Centennial Coal

MODIFICATION REPORT

Airly Mine Extension Project

State Significant Development 5581

Modification 3

Volume 2: Part 2 Appendices H – N

October 2019

Airly Mine

SSD 5581 – Modification 3

MODIFICATION REPORT

APPENDICES H – N

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APPENDICES H – N

Appendix H:	**Road Traffic Impact Assessment**
Appendix I:	**Rail Traffic Impact Assessment**
Appendix J:	**Noise & Vibration Impact Assessment**
Appendix K:	**Air Quality Impact Assessment & Greenhouse Gas Assessment**
Appendix L:	**Economic Assessment**
Appendix M:	**Social Impact Assessment**
Appendix N:	**BDAR Waiver Request Table 1**

Road Traffic Impact Assessment

APPENDIX – H

Transport Impact Assessment

Airly Mine, Capertee NSW
Extension Project Modification 3

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Table of Contents

Appendices

Tables

Figures

1 Introduction

1.1 Overview

Centennial Airly Pty Ltd (Centennial) proposes a Modification (MOD 3) to the existing Airly Mine State Significant Development Approval (SSD 5581) consent of December 2015 to allow for the extraction of up to 3.0 million tonnes per annum (Mtpa) of coal from the existing Airly Coal Mine (Airly) operations, noting that under the SSD 5581 approval, coal production at Airly is currently limited to 1.8 Mtpa of Run of Mine (ROM) and/or beneficiated coal.

Along with this production increase, MOD 3 also provides for:

- An increase in workforce from the approved 155 FTE personnel to 200 FTE personnel;
- Approval to undertake underground blasting or shot-firing activities for the removal of geological structures in the event they are encountered within the mining areas;
- An increase in the movement of laden coal trains and water trains leaving the site from the approved average of 2 trains per day to 3 trains per day over any calendar year but maintaining the approved maximum 5 trains per day leaving the site on any day; and
- An amendment to the approved 20-year mine schedule for the increased production rate.

Full details of MOD 3 are provided in the Modification Report prepared in support of the MOD 3, which this assessment accompanies.

1.2 Transport Impact Assessment Methodology

Ason Group has been commissioned by Centennial to prepare this Transport Impact Assessment (TIA) to appropriately and independently assess the access, traffic and parking characteristics of MOD 3. This has included a detailed assessment of:

- Existing Airly operations, including peak traffic generating periods across the day and week;
- Existing road network operations, focusing on the key intersections providing access between Airly and the regional road network;
- The future peak period trip generation and distribution of Airly further to the Modification, and the potential impact of those additional trips on the road network; and
- Parking requirements and provision.

This methodology specifically responds to the Director General's Requirements (DGRs) previously detailed by the (then) Department of Planning & Infrastructure in regard to SSD 5581, which provided the following in regard to traffic and transport:

- *an assessment of potential traffic impacts on the capacity, efficiency and safety of the road network*

- *a description of the measures that would be implemented to maintain and/or improve the capacity, efficiency and safety of the road network in the surrounding area over the life of the development*.

It also reflects the more detailed assessment requests provided by NSW Road & Maritime Services (RMS) in regard to SSD 5581, which include:

- *Hours*
- *infrastructure to support any increased demand on the rail or road network as a result and days of construction and operation for each stage of the project and how proposed operations will interact with existing operations;*
- *Road and rail traffic and transport volumes and types broken down into origin and destination, travel routes and peak hours for the construction, operation and decommissioning of the project. The study should provide details of existing and projected transport operations including volumes of traffic and tonnage transported (export and domestic). Volumes should also include mine input related traffic generation (e.g. fuel deliveries, potable water delivers, maintenance, services etc) and impact of mine related traffic generation in public roads and the rail network. The traffic study should address internal traffic movements and parking facilities;*
- *Any oversize and overmass vehicles and loads expected for the construction, operation of decommissioning of the project;*
- *Temporary and permanent staff numbers (including employees and contractors) and staff parking arrangements during the construction, operation and decommissioning of the project;*
- *The impact of generated traffic and measures employed to ensure efficiency and safety on the public road and rail networks, in particular the Castlereagh Hwy (HW 18) and intersection of Glen David Road and HW18 during the construction, operation and decommissioning of the project. The study should address cumulative impacts of existing operation and construction and subsequent expanded and extended operations;*
- *Any mitigating measures required to address expected traffic generation;*
- *Local climate conditions that may affect road safety for vehicles used during the construction and operation of the project (e.g. dust, fog, wet weather etc); and*
- *Details of any required of this project.*

1.3 Reference Documents

This TIA references the traffic and transport guidelines and assessment requirements noted within the SSD 5581 DGRs, and more broadly as appropriate to the specific characteristics of MOD 3. Key references include: -

- *Guide to Traffic Generating Developments*, Roads & Maritime Services (RMS Guide);
- *Environmental Impact Statement Guidelines*, Department of Planning & Environment;

- *Guide to Transport Impact Assessments*, Transport for NSW (TfNSW);
- *Guide to Road Design Part 4A Unsignalised & Signalised Intersections*, Austroads (GRD 4A);
- *Rural Road Design Guide*, Austroads (RRDG); and
- *Guide to Traffic Engineering Practice Part 5 Intersections at Grade*, Austroads (GTEP 5).

A traffic and transport assessment was prepared for the Airly Mine Extension Project was prepared on behalf of Centennial for the original SSD application. A project description has been prepared by Centennial for Modification 3. In this regard, Ason Group has referenced the following documents:

- *Project Description: Airly Mine Extension Project State Significant Development 5581 Modification 3*, 2019 prepared by Centennial (Project Description).

Ason has also relied on traffic survey data undertaken by TTM in the period 7-day from 30 November to 06 December 2018 (**Appendix A**).

2 The Airly Mine

2.1 Location

Airly is located near the village of Capertee, approximately 40km northwest of Lithgow, and 70km west of Sydney. The SSD 5581 Project Application Area (PAA) includes an area of some 3,982ha, of which approximately 3,090ha lies within the Mugii Murrum-ban State Conservation Area.

Airly is shown in its regional context in **Figure 1**, while the Project Application Area is shown in **Figure 2**.

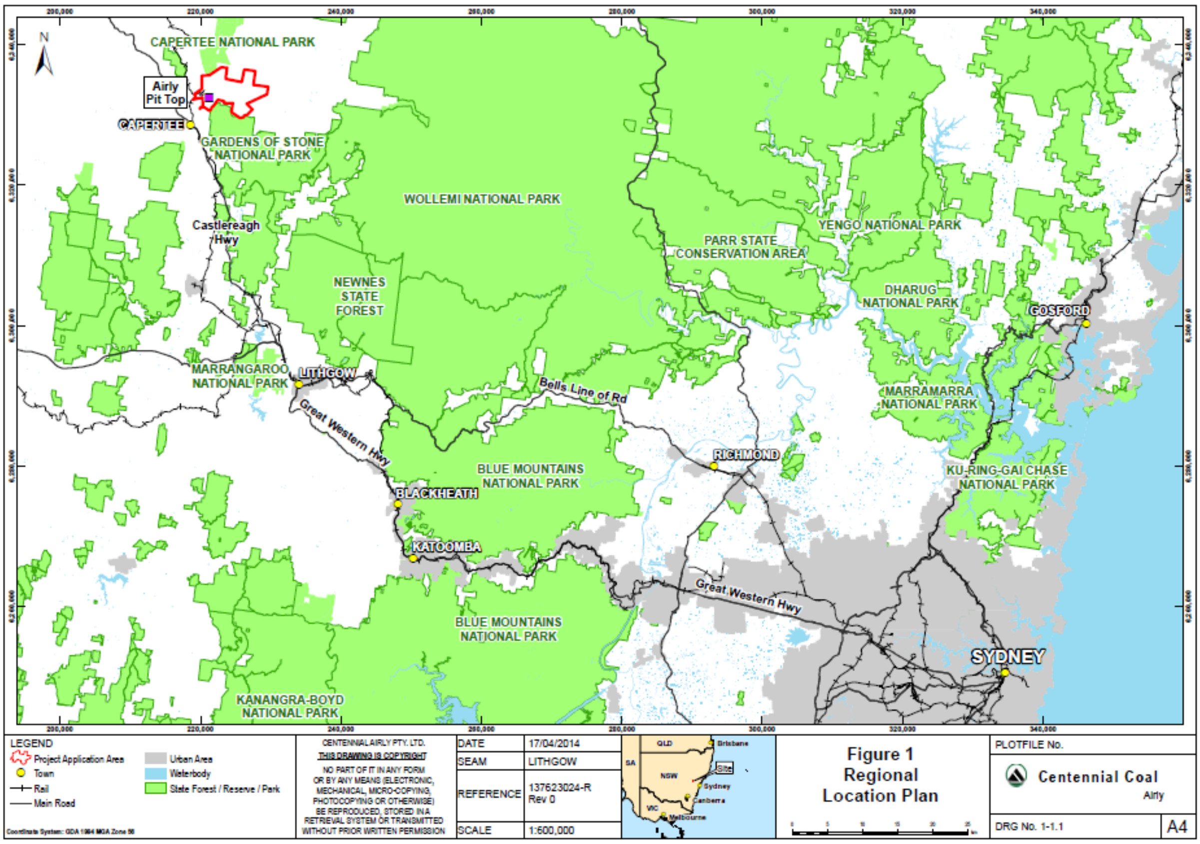

Figure 1: Airly Regional Location Plan

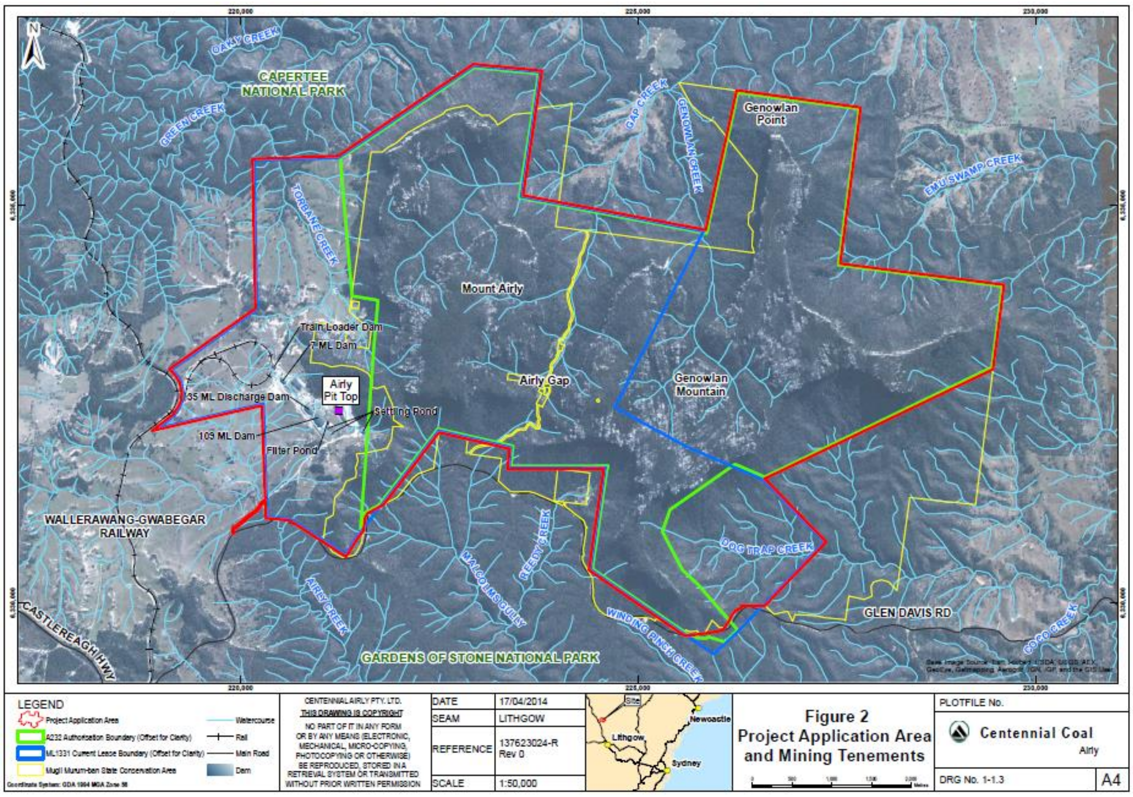

Figure 2: SSD 5581 Project Application Area

2.2 Existing Mine Operations

2.2.1 Overview

Airly is an underground coal mine producing high quality thermal coal, with all coal transported from the Airly to domestic power stations, and for the export market, by rail. No coal is transferred from Airly by road.

Mining at Airly commenced in 1994, under a development consent granted in 1993 (DA 162/91), though Airly is currently operating under consolidated State significant consent SSD 5581. SSD 5581 allows mining operations to continue until 31 December 2037, and permits:

- The extraction of 1.8 Mtpa of ROM coal by partial extraction mining methods;
- The transportation of coal by rail to Eraring Power Station (Eraring) and to coal terminals for the export markets;
- The employment of up to 155 staff, including up to 20 contractors;
- The operation of supporting infrastructure; and
- The subsequent rehabilitation following the end of mining operations.

2.2.2 Access

Vehicle access to the Airly Pit Top (the Pit Top) is provided via Glen Davis Road to Mine Access Road, and then Torbane Road which runs north to the Pit Top.

To the south-west of Airly, Glen Davis Road intersects with Castlereagh Highway, which essentially provides for all staff and service vehicle trips to and from Airly. The Airly access road network is shown in **Figure 1**.

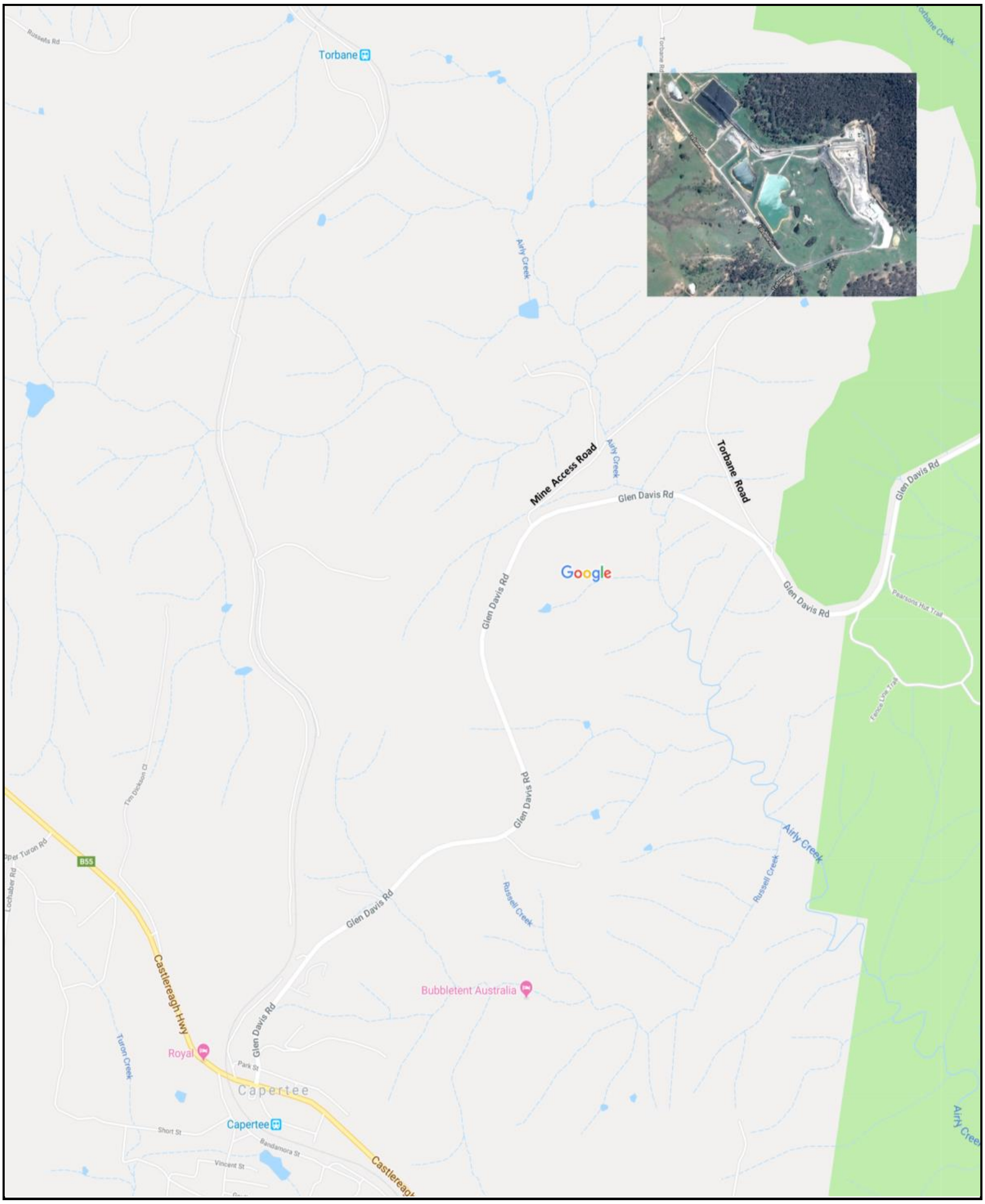

Figure 3: Airly Access Roads

2.2.3 Operational Shifts & Staff

Airly operates 24 hours a day, 7 days a week, and is approved to employ 155 FTE staff, including up to 20 contract staff, though it is noted that at this time Airly employs slightly fewer total staff than the approval provides for (some 146 staff). Shifts and staffing levels are shown below in **Table 1**.

Table 1: Airly Existing Staff & Shift Structure

Approved Staff & Shift Structure	Weekday Shifts (Mon - Fri)			Weekend Shifts (Sat – Sun)	
	Day 7:00am – 3:30pm	Afternoon 3:00pm – 11:30pm	Night 11:00pm – 7:30am	Day 7:00am – 7:00pm	Night 7:00pm – 7:00am
Mining staff	25	25	25	21	14
General Staff and Contractors	26	4	2	2	2
Total	**51**	**29**	**27**	**23**	**16**

2.3 Traffic Generation & Distribution

2.3.1 Staff Trips

Based on a review of 2018 traffic survey data in Mine Access Road (**Appendix A**) it is apparent that almost the entire staff cohort drives to the Pit Top via private vehicle. This is not surprising considering the nature (and hours) of the work; the location of Airly; and the lack of other viable travel options (such as public transport).

With reference to **Table 1**, Airly staff arrival and departure peaks are off-set as a function of the shift structure; for example, the traffic peak associated with arrivals for the Weekday Day shift (prior to 7:00am) is over before the traffic peak associated with departures from the Weekday Night shift commences (after 7:30am). The end of the Weekday Day shift and start of the Weekday Afternoon shift; and end of the Weekday Afternoon shift and start of the Weekday Night shift; are both similarly off-set.

It is also important to note that – as for many mines assessed by Ason Group – not all staff arrive and depart in the immediate periods prior to any after each shift; rather, the arrival and departure period are generally generated over 1 – 2 hours. This is true not only for mining staff but also for general staff, where arrival and departure periods tend to occur over extended (1 – 2 hour) AM and PM peak periods respectively.

As discussed previously, at this time (and at the time of the traffic surveys in December 2018) staff numbers were slightly lower than currently approvals provide for, with 146 FTE staff (including contractors), some 9 staff lower than the 155 FTE approved staff total. Notwithstanding, with reference to the 2018 traffic survey data, Airly staff currently generate:

- Approximately 224 weekday vehicle trips per day (vpd);
- A weekday AM peak hour generation of some 32 vehicle trips per hour (vph), coinciding with the arrival period for the Weekday Day shift;
- A weekday PM peak hour generation of some 26vph, coinciding with the departure period for the Weekday Day shift.
- Up to 43 weekend (Sunday) vpd; and
- A maximum of 19vph on the weekend, occurring in the arrival peak for the Weekday Night shift (which actually occurs on the Sunday evening).

2.3.2 Heavy Vehicle Trips

With reference to the traffic surveys, Airly generates only a very minor heavy (service) vehicle demand – an average of some 22 heavy vehicle trips per day - including deliveries of equipment and light materials; maintenance vehicles; and occasionally machinery and the like.

It is noted that there is no expectation of the Airly heavy vehicle trip generation being affected by MOD 3, and again no coal is or will be transport by road.

2.3.3 Trip Distribution

With reference to Airly staff records, approximately 55% of staff reside to the south of Airly (primarily the Lithgow region) and 45% of staff reside to the north of Airly (primarily Kandos and Rylestone. Almost all heavy vehicle trips are to/from the south.

2.4 Parking

The Pit Top car park provides some 119 parking spaces. Given that the maximum on-site parking demand at any one time is for approximately 80 staff vehicles (during the changeover between the Weekday Day shift and Weekday Afternoon shift, generally between 2:00pm and 4:00pm) the car park provides more than adequate capacity to accommodate the peak demand, which ensures that there is no off-site parking requirement.

3 The Road Network

The sub-regional road network which provides access for Airly is shown in **Figure 3**, and detailed further in sections below.

3.1 Key Roads & Intersections

3.1.1 Castlereagh Highway

Castlereagh Highway (State Route 86, National Route B55) is a regional highway connecting the Great Western Highway at Marrangaroo to Mudgee and Gulgong, and then further through north-west NSW. It generally provides two traffic lanes and at-grade, and grade separated, intersections appropriate to the through and turning traffic demands in different parts of the regional network.

Castlereagh Highway has a posted speed limit of 50km/h through Capertee (including through the intersection with Glen Davis Road) but otherwise generally has a posted speed limit 100km/h.

3.1.2 Great Western Highway

The Great Western Highway (State Highway 5, National Route 32) is a regional highway which intersects with the Castlereagh Highway at Marrangaroo. The Great Western Highway links to the east to Lithgow, Katoomba and then through to the broader Sydney metropolitan area (M4); and to the west to Bathurst.

3.1.3 Glen Davis Road

Glen Davis Road is a lightly trafficked rural road which runs from Castlereagh Highway in the south, then north (to the immediate east of Airly) before turning east to the small village of Glen Davis. Glen Davis Road generally provides two traffic lanes and wide verges through to a point north of Airly, after which it continues to provide two traffic lanes but narrower verges.

Glen Davis Road has a posted speed limit of 50km/h through Capertee, as well as School Zone speed restrictions (40km/h) during school peak periods. Outside of Capertee it has a posted speed limit of 100km/h.

3.1.4 Mine Access Road

Mine Access Road is a sealed private road providing access between Glen Davis Road and the Pit Top. Mine Access Road provides two traffic lanes and has a posted speed limit of 60km/h.

3.1.5 Torbane Road

As discussed, Torbane Road is a sealed private road providing access between Mine Access Road and the Pit Top; like Mine Access Road, it provides two traffic lanes and has a posted speed limit of 60km/h.

Between Glen Davis Road and Mine Access Road, Torbane Road provides a wide unsealed carriageway, with a nominal speed limit (per State Forest speed guidelines) of 60km/h, but in practice is rarely used by any vehicular traffic.

3.1.6 Castlereagh Highway & Glen Davis Road

The intersection of Castlereagh Highway & Glen Davis Road operates under priority (Give Way) control, and provides significant auxiliary infrastructure, including:

- A Channelised Left (CHL) lane, Castlereagh Highway to Glen Davis Road; and
- A Channelised Right (CHR) lane, Castlereagh Highway to Glen Davis Road.

It is our understanding that the intersection was upgraded (to provide this auxiliary infrastructure) as part of past Airly approvals.

3.1.7 Glen Davis Road & Mine Access Road

The intersection of Glen Davis Road & Mine Access Road operates under priority (Stop) control, and provides a Basic Left design Glen Davis Road to Mine Access Road; it is noted that there is essentially no trip demand for the right turn Glen Davis Road to Mine Access Road (nor any significant southbound through traffic volume) and as such no demand for any higher order intersection treatment.

3.2 Traffic Surveys

In order to define traffic volumes in the local road network, 7 day traffic surveys were undertaken by TTM in the period 30 November to 06 December 2018 at the following locations:

- Castlereagh Highway east and west of Glen Davis Road;
- Glen Davis Road south of Mine Access Road; and
- Mine Access Road north of Glen Davis Road.

These surveys are provided in full (in electronic form) in **Appendix A**.

3.3 Daily Traffic Volumes

A summary of average weekday traffic volumes at all survey locations is provided in **Table 2**, with the Airly shift arrival and departure peak periods highlighted. Survey data for daily weekend traffic volumes are provided in **Appendix A**, noting that these volumes are significantly lower than the average weekday volumes, and that Airly generates significantly fewer trips over the weekend (see also **Section 3.4** below).

Table 2: 2019 Average Weekday Traffic Volumes

Time	Castlereagh Hwy East of Glen Davis Rd		Castlereagh Hwy West of Glen Davis Rd		Glen Davis Rd north of Castlereagh Hwy		Mine Access Rd	
	Eastbound	Westbound	Eastbound	Westbound	Northbound	Southbound	Northbound	Southbound
0000-0100	5	7	3	6	1	1	0	1
0100-0200	3	6	2	5	0	1	0	0
0200-0300	2	9	1	7	0	0	0	0
0300-0400	5	12	3	12	0	1	0	0
0400-0500	9	12	7	10	2	1	1	0
0500-0600	26	24	22	17	6	2	7	1
0600-0700	41	58	46	34	34	4	32	1
0700-0800	68	54	55	55	11	29	7	24
0800-0900	76	73	73	68	14	12	6	6
0900-1000	88	75	81	66	9	9	4	2
1000-1100	94	88	94	83	13	10	8	7
1100-1200	93	84	84	81	8	12	4	7
1200-1300	87	87	84	84	8	10	5	4
1300-1400	97	97	89	90	9	11	4	5
1400-1500	89	93	92	86	22	10	17	4
1500-1600	98	96	78	99	7	31	1	26
1600-1700	85	98	76	102	8	18	1	11
1700-1800	65	89	61	90	8	10	1	5
1800-1900	49	61	47	59	5	6	1	2
1900-2000	33	57	33	55	4	3	0	1
2000-2100	23	48	23	45	4	2	1	1
2100-2200	13	29	14	25	5	1	2	0
2200-2300	11	31	16	18	18	0	19	0
2300-2400	12	11	4	19	1	17	0	17
Total ADT	2474		2305		398		245	

3.4 Peak Period Traffic Volumes

The assessment of the two key intersections providing access to Airly appropriately focuses on the peak mining shift arrival and departure periods. Surveyed traffic volumes during these key peaks are shown in **Figure 4**.

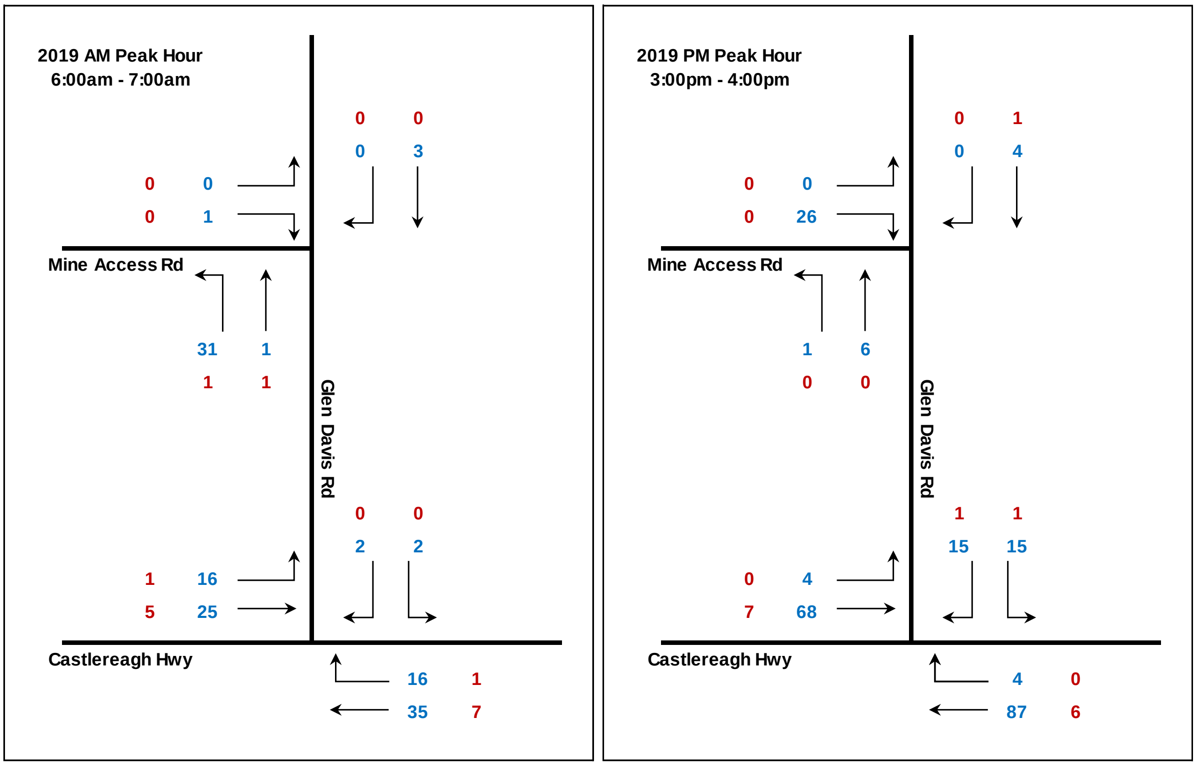

Figure 4: Airly Mine Shift Peak Hour Traffic Volumes

As discussed previously, the peak hour generation on either a Saturday or Sunday was 19vph in the Sunday arrival peak for the Weekday Night shift, which actually commences on the Sunday evening at 11:00pm. With reference to the detailed survey data in **Appendix A**, traffic flows in Castlereagh Highway at this time are less than 20vph at this time, and as such further analysis of this peak is in our opinion not warranted.

3.5 Existing Intersection Operations

3.5.1 The SIDRA Model

SIDRA intersection modelling has been undertaken to establish the existing performance of the key intersections in the vicinity of the Site, so as to provide an appropriate baseline against which the relative impacts of the Proposal can be measured.

The SIDRA model provides a number of outputs by which to measure the performance of an intersection, including:

- **Average Vehicle Delay (AVD):** AVD (or average delay per vehicle in seconds) for intersections is used to determine an intersection's Level of Service (see below). For signalised intersections, the AVD reported relates to the average of all vehicle movements through the intersection.
- **Degree of Saturation (DOS):** DOS is defined as the ratio of demand (arrival) flow to capacity.
- **Level of Service (LOS):** LOS is a comparative measure that provides an indication of the operating performance, based on AVD.

Table 3 provides the SIDRA recommended criteria for the assessment of intersections, which reference the LOS and delay criteria outlined in the RMS Guide, while **Table 4** provides a summary of the existing performance of the key intersections. The more detailed SIDRA outputs are provided in **Appendix B**.

Table 3: SIDRA Level of Service Criteria for Intersections

Level of Service	Average Delay per Vehicle (secs/veh)	Traffic Signals & Roundabout	Give Way & Stop Signs
A	less than 14	Good operation	Good operation
B	15 to 28	Good with acceptable delays & spare capacity	Acceptable delays & spare capacity
C	29 to 42	Satisfactory	Satisfactory, but accident study required
D	43 to 56	Operating near capacity	Near capacity & accident study required
E	57 to 70	At capacity; at signals, incidents will cause excessive delays	At capacity, requires other control mode
		Roundabouts require other control mode	
F	More than 70	Unsatisfactory and requires additional capacity.	Unsatisfactory and requires other control mode or major treatment.

Table 4: Existing Intersection Performance

Intersection	Peak Period	Degree of Saturation (DoS)	Average Vehicle Delay (AVD)	Level of Service (LoS)
Castlereagh Highway / Glen Davis Road	AM	0.004	5.2 sec	A
	PM	0.034	5.9 sec	A
Glen Davis Road / Mine Access Road	AM	0.020	5.6 sec	A
	PM	0.022	5.6 sec	A

With reference to **Table 4** – and indeed with simple reference to the peak hour traffic volumes shown in **Figure 4** - the key intersections currently operate at a very good LOS A during each of the Airly shift arrival and departure peak periods, with essentially no delays and significant available capacity.

3.6 Intersection Design: Castlereagh Highway & Glen Davis Road

As discussed, this intersection provides both an CHL and CHR, Castlereagh Highway to Glen Davis Road. This design provides significant capacity, and indeed significantly capacity greater than would generally be required to accommodate the surveyed traffic volumes under the low speed conditions in Capertee, as shown with reference to the GRD 4A upgrade warrants as shown in **Figure 5** below.

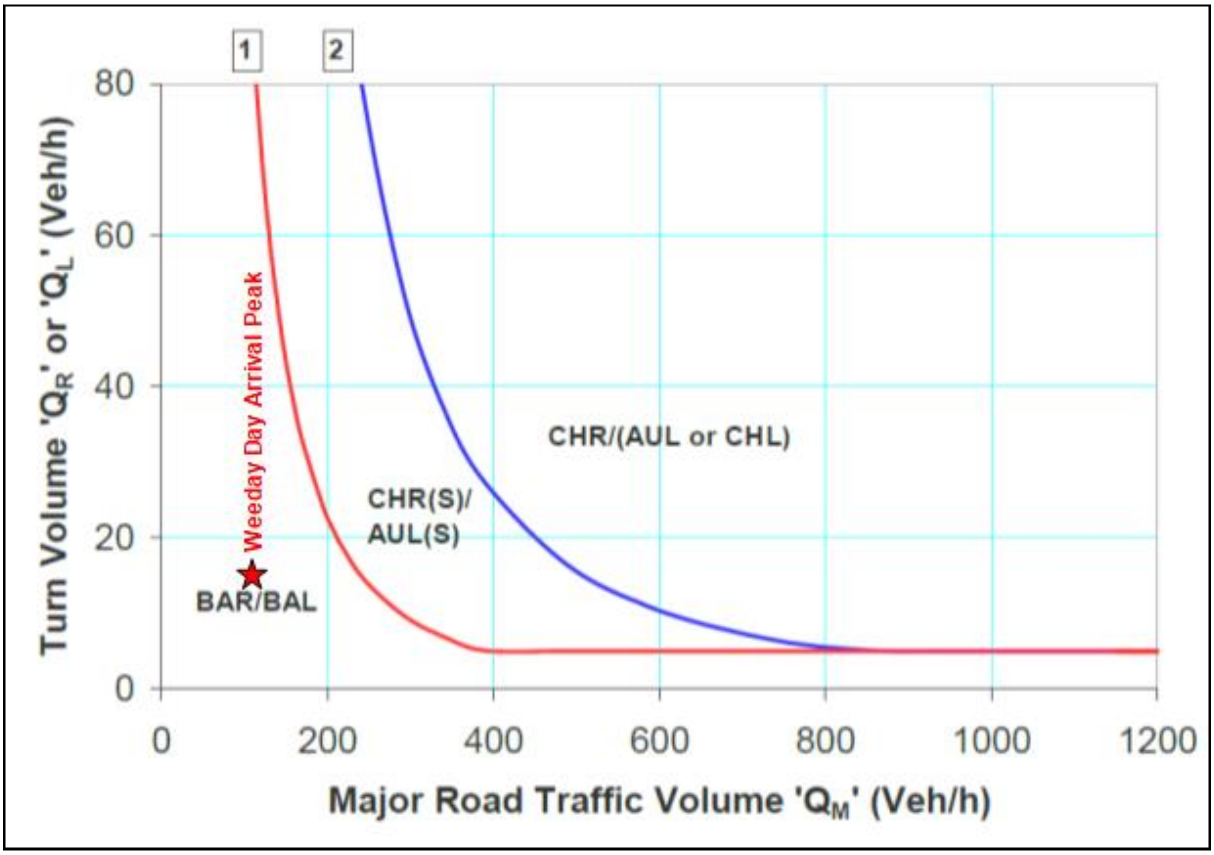

Figure 5: Austroads Intersection Warrants - Castlereagh Highway & Glen Davis Road

3.7 Road Capacity

While the capacity of urban and rural roads is generally determined by the capacity of intersections, capacity can also be assessed with reference to general traffic carrying capacity. Table 4.6 of the RMS Guide (reproduced below) provides a basic means by which to assess LOS for urban conditions (such as the Castlereagh Highway through Capertee) while Table 4.5 of the RMS Guide provides criteria for two-way, two-lane rural roads such as Glen Davis Road. Both of these RMS Guide tables are reproduced below.

Table 5: RMS Guide Urban Road LOS Criteria

Level of Service	One Lane (veh/hr)	Two Lanes (veh/hr)
A	200	900
B	380	1400
C	600	1800
D	900	2200
E	1400	2800

Table 6: RMS Guide Rural Road LOS Criteria

Terrain	Level of Service	Percent of Heavy Vehicles			
		0	5	10	15
Level	B	630	590	560	530
	C	1030	970	920	870
	D	1630	1550	1480	1410
	E	2630	2500	2390	2290
Rolling	B	500	420	360	310
	C	920	760	650	570
	D	1370	1140	970	700
	E	2420	2000	1720	1510
Mountainous	B	340	230	180	150
	C	600	410	320	260
	D	1050	680	500	400
	E	2160	1400	1040	820

It is noted that the rural road LOS criteria in **Table 6** is based on the following conditions:

- A 60/40 directional split of traffic during peak periods;
- Level terrain with good overtaking opportunities; and
- Wide traffic lanes with good side clearances.

With reference to the traffic survey data, the traffic volumes in both Castlereagh Highway and Glen Davis Road sit comfortably within the highest (best) LOS criteria, being LoS A for Castlereagh Highway (Table 5) and LoS B for Glen Davis Road (Table 6).

3.8 Sub-Regional Traffic Growth

Historic Average Annual Daily Traffic (AADT) data is not available from the RMS AADT Viewer for count stations in Castlereagh Highway north of Lidsdale.

However, data is available for Count Station 99084, which is located north Gemalong Close, Marrangaroo. Data records for this Count Station are available for the period 2008 – 2012 inclusive, and indicate a rise in traffic volumes between 2008 and 2011, but then a fall to 2012, as shown in **Figure 6** below.

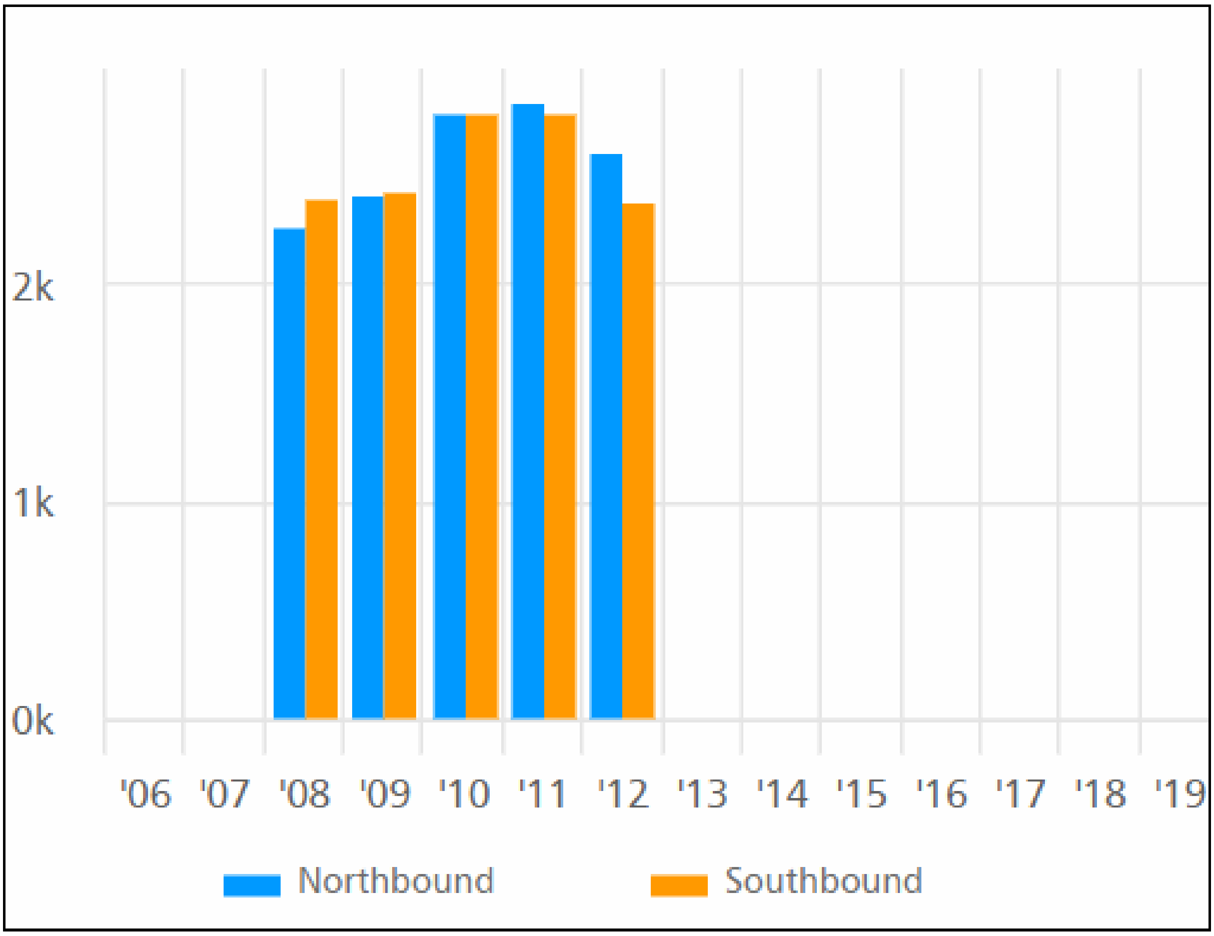

Figure 6: Castlereagh Highway Historical AADT Data Marrangaroo

In general, it is likely that these data fluctuations reflect the operation of local mines; for example, different production stages for both Angus Place and Springvale mines at Lidsdale, or new mines coming on line.

With reference to the DPIE Major Projects Register, the potential exists for Angus Place – which has operated under 'care and maintenance' since 2015 - to recommence operations in the short-medium term; however, this is expected to occur at the same time as production at Springvale is wound down.

Other than these sites, there is little potential for any new developments with any significant traffic generation potential through Capertee.

Notwithstanding, for the assessment of future conditions Ason Group has factored the existing traffic volumes in the Castlereagh Highway by 2% per year (to 2029) so as to provide a worst case assessment of future conditions (further to MOD 3) at the intersection with Glen Davis Road.

3.9 Accident Data

An analysis of crash statistics from the TfNSW Centre for Road Safety database reveals that a total of 5 crashes were recorded in the local area during the 5 year period between 2013 and 2017; **Figure 7** details these crash locations, while **Table 7Figure 7** summarises information available in regard to each crash.

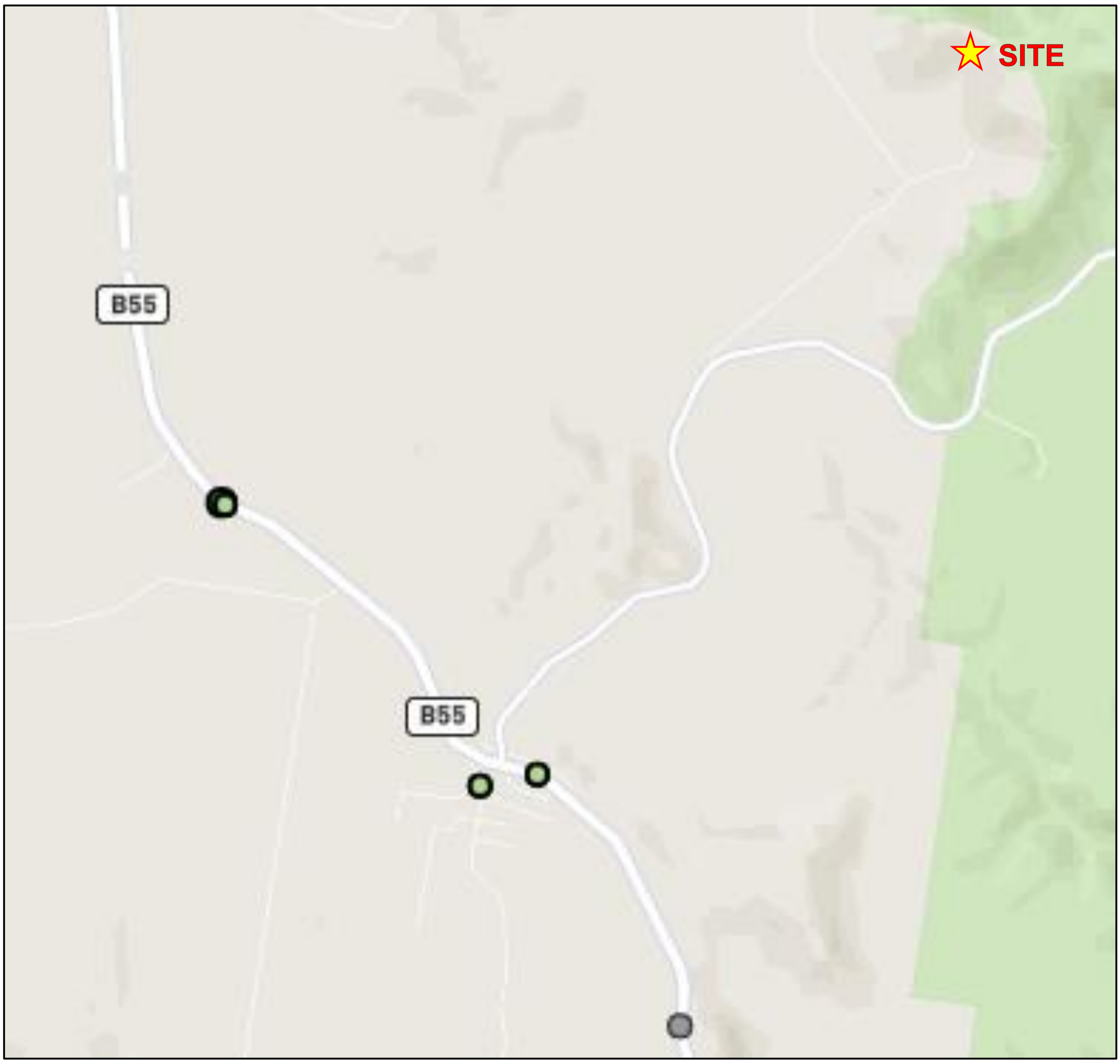

Figure 7: Historical Crash Locations

Table 7: Historical Crash Data

Year	Degree of Crash	RUM Code	RUM Description
2013	Non-casualty	81	Off carriageway – left on right band into object
2014	Non-casualty	81	Off carriageway – left on right band into object
2015	Serious Injury	81	Off carriageway – left on right band into object
2016	Serious Injury	81	Off carriageway – left on right band into object
2017	Non-casualty	81	Off carriageway – left on right band into object

It is noted that all crashes occurred in Castlereagh Highway, and that all incidents were due to a single vehicle leaving the carriageway midblock and colliding with an off-road object. No fatalities were recorded in the local road network within the data period.

