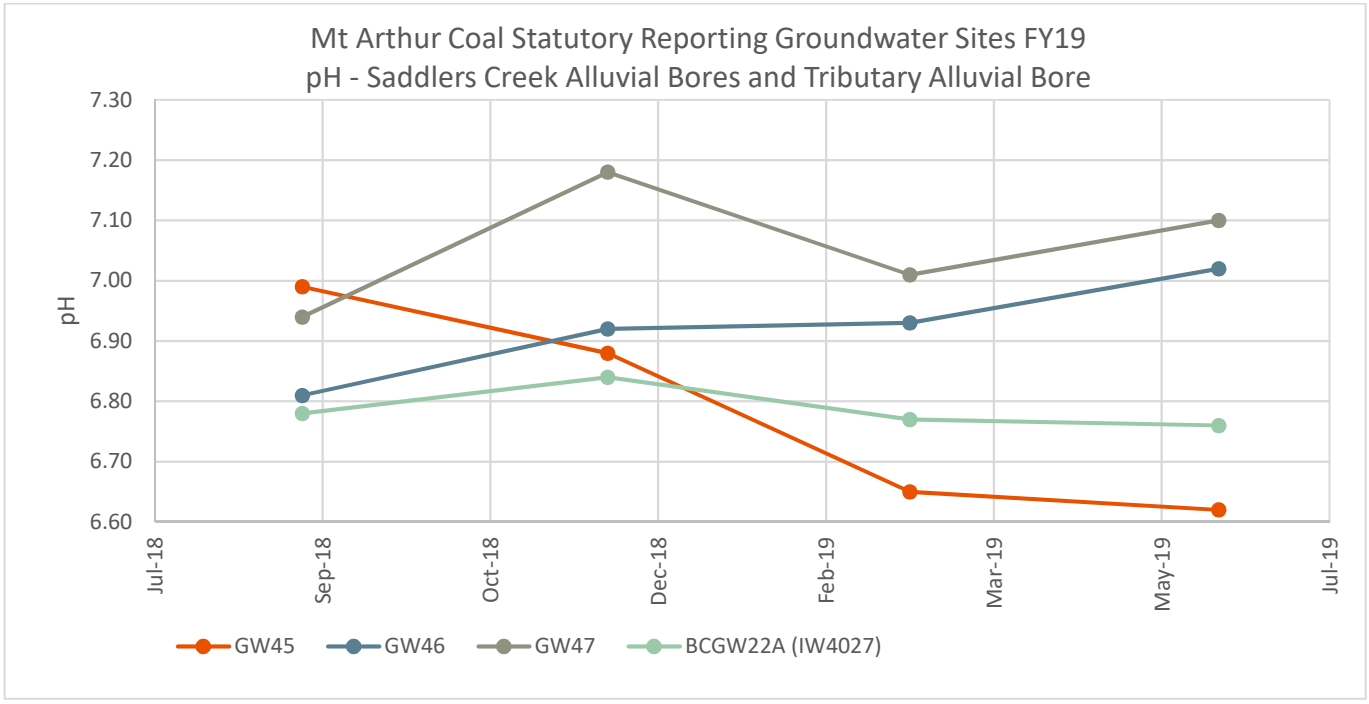
NM – Not monitored / data not available.

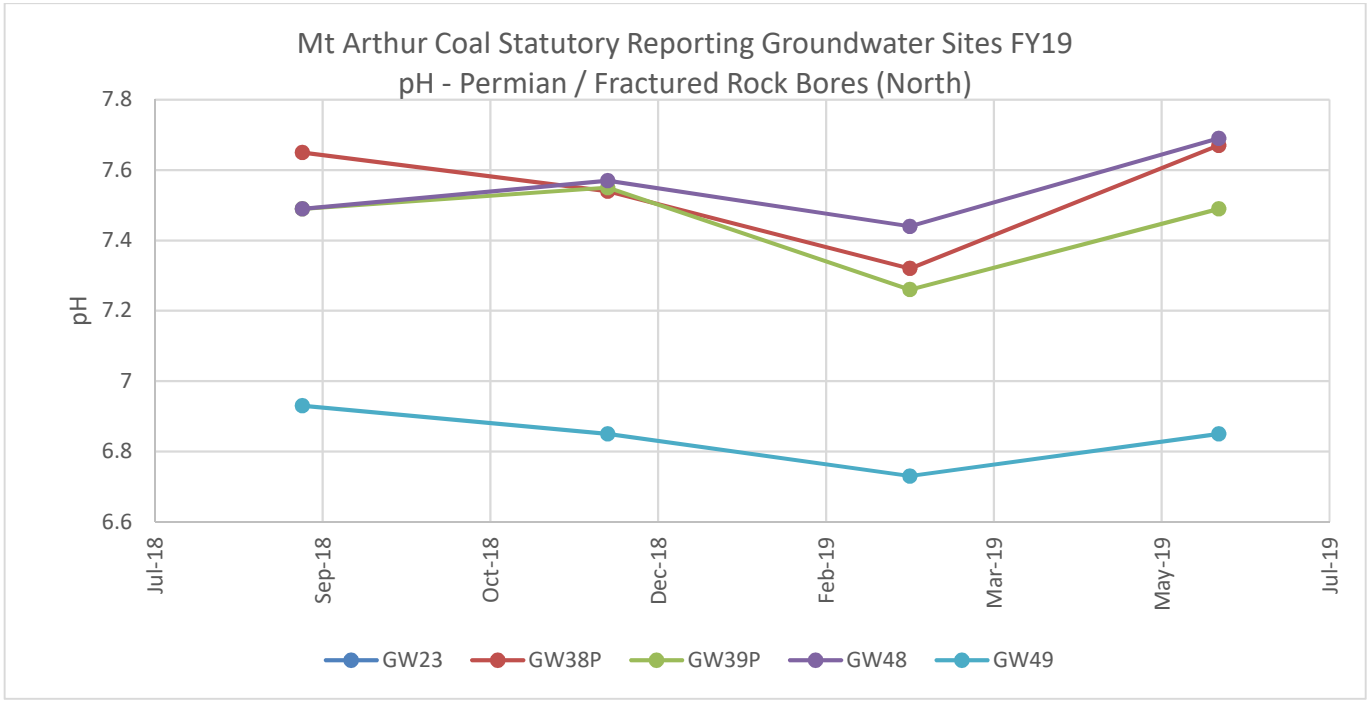
Sample Date: ALS Batch Number: Client sample ID (1st): Analyte grouping/Analyte	Unit	LOR	19/09/2018 ES1827901 IW4027	19/09/2018 ES1827901 DUPLICATE	Relative Percentage Difference	19/12/2018 ES1838607 GW2	19/12/2018 ES1838607 DUPLICATE	Relative Percentage Difference	08/03/2019 ES1907336 GW21	08/03/2019 ES1907336 DUPLICATE	Relative Percentage Difference
Physical parameters											
pH Value	pH Unit	0.01	7.18	7.13	0.7%	7.85	7.94	1.1%	7.46	7.52	0.8%
Electrical Conductivity @ 25°C	µS/cm	1	11600	11600	0.0%	4440	4340	2.3%	1040	1050	1.0%
Total Dissolved Solids @180°C	mg/L	10	7860	7910	0.6%	2410	2490	3.2%	660	582	13.4%
Suspended Solids (SS)	mg/L	5	14	10	40.0%	21	20	5.0%	<5	<5	0%
Major ions											
Hydroxide Alkalinity as CaCO3	mg/L	1	<1	<1	0%	<1	<1	0%	<1	<1	0%
Carbonate Alkalinity as CaCO3	mg/L	1	<1	<1	0%	<1	<1	0%	<1	<1	0%
Bicarbonate Alkalinity as CaCO3	mg/L	1	816	836	2.4%	1080	1130	4.4%	409	390	4.9%
Total Alkalinity as CaCO3	mg/L	1	816	836	2.4%	1080	1130	4.4%	409	390	4.9%
Sulfate as SO4 - Turbidimetric	mg/L	1	252	250	0.8%	141	139	1.4%	34	40	15.0%
Chloride by Discrete Analyser	mg/L	1	3730	3690	1.1%	714	719	0.7%	82	82	0.0%
Calcium	mg/L	1	224	232	3.4%	16	16	0.0%	82	82	0.0%
Magnesium	mg/L	1	361	372	3.0%	13	13	0.0%	51	51	0.0%
Sodium	mg/L	1	1760	1860	5.4%	946	950	0.4%	66	65	1.5%
Potassium	mg/L	1	6	6	0.0%	4	4	0.0%	<1	<1	0.0%
Total Phosphorus as P	mg/L	0.01									
Total Anions	meq/L	0.01	127	126	0.8%	44.6	45.8	2.6%	11.2	10.9	2.8%
Total Cations	meq/L	0.01	118	123	4.1%	43.1	43.3	0.5%	11.2	11.1	0.9%
Dissolved Metals											
Aluminium	mg/L	0.01									
Antimony	mg/L	0.001									
Arsenic	mg/L	0.001									
Barium	mg/L	0.001									
Boron	mg/L	0.05									
Cadmium	mg/L	0.0001									
Chromium	mg/L	0.001									
Copper	mg/L	0.001									
Iron	mg/L	0.05	<0.05	<0.05	0%	0.07	0.07	0.0%	<0.05	<0.05	0%
Lead	mg/L	0.001									
Mercury	mg/L	0.0001									
Molybdenum	mg/L	0.001									
Nickel	mg/L	0.001									
Selenium	mg/L	0.01									
Zinc	mg/L	0.005									