There is no information to suggest that these incidents were in any related to the operation of Airly.

4 Modification 3

4.1 Overview

As stated, MOD 3 provides for an increase in the production rate at Airly from the approved 1.8 Mtpa to 3.0 Mtpa. Along with this production increase, MOD 3 also provides for:

- An increase in workforce from the approved 155 FTE personnel to 200 FTE personnel;
- An increase in the movement of laden coal trains and water trains leaving Airly from the approved average of 2 trains per day to 3 trains per day over any calendar year, but maintaining the approved maximum 5 trains per day leaving the site on any day;
- Approval to undertake underground blasting or shot-firing activities for the removal of geological structures in the event they are encountered within the mining areas; and
- An amendment to the approved 20-year mine schedule for the increased production rate.

It is noted that the proposed increase in train movements is assessed elsewhere in the MOD 3 Modification Report, which this assessment accompanies.

4.2 Access

Access to the Pit Top would be unaffected by MOD 3.

4.3 Staff Increase

MOD 3 will result in additional Pit Top trip generation associated with the proposed increase in FTE staff, as shown in **Table 8** below.

Table 8: Modification 3 Staff Total

Modification 3 Staff & Shift Structure	**Weekday Shifts (Mon - Fri)**			**Weekend Shifts (Sat – Sun)**	
	Day 7:00am – 3:30pm	Afternoon 3:00pm – 11:30pm	Night 11:00pm – 7:30am	Day 7:00am – 7:00pm	Night 7:00pm – 7:00am
Mining staff	33	32	32	29	24
General Staff and Contractors	30	6	4	5	5
Total	**63**	**38**	**36**	**34**	**19**

With reference to **Table 8**, and the existing staff and shift information provided in **Table 1**, the MOD 3 staff increases are summarised in **Table 9**.

Table 9: Airly MOD 3 Staff Increases Summary

Modification 3 Additional Staff Summary	**Weekday Shifts (Mon - Fri)**			**Weekend Shifts (Sat – Sun)**	
	Day 7:00am – 3:30pm	Afternoon 3:00pm – 11:30pm	Night 11:00pm – 7:30am	Day 7:00am – 7:00pm	Night 7:00pm – 7:00am
Mining staff	8	7	7	8	10
General Staff and Contractors	4	2	2	3	3
Total	**12**	**9**	**9**	**11**	**13**

4.4 Service Vehicle Increases

As previously discussed, there is no information to suggest any increase in service vehicle trip generation arising from MOD 3.

4.5 Trip Generation & Distribution

4.5.1 Trip Generation

There is no information to suggest that the trip generation potential of the additional staff would be any different to existing staff, i.e. it is expected that each staff member would drive to and from Airly.

4.5.2 Trip Distribution

Information provided by Centennial suggests the potential for a slight increase in the percentage of staff trips being generated to/from local centres to the north of Airly - such as Kandos and Rylestone - further to the broader staff increases provided for under MOD 3. As such, it is estimated that a total of approximately 50% of all staff trips will be generated to/from the north, and approximately 50% of all staff trips will be generated to/from the south.

4.6 Trip Assignment

The additional staff trips determined in sections above have been assigned to the intersection of Castlereagh Highway & Glen Davis Road, and Glen Davis Road & Mine Access Road along with the 2029 base flows (as discussed in **Section 3.8**). In addition, and again noting that at the time of the traffic surveys Airly staffing levels were slightly below those of current approval maximum levels, the assessment includes the full complement of existing approved staff levels, i.e. it also includes the potential generation of an additional 9 staff appropriately distributed across the existing Airly shifts.

The resulting total traffic volumes at these intersections are shown in **Figure 8**.

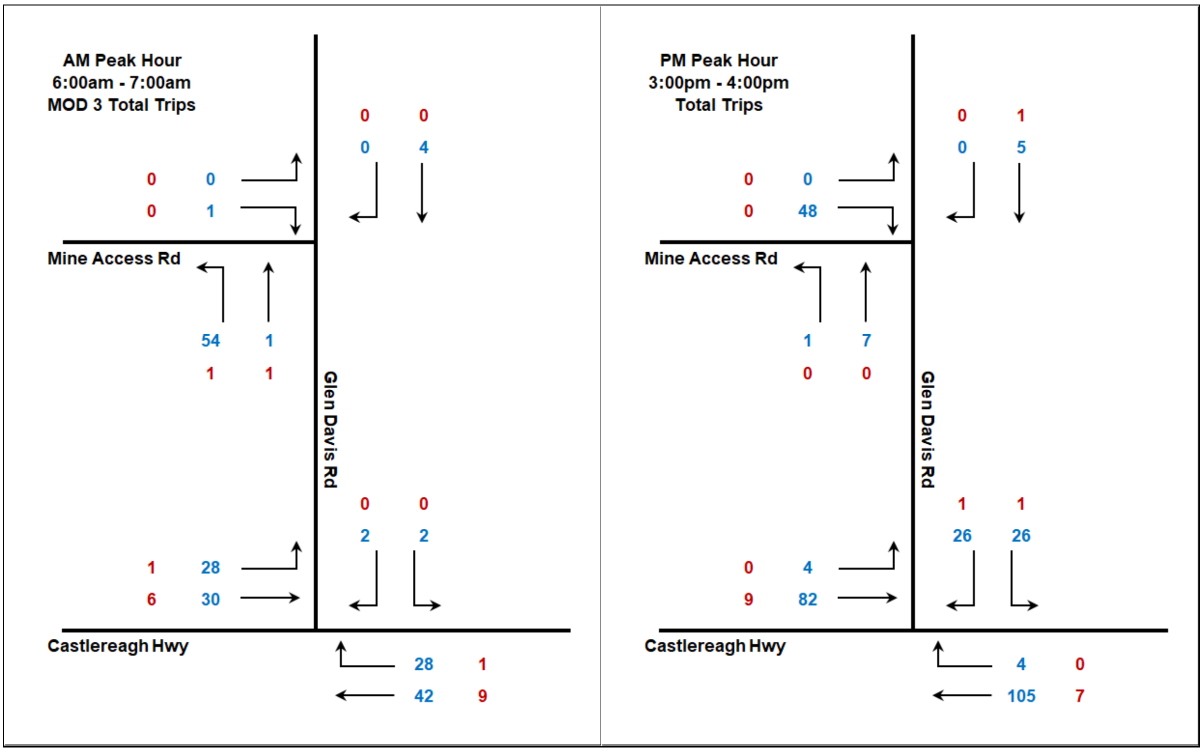

Figure 8: 2029 Total Peak Hour Traffic Volumes

It is noted again that while there are increases in the Weekend Day and Night shifts arising from MOD 3, the total vehicle flows at the key intersections would remain very low. For example, total flows (all movements) at the intersection of Castlereagh Highway & Glen Davis Road during the Sunday peak hour (10:00pm – 11:00pm, prior to the start of the Weekday Night shift) would be less than 40vph, and as such not, warrant any further detailed analysis.

4.7 Future Road Network Performance

4.7.1 Future Intersection Performance

The key intersections have again been assessed using SIDRA using the 2029 total traffic volumes as detailed in **Figure 8**; the results of the SIDRA analysis are summarised in **Table 10**.

Table 10: 2029 Intersection Operations

Intersection	Peak Period	Degree of Saturation (DoS)	Average Vehicle Delay (AVD)	Level of Service (LoS)
Castlereagh Highway / Glen Davis Road	AM	0.004	5.4 sec	A
	PM	0.059	6.2 sec	A
Glen Davis Road / Mine Access Road	AM	0.033	5.6 sec	A
	PM	0.004	5.7 sec	A

With reference to **Table 10**, the keys intersections will continue to operate at a very good LOS A during each of the Airly shift arrival and departure peak periods further to MOD 3, with again essentially no delays and significant available capacity.

4.7.2 General Capacity Traffic Impacts

More broadly – and with reference to **Figure 5**, **Table 5** and **Table 6** - the additional traffic generated further to MOD 3 would not require any upgrades of the key intersections, nor result in any change in the LOS of Castlereagh Highway or Glen Davis Road.

4.8 Parking

Further to MOD 3, the peak parking demand at any one time would increase to 101 staff vehicles, again during the changeover between the Weekday Day shift and Weekday Afternoon shift (generally between 2:00pm and 4:00pm). As such, the 119 car spaces available in the existing car park will continue to fully meet peak parking demand.

5 Conclusions

Further to a detailed assessment of the access, traffic and parking characteristics of the Airly MOD 3, Ason Group has determined the following:

- The additional staff trip generation of Airly further to MOD 3 is minimal, estimated at no more than 20vph in any shift changeover period;
- There is no information to suggest any change in current Airly service vehicle demands further to MOD 3;
- The roads and intersections providing access to Airly have significant inbuilt capacity, such that the additional trips would have no impact on LOS even under future conditions with additional background traffic growth in Castlereagh Highway; and
- Parking is already provided on-site in excess of the peak staff parking demand further to MOD 3.

As such, it is the conclusion of Ason Group that MOD 3 is entirely supportable with regard to access, traffic and parking considerations, and moreover that the proposed increase in Airly staff by 45 FTE staff would have no impact on the capacity, efficiency or safety of the local and sub-regional road network through the life of the project.

Appendix A

Traffic Surveys

Traffic Survey: Mine Access Road, north of Glen Davis Road

18SYD0204

Mine Access Rd, north of Glen Davis Rd
Combined

Time	Week 1								
	Fri	Sat	Sun	Mon	Tue	Wed	Thu	Averages	
	30/11/2018	1/12/2018	2/12/2018	3/12/2018	4/12/2018	5/12/2018	6/12/2018	Weekday	7-day
0000-0100	1	2	0	0	1	1	1	1	1
0100-0200	1	1	0	0	1	0	1	1	1
0200-0300	1	0	0	0	0	0	0	0	0
0300-0400	0	0	2	1	0	0	0	0	0
0400-0500	0	0	0	1	2	1	1	1	1
0500-0600	9	0	0	7	8	7	7	8	5
0600-0700	34	0	0	37	32	36	28	33	24
0700-0800	26	0	0	31	36	33	26	30	22
0800-0900	14	0	1	13	10	13	10	12	9
0900-1000	2	3	8	6	7	8	7	6	6
1000-1100	12	4	0	13	18	15	15	15	11
1100-1200	14	0	0	7	11	16	8	11	8
1200-1300	2	2	1	8	12	14	9	9	7
1300-1400	8	0	0	15	3	12	6	9	6
1400-1500	26	0	2	24	17	17	18	20	15
1500-1600	29	0	0	23	33	25	22	26	19
1600-1700	4	0	0	19	10	9	16	12	8
1700-1800	2	0	0	8	6	9	7	6	5
1800-1900	0	0	1	3	3	4	3	3	2
1900-2000	0	1	8	2	2	1	1	1	2
2000-2100	1	8	0	0	4	0	1	1	2
2100-2200	5	0	1	0	3	2	3	3	2
2200-2300	1	0	19	24	25	23	20	19	16
2300-2400	16	0	0	16	17	18	22	18	13

Totals

0000-0000	**208**	**21**	**43**	**258**	**261**	**264**	**232**	**245**	**184**
0700-0900	40	0	1	44	46	46	36	42	30
1600-1800	6	0	0	27	16	18	23	18	13
Off-Peak	162	21	42	187	199	200	173	184	141

asongroup

Traffic Survey: Glen Davis Road, north of Castlereagh Highway

18SYD0204

Glen Davis Rd, north of Castlereagh Hwy
Combined

Time	Week 1								
	Fri	Sat	Sun	Mon	Tue	Wed	Thu	Averages	
	30/11/2018	1/12/2018	2/12/2018	3/12/2018	4/12/2018	5/12/2018	6/12/2018	Weekday	7-day
0000-0100	2	2	0	0	2	2	3	2	2
0100-0200	1	2	0	1	2	0	1	1	1
0200-0300	1	1	0	1	0	0	0	0	0
0300-0400	0	1	2	3	0	0	0	1	1
0400-0500	2	0	0	3	3	2	2	2	2
0500-0600	9	4	2	10	7	8	7	8	7
0600-0700	39	4	1	39	38	42	32	38	28
0700-0800	33	11	6	43	51	40	35	40	31
0800-0900	26	12	9	34	27	23	19	26	21
0900-1000	13	11	26	17	20	26	15	18	18
1000-1100	16	31	14	21	28	26	24	23	23
1100-1200	21	19	15	23	19	25	13	20	19
1200-1300	13	17	38	28	14	22	15	18	21
1300-1400	21	13	17	23	13	30	13	20	19
1400-1500	38	20	25	38	29	30	25	32	29
1500-1600	42	14	21	37	41	34	36	38	32
1600-1700	19	19	14	31	26	21	33	26	23
1700-1800	18	12	5	21	14	19	17	18	15
1800-1900	16	8	12	8	11	11	6	10	10
1900-2000	12	12	10	10	4	4	6	7	8
2000-2100	13	9	3	2	7	2	5	6	6
2100-2200	10	4	3	1	6	6	5	6	5
2200-2300	2	2	20	24	23	22	21	18	16
2300-2400	16	1	1	18	18	19	22	19	14

Totals

0000-0000	**383**	**229**	**244**	**436**	**403**	**414**	**355**	**398**	**352**
0700-0900	59	23	15	77	78	63	54	66	53
1600-1800	37	31	19	52	40	40	50	44	38
Off-Peak	287	175	210	307	285	311	251	288	261

Traffic Survey: Castlereagh Highway, East of Glen Davis Road

18SYD0204

Castlereagh Hwy, east of Glen Davis Rd
Combined

Time	Week 1								
	Fri	Sat	Sun	Mon	Tue	Wed	Thu	Averages	
	30/11/2018	1/12/2018	2/12/2018	3/12/2018	4/12/2018	5/12/2018	6/12/2018	Weekday	7-day
0000-0100	19	13	19	10	12	8	10	12	13
0100-0200	10	12	5	8	12	8	5	9	9
0200-0300	12	6	4	12	6	19	8	11	10
0300-0400	15	13	4	31	10	12	18	17	15
0400-0500	20	14	4	37	10	16	19	20	17
0500-0600	46	27	10	55	58	45	45	50	41
0600-0700	87	71	31	122	91	95	98	99	85
0700-0800	114	113	60	133	141	114	112	123	112
0800-0900	171	199	111	174	128	131	143	149	151
0900-1000	218	229	214	164	152	150	135	164	180
1000-1100	233	238	258	214	143	148	170	182	201
1100-1200	225	245	327	194	141	157	171	178	209
1200-1300	226	240	365	181	144	147	173	174	211
1300-1400	279	186	288	193	162	162	175	194	206
1400-1500	254	208	318	173	115	175	191	182	205
1500-1600	299	198	305	190	172	158	154	195	211
1600-1700	256	153	240	145	148	160	207	183	187
1700-1800	250	121	206	114	118	132	156	154	157
1800-1900	182	91	152	85	92	93	98	110	113
1900-2000	169	56	84	75	62	60	85	90	84
2000-2100	136	28	68	52	50	37	80	71	64
2100-2200	74	37	33	30	27	27	54	42	40
2200-2300	57	13	32	33	47	32	41	42	36
2300-2400	30	13	12	18	21	22	26	23	20

Totals

0000-0000	**3,382**	**2,524**	**3,150**	**2,443**	**2,062**	**2,108**	**2,374**	**2,474**	**2,578**
0700-0900	285	312	171	307	269	245	255	272	263
1600-1800	506	274	446	259	266	292	363	337	344
Off-Peak	2,591	1,938	2,533	1,877	1,527	1,571	1,756	1,864	1,970

Traffic Survey: Castlereagh Highway, west of Glen Davis Road

18SYD0204

Castlereagh Hwy, west of Glen Davis Rd

Combined

Time	Week 1								
	Fri	Sat	Sun	Mon	Tue	Wed	Thu	Averages	
	30/11/2018	1/12/2018	2/12/2018	3/12/2018	4/12/2018	5/12/2018	6/12/2018	Weekday	7-day
0000-0100	14	17	20	8	11	7	7	9	12
0100-0200	9	8	5	7	6	6	6	7	7
0200-0300	11	5	4	6	6	12	7	8	7
0300-0400	16	9	5	18	10	13	19	15	13
0400-0500	18	13	3	24	9	16	14	16	14
0500-0600	38	23	10	43	42	33	36	38	32
0600-0700	69	73	30	96	74	79	84	80	72
0700-0800	99	96	60	135	114	96	105	110	101
0800-0900	160	192	111	162	124	128	131	141	144
0900-1000	192	227	217	157	129	135	125	148	169
1000-1100	217	243	265	208	140	154	167	177	199
1100-1200	207	242	331	183	119	149	167	165	200
1200-1300	215	233	357	178	130	144	176	169	205
1300-1400	269	199	293	160	156	142	166	179	198
1400-1500	260	207	312	164	115	165	182	177	201
1500-1600	278	187	288	163	151	148	142	176	194
1600-1700	255	155	229	135	144	159	194	177	182
1700-1800	236	124	210	109	120	130	164	152	156
1800-1900	176	87	149	74	97	84	101	106	110
1900-2000	163	69	88	64	65	67	82	88	85
2000-2100	132	34	77	48	49	38	73	68	64
2100-2200	70	41	32	24	22	28	50	39	38
2200-2300	54	13	25	24	38	30	27	35	30
2300-2400	31	12	11	13	20	25	28	23	20

Totals

0000-0000	**3,189**	**2,509**	**3,132**	**2,203**	**1,891**	**1,988**	**2,253**	**2,305**	**2,452**
0700-0900	259	288	171	297	238	224	236	251	245
1600-1800	491	279	439	244	264	289	358	329	338
Off-Peak	2,439	1,942	2,522	1,662	1,389	1,475	1,659	1,725	1,870

Appendix B

SIDRA Output Summaries

SIDRA Summary: Castlereagh Highway & Glen Davis Road AM 2019

MOVEMENT SUMMARY

Site: [Castlereagh Highway / Glen Davis Road AM Existing]

Castlereagh Highway / Glen Davis Road
Site Category: (None)
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
East: Castlereagh Highway (East)												
5	T1	44	16.7	0.025	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	50.0
6	R2	18	5.9	0.013	4.8	LOS A	0.1	0.4	0.14	0.51	0.14	46.0
Approach		62	13.6	0.025	1.4	NA	0.1	0.4	0.04	0.15	0.04	48.8
North: Glen Davis Road												
7	L2	2	0.0	0.004	4.7	LOS A	0.0	0.1	0.12	0.51	0.12	46.3
9	R2	2	0.0	0.004	5.2	LOS A	0.0	0.1	0.12	0.51	0.12	46.1
Approach		4	0.0	0.004	4.9	LOS A	0.0	0.1	0.12	0.51	0.12	46.2
West: Castlereagh Highway (West)												
10	L2	18	5.9	0.010	4.6	LOS A	0.0	0.0	0.00	0.53	0.00	46.5
11	T1	32	16.7	0.018	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	50.0
Approach		49	12.8	0.018	1.7	NA	0.0	0.0	0.00	0.19	0.00	48.7
All Vehicles		116	12.7	0.025	1.6	NA	0.1	0.4	0.03	0.18	0.03	48.6

SIDRA Summary: Castlereagh Highway & Glen Davis Road AM 2029

MOVEMENT SUMMARY

Site: [Castlereagh Highway / Glen Davis Road AM 2029]

Castlereagh Highway / Glen Davis Road
Site Category: (None)
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
East: Castlereagh Highway (East)												
5	T1	54	17.6	0.031	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	50.0
6	R2	32	3.3	0.024	4.8	LOS A	0.1	0.7	0.16	0.51	0.16	46.0
Approach		85	12.3	0.031	1.8	NA	0.1	0.7	0.06	0.19	0.06	48.4
North: Glen Davis Road												
7	L2	2	0.0	0.004	4.7	LOS A	0.0	0.1	0.14	0.51	0.14	46.3
9	R2	2	0.0	0.004	5.4	LOS A	0.0	0.1	0.14	0.51	0.14	46.1
Approach		4	0.0	0.004	5.0	LOS A	0.0	0.1	0.14	0.51	0.14	46.2
West: Castlereagh Highway (West)												
10	L2	29	3.6	0.016	4.6	LOS A	0.0	0.0	0.00	0.53	0.00	46.6
11	T1	38	16.7	0.022	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	50.0
Approach		67	10.9	0.022	2.0	NA	0.0	0.0	0.00	0.23	0.00	48.4
All Vehicles		157	11.4	0.031	2.0	NA	0.1	0.7	0.04	0.22	0.04	48.4

SIDRA Summary: Castlereagh Highway & Glen Davis Road PM 2019

MOVEMENT SUMMARY

Site: [Castlereagh Highway / Glen Davis Road PM Existing]

Castlereagh Highway / Glen Davis Road
Site Category: (None)
Giveway / Yield (Two-Way)

Movement Performance - Vehicles												
Mov ID	Turn	Demand Flows Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
East: Castlereagh Highway (East)												
5	T1	98	6.5	0.052	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	50.0
6	R2	4	0.0	0.003	4.9	LOS A	0.0	0.1	0.18	0.50	0.18	46.0
Approach		102	6.2	0.052	0.2	NA	0.0	0.1	0.01	0.02	0.01	49.8
North: Glen Davis Road												
7	L2	17	6.3	0.034	4.9	LOS A	0.1	0.9	0.22	0.52	0.22	46.0
9	R2	17	6.3	0.034	5.9	LOS A	0.1	0.9	0.22	0.52	0.22	45.8
Approach		34	6.3	0.034	5.4	LOS A	0.1	0.9	0.22	0.52	0.22	45.9
West: Castlereagh Highway (West)												
10	L2	4	0.0	0.002	4.6	LOS A	0.0	0.0	0.00	0.53	0.00	46.6
11	T1	79	9.3	0.043	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	50.0
Approach		83	8.9	0.043	0.2	NA	0.0	0.0	0.00	0.03	0.00	49.8
All Vehicles		219	7.2	0.052	1.0	NA	0.1	0.9	0.04	0.10	0.04	49.2

SIDRA Summary: Castlereagh Highway & Glen Davis Road PM 2029

MOVEMENT SUMMARY

Site: [Castlereagh Highway / Glen Davis Road PM 2029]

Castlereagh Highway / Glen Davis Road
Site Category: (None)
Giveway / Yield (Two-Way)

Movement Performance - Vehicles												
Mov ID	Turn	Demand Flows Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
East: Castlereagh Highway (East)												
5	T1	118	6.3	0.063	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	50.0
6	R2	4	0.0	0.003	4.9	LOS A	0.0	0.1	0.20	0.50	0.20	45.9
Approach		122	6.0	0.063	0.2	NA	0.0	0.1	0.01	0.02	0.01	49.8
North: Glen Davis Road												
7	L2	29	3.6	0.059	5.0	LOS A	0.2	1.6	0.25	0.54	0.25	46.0
9	R2	27	3.8	0.059	6.2	LOS A	0.2	1.6	0.25	0.54	0.25	45.8
Approach		57	3.7	0.059	5.6	LOS A	0.2	1.6	0.25	0.54	0.25	45.9
West: Castlereagh Highway (West)												
10	L2	4	0.0	0.002	4.6	LOS A	0.0	0.0	0.00	0.53	0.00	46.6
11	T1	96	9.9	0.052	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	50.0
Approach		100	9.5	0.052	0.2	NA	0.0	0.0	0.00	0.02	0.00	49.8
All Vehicles		279	6.8	0.063	1.3	NA	0.2	1.6	0.05	0.12	0.05	49.0

SIDRA Summary: Glen Davis Road & Mine Access Road AM 2019

MOVEMENT SUMMARY

Site: [Glen Davis Road / Mine Access Road AM Existing]

Glen Davis Road / Mine Access Road
Site Category: (None)
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
NorthEast: Glen Davis Road (North)												
5	T1	3	0.0	0.002	0.0	LOS A	0.0	0.0	0.06	0.15	0.06	58.5
6	R2	1	0.0	0.002	5.5	LOS A	0.0	0.0	0.06	0.15	0.06	56.3
Approach		4	0.0	0.002	1.4	NA	0.0	0.0	0.06	0.15	0.06	57.9
NorthWest: Mine Access Road												
7	L2	1	0.0	0.001	5.5	LOS A	0.0	0.0	0.02	0.58	0.02	53.6
9	R2	1	0.0	0.001	5.5	LOS A	0.0	0.0	0.02	0.58	0.02	53.1
Approach		2	0.0	0.001	5.5	LOS A	0.0	0.0	0.02	0.58	0.02	53.3
SouthWest: Glen Davis Road (South)												
10	L2	34	3.1	0.020	5.6	LOS A	0.0	0.0	0.00	0.54	0.00	53.6
11	T1	2	50.0	0.020	0.0	LOS A	0.0	0.0	0.00	0.54	0.00	55.1
Approach		36	5.9	0.020	5.3	NA	0.0	0.0	0.00	0.54	0.00	53.7
All Vehicles		42	5.0	0.020	4.9	NA	0.0	0.0	0.01	0.51	0.01	54.1

SIDRA Summary: Glen Davis Road & Mine Access Road AM 2029

MOVEMENT SUMMARY

Site: [Glen Davis Road / Mine Access Road AM 2029]

Glen Davis Road / Mine Access Road
Site Category: (None)
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
NorthEast: Glen Davis Road (North)												
5	T1	4	0.0	0.003	0.0	LOS A	0.0	0.0	0.06	0.12	0.06	58.7
6	R2	1	0.0	0.003	5.6	LOS A	0.0	0.0	0.06	0.12	0.06	56.6
Approach		5	0.0	0.003	1.2	NA	0.0	0.0	0.06	0.12	0.06	58.2
NorthWest: Mine Access Road												
7	L2	1	0.0	0.001	5.5	LOS A	0.0	0.0	0.02	0.58	0.02	53.6
9	R2	1	0.0	0.001	5.6	LOS A	0.0	0.0	0.02	0.58	0.02	53.1
Approach		2	0.0	0.001	5.6	LOS A	0.0	0.0	0.02	0.58	0.02	53.4
SouthWest: Glen Davis Road (South)												
10	L2	58	1.8	0.033	5.6	LOS A	0.0	0.0	0.00	0.56	0.00	53.6
11	T1	2	50.0	0.033	0.0	LOS A	0.0	0.0	0.00	0.56	0.00	55.1
Approach		60	3.5	0.033	5.4	NA	0.0	0.0	0.00	0.56	0.00	53.7
All Vehicles		67	3.1	0.033	5.0	NA	0.0	0.0	0.01	0.52	0.01	54.0

SIDRA Summary: Glen Davis Road & Mine Access Road PM 2019

MOVEMENT SUMMARY

Site: [Glen Davis Road / Mine Access Road PM Existing]

Glen Davis Road / Mine Access Road
Site Category: (None)
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
NorthEast: Glen Davis Road (North)												
5	T1	5	20.0	0.004	0.0	LOS A	0.0	0.0	0.01	0.10	0.01	58.9
6	R2	1	0.0	0.004	5.5	LOS A	0.0	0.0	0.01	0.10	0.01	56.7
Approach		6	16.7	0.004	0.9	NA	0.0	0.0	0.01	0.10	0.01	58.5
NorthWest: Mine Access Road												
7	L2	1	0.0	0.022	5.6	LOS A	0.1	0.5	0.05	0.58	0.05	53.5
9	R2	27	0.0	0.022	5.5	LOS A	0.1	0.5	0.05	0.58	0.05	53.0
Approach		28	0.0	0.022	5.5	LOS A	0.1	0.5	0.05	0.58	0.05	53.0
SouthWest: Glen Davis Road (South)												
10	L2	1	0.0	0.004	5.5	LOS A	0.0	0.0	0.00	0.09	0.00	57.6
11	T1	6	0.0	0.004	0.0	LOS A	0.0	0.0	0.00	0.09	0.00	59.2
Approach		7	0.0	0.004	0.8	NA	0.0	0.0	0.00	0.09	0.00	59.0
All Vehicles		42	2.5	0.022	4.0	NA	0.1	0.5	0.04	0.42	0.04	54.8

SIDRA Summary: Glen Davis Road & Mine Access Road PM 2029

MOVEMENT SUMMARY

Site: [Glen Davis Road / Mine Access Road PM 2029]

Glen Davis Road / Mine Access Road
Site Category: (None)
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
NorthEast: Glen Davis Road (North)												
5	T1	1	0.0	0.004	0.0	LOS A	0.0	0.2	0.05	0.50	0.05	56.7
6	R2	6	16.7	0.004	5.7	LOS A	0.0	0.2	0.05	0.50	0.05	53.0
Approach		7	14.3	0.004	4.9	NA	0.0	0.2	0.05	0.50	0.05	53.3
NorthWest: Mine Access Road												
7	L2	1	0.0	0.040	5.6	LOS A	0.1	0.9	0.06	0.58	0.06	53.5
9	R2	51	0.0	0.040	5.5	LOS A	0.1	0.9	0.06	0.58	0.06	53.0
Approach		52	0.0	0.040	5.5	LOS A	0.1	0.9	0.06	0.58	0.06	53.0
SouthWest: Glen Davis Road (South)												
10	L2	1	0.0	0.004	5.5	LOS A	0.0	0.0	0.00	0.07	0.00	57.7
11	T1	7	0.0	0.004	0.0	LOS A	0.0	0.0	0.00	0.07	0.00	59.3
Approach		8	0.0	0.004	0.7	NA	0.0	0.0	0.00	0.07	0.00	59.1
All Vehicles		67	1.6	0.040	4.8	NA	0.1	0.9	0.05	0.51	0.05	53.8

Rail Traffic Impact Assessment

APPENDIX – I

Rail Impact Assessment

Airly Mine Modification to Consent

(Our Reference: 19461-R01_c)

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date
16.09.2019

reference
19461-R01_c

receiver
Centennial Airly Pty Limited
Attn: Ms Nagindar Singh
Level 8, I Market Street
Sydney NSW 2000

Dear Madam,

Airly Mine Modification to Consent - Traffic Impact Assessment

This report analyses the impacts to Centennial Airly Pty Limited (Centennial Airly) proposed modifications to State Significant Development (SSD) 5581 consent, which granted approval to the Airly Mine Extension Project.

If you have any further enquiries regarding this matter, please contact the undersigned.

Yours faithfully
BARNSON PTY LTD

Luke Morris
BE MIEAust CPEng (Reg)
DIRECTOR

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Disclaimer

This report has been prepared solely for Centennial Airly Pty Limited in accordance in accordance with the scope provided by the client and for the purpose(s) as outlined throughout this report.

Barnson Pty Ltd accepts no liability or responsibility for or in respect of any use or reliance upon this report and its supporting material by anyone other than the client.

Project Name:	Rail Impact Assessment – Airly Mine Extension Project
Client:	Centennial Airly Pty Limited
Project No.	19461
Report Reference	19461-R01_c
Date:	16.09.2019
Revision:	C

Prepared by:
Luke Morris BE MIEAust CPEng (NPER) Director

barnson
DESIGN.PLAN.MANAGE

LIST OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

EXECUTIVE SUMMARY

Centennial Airly Pty Limited (Centennial Airly) is proposing to modify State Significant Development (SSD) 5581 consent, which granted approval to the Airly Mine Extension Project (The Project). Centennial Airly Pty Ltd, the operator of Airly Mine (Airly) is seeking approval to modify its existing mining operations consent from current production of 1.8 million tonnes per annum (Mtpa) to 3.0 million tonnes per annum run-of-mine coal (ROM) using partial extraction mining methods. The mine is approved to 31 January 2037.

The proposed modification elements comprise:

- an increase in the production rate from the approved 1.8 Mtpa to 3.0 Mtpa;
- an increase in workforce from the approved 155 FTE personnel to 200 FTE personnel;
- an increase in the average train movements from the approved two trains per day to three trains per day in a calendar year, without change to the approved maximum five trains per day;
- an amendment to the approved 20-year mine schedule for the increased production rate.

Coal (beneficiated or ROM) will be transported from the site via the existing rail load out facilities. No coal will be transported off site using roads. An increase to the number of staff proposed to be employed at Airly is not anticipated to result in significant increases to traffic in the area.

The purpose of this study is to:

- Analyse existing rail volumes adjacent to site;
- Analyse proposed traffic volumes adjacent to site;
- Provide additional information regarding potential cumulative impact(s) where applicable.

Existing Rail Environment

The Wallerawang-Gwabegar rail line is utilised for the transportation of product coal from the Airly Mine pit top and for the importation of water from Charbon Colliery. The Wallerawang-Gwabegar rail line is not operated to any timetable, and currently the rail line is only used by Airly Mine. All product coal is transported from the site via the rail network. Only one water train per day can be received from Charbon Colliery. The following additional restrictions apply to trains leaving the Airly Mine pit top:

- no more than an average of two trains leaving the site per day over a calendar year; and
- no more than five trains leaving the site on any day.

The Wallerawang-Gwabegar rail line merges with the Main Western Line at Wallerawang, and coal trains travel on the Main Western Line and other train lines to reach the domestic power stations (Vales Point, Eraring) and Port Newcastle.

Airly mine is approved to operate 24 hours per day, 7 days per well and the rail network is accessed 24 hours a day, seven days per week.

Trains from the Airly pit top enter the Wallerawang-Gwabegar rail line using the Airly rail loop, which is owned and maintained by Centennial Airly. The entrance to the rail loop is located approximately 4 km north of Capertee. A Safety Interface Agreement exists between John Holland Rail (JHR), as the Rail Infrastructure Manager for Country Rail Network (CRN) and Centennial Airly as the RIM for *Airly Coal Balloon Loop Private Siding*, dated 13 December 2018. The SIA provides surety regarding management of risks to the environment posed by the operations of the Airly rail loop on any potential or actual impacts on the JHR operational corridor.

Proposed Rail Environment and Impact Assessment

The modification will increase the approved coal extraction rate to 3.0 Mtpa, to be transported to from the site via the Wallerawang-Gwabegar rail line.

The total average frequency of trains (coal and water) entering and leaving Airly is proposed to be increased to three trains per day, while maintaining the current approved maximum of five trains per day. Both coal and water trains may operate 24 hours a day, seven days a week.

This report has assessed that the impact on the Wallerawang-Gwabegar rail line will be an increase of average daily trains travelling on the line from two to three trains, with a maximum of five trains per day. No other developments in the area currently utilise the Wallerawang-Gwabegar rail line between Kandos and Wallerawang. The rail line is not operated to any timetable, and hence all train paths on this line could be available to Centennial to utilise.

Additionally, the proposal will result in a marginal increase of trains utilising the Main Western Rail line, as the Wallerawang-Gwabegar rail line merges into the Main Western Line at Wallerawang. The impact of the proposed increase is evaluated to be negligible and can be accommodated within the existing network capacity, contingent on Centennial Airly negotiating pathing availability with John Holland Rail / Country Rail Network.

In order to mitigate impacts on the rail network and other users, it is recommended that the timing and pathing availability of additional train movements be organised in consultation with John Holland Rail.

Mitigation of cumulative impacts for Traffic from other developments in vicinity

There are no other existing developments or new developments proposed in the vicinity of Airly Coal Mine. Charbon Colliery, now in the rehabilitation phase, does not utilise the approved train movements (8 train movements in day period and 2 train movements in night period) on a regular basis.

Mitigation of Impacts on the Rail Network

Transportation of coal and importation of water by Airly Mine has been limited to the rail network to mitigate impacts on public roads.

The existing rail network capacity is sufficient for the proposed increase in average daily train trips. In order to mitigate impacts on the rail network and other users, it is recommended that the timing and pathing of additional train movements be determined in consultation with JHR.

1.0 INTRODUCTION

1.1 Project Overview

Centennial Airly Pty Limited (Centennial Airly) is proposing to modify State Significant Development (SSD) 5581 consent, which granted approval to the Airly Mine Extension Project (the Project). The consent was granted under the previous Section 89E of the Environmental Planning and Assessment Act 1979 (EP&A Act) on 15 December 2016 by the Planning Assessment Commission of NSW, as delegate of the Minister of Planning. The consent allows mining operations at Airly Mine for a period of 20 years from the date of commencement, and rehabilitation to be undertaken after this period. The consent SSD 5581 will lapse on 31 January 2037.

The Project is a controlled action (EBPC 2013/7076) pursuant to sections 130(1) and 133 of the Environment Protection and Biodiversity Conservation Act 1999. The approval EBPC 2013/7076 was granted on 18 May 2017 and has effect until 31 March 2047.

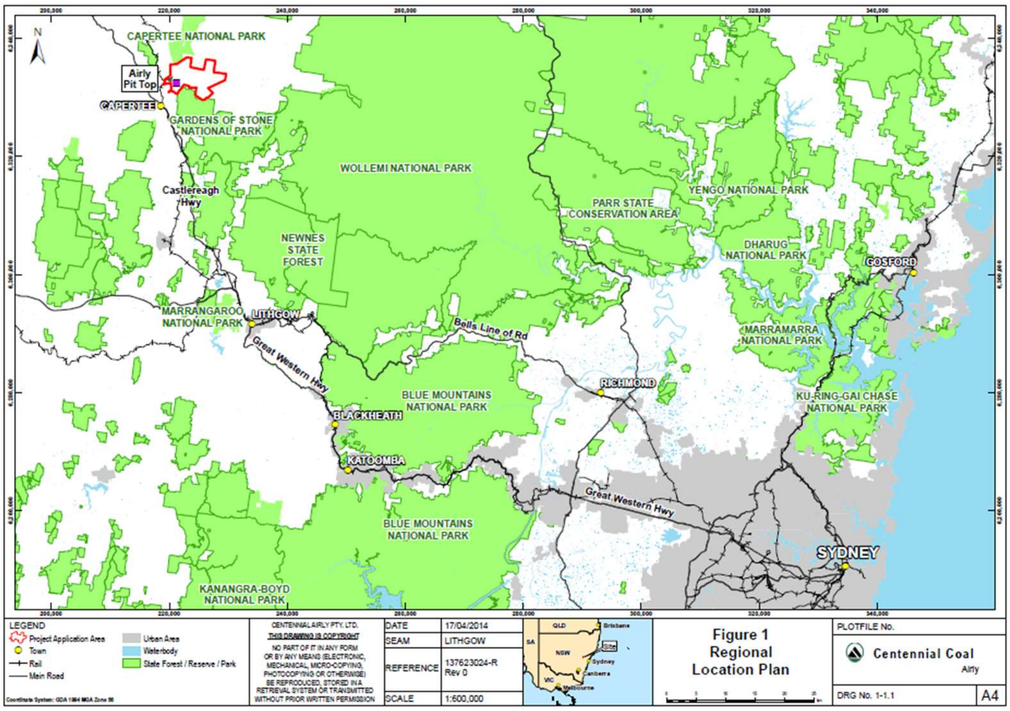


Figure 1 Regional Location Plan

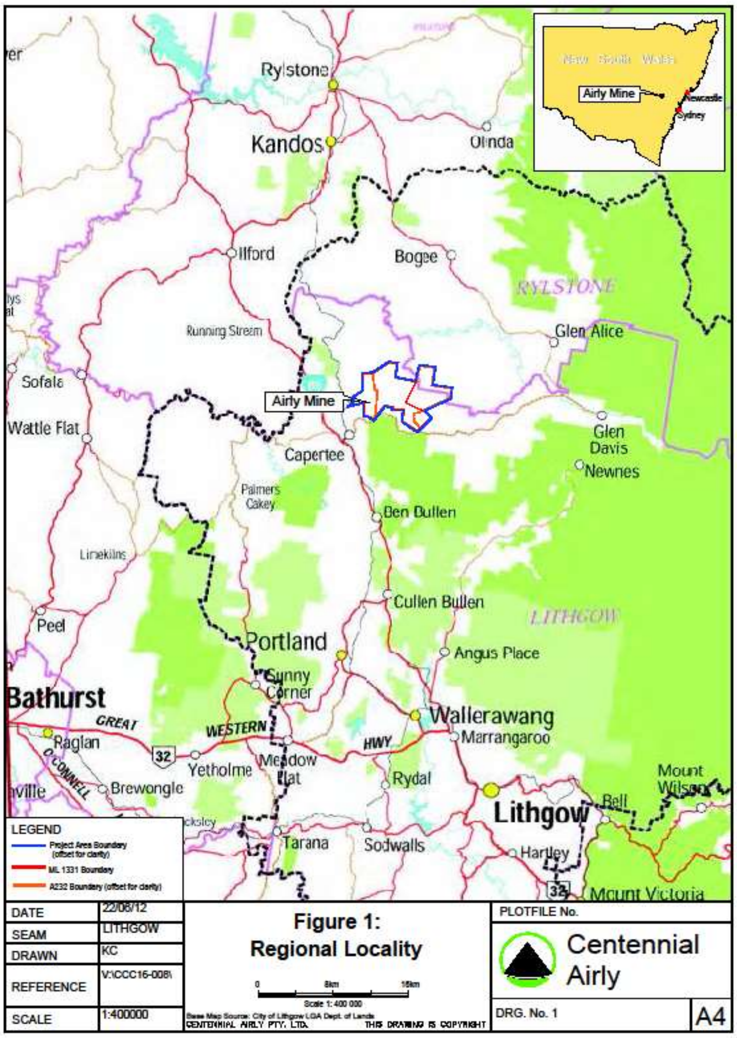


Figure 2 Locality Plan

1.2 Project Objectives

The proposed modification elements comprise:

- an increase in the production rate from the approved 1.8 Mtpa to 3.0 Mtpa;
- an increase in workforce from the approved 155 FTE personnel to 200 FTE personnel;
- an increase in the average train movements from the approved 2 trains per day to 3 trains per day in a calendar year, without change to the approved maximum 5 trains per day;
- an amendment to the approved 20-year mine schedule for the increased production rate.

The proposed increase in the average train movements per day in the modification forms the basis of this rail impact assessment.

1.3 Existing Infrastructure

The Project will continue to utilise the majority of the existing infrastructure located within the pit top and underground and construct approved infrastructure as required, as follows:

- Water supply infrastructure and water management structures;
- Product stockpiling areas;
- Coal crusher and screening plant;
- Train loading and refuelling facilities;
- Site car parking area;
- Visual, noise and safety bunds;
- Workshops and associated infrastructure;
- The Effluent Treatment System;
- Site security fencing;
- Waste management facilities;
- Coal preparation plant (CPP) including run of mine stockpile and reclaim system (approved but not yet constructed);
- Reject emplacement area and associated water management infrastructure (approved but not yet constructed);
- Underground mining equipment;
- Internal access roads.

1.4 Proposed Infrastructure

No new surface infrastructure facilities are proposed.

2.0 SITE DESCRIPTION

Airly Mine (Airly) is located 40 km north-northwest of Lithgow and 171 km west of Sydney. Road access to the mine is via the Glen Davis Road, off the Castlereagh Highway at Capertee. The development consent boundary for SSD 5581 corresponds to the Project Application Area boundary defined in the Airly EIS, and shown in Figure 2.

The Project Application Area encompasses an area of 3,982 ha and is characterised by environmental features such as rock outcrops, sandstone cliffs and deep valleys. Approximately 3,090 ha or 78% of the Project Application Area is within the 3,650 ha Mugii Murrum-ban State Conservation Area.