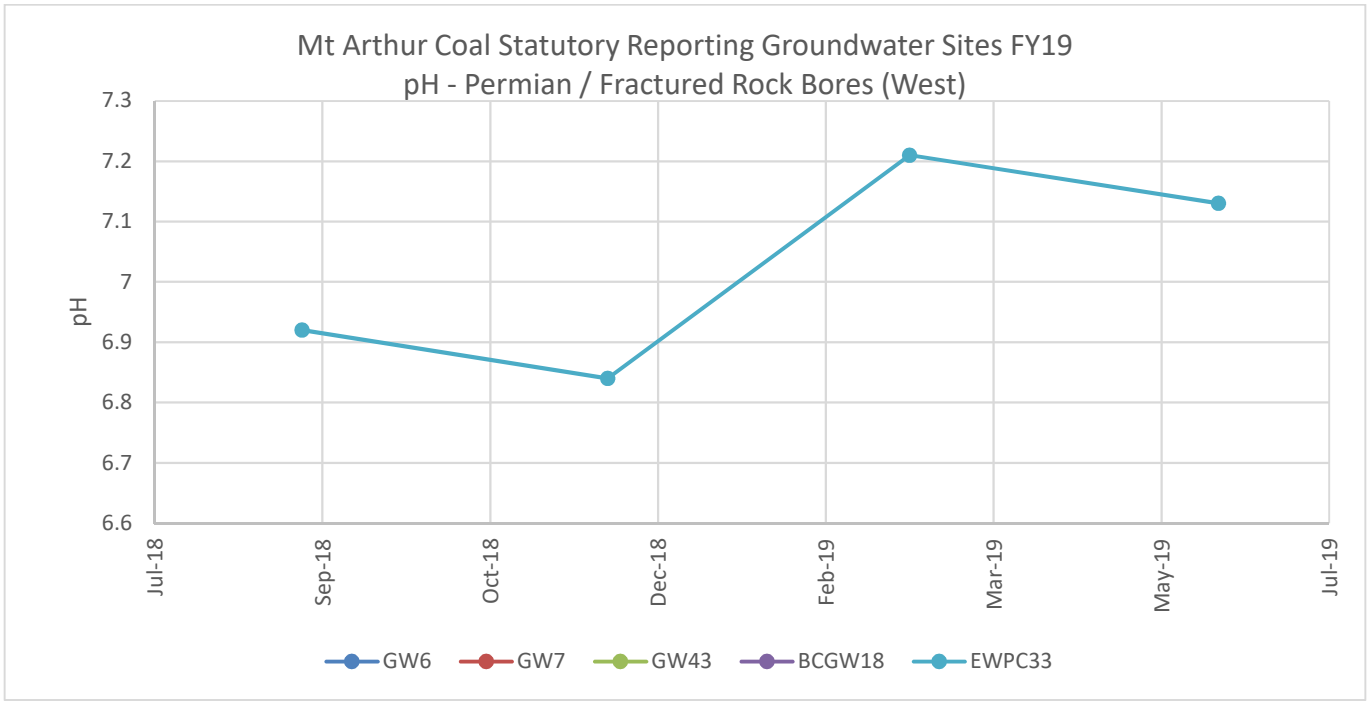
Sample Date: ALS Batch Number: Client sample ID (1st): Analyte grouping/Analyte	Unit	LOR	27/06/2019 ES1920121 GW2	27/06/2019 ES1920121 DUPLICATE	Relative Percentage Difference							
Physical parameters												
pH Value	pH Unit	0.01	8.08	8.14	0.7%							
Electrical Conductivity @ 25°C	µS/cm	1	4660	4670	0.2%							
Total Dissolved Solids @180°C	mg/L	10	2440	2400	1.7%							
Suspended Solids (SS)	mg/L	5	6	11	45.5%							
Major ions												
Hydroxide Alkalinity as CaCO3	mg/L	1	<1	<1	0%							
Carbonate Alkalinity as CaCO3	mg/L	1	<1	<1	0%							
Bicarbonate Alkalinity as CaCO3	mg/L	1	1010	999	1.1%							
Total Alkalinity as CaCO3	mg/L	1	1010	999	1.1%							
Sulfate as SO4 - Turbidimetric	mg/L	1	108	108	0.0%							
Chloride by Discrete Analyser	mg/L	1	674	674	0.0%							
Calcium	mg/L	1	15	14	7.1%							
Magnesium	mg/L	1	14	14	0.0%							
Sodium	mg/L	1	948	965	1.8%							
Potassium	mg/L	1	4	3	33.3%							
Total Phosphorus as P	mg/L	0.01	0.02	0.03	33.3%							
Total Anions	meq/L	0.01	41.4	41.2	0.5%							
Total Cations	meq/L	0.01	43.2	43.9	1.6%							
Dissolved Metals												
Aluminium	mg/L	0.01	0.02	0.01	100.0%							
Antimony	mg/L	0.001	<0.001	<0.001	0%							
Arsenic	mg/L	0.001	<0.001	<0.001	0%							
Barium	mg/L	0.001	0.063	0.062	1.6%							
Boron	mg/L	0.05	0.2	0.22	9.1%							
Cadmium	mg/L	0.0001	<0.0001	<0.0001	0%							
Chromium	mg/L	0.001	<0.001	<0.001	0%							
Copper	mg/L	0.001	<0.001	<0.001	0%							
Iron	mg/L	0.05	0.07	0.07	0.0%							
Lead	mg/L	0.001	<0.001	<0.001	0%							
Mercury	mg/L	0.0001	<0.0001	<0.0001	0%							
Molybdenum	mg/L	0.001	<0.001	<0.001	0%							
Nickel	mg/L	0.001	<0.001	<0.001	0%							
Selenium	mg/L	0.01	<0.01	<0.01	0%							
Mercury	mg/L	0.0001	0.005	0.006	16.7%							

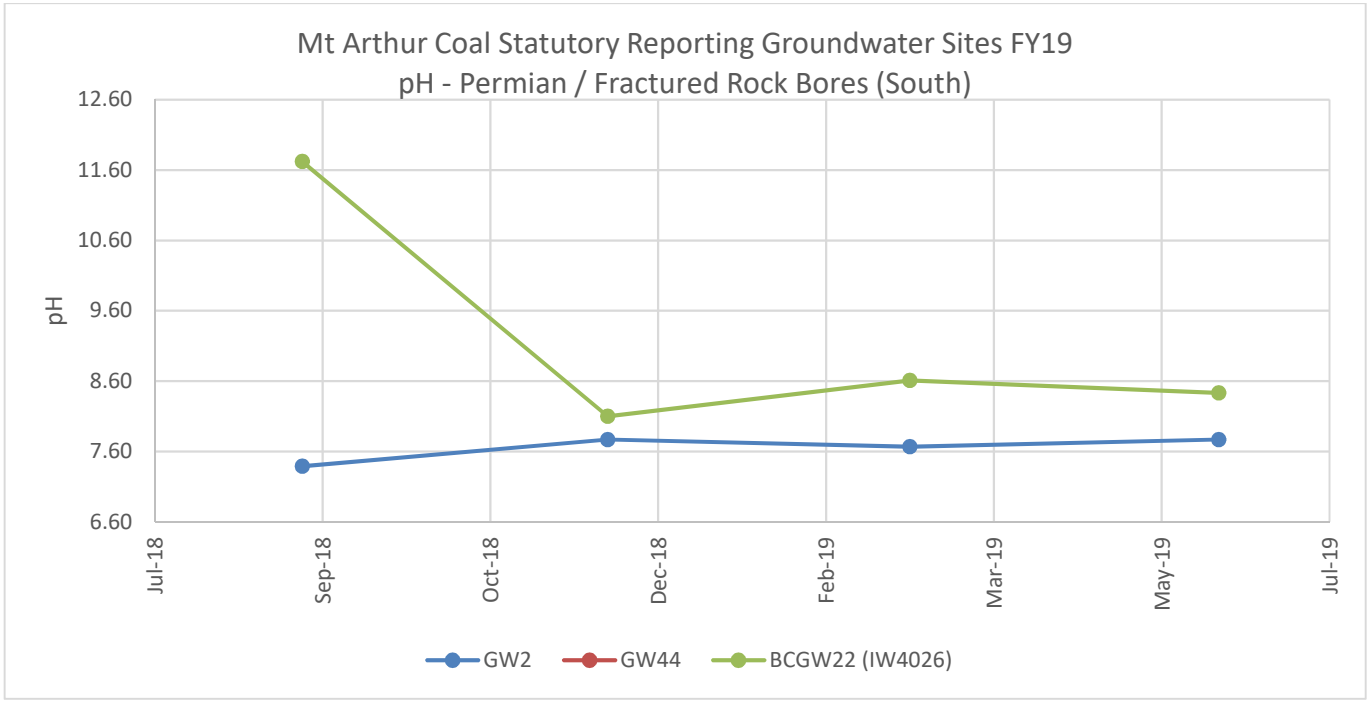
Groundwater Quality Plots (pH)



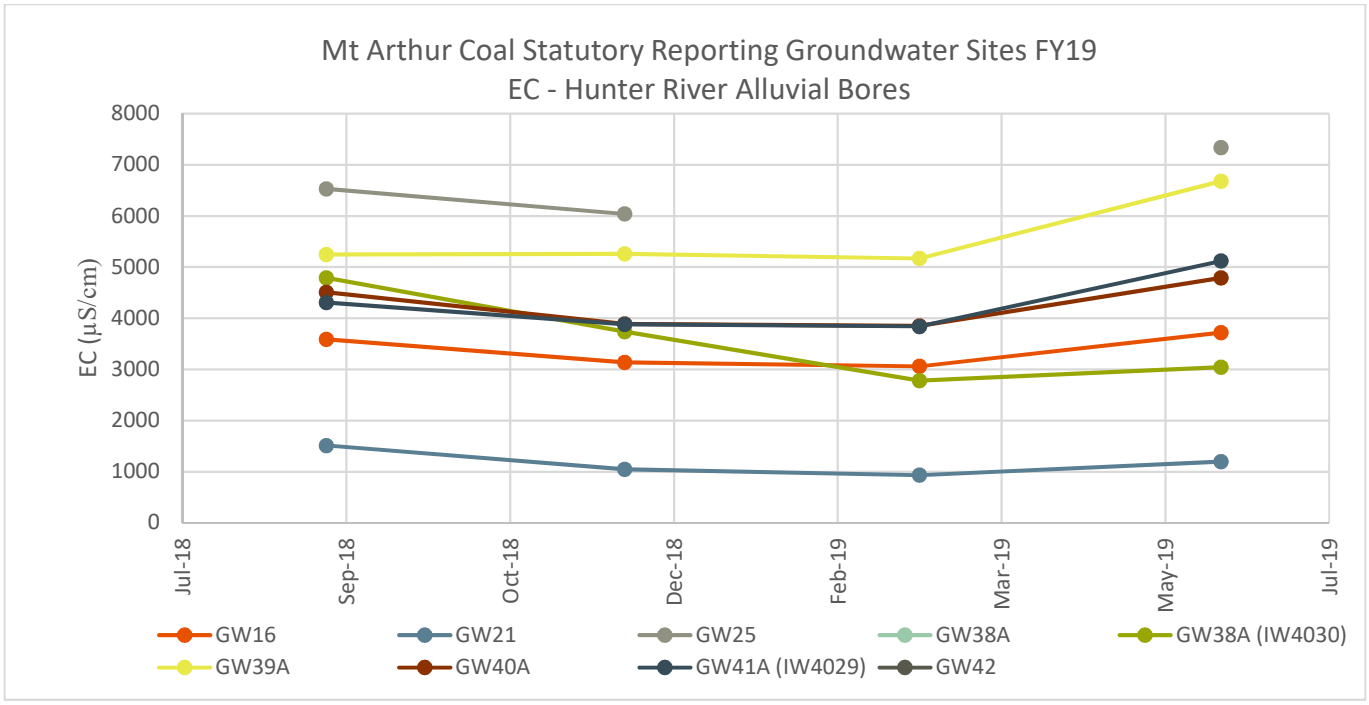


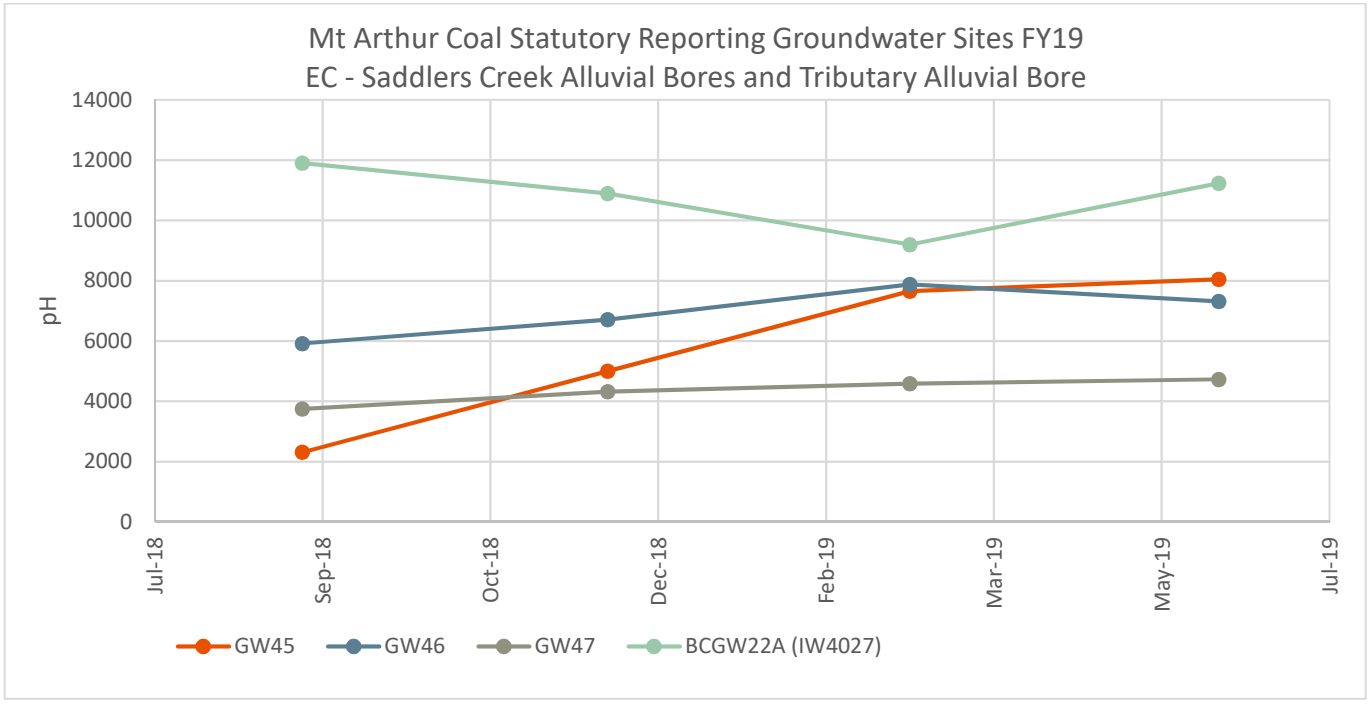

Mt Arthur Coal Statutory Reporting Groundwater Sites FY19
pH - Permian / Fractured Rock Bores (North)
pH
7.8
7.6
7.4
7.2
7
6.8
6.6
Jul-18
Sep-18
Oct-18
Dec-18
Feb-19
Mar-19
May-19
Jul-19
GW23
GW38P
GW39P
GW48
GW49