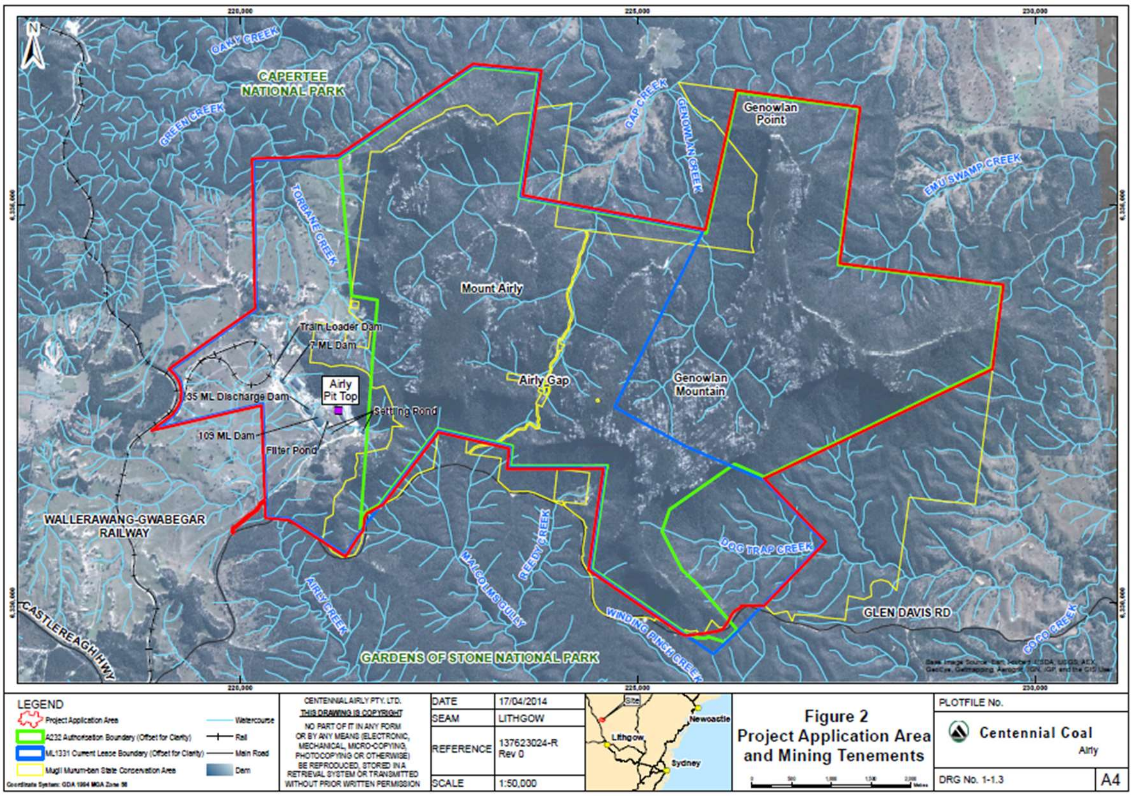


Figure 3 Project application area and mining tenements

3.0 EXISTING RAIL ENVIRONMENT

3.1 Coal and Water Train Movements

Coal is transported to power stations (Eraring and Vales Point and Port Newcastle) from the site via the Wallerawang-Gwabegar rail network, requiring access 24 hours a day, seven days per week. The average frequency is two trains per day over a calendar year with a maximum of five trains per day.

Following determination of Modification 2 in July 2019, water transportation to Airly from Charbon Colliery by rail has commenced on the Wallerawang-Gwabegar rail network. The approved one water laden train per day falls within the average frequency of two trains per day in a calendar year, and the maximum five trains on any day, as per Condition 8 under Schedule 2 of Airly Mine's consent SSD 5581.

3.2 Airly Rail Loop

The Airly rail loop infrastructure is owned and maintained by Airly Mine. The rail loop joins the Wallerawang-Gwabegar rail line approximately 4 km north of Capertee. A Safety Interface Agreement (SIA) exists between John Holland Rail (JHR), as the Rail Infrastructure Manager (RIM) for Country Rail Network (CRN) and Centennial Airly Pty Limited as the RIM for *Airly Coal Balloon Loop Private Siding*, dated 13 December 2018. The SIA relates to the interface between the Airly Mine's private rail loops and CRN's main rail line, specifically the Wallerawang to Kandos section, referred to as the Wallerawang-Gwabegar Railway in this assessment. The SIA provides surety regarding management of risks to the environment posed by the operations of the Airly rail loop on any potential or actual impacts on the JHR operational corridor.

The SIA stipulates that Airly Mine's operations should not pose potential or actual risks to the continuation of JHR's EPL 13421. The SIA also identifies communication and dispute resolution protocols between Centennial Airly and JHR.

3.3 Train Loading and Unloading

Coal trains are loaded automatically, in a continuous operation as the train propels in an anticlockwise direction around a loop. The train traverses the southern portion of the loop, loads at the eastern extremity of the loop and departs from the northern side of the loop back onto the Wallerawang-Gwabegar rail line. Coal is fed to the wagons from the bin via a hydraulically operated guillotine gate at the base of the cone of the bin. The full train loading process takes 1.5-2 hours.

Water laden trains arriving from the north (Charbon Colliery) on the Wallerawang-Gwabegar rail line reverse into the Airly rail loop. The trains travel past the Airly rail loop entry, and after stopping for a short duration, reverse into the rail loop. As in the case of coal trains, the water laden train traverses along the southern portion of the rail loop and propels in the anticlockwise direction around the loop. Water is unloaded at the eastern extremity of the rail loop. Water is discharged directly into the Train Loader Dam using flexible hoses. The empty trains continue to travel in the anti-clockwise direction and reverse out of the rail loop on to the Wallerawang-Gwabegar rail line, and after stopping for a short duration, travels back north to Charbon Colliery.

Operation of the infrastructure occurs as required, seven days a week, 24 hours a day including the use of existing rail and associated rail infrastructure.

3.4 Wallerawang-Gwabegar Rail Line

Airly has a rail loop linking to the Wallerawang-Gwabegar rail line. Previous modifications to facilities at Wallerawang Colliery Siding were made, by upgrading to a rail loop with unloading facilities to accommodate for the additional coal volumes.

The Wallerawang-Gwabegar rail line was operated by Australian Rail Track Corporation until 2012 and is now operated by (JHR). The rail line is not operated to a timetable currently. The line previously accommodated coal from Airly as well as Baal Bone, Invincible and Charbon Collieries. Over the past few years however, these facilities have all ceased formal mining operations.

Considering this in context, the Wallerawang-Gwabegar rail line accommodates four rail movements per day on average solely relating to Airly Mine's operations. This means that it services two trains, completing four trips (twice empty and twice loaded) on a daily basis. This figure indicates that there is significant capacity to increase the number of rail movements on this line without causing congestion issues.

In summary, the trains making up the average and the maximum trains per day could either originate in the north at Charbon Colliery (for water importation) or arrive at the Airly Mine pit top from the south on the Wallerawang-Gwabegar Rail Line. The water laden trains arriving from the north will leave empty from the pit top after discharging the water, while the empty trains that arrive from the south will leave the pit top loaded with coal destined for domestic power stations (Eraring and Vales Point) and Newcastle port for export.

As per condition 8 under Schedule 2 of SSD 5581 the following restrictions apply to Airly Mine in respect of rail movements:

(a) All product coal is transported from site by rail;

(b) Movement of laden coal trains and water trains is restricted to:

(ii) no more than an average of two trains leaving the site per day over a calendar year; and

(ii) no more than 5 trains leaving the site on any day; and

(c) No more than one water train is received from Charbon Colliery on any day. .

3.5 Level rail crossings

Between Charbon and Wallerawang, the Wallerawang-Gwabegar rail line has six main road crossings which occur around Clandulla and Ben Bullen, as shown in Figure 4 and Figure 5. Two of the six rail crossings feature an overpass such that the trains do not interact with traffic. The other four crossings are analysed below.

Figure 4 Rail crossing locations between Charbon and Wallerawang

Figure 5 Clandulla rail crossing locations

3.5.1 Canary Street (Clandulla)

The level rail crossing at Canary Street, Clandulla features a "Railway crossing stop" signage assembly. The signage and line marking generally complies with Australian Standard AS1742.7 – Manual of uniform traffic control devices; Part 7 – Railway Crossings (2016).

Figure 6 Canary Street level rail crossing – east view

Figure 7 Canary Street level rail crossing – west view

The RMS crash and casualty statistics indicated that there have been no recorded accidents in proximity to the crossing.

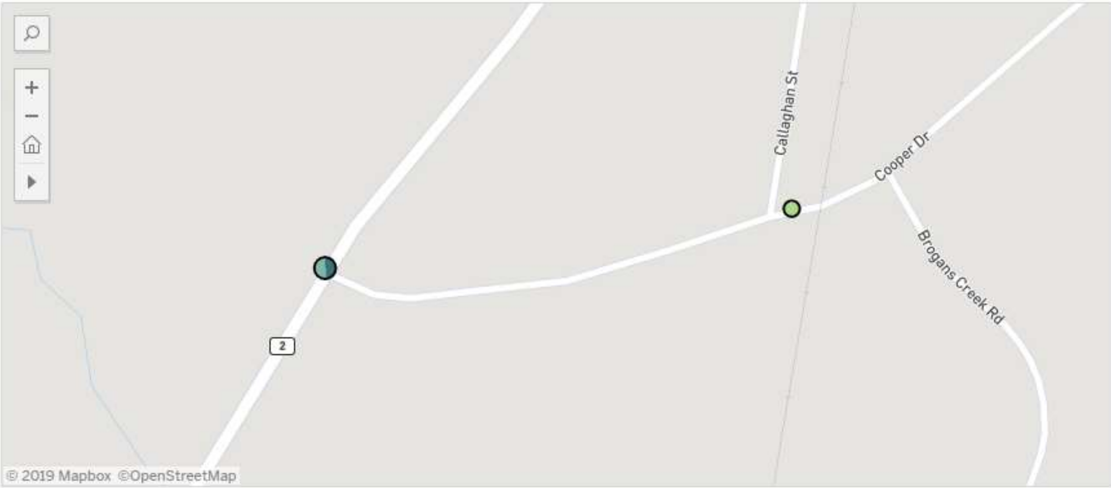
3.5.2 Carwell Street (Clandulla)

The level rail crossing at Carwell Street displays flashing lights which are manually activated by the driver of the train approaching the crossing. The signage and line marking generally complies with AS1742.7.

Figure 8 Carwell Street level rail crossing – east view

Figure 9 Carwell Street level rail crossing – west view

Traffic accident history of the area around the crossing has been obtained from the RMS crash and casualty statistics and is shown in Figure 10 below. It indicates that for the five year period between 2013-2017, there have been three accidents in the proximity of the crossing ranging from non-casualty to serious injury.



Degree of crash

Fatal · Serious Injury · Moderate Injury · Minor/Other Injury · Non-casualty (towaway)

Repo..	Crash ID	Degree of crash	RUM - code	RUM - descripti..	Type of location	Natural l..	Longitude	Lattitude	No ..	No Inju..
2013	831797	Non-casualty (t..	81	Off left/rt bnd=>obj	2-way undivided	Darkness	149.945455	-32.913477	-	-
	842719	Serious Injury	75	Off end of road	T-junction	Daylight	149.939479	-32.914114	-	1
2014	1035240	Moderate Injury	80	Off left/right bend	T-junction	Daylight	149.939479	-32.914114	-	1

Figure 10 Accident history – Carwell Street crossing at Clandulla

3.5.3 Flatlands Road (Clandulla)

The level rail crossing at Canary Street, Clandulla features a “Railway crossing stop” signage assembly. The signage generally complies with the Australian Standard. RMS crash and casualty statistics indicate there have been no recorded accidents in the area.

Figure 11 Flatlands Road level rail crossing – south view

Figure 12 Flatlands Road level rail crossing – north view

3.5.4 Castlereagh Highway (Ben Bullen)

Similarly to the Carwell Street crossing, the Castlereagh Highway rail level crossing at Ben Bullen displays warning flashing lights operated by the train driver. The signage and line marking generally complies with AS1742.7.

Figure 13 Castlereagh Highway level rail crossing – east view

Figure 14 Castlereagh Highway level rail crossing – west view

Traffic accident history of the Project Application Area from the RMS website is shown in Figure 15 below, indicating that between 2013-2017 there has been one non-casualty accident in the proximity of the crossing.

Degree of crash

Fatal | Serious Injury | Moderate Injury | Minor/Other Injury | Non-casualty (towaway)

Repo..	Crash ID	Degree of crash	RUM - code	RUM - descripti..	Type of location	Natural l..	Longitude	Lattitude	No ..	No Inju..
2013	827598	Non-casualty (t..	80	Off left/right bend	2-way undivided	Daylight	150.023047	-33.21935	-	-

Figure 15 Accident history – Castlereagh Highway crossing at Ben Bullen

3.6 Operating Hours

Airly has consent to operate 24 hours a day, seven days a week. Rail transport of coal and water are also approved to occur 24 hours a day, seven days a week. There are no proposed changes to these operating hours.

4.0 PROSPOSED RAIL ENVIRONMENT

4.1 Coal and Water Train Movements

Coal will continue to be transported from the site to Eraring and Vales Point power stations and Port Newcastle via the rail network with access 24 hours a day, seven days per week.

A water train between Charbon and Airly on an “as required” basis will continue to be operated on the Wallerawang-Gwabegar rail line at the frequency of one train per day.

The average frequency of total trains (coal and water) entering and leaving Airly is proposed to be increased to three trains per day (six train movements) over a calendar year, but maintaining the current maximum of five trains (ten train movements) per day. The following restrictions on rail movements for both water importation and coal transport off site will apply:

- All product coal will be transported from the site by rail;
- movement of coal trains and water trains will be restricted to:
  - no more than an average of three trains leaving the site per day over a calendar year; and
  - no more than five trains leaving the site on any day; and
- no more than one water train will be received from Charbon Colliery on any day.

4.2 Airly Rail Loop

The existing SIA between Centennial Airly and JHR does not have an expiry date, and the agreement will continue to be valid. Centennial Airly is recommended to consult with JHR on the proposal to increase the number of trains arriving at Airly pit top and accessing the site from the Airly Rail Loop and Gwabegar-Wallerawang rail line interface.

4.3 Wallerawang-Gwabegar Rail Line

As discussed in Section 1.2 and 4.1, an increase in average train movements is proposed to keep up with the increased coal production rate. However, the maximum trains per day will be maintained as existing as 5 trains per day.

The current and proposed train volumes for both coal and water transportation on the Wallerawang-Gwabegar rail line are summarised in Table 2.

Table 1 Summary of existing and proposed train volumes

Location	Existing/Proposed Average Daily Trains	Existing/Proposed Peak Daily Trains
Wallerawang-Gwabegar Rail Line	4 / 6	5 / 5

It is expected that the increase in average daily train movements from four trips to six trips will have negligible effects on the Wallerawang-Gwabegar rail line, considering it has previously serviced multiple mining operations including Baal Bone, Invincible and Charbon Collieries which have now ceased operations. More train paths exist on the Wallerawang-Gwabegar rail line than proposed to be utilised by Airly Mine for the transport of water and coal.

4.4 Main Western Rail Line

Coal trains travelling along the Wallerawang-Gwabegar rail line will merge onto the Main Western rail line in Wallerawang. Upon consultation with JHR's Business Development Manager (pers comm, dated 06 August 2019) , it was deemed that an average increase of two train movements per day along this rail line is marginal in comparison to current traffic; and can be accommodated within the line's capacity. However, train pathing arrangements will require to be negotiated between Centennial Airly and JHR.

4.5 Train Loading and Unloading

Coal trains will continue to be loaded at the Airly rail loop as per the process described in Section 3.3. Water trains arriving from Charbon Colliery will continue to discharge water into the Airly water management system as described in Section 3.3.

4.6 Cumulative Impacts

There are no other major developments planned in the area, therefore there will be no cumulative impact to rail traffic generation. The only trains operating on the Wallerawang-Gwabegar rail line are those operated by Centennial Airly.

5.0 MITIGATION OF TRANSPORT IMPACTS

Negligible impact is expected to the Wallerawang-Gwabegar and Main Western rail lines as a result of the increase in average daily train movements, since services will still be less than historical activity on the line while other mine sites were operational. Currently, only Centennial Airly only operate on the Wallerawang-Gwabegar rail line.

It is recommended that Centennial Airly consult with JHR regarding the proposed timing of rail movements for both coal and water transport, in order to facilitate all services and minimise interactions between Centennial trains and any other users of the rail lines.

6.0 CONCLUSION

This report has assessed that the impact on the Wallerawang-Gwabegar rail line will be an increase of average daily trains travelling on the line from two to three trains, with a maximum of five trains per day. Additionally, the proposal will result in a marginal increase of trains utilising the Main Western Rail line. The impact of this increase is evaluated to be negligible and can be accommodated within the existing network capacity.

In order to mitigate impacts on the rail network and other users, it is recommended that the timing and pathing availability of additional train movements be determined in consultation with John Holland Rail and Country Road Network.

APPENDIX – J

Noise and Vibration Impact Assessment

AIRLY MINE - MOD3

Noise and Vibration Impact Assessment

Prepared for:

Centennial Airly Pty Limited
Glen Davis Road
CAPERTEE NSW 2846

SLR Ref: 630.12598-R01
Version No: -v1.0
October 2019

PREPARED BY

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BASIS OF REPORT

This report has been prepared by SLR Consulting Australia Pty Ltd (SLR) with all reasonable skill, care and diligence, and taking account of the timescale and resources allocated to it by agreement with Centennial Airly Pty Limited (the Client). Information reported herein is based on the interpretation of data collected, which has been accepted in good faith as being accurate and valid.

This report is for the exclusive use of the Client. No warranties or guarantees are expressed or should be inferred by any third parties. This report may not be relied upon by other parties without written consent from SLR.

SLR disclaims any responsibility to the Client and others in respect of any matters outside the agreed scope of the work.

DOCUMENT CONTROL

Reference	Date	Prepared	Checked	Authorised
630.12598-R01-v1.0	9 October 2019	Martin Davenport	Robert Hall	Martin Davenport

CONTENTS

CONTENTS

DOCUMENT REFERENCES

TABLES

CONTENTS

FIGURES

APPENDICES

1 Introduction

SLR Consulting was commissioned by Centennial Airly Pty Ltd (Centennial Airly) to undertake a Noise and Vibration Impact Assessment (NVIA) for Modification 3 (MOD 3) of the Airly Mine Extension Project (hereafter 'the Project').

The Project was granted State Significant Development Consent (SSD) 5581 on 15 December 2016 and allows for mining at Airly Mine for 20 years, in addition to the operation and construction of infrastructure to facilitate the receipt, handling and processing of 1.8 Million tonnes per annum (Mtpa) of coal, and transportation of this coal by rail to domestic and overseas markets. The consent SSD 5581 will lapse on 31 January 2037.

In addition to the currently approved operations, MOD 3 involves the following modifications, relevant to potential off-site noise and vibration impacts:

- An increase in the production rate from the approved 1.8 Mtpa to 3.0 Mtpa.
- An increase in workforce from the approved 155 FTE personnel to 200 FTE personnel.
- Underground blasting (or shot-firing) activities for the removal of geological structures in the event they are encountered within the mining areas.
- An increase in the movement of laden coal trains and water trains leaving the site from the approved average of two trains per day to three trains per day over any calendar year but maintaining the approved maximum five trains per day leaving the site on any day.

The NVIA has been prepared with reference to Australian Standards (AS) 1055:2018 *Acoustics - Description and Measurement of Environmental Noise* and in general accordance with the Environment Protection Authority's (EPA) NSW *Noise Policy for Industry* (NPfI), *NSW Road Noise Policy* (*RNP)* and *NSW Rail Infrastructure Noise Guideline* (RING). Blasting has been assessed using the ANZEC *Technical basis for Guidelines to Minimise Annoyance due to Blasting Overpressure and Ground Vibration*.

In preparing this assessment SLR has considered the following documents:

- SLR report 630.10123.03010R1R1 Airly Mine Extension Project - Noise and Vibration Impact Assessment dated 24 March 2014 (EIS -NIA).
- *Centennial Coal - Noise Management Plan - Western Region* dated July 2016 (NMP).

Construction noise was assessed in the EIS - NIA. No changes to approved construction activities are proposed as part of this project. Accordingly construction noise is not considered further in this assessment.

This report uses specialist terminology an explanation of which is provided in **Appendix A**.

2 Project Overview

Airly Mine is an underground coal mine operating under the provisions of the State Significant Development Consent SSD 5581, which granted approval to the Airly Mine Extension Project. The consent was granted under Section 89E of the *Environmental Planning and Assessment Act 1979* (EP&A Act) on 15 December 2016 by the then Planning Assessment Commission of NSW, as delegate of the Minister of Planning.

2.1 Project Location

Airly Mine is situated approximately 40 kilometres (km) north-northwest of Lithgow and around 4 km northeast of Capertee, as shown in **Figure 1**. Access to the area is via the Castlereagh Highway to Capertee and then 3 km along the Glen Davis Road to the private access road. The Wallerawang to Kandos railway line (Wallerawang-Gwabegar rail line) is situated 3 km to the west of the pit top area.

Centennial owns Airly Mine as well as a substantial buffer zone (approximately 2,000 hectares) around the Airly Pit Top.

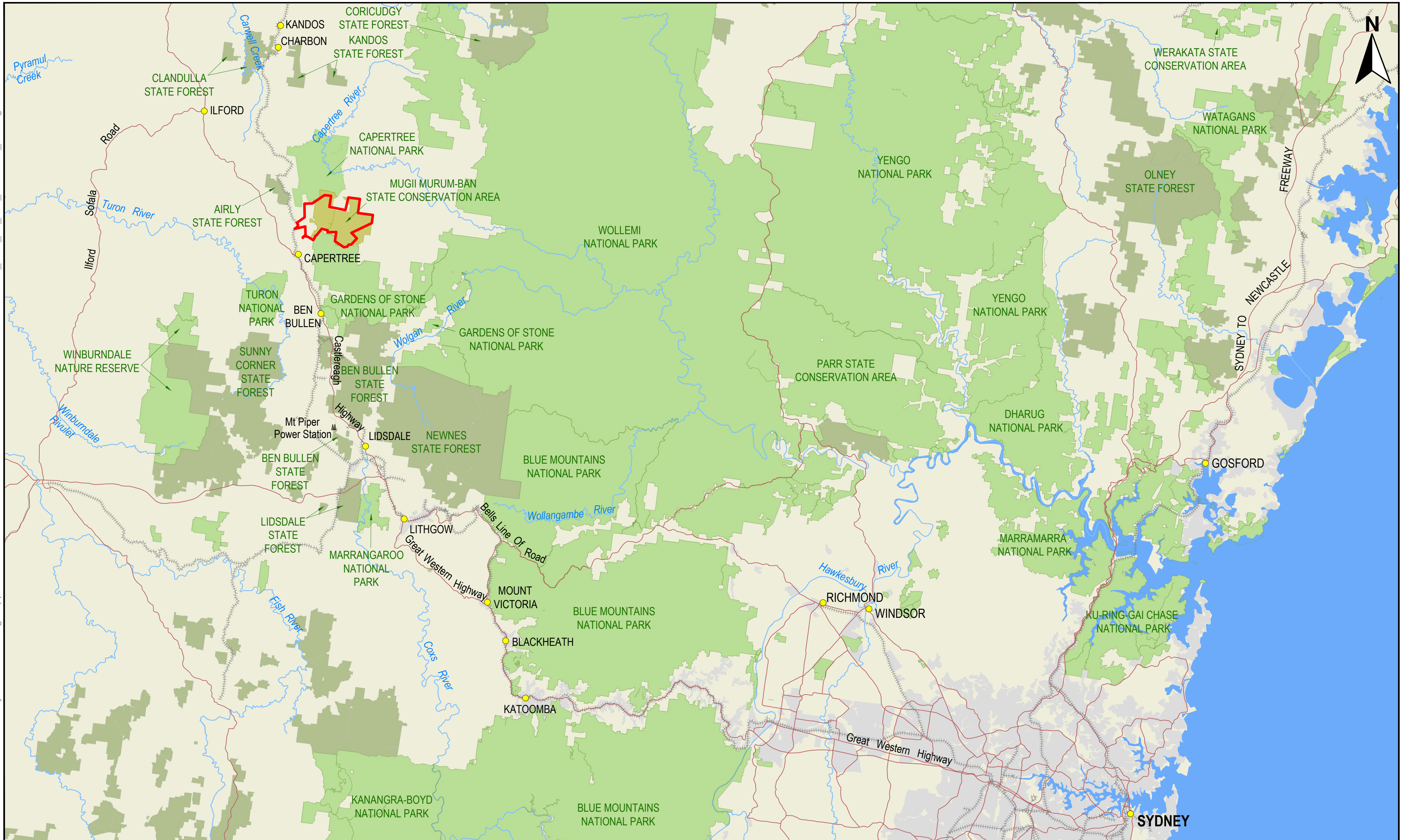
2.2 Approved Operations

The approved components of Airly Mine operations are:

- Extraction of up to 1.8 Mtpa of run of mine (ROM) coal from the Lithgow seam underlying the Project Application Area (PAA) for a period of 20 years.
- Operation and maintenance of existing ancillary surface infrastructure for mine access, underground ventilation, electricity, water, materials supply, and communications at the pit top, and upgrade the infrastructure as required for mining operations.
- Management and handling of ROM coal through a crushing and screening plant at the pit top for transfer to stockpile areas as required to meet market demands.
- Construction of a coal processing plant (CPP) to beneficiate (wash) ROM coal.
- Construction of a life of mine rejects emplacement area (REA) for the emplacement of reject materials from the CPP and the underground mine.
- Transport of coal to domestic power stations and for the export market by rail and importation of water from Charbon Colliery, with the following restrictions:
  - All product coal is transported from the site by rail
  - Movement of laden coal trains and water trains is restricted to:
    - No more than an average of two trains leaving the site per day over any calendar year;
    - No more than five laden trains leaving the site on any day, and
  - no more than one water train received from Charbon Colliery on any day.
- 24 hours per day and seven days per week operation.
- Employment of 155 full time equivalent workforce comprising 135 employees and 20 contractors.
- Progressive rehabilitation of disturbed areas at the pit top no longer required for mining operations and exploration boreholes.

The CPP and the REA are approved but not yet constructed. The proposed locations of the approved infrastructure at the Airly Pit Top are shown in **Figure 2**.

H:\Projects-SLR\630-SrvNTL\630.12381 Airly MOD 2 Drafting Support\06 SLR Data\01 CADGIS\CAD\AIRLY MOD 2 SEE\SLR63012381_AM3_F1_AIR_REGLOC_02.dwg



LEGEND:

- Project Application Area
- Major Roads
- Watercourse
- Railway
- Built-up Areas
- City / Township / Village
- State Forest
- National Park
- State Conservation Area

DATE	04.10.2019
SEAM	LITHGOW
REFERENCE	SLR63012381_AM3_F01_REGLOC_02.dwg
SCALE	1 : 700000

NEW SOUTH WALES
Tamworth
Dubbo
Muswellbrook
Singleton
Airly Mine Project Site
Newcastle
Sydney
Canberra

Figure 1
Regional Location Map

0 15 30 KM

Centennial Coal
Airly

Prepared by: SLR

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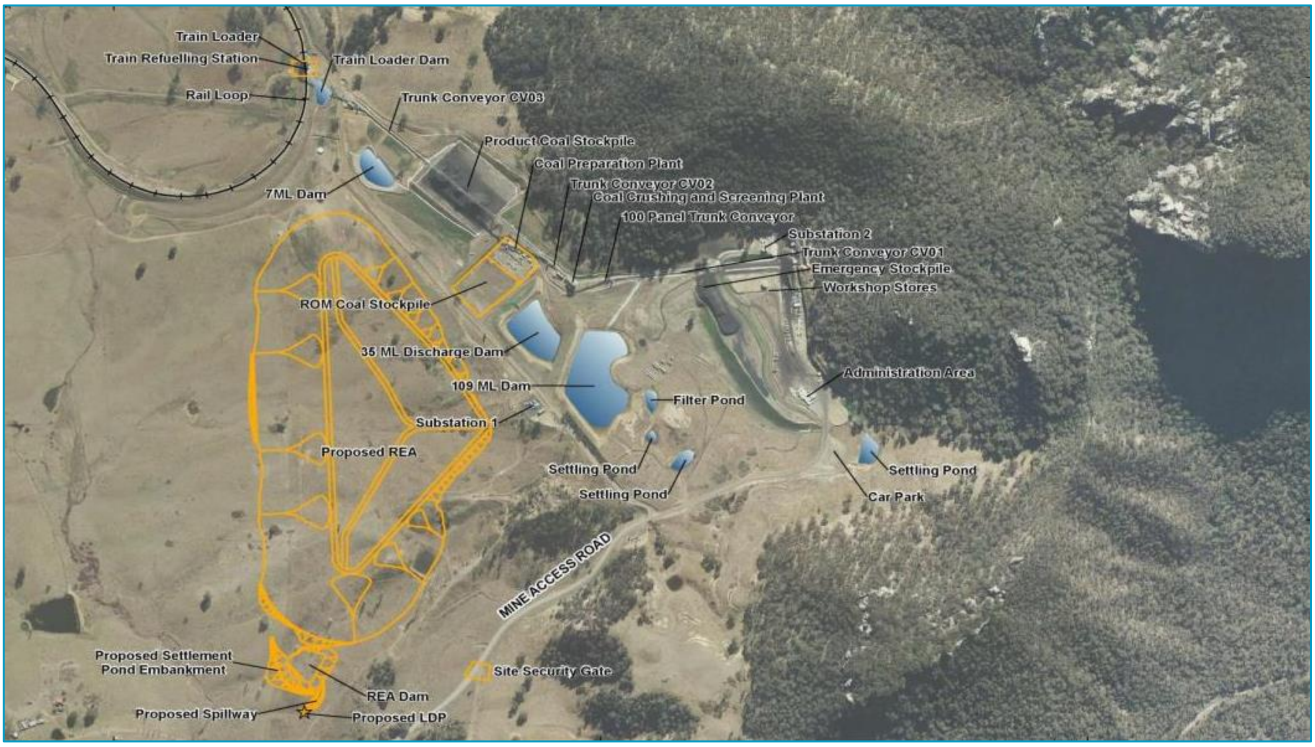
Figure 2 Location of the Approved Surface Infrastructure at the Airly Pit Top



Source: Appendix 3 of Airly 2016

2.3 Proposed Operations

The proposed modification elements under MOD 3 are:

- An increase in the production rate from the approved 1.8 Mtpa to 3.0 Mtpa.
- An increase in workforce from the approved 155 full-time equivalent (FTE) personnel to 200 FTE personnel.
- Underground blasting (or shot-firing) activities for the removal of geological structures in the event they are encountered within the mining areas.
- An increase in the movement of laden coal trains and water trains leaving the site from the approved average of two trains per day to three trains per day over any calendar year but maintaining the approved maximum five trains per day leaving the site on any day.

A summary of the approved operations of Extension Project (as modified) and the proposed modifications under MOD 3 is shown in **Table 1**.

Table 1 Key Features of the Approved Operations and Proposed MOD 3 Changes

Key Feature	Description of Approved Operations	Proposed Change (MOD 3)
Project Life	Mining for 20 years from date of commencement (15 December 2016). The consent will continue to apply in all other respects beyond this date other than the right to conduct mining operations, until the rehabilitation of the site has been carried out..	No change
Development Consent Boundary	Corresponds to the PAA boundary comprising Mining Lease ML1331 and Authorisation 232 (A232) with areas of 2,744 ha and 3,096 ha respectively, and a total 3,982 ha.	No change
Hours of Operation	24 hours per day, 7 days per week	No change
Employment	155 FTE personnel including contractors	200 FTE personnel including contractors.
Mining Method and Mining Area	Underground mining using a combination of first workings and partial extraction mining methods, with the mining areas divided into five mining zones of varying mining systems to engineer the desired subsidence level for each zone. - Panel and Pillar Zone - Cliff Line and First Workings Zone - Partial Pillar Extraction Zone - Shallow Zone - New Hartley Shale Mine Potential Interaction Zone (first workings only) Restrictions on mining are as per Condition 1 of Schedule 3.	No change
ROM Coal Production	1.8 Mtpa	3.0 Mtpa
Coal Handling, Stockpiling and Processing	A system of surface and underground conveyors constructed to operate at 500 tonne per hour. Three coal stockpiles: - a 30,000 tonne ROM Emergency Stockpile - a 200,000 tonne Product Coal Stockpile - a 40,000 tonne ROM Coal Stockpile (not yet established) in the vicinity of the CPP. A CPP with a processing capacity of 500 tonnes per hour.	No change
Coal Transport	Rail to domestic power stations and for export. No more than an average of two trains leave the site each day over any calendar year No more than five trains leave the site on any day No more than one water train is received from Charbon Colliery on any day	No change in coal destinations. Increase in the trains to leave the site to an average of three trains per day over a calendar year but maintaining the approved maximum 5 trains leaving the site on any day.
Reject Management	Co-disposal REA for emplacement of fine and coarse reject materials. REA capacity of 5.3 Mm^3 Reject materials hauled from CPP to REA using trucks.	No change
Site Access	Mine Access Road off Glen Davis Road, 3 km from Capertee Village	No change
Mine Support Facilities	Underground access and associated infrastructure Engineering and services Coal handling, preparation and transport infrastructure Support services and administration at the Pit Top Non- mine owned infrastructure	No change
Underground Water Management	A mine dewatering system, comprising pipelines, underground impoundment dams and pump stations, to pump mine inflows from the underground to the 109 ML Dirty Water Dam for storage and subsequent use as process water.	No change

Key Feature	Description of Approved Operations	Proposed Change (MOD 3)
Surface Water Management	A system of water management structures comprising settling ponds, clean and dirty water diversion drains allow separation and storage of clean and dirty water at the pit top, for use as process water. Clean and dirty water dams comprise: - 109 ML Dirty Water Dam - 7 ML Dam - Train Loader Dam - REA Dam (not constructed) - 35 ML Discharge Dam - Three Licensed discharge points on EPL 1237- LDP001, LDP002, LDP003 Up to 170 ML/year of water imported from Charbon Colliery by rail will be managed within the existing water management system	No change
Process Water	Process water is obtained in priority order from the following sources: - Mine inflows (when available) - Surface dams - Production Bore (Bore Licence Number 10BL603503) - Imported water (up to 170 ML/year) from Charbon Colliery by rail	No change
Mine Ventilation	Two electrically powered centrifugal fans (exhausting types), attached to the northern-most access adit at the pit top, draw fresh air from the remaining three access portals, through the workings, and vent the used air to the external atmosphere through the fans.	No change
Waste Management	Production (reject) and non-production waste (putrescibles and recyclables)	No change
Construction & Exploration	Construction of REA and CPP Construction hours: - 7:00 am - 6:00 pm Monday to Friday - 8:00 am to 1:00 pm Saturdays - No construction work is to take place on Sundays or Public Holidays.	No change
Rehabilitation	Progressive and life of mine	No change
Exploration	Within ML1331 and A232	No change

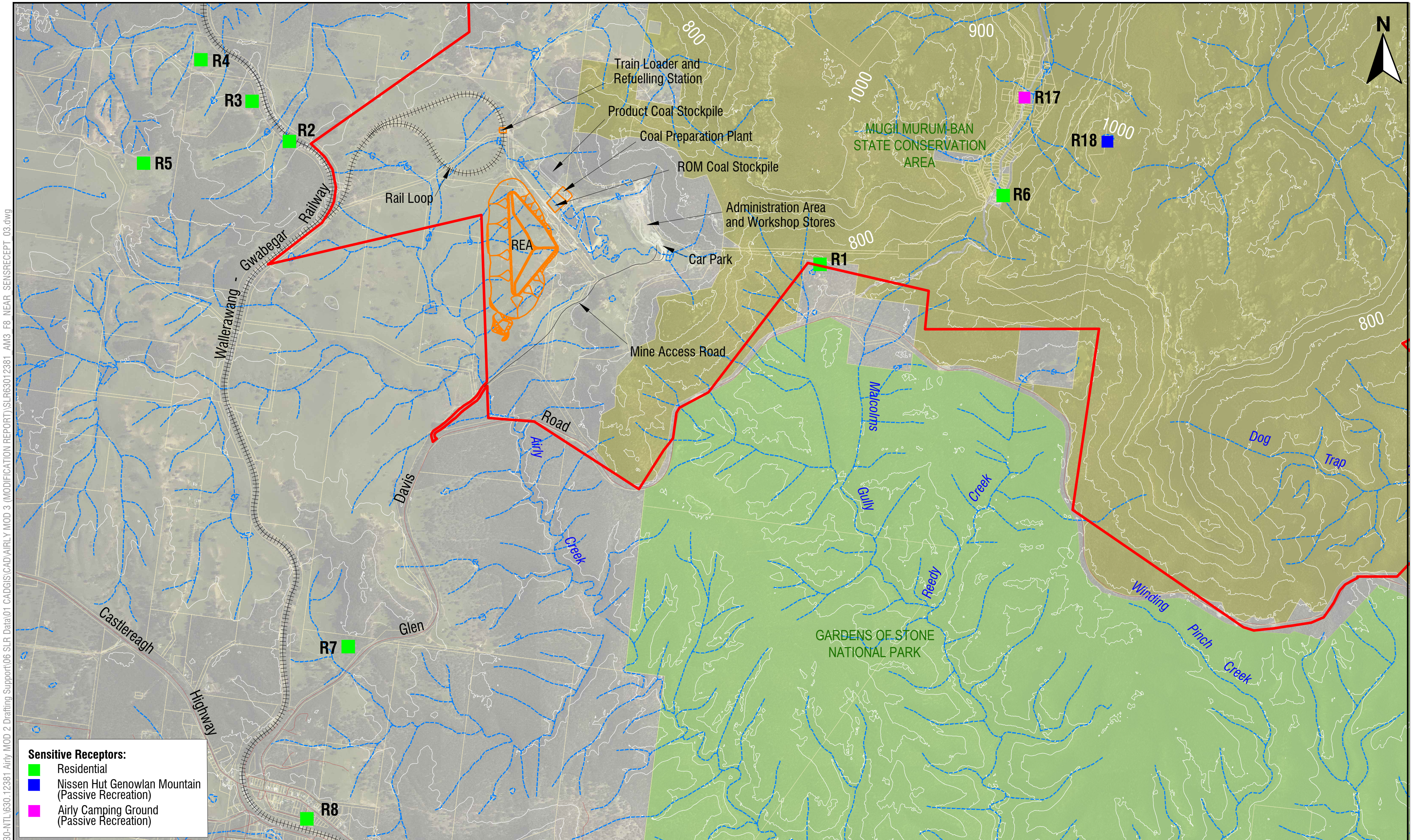
Source: Centennial 2018

2.4 Sensitive Receptors

There are a number of rural/residential properties in the vicinity of the Project and Centennial maintains a substantial holding of land around the PAA. The closest identified non-mine owned residential receptors to the Airly Pit Top are shown in **Table 2** and **Figure 3**.

Table 2 Surrounding Sensitive Receptor Locations – MOD 3

Receiver ID	Location	Location (m, UTM)		Elevation (m, AHD)
		Easting	Northing	
R1	Residential	222,595	6,332,019	686
R2	Residential	218,725	6,332,953	735
R3	Residential	218,480	6,333,266	723
R4	Residential	218,118	6,333,545	724
R5	Residential	217,740	6,332,796	788
R6	Residential	223,867	6,332,572	814
R7	Residential	219,059	6,329,306	747
R8	Residential	218,982	6,328,302	752
R17	Airly camping ground (passive recreation)	224,016	6,333,253	750
R18	Nissen Hut Genowlan Mountain (passive Recreation)	224,592	6,332,947	996



LEGEND:

- Project Application Area
- Catchment Boundary
- Major Roads
- Watercourse
- Contour (50m interval)
- Infrastructure (not constructed)
- Railway
- State Forest
- National Park
- State Conservation Area

DATE	08.10.2019
SEAM	LITHGOW
REFERENCE	SLR63012381_AM3_F8_AIR_NEAR_SENSRECEPT_03.dwg
SCALE	1 : 35000

Figure 3
Nearest Sensitive Receptors

0 0.75 1.5 KM

Centennial Coal
Airly

Prepared by: SLR

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2.5 Existing Consent Conditions

The development consent for the Extension Project as modified was granted in July 2019. Under Schedule 4 - Environmental Performance Conditions (General), the following noise criteria are specified:

> *The Applicant must ensure that the noise generated by the development does not exceed the criteria in Table 4.*

Table 4: Noise criteria dB(A)

Land	Day $L_{Aeq(15\ min)}$	Evening $L_{Aeq(15\ min)}$	Night $L_{Aeq(15\ min)}$	Night $L_{A\ (max)}$
Any residence on privately-owned land	35	35	35	52
	$L_{Aeq\ (period)}$			
R17 (camp ground)	50 (when in use)			N/A
R18 (Nissen Hut)	50 (when in use)			N/A

Note: To interpret the locations referred to in Table 4 see the applicable figure(s) in Appendix 7.

Noise generated by the development is to be measured in accordance with the relevant requirements of the *NSW Industrial Noise Policy*. Appendix 8 sets out the meteorological conditions under which these criteria apply and the requirements for evaluating compliance with these criteria.

However, these criteria do not apply if the Applicant has a negotiated agreement with the owner/s of the relevant residence or land to generate higher noise levels, and the Applicant has advised the Department in writing of the terms of this agreement.

The meteorological conditions under which the criteria apply are contained in Appendix 8 and are reproduced below:

Applicable Meteorological Conditions

1. The noise criteria in Table 4 in Schedule 4 are to apply to a receiver under all meteorological conditions except under:
   (a) wind speeds greater than 3 m/s at 10 m above ground level; or
   (b) stability category F temperature inversions and wind speed greater than 2 m/s at 10 m above ground level; or
   (c) stability category G temperature inversion conditions.

2.6 Noise Compliance

A requirement of the approved project Noise Management Plan (NMP), operator attended noise monitoring is conducted annually at locations representative of the nearest residential receivers. Noise monitoring to date indicates that the operation of Airly Mine complies with the SSD 5581 criteria. Furthermore it is noted that existing Airly Mine noise emissions do not trigger any modifying factors as described by the NPfI.

It is also noted that, to date, no complaints regarding noise emissions from Airly Mine have been received.

3 Noise Impact Assessment Procedures

3.1 NPfI Trigger Noise Levels

The EPA has regulatory responsibility for the control of noise from 'scheduled premises' under the *Protection of the Environment Operations Act 1997*. In implementing the NPfI, the EPA has two broad objectives:

- Controlling intrusive noise levels in the short term
- Maintaining noise amenity levels for particular land uses over the medium to long-term.

In general terms, the NPfI sets out procedures for establishing the project intrusiveness $L_{Aeq(15minute)}$ and project amenity $L_{Aeq(period)}$ noise levels, with a view to determining the lower (that is, the more stringent) being the Project Trigger Noise Level (PTNL), NPfI Section 2.1 states:

> *The project intrusiveness noise level aims to protect against significant changes in noise levels, whilst the project amenity noise level seeks to protect against cumulative noise impacts from industry and maintain amenity for particular land uses. Applying the most stringent requirement as the project noise trigger level ensures that both intrusive noise is limited and amenity is protected and that no single industry can unacceptably change the noise level of an area.*

For assessing intrusiveness, the existing background noise generally needs to be measured. The intrusiveness trigger level essentially means that the equivalent continuous noise level (L_{Aeq}) of the source should not be more than 5 dBA above the measured (or default) Rating Background Level (RBL).

The amenity assessment is based on amenity noise levels specific to the land use and associated activities. The project amenity noise levels are shown in **Table 3** and relate only to industrial-type noise and do not include road, rail or community-related noise. Based on the NPfI land use descriptions residences surrounding the development have been classified for the purposes of this noise assessment as 'rural residential'.

Table 3 Amenity Criteria - Recommended Amenity Noise Levels

Type of Receiver	Noise Amenity Area	Time of Day	Recommended $L_{Aeq(Period)}$ Noise Level, dBA
Residential	Rural	Day	50
		Evening	45
		Night	40
Area specifically reserved for passive recreation (e.g. national park)	All	When in use	50

The PTNLs are then determined in accordance with NPfI Section 2.1 *Project Noise Trigger Level* by identifying the lower of the project amenity or project intrusive noise levels (following conversion of the $L_{Aeq(period)}$ project amenity noise level to an equivalent $L_{Aeq(15minute)}$ value for comparison with the $L_{Aeq(15minute)}$ project intrusive noise level). NPfI Section 2.2 *Noise Descriptors* assumes a default conversion factor of +3 dB for the conversion of $L_{Aeq(period)}$ noise levels to $L_{Aeq(15minute)}$ noise levels.

In addition to the PTNLs, NPfI provides guidance in relation to the assessment of Sleep Disturbance Noise Levels (SDNLs). Specifically, the NPfI states:

Where the subject development/premises night-time noise levels at a residential location exceed:

- *$L_{Aeq(15minute)}$ 40 dBA or the prevailing RBL plus 5 dB, whichever is the greater, and/or*

- *L_{AFmax} 52 dBA or the prevailing RBL plus 15 dB, whichever is the greater,*

a detailed maximum noise level assessment should be undertaken.

Where those trigger levels are not met, it is appropriate to consider any effect of the noise with regard to:

- The extent to which the maximum noise level exceeds the rating background noise level.
- How often high noise events will occur.
- The distribution of likely events across the night-time period and the existing ambient maximum events in the absence of the subject development.
- Whether there are times of day when there is a clear change in the noise environment (such as during early-morning shoulder periods).
- Current scientific literature available at the time of the assessment regarding the impact of maximum noise level events at night.

It may also be appropriate to consider other published research including the NSW *Road Noise Policy* which contains additional guidance relating to potential sleep disturbance impacts.

A review of research on sleep disturbance in the RNP indicates that in some circumstances, higher noise levels may occur without significant sleep disturbance. Based on studies into sleep disturbance, the RNP concludes that:

- Maximum internal noise levels below 50 dBA to 55 dBA are unlikely to cause awakening reactions; and that
- One or two noise events per night, with maximum internal noise levels of 65 dBA to 70 dBA, are not likely to affect health and wellbeing significantly.

Internal noise levels in a dwelling, with the windows open, are commonly 10 dB lower than external noise levels. Therefore, the first conclusion above suggests that short-term external noises of 60 dBA to 65 dBA are unlikely to cause awakening reactions. The second conclusion suggests that one or two noise events per night with maximum external noise levels of 75 dBA to 80 dBA are not likely to affect health and wellbeing significantly.