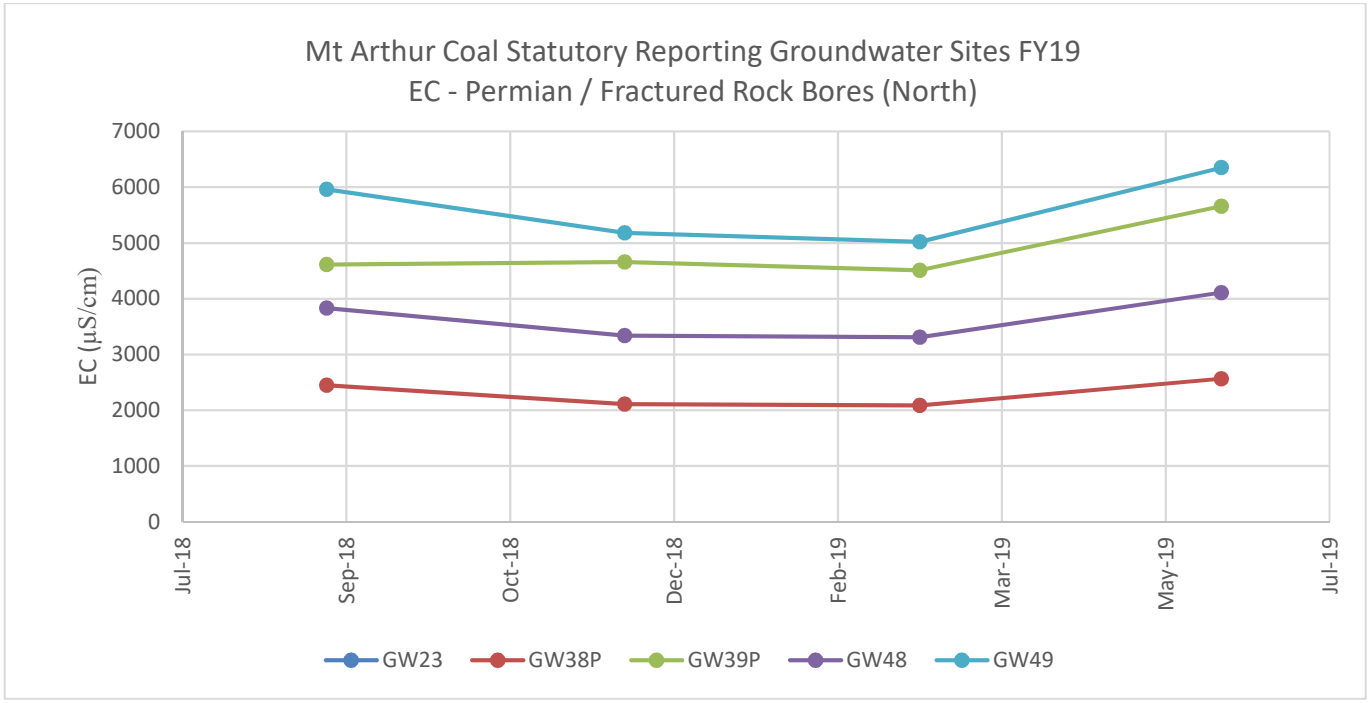

Mt Arthur Coal Statutory Reporting Groundwater Sites FY19
pH - Permian / Fractured Rock Bores (West)
pH
7.3
7.2
7.1
7
6.9
6.8
6.7
6.6
Jul-18
Sep-18
Oct-18
Dec-18
Feb-19
Mar-19
May-19
Jul-19
GW6
GW7
GW43
BCGW18
EWPC33

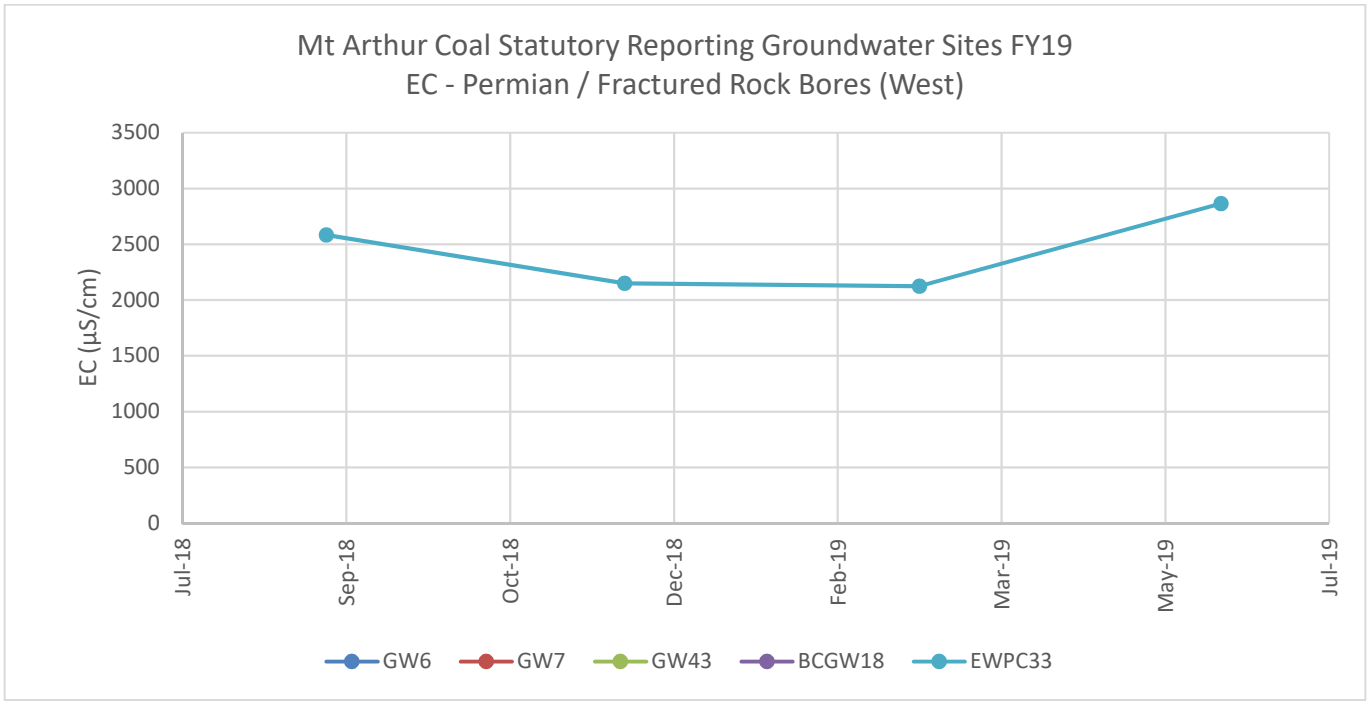

Mt Arthur Coal Statutory Reporting Groundwater Sites FY19
pH - Permian / Fractured Rock Bores (South)
12.60
11.60
10.60
9.60
8.60
7.60
6.60
pH
Jul-18
Sep-18
Oct-18
Dec-18
Feb-19
Mar-19
May-19
Jul-19
GW2
GW44
BCGW22 (IW4026)

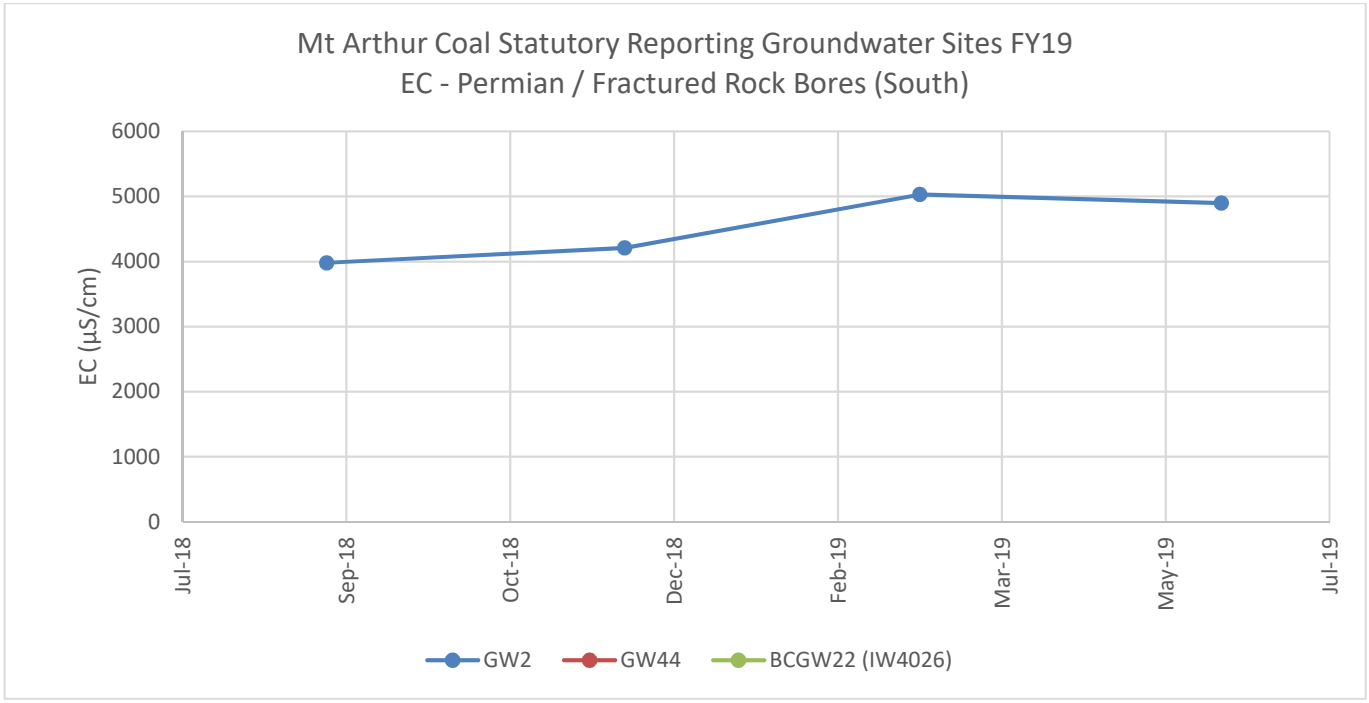
Groundwater Quality Plots (Electrical Conductivity)






Mt Arthur Coal Statutory Reporting Groundwater Sites FY19
EC - Permian / Fractured Rock Bores (North)
EC (µS/cm)
7000
6000
5000
4000
3000
2000
1000
0
Jul-18
Sep-18
Oct-18
Dec-18
Feb-19
Mar-19
May-19
Jul-19
GW23
GW38P
GW39P
GW48
GW49


Mt Arthur Coal Statutory Reporting Groundwater Sites FY19
EC - Permian / Fractured Rock Bores (West)
EC (µS/cm)
3500
3000
2500
2000
1500
1000
500
0
Jul-18
Sep-18
Oct-18
Dec-18
Feb-19
Mar-19
May-19
Jul-19
GW6
GW7
GW43
BCGW18
EWPC33


Mt Arthur Coal Statutory Reporting Groundwater Sites FY19
EC - Permian / Fractured Rock Bores (South)
EC (µS/cm)
6000
5000
4000
3000
2000
1000
0
Jul-18
Sep-18
Oct-18
Dec-18
Feb-19
Mar-19
May-19
Jul-19
GW2
GW44
BCGW22 (IW4026)

Appendix 4 – Community Complaints

Month	Date and time	From	Issue	Lodgement type	Investigation and response to caller
July	04/07/2018 11:41	Denman Road	Blast Fume	Community Response Line	Investigation revealed weather conditions were suitable for blasting at the time. Results indicated fume, overpressure noise and ground vibration levels were within regulatory criteria. Caller was advised of investigation and monitoring results.
	04/07/2018 13:51	Denman Road	Blast Fume	Community Response Line	Investigation revealed weather conditions were suitable for blasting at the time. Results indicated fume, overpressure noise and ground vibration levels were within regulatory criteria. Caller was advised of investigation and monitoring results.
	12/07/2018 9:44	Muswellbrook	Other	Lodge With Third Party	Investigation revealed dump heights were well under the max limit allowed to the mine. The Department of Planning and Environment was advised of findings.
	18/07/2018 15:00	Denman	General Dust	Other	Investigation revealed that the percentage target for rehab was completed and exceeded in FY18. Called was advised of investigation findings.
	20/07/2018 21:00	Muswellbrook	Lighting	Community Response Line	Investigation revealed location of lights, which were redirected or turned off. Caller was advised of investigation results and action taken. Caller advised they were satisfied that the issue had been resolved
	31/07/2018 11:01	Muswellbrook	Blast Fume	Community Response Line	Investigation revealed weather conditions were suitable for blasting at the time. Results indicated fume, overpressure noise and ground vibration levels were within regulatory criteria. Caller was advised of investigation and monitoring results.
August	02/08/2018 16:42	Racecourse Road/Sheppard Avenue	General Dust	Community Response Line	Investigation revealed mining operations had already ceased at the time. Results at the nearest monitor indicated dust levels were not elevated at the time, and the 24 hour average remained within regulatory criteria. Caller was advised of investigation and monitoring results.
	02/08/2018 22:30	Racecourse Road/Sheppard Avenue	Lighting	Phone Call	Investigation revealed location of lights, which were redirected or turned off. Caller was advised of investigation results and action taken. Caller advised they were satisfied that the issue had been resolved.
	08/08/2018 20:15	Racecourse Road/Sheppard Avenue	Lighting	Phone Call	Investigation revealed location of lights, which were redirected or turned off. Caller was advised of investigation results and action taken. Caller advised they were satisfied that the issue had been resolved.
	10/08/2018 9:25	Racecourse Road/Sheppard Avenue	General Dust	Email	Investigation revealed mining operations had already ceased at the time. Results at the nearest monitor indicated dust levels were not elevated at the time, and the 24 hour average remained within regulatory criteria. Caller was advised of investigation and monitoring results.
	17/08/2018 18:08	Racecourse Road/Sheppard Avenue	Blast Vibration	Phone Call	Mt Arthur Coal did not Blast.
	22/08/2018 9:01	Racecourse Road/Sheppard Avenue	General Dust	Community Response Line	Investigation revealed mining operations had already ceased at the time. Results at the nearest monitor indicated dust levels were not elevated at the time, and the 24 hour average remained within regulatory criteria. Caller was advised of investigation and monitoring results

Month	Date and time	From	Issue	Lodgement type	Investigation and response to caller
	23/08/2018 9:20	Racecourse Road/Sheppard Avenue	General Dust	Community Response Line	Investigation revealed mining operations had already ceased at the time. Results at the nearest monitor indicated dust levels were not elevated at the time, and the 24 hour average remained within regulatory criteria. Caller was advised of investigation and monitoring results
	23/08/2018 17:58	Racecourse Road/Sheppard Avenue	Lighting	Phone Call	Investigation revealed location of lights, which were redirected or turned off. Caller was advised of investigation results and action taken. Caller advised they were satisfied that the issue had been resolved.
	25/08/2018 21:11	Racecourse Road/Sheppard Avenue	Lighting	Phone Call	Investigation revealed location of lights, which were redirected or turned off. Caller was advised of investigation results and action taken. Caller advised they were satisfied that the issue had been resolved
September	06/09/2018 13:55	Racecourse Road/Sheppard Avenue	General Dust	Community Response Line	Investigation revealed mining operations had already ceased at the time. Results at the nearest monitor indicated dust levels were not elevated at the time, and the 24 hour average remained within regulatory criteria. Caller was advised of investigation and monitoring results.
	07/09/2018 12:44	Denman Road	Blast Vibration	Community Response Line	Investigation revealed weather conditions were suitable for blasting at the time. Results indicated overpressure noise and ground vibration levels were within regulatory criteria. Caller was advised of investigation and monitoring results.
	10/09/2018 17:56	Racecourse Road/Sheppard Avenue	General Dust	Community Response Line	Results at the nearest monitor indicated dust levels were not elevated at the time, and the 24 hour average remained within regulatory criteria.
	11/09/2018 9:40	Racecourse Road/Sheppard Avenue	General Dust	Community Response Line	Results at the nearest monitor indicated dust levels were not elevated at the time, and the 24 hour average remained within regulatory criteria.
	11/09/2018 21:04	Racecourse Road/Sheppard Avenue	Lighting	Community Response Line	Investigation revealed location of lights, which were redirected or turned off. Caller was advised of investigation results and action taken. Caller advised they were satisfied that the issue had been resolved
	11/09/2018 21:04	Racecourse Road/Sheppard Avenue	General Dust	Community Response Line	Results at the nearest monitor indicated dust levels were not elevated at the time, and the 24 hour average remained within regulatory criteria.
	12/09/2018 20:17	Racecourse Road/Sheppard Avenue	General Dust	Community Response Line	Results at the nearest monitor indicated dust levels were not elevated at the time, and the 24 hour average remained within regulatory criteria.
	14/09/2018 22:12	Racecourse Road/Sheppard Avenue	Lighting	Community Response Line	Investigation revealed location of lights, which were redirected or turned off. Caller was advised of investigation results and action taken. Caller advised they were satisfied that the issue had been resolved
	14/09/2018 22:16	Racecourse Road/Sheppard Avenue	General Dust	Community Response Line	Results at the nearest monitor indicated dust levels were not elevated at the time, and the 24 hour average remained within regulatory criteria.
	19/09/2018 17:31	Racecourse Road/Sheppard Avenue	General Dust	Community Response Line	Results at the nearest monitor indicated dust levels were elevated at the time