3.2 Rail Traffic Noise

The EPA released *Rail Infrastructure Noise Guideline* (RING) in May 2013. The Guideline provides requirements in Appendix 2 for rail traffic-generating developments and are reproduced as follows:

Land-use developments other than rail projects that are likely to generate additional rail traffic on an existing rail network should be assessed against the following requirements:

- *Identify the typical offset distance/s of sensitive receivers from the rail line/s that are likely to be affected by increased rail movements.*
- *Quantify the existing level of rail noise at the offset distance/s identified above using the noise descriptors $L_{Aeq,15/9hr}$ and L_{Amax} (95th percentile) dB(A).*
- *Predict the cumulative rail noise level (i.e. from the existing and proposed rail movements) using a calibrated noise model (based on predicted increased rail movements) at the offset distances identified above.*
- *Compare the cumulative noise level with the rail noise assessment trigger levels: $L_{Aeq,15hr}$ 65 dB(A), $L_{Aeq,9hr}$ 60 dB(A), and L_{Amax} (95th percentile) 85 dB(A).*
- *Implement all feasible and reasonable noise mitigation measures where the cumulative noise level exceeds the noise assessment trigger levels and project-related noise increases are predicted.*
- *Where the L_{Aeq} noise level increases are more than 2 dB(A), which is equivalent to approximately 60 per cent of the total line or corridor rail traffic, and exceeds the relevant noise assessment trigger level, strong justification should be provided as to why it is not feasible or reasonable to reduce the increase.*

Notes

1. *A project-related noise increase is an increase of more than 0.5 dB over the day or night periods.*
2. *The geographical extent of the rail noise assessment ideally should be where project-related rail noise increases are less than 0.5 dB. This roughly equates to where project-related rail traffic represents less than 10 per cent of the total line or corridor rail traffic.*

Mitigating noise from rail traffic-generating developments

For a traffic-generating development like a coal mine, the proponent would not have control over the public rail infrastructure. Consequently they would have limited opportunities to implement mitigation, such as noise barriers. In such cases, control of noise and vibration at the source is the most effective means of mitigation. However, the land-use developer responsible for the additional rail traffic (such as a mine, quarry or industrial site) could contract to a rail service provider who would use best practice rolling stock, including locomotives approved to operate on the NSW rail network in accordance with environment protection licences issued by the EPA. At property (architectural) treatments should be considered for affected receivers, if reasonable.

John Holland Rail's EPL 13421 also contains noise limits (set as goals) for the operation of the Wallerawang-Gwabegar rail line and is reproduced below:

L2.1 It is an objective of this License to progressively reduce noise levels to the goals of 65 dB(A)Leq, (day time from 7am - 10pm), 60 dB(A)Leq, (night time from 10pm - 7am) and 85 dB(A) (24 hr) max pass-by noise, at one metre from the façade of affected residential properties.

The noise goals provided in EPL 13421 are consistent with the RING trigger levels outlined above.

3.3 Road Traffic Noise

The RNP sets out noise criteria applicable to particular types of projects, road categories and land uses for the purpose of defining traffic noise impacts.

Table 4 presents the most relevant RNP criteria for residential land uses affected by noise from additional traffic on a freeway, arterial, sub-arterial, or local road. Noise levels provided in **Table 4** are external noise levels and refer only to road traffic noise; they do not include ambient noise from other sources.

Table 4 Road Traffic Noise Assessment Criteria for Residential Land Uses

Road Category	Type of Project/Land Use	Assessment Criteria - dBA	
		Day (7:00 am to 10:00 pm)	Night (10:00 pm to 7:00 am)
Freeway/ arterial/ sub-arterial roads	Existing residences affected by additional traffic on existing freeways/arterial/sub-arterial roads generated by land use developments	$L_{Aeq(15hour)}$ 60 (external)	$L_{Aeq(9hour)}$ 55 (external)
Local roads	Existing residences affected by additional traffic on existing local roads generated by land use developments	$L_{Aeq(1hour)}$ 55 (external)	$L_{Aeq(1hour)}$ 50 (external)

Furthermore, Section 2.4 of the RNP states that in addition to the assessment criteria presented in **Table 4**, any increase in the traffic noise level at a location due to a traffic generating development must be considered. Residences experiencing increases in total traffic noise level above the relative increase criteria should also be considered for mitigation. **Table 5** shows relative increase criteria for residential land uses. The relative increase criterion does not apply for local roads.

Table 5 Relative Increase Criteria for Residential Land Uses

Road Category	Type of Project/Land Use	Total Traffic Noise Level Increase	
		Day (7:00 am to 10:00 pm)	Night (10:00 pm to 7:00 am)
Freeway/ arterial/ sub-arterial roads	New road corridor/redevelopment of existing road/land use development with the potential to generate additional traffic on existing road	Existing traffic $L_{Aeq(15hour)}$ + 12 dB (external)	Existing traffic $L_{Aeq(9hour)}$ + 12 dB (external)

In **Table 5** the 'existing' traffic noise level refers to the level from all road categories which would occur for the relevant 'no build' option. Where the existing $L_{Aeq(period)}$ road traffic noise level is found to be less than 30 dBA, it is deemed to be 30 dBA.

Section 3.4 of the RNP also states:

Where existing traffic noise levels are above the noise assessment criteria, the primary objective is to reduce these through feasible and reasonable measures to meet the assessment criteria. A secondary objective is to protect against excessive decreases in amenity as the result of a project by applying the relative increase criteria.

In assessing feasible and reasonable mitigation measures, an increase of up to 2 dB represents a minor impact that is considered barely perceptible to the average person.

For existing residences and other sensitive land uses affected by additional traffic on existing roads generated by land use developments, any increase in the total traffic noise level should be limited to 2 dB above that of the corresponding 'no build option'.

4 Existing Meteorological and Noise Environment

4.1 Meteorological Environment

The Mine Site meteorological environment has been assessed in accordance with the requirements of the NPfI Fact Sheet D, which sets out procedures for establishing noise enhancing weather conditions. There are two options available to consider meteorological effects, as follows.

1. *Adopt the **noise-enhancing meteorological conditions** for all assessment periods for noise impact assessment purposes without an assessment of how often these conditions occur - a conservative approach that considers source-to-receiver wind vectors for all receivers and F class temperature inversions with wind speeds up to 2 m/s at night.*

Or

2. *Determine the **significance** of noise-enhancing conditions. This involves assessing the significance of temperature inversions (F and G class stability categories) for the night-time period and the significance of light winds up to and including 3 m/s for all assessment periods during stability categories other than E, F or G. Significance is based on a threshold of occurrence of 30% determined in accordance with the provisions in this policy. Where noise-enhancing meteorological conditions occur for less than 30% of the time, standard meteorological conditions may be adopted for the assessment.*

NPfI Fact Sheet D also contains several important notes, and in particular states:

Noise limits derived for consents and licences will apply under the meteorological conditions used in the environmental assessment process, that is, standard or noise-enhancing meteorological conditions. For 'very noise-enhancing meteorological conditions' (see glossary) a limit is set based on the limit derived under standard or noise-enhancing conditions (whichever is adopted in the assessment) plus 5 dB. In this way a development is subject to noise limits under all meteorological conditions.

It should be noted that noise limit conditions will include the wind speed (scalar quantity without direction) under which noise limits will apply.

To provide a conservative approach and based on NPfI Table D1, the standard and noise enhancing meteorological conditions are presented in **Table 6**.

Table 6 NPfI Table D1 Standard and Noise Enhancing Meteorological Conditions

Meteorological Conditions	Meteorological Parameters
Standard	Day/evening/night: stability categories A-D with wind speed up to 0.5m/s at 10m AGL
Noise-enhancing	Day/evening: stability categories A-D with light winds (up to 3m/s at 10m AGL) Night-time: stability categories A-D with light winds (up to 3m/s at 10m AGL) and/or stability category F with winds up to 2m/s at 10m AGL

Notes: m/s = metres per second, m = metres, AGL = above ground level

where a range of conditions is nominated, the meteorological condition delivering the highest predicted noise level should be adopted for assessment purposes. However, feasible and reasonable noise limits in consents and licences derived from this process would apply under the full range of meteorological conditions nominated under standard or noise-enhancing conditions as relevant. All wind speeds are referenced to 10m AGL. Stability categories are based on the Pasquill-Gifford stability classification scheme.

The NPfI standard and noise enhancing meteorological conditions can be further defined for noise modelling purposes as presented in **Table 7**.

Table 7 Meteorological Parameters Considered for Noise Predictions

Period	Meteorological Conditions	Air Temperature (°C)	Humidity (%)	Wind Speed (m/s) (Source to receiver)	Stability Category
Day	Standard	16	68	0	D Class
	Noise enhancing			3	
Evening	Standard	13	77	0	D Class
	Noise enhancing			3	
Night	Standard	9	89	0	D Class
	Noise enhancing			3	
				2	F Class

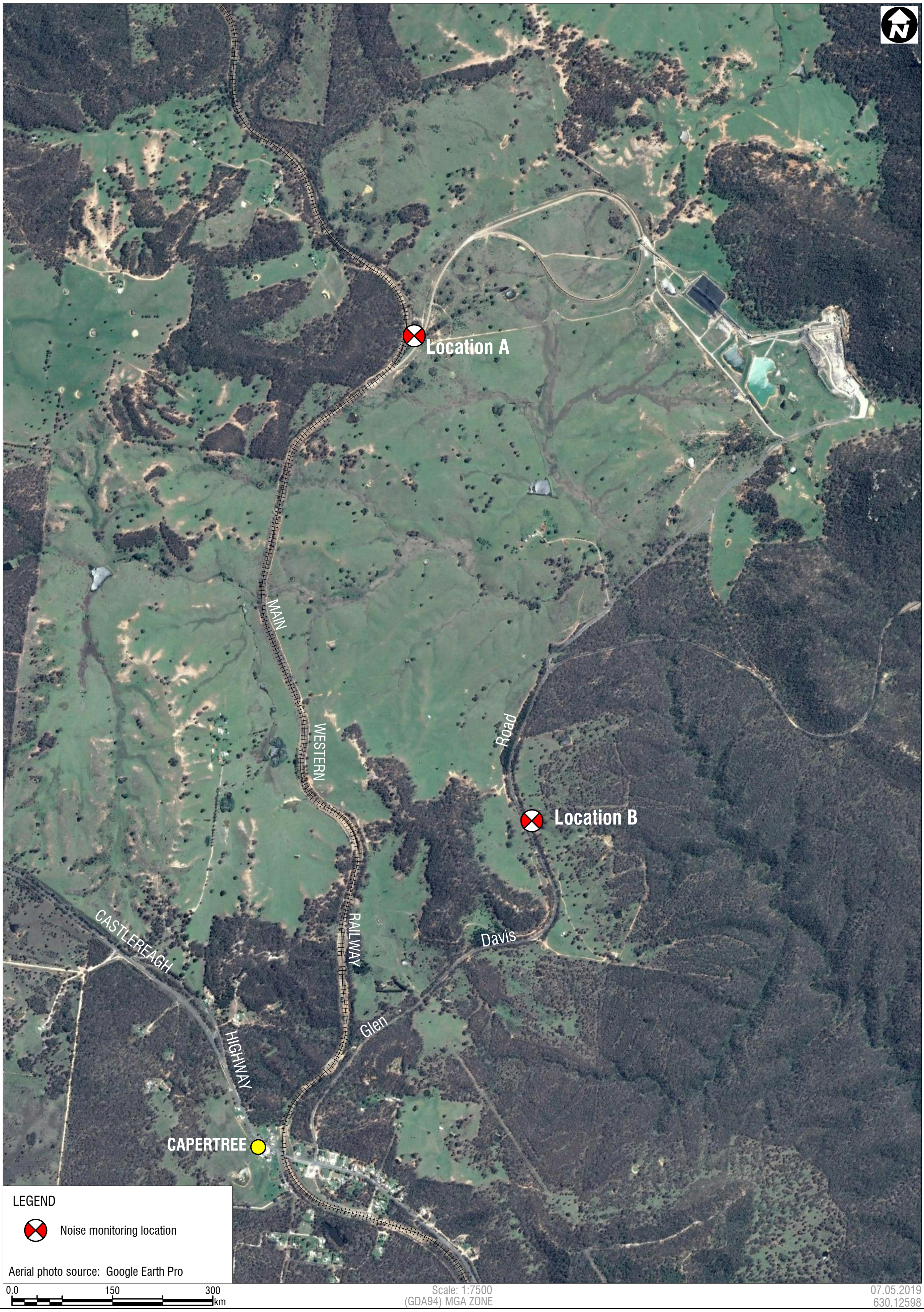
Note: The temperature and humidity parameters have been chosen based on averages of actual meteorological data from Airly Mine as presented in the EA - NIA.

4.2 Existing Noise Environment

The EIS - NIA presents results of pre mining background noise monitoring conducted in February and March of 2009. Monitoring was conducted at four locations surrounding Airly Mine, representative of the nearest potentially affected receivers. Rating Background Levels (RBLs) at all locations were determined in accordance with the NSW *Industrial Noise Policy* (INP) to be 30 dBA.

No significant industrial development, other than Airly Mine, has occurred in the vicinity of these residences, hence, results of previous noise monitoring are considered to be relevant to the current assessment.

Additional noise monitoring was conducted in November 2018 to determine existing road traffic noise levels on Glen Davis Road as well as rail noise levels in the vicinity of the Airly Mine rail loop. Noise loggers would also quantify the existing ambient noise levels. The two (2) environmental noise loggers were positioned at locations shown in **Figure 4**. Details of the loggers and their locations are provided in **Table 8**.



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NOISE MONITORING LOCATIONS

FIGURE 4

Table 8 Noise Logger Details

Location Reference	Location	Noise Logger Type / Serial No.	Monitoring Period
Location - A	Airly Rail Loop	SVAN 957 / 23815	Monday 5 November 2018 to Tuesday 13 November 2018, inclusive
Location - B	Glen Davis Road	ARL Type EL316 / 16-203-505	Monday 5 November 2018 to Tuesday 13 November 2018, inclusive

All acoustic instrumentation employed throughout the monitoring programme has been designed to comply with the requirements of AS IEC 61672.1-2004 *Electroacoustics - Sound level meters - Specifications* and carries current NATA or manufacturer calibration certificates. Instrument calibration was checked before and after each measurement survey, with the variation in calibrated levels not exceeding ±0.5 dBA.

Each noise logger was set to record statistical indices over 15-minute intervals including LAmax, L_{A1}, L_{A10}, L_{A90} and L_{Aeq} noise levels.

Weather data for the survey period was obtained from the Airly Mine weather station. Unattended noise data corresponding with periods of rainfall and/or wind speeds in excess of 5 m/s (approximately 18km/h) were discarded in accordance with NPfI data exclusion methodology.

Results of the unattended noise monitoring program are provided in graphical format in **Appendix B**. A summary of noise levels measured during the unattended noise monitoring program is provided in **Table 9.**

Table 9 Summary of Existing Ambient Noise Levels

Location ID	Period	Rating Background Level	Measured $L_{Aeq(period)}$
Location - A	Day	35 dBA	47 dBA
	Evening	30 dBA	50 dBA
	Night	30 dBA	52 dBA
Location - B	Day	35 dBA	52 dBA
	Evening	30 dBA	46 dBA
	Night	30 dBA	48 dBA

Note: Daytime 7.00 am to 6.00 pm; Evening 6.00 pm to 10.00 pm; Night-time 10.00 pm to 7.00 am
On Sundays and Public Holidays, Daytime 8.00 am to 6.00 pm; Evening 6.00 pm to 10.00 pm; Night-time 10.00 pm to 8.00 am
In accordance with NPfI Table 2.1, if the daytime RBL is < 30dB(A), then 35dB(A) shall be the assumed RBL if the evening or night RBL is < 30dB(A), then 30dB(A) shall be the assumed RBL.

Results of the unattended road traffic noise monitoring at Location B are provided in **Table 10**.

Table 10 Unattended Road Traffic Noise Monitoring

Location	$L_{Aeq(15hour)}$	$L_{Aeq(9hour)}$	$L_{Aeq(1hour)}$ Day	$L_{Aeq(1hour)}$ Night
Location B Approximately 21 m from the centreline of Glen Davis Road	51 dBA	48 dBA	54 dBA	55 dBA

5 Project Noise Impact Assessment Criteria

5.1 Operational Noise

Applicable PTNLs and Sleep Disturbance Noise Levels (SDNLs) for all receiver areas surrounding the Project have been established with reference to the NPfI and are contained in **Table 11**.

Table 11 Operational Project Trigger and Sleep Disturbance Noise Levels

Location	Period	Project Intrusiveness[1] $L_{Aeq(15minute)}$	Project Amenity[2] $L_{Aeq(period)}$	Project Amenity[3] $L_{Aeq(15minute)}$	Resulting PTNL[4] $L_{Aeq(15minute)}$	SDNL[5] $L_{Aeq(15minute)}$ / L_{Amax}
R1-R8	Day	40 dBA	45 dBA	48 dBA	40 dBA	n/a
	Evening	35 dBA	40 dBA	43 dBA	35 dBA	n/a
	Night	35 dBA	35 dBA	38 dBA	35 dBA	40 dBA / 52 dBA
R17-R18	When in use	N/A	45 dBA	48 dBA	48 dBA	n/a

Note 1: Project Intrusiveness is the RBL plus 5 dBA.

Note 2: Project Amenity (period) noise level is the Amenity Criteria minus 5 dBA.

Note 3: Project Amenity (15 minute) is the Project Amenity (period) noise level plus 3 dB

Note 4: Resulting PTNL is the lower of the Project Intrusiveness and the Project Amenity (15 minute) noise levels.

Note 5: SDNL as described in **Section 3.1**.

5.2 Road Traffic Noise Goals

Section 3.3 provides the relevant project specific operational and construction road traffic noise goals that are applicable for the Project.

5.3 Rail Noise Goals

Table 12 provides the relevant off-site rail noise goals.

Table 12 Rail Noise Assessment Trigger Levels for Rail Generating Developments

Descriptor	Residential Noise Trigger Levels (dBA)
$L_{Aeq(15hour)}$	65
$L_{Aeq(9hour)}$	60
L_{Amax}[1]	85

Note1 : 95th percentile equates to the 5% exceedance value.

6 Operational Noise Impact Assessment

6.1 Noise Modelling Methodology and Assumptions

A computer model was used to predict noise emissions from the operation of the Project. The operational noise modelling was undertaken using the Concawe algorithms within SoundPLAN v7.4 software. A three-dimensional digital terrain map providing relevant topographic information was used in the modelling process, together with noise source data, shielding by barriers and/or adjacent buildings and atmospheric information to predict noise levels at the nearest potentially affected receivers.

Prediction of noise emission levels was carried out under standard and noise-enhancing atmospheric conditions (refer to **Table 6**) as detailed in the NPfI.

Modelling was conducted for two (2) stages of REA development representing material being placed at the commencement of Stage 1 as well as at a final height of 765 m at the completion of Stage 4.

The operational scenario modelled during each period together with sound power level information is summarised in **Table 13**. A tick (✓) indicates that the equipment is in operation, a cross (×) indicates that the equipment is not in operation. Where there is a number in brackets following a tick, this represents the number of items of the equipment that has been considered in the noise model. Sound power levels of onsite plant and equipment have been determined from onsite noise measurements or sourced from similar equipment at other Centennial sites or a SLR database of similar equipment.

Table 13 Operational Scenario

Plant and Equipment	Sound Power Level dBA $L_{Aeq(15minute)}$	Day	Evening	Night
Crusher Station	105	✓	✓	✓
UC CV01	83 per m	✓	✓	✓
CV01	84 per m	✓	✓	✓
CV01 Transfer Point	106	✓	✓	✓
CV02	82 per m	✓	✓	✓
CV03	82 per m	✓	✓	✓
UC CV01 Drive	104	✓	✓	✓
CV01 Drive	97	✓	✓	✓
CV02 Drive	101	✓	✓	✓
CV03 Drive	107	✓	✓	✓
Other Approved Surface Conveyors	78 per m	✓	✓	✓
Sub Station	84	✓ (2)	✓ (2)	✓ (2)
Ventilation Fan	102	✓	✓	✓
Compressor Shed	97	✓	✓	✓

Plant and Equipment	Sound Power Level dBA $L_{Aeq(15minute)}$	Day	Evening	Night
Light Utility vehicles	97	✓ (3)	✓ (3)	✓ (3)
Water Cart	105	✓	✓	✓
Workshop Hand tools (Grinding)	101	✓	✓	✓
Diesel Pumps	95	✓ (2)	×	×
PJB	105	✓ (4)	✓ (4)	✓ (4)
Eimco	106	✓ (3)	✓ (3)	✓ (3)
Forklift	91	✓	✓	✓
CHPP	107	✓	✓	✓
40t Truck	104	✓	✓	✓
D10 Dozer Secondary Stockpile	115	✓	✓	✓
D10 Dozer Washed Coal/Rom Stockpile	115	✓	✓	✓
D10 REA	115	✓	✓	✓
Train Loader	111	✓	✓	✓
Rail Locomotives in loop	108	✓	✓	✓
Coal Wagons	96	✓	✓	✓
Train Refuelling Station	95	✓	✓	✓
Water Treatment Plant (pumps)	95	✓ (3)	✓ (3)	✓ (3)

Sleep disturbance noise levels were predicted using the following L_{Amax} sound power levels on significant plant and equipment:

- Dozer 120 dBA
- Truck tipping 112 dBA
- CHPP 120 dBA
- Rail locomotives 112 dBA
- Automatic train loader 124 dBA

Assumptions made in modelling noise emissions from the Project include the following:

- All acoustically significant plant and equipment operates simultaneously.
- Mobile noise sources were modelled at typical locations and assumed to operate in repetitive cycles.

6.2 Modify Factor Assessment

Where a noise source contains certain characteristics, such as dominant low frequency content, the NPfI Fact Sheet C states that there is evidence to suggest that it can cause greater annoyance at a receiver than other noise at the same noise level. The modifying factors (if applicable) are to be applied to the measured or predicted noise level at the receiver and then assessed against the PNTLs. In the case of low frequency (10 hertz [Hz] to 160Hz) noise at the receiver, subject to the extent of the exceedance above the thresholds presented in the NPfI's Fact Sheet C (Table C2), requires a 2 dB to 5 dB correction to be applied to the measured or predicted intrusive noise levels where the difference between the C and A weighted level is 15dB (or more) in accordance with NPfI's Fact Sheet C (Table C1).

As noted in **Section 2.6** existing Airly Mine noise emissions do not trigger any modifying factors as described by the NPfI, however given that additional approved infrastructure and mobile equipment may operate in the future, an assessment of low frequency noise at the nearest most potentially impacted receiver (R2) has been conducted. The resulting C and A weighted predicted intrusive $L_{Aeq(15minute)}$ noise level differences under enhancing meteorological conditions is presented in **Table 14**.

Table 14 C and A Weighted Predicted Intrusive Noise Level Differences

Assessed Receiver	$L_{Aeq(15minute)}$	$L_{Ceq(15minute)}$	Level Difference
R2	35 dBA	51 dBC	16 dB

As shown in **Table 14**, the resulting C and A weighted predicted (noise enhancing) intrusive noise level difference exceeds 15 dB and therefore triggers a more detailed assessment of low frequency noise. **Table 15** summarises the predicted octave Project noise emission levels against the NPfI low frequency 1/3 octave low frequency threshold values.

Table 15 NPfI Low Frequency Analysis

<table>
<tr><th>Frequency (Hz)</th><th>10</th><th>12.5</th><th>16</th><th>20</th><th>25</th><th>31.5</th><th>40</th><th>50</th><th>63</th><th>80</th><th>100</th><th>125</th><th>160</th></tr>
<tr><td>$L_{Zeq(15minute)}$ NPFI threshold Level dBZ</td><td>92</td><td>89</td><td>86</td><td>77</td><td>69</td><td>61</td><td>54</td><td>50</td><td>50</td><td>48</td><td>48</td><td>46</td><td>44</td></tr>
<tr><td>Project Octave band $L_{Zeq(15minute)}$ noise level dBZ</td><td>-</td><td colspan="3">53</td><td colspan="3">52</td><td colspan="3">44</td><td colspan="3">38</td></tr>
<tr><td>Exceedance</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td></tr>
</table>

As shown in **Table 15**, all predicted Project octave band $L_{Zeq(15minute)}$ noise levels are below the NPfI 1/3 octave low frequency threshold values. As such, no modifying factor correction for low-frequency noise is triggered for the Project.

6.3 Operational Noise Modelling Results and Discussion

Predicted noise emission levels at the nearest noise sensitive receiver locations are provided in **Table 16**. Results shown are the highest predicted noise level for each scenario under applicable standard or noise enhancing weather conditions.

A noise contour map representing the outer envelope noise emissions under noise enhancing weather conditions is provided in **Appendix C**.

Table 16 Predicted Noise Levels

Receiver ID	Period	Predicted $L_{Aeq(15minute)}$ Noise Level dBA		Predicted SDNL L_{Amax} dBA	Noise Assessment Criteria dBA	
		Standard Weather Conditions	Noise Enhancing Weather Conditions	Noise Enhancing Weather Conditions	PTNL $L_{Aeq(15minute)}$ / SDNL L_{Amax}	SSD 5581 $L_{Aeq(15minute)}$ / L_{Amax}
R1	Day	<30	<30	-	40	35
	Evening	<30	<30	-	35	35
	Night	<30	<30	<30	35/52	35/52
R2	Day	31	35	-	40	35
	Evening	31	35	-	35	35
	Night	31	35	45	35/52	35/52
R3	Day	<30	<30	-	40	35
	Evening	<30	<30	-	35	35
	Night	<30	<30	36	35/52	35/52
R4	Day	<30	30	-	40	35
	Evening	<30	30	-	35	35
	Night	<30	30	38	35/52	35/52
R5	Day	<30	<30	-	40	35
	Evening	<30	<30	-	35	35
	Night	<30	<30	31	35/52	35/52
R6	Day	<30	<30	-	40	35
	Evening	<30	<30	-	35	35
	Night	<30	<30	<30	35/52	35/52
R7	Day	<30	<30	-	40	35
	Evening	<30	<30	-	35	35
	Night	<30	<30	<30	35/52	35/52
R8	Day	<30	<30	-	40	35
	Evening	<30	<30	-	35	35
	Night	<30	<30	32	35/52	35/52

Receiver ID	Period	Predicted $L_{Aeq(15minute)}$ Noise Level dBA		Predicted SDNL L_{Amax} dBA	Noise Assessment Criteria dBA	
R17	When in use	<30	<30	-	48	50 $L_{Aeq(period)}$
R18	When in use	<30	<30	-	48	50 $L_{Aeq(period)}$

Results presented in **Table 16** (and the associated noise contour plots) indicate that noise levels from the modelled operational scenarios are predicted to be below the relevant PTNL/SDNL and SSD 5581 criteria at all privately owned residential assessment locations under all considered meteorological conditions.

Operational noise levels are also predicted to comply with the relevant PTNL and SSD 5581 criteria at Airly Gap and the Nissen Hut.

6.4 Cumulative Assessment

Excelsior Limestone Quarry is located approximately 4 km north of R4 and is the only identified existing extractive industry in the locality. The noise impact assessment for the Excelsior Limestone Quarry is not available publicly and therefore a quantitative assessment of the cumulative impacts is not possible for the Project and the Excelsior Limestone Quarry.

Notwithstanding, given that predicted noise levels from the Project are significantly below the Project Amenity $L_{Aeq(15minute)}$ noise level (**Table 11**) any cumulative noise impacts would be considered negligible.

7 Offsite Rail Traffic Noise

Noise from offsite rail activities associated with the Project on the Wallerawang-Gwabegar rail line between the Project and Charbon Colliery to the north as well as to the Great Western Rail Line to the south has been considered as part of the offsite rail traffic noise impact assessment, in accordance with the RING. Noise associated with operation of the onsite rail loop, such as train movements, direction changes, noise from loading and unloading wagons and locomotive noise has been assessed as part of the operational assessment in **Section 6**.

7.1 Methodology

The calculation of L_{Aeq} and the maximum passby levels have been conducted using the Nordic Rail Prediction Method (1994). The prediction model uses characteristic noise levels for the various sources (locomotive engine and exhaust noise as a function of throttle notch, wheel/rail noise as a function of train speed, and wagon type, etc) at a fixed reference distance. The model then makes adjustments for the train length and distance from the track (assuming no barriers). Parameters including the daytime $L_{Aeq(15hour)}$, night-time $L_{Aeq(9hour)}$, and maximum passby level (L_{Amax}) can then be determined by summing the effects of the individual noise sources and by incorporating the number of train events.

Note, the model assumes no intervening structures (i.e. existing topography, buildings and the like), therefore, the predicted noise levels are indicative and in some cases likely to be conservative at some receiver distances.

7.2 Assumptions

7.2.1 Coal Train Movements South of the Project

Assumptions made (based on information provided by Centennial Airly) for the purpose of the offsite rail noise predictions on the Wallerawang-Gwabegar Rail Line and the Great Western Rail Line are provided in **Table 17** and **Table 18**, respectively. To provide a conservative assessment it has been assumed that all Airly Mine coal rail traffic (peak daily and average daily movements) would occur either during the daytime period or the night-time period. This provides a conservative assessment approach as actual rail movements are likely to be distributed across the daytime and night-time periods.

Table 17 Wallerawang-Gwabegar Rail Line Train Movements - South of Airly

Status	Train Type	Train Movements						Train Length (m)	Train Speed (m)
		Daytime		**Night-time**		**24 Hours**			
		Average	**Peak**	**Average**	**Peak**	**Average**	**Peak**		
Existing	Passenger	0	0	0	0	0	0	160	80
	Freight/Coal	0	0	0	0	0	0	1080	80
	Existing Airly Mine	2	5	2	5	2	5	1080	80
The Project	Coal Train	1	0	1	0	1	0	1080	80
Total Without Project		2	5	2	5	2	5		
Total With Project		3	5	3	5	3	5		
% Increase due to the Project		50%	0%	50%	0%	50%	0%		

As can be seen from **Table 17**, the average percentage increase due to the Modification would comprise of up to 50% of cumulative train movements along the Wallerawang-Gwabegar railway. No change in peak movements is proposed.

Table 18 Great Western Rail Line Train Movements

Status	Train Type	Train Movements						Train Length (m)	Train Speed (m)
		Daytime		**Night-time**		**24 Hours**			
		Average	**Peak**	**Average**	**Peak**	**Average**	**Peak**		
Existing	Passenger	21	21	13	13	34	34	160	80
	Freight/Coal	6	6	7	7	13	13	1080	80
	Existing Airly Mine	2	5	2	5	2	5	1080	80
The Project	Coal Train	1	0	1	0	1	0	1080	80
Total Without Project		29	32	22	25	49	52		
Total With Project		30	32	23	25	50	52		
% Increase due to the Project		3%	0%	5%	0%	2%	0%		

As can be seen from **Table 18**, the average percentage increase due to the Modification would comprise less than 10% of cumulative train movements along the Great Western railway.

The Wallerawang-Gwabegar railway line joins the Great Western railway line at Wallerawang, where the trains join the metropolitan network. Currently the only trains to use the Wallerawang-Gwabegar railway line are trains associated with Airly Mine. Therefore, the practical maximum rail noise impacts would occur on the Wallerawang-Gwabegar railway line between Airly Mine and Wallerawang. Hence, only the Wallerawang-Gwabegar railway line has been assessed as it is representative of the potentially most impacted section of railway line from the Project.

7.2.2 Water Train Movements North of the Project

The nearest receiver to the Wallerawang-Gwabegar rail line between Airly and Charbon Pit tops is located approximately 50 m from the centreline of the track in the township of Clandulla. As the Wallerawang-Gwabegar rail line between Charbon Colliery and Airly is operated infrequently and not to a fixed timetable, existing rail noise levels would be low across the project area.

7.3 Wallerawang-Gwabegar Rail Line Noise Predictions and Assessment

7.3.1 Wallerawang-Gwabegar Rail Line - South of Airly

The $L_{Aeq(period)}$ and maximum (5% exceedance) pass-by noise levels for the existing and proposed rail traffic during the daytime and night-time are presented in **Table 19** and **Table 20**.

Table 19 Daytime Predicted Rail Traffic Noise - Wallerawang-Gwabegar Rail Line - South of Airly

Distance to Receiver	Total Without Project dBA			Total With Project dBA			Increase in Noise Levels dB	
	LAeq(15hour)		LAmax	LAeq(15hour)		LAmax	LAeq(15hour)	
	Average	Peak		Average	Peak		Average	Peak
11	57	61	**91**	59	61	91	1.8	0.0
25	53	57	**87**	55	57	87	1.8	0.0
50	50	54	84	52	54	84	1.8	0.0
100	47	51	81	49	51	81	1.8	0.0
150	45	49	79	47	49	79	1.8	0.0

Table 20 Night-Time Predicted Rail Traffic Noise - Wallerawang-Gwabegar Rail Line - South of Airly

Distance to Receiver	Total Without Project dBA			Total With Project dBA			Increase in Noise Levels dB	
	LAeq(9hour)		LAmax	LAeq(9hour)		LAmax	LAeq(9hour)	
	Average	Peak		Average	Peak		Average	Peak
11	59	**63**	**91**	**61**	**63**	**91**	1.8	0.0
25	56	59	**87**	57	59	**87**	1.8	0.0
50	52	56	84	54	56	84	1.8	0.0
100	49	53	81	51	53	81	1.8	0.0
150	48	52	79	49	52	79	1.8	0.0

The following assessments are derived from the predicted rail noise levels south of Airly:

- A comparison of the existing and proposed operating average rail movements indicates that average $L_{Aeq(15hour)}$ and $L_{Aeq(9hour)}$ noise levels would increase by up to 1.8 dB.
- No increase in peak $L_{Aeq(15hour)}$ or $L_{Aeq(9hour)}$ noise levels is predicted.
- The proposed operating average and peak $L_{Aeq(15hour)}$ noise levels meets the 65 dBA criterion at all receivers on the Wallerawang-Gwabegar Rail line.
- The proposed operating average $L_{Aeq(9hour)}$ noise level meets the 60 dBA criterion at a distance of 14 m (and greater).
- The proposed operating peak $L_{Aeq(9hour)}$ would remain unchanged due to the Project and would continue to meet the 60 dBA criterion at a distance of 23 m (and greater).
- The existing and proposed/operating maximum pass-by noise level would remain unchanged due to the Project and would continue to meet the criterion of 85 dBA at a distance of 41 m (and greater).
- In all instances the predicted increase in noise levels due to the Project is less than 2 dB.

7.3.2 Wallerawang-Gwabegar Rail Line - North of Airly

Predicted rail noise levels at the offset distance to the nearest receiver north of Airly for one train load per day (i.e two movements during the day or night period) are provided in **Table 21**.

Table 21 Predicted Rail Traffic Noise Levels - Wallerawang-Gwabegar between Airly and Charbon

Distance to Wallerawang-Gwabegar rail line	Predicted Noise Levels dBA			Trigger Levels dBA		
	Day $L_{Aeq(15hour)}$	Night $L_{Aeq(9hour)}$	Passby L_{Amax}	Day $L_{Aeq(15hour)}$	Night $L_{A60eq(9hour)}$	Passby L_{Amax}
50 m	43	45	83	65	60	85

Rail noise levels from the Project are predicted to be below the trigger levels at all receiver locations north of Airly, and would not change as a result of the Project.

8 Offsite Road Traffic Noise

Access to Airly Mine is via an access road off Glen Davis Road. Glen Davis Road meets the Castlereagh Highway at Capertee.

As part of the Project it is proposed to increase staff at the Airly Mine from the approved 155 FTE personnel to 200 FTE personnel. The additional 45 staff would equate to an additional 12 hourly vehicle movements across shifts and as such an additional 12 arrival trips and 12 departure trips before/after each shift.

Existing road traffic counts have been conducted on the surrounding network November and December of 2018. The existing and Project related traffic flows on the road network are provided in **Table 22**.

Table 22 Existing and Project Related Traffic Volumes

Location	Time Period	Existing Traffic Flows	Additional Project Related Traffic Flows	Total
Castlereagh Highway - East of Glen Davis Road	Day	2191	66[1]	2257
	Night	283	16[1]	299
Castlereagh Highway - West of Glen Davis Road	Day	2072	66[1]	2138
	Night	233	16[1]	249
Glen Davis Road - South of Airly Mine Entrance	Day - Peak Hourly Movements	40	12	52
	Night - Peak Hourly Movements	38	12	50

Note 1: This conservatively assumes that all Project traffic travels to Airly Mine on the Castlereagh Highway via the east or west of Glen Davis Road.

Based upon the expected road traffic movements presented in **Table 22**, **Table 23** contains a summary of the results of the road traffic noise assessment for Glen Davis Road at the nearest receiver located approximately 170 m from the roadway.

Table 23 Glen Davis Road Traffic Noise Assessment

Location	Period	Existing Road Traffic Noise Level - $L_{Aeq(1hour)}$	Predicted Road Traffic Noise Level - including Project $L_{Aeq(1hour)}$	Assessment Criteria $L_{Aeq(1hour)}$
Glen Davis Road - 170m from Roadway	Day	47 dBA	48 dBA	$L_{Aeq(1hour)}$ 55 dBA
	Night	48 dBA	49 dBA	$L_{Aeq(1hour)}$ 50 dBA

As presented in **Table 23** the road traffic noise levels from the existing and proposed traffic volumes comply with the RNP noise criteria at the nearest affected receivers on Glen Davis Road during the day and night-time periods.

Additional traffic due to the Project on the Castlereagh Highway equates to an increase in traffic volumes of up to 3% during the daytime and 7% during the night time. This would lead to a minor increase noise levels on the Castlereagh Highway of up to 0.1 dB during the daytime and 0.3 dB during the night-time period. Hence, the increase in traffic noise arising from the Project is predicted to be less than 2 dB. In accordance with the RNP, in assessing feasible and reasonable mitigation measures, an increase of up to 2 dB represents a minor impact that is considered barely perceptible to the average person.

9 Underground Blasting Assessment

In the case that rock dykes or other geological structures are identified in underground mining areas, they may require removal in order to continue mining. The use of explosives may be required to dislodge and fracture the rocky material to enable its extraction and removal. To achieve this, holes would be drilled into the rock in a designed pattern giving strict attention to their angle, depth and spacing. These holes are then filled with an explosive charge and initiated with the aid of primers and detonators. The detonation of holes would be delayed in a pre-designed sequence to ensure that holes are fired in quick succession. A delayed firing technique improves the efficiency of the blast and also reduces its environmental impacts.

As the blasting would be conducted underground, airblast pressure would propagate from the blast location through the underground workings where it would eventually exit through openings to the surface such as ventilation shafts and the portal. The airblast level would attenuate as it travels through the underground workings and is likely to have no adverse impacts at the nearest sensitive receivers. As such the impact of airblast from underground blasting has not been considered as part of this assessment.

9.1 Blasting Assessment Criteria

9.1.1 Australian Standards

Australian Standard (AS) 2187: *Part 2-2006 Explosives - Storage and Use - Part 2: Use of Explosives* (AS 2187), provides guidance in assessing blast-induced ground (and structural) vibration and airblast overpressure effects on buildings and their occupants, with details are presented in Appendix J of AS 2187.

Recommended vibration limits are based on international standards (or studies) as presented in Appendix J, Tables J4.5(A) and J4.5(B) of AS 2187, for human comfort and structural building damage respectively. Similarly, recommended human comfort and structural damage airblast overpressure limits are presented in Appendix J, Tables J5.4(A) and J5.4(B) AS 2187, respectively.

9.1.2 Human Comfort Ground Vibration

Ground vibration levels which cause human discomfort are lower than recommended structural damage limits. Therefore, compliance with the lowest applicable human comfort criteria generally ensures that the potential to cause structural damage is negligible. The EPA currently adopts the ANZEC Technical Basis for Guidelines to Minimise Annoyance due to Blasting Overpressure and Ground Vibration dated September 1990 for assessing potential annoyance from blasting during daytime hours, as follows:

- The recommended maximum for ground vibration is a Peak Vector Sum (PVS) vibration velocity of 5mm/s. It is recommended however, that 2mm/s PVS be considered the long-term regulatory goal for the control of ground vibration.
- The ground vibration level of 5mm/s (PVS) may be exceeded on up to 5% of the total number of blasts over a period of 12 months. The level should not exceed 10mm/s (PVS) at any time.

9.1.3 Building Damage Vibration Criteria

The applicable building damage vibration criteria AS 2187: Part 2-2006 Appendix J, Table J4.5(B) is derived from British Standard 7385: Part 2-1993 Evaluation and Measurement for Vibration in Buildings Part 2 - Guideline to damage levels from ground-borne vibration. The standard sets guideline values for building vibration based on the lowest vibration levels above which damage has been credibly demonstrated. These levels have been established to give a minimum risk of vibration induced damage, where “minimum risk” for a named effect is usually taken as equating to a 95% probability of no effect.

Sources of vibration which are considered in the standard include blasting (carried out during mineral extraction or construction excavation), demolition, piling, ground treatments (e.g. compaction), construction equipment, tunnelling, road and rail traffic and industrial machinery.

The recommended limits (guide values) for transient vibration to ensure minimal risk of cosmetic damage to residential and industrial buildings are presented numerically in **Table 24**.

Table 24 Transient Vibration Guide Values - Minimal Risk of Cosmetic Damage

Type of Building	Vibration PCPV[1] in Frequency Range of Predominant Pulse	
	4 to 15 Hz	15 Hz and Above
Reinforced of framed structures - Industrial and heavy commercial buildings	50 mm/s at 4 Hz and above	
Unreinforced or light framed structures - Residential or light commercial type buildings	15 mm/s at 4 Hz increasing to 20 mm/s at 15 Hz	20 mm/s at 15 Hz increasing to 50 mm/s at 40 Hz and above

1. Peak Component Particle Velocity

The standard goes on to state that minor damage is possible at vibration magnitudes which are greater than twice those given in **Table 24** and major damage to a building structure may occur at vibration magnitudes greater than four times the tabulated values. It is noteworthy that additional to the guide values nominated in **Table 24**, the standard states that:

> *Some data suggests that the probability of damage tends towards zero at 12.5 mm/s peak component particle velocity. This is not inconsistent with an extensive review of the case history information available in the UK.*

Also that:

> *A building of historical value should not (unless it is structurally unsound) be assumed to be more sensitive.*

Based on the foregoing, a conservative vibration (PCPV) damage assessment criterion of 12.5mm/s would be applicable to all privately-owned residences in the vicinity of the Project.

9.1.4 Infrastructure Vibration Damage Criteria

Infrastructure located outside or within the underground mining footprint includes a telecommunications tower and associated telecommunications cable as well as roads and tracks. Accordingly, consideration has been given to potential vibration effects on such infrastructure.

The German Standard DIN 4150-3:2016 Vibrations in Buildings Part 3: Effects on Structures (Section 5.2) provides guideline values for evaluating the effect of short term vibration on massive structural components and underground structures. The values are based on the assumption that the structures have been manufactured and applied using current technology. Based on the guideline values, the recommended short term vibration assessment criteria to ensure minimal risk of damage are:

- The telecommunications tower is assumed to comprise mainly of steel and similar materials. ACARP report C14057 "Effect of blasting on infrastructure" recommends 100 mm/s for transmission line steel towers. However given that other sensitive telecommunications infrastructure would be associated with the tower a vibration (PCPV) damage assessment criterion of 50 mm/s has been adopted.
- Roadway and track infrastructure (i.e culverts and abutments) comprise mainly reinforced concrete and similar materials and a vibration (PCPV) damage assessment criterion of 80mm/s would be applicable.
- Based on similar projects, a vibration (PCPV) damage criterion of 50mm/s has been adopted for the assessment of the telecommunications cable.

9.1.5 Archaeological/Geological Vibration Damage Criteria

There are no regulatory criteria nominated in Australia for the assessment of damage to archaeological/geological structures from vibration. Research, however, has been undertaken by the United States (US) Army Corps of Engineers into the effects of large surface blasts on the dynamic stability of nearby unlined tunnels of various diameters in sandstone and granite (Blast Vibration Monitoring and Control [Dowding, 1985]). The results of the research indicated that intermittent rock fall or observable damage was not observed until vibration levels exceeded 460 mm/s.

This assessment therefore adopts a conservative safe blast design vibration criterion of 250 mm/s (5% exceedance) as being applicable to archaeological/geological structures and Aboriginal heritage sites (i.e. rock shelters or the like), if present.

9.2 Blasting Vibration Assessment - Generalised Safe Working Distances

In the absence of field data it is possible to predict ground vibration using generic site law models established in accordance with AS 2187: Part 2-2006 Appendix J Section J7.3. The charge weight scaling law for ground vibration is:

$$PPV = \mathrm{K}\left(\frac{\mathrm{D}}{\sqrt{\mathrm{m}}}\right)^{-1.6}$$

Where:

PPV = Peak Particle Velocity (mm/s)
m = Maximum Instantaneous Charge mass (kilogram [kg] MIC)
D = Distance (m)
K = Site constant

The K value is dependent on the blast interface and the type of rock the blast is being transferred to. A K factor of 1869 has been used to predict the 5% exceedance ground vibration level based on the geological structure to be blasted consisting of a free face of hard or highly structure rock.

The generalised predicted ground vibration level safe working distances from typical MIC blast designs for vibration sensitive locations is provided in **Table 25**.

Table 25 Generalised Safe Working Distances

Vibration Receiver	Safe Working Distances (m) 5% Blast Vibration Exceedance Level			
	5 kg MIC	10 kg MIC	15 kg MIC	20 kg MIC
Residential Receiver 5 mm/s	91	129	158	182
Historical Sensitive/Heritage 12.5 mm/s	52	73	89	103
Telecommunications Tower and cable 50 mm/s	22	31	38	43
Roadway (culvert) Vibration 80 mm/s	17	23	28	33
Archaeological/Geological Structure Vibration 250 mm/s	8	12	14	16

It is recommended that should blasting be required for the Project approaching these calculated safe working distances, vibration monitoring be conducted to ensure compliance with relevant criteria, and validate the blasting predictions presented above.

10 Conclusion

Operational noise predictions indicate that noise levels from the Project will be below relevant project trigger noise levels and SSD 5581 criteria at all privately owned residential assessment locations under standard and noise enhancing meteorological conditions.

Operational noise levels are also predicted to comply with the relevant project trigger noise levels and SSD 5581 criteria at Airly Gap and the Nissen Hut. Cumulative impacts are predicted to be negligible at all identified receivers.

The L_{Amax} noise levels are predicted to be below the sleep disturbance noise levels under standard and noise enhancing meteorological conditions at all privately owned residential receptors.

A comparison of the existing and proposed operating average rail movements indicates that average $L_{Aeq(15hour)}$ and $L_{Aeq(9hour)}$ noise levels would increase by up to 1.8 dB on the Wallerawang-Gwabegar Railway between Airly Mine and Wallerawang. The proposed operating average and peak $L_{Aeq(15hour)}$ noise levels meets the 65 dBA criterion at all receivers on the Wallerawang-Gwabegar Rail line, with the proposed operating average $L_{Aeq(9hour)}$ noise level meeting the 60 dBA criterion at a distance of 14 m (and greater). The existing and proposed/operating maximum pass-by noise level would remain unchanged due to the Project and would continue to meet the criterion of 85 dBA at a distance of 41 m (and greater).

Rail noise levels from the Project are predicted to be below the trigger levels at all receiver locations on the Wallerawang-Gwabegar Railway north of Airly, and would not change as a result of the Project.

Road traffic noise levels from the existing and proposed traffic volumes comply with the RNP noise criteria at the nearest affected receiver on Glen Davis Road during the day and night-time periods. Additional traffic due to the Project on the Castlereagh Highway equates to an increase of less than 2 dB which, in accordance with the RNP, represents a minor impact that is considered barely perceptible.

Minimum safe blasting distances have been recommended from vibration sensitive locations to remain within the recommended vibration criteria.

Should blasting be required for the Project approaching the minimum safe working distances, vibration monitoring would be conducted to validate predicted vibration levels.

APPENDIX A

Acoustic Terminology

1. Sound Level or Noise Level

The terms 'sound' and 'noise' are almost interchangeable, except that 'noise' often refers to unwanted sound.

Sound (or noise) consists of minute fluctuations in atmospheric pressure. The human ear responds to changes in sound pressure over a very wide range with the loudest sound pressure to which the human ear can respond being ten million times greater than the softest. The decibel (abbreviated as dB) scale reduces this ratio to a more manageable size by the use of logarithms.

The symbols SPL, L or LP are commonly used to represent Sound Pressure Level. The symbol LA represents A-weighted Sound Pressure Level. The standard reference unit for Sound Pressure Levels expressed in decibels is 2 x 10^{-5} Pa.

2. 'A' Weighted Sound Pressure Level

The overall level of a sound is usually expressed in terms of dBA, which is measured using a sound level meter with an 'A-weighting' filter. This is an electronic filter having a frequency response corresponding approximately to that of human hearing.

People's hearing is most sensitive to sounds at mid frequencies (500 Hz to 4,000 Hz), and less sensitive at lower and higher frequencies. Different sources having the same dBA level generally sound about equally loud.

A change of 1 dB or 2 dB in the level of a sound is difficult for most people to detect, whilst a 3 dB to 5 dB change corresponds to a small but noticeable change in loudness. A 10 dB change corresponds to an approximate doubling or halving in loudness. The table below lists examples of typical noise levels.

Sound Pressure Level (dBA)	Typical Source	Subjective Evaluation
130	Threshold of pain	Intolerable
120	Heavy rock concert	Extremely noisy
110	Grinding on steel	
100	Loud car horn at 3 m	Very noisy
90	Construction site with pneumatic hammering	
80	Kerbside of busy street	Loud
70	Loud radio or television	
60	Department store	Moderate to quiet
50	General Office	
40	Inside private office	Quiet to very quiet
30	Inside bedroom	
20	Recording studio	Almost silent

Other weightings (eg B, C and D) are less commonly used than A-weighting. Sound Levels measured without any weighting are referred to as 'linear', and the units are expressed as dB(lin) or dB.

3. Sound Power Level

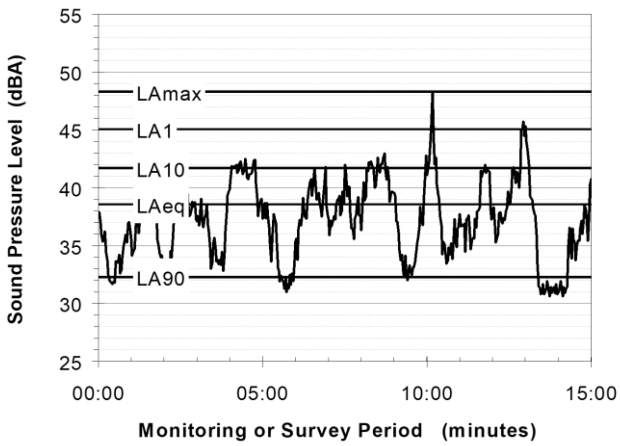
The Sound Power of a source is the rate at which it emits acoustic energy. As with Sound Pressure Levels, Sound Power Levels are expressed in decibel units (dB or dBA), but may be identified by the symbols SWL or LW, or by the reference unit 10^{-12} W.

The relationship between Sound Power and Sound Pressure is similar to the effect of an electric radiator, which is characterised by a power rating but has an effect on the surrounding environment that can be measured in terms of a different parameter, temperature.

4. Statistical Noise Levels

Sounds that vary in level over time, such as road traffic noise and most community noise, are commonly described in terms of the statistical exceedance levels LAN, where LAN is the A-weighted sound pressure level exceeded for N% of a given measurement period. For example, the LA1 is the noise level exceeded for 1% of the time, LA10 the noise exceeded for 10% of the time, and so on.

The following figure presents a hypothetical 15 minute noise survey, illustrating various common statistical indices of interest.



Of particular relevance, are:

LA1 The noise level exceeded for 1% of the 15 minute interval.

LA10 The noise level exceeded for 10% of the 15 minute interval. This is commonly referred to as the average maximum noise level.

LA90 The noise level exceeded for 90% of the sample period. This noise level is described as the average minimum background sound level (in the absence of the source under consideration), or simply the background level.

LAeq The A-weighted equivalent noise level (basically, the average noise level). It is defined as the steady sound level that contains the same amount of acoustical energy as the corresponding time-varying sound.

5. Frequency Analysis

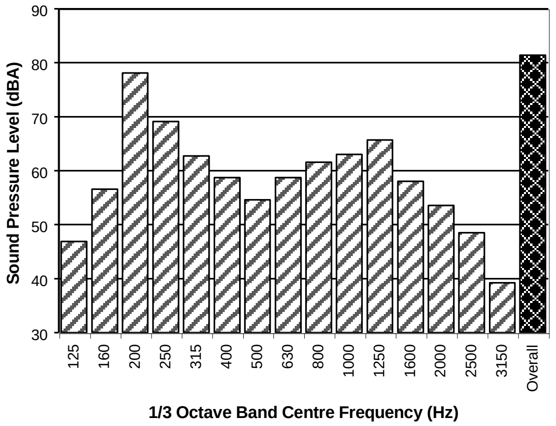
Frequency analysis is the process used to examine the tones (or frequency components) which make up the overall noise or vibration signal.

The units for frequency are Hertz (Hz), which represent the number of cycles per second.

Frequency analysis can be in:

- Octave bands (where the centre frequency and width of each band is double the previous band)
- 1/3 octave bands (three bands in each octave band)
- Narrow band (where the spectrum is divided into 400 or more bands of equal width)

The following figure shows a 1/3 octave band frequency analysis where the noise is dominated by the 200 Hz band. Note that the indicated level of each individual band is less than the overall level, which is the logarithmic sum of the bands.



6. Annoying Noise (Special Audible Characteristics)

A louder noise will generally be more annoying to nearby receivers than a quieter one. However, noise is often also found to be more annoying and result in larger impacts where the following characteristics are apparent:

- **Tonality** - tonal noise contains one or more prominent tones (ie differences in distinct frequency components between adjoining octave or 1/3 octave bands), and is normally regarded as more annoying than 'broad band' noise.
- **Impulsiveness** - an impulsive noise is characterised by one or more short sharp peaks in the time domain, such as occurs during hammering.
- **Intermittency** - intermittent noise varies in level with the change in level being clearly audible. An example would include mechanical plant cycling on and off.
- **Low Frequency Noise** - low frequency noise contains significant energy in the lower frequency bands, which are typically taken to be in the 10 to 160 Hz region.

7. Vibration

Vibration may be defined as cyclic or transient motion. This motion can be measured in terms of its displacement, velocity or acceleration. Most assessments of human response to vibration or the risk of damage to buildings use measurements of vibration velocity. These may be expressed in terms of 'peak' velocity or 'rms' velocity.

The former is the maximum instantaneous velocity, without any averaging, and is sometimes referred to as 'peak particle velocity', or PPV. The latter incorporates 'root mean squared' averaging over some defined time period.

Vibration measurements may be carried out in a single axis or alternatively as triaxial measurements (ie vertical, longitudinal and transverse).

The common units for velocity are millimetres per second (mm/s). As with noise, decibel units can also be used, in which case the reference level should always be stated. A vibration level V, expressed in mm/s can be converted to decibels by the formula 20 log (V/Vo), where Vo is the reference level (10^{-9} m/s). Care is required in this regard, as other reference levels may be used.

8. Human Perception of Vibration

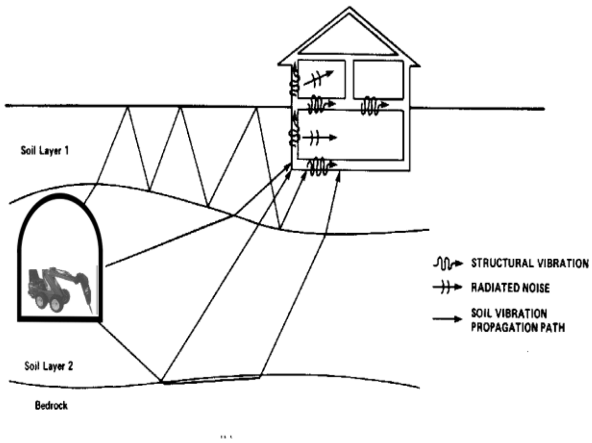
People are able to 'feel' vibration at levels lower than those required to cause even superficial damage to the most susceptible classes of building (even though they may not be disturbed by the motion). An individual's perception of motion or response to vibration depends very strongly on previous experience and expectations, and on other connotations associated with the perceived source of the vibration. For example, the vibration that a person responds to as 'normal' in a car, bus or train is considerably higher than what is perceived as 'normal' in a shop, office or dwelling.

9. Ground-borne Noise, Structure-borne Noise and Regenerated Noise

Noise that propagates through a structure as vibration and is radiated by vibrating wall and floor surfaces is termed 'structure-borne noise', 'ground-borne noise' or 'regenerated noise'. This noise originates as vibration and propagates between the source and receiver through the ground and/or building structural elements, rather than through the air.

Typical sources of ground-borne or structure-borne noise include tunnelling works, underground railways, excavation plant (eg rockbreakers), and building services plant (eg fans, compressors and generators).

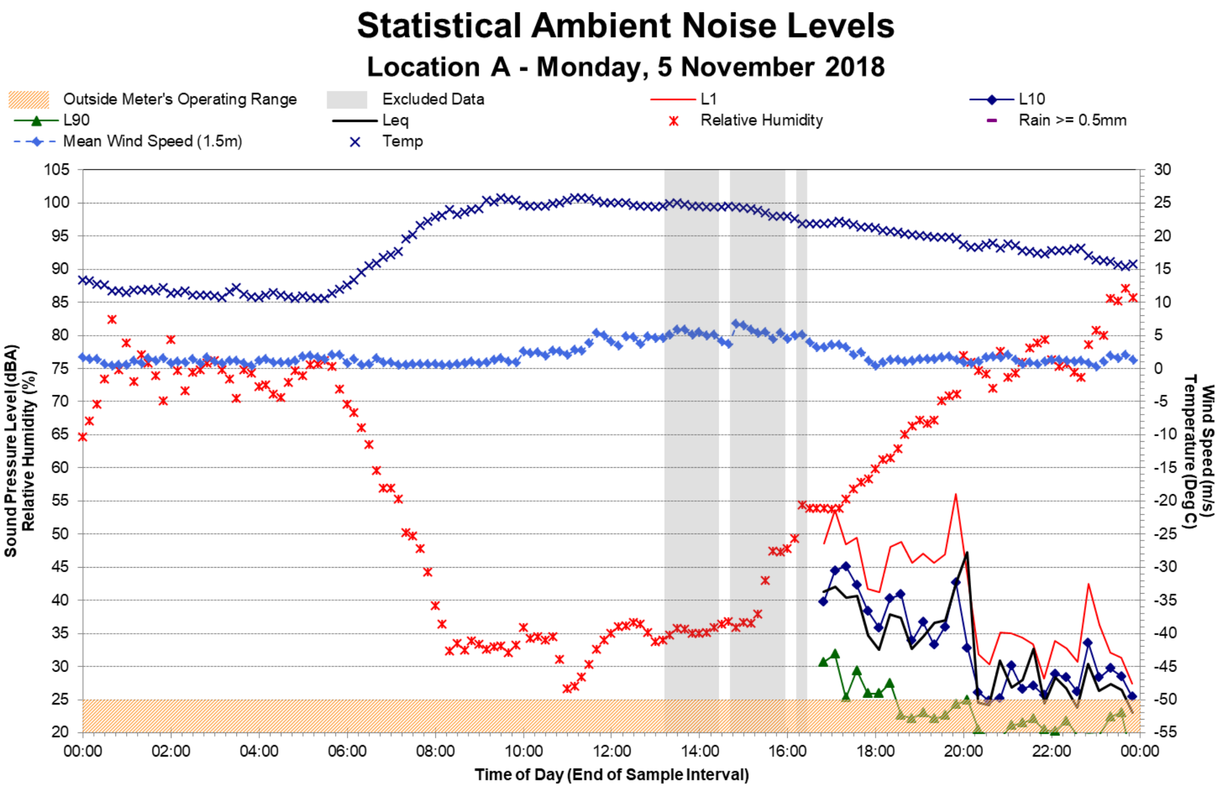
The following figure presents an example of the various paths by which vibration and ground-borne noise may be transmitted between a source and receiver for construction activities occurring within a tunnel.



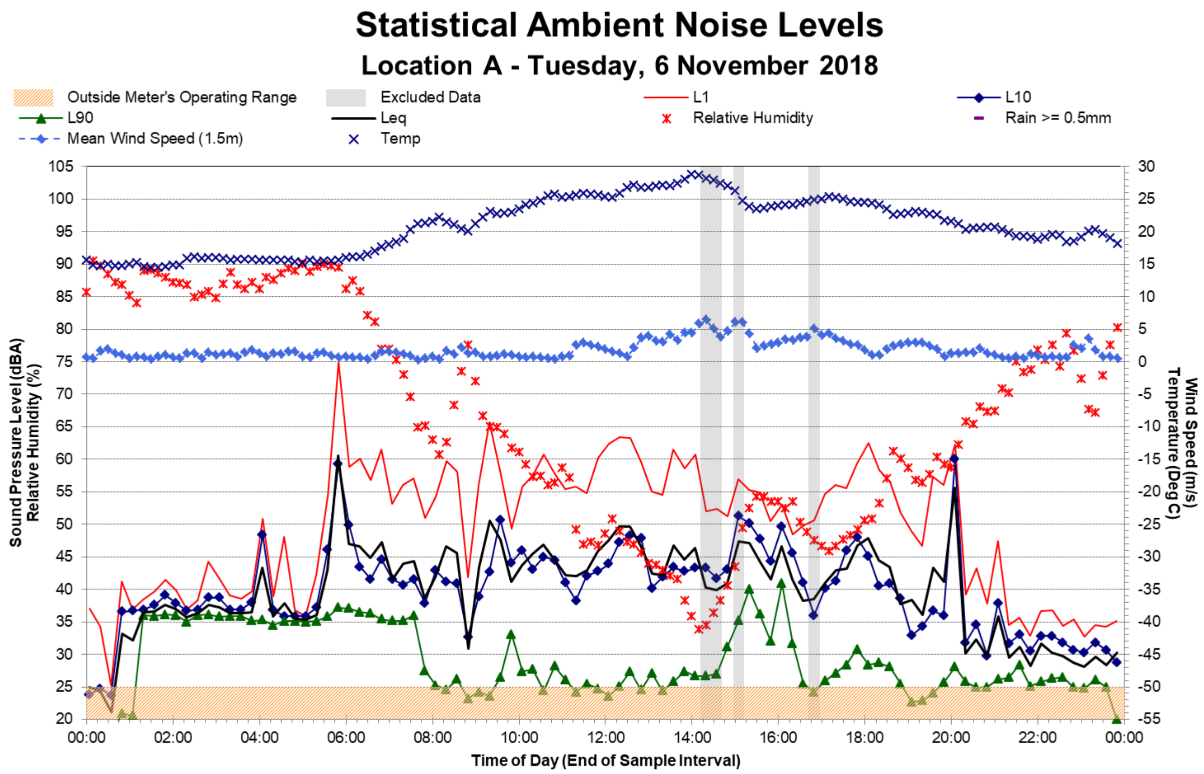
The term 'regenerated noise' is also used in other instances where energy is converted to noise away from the primary source. One example would be a fan blowing air through a discharge grill. The fan is the energy source and primary noise source. Additional noise may be created by the aerodynamic effect of the discharge grill in the airstream. This secondary noise is referred to as regenerated noise.

APPENDIX B

Statistical Ambient Noise Levels



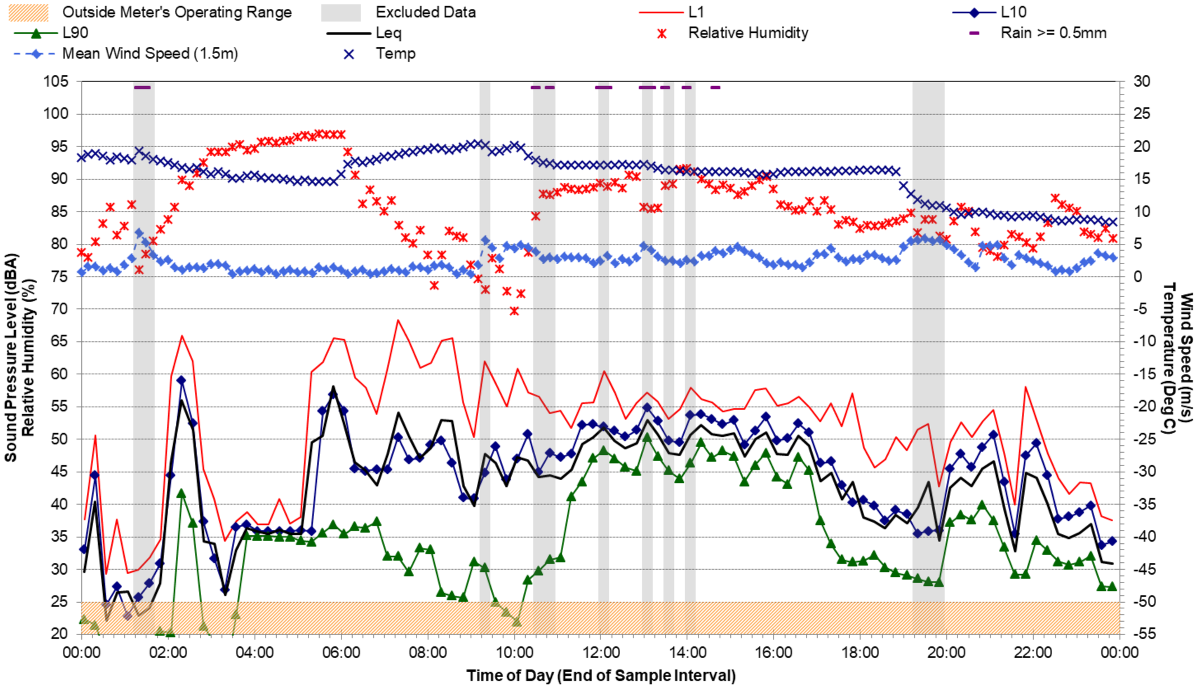
Statistical Ambient Noise Levels
Location A - Monday, 5 November 2018
Outside Meter's Operating Range
Excluded Data
L1
L10
L90
Leq
Relative Humidity
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Temp
Sound Pressure Level (dBA)
Relative Humidity (%)
Wind Speed (m/s)
Temperature (Deg C)
Time of Day (End of Sample Interval)



Statistical Ambient Noise Levels
Location A - Tuesday, 6 November 2018
Outside Meter's Operating Range
Excluded Data
L1
L10
L90
Leq
Relative Humidity
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Temp
Sound Pressure Level (dBA)
Relative Humidity (%)
Wind Speed (m/s)
Temperature (Deg C)
Time of Day (End of Sample Interval)

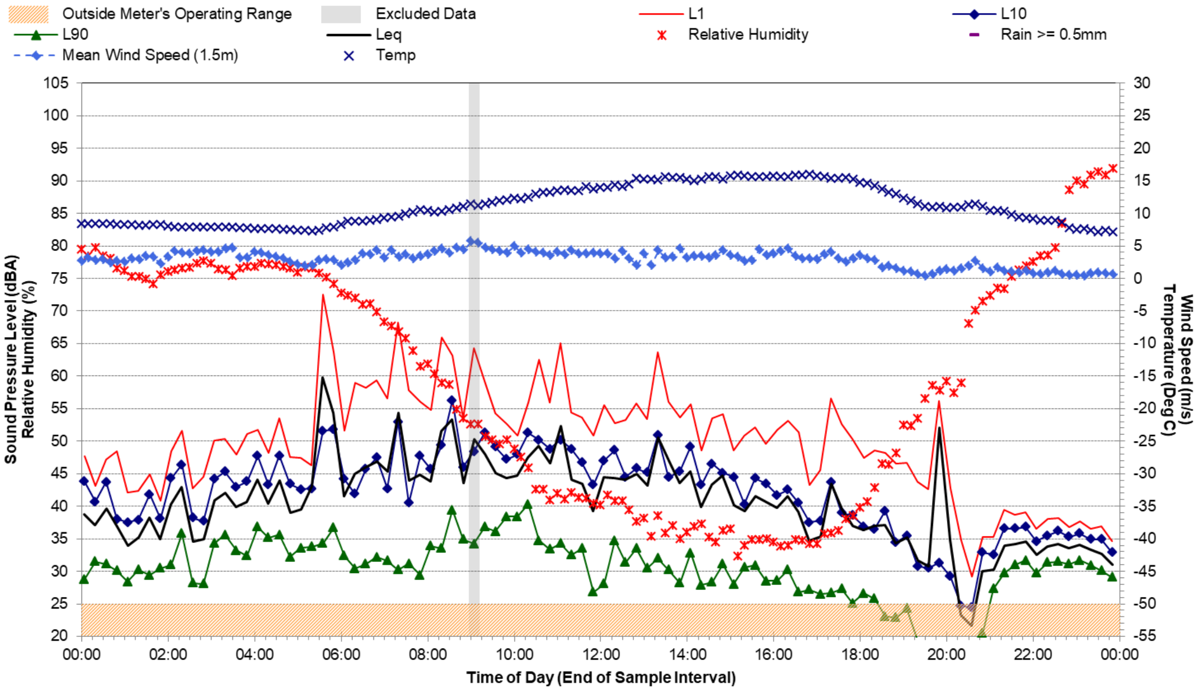
Statistical Ambient Noise Levels

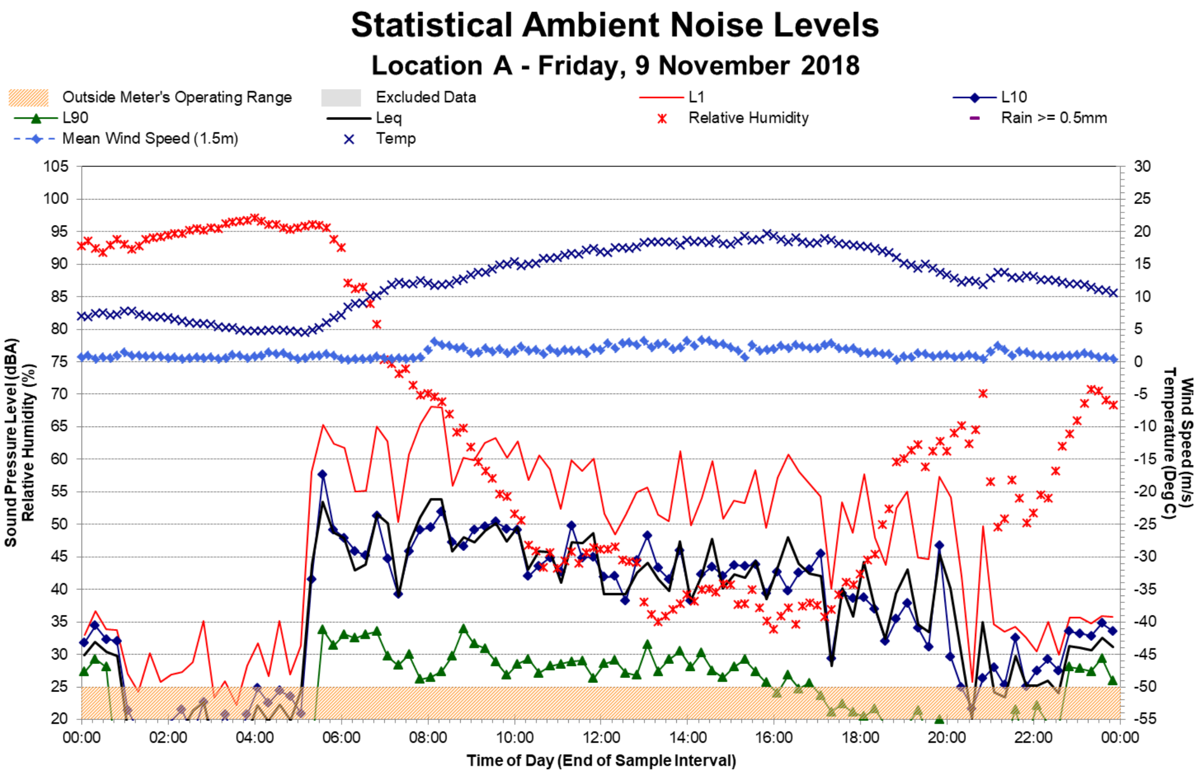
Location A - Wednesday, 7 November 2018



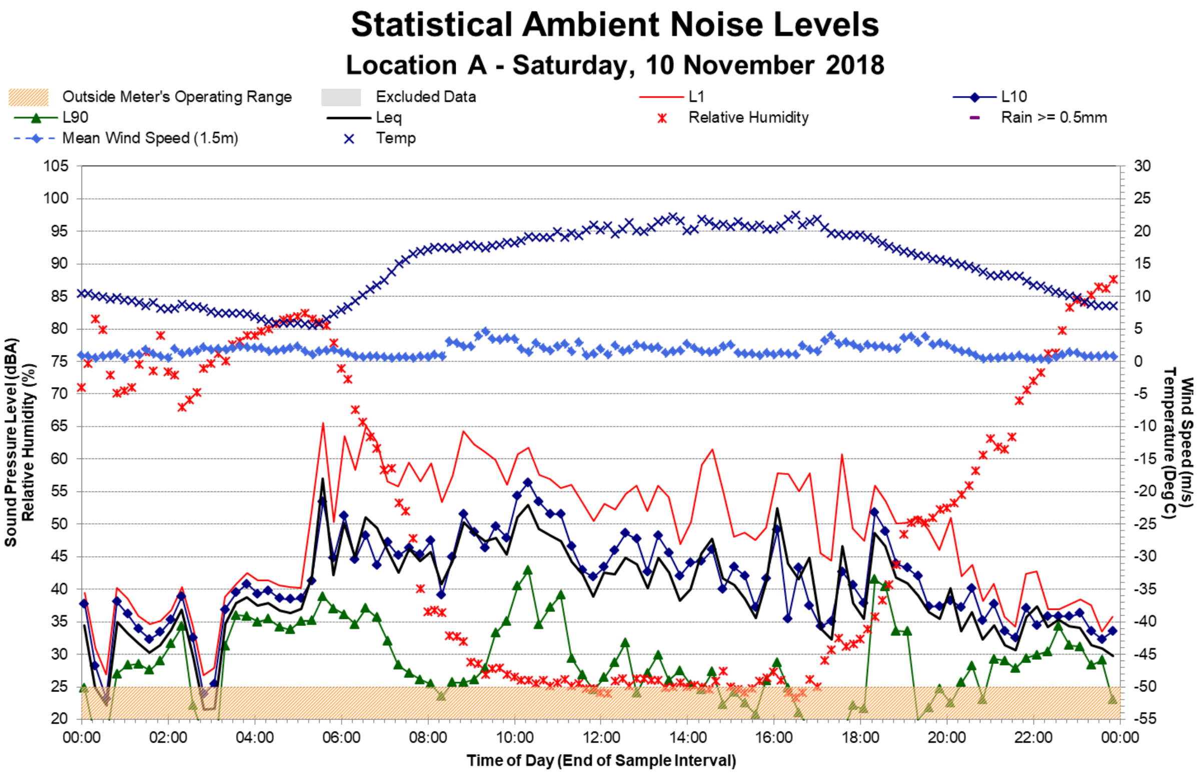
Statistical Ambient Noise Levels

Location A - Thursday, 8 November 2018

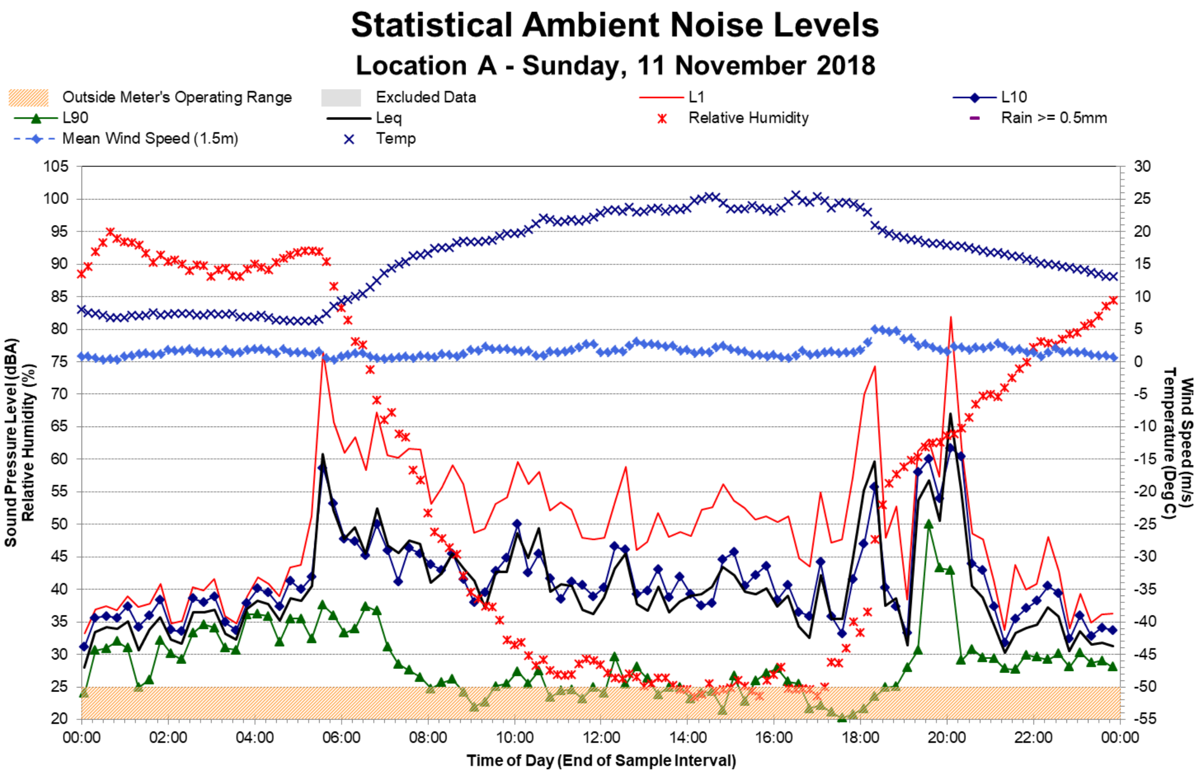




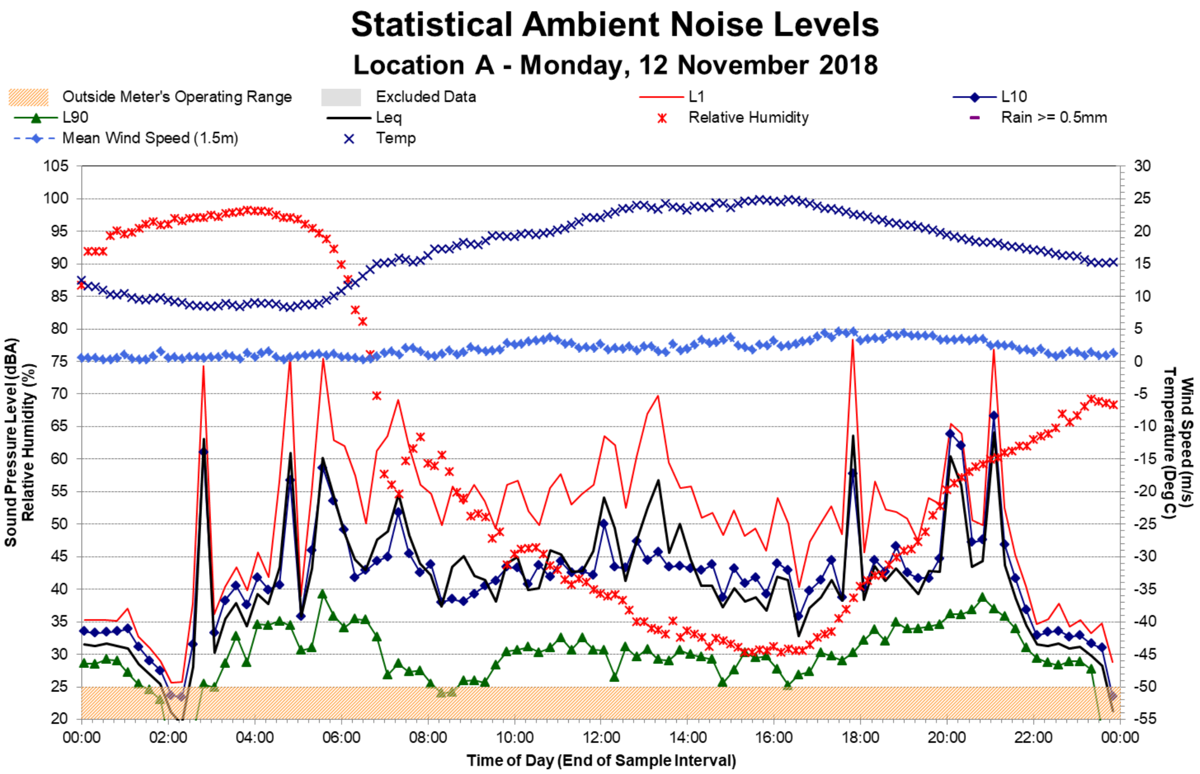
Statistical Ambient Noise Levels
Location A - Friday, 9 November 2018
Outside Meter's Operating Range
Excluded Data
L1
L10
L90
Leq
Relative Humidity
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Temp
Sound Pressure Level (dBA)
Relative Humidity (%)
Wind Speed (m/s)
Temperature (Deg C)
Time of Day (End of Sample Interval)



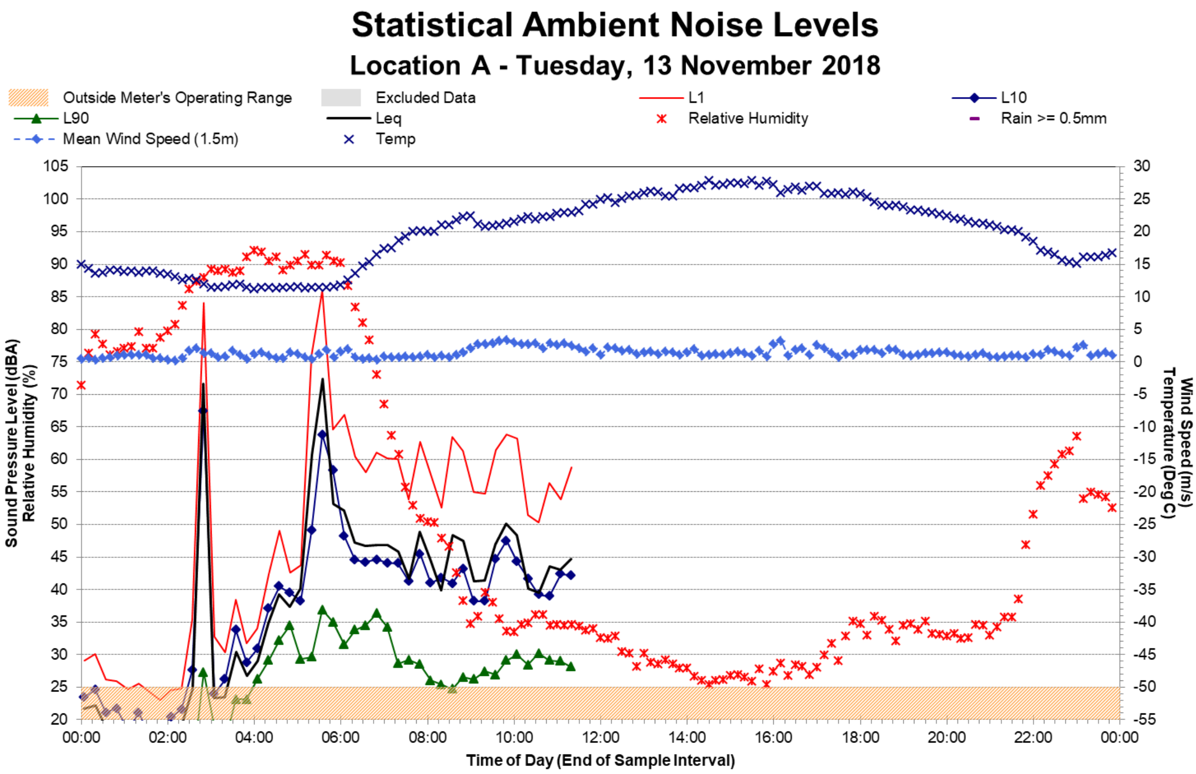
Statistical Ambient Noise Levels
Location A - Saturday, 10 November 2018
Outside Meter's Operating Range
Excluded Data
L1
L10
L90
Leq
Relative Humidity
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Temp
Sound Pressure Level (dBA)
Relative Humidity (%)
Wind Speed (m/s)
Temperature (Deg C)
Time of Day (End of Sample Interval)

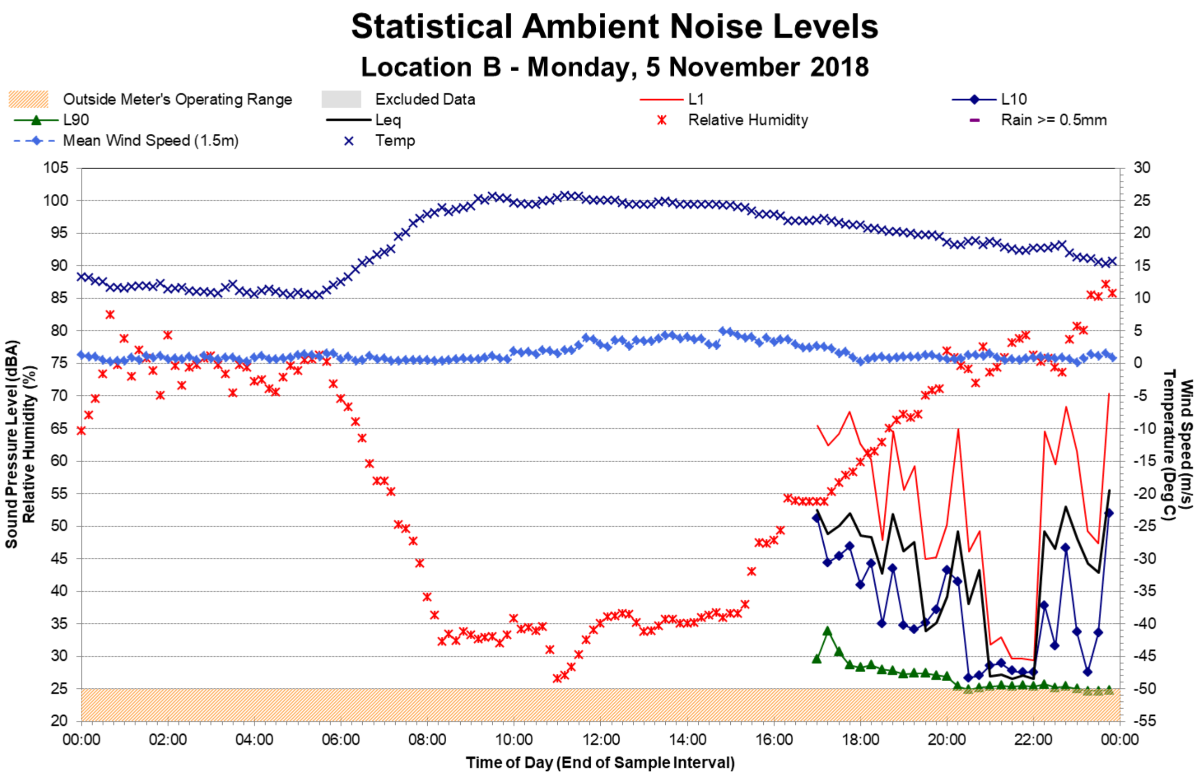


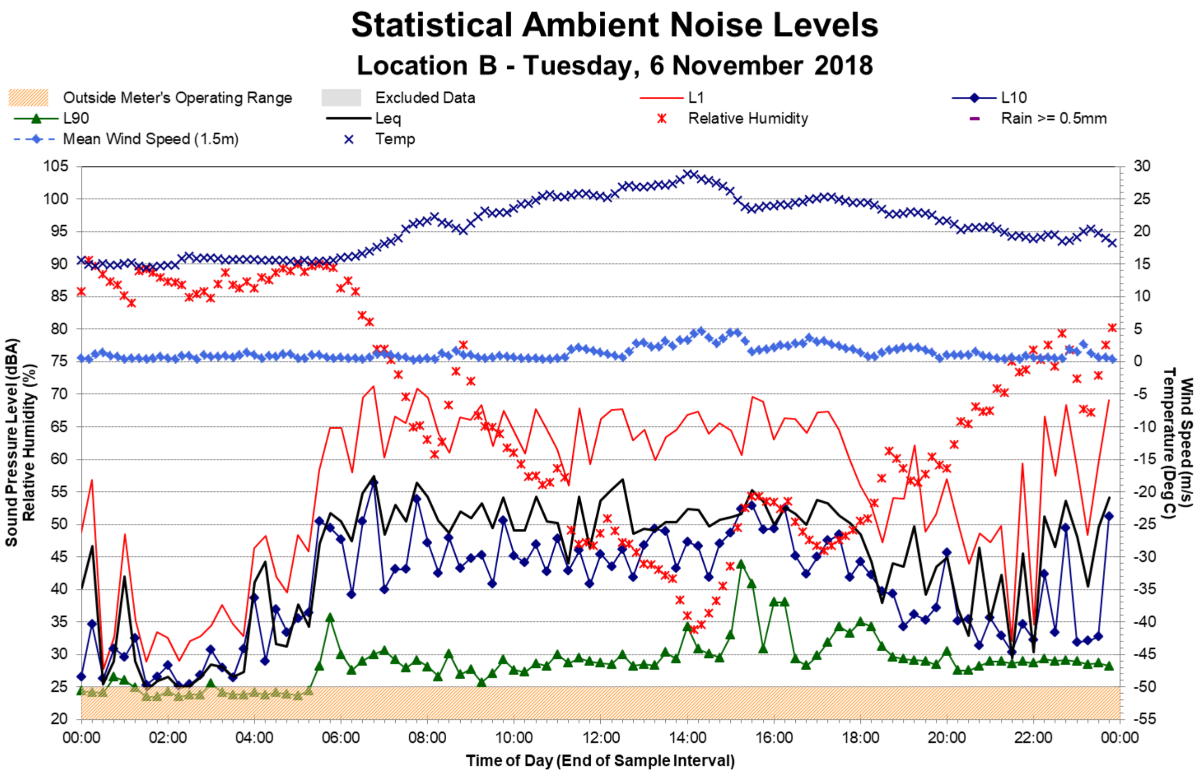
Statistical Ambient Noise Levels
Location A - Sunday, 11 November 2018
Outside Meter's Operating Range
Excluded Data
L1
L10
L90
Leq
Relative Humidity
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Temp
Sound Pressure Level (dBA)
Relative Humidity (%)
Wind Speed (m/s)
Temperature (Deg C)
Time of Day (End of Sample Interval)