Month	Date and time	From	Issue	Lodgement type	Investigation and response to caller
	19/09/2018 19:33	Racecourse Road/Sheppard Avenue	General Dust	Community Response Line	Results at the nearest monitor indicated dust levels were elevated at the time
	19/09/2018 10:48	Denman Road	Other	Community Response Line	As part of its blasting procedures, Mt Arthur Coal places reduced speed signs along a public road approximately one hour before the anticipated time of the blast event. These signs are put in place for the safety of both the general public and company personnel who are located along the roadway in preparation for a blast. Investigation revealed that speed limit signs were erected within the timeframe set out in Mt Arthur Coal's blasting procedures, which aim to ensure the safety of Mt Arthur Coal personnel and community members.
October	06/10/2018 17:45	Other	Spontaneous Combustion	Community Response Line	Investigation revealed spontaneous combustion activity at the time of the call. Mining operations were altered to reduce spontaneous combustion related activity. Caller was advised of investigation.
	09/10/2018 20:22	Racecourse Road/Sheppard Avenue	Lighting	Community Response Line	Investigation revealed location of lights, which were redirected or turned off. Caller was advised of investigation results and action taken. Caller advised they were satisfied that the issue had been resolved.
	26/10/2018 10:32	Racecourse Road/Sheppard Avenue	Blast Vibration	Community Response Line	Investigation revealed weather conditions were suitable for blasting at the time. Results indicated overpressure noise and ground vibration levels were within regulatory criteria. Caller did not request to be called back regarding investigation and monitoring.
	26/10/2018 18:25	Thomas Mitchell Drive	General Dust	Lodged with Third Party	BHP provided requested information to EPA
November	02/11/2018 21:47	Racecourse Road/Sheppard Avenue	General Dust	Community Response Line	Investigation revealed mining operations had already ceased at the time. Results at the nearest monitor indicated dust levels were not elevated at the time, and the 24 hour average remained within regulatory criteria. Caller did not request to be called back regarding investigation and monitoring results.
	02/11/2018 20:33	Other	Lighting	Community Response Line	Investigation revealed no offending lights. Caller did not request to be called back regarding investigation results.
	02/11/2018 21:47	Racecourse Road/Sheppard Avenue	Lighting	Community Response Line	Investigation revealed location of lights, which were turned off or redirected. Caller did not request to be called back regarding investigation results.
	07/11/2018 11:37	Racecourse Road/Sheppard Avenue	Blast Vibration	Community Response Line	Investigation revealed weather conditions were suitable for blasting at the time. Results indicated overpressure noise and ground vibration levels were within regulatory criteria. Caller was advised of investigation.
	13/11/2018 20:59	Racecourse Road/Sheppard Avenue	Lighting	Community Response Line	Investigation revealed location of lights, which were redirected or turned off. Caller was advised of investigation results and action taken. Caller advised they were satisfied that the issue had been resolved.
	22/11/2018 9:26	Roxburgh Road	General Dust	Community Response Line	Results at the nearest monitor indicated dust levels were not elevated at the time, however the 24 hour average exceeded regulatory criteria. Caller did not request to be called back regarding investigation and monitoring results.

Month	Date and time	From	Issue	Lodgement type	Investigation and response to caller
	22/11/2018	Thomas Mitchell Drive	Other	Lodged with Third Party	Investigation revealed source of complaint and measures will be undertaken to review processes.
	23/11/2018 21:06	Skellatar Stock Route	General Dust	Community Response Line	Investigation revealed mining operations were reduced at the time. Results at the nearest monitor indicated dust levels were elevated at the time. Unable to contact caller to advised of investigation and monitoring results.
	23/11/2018 21:06	Skellatar Stock Route	Lighting	Community Response Line	Investigation revealed location of lights, which were redirected or turned off. Caller was advised of investigation results and action taken. Caller advised they were satisfied that the issue had been resolved
	27/11/2018 21:33	Racecourse Road/Sheppard Avenue	Lighting	Community Response Line	Investigation revealed no issues with lights
December	4/12/2018 10:21	Other	Blast Vibration	Community Response Line	Investigation revealed weather conditions were suitable for blasting at the time. Results indicated overpressure noise and ground vibration levels were within regulatory criteria. Caller was advised of investigation and monitoring results.
	9/12/2018 10:02	Roxburgh Road	Lighting	Community Response Line	Investigation revealed location of lights, which were redirected or turned off. Caller was advised of investigation results and action taken. Caller advised they were satisfied that the issue had been resolved
	20/12/2018 20:17	Thomas Mitchell Drive	Other	Community Response Line	Caller thanked for information supplied.
	23/12/2018 22:40	Roxburgh Road	Lighting	Community Response Line	Investigation revealed location of lights, which were redirected or turned off. Caller was advised of investigation results and action taken. Caller advised they were satisfied that the issue had been resolved
	24/12/2018 11:04	Muswellbrook	Other	Community Response Line	As part of its blasting procedures, Mt Arthur Coal places reduced speed signs along a public road approximately one hour before the anticipated time of the blast event. These signs are put in place for the safety of both the general public and company personnel who are located along the roadway in preparation for a blast. Investigation revealed that speed limit signs were erected within the timeframe set out in Mt Arthur Coal's blasting procedures, which aim to ensure the safety of Mt Arthur Coal personnel and community members.
	24/12/2018 14:16	Denman Road	Blast Vibration	Community Response Line	Investigation revealed weather conditions were suitable for blasting at the time. Results indicated overpressure noise and ground vibration levels were not within regulatory criteria. Caller was advised of investigation and monitoring results.
	24/12/2018 14:23	Racecourse Road/Sheppard Avenue	Blast Vibration	Phone Call	Investigation revealed weather conditions were suitable for blasting at the time. Results indicated overpressure noise and ground vibration levels were not within regulatory criteria. Caller was advised of investigation and monitoring results.
	24/11/2018 01/12/2018	Other	Train Noise	Other	Investigation revealed trains were not operating at the time. Results at the nearest real-time monitor indicated noise levels were within regulatory criteria. Caller was advised of investigation and monitoring results.
January	04/01/2019 10:50	Denman Road	Blast Vibration	Community Response Line	Investigation revealed weather conditions were suitable for blasting at the time. Results indicated overpressure noise and ground vibration levels were within regulatory criteria.

Month	Date and time	From	Issue	Lodgement type	Investigation and response to caller
	05/01/2019 8:55	Racecourse Road/Sheppard Avenue	Lighting	Community Response Line	Investigation revealed location of lights, which were redirected or turned off. Caller was advised of investigation results and action taken. Caller advised they were satisfied that the issue had been resolved
	05/01/2019 8:55	Racecourse Road/Sheppard Avenue	General Dust	Community Response Line	Investigation revealed mining operations had already ceased at the time. Results at the nearest monitor indicated dust levels were not elevated at the time, and the 24 hour average remained within regulatory criteria. Caller was advised of investigation and monitoring results.
	07/01/2019 9:19	Roxburgh Road	Operational Noise	Community Response Line	Investigation revealed no unusual mining operations were occurring at the time. Results at the nearest real-time monitor indicated noise levels were within regulatory criteria. Caller was advised of investigation and monitoring results.
	08/01/2019 23:11	Roxburgh Road	Operational Noise	Community Response Line	Investigation revealed no unusual mining operations were occurring at the time. Results at the nearest real-time monitor indicated noise levels were within regulatory criteria. Caller was advised of investigation and monitoring results.
	17/01/2019 19:06	Thomas Mitchell Drive	Other	Community Response Line	Caller thanked for information supplied.
	17/01/2019 20:46	Racecourse Road/Sheppard Avenue	Lighting	Community Response Line	Investigation revealed location of lights, which were redirected or turned off. Caller was advised of investigation results and action taken. Caller advised they were satisfied that the issue had been resolved
	22/01/2019 20:57	Racecourse Road/Sheppard Avenue	Lighting	Community Response Line	Investigation revealed location of lights, which were redirected or turned off. Caller was advised of investigation results and action taken. Caller advised they were satisfied that the issue had been resolved
	23/01/2019 21:43	Roxburgh Road	Lighting	Community Response Line	Investigation revealed location of lights, which were redirected or turned off. Caller was advised of investigation results and action taken. Caller advised they were satisfied that the issue had been resolved
	30/01/2019 5:13	Roxburgh Road	Operational Noise	Community Response Line	Investigation revealed no unusual mining operations were occurring at the time. Results at the nearest real-time monitor indicated noise levels were within regulatory criteria. Caller was advised of investigation and monitoring results
	31/01/2019 23:10	Racecourse Road/Sheppard Avenue	Lighting	Community Response Line	Investigation revealed location of lights, which were redirected or turned off. Caller was advised of investigation results and action taken. Caller advised they were satisfied that the issue had been resolved
February	03/02/2019 23:26	Roxburgh Road	Operational Noise	Community Response Line	Investigation revealed no unusual mining operations were occurring at the time. Results at the nearest real-time monitor were un available due to monitor being non-operational.
	04/02/2019 17:46	Racecourse Road/Sheppard Avenue	General Dust	Community Response Line	Investigation revealed mining operations had already ceased at the time. Results at the nearest monitor indicated dust levels were not elevated at the time, and the 24 hour average remained within regulatory criteria. Caller was advised of investigation and monitoring results.
	04/02/2019 17:49	Racecourse Road/Sheppard Avenue	General Dust	Community Response Line	Investigation revealed mining operations had already ceased at the time. Results at the nearest monitor indicated dust levels were not elevated at the time, and the 24 hour average remained within regulatory criteria. Caller was advised of investigation and monitoring results.

Month	Date and time	From	Issue	Lodgement type	Investigation and response to caller
	06/02/2019 4:48	Roxburgh Road	Operational Noise	Community Response Line	Investigation revealed no unusual mining operations were occurring at the time. Results at the nearest real-time monitor were un available due to monitor being non-operational.
	08/02/2019 11:33	Denman Road	Blast Vibration	Community Response Line	Investigation revealed weather conditions were suitable for blasting at the time. Results indicated overpressure noise and ground vibration levels were within regulatory criteria.
	08/02/2019 12:00	Denman Road	Blast Vibration	Community Response Line	Investigation revealed weather conditions were suitable for blasting at the time. Results indicated overpressure noise and ground vibration levels were within regulatory criteria.
	11/02/2019 22:28	Roxburgh Road	Operational Noise	Community Response Line	Investigation revealed no unusual mining operations were occurring at the time. Results at the nearest real-time monitor were un available due to monitor being non-operational.
	15/02/2019 12:58	Muswellbrook	General Dust	Community Response Line	Investigation revealed mining operations had already ceased at the time. Results at the nearest monitor indicated dust levels were not elevated at the time, and the 24 hour average remained within regulatory criteria. Caller was advised of investigation and monitoring results.
	20/02/2019 11:45	Roxburgh Road	Operational Noise	Community Response Line	Investigation revealed no unusual mining operations were occurring at the time. Results at the nearest real-time monitor indicated noise levels were within regulatory criteria.
	21/02/2019 10:56	Muswellbrook	Blast Dust	Community Response Line	Investigation revealed weather conditions were suitable for blasting at the time. Results at the nearest monitor indicated dust levels were not elevated at the time, and the 24 hour average remained within regulatory criteria. Caller was advised of investigation and monitoring results.
	28/02/2019 1:05	Roxburgh Road	Operational Noise	Community Response Line	Investigation revealed no unusual mining operations were occurring at the time. Results at the nearest real-time monitor indicated noise levels were within internal benchmarks.
March	05/03/2019 9:45	Racecourse Road/Sheppard Avenue	Blast Vibration	Community Response Line	Investigation revealed weather conditions were suitable for blasting at the time. Results indicated overpressure noise and ground vibration levels were within regulatory criteria. Caller was advised of investigation and monitoring results.
	08/03/2019 20:27	Roxburgh Road	Lighting	Community Response Line	Investigation revealed location of lights, which were redirected or turned off. Caller was advised of investigation results and action taken. Caller advised they were satisfied that the issue had been resolved
	12/03/2019 12:45	Roxburgh Road	Low Frequency Noise	Community Response Line	Investigation revealed no unusual mining operations were occurring at the time. Results at the nearest real-time monitor indicated noise levels were within regulatory criteria.
	19/03/2019 10:48	Muswellbrook	Other	Community Response Line	As part of its blasting procedures, Mt Arthur Coal places reduced speed signs along a public road approximately one hour before the anticipated time of the blast event. These signs are put in place for the safety of both the general public and company personnel who are located along the roadway in preparation for a blast. Investigation revealed that speed limit signs were erected within the timeframe set out in Mt Arthur Coal's blasting procedures, which aim to ensure the safety of Mt Arthur Coal personnel and community members.

Month	Date and time	From	Issue	Lodgement type	Investigation and response to caller
	20/03/2019 12:46	Roxburgh Road	Low Frequency Noise	Community Response Line	Investigation revealed no unusual mining operations were occurring at the time. Results at the nearest real-time monitor indicated noise levels were within regulatory criteria.
	23/03/2019 23:56	Roxburgh Road	Low Frequency Noise	Community Response Line	Investigation revealed no unusual mining operations were occurring at the time. Results at the nearest real-time monitor indicated noise levels were within regulatory criteria.
	24/03/2019 12:03	Roxburgh Road	Low Frequency Noise	Community Response Line	Investigation revealed no unusual mining operations were occurring at the time. Results at the nearest real-time monitor indicated noise levels were within regulatory criteria.
April	17/04/2019	Muswellbrook	Blast Fume	Lodged with Third Party	Investigation revealed fume event occurred after Blast. Nil Injury or Health Impact. Department was advised of investigation and monitoring results.
	17/04/2019 2:01	Roxburgh Road	Low Frequency Noise	Community Response Line	Investigation revealed no unusual mining operations were occurring at the time. Results at the nearest real-time monitor indicated noise levels were within regulatory criteria.
May	02/05/2019 13:16	Racecourse Road/Sheppard Avenue	Blast Vibration	Community Response Line	Investigation revealed weather conditions were suitable for blasting at the time. Results indicated overpressure noise and ground vibration levels were within regulatory criteria. Caller was advised of investigation and monitoring results.
	08/05/2019 21:32	Muswellbrook	Lighting	Community Response Line	Investigation revealed location of lights, which were redirected or turned off. Caller was not advised of investigation results and action taken.
	08/05/2019 18:30	Racecourse Road/Sheppard Avenue	Lighting	Community Response Line	Investigation revealed location of lights, which were redirected or turned off. Caller was not advised of investigation results and action taken.
	18/05/2019 22:44	Roxburgh Road	Operational Noise	Community Response Line	Investigation revealed no unusual mining operations were occurring at the time. Results at the nearest real-time monitor indicated noise levels were within regulatory criteria.
June	26/06/2019 3:32	Roxburgh Road	Operational Noise	Community Response Line	Investigation revealed no unusual mining operations were occurring at the time. Results at the nearest real-time monitor indicated noise levels were within internal benchmarks. Caller did not request to be called back regarding investigation and monitoring results.

Appendix 5 – Rehabilitation Plan

ML1757
ML1487
ML1548
ML1593S
ML1593
ML1358
AUTH171
ML1655
MPL263
CCL744
CL396
ML1739
ML1739
CL395
ML1739
CL229
ML1739
AUTH437
AUTH437
EL5965
DENMAN ROAD
EDDERTON ROAD
EDDERTON ROAD
EDDERTON ROAD
HUNTER RIVER
MUSWELLBROOK
WHITES CREEK
Sadlers Creek
BLACK HILL
LITTLE GRASSTREE HILL
EDINGLASSIE
BALMORAL CORNER
RFS
RFS

Actual Rehabilitation (June 2019)

Rehabilitation vegetation type

- Rehabilitation Area - Box Gum Woodland
- Rehabilitation Area - Native Woodland
- Rehabilitation Area - Pasture
- FY19 Rehabilitation Areas

Actual Disturbance (June 2019)

- Active Mining Area (Open cut void)
- Overburden Emplacement Area
- Landform Establishment
- Growth Media Development
- Infrastructure Area
- Tailings Storage Facility
- Topsoil Stockpile
- Water Management Area

BHP

Mapping Services Brisbane

0 500 1,000 1,500 2,000 m

Transverse Mercator Projection.
MGA Zone 56. GDA94 Datum.

MOUNT ARTHUR COAL

Annual Review - Rehabilitation Plan

Drawn: B. Kleinschmidt	Checked: L. Neil	Date: 31/7/2019	Revision: 0	Filename: MAC_AR_RehabPlan	Appen. 5

Appendix 6 – Annual Coal Transport Report FY19

This report has been prepared in accordance with Schedule 3 Condition 46 of Project Approval 09_0062 MOD 1:

Monitoring of Coal Transport

46. The Proponent shall keep records of the:
    (a) amount of coal transported from the site in each financial year;
    (b) number of coal haulage train movements generated by the Mt Arthur mine complex (on a daily basis); and
    (c) make these records available on its website at the end of each financial year.

For the 12 month period ending 30 June 2019:

- Approximately 17 million tonnes of export product coal was transported by rail to the Port of Newcastle. This is compliant with Schedule 2 Condition 7(a) of Project Approval 09_0062 MOD 1, which restricts Mt Arthur Coal's coal transport on the Antiene rail spur to a maximum of 27 million tonnes of product coal in a financial year;
- Approximately two million tonnes of domestic product coal was transported by conveyor to the Bayswater Power Station;
- The total number of train movements was 4,016; and
- The maximum number of train movements in a single day was 20, which occurred once only throughout the reporting period. This is compliant with Schedule 2 Condition 7(b) of Project Approval 09_0062 MOD 1, which restricts Mt Arthur Coal's coal transport on the Antiene rail spur to a maximum of 30 train movements a day.