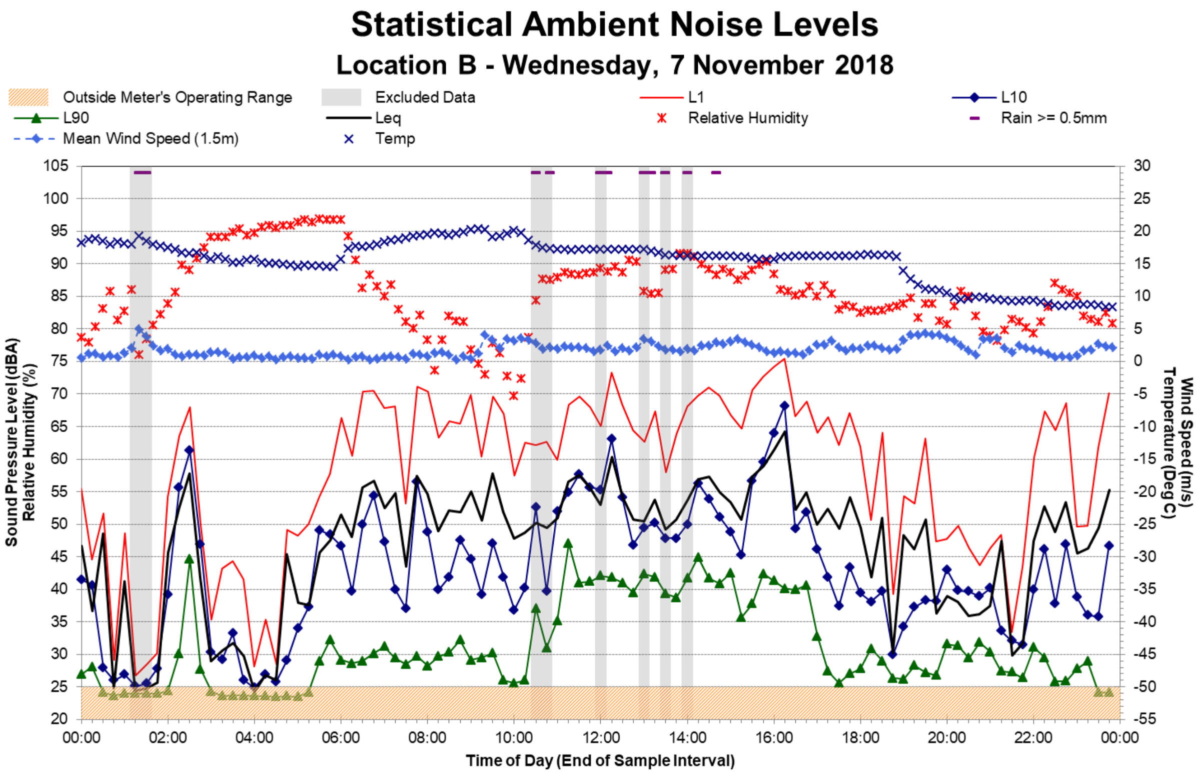
Statistical Ambient Noise Levels
Location A - Monday, 12 November 2018
Outside Meter's Operating Range
Excluded Data
L1
L10
L90
Leq
Relative Humidity
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Temp
Sound Pressure Level (dBA)
Relative Humidity (%)
Wind Speed (m/s)
Temperature (Deg C)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
Location A - Tuesday, 13 November 2018
Outside Meter's Operating Range
Excluded Data
L1
L10
L90
Leq
Relative Humidity
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Temp
Sound Pressure Level (dBA)
Relative Humidity (%)
Wind Speed (m/s)
Temperature (Deg C)
Time of Day (End of Sample Interval)

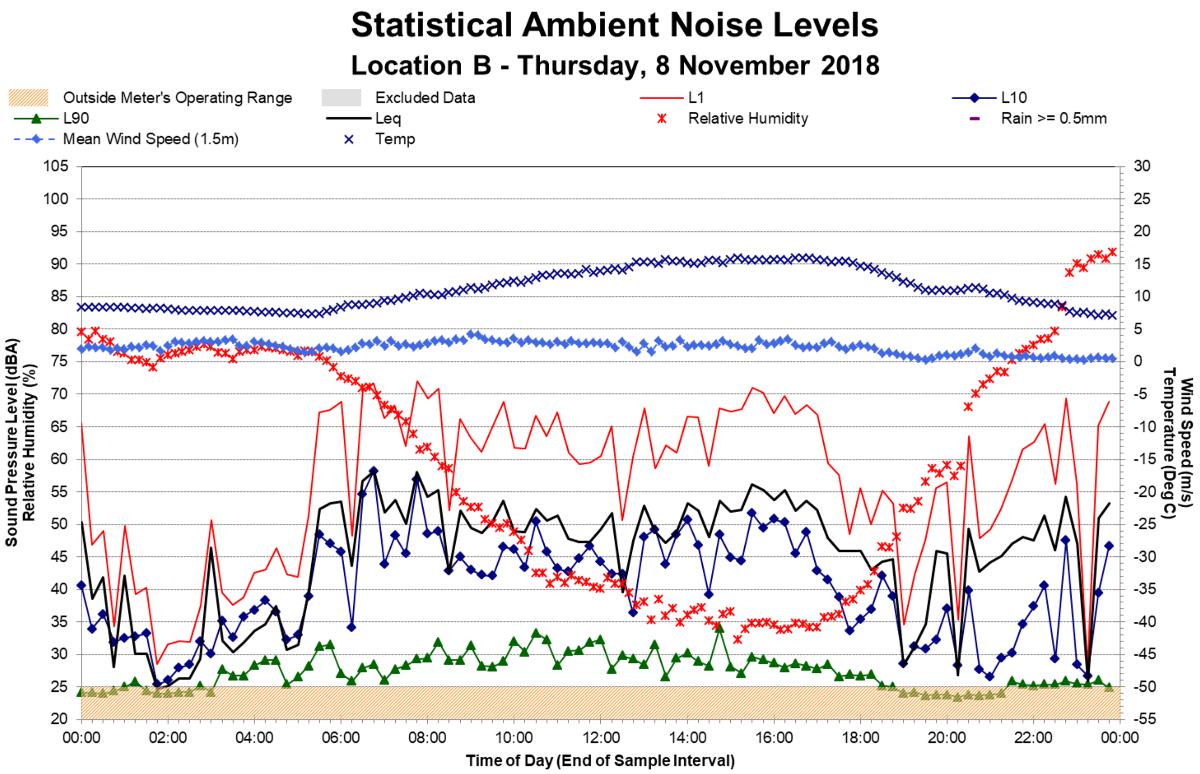

Statistical Ambient Noise Levels
Location B - Monday, 5 November 2018
Outside Meter's Operating Range
Excluded Data
L1
L10
L90
Leq
Relative Humidity
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Temp
Sound Pressure Level (dBA)
Relative Humidity (%)
Wind Speed (m/s)
Temperature (Deg C)
Time of Day (End of Sample Interval)

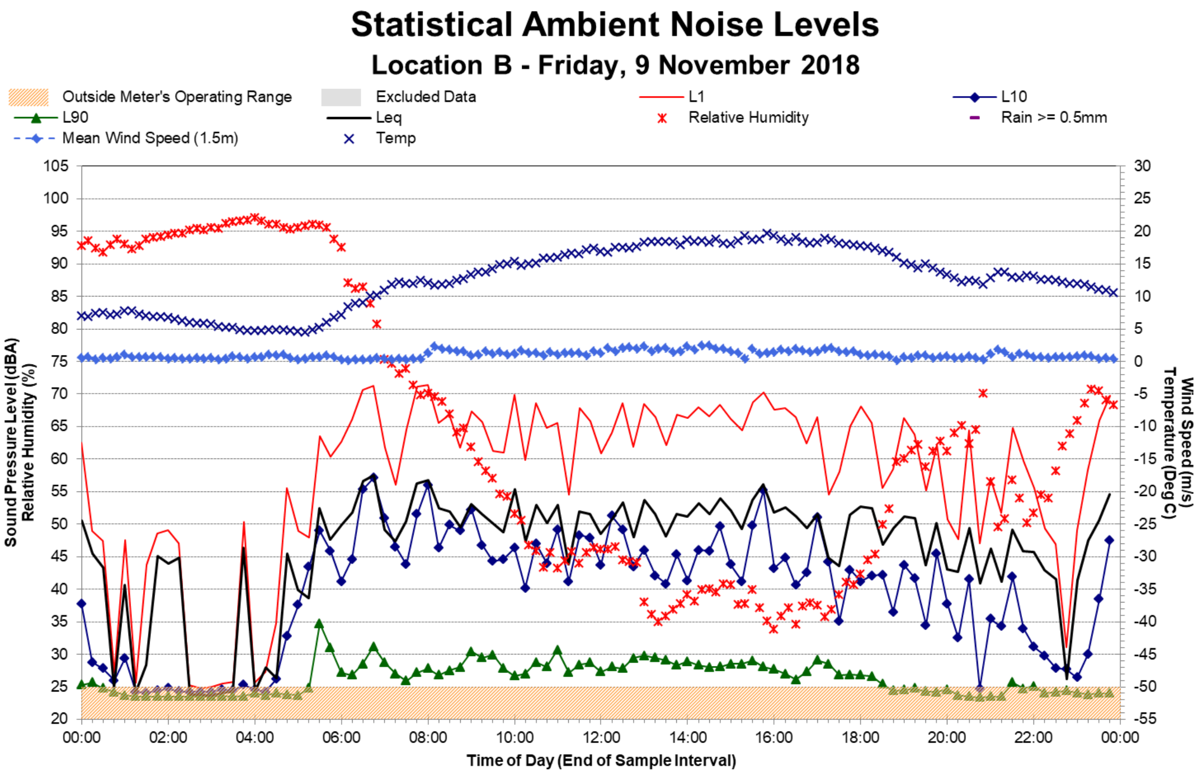


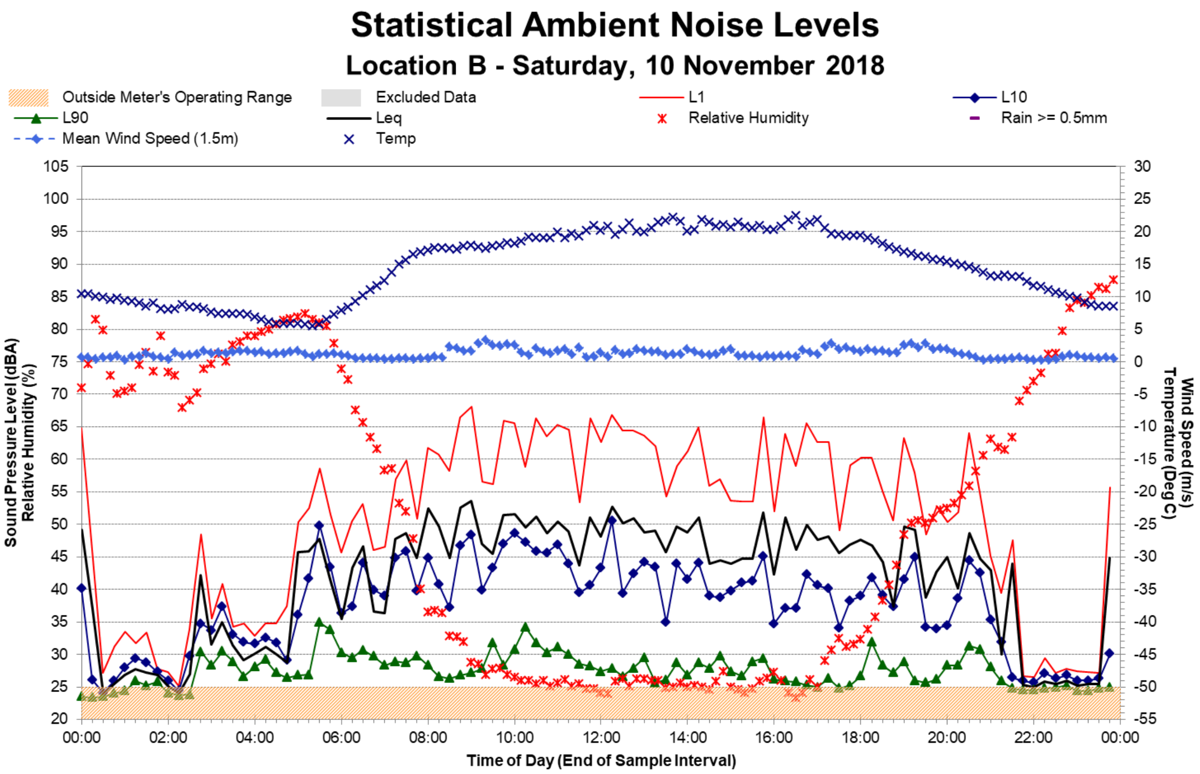
Statistical Ambient Noise Levels
Location B - Tuesday, 6 November 2018
Outside Meter's Operating Range
Excluded Data
L1
L10
L90
Leq
Relative Humidity
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Temp
Sound Pressure Level (dBA)
Relative Humidity (%)
Wind Speed (m/s)
Temperature (Deg C)
Time of Day (End of Sample Interval)



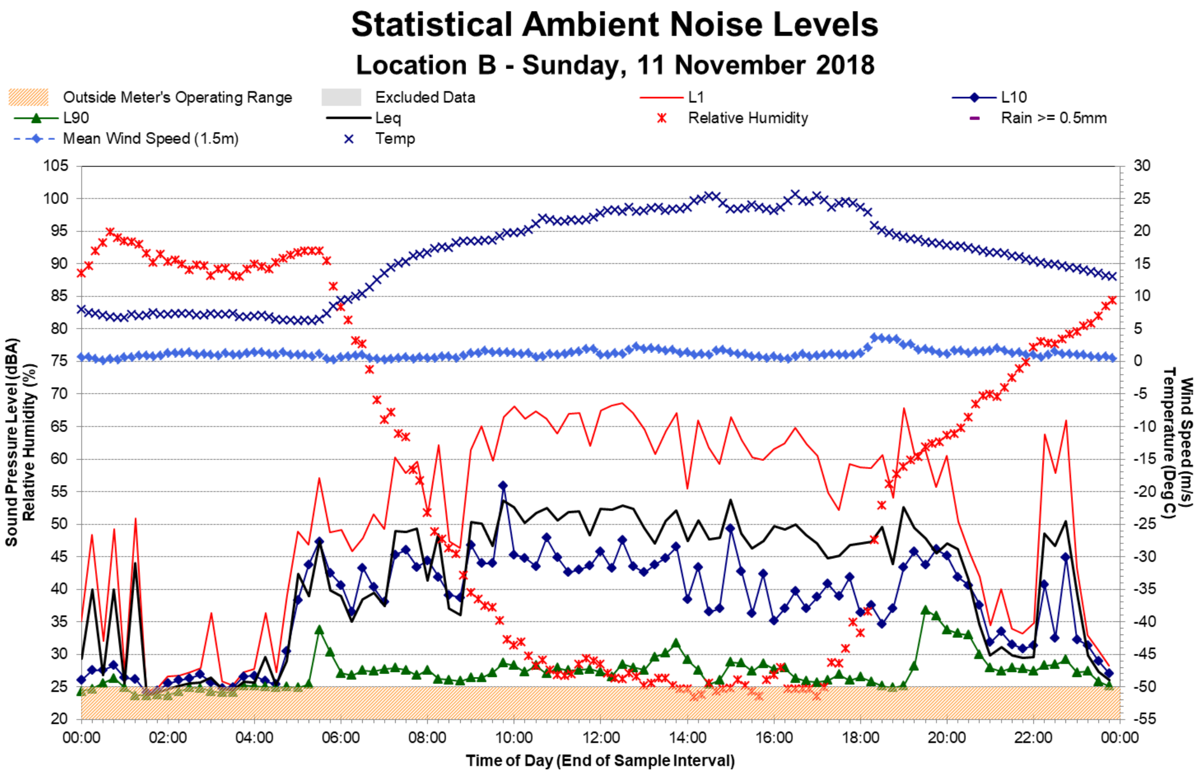
Statistical Ambient Noise Levels
Location B - Wednesday, 7 November 2018
Outside Meter's Operating Range
Excluded Data
L1
L10
L90
Leq
Relative Humidity
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Temp
Sound Pressure Level (dBA)
Relative Humidity (%)
Wind Speed (m/s)
Temperature (Deg C)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
Location B - Thursday, 8 November 2018
Outside Meter's Operating Range
Excluded Data
L1
L10
L90
Leq
Relative Humidity
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Temp
Sound Pressure Level (dBA)
Relative Humidity (%)
Wind Speed (m/s)
Temperature (Deg C)
Time of Day (End of Sample Interval)

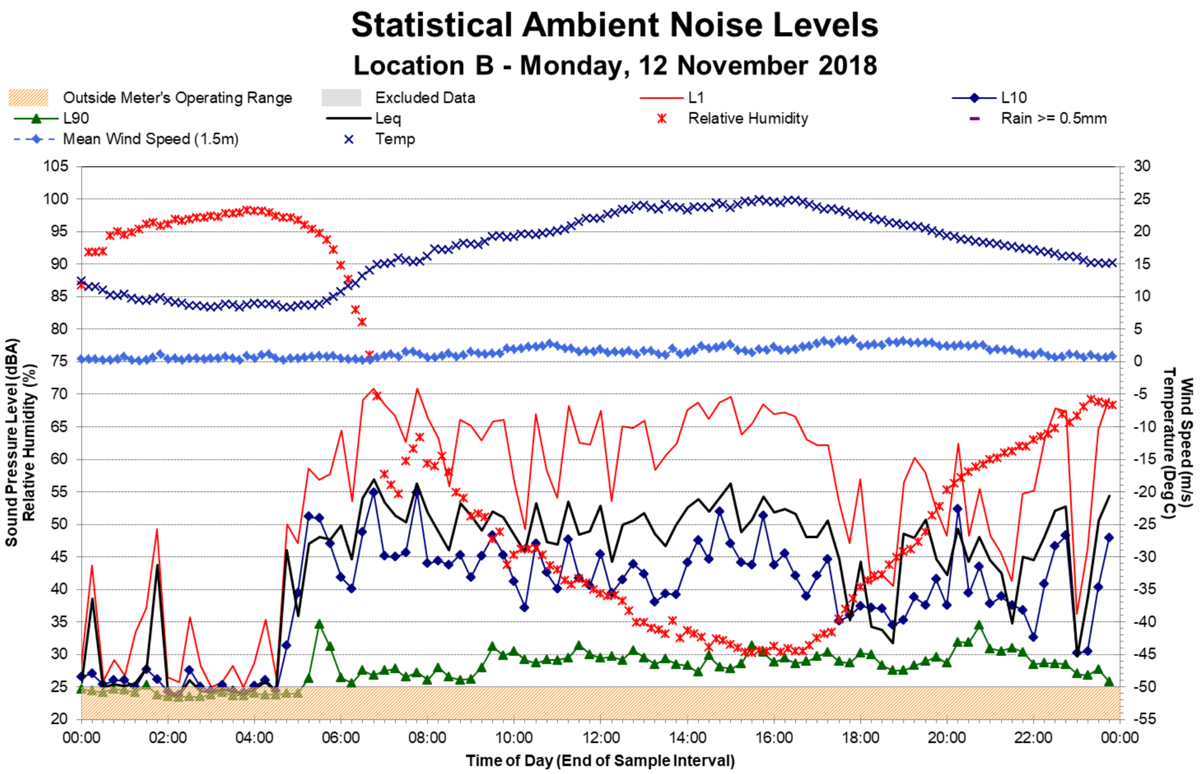

Statistical Ambient Noise Levels
Location B - Friday, 9 November 2018
Outside Meter's Operating Range
Excluded Data
L1
L10
L90
Leq
Relative Humidity
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Temp
Sound Pressure Level (dBA)
Relative Humidity (%)
Wind Speed (m/s)
Temperature (Deg C)
Time of Day (End of Sample Interval)

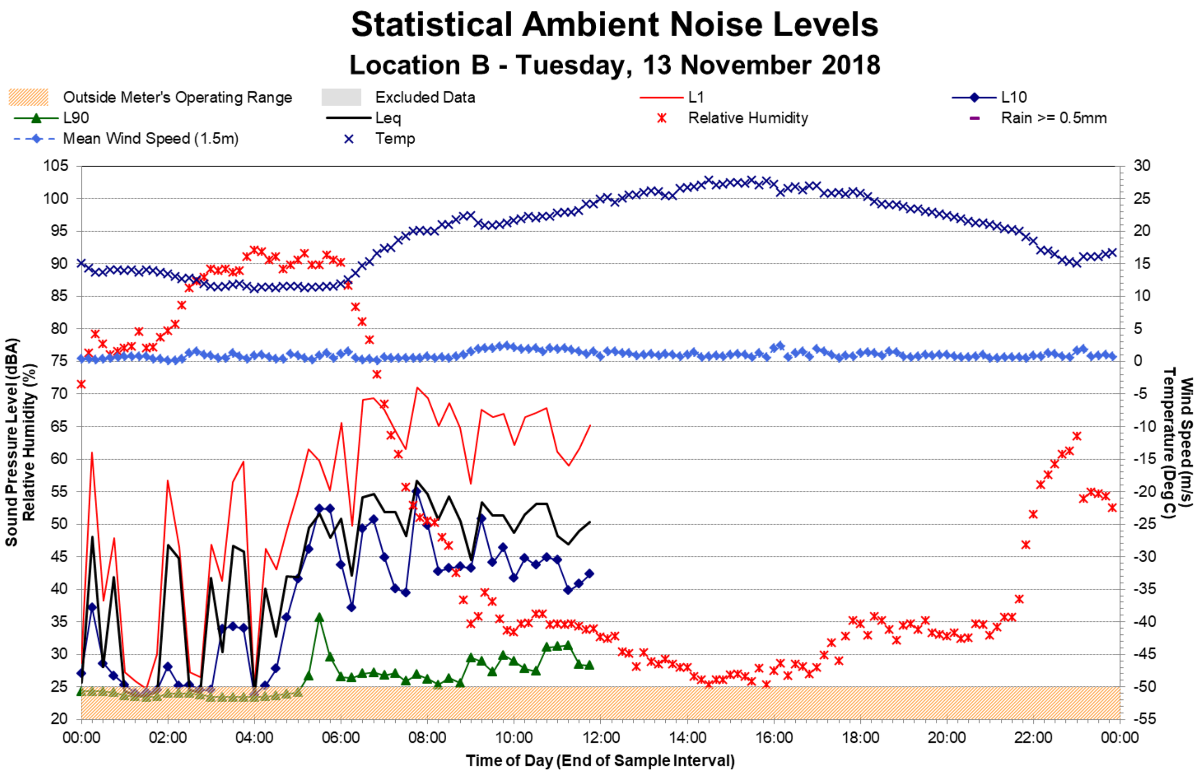


Statistical Ambient Noise Levels
Location B - Saturday, 10 November 2018
Outside Meter's Operating Range
Excluded Data
L1
L10
L90
Leq
Relative Humidity
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Temp
Sound Pressure Level (dBA)
Relative Humidity (%)
Wind Speed (m/s)
Temperature (Deg C)
Time of Day (End of Sample Interval)



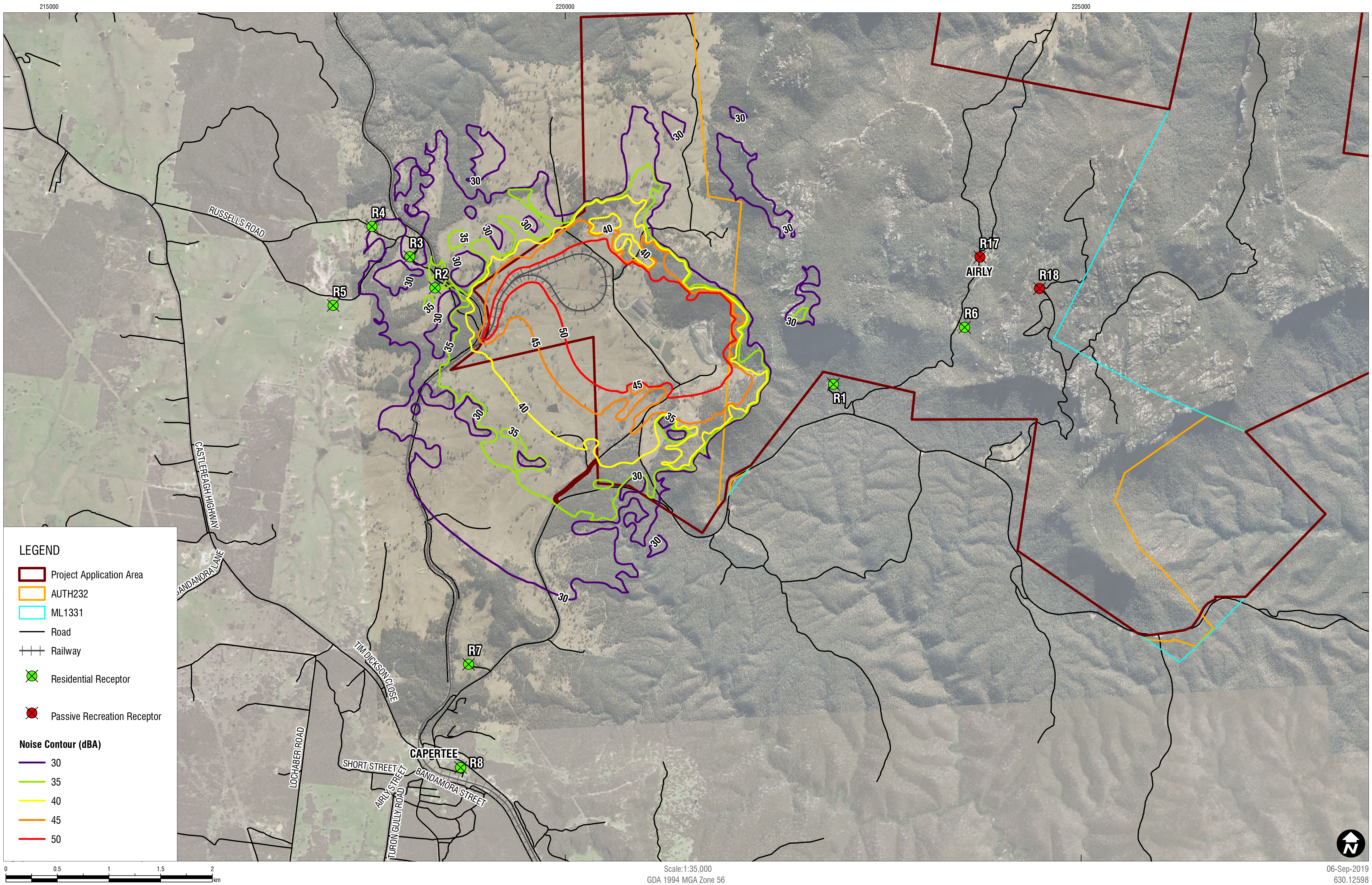
Statistical Ambient Noise Levels
Location B - Sunday, 11 November 2018
Outside Meter's Operating Range
Excluded Data
L1
L10
L90
Leq
Relative Humidity
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Temp
Sound Pressure Level (dBA)
Relative Humidity (%)
Wind Speed (m/s)
Temperature (Deg C)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
Location B - Monday, 12 November 2018
Outside Meter's Operating Range
Excluded Data
L1
L10
L90
Leq
Relative Humidity
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Temp
Sound Pressure Level (dBA)
Relative Humidity (%)
Wind Speed (m/s)
Temperature (Deg C)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
Location B - Tuesday, 13 November 2018
Outside Meter's Operating Range
Excluded Data
L1
L10
L90
Leq
Relative Humidity
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Temp
Sound Pressure Level (dBA)
Relative Humidity (%)
Wind Speed (m/s)
Temperature (Deg C)
Time of Day (End of Sample Interval)

APPENDIX C

Outer Envelope Noise Contour Map



Sheet Size : A3

SLR

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Outer Envelope Noise Contour Map

APPENDIX C

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Air Quality Impact Assessment &
Greenhouse Gas Assessment

APPENDIX – K

AIRLY MINE

Air Quality Impact Assessment and Greenhouse Gas Assessment

Prepared for:

Centennial Airly Pty Ltd
Glen Davis Road
CAPERTEE NSW 2846

SLR Ref: 610.18385-R01
Version No: -v2.0
August 2019

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BASIS OF REPORT

This report has been prepared by SLR Consulting Australia Pty Ltd with all reasonable skill, care and diligence, and taking account of the timescale and resources allocated to it by agreement with Centennial Airly Pty Ltd (the Client). Information reported herein is based on the interpretation of data collected, which has been accepted in good faith as being accurate and valid.

This report is for the exclusive use of the Client. No warranties or guarantees are expressed or should be inferred by any third parties. This report may not be relied upon by other parties without written consent from SLR

SLR disclaims any responsibility to the Client and others in respect of any matters outside the agreed scope of the work.

DOCUMENT CONTROL

Reference	Date	Prepared	Checked	Authorised
610.18385-R01-v2.0	30 August 2019	Varun Marwaha	Kirsten Lawrence	Kirsten Lawrence
610.18385-R01-v1.1	3 May 2019	Varun Marwaha	Kirsten Lawrence	Kirsten Lawrence
610.18385-R01-v1.0	24 April 2019	Varun Marwaha	Kirsten Lawrence	Kirsten Lawrence

CONTENTS

CONTENTS

CONTENTS

DOCUMENT REFERENCES

TABLES

CONTENTS

FIGURES

APPENDICES

ABBREVIATIONS

%	percent
°C	degrees Celsius
µg	microgram
$\mu g/m^3$	microgram per cubic metre of air
µm	micrometre or micron
AHD	Australian Height Datum
AP-42	US EPA Emission Factor Handbook
AQIA	Air Quality Impact Assessment
AQMS	Air Quality Monitoring Station
Centennial Airly Pty Ltd	Centennial Airly
Centennial Coal Company	Centennial
CH_4	methane
CO	carbon monoxide
CO_2	carbon dioxide
CPP	coal preparation plant
DDG	dust deposition gauge
EETM	Emission Estimation Technique Manual
EF	Emission Factor
EIS	Environmental Impact Statement
EPA	Environment Protection Authority
FEL	front-end loader
FTE	full-time equivalent
g	gram
GHG	Greenhouse Gas
g/m^2/month	grams per square metre per month
ha	hectare
kg	kilogram
kg/hr	kilogram per hour
km	kilometre
m	metre
M	million
m/s	metre per second
m^2	square metre
m^3	cubic metre
min	minute
mm	millimetre
Mt	million tonnes

ABBREVIATIONS

Mtpa	million tonnes per annum
NEPC	National Environment Protection Council
NEPM	National Environment Protection Measure
NPI	National Pollutant Inventory (Australia)
NSW	New South Wales
OEH	NSW Office of Environment and Heritage
PM_{10}	particulate matter with an equivalent aerodynamic diameter of 10 microns or less
$PM_{2.5}$	particulate matter with an equivalent aerodynamic diameter of 2.5 microns or less
PAA	Project Application Area
REA	Reject Emplacement Area
ROM	run of mine
SSD	State Significant Development
t	tonne
tpa	tonnes per annum
TSP	total suspended particulate matter
US EPA	United States Environmental Protection Agency
UTM	Universal Transverse Mercator
WCS	Western Coal Services

GLOSSARY

air dispersion model	A computer-based software program which provides a mathematical prediction of how pollutants from a source will be distributed in the surrounding area under specific conditions of wind, temperature, humidity and other environmental factors
ambient	Pertaining to the surrounding environment or prevailing conditions
atmosphere	A gaseous mass surrounding the planet Earth that is retained by Earth's gravity. It is divided into five layers. Most of the weather and clouds are found in the first layer
atmospheric stability	The tendency of the atmosphere to resist or enhance vertical motion
background	The existing air quality in the Project area excluding the impacts from the proposed development
CALMET	A meteorological model that develops wind and temperature fields on a three-dimensional gridded modelling domain
CALPOST	A post-processor used to process CALPUFF files, producing tabulations that summarize results of the simulation for user-selected averaging periods
CALPUFF	A transport and dispersion model that advects “puffs” of material emitted from modelled sources, simulating dispersion and transformation processes
combustion	The process of thermal oxidation. A chemical change, especially oxidation, accompanied by the production of heat and light
crushers	A machine designed to reduce large rocks or coal into smaller rocks, gravel, or rock dust
dust deposition	Settling of particulate matter out of the air through gravitational effects (dry deposition) and scavenging by rain and snow (wet deposition)
dispersion	The spreading and dilution of substances emitted in a medium (e.g. air or water) through turbulence and mixing effects
diurnal	Relating to or occurring in a 24-hour period; daily
downwind	The direction in which the wind is blowing
emission factor	A measure of the amount of a specific pollutant or material emitted by a specific process, fuel, equipment, or source based on activity data such as the quantity of fuel burnt, hours of operation or quantity of raw material consumed
emissions inventory	A database that lists, by source, the amount of air pollutants discharged into the atmosphere from a facility over a set period of time (e.g. per annum, per hour)
fugitive emissions	Pollutants which escape from an industrial process due to leakage, materials handling, transfer, or storage
guideline	A general rule, principle, or piece of advice. A statement or other indication of policy or procedure by which to determine a course of action
meteorological	The science that deals with the phenomena of the atmosphere, especially weather and weather conditions
mixing height	The height to which the lower atmosphere will undergo mechanical or turbulent mixing, producing a nearly homogeneous air mass
modelling domain	The area over which the model is making predictions
particulate	Of, relating to, or formed of minute separate particles. A minute separate particle, as of a granular substance or powder
plume	A space in air, water, or soil containing pollutants released from a point source
pollutant	A substance or energy introduced into the environment that has undesired effects, or

GLOSSARY

	adversely affects the usefulness of a resource
prognostic	A prediction of the value of variables for some time in the future on the basis of the values at the current or previous times
quantitative assessment	An assessment of impacts based on estimates of emission rates and air dispersion modelling techniques to provide estimate values of ground level pollutant concentrations
receptor	Coordinate locations specified in an air dispersion model where ground level pollutant concentrations are calculated by the model
sensitive receptor	Locations such as residential dwellings, hospitals, churches, schools, recreation areas etc where people (particularly the young and elderly) may often be present, or locations with sensitive vegetation and crops
spatial variation	Pertaining to variations across an area
standard	The prescribed level of a pollutant in the outside air that should not be exceeded during a specific time period to protect public health
topography	Detailed mapping or charting of the features of a relatively small area, district, or locality
wind direction	The direction from which the wind is blowing
wind erosion	Detachment and transportation of loose topsoil or sand due to action by the wind
wind rose	A meteorological diagram depicting the distribution of wind direction and speed at a location over a period of time

1 Introduction

SLR Consulting was commissioned by Centennial Airly Pty Ltd (Centennial Airly) to undertake an Air Quality Impact Assessment (AQIA) and Greenhouse Gas (GHG) Assessment for Modification 3 (MOD 3) of the Airly Mine Extension Project (hereafter 'the Extension Project').

The Extension Project was granted State Significant Development Consent (SSD) 5581 on 15 December 2016 and allows for mining at Airly Mine for 20 years, in addition to the operation and construction of infrastructure to facilitate the receipt, handling and processing of 1.8 Million tonnes per annum (Mtpa) of coal, and transportation of this coal by rail to domestic and overseas markets. The consent SSD 5581 is due to lapse on 31 January 2037.

In addition to the current approved operations, MOD 3 involves the following modifications, relevant to potential off-site air quality impacts:

- An increase in the production rate from the approved 1.8 Mtpa to 3.0 Mtpa; and
- An increase in the movement of laden coal trains and water trains leaving the site from the approved average of 2 trains per day to 3 trains per day over any calendar year but maintaining the approved maximum 5 trains per day leaving the site on any day.

1.1 Background

SLR completed the AQIA for the Airly Mine Extension Project in April 2014 (SLR 2014, hereafter 'Extension Project AQIA'). The Extension Project AQIA presented air dispersion modelling results for four distinct scenarios:

- Scenario 1a - Existing infrastructure (1.8 Mtpa production);
- Scenario 1b - Construction of the Coal Processing Plant (CPP) and Rejects Emplacement Area (REA);
- Scenario 2 - Normal operation of approved infrastructure (1.8 Mtpa production); and
- Scenario 3 - Normal operation of proposed infrastructure (1.8 Mtpa production).

It was concluded that the predicted short term and long term TSP, PM_{10} and $PM_{2.5}$ concentrations were below the respective NSW EPA assessment criteria at all off-site sensitive receptor locations for all scenarios.

The 'Scenario 3 - normal operation of proposed infrastructure (1.8 Mtpa production)' scenario in the Extension Project AQIA was approved and adopted by Centennial Airly as the operational scenario moving forward. The AQIA presented in this report has used the 'normal operation of proposed infrastructure' scenario from the Extension Project AQIA as the basis for MOD 3, revised for an increased coal throughput of 3 Mtpa.

This current AQIA for MOD 3 references relevant information and data compiled as part of the Extension Project AQIA (SLR 2014). An overview of how the methodology used in this study relates to the methodology and inputs used in the Extension Project AQIA is provided below:

- Topographical data - Identical to the Extension Project AQIA and discussed in **Section 2.5**.
- Sensitive receptors – Identical to the Extension Project AQIA and discussed in **Section 2.6**.
- Air quality criteria – Updated air quality criteria which conform to the current State and Federal Government air quality criteria and discussed in **Section 3**.

- Emission estimation methodology and emission factors used – Some changes have been made to the emission estimation approach to be consistent with current best practice. Some emission sources have been removed from the emission inventory due to their low potential for dust generation, such as particulate emissions related to rejects handling, and discussed further in **Section 4.1**.
- Dispersion model – Identical to the Extension Project AQIA, and discussed in **Section 5.1**.
- Meteorological data – Some changes have been made to the meteorological modelling approach to be consistent with current best practice and recent meteorological modelling conducted for other Centennial operations in the region, such as the Springvale Mine and Western Coal Services (WCS). The methodology used is identical to that adopted for the Springvale Mine AQIA (SLR 2016) and WCS MOD 3 AQIA (SLR 2017) and discussed in **Section 5.2**.
- Background air quality data – Identical approach to that used in the Extension Project AQIA ie background data adopted from data monitored by Airly Mine and data from Bathurst Air Quality Monitoring Station (AQMS), however for a different year (2014), as discussed in **Section 6**.

2 Project Overview

Airly Mine is an underground coal mine operating under the provisions of the Development Consent SSD 5581, which granted approval to the Airly Mine Extension Project. The consent was granted under Section 89E of the *Environmental Planning and Assessment Act 1979* (EP&A Act) on 15 December 2016 by the Planning Assessment Commission of NSW, as delegate of the Minister of Planning.

2.1 Project Location

Airly Mine is situated approximately 40 kilometres (km) north-northwest of Lithgow and around 4 km northeast of Capertee, as shown in **Figure 1**. Access to the area is via the Castlereagh Highway to Capertee and then 3 km along the Glen Davis Road to the private access road. The Wallerawang to Kandos railway line (Wallerawang-Gwabegar rail line) is situated 3 km to the west of the pit top area.

Centennial owns Airly Mine as well as a substantial buffer zone (approximately 2,000 hectares) around the Airly Pit Top.

2.2 Approved Operations

The approved components of Airly Mine operations are:

- Extraction of up to 1.8 Mtpa of run of mine (ROM) coal from the Lithgow seam underlying the Project Application Area (PAA) for a period of 20 years.
- Operation and maintenance of existing ancillary surface infrastructure for mine access, underground ventilation, electricity, water, materials supply, and communications at the pit top, and upgrade the infrastructure as required for mining operations.
- Management and handling of ROM coal through a crusher and screening plant at the pit top for transfer to the existing and proposed stockpile areas as required to meet market demands.
- Construction of a CPP to beneficiate (wash) ROM coal.

- Construction of a life of mine rejects emplacement area (REA) for the emplacement of reject materials from the CPP and the underground mine.
- Transport of coal to domestic power stations and for the export market by rail and importation of water from Charbon Colliery, with the following restrictions:
    - All product coal is transported from the site by rail.
    - Movement of laden coal trains and water trains is restricted to:
        - No more than an average of two trains leaving the site per day over any calendar year;
        - No more than five laden trains leaving the site on any day; and
        - No more than one train is received from Charbon Colliery on any day
- Operate 24 hours per day and seven days per week.
- Provide employment to a full time workforce of 155 full time equivalent personnel, comprising 135 employees and 20 contractors.
- Progressively rehabilitate disturbed areas at the pit top no longer required for mining operations and exploration boreholes.

The CPP and the REA are approved but not yet constructed. The proposed locations of the approved infrastructure at the Airly Pit Top are shown in **Figure 2**.

Figure 1 Regional Setting of the Project

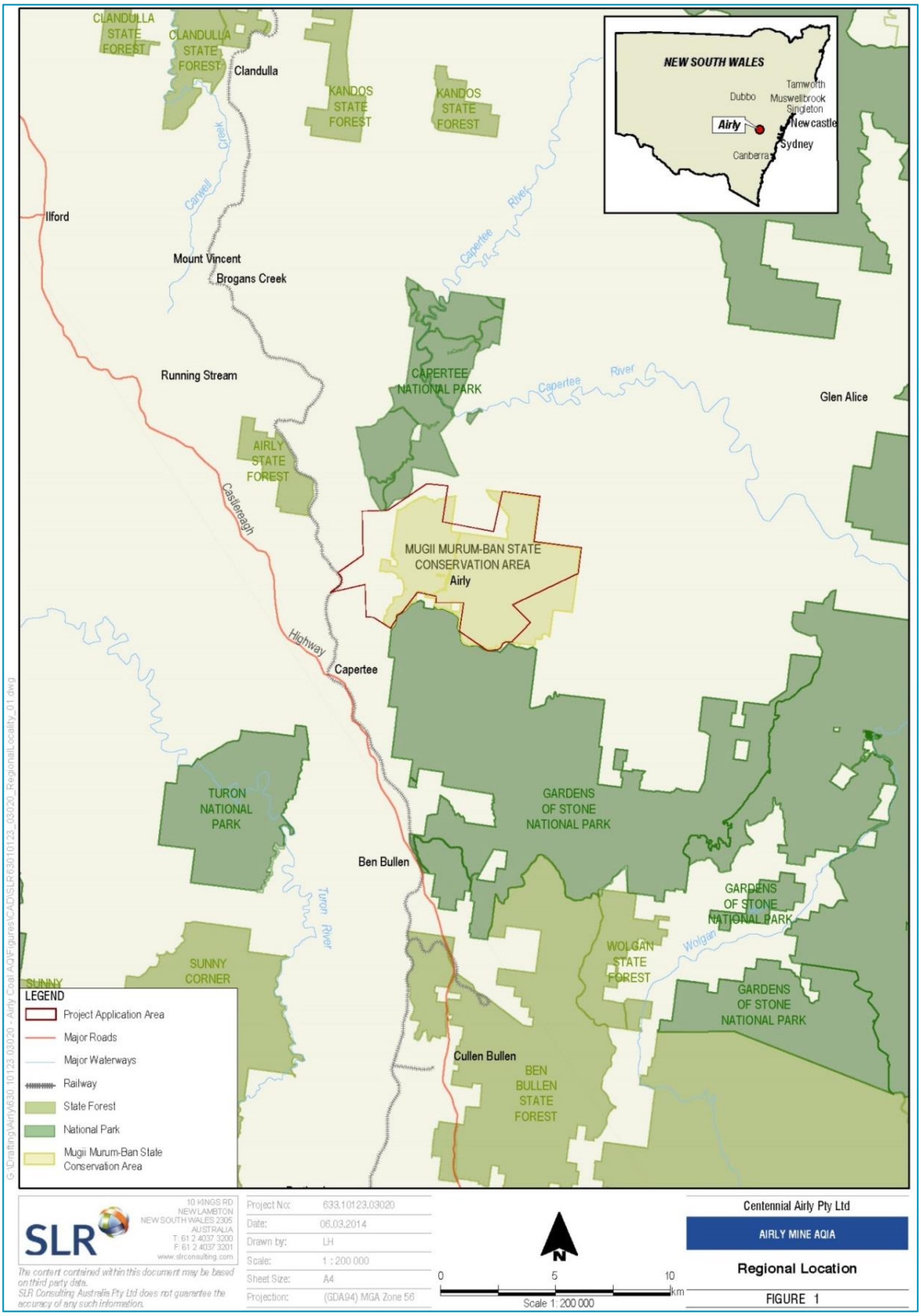
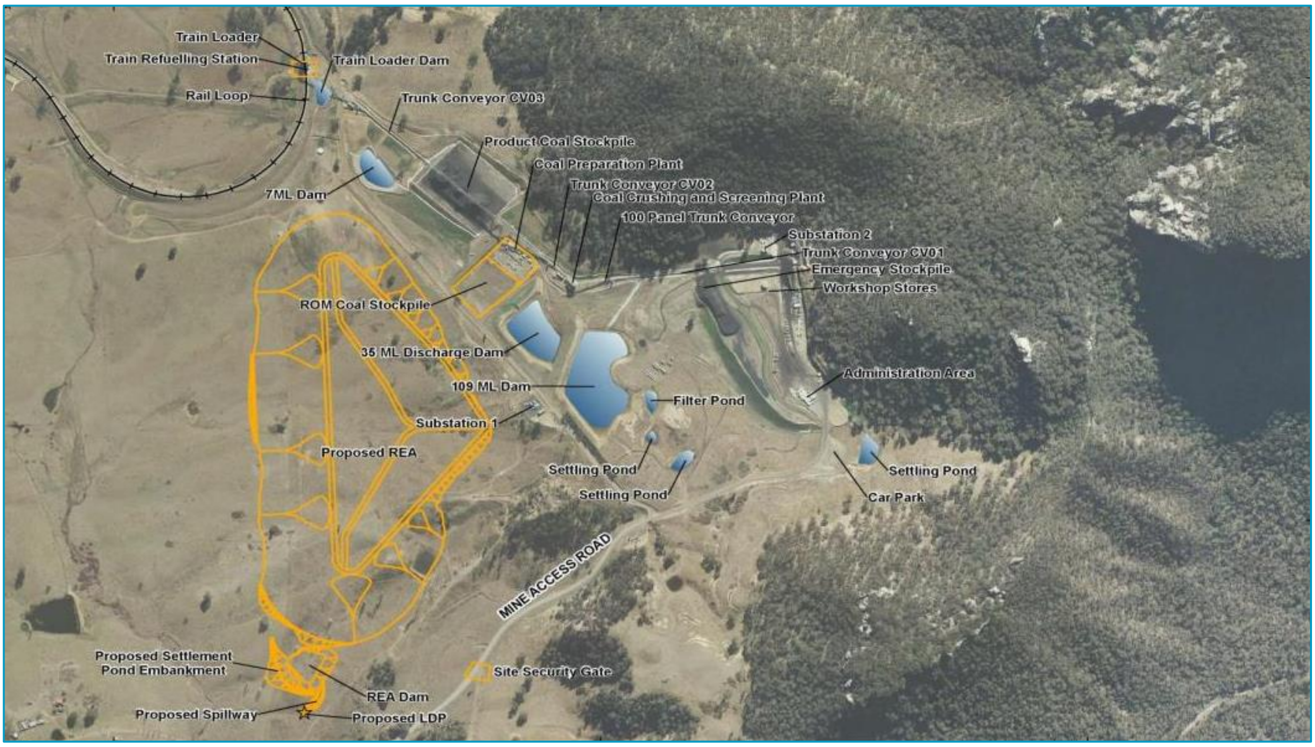


Figure 2 Location of the Approved Surface Infrastructure at the Airly Pit Top



Source: Appendix 3 of Airly 2016

2.3 Proposed Operations

The proposed modification elements under MOD 3 are:

- An increase in the production rate from the approved 1.8 Mtpa to 3.0 Mtpa;
- An increase in workforce from the approved 155 full-time equivalent (FTE) personnel to 200 FTE personnel;
- Underground blasting (or shot-firing) activities for the removal of geological structures in the event they are encountered within the mining areas;
- An increase in the movement of laden coal trains and water trains leaving the site from the approved average of two trains per day to three trains per day over any calendar year but maintaining the approved maximum five trains per day leaving the site on any day; and
- An amendment to the approved 20 year mine schedule for the increased production rate.