Note: Each train entering and exiting the site is classified as two train movements and a day refers to the 24 hours from midnight to midnight the next day.

Table A6.1. Daily train movements FY19

Date	Number of train movements
1/07/2018	16
2/07/2018	12
3/07/2018	16
4/07/2018	6
5/07/2018	14
6/07/2018	14
7/07/2018	4
8/07/2018	8
9/07/2018	16
10/07/2018	18
11/07/2018	16
12/07/2018	12
13/07/2018	6
14/07/2018	0
15/07/2018	14
16/07/2018	8
17/07/2018	16
18/07/2018	10
19/07/2018	14
20/07/2018	14
21/07/2018	16
22/07/2018	12
23/07/2018	20
24/07/2018	8
25/07/2018	0
26/07/2018	0
27/07/2018	6
28/07/2018	12
29/07/2018	14
30/07/2018	12
31/07/2018	0
1/08/2018	0
2/08/2018	2
3/08/2018	10
4/08/2018	16
5/08/2018	14
6/08/2018	10
7/08/2018	6
8/08/2018	12
9/08/2018	12
10/08/2018	14
11/08/2018	12
12/08/2018	14
13/08/2018	14
14/08/2018	2
15/08/2018	14
16/08/2018	6

Date	Number of train movements
17/08/2018	8
18/08/2018	0
19/08/2018	6
20/08/2018	14
21/08/2018	8
22/08/2018	12
23/08/2018	0
24/08/2018	0
25/08/2018	0
26/08/2018	0
27/08/2018	8
28/08/2018	12
29/08/2018	16
30/08/2018	16
31/08/2018	16
1/09/2018	10
2/09/2018	14
3/09/2018	12
4/09/2018	8
5/09/2018	8
6/09/2018	12
7/09/2018	8
8/09/2018	16
9/09/2018	14
10/09/2018	18
11/09/2018	14
12/09/2018	14
13/09/2018	20
14/09/2018	18
15/09/2018	10
16/09/2018	10
17/09/2018	8
18/09/2018	0
19/09/2018	0
20/09/2018	0
21/09/2018	18
22/09/2018	12
23/09/2018	10
24/09/2018	16
25/09/2018	10
26/09/2018	8
27/09/2018	0
28/09/2018	0

Date	Number of train movements
29/09/2018	0
30/09/2018	0
1/10/2018	12
2/10/2018	18
3/10/2018	14
4/10/2018	20
5/10/2018	12
6/10/2018	16
7/10/2018	16
8/10/2018	12
9/10/2018	14
10/10/2018	20
11/10/2018	10
12/10/2018	18
13/10/2018	18
14/10/2018	10
15/10/2018	16
16/10/2018	10
17/10/2018	6
18/10/2018	12
19/10/2018	10
20/10/2018	18
21/10/2018	18
22/10/2018	14
23/10/2018	6
24/10/2018	8
25/10/2018	14
26/10/2018	14
27/10/2018	16
28/10/2018	10
29/10/2018	10
30/10/2018	12
31/10/2018	2
1/11/2018	14
2/11/2018	14
3/11/2018	18
4/11/2018	18
5/11/2018	16
6/11/2018	20
7/11/2018	10
8/11/2018	14
9/11/2018	18
10/11/2018	20

Date	Number of train movements
11/11/2018	12
12/11/2018	18
13/11/2018	18
14/11/2018	12
15/11/2018	12
16/11/2018	14
17/11/2018	14
18/11/2018	20
19/11/2018	0
20/11/2018	0
21/11/2018	0
22/11/2018	0
23/11/2018	0
24/11/2018	0
25/11/2018	0
26/11/2018	0
27/11/2018	0
28/11/2018	0
29/11/2018	0
30/11/2018	0
1/12/2018	8
2/12/2018	12
3/12/2018	8
4/12/2018	8
5/12/2018	14
6/12/2018	12
7/12/2018	16
8/12/2018	18
9/12/2018	20
10/12/2018	14
11/12/2018	12
12/12/2018	14
13/12/2018	18
14/12/2018	14
15/12/2018	16
16/12/2018	14
17/12/2018	18
18/12/2018	8
19/12/2018	10
20/12/2018	14
21/12/2018	12
22/12/2018	16
23/12/2018	12

Date	Number of train movements
24/12/2018	8
25/12/2018	0
26/12/2018	2
27/12/2018	12
28/12/2018	14
29/12/2018	14
30/12/2018	14
31/12/2018	16
1/1/2019	18
2/1/2019	16
3/1/2019	12
4/1/2019	12
5/1/2019	14
6/1/2019	10
7/1/2019	10
8/1/2019	2
9/1/2019	0
10/1/2019	10
11/1/2019	8
12/1/2019	14
13/1/2019	12
14/1/2019	6
15/1/2019	16
16/1/2019	14
17/1/2019	10
18/1/2019	8
19/1/2019	10
20/1/2019	12
21/1/2019	14
22/1/2019	4
23/1/2019	10
24/1/2019	4
25/1/2019	10
26/1/2019	4
27/1/2019	6
28/1/2019	12
29/1/2019	14
30/1/2019	12
31/1/2019	14
1/02/2019	18
2/02/2019	14
3/02/2019	20
4/02/2019	12

Date	Number of train movements
5/02/2019	10
6/02/2019	4
7/02/2019	18
8/02/2019	14
9/02/2019	20
10/02/2019	18
11/02/2019	16
12/02/2019	12
13/02/2019	10
14/02/2019	6
15/02/2019	6
16/02/2019	12
17/02/2019	12
18/02/2019	6
19/02/2019	0
20/02/2019	0
21/02/2019	0
22/02/2019	12
23/02/2019	4
24/02/2019	12
25/02/2019	8
26/02/2019	10
27/02/2019	8
28/02/2019	10
1/03/2019	10
2/03/2019	14
3/03/2019	6
4/03/2019	8
5/03/2019	12
6/03/2019	10
7/03/2019	18
8/03/2019	12
9/03/2019	2
10/03/2019	0
11/03/2019	0
12/03/2019	8
13/03/2019	8
14/03/2019	10
15/03/2019	14
16/03/2019	12
17/03/2019	6
18/03/2019	14
19/03/2019	4

Date	Number of train movements
20/03/2019	6
21/03/2019	16
22/03/2019	12
23/03/2019	14
24/03/2019	8
25/03/2019	6
26/03/2019	8
27/03/2019	10
28/03/2019	12
29/03/2019	16
30/03/2019	12
31/03/2019	18
01/04/2019	16
02/04/2019	16
03/04/2019	0
04/04/2019	0
05/04/2019	4
06/04/2019	16
07/04/2019	6
08/04/2019	6
09/04/2019	0
10/04/2019	0
11/04/2019	2
12/04/2019	12
13/04/2019	14
14/04/2019	20
15/04/2019	16
16/04/2019	10
17/04/2019	18
18/04/2019	16
19/04/2019	12
20/04/2019	16
21/04/2019	10
22/04/2019	14
23/04/2019	10
24/04/2019	12
25/04/2019	14
26/04/2019	12
27/04/2019	12
28/04/2019	20
29/04/2019	14
30/04/2019	12
01/05/2019	20

Date	Number of train movements
02/05/2019	14
03/05/2019	18
04/05/2019	18
05/05/2019	18
06/05/2019	16
07/05/2019	18
08/05/2019	16
09/05/2019	16
10/05/2019	16
11/05/2019	14
12/05/2019	14
13/05/2019	16
14/05/2019	8
15/05/2019	12
16/05/2019	18
17/05/2019	14
18/05/2019	12
19/05/2019	16
20/05/2019	12
21/05/2019	0
22/05/2019	0
23/05/2019	2
24/05/2019	6
25/05/2019	6
26/05/2019	18
27/05/2019	18
28/05/2019	16
29/05/2019	8
30/05/2019	20
31/05/2019	10
01/06/2019	14
02/06/2019	16
03/06/2019	14
04/06/2019	14
05/06/2019	12
06/06/2019	14
07/06/2019	12
08/06/2019	16
09/06/2019	14
10/06/2019	14
11/06/2019	14
12/06/2019	8
13/06/2019	14

Date	Number of train movements
14/06/2019	14
15/06/2019	12
16/06/2019	8
17/06/2019	14
18/06/2019	10
19/06/2019	10
20/06/2019	12
21/06/2019	16
22/06/2019	14
23/06/2019	18
24/06/2019	12
25/06/2019	12
26/06/2019	12
27/06/2019	14
28/06/2019	12
29/06/2019	6
30/06/2019	16
Total	**4016**
Maximum daily train movements	**20**