A summary of the approved operations of Extension Project (as modified) and the proposed modifications under MOD 3 is shown in **Table 1**.

Table 1 Key Features of the Approved Operations and Proposed MOD 3 Changes

Key Feature	Description of Approved Operations	Proposed Change (MOD 3)
Project Life	20 years from date of commencement (15 December 2016) with expiry date of 16 December 2036.	No change
Development Consent Boundary	Corresponds to the PAA boundary comprising Mining Lease ML1331 and Authorisation 232 (A232) with areas of 2,744 ha and 3,096 ha respectively, and a total 3,982 ha.	No change
Hours of Operation	24 hours per day, 7 days per week	No change
Employment	155 FTE personnel including contractors	200 FTE personnel
Mining Method and Mining Area	Underground mining using a combination of first workings and partial extraction mining methods, with the mining areas divided into five mining zones of varying mining systems to engineer the desired subsidence level for each zone. - Panel and Pillar Zone - Cliff Line and First Workings Zone - Partial Pillar Extraction Zone - Shallow Zone - New Hartley Shale Mine Potential Interaction Zone Restrictions on mining are as per Condition 1 of Schedule 3.	No change
ROM Coal Production	1.8 Mtpa	3.0 Mtpa
Coal Handling, Stockpiling and Processing	A system of surface and underground conveyors constructed to operate at 500 tonne per hour. Three coal stockpiles: - a 30,000 tonne ROM Emergency Stockpile - a 200,000 tonne Product Coal Stockpile - a 40,000 tonne ROM Coal Stockpile (not yet established) in the vicinity of the CPP. A CPP with a processing capacity of 500 tonne per hour with water recycling facility is approved but is not constructed as yet.	No change
Coal Transport	Rail to domestic power stations and for export. - No more than an average of two laden trains leave the site each day over any calendar year - No more than five trains (10 movements) per day leave the site on any day - No more than one water train (2 movements) is received from Charbon Colliery on any day	No change in coal destinations Increase in the trains to leave the site to an average of three trains per day over a calendar year but maintaining the approved maximum five trains leaving the site on any day.
Reject Management	Co-disposal REA for emplacement of fine and coarse reject materials. REA capacity of 5.3 Mm^3 Reject materials hauled from CPP to REA using trucks.	No change
Site Access	Mine Access Road off Glen Davis Road, 3 km from Capertee Village	No change
Mine Support Facilities	Underground access and associated infrastructure Engineering and services Coal handling, preparation and transport infrastructure Support services and administration at the Pit Top Non- mine owned infrastructure	No change
Underground Water Management	A mine dewatering system, comprising pipelines, underground impoundment dams and pump stations, to pump mine inflows from the underground to the 109 ML Dirty Water Dam for storage and subsequent use as process water.	No change

Key Feature	Description of Approved Operations	Proposed Change (MOD 3)
Surface Water Management	A system of water management structures comprising settling ponds, clean and dirty water diversion drains allow separation and storage of clean and dirty water at the pit top, for use as process water. Clean and dirty water dams comprise: - 109 ML Dirty Water Dam - 7 ML Dam - Train Loader Dam - REA Dam (not constructed) - 35 ML Discharge Dam - Three Licensed discharge points on EPL 1237- LDP001, LDP002, LDP003 Up to 170 ML/year of water imported from Charbon Colliery by rail will be managed within the existing water management system	No change
Process Water	Process water is obtained in priority order from the following sources: - Mine inflows (when available) - Surface dams - Production Bore (Bore Licence Number 10BL603503) - Imported water (up to 170 ML/year) from Charbon Colliery	No change
Mine Ventilation	Two electrically powered centrifugal fans (exhausting types), attached to the northern-most access adit at the pit top, draw fresh air from the remaining three access portals, through the workings, and vent the used air to the external atmosphere through the fans.	No change
Waste Management	Production (reject) and non-production waste (putrescibles and recyclables)	No change
Construction & Exploration	Construction of REA and CPP Construction hours: - 7:00 am - 6:00 pm Monday to Friday - 8:00 am to 1:00 pm Saturdays - No construction work is to take place on Sundays or Public Holidays.	No change
Rehabilitation	Progressive and life of mine	No change
Exploration	Within ML1331 and A232	No change

Source: Centennial 2018

2.4 Project Elements with Potential for Air Quality Impacts

The key air emissions from MOD 3 with potential for off-site impacts would be emissions of particulate matter from materials handling activities, wheel generated dust and wind erosion.

Exhaust emissions will also occur as a result of the use of mobile plant and machinery and haul trucks. These emissions would be emitted over a relatively large area and would not have potential to give rise to off-site exceedances of relevant air quality guidelines. They have therefore not been considered further and the scope of this AQIA is limited to particulate matter emissions.

There is one ventilation facility consisting of two fans located at the Airly Pit Top to ventilate the underground workings of the mine, although only one fan is operational at any one time. A summary of the identified dust emission sources and the respective emission controls adopted in the assessment is shown in **Table 2**.

Table 2 Summary of Potential Emission Sources

Emission Source	Emission Type	Pollutants	Controls[1]
Material Handling - Coal			
Coal transfer points	Material handling	TSP, PM_{10}, $PM_{2.5}$	Enclosure (70%)
Loading emergency stockpile[2]	Material handling	TSP, PM_{10}, $PM_{2.5}$	Water sprays (50%)
FEL on emergency stockpile[2]	Material handling	TSP, PM_{10}, $PM_{2.5}$	Water sprays (50%)
Bulldozer on emergency stockpile[2]	Material handling	TSP, PM_{10}, $PM_{2.5}$	None
Screening	Material handling	TSP, PM_{10}, $PM_{2.5}$	Enclosure (70%)
Crusher	Material handling	TSP, PM_{10}, $PM_{2.5}$	Enclosure (70%)
Loading ROM stockpile	Material handling	TSP, PM_{10}, $PM_{2.5}$	Water sprays (50%)
Bulldozer on ROM coal stockpile	Material handling	TSP, PM_{10}, $PM_{2.5}$	None
Loading product stockpile	Material handling	TSP, PM_{10}, $PM_{2.5}$	Water sprays (50%)
Bulldozer on product coal stockpile	Material handling	TSP, PM_{10}, $PM_{2.5}$	None
Loading trains	Material handling	TSP, PM_{10}, $PM_{2.5}$	Enclosure (70%)
Material Handling - Rejects			
Loading - rejects loading bin	Material handling	TSP, PM_{10}, $PM_{2.5}$	Material wet (100%)
Loading - trucks with rejects	Material handling	TSP, PM_{10}, $PM_{2.5}$	Material wet (100%)
Trucks dumping rejects at REA	Material handling	TSP, PM_{10}, $PM_{2.5}$	Material wet (100%)
Road Haulage (Wheel Generated Dust)			
Light vehicles movements	Wheel generated dust	TSP, PM_{10}, $PM_{2.5}$	Level 1 watering (50%)
Heavy vehicle movements	Wheel generated dust	TSP, PM_{10}, $PM_{2.5}$	Level 1 watering (50%)
Open Areas (Wind Erosion)			
Product stockpile	Wind erosion	TSP, PM_{10}, $PM_{2.5}$	Water sprays (50%)
CPP ROM stockpile	Wind erosion	TSP, PM_{10}, $PM_{2.5}$	Water sprays (50%)
Emergency stockpile	Wind erosion	TSP, PM_{10}, $PM_{2.5}$	Water sprays (50%)
REA	Wind erosion	TSP, PM_{10}, $PM_{2.5}$	50% area dewatered and prone to wind erosion
Coal wagon surface	Wind erosion	TSP, PM_{10}, $PM_{2.5}$	None
Ventilation Fan			
Ventilation fan	Process emissions	TSP, PM_{10}, $PM_{2.5}$	None

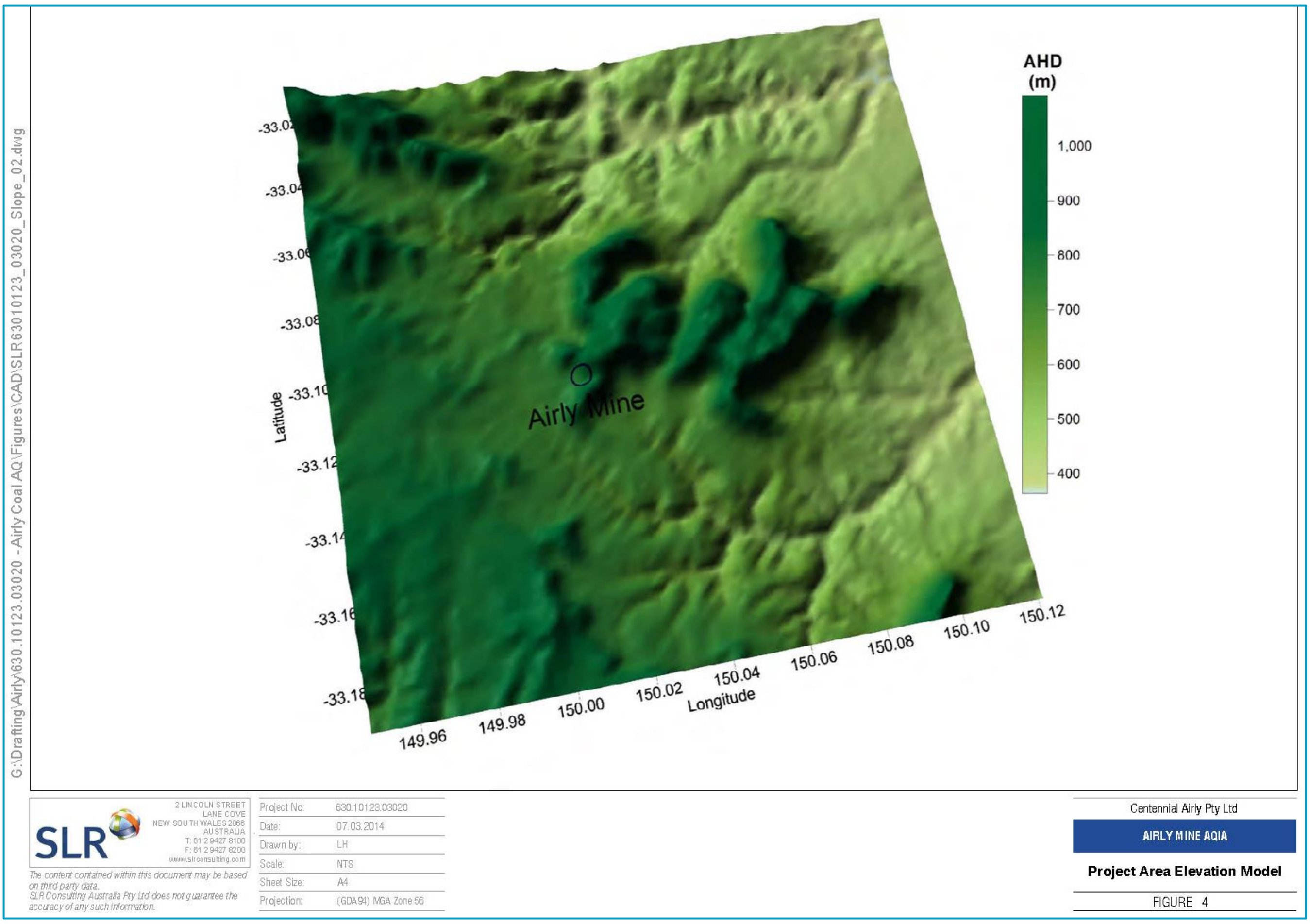
1 Source: DSEWPC 2012
2 The emergency stockpile will be operational on average one day per month, to accommodate for any unforeseen circumstances.

2.5 Local Topography

The topographical data used in the CALPUFF model was sourced from the United States Geological Service's Shuttle Radar Topography Mission database that has recorded topography across Australia with a 3 arc second (~90 m) spacing.

The topography of the region was incorporated into the meteorological modelling and dispersion modelling. Airly Mine is located within a complicated topographical region with elevated land located on all sides except the southwest. The topography of the region has the potential to significantly affect wind flows and the dispersion of air pollutants in the region and hence the resultant downwind pollutant concentrations. The topography of the local region surrounding Airly Mine is presented in **Figure 3**.

Figure 3 Topography Surrounding the Airly Mine



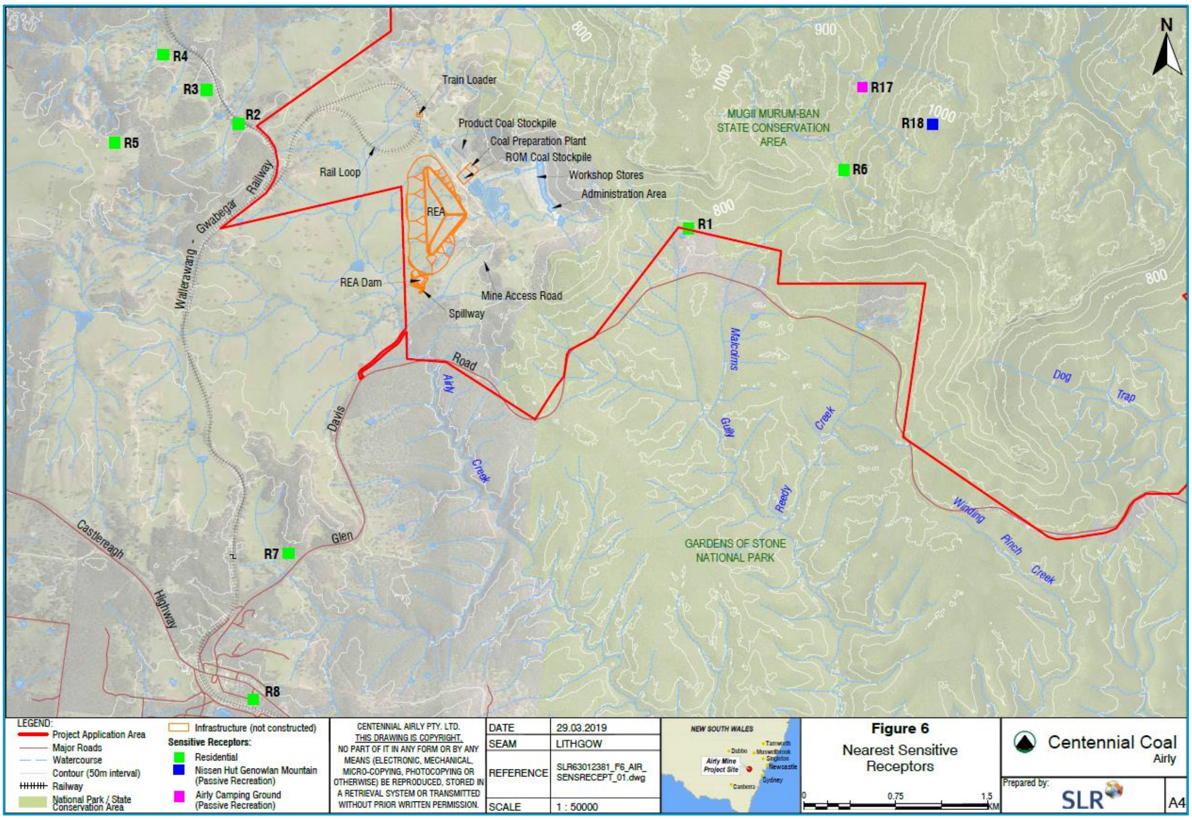
2.6 Sensitive Receptors

There are a number of rural/residential properties in the vicinity of the Project and Centennial maintains a substantial holding of land around the PAA. The closest identified non-mine owned residential receptors to the Airly Pit Top are shown in **Table 3** and **Figure 4**.

Table 3 Surrounding Sensitive Receptor Locations – MOD 3

Receiver ID	Location	Location (m, UTM)		Elevation (m, AHD)
		Easting	Northing	
R1	Residential	222,595	6,332,019	686
R2	Residential	218,725	6,332,953	735
R3	Residential	218,480	6,333,266	723
R4	Residential	218,118	6,333,545	724
R5	Residential	217,740	6,332,796	788
R6	Residential	223,867	6,332,572	814
R7	Residential	219,059	6,329,306	747
R8	Residential	218,982	6,328,302	752
R17	Airly camping ground (passive recreation)	224,016	6,333,253	750
R18	Nissen Hut Genowlan Mountain (passive Recreation)	224,592	6,332,947	996

Figure 4 Surrounding Sensitive Receptor Locations – MOD 3



3 Ambient Air Quality Criteria

The development consent for the Extension Project was granted in December 2016 and updated in July 2019. Under Schedule 4 - Environmental Performance Conditions (General), the following air quality criteria are specified:

The Applicant must ensure that all reasonable and feasible avoidance and mitigation measures are employed so that the particulate matter emissions generated by the development do not cause exceedances of the criteria in Table 5 at any residence on privately-owned land.

Table 5: Air quality criteria

Pollutant	Averaging Period	Criterion	
Particulate matter < 10 µm (PM_{10})	Annual	[a,d] 25 µg/m^3	
Particulate matter < 10 µm (PM_{10})	24 hour	[a] 50 µg/m^3	
Total suspended particulates (TSP)	Annual	[a,d] 90 µg/m^3	
[c] Deposited dust	Annual	[b] 2 g/m^2/month	[a,d] 4 g/m^2/month

Notes to Table 5:
a Cumulative impact (ie increase in concentrations due to the development plus background concentrations due to all other sources).
[b] Incremental impact (ie increase in concentrations due to the development alone, with zero allowable exceedances of the criteria over the life of the development.
[c] Deposited dust is to be assessed as insoluble solids as defined by Standards Australia, AS/NZS 3580.10.1:2003: Methods for Sampling and Analysis of Ambient Air - Determination of Particulate Matter - Deposited Matter - Gravimetric Method.
[d] Excludes extraordinary events such as bushfires, prescribed burning, dust storms, fire incidents or any other activity agreed by the Secretary.
e "Reasonable and feasible avoidance measures" includes, but is not limited to, the operational requirements in conditions 6 and 7 to develop and implement an air quality management system that ensures operational responses to the risks of exceedance of the criteria.

On 15 December 2015, the National Clean Air Agreement (NCAA) was endorsed by Commonwealth, State and Territory Environment Ministers. In this agreement, the Ministers agreed to strengthen national ambient air quality reporting standards for airborne fine particles. All jurisdictions have agreed to implement strengthened standards for particles, as well as move to even tighter standards for annual average and 24-hour $PM_{2.5}$ in 2025.

As such, in February 2016, a variation to the Ambient Air Quality National Environment Protection Measure (NEPM) was made to extend its coverage to $PM_{2.5}$, setting reporting standards for $PM_{2.5}$ with no allowable exceedances (NEPC 2016). In addition, the Ambient Air Quality NEPM revised the standard for annual average PM_{10} to be in line with the NCAA.

These standards have now been adopted by NSW Environment Protection Authority (EPA). The updated standards are outlined in the NSW EPA document '*Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales*' (EPA 2017) (hereafter 'the Approved Methods'). The June 2019 update to the development consent adopted the reduced annual average standard for PM_{10}.

The air quality goals adopted for particulate matter in this study, which conform to current EPA and Federal air quality criteria, are summarised in **Table 4**.

Table 4 Project Air Quality Goals

Pollutant	Averaging Period	Criteria (µg/m^3)	Source
PM_{10}	24 hours	50	EPA 2017
	Annual	25	EPA 2017
$PM_{2.5}$	24 hours	25	EPA 2017
	Annual	8	EPA 2017
TSP	Annual	90	EPA 2017
		Criteria (g/m^2/month)	
Deposited dust	Annual	2 (maximum increase in deposited dust level) 4 (maximum total deposited dust level)	EPA 2017

4 Emissions Estimation

This section describes the scenario assessed and the activities included within that scenario (**Section 4.1**), the emission factors used to estimate emissions from those activities (**Section 4.2**), the relevant activity data (**Section 4.3**) and the calculated emissions for each emission source type (**Section 4.4**).

4.1 Operational Scenario Assessed

In this AQIA, only one proposed operational scenario has been assessed, which is based on the 'Scenario 3 - normal operation of proposed infrastructure (1.8 Mtpa production)' scenario in the Extension Project AQIA (SLR 2014), modified to reflect an increased coal throughput of 3 Mtpa.

The following activities have been modified from those assessed in the Extension Project AQIA (SLR 2014):

- Emissions due to handling of reject material have not been included in the current assessment. It is understood that the reject material will be wet during the loading and unloading operations, therefore unlikely to generate any air borne emissions. It is noted however, that the wheel generated dust due to transportation of reject material, and the wind erosion emissions from the dried REA (**Figure 2**) have been included in the current assessment.

The following activities have been included within the current assessment:

- Coal handling emissions including:
  - Coal conveyors and transfer points;
  - Bulldozers on coal
  - Train loading
- Wheel generated dust due to transportation of reject material and use of light vehicles on unpaved roads;
- Wind erosion from coal stockpiles and REA;
- Ventilation fans emissions mine ventilation fan.

This scenario assumes that all the proposed activities are being performed concurrently at their maximum proposed capacity, which will provide a conservative representation of impacts compared to current Airly Pit Top operations. In reality, all proposed operations will not occur at their maximum capacity, and concurrently as has been assumed in this assessment. Therefore the results presented in this assessment should be viewed as conservative representation of the potential off-site impacts from MOD 3 operations.

4.2 Emission Factors

The particulate emissions for the identified emission sources have been calculated using default or calculated emission factors from:

- The National Pollutant Inventory (NPI) *Emission Estimation Technique Manual (EETM) for Mining* version 3.1 (DSEWPC 2012);
- *Chapter 11 - Western Surface Coal Mining* or *Chapter 13 - Miscellaneous Sources* of the US EPA *AP-42 Emission Factor Handbook* (USEPA 1998), where suitable factors do not exist within the NPI documentation; or
- Australian Coal Association Research Program Project C22027 – *Development of Australia Specific PM_{10} Emission Factors for Coal Mines* (ACARP 2015).

The emission factors used for the estimation of TSP, PM_{10} and $PM_{2.5}$ emissions from the operational activities are presented in **Table 5**. The following emission factors have been updated from those used in the Extension Project AQIA (SLR 2014):

- Loading/Unloading of coal (including conveying);
- Bulldozer operations on coal (for TSP only);
- Wheel generated dust due to movements of heavy and light vehicles.

Table 5 Summary of Emission Factors Used to Estimate Emissions from Identified Sources

Emission Source	Emission Factor Equation	Units	Variables	Source
Loading/ unloading coal	$EF_{TSP} = 0.00055$ $EF_{PM10} = 0.00026$ $EF_{PM2.5} = 0.00004$	kg/t	-	ACARP 2015
Bulldozer on coal	$EF_{TSP} = 35.6 \times \frac{s^{1.2}}{M^{1.3}}$ $EF_{PM_{10}} = 6.33 \times \frac{s^{1.5}}{M^{1.4}}$ $EF_{PM2.5} = 0.022 \times EF_{TSP}$	kg/h/vehicle	s=silt content (%) M=Moisture content (%)	US EPA 1998
Wind erosion	$EF_{TSP} = 0.4$ $EF_{PM10} = 0.2$ $EF_{PM2.5} = 0.0468 \times EF_{TSP}$	kg/ha/h	-	DSEWPC 2012
Unpaved haul route wheel dust (heavy vehicles)	$EF = k \times \left(\frac{s}{12}\right)^a \times \left(\frac{W}{3}\right)^b$	kg/VKT	k = 4.9; a = 0.7, b = 0.45 (TSP) k = 1.5; a = 0.9, b = 0.45 (PM_{10}) k = 0.15; a = 0.9, b = 0.45 ($PM_{2.5}$) s = silt content (%) W = vehicle gross mass (tonnes)	USEPA 2006a

Emission Source	Emission Factor Equation	Units	Variables	Source
Unpaved haul route wheel dust (light vehicles)	$EF = \frac{k \times \left(\frac{s}{12}\right)^a \times \left(\frac{W}{30}\right)^b}{\left(\frac{M}{0.5}\right)^c}$	kg/VKT	k = 6; a = 1.0, b = 0.3, c = 0.3 (TSP) k = 1.8; a = 1.0, b = 0.5, c = 0.2 (PM_{10}) k = 0.18; a = 1.0, b = 0.5, c = 0.2 ($PM_{2.5}$) s = silt content (%) M = moisture content (%) W = vehicle gross mass (tonnes)	USEPA 2006a
Ventilation fans	EF_{TSP} = 0.593 EF_{PM10} = 0.040 $EF_{PM2.5}$ = 0.030	g/s g/s g/s	-	SLR 2013a SLR 2013a SLR 2013a

4.3 Activity Rates

The activity data used in the emission calculations for the activities occurring as part of MOD 3 is shown in **Table 6**.

Table 6 Peak Daily Activity Data for Material Handling Operations

Emission Generating Activities	MOD 3	Units
Material Handling - Coal		
Coal transfer point 1 - underground drift[a]	791.7	tonnes/hour
Coal transfer point 2 - emergency stockpile[a]	791.7	tonnes/hour
Coal transfer point 3 - surface conveyor[a]	791.7	tonnes/hour
Coal transfer point 4 - coal crusher[a]	791.7	tonnes/hour
Coal transfer point 5 - from underground reclaimer[a]	791.7	tonnes/hour
Coal transfer point 6 - pre train loading bin[a]	791.7	tonnes/hour
Coal transfer point 7 - loading train loading bin[a]	791.7	tonnes/hour
Coal transfer point 8 – CPP[a]	791.7	tonnes/hour
Coal transfer point 9 –ROM stockpile[a]	791.7	tonnes/hour
Loading Emergency stockpile	791.7	tonnes/hour
FEL on Emergency stockpile	791.7	tonnes/hour
Bulldozer on Emergency Coal Stockpile	12	hours/day
Screening (controlled)	791.7	tonnes/hour
Primary Crusher (controlled)	791.7	tonnes/hour
Secondary Crusher (controlled)	791.7	tonnes/hour
Loading ROM stockpile[a]	791.7	tonnes/hour
Bulldozer on ROM stockpile	12	hours/day
Loading product stockpile[a]	791.7	tonnes/hour
Bulldozer on product stockpile	12	hours/day
Loading Trains[b]	1,046.9	tonnes/hour
Wheel Generated Dust		

Emission Generating Activities	MOD 3	Units
Light vehicle movements[c]	6.6	VKT/hour
Heavy vehicle movements[d]	1.3	VKT/hour
Wind Erosion		
Product Stockpile	3.75	ha
CPP ROM Stockpile	0.75	ha
Emergency Stockpile	0.75	ha
REA[e]	16.8	ha
Coal Wagon surface (based on 15m x 3m, 67 cars)[f]	0.30	ha

[a] Coal throughput based on maximum production of 19,000 tonnes per day.
[b] Calculated based on maximum of 5 trains per day, 67 wagons/train and 75 tonnes/wagon.
[c] Based on a total of 50 trips per day for light utility vehicles, 2 trips per day of site vehicles, and 24 trips per day of telehandler. The distance covered in each trip is assumed to be approximately 1.05 km.
[d] Based on total rejects throughput of 450,000 tonnes per year, haul truck capacity of 39 tonnes. The distance covered in each trip is estimated to be approximately 500 m.
[e] Assumed to be 50% dewatered and prone to wind erosion and 50% wet.
[f] Estimated based on wagon surface area of 15 m x 3 m; maximum of 67 wagons at any given time.

4.4 Estimated Emissions

A summary of the emissions inventory for all the components of MOD 3 is shown in **Table 7**. A detailed emission inventory can be found in **Appendix A**.

Table 7 Emissions Inventory for MOD 3

Activity	TSP (kg/year)	PM_{10} (kg/year)	$PM_{2.5}$ (kg/year)
Coal transfer/handling	240,091	68,517	8,237
Rejects transfer/handling	0	0	0
Wheel generated dust	37,752	6,810	1,438
Wind erosion - Coal stockpiles	9,198	4,599	430
Wind erosion - REA	29,434	14,717	1,377
Wind erosion - Coal train wagons	1,056	528	49
Ventilation fans	5,193	346	260
Total	**322,725**	**95,517**	**11,792**
Extension Project AQIA (SLR 2014)	**215,969**	**79,543**	**9,876**

The total estimated emissions for the MOD 3 operations are higher for TSP, PM_{10} and $PM_{2.5}$ compared to those calculated for the Extension Project AQIA (SLR 2014).

5 Air Dispersion Modelling Methodology

5.1 Model Selection

Emissions from MOD 3 have been modelled using the CALPUFF (Version 6.267) modelling system. CALPUFF is one of the air dispersion modelling tools accepted by the NSW EPA. It is a transport and dispersion model that breaks emission plumes into "puffs" of material emitted from modelled sources. The model predicts the trajectory of these puffs, simulating dispersion and transformation processes along the way.

In order to model the trajectory and dispersion / transformation of these puffs, the model requires input data on the emissions themselves (location, release times / frequencies, type and strength of the releases), the terrain over which the puffs travel and the meteorological conditions that occur at the location and in the time period under consideration. Both the terrain and meteorological data are in incorporated in three dimensions.

For the meteorological data, CALPUFF typically uses wind field data generated by the meteorological pre-processor CALMET, discussed further below. Temporal and spatial variations in the meteorological fields selected are explicitly incorporated in the resulting distribution of puffs throughout a simulation period.

The primary output files from CALPUFF contain either hourly concentrations or hourly deposition fluxes calculated at selected receptor locations. The CALPOST post-processor is then used to process these files, producing tabulations that summarise results of the simulation for user-selected averaging periods.

5.2 Meteorological Modelling Methodology

Meteorological mechanisms govern the dispersion, transformation and eventual removal of pollutants from the atmosphere. The extent to which pollution will accumulate or disperse in the atmosphere is dependent on the degree of thermal and mechanical turbulence within the Earth's boundary layer (that layer of the atmosphere closest to the surface of the Earth. Dispersion comprises vertical and horizontal components of motion. The stability of the atmosphere and the depth of the surface-mixing layer define the vertical component. The horizontal dispersion of pollution in the boundary layer is primarily a function of the wind field. The wind speed determines both the distance of downwind transport and the rate of dilution as a result of plume 'stretching'. The generation of mechanical turbulence is similarly a function of the wind speed, in combination with the surface roughness. The wind direction, and the variability in wind direction, determines the general path pollutants will follow, and the extent of crosswind spreading.

Pollution concentration levels therefore fluctuate in response to changes in atmospheric stability, to concurrent variations in the mixing depth, and to shifts in the wind field (Oke 2004). To adequately characterise the dispersion meteorology of the study site, information is needed on the prevailing wind regime, mixing depth and atmospheric stability and other parameters such as ambient temperature, rainfall and relative humidity.

To adequately characterise the dispersion meteorology of the region covered by the Airly Pit Top, information is needed on the prevailing wind regime, ambient temperature, rainfall, relative humidity, mixing depth and atmospheric stability. The meteorology of the region was characterised based on a 3-dimensional prognostic meteorological dataset.

5.2.1 Meteorological Modelling Methodology

Meteorological data used by SLR in the Extension Project AQIA (SLR 2014) were compiled using regional observational data incorporated into the TAPM and CALMET models (generally known as the 'with obs' approach) for the 2010 calendar year. In this current assessment, the advanced Weather Research and Forecast (WRF) model was used to produce the meteorological field required as an input to the CALMET meteorological model (see **Section 5.2.2**). The modelled year was also updated to the 2014 calendar year.

The meteorological modelling methodology and the modelled year (ie 2014) used in this assessment are consistent with the meteorological data and modelled year recently used by SLR for other Centennial sites within the region (ie Springvale Mine and WCS). Although no specific guidance is prescribed as to the metrological year to be used in air quality impact assessments, the Approved Methods suggests adopting a 'representative' meteorological year within the last five years. The approach taken in this assessment is consistent with the Approved Methods.

Further, the Approved Methods prescribe the use of same background data year to that used for modelled year for contemporaneous analysis. Therefore, the background data used for this assessment is also based on monitoring data from 2014 (see **Section 6**).

It is noted that due to these differences in the modelling approach between the AQIA for the Extension Project (SLR 2014) and this current assessment (ie different meteorological data inputs, different modelled year and different background dataset), the predicted results showed in the 2014 SLR report should not be viewed as directly comparable to those presented in this report.

5.2.2 Weather Research and Forecast Model

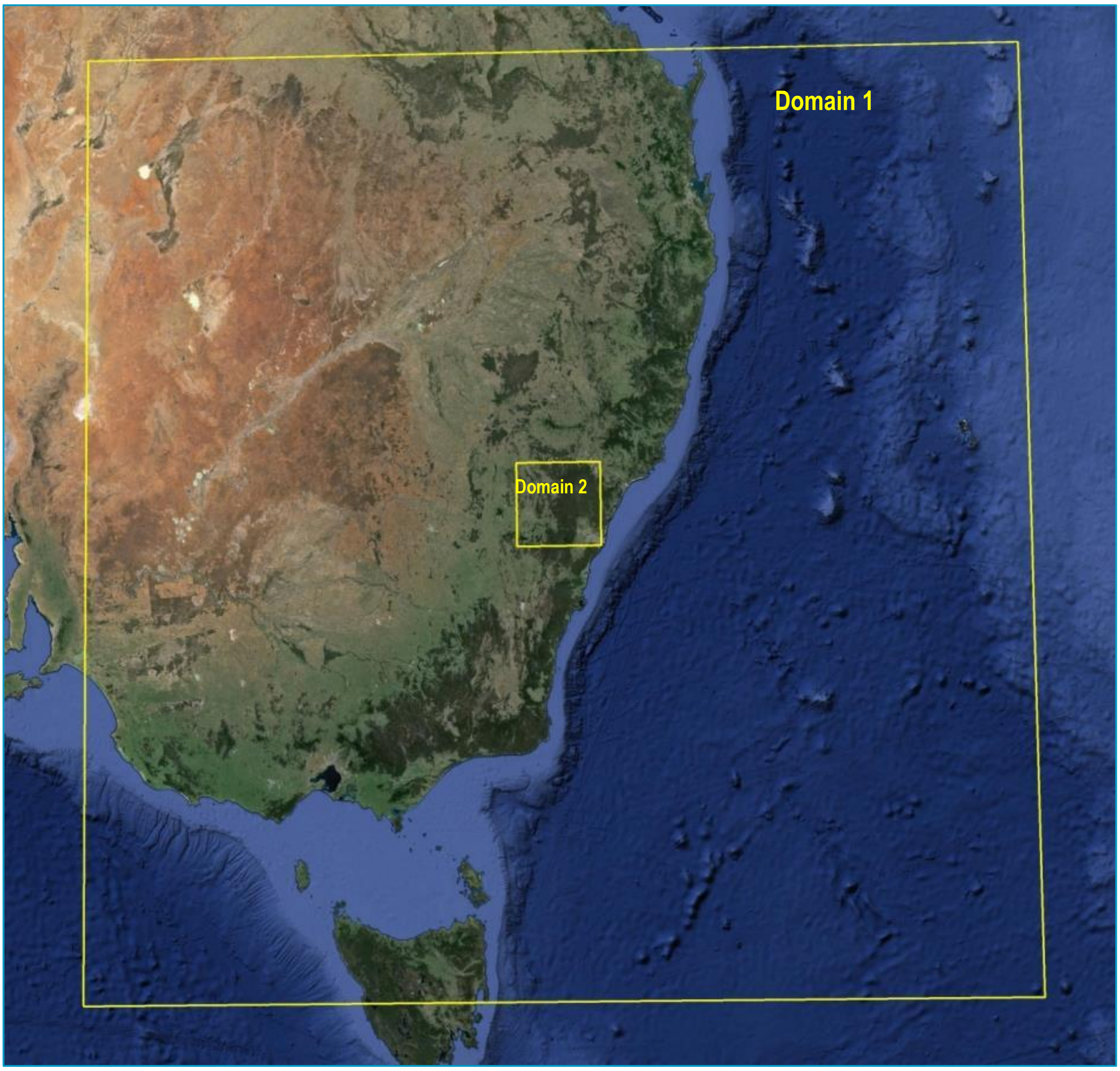
The WRF model is a next generation mesoscale numerical weather prediction system designed for both atmospheric research and operational forecasting needs. It features two dynamical cores; a data assimilation system and a software architecture facilitating parallel computation and system extensibility. The model serves a wide range of meteorological applications across scales from tens of meters to thousands of kilometres.

For this assessment, the WRF modelling system was used to produce the meteorological field required as an input to the CALMET meteorological model over the domains shown in **Figure 5**. Parameters used in the WRF model for this assessment are presented in **Table 8**. Modelling was performed for the 2014 calendar year, which is consistent with modelled year for the Springvale Mine AQIA (SLR 2016) and WCS MOD 3 AQIA (SLR 2017).

Table 8 Meteorological Parameters used for this Study (WRF)

Parameter	Domain 1	Domain 2
Modelling domain	2,100 km × 2,100 km	190 km × 190 km
Grid resolution	30 km	10 km
Number of vertical levels	30	30

Figure 5 WRF Modelling Domains



5.2.3 CALMET

In the simplest terms, CALMET is a meteorological model that develops wind and temperature fields on a three-dimensional gridded modelling domain. Associated two-dimensional fields such as mixing height, surface characteristics and dispersion properties are also included in the file produced by CALMET. The interpolated wind field is then modified within the model to account for the influences of topography, as well as differential heating and surface roughness associated with different land uses across the modelling domain. These modifications are applied to the winds at each grid point to develop a final wind field. The final wind field thus reflects the influences of local topography and land uses.

CALMET modelling was conducted using the nested CALMET approach, where the final results from a coarse-grid run were used as the initial "guess" of a fine-grid run. This has the advantage that off-domain terrain features including slope flows and blocking effects can be allowed to take effect and the larger scale wind flow provides a better start in the fine-grid run.

The outer domain (120 km × 120 km) was modelled with a resolution of 3 km. WRF-generated 3-dimensional meteorological data was used as the initial guess wind field and the local topography and available surface weather observations in the area were used to refine the wind field predetermined by WRF.

The output from the outer domain CALMET modelling was then used as the initial guess field for the mid domain CALMET modelling. The mid domain encompasses an area of 50 km × 50 km. A horizontal grid spacing of 1 km was used to adequately represent the important local terrain features and land use.

The output from the mid domain CALMET modelling was then used as the initial guess field for the inner domain CALMET modelling. The inner domain encompassed an area of 20 km × 20 km with a horizontal grid spacing of 200 m to adequately represent the important local terrain features and land use. The fine scale local topography and land use information were used in this run to refine the wind field parameters predetermined by the coarse CALMET run.

Table 9 details the parameters used in the CALMET modelling. The CALMET modelling approach used in this assessment is identified in the *Generic Guidance and Optimum Model Settings for the CALPUFF Modelling System* prepared for NSW Office of Environment and Heritage (TRC 2011) as the CALMET Hybrid Mode and is considered to be an 'advanced model simulation'.

Table 9 Meteorological Parameters used in this Assessment (CALMET v 6.42)

Outer Domain	
Meteorological grid	120 km × 120 km
Meteorological grid resolution	3 km
Initial guess filed	3D output from WRF model
Mid Domain	
Meteorological grid	50 km × 50 km
Meteorological grid resolution	1 km
Initial guess field	3D output from 'outer' domain model run
Inner Domain	
Meteorological grid	20 km × 20 km
Meteorological grid resolution	0.2 km
Initial guess field	3D output from 'mid' domain model run

5.3 Meteorological Data Used in Modelling

To provide a summary of the meteorological conditions predicted within the Airly Pit Top area using the methodology described in **Section 5.2**, a single-point, ground-level meteorological dataset was 'extracted' from the 3-dimensional dataset and is presented in this section. It is noted that wind conditions used in the modelling at other locations within the modelling domain may be different to those predicted within the Airly Pit Top area.

5.3.1 Wind Speed and Direction

A summary of the annual wind behaviour predicted by CALMET for the Airly Pit Top for the year 2014 is presented as wind speed frequency chart in **Figure 6** and wind roses in **Figure 7**.

Wind roses show the frequency of occurrence of winds by direction and strength. The bars correspond to the 16 compass points (degrees from north). The bar at the top of each wind rose diagram represents winds blowing from the north (i.e. northerly winds), and so on. The length of the bar represents the frequency of occurrence of winds from that direction, and the widths of the bar sections correspond to wind speed categories, the narrowest representing the lightest winds. Thus it is possible to visualise how often winds of a certain direction and strength occur over a long period, either for all hours of the day, or for particular periods during the day.

The following description of wind speeds references the Beaufort Wind Scale, as outlined in **Table 10**. Use of the Beaufort Wind Scale is consistent with terminology used by the BoM.

Table 10 Beaufort Wind Scale

Beaufort Scale #	Description	Wind Speed (m/s)	Description on Land
0	Calm	0-0.5	Smoke rises vertically
1	Light air	0.5-1.5	Smoke drift indicates wind direction
2-3	Light/gentle breeze	1.5-5.3	Wind felt on face, leaves rustle, light flags extended, ordinary vanes moved by wind
4	Moderate winds	5.3-8.0	Raises dust and loose paper, small branches are moved
5	Fresh winds	8.0-10.8	Small trees in leaf begin to sway, crested wavelets form on inland waters
6	Strong winds	>10.8	Large branches in motion, whistling heard in telephone wires; umbrellas used with difficulty

Source: http://www.bom.gov.au/lam/glossary/beaufort.shtml

Figure 6 and **Figure 7** indicate that winds experienced at Airly Pit Top predominantly range between a gentle breeze and moderate winds (between 1.5 m/s and 8 m/s) with a small percentage of strong winds (>10.8 m/s) that mainly blow from the west. Calm wind conditions (wind speed less than 0.5 m/s) were predicted to occur approximately 3% of the time during a year.

The predominant wind direction is seasonally dependent, with the seasonal wind roses indicating that:

- In summer, wind speeds range from light to fresh winds (between 0.5 m/s and 9.9 m/s) but are typically less than 5.3 m/s. The majority of winds blow from the east and east-southeast, with very few winds from the north and west. The strongest winds blow from the east-southeast. Calm wind conditions were predicted to occur less than 2% of the time during summer.
- In autumn, wind speeds ranged from light to fresh winds (between 0.5 m/s and 10.7 m/s), with the strongest winds again blowing from the west-southwest. The majority of winds blow from the east and east-southeast, with very few winds from the north. Calm wind conditions were predicted to occur approximately 3.5% of the time during autumn.

- Winds are strongest during winter, with wind speeds typically being greater than 1.5 m/s and ranging up to 13.2 m/s. The majority of winds blow from between the south east-southeast and south, and between west-southwest and west directions, with very few winds from the north. Calm wind conditions were predicted to occur approximately 4% of the time during winter.
- In spring, wind speeds ranged from light to strong winds (between 0.5 m/s and 10.9 m/s). The majority of winds blow from east and south directions, with very few winds from the north. Calm wind conditions were predicted to occur approximately 2% of the time during spring.

Figure 6 Wind Speed Frequency Chart for the Airly Pit Top (CALMET predictions, 2014)

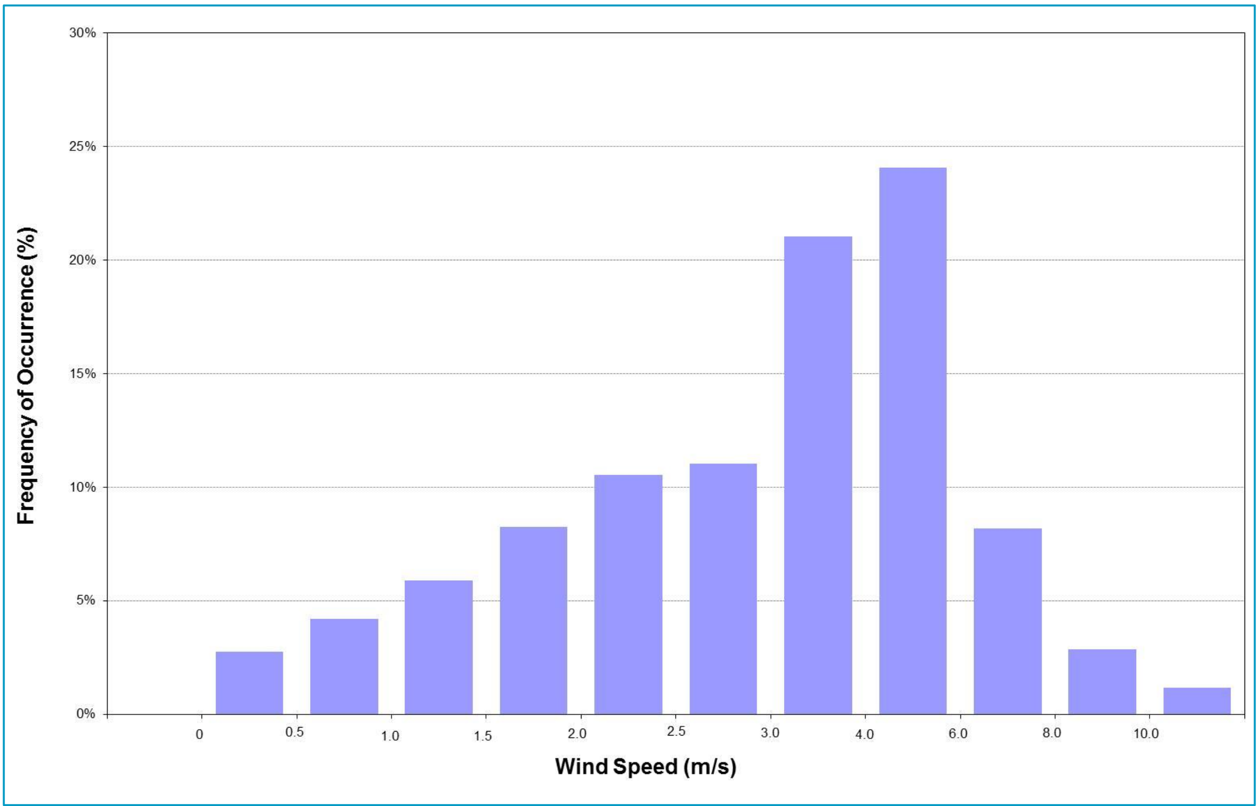
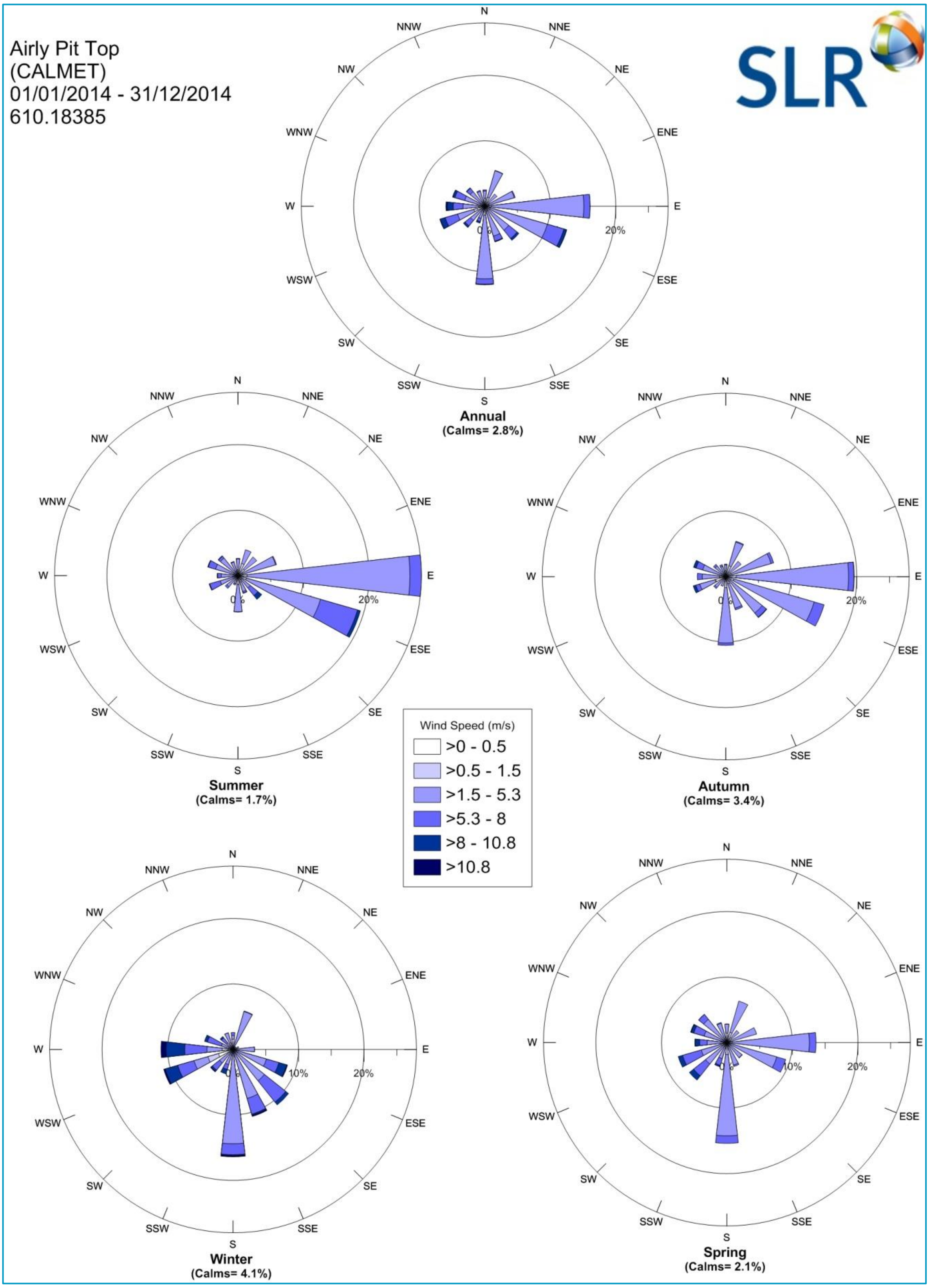


Figure 7 Annual Wind Roses for the Airly Pit Top (CALMET predictions, 2014)



5.3.2 Atmospheric Stability

Atmospheric stability refers to the tendency of the atmosphere to resist or enhance vertical motion. The Pasquill-Gifford-Turner (PGT) assignment scheme identifies six Stability Classes, A to F, to categorize the degree of atmospheric stability as follows:

- A = Extremely unstable conditions
- B = Moderately unstable conditions
- C = Slightly unstable conditions
- D = Neutral conditions
- E = Slightly stable conditions
- F = Moderately stable conditions

The meteorological conditions defining each PGT stability class are shown in **Table 11**.

Table 11 Meteorological Conditions Defining PGT Classes

Surface wind speed (m/s)	Daytime insolation			Night-time conditions	
	Strong	Moderate	Slight	Thin overcast or > 4/8 low cloud	≤ 4/8 cloudiness
< 2	A	A - B	B	E	F
2 - 3	A - B	B	C	E	F
3 - 5	B	B - C	C	D	E
5 - 6	C	C - D	D	D	D
> 6	C	D	D	D	D

Source: NOAA 2018

Notes:

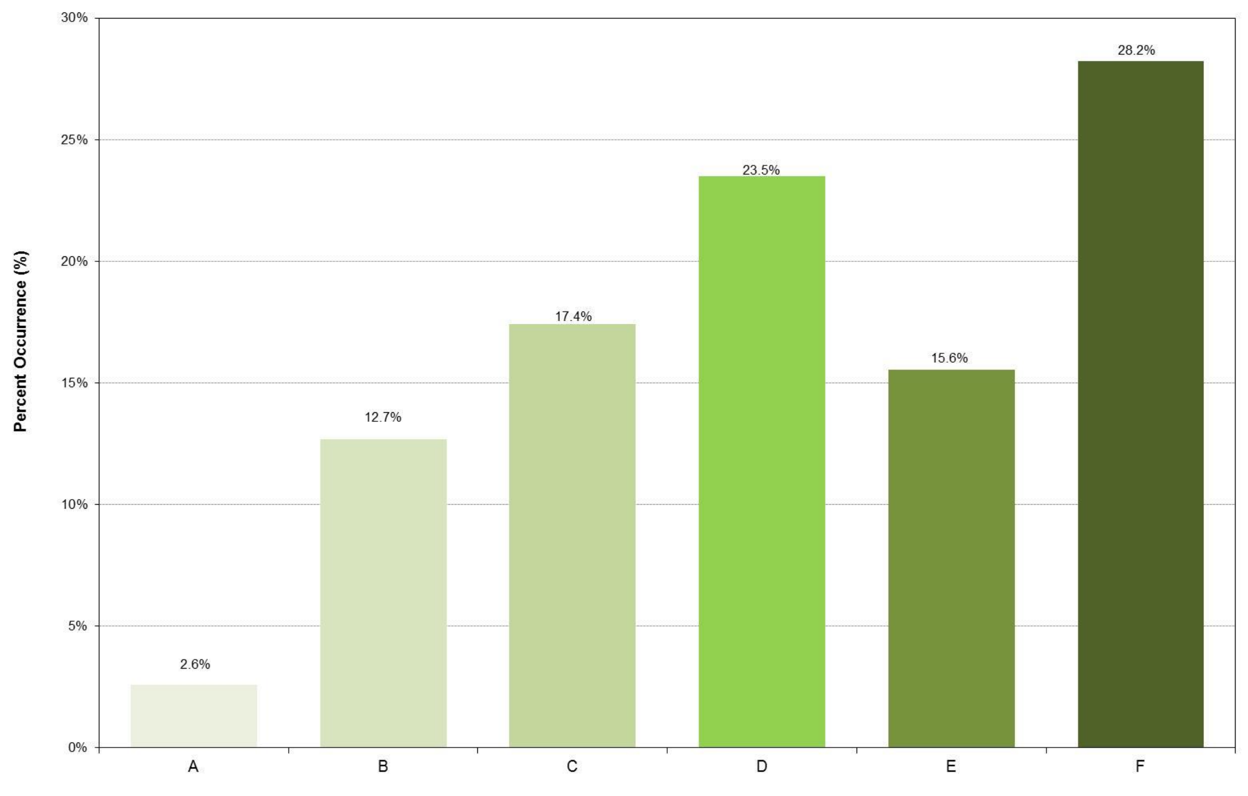
1 Strong insolation corresponds to sunny midday in midsummer in England; slight insolation to similar conditions in midwinter.

2 Night refers to the period from 1 hour before sunset to 1 hour after sunrise.

3 The neutral category D should also be used, regardless of wind speed, for overcast conditions during day or night and for any sky conditions during the hour preceding or following night as defined above.

The frequency of each stability class predicted by CALMET, extracted at Airly Pit Top, during the modelling period is presented in **Figure 8**. The results indicate a very high frequency of conditions typical to Stability Class F. Stability Class F is indicative of very stable night time conditions, conducive to a low level of pollutant dispersion due to mechanical mixing resulting in higher pollutant concentrations.

Figure 8 Stability Class Frequencies at the Airly Pit Top (CALMET predictions, 2014)

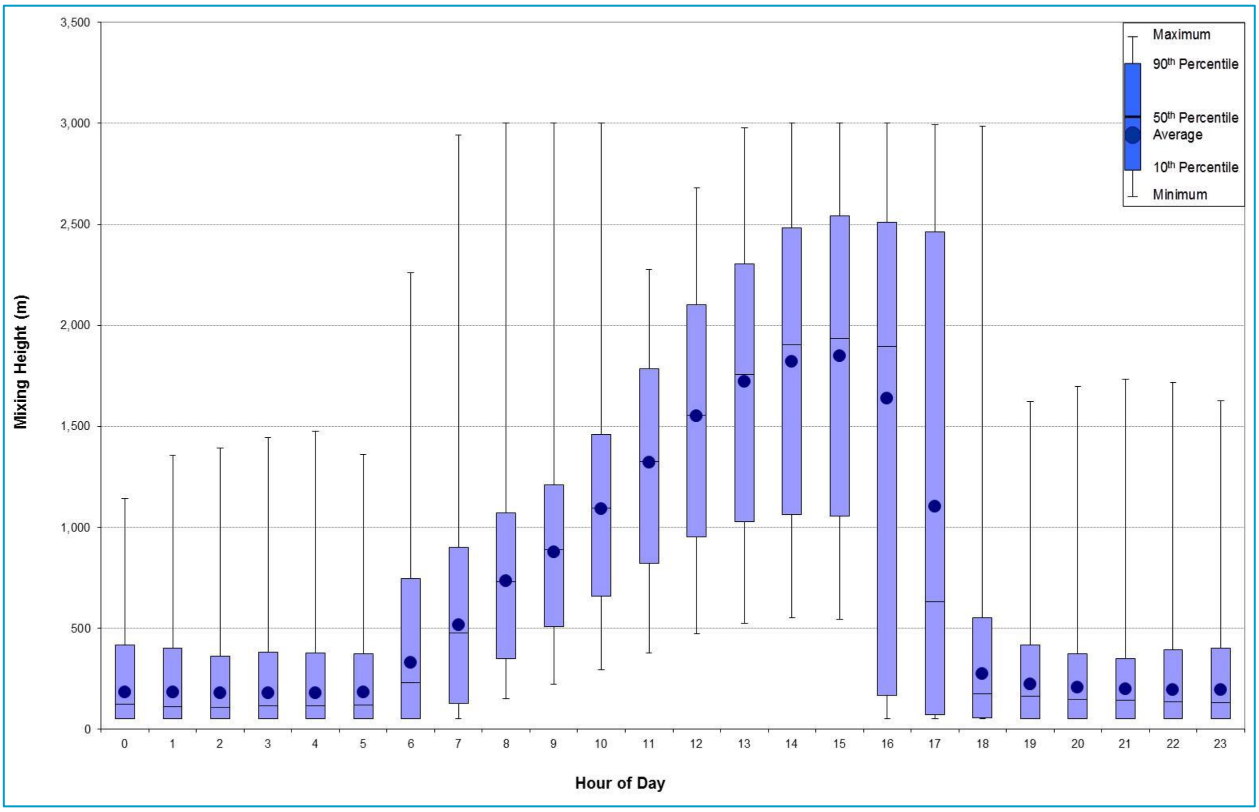


5.3.3 Mixing Heights

Diurnal variations in maximum and average mixing depths predicted by CALMET at Airly Pit Top during 2014 are illustrated in **Figure 9**.

As would be expected, an increase in the mixing depth during the morning is apparent, arising due to the onset of vertical mixing following sunrise. Maximum mixing heights occur in the mid to late afternoon, due to the dissipation of ground-based temperature inversions and the growth of the convective mixing layer.

Figure 9 Mixing Heights at the Airly Pit Top (CALMET predictions, 2014)



5.4 Dispersion Model Configuration

As discussed in **Section 5.1**, dispersion modelling was conducted using the CALPUFF dispersion model and three dimensional meteorological data output from CALMET.

Emissions from the coal handling, processing and transportation activities were represented by a series of volume sources, while wind erosion from exposed areas was represented by area sources.

The estimated particulate emissions were modelled as:

- Fine particulates (FP < 2.5 µm);
- Coarse matter (2.5 µm<CM<10 µm); and
- Rest of the particulates (RE>10 µm).

These parameters were then grouped using CALPOST to predict $PM_{2.5}$, PM_{10} and TSP concentrations at surrounding receptor locations. This approach provides the most realistic treatment of the differing size fractions, with the lighter, finer particulate matter being dispersed further than the heavier size fraction which settles out of the air more rapidly.

Based on the sensitivity of each activity to wind speed, an hourly varying emission file representing hourly FP, CM and RE emissions for each source was generated using the annual average emission rate estimated for each activity. Details of the algorithm used to generate the variable emission files are presented in **Appendix B**.

5.5 Accuracy of Air Dispersion Modelling

Atmospheric dispersion models represent a simplification of the many complex processes involved in the dispersion of pollutants in the atmosphere. To obtain good quality results it is important that the most appropriate model is used and the quality of the input data (meteorological, terrain, source characteristics) is adequate.

The main sources of uncertainty in dispersion models, and their effects, are discussed below.

- **Oversimplification of physics**: This can lead to both under-prediction and over-prediction of ground level pollutant concentrations. Errors are greater in Gaussian plume models as they do not include the effects of non-steady-state meteorology (i.e., spatially- and temporally-varying meteorology).
- **Errors in emission rates**: Ground level concentrations are proportional to the pollutant emission rate. In addition, most modelling studies assume constant worst case emission levels or are based on the results of a small number of stack tests, however operations (and thus emissions) are often quite variable. This is particularly the case for fugitive dust emission sources such as those modelled in this assessment.
- **Errors in source parameters**: Plume rise is affected by source dimensions, temperature and exit velocity. Inaccuracies in these values will contribute to errors in the predicted height of the plume centreline and thus ground level pollutant concentrations. As this study involves emissions of particulate from non-buoyant ground level sources, plume buoyancy factors will be negligible. However, inaccuracies in source location etc can potentially impact on the results of the modelling.
- **Errors in wind direction and wind speed**: Wind direction affects the direction of plume travel, while wind speed affects plume rise and dilution of plume. Errors in these parameters can result in errors in the predicted distance from the source of the plume impact, and magnitude of that impact. In addition, aloft wind directions commonly differ from surface wind directions. The preference to use rugged meteorological instruments to reduce maintenance requirements also means that light winds are often not well characterised.
- **Errors in mixing height**: If the plume elevation reaches 80% or more of the mixing height, more interaction will occur, and it becomes increasingly important to properly characterise the depth of the mixed layer as well as the strength of the upper air inversion. As this study involves emissions of particulate from non-buoyant ground level sources, mixing height errors would not have a significant impact on the accuracy of the results.
- **Errors in temperature**: Ambient temperature affects plume buoyancy, so inaccuracies in the temperature data can result in potential errors in the predicted distance from the source of the plume impact, and magnitude of that impact. As this study involves emissions of particulate from non-buoyant ground level sources, ambient temperature errors would not have a significant impact on the accuracy of the results.
- **Errors in stability estimates**: Gaussian plume models use estimates of stability class, and 3D models use explicit vertical profiles of temperature and wind (which are used directly or indirectly to estimate stability class for Gaussian models). In either case, errors in these parameters can cause either under-prediction or over-prediction of ground level concentrations. For example, if an error is made of one stability class, then the computed concentrations can be off by 50% or more.

The US EPA makes the following statement in its Modelling Guideline (TRC 2011) on the relative accuracy of models:

> *"Models are more reliable for estimating longer time-averaged concentrations than for estimating short-term concentrations at specific locations; and the models are reasonably reliable in estimating the magnitude of highest concentrations occurring sometime, somewhere within an area. For example, errors in highest estimated concentrations of ±10 to 40% are found to be typical, i.e., certainly well within the often quoted factor-of-two accuracy that has long been recognised for these models. However estimates of concentrations that occur at a specific time and site, are poorly correlated with actually observed concentrations and are much less reliable."*

This study utilises the CALPUFF dispersion model in full 3D mode, incorporating the 3D meteorological output from CALMET. The meteorological dataset developed for use in this assessment has been compiled to provide a robust and conservative assessment of potential downwind impacts due to particulate emissions from MOD 3 operations.

6 Existing Air Quality

For the purposes of assessing potential cumulative off-site air quality impacts, an estimation of ambient air quality concentrations is required. The methodology to estimate site-specific background ambient air quality concentrations adopted for this assessment is consistent with that used in the SLR Report in the Extension Project AQIA (SLR 2014), however the data have been updated to the 2014 calendar year consistent with the meteorological year used in the modelling.

This section outlines the methodology used to generate the background particulate dataset used in this assessment. It involves the following steps:

- Assessment of suitability of site-specific air quality monitoring to assess the pollutant levels in the immediate vicinity of the Project (**Section 6.1**).
- Selection of an appropriate background dataset representative of regional air quality without the influence of major industrial sources in the local area (ie other local emissions sources and Project-related emissions) (**Section 6.2**).
- Assessment of an appropriate incremental contribution (if any) to ambient particulate levels due to controlled process and fugitive emissions from other mining and ancillary operations in the local area, such as Excelsior Limestone Quarry, other activities related to forestry recreation and agriculture (**Section 6.2.3**).

6.1 Airly Mine Ambient Air Quality Monitoring Programme

Dust deposition monitoring has been conducted by Airly Mine at four monitoring locations, as shown in **Figure 10**.

A summary of the long term average monthly dust deposition rate for each monitoring location is presented in **Table 12** and **Figure 11**. All dust deposition results met the cumulative assessment criterion of 4 g/m^2/month.

It is noted that the long term average dust deposition rates shown in **Table 12** include the contribution of operations at Airly Mine and background dust levels.

Table 12 Summary of the Dust Deposition Monitoring Program at Airly Mine (2013-2017)

Dust Gauge	Annual Average Dust Deposition ($g/m^2/month$)					
	2013	2014	2015	2016	2017	Average
DM1	0.6	1.3	1.3	1.2	1.5	**1.2**
DM2	0.7	0.6	1.0	1.1	1.9	**1.1**
DM3	1.5	1.1	2.4	1.3	1.3	**1.5**
DM4	0.8	0.6	0.4	0.6	1.1	**0.7**

Figure 10 Locations of Dust Gauges – Airly Mine

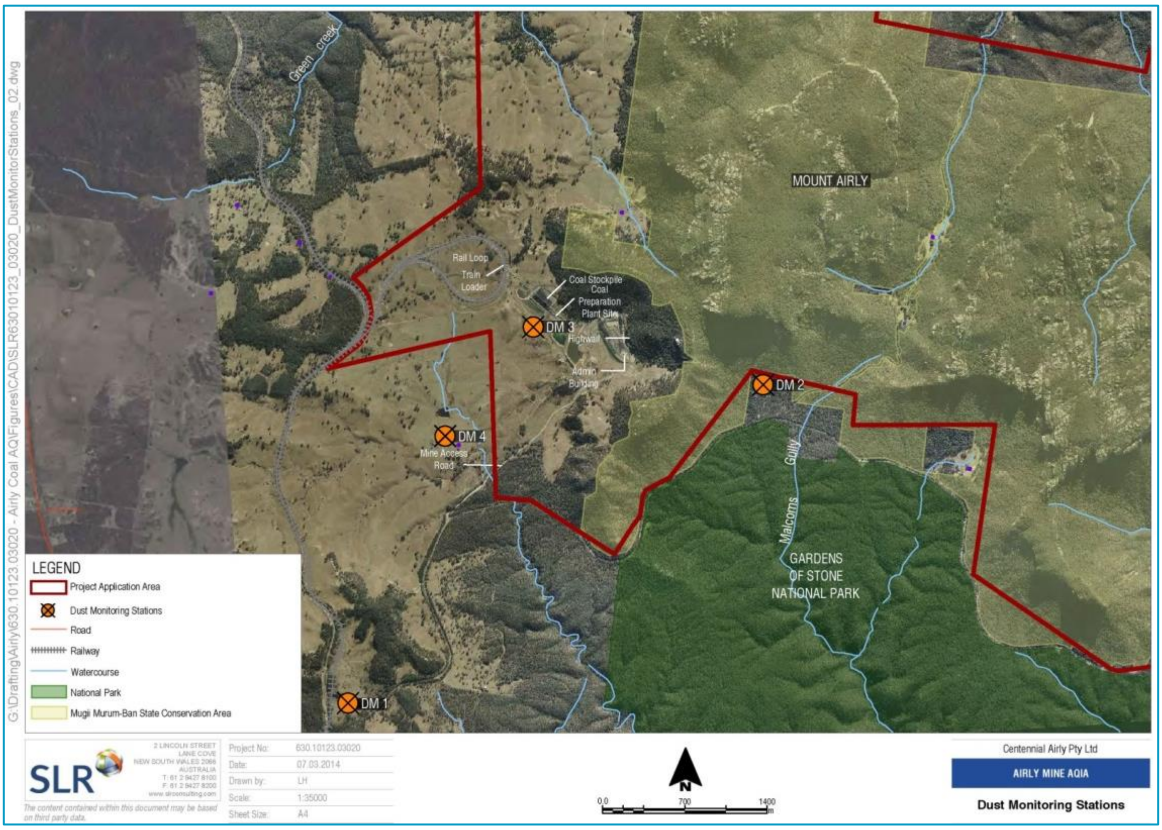
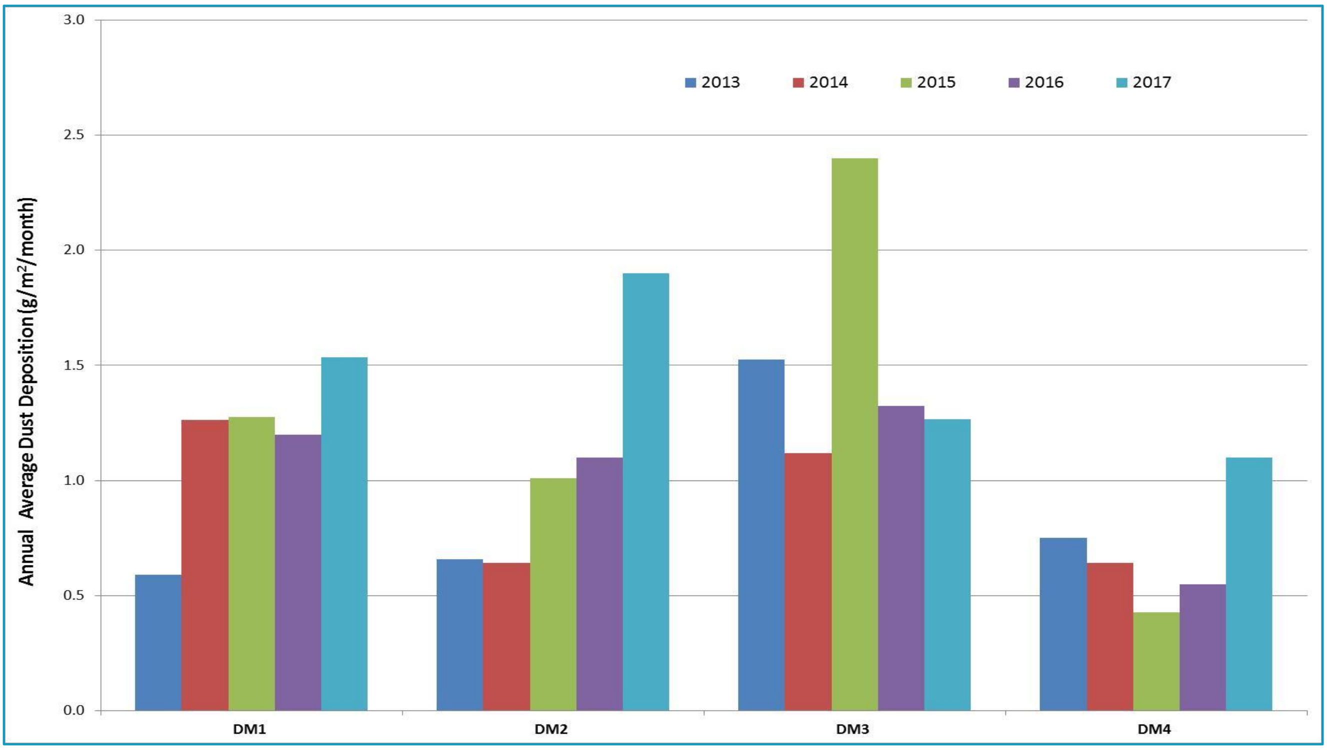


Figure 11 Summary of the Dust Deposition Monitoring Program at Airly Mine (2013-2017)



Considering that the monitored dust deposition rates include the contribution of current mining operations as well as regional background dust levels, based on the data presented in **Table 12**, a conservative background dust deposition rate of 1.2 g/m^2/month has been adopted for use in this assessment. This is consistent with the background dust deposition rate adopted in the Extension Project AQIA.

No monitoring of TSP, PM_{10} or $PM_{2.5}$ is conducted at the Airly Mine.

6.2 Regional Background Air Quality

The nearest OEH Air Quality Monitoring Station (AQMS) measuring continuous PM_{10} and $PM_{2.5}$ concentrations is located in Bathurst, approximately 50 km southwest of Airly Pit Top. The area surrounding the Bathurst AQMS is predominantly urban/residential in nature and PM_{10} concentrations recorded by this station are likely to be influenced by vehicle exhaust emissions and residential activities (eg lawn-mowing, wood heaters). Given the much lower population density in the region surrounding Airly Pit Top, emissions from these types of sources will be much less significant and the Bathurst measurements are likely to provide a conservative estimate of regional background particulate levels.

Further details regarding the particulate concentrations recorded in Bathurst are provided below.

6.2.1 PM_{10}

A summary of the 24-hour average PM_{10} concentrations measured by the Bathurst monitoring site during 2014 (contemporaneous with the meteorological data used in the modelling) is presented in **Figure 12** and **Table 13**.

Figure 12 24-Hour Average PM_{10} Data Monitored at Bathurst Monitoring Station (2014)

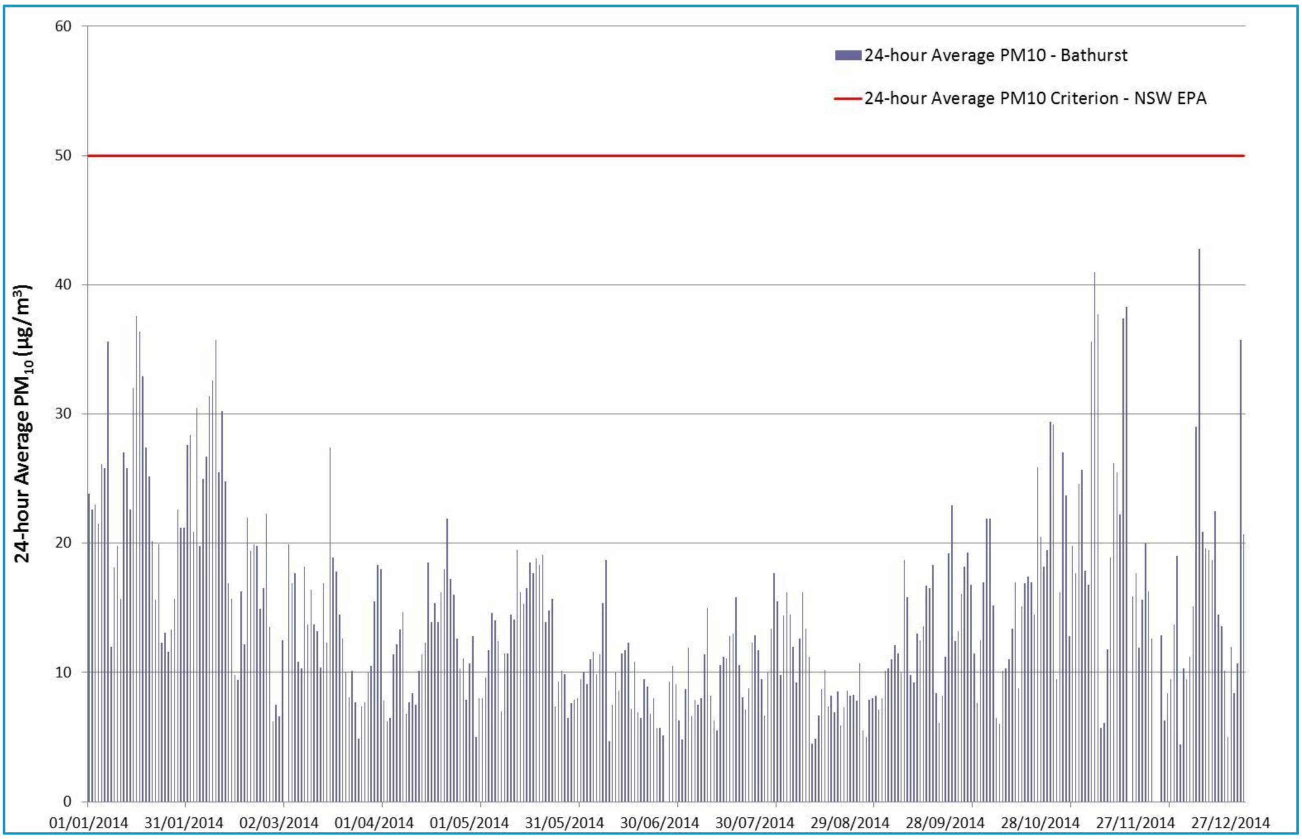


Table 13 Statistical Summary of Measured 24-Hour Average PM_{10} Concentration at Bathurst during 2014

Parameter	Value
Data availability (data capture rate)	360 days during 2014 (98.6%)
Annual Average	14.6 µg/m^3
1st highest 24-hour average	42.8 µg/m^3
2nd highest 24-hour average	41.0 µg/m^3
3rd highest 24-hour average	38.3 µg/m^3
4th highest 24-hour average	37.7 µg/m^3
5th highest 24-hour average	37.6 µg/m^3

A review of the measured 24-hour average PM_{10} concentrations indicates that the air quality in the region is generally good, with intermittent elevations in 24-hour average PM_{10}. Daily-varying PM_{10} data for 2014 from Bathurst were used in the modelling to represent regional background levels.

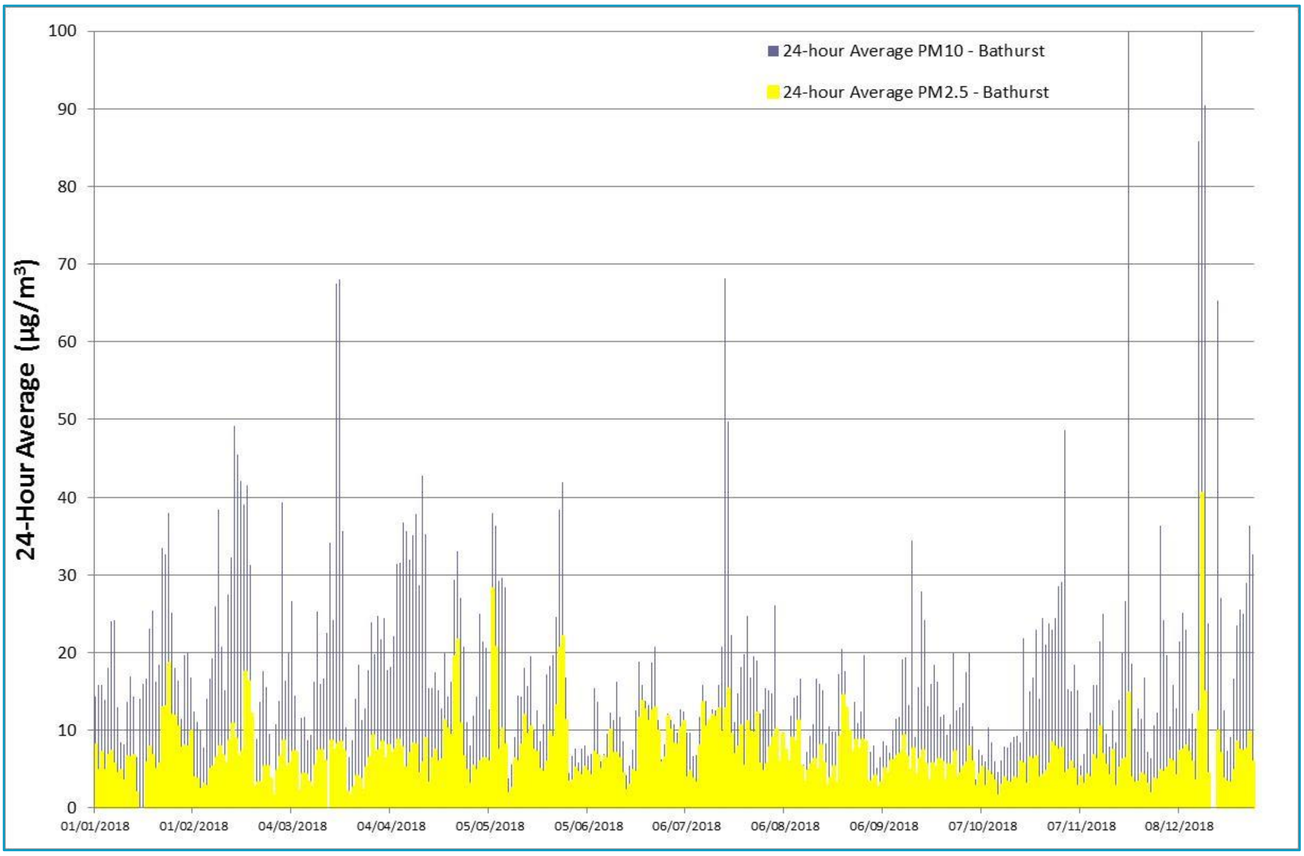
6.2.2 $PM_{2.5}$

Ambient background $PM_{2.5}$ concentrations have been monitored at Bathurst AQMS since 23 April 2016. In the absence of monitoring data for $PM_{2.5}$ for 2014, daily-varying ambient $PM_{2.5}$ concentrations have been estimated from the monitored 2014 PM_{10} concentrations using a $PM_{2.5}/PM_{10}$ ratio derived from concurrent measurements recorded during the latest full year, 2018.

The 24-hour average PM_{10} and $PM_{2.5}$ concentrations monitored during 2018 are shown in **Figure 13**. On average, the 24-hour average $PM_{2.5}$ concentrations were approximately 0.44 times the 24-hour average PM_{10} concentrations. Therefore for cumulative analysis purposes, the annual average background $PM_{2.5}$ concentration is estimated to be 6.4 µg/m^3.

It is noted that a few exceedances of the 24 hour average criteria for PM_{10} and $PM_{2.5}$ were recorded during 2018. At the time of writing this report, the air quality compliance report for 2018 has not been published by the NSW EPA.

Figure 13 24-Hour Average PM_{10} and $PM_{2.5}$ Data Monitored at Bathurst Monitoring Station (2018)



Note: x-axis is truncated at 100 µg/m^3.

6.2.3 TSP

No TSP monitoring is conducted by the Bathurst AQMS. In the absence of any monitoring data for TSP, daily-varying ambient TSP concentrations have been estimated from the monitored PM_{10} concentrations from Bathurst using a PM_{10}/TSP ratio of 0.5, which is typical for rural areas in Australia. This approach is consistent with that used in the Extension Project AQIA (SLR 2014).

Therefore, for cumulative analysis purposes, the annual average background TSP concentration is estimated to be 29.2 µg/m^3.

6.3 Surrounding Mining and Ancillary Industries

6.3.1 Excelsior Limestone Quarry:

Excelsior Limestone Quarry is located approximately 5 km northwest of the Airly Mine and is the only identified existing extractive industry in the locality. The air quality impact assessment for the Excelsior Limestone Quarry is not available publicly and therefore a quantitative assessment of the cumulative impacts is not possible for the Airly Mine and the Excelsior Limestone Quarry.

Considering the separation distance of 5 km between the Excelsior Limestone Quarry and the Airly Mine, it is not considered that it will have significant cumulative impacts with the Airly Mine operations and has therefore not been considered further.

6.3.2 Conservation and Recreation Activities:

Conservation and recreation related activities occur within the Mugii Murum-Ban State Conservation Area, Gardens of Stone National Park and other areas around the Extension Project. Potentially dust-generating activities will be limited to unsealed road use by vehicles. Given the likely infrequent nature of these activities, it is not considered that these will have a significant cumulative impact with the Project operation and they have not been considered further.

6.3.3 Agricultural Activities:

Agricultural activities occur in the region surrounding the PAA, with grazing being the most frequent agricultural related activity in the region. In SLR's opinion, grazing is likely to have negligible impact on ambient particulate levels, therefore agricultural activities are not considered to have a cumulative impact with the Project operation and have not been considered further.

6.4 Adopted Background for this Assessment

For the purpose of assessing potential cumulative air quality impacts, an estimation of the background TSP, PM_{10} and $PM_{2.5}$ concentrations and dust deposition rates is required. The site-specific background ambient air quality concentrations adopted for use in this assessment are summarised in **Table 14**.

Table 14 Adopted Background Data

Pollutant	Averaging Period	Regional Background	Notes
TSP	Annual	29.2 µg/m^3	Assumed to be twice the monitored PM_{10} concentrations at Bathurst
PM_{10}	24-hour	Daily varying	As monitored at Bathurst AQMS during 2014
	Annual	14.6 µg/m^3	As monitored at Bathurst AQMS during 2014
$PM_{2.5}$	24-hour	Daily varying	Assumed to be half of monitored PM_{10} concentrations at Bathurst
	Annual	7.3 µg/m^3	Assumed to be half of monitored PM_{10} concentrations at Bathurst
Deposited dust	Annual	1.2 g/m^2/month	Estimated from on-site monitoring programme

7 Air Quality Impact Assessment

TSP, PM_{10} and $PM_{2.5}$ concentrations and dust deposition rates predicted by the dispersion model at the residences/properties nominated in **Section 2.6** are presented in **Section 7.1** to **Section 7.4**. Pollutant isopleth plots are also provided in **Appendix B,** which show the maximum incremental particulate concentrations and deposition rates predicted during the Modified Extension Project operations.

As presented in **Section 6**, regional background particulate concentrations in the area surrounding Airly Pit Top have been estimated based on data recorded in Bathurst. Within this results section, the predicted incremental contribution during the Modified Extension Project operations has been added to the relevant background dataset in order to provide information on the potential cumulative impact of the proposed Airly Mine activities on air quality within the local area.

7.1 TSP

Table 15 presents the annual average incremental and cumulative TSP concentrations predicted at each of the identified receptors during the Modified Extension Project operations. Also presented in the table for comparison are the annual average TSP concentrations predicted for the current approved operations in the Extension Project AQIA (SLR 2014).

Contour plots of the predicted incremental increase in annual average TSP concentrations during the Modified Extension Project operations in isolation are presented in **Appendix B**.

Table 15 Predicted Annual Average TSP Concentrations

Receptor ID	Annual Average TSP Concentrations (µg/m^3)				
	MOD 3			Current Approved Operations[2]	
	Regional Background[1]	Incremental Impact	Cumulative Impact	Incremental Impact	Cumulative Impact
R1	29.2	1.3	30.5	1.1	19.8
R2	29.2	3.3	32.5	2.9	21.7
R3	29.2	2.5	31.7	1.8	20.5
R4	29.2	1.8	31.0	1.1	19.8
R5	29.2	1.6	30.8	1.2	20.0
R6	29.2	0.5	29.7	ND[3]	ND[3]
R7	29.2	0.2	29.4	0.1	18.9
R8	29.2	0.1	29.3	0.1	18.8
R17	29.2	0.5	29.6	0.5	19.3
R18	29.2	0.4	29.6	ND[3]	ND[3]
Criterion			**90**		**90**

[1] Regional background estimated from PM_{10} levels recorded by the Bathurst AQMS in 2014 using a PM_{10}/TSP ratio of 0.5 (See **Section 6.2.3**).
[2] As reported in the Extension Project AQIA for Scenario 3 - Proposed Scenario (SLR 2014).
[3] These receptor locations were not assessed in the Extension Project AQIA (SLR 2014).

Table 15 shows that the cumulative annual average TSP concentrations at all nominated residences/properties surrounding the Airly Pit Top are predicted to be well below the criterion of 90 µg/m^3.

7.2 PM_{10}

7.2.1 Maximum 24-Hour Average PM_{10} Concentrations

Table 16 presents the maximum incremental and cumulative 24-hour average PM_{10} concentrations predicted at each of the identified receptors during the Modified Extension Project operations. Also presented in the table for comparison are the 24-hour average PM_{10} concentrations predicted for the current approved operations in the Extension Project AQIA (SLR 2014).

Contour plots of the predicted incremental increase in maximum 24-hour average PM_{10} concentrations for the proposed Modified Extension Project operations in isolation are presented in **Appendix B**.

Table 16 Predicted 24-Hour Average PM_{10} Concentrations

Receptor ID	Maximum 24-Hour Average PM_{10} Concentrations (µg/m^3)				
	MOD 3			Current Approved Operations[2]	
	Regional Background[1]	Incremental Impact	Cumulative Impact	Incremental Impact	Cumulative Impact
R1	42.8	4.9	43.7	8.6	<43.4
R2	42.8	6.5	45.1	7.9	<43.4
R3	42.8	6.4	44.1	6.1	<43.4
R4	42.8	4.6	43.1	4.5	<43.4
R5	42.8	3.6	44.6	3.9	<43.4
R6	42.8	2.0	43.0	ND[3]	ND[3]
R7	42.8	1.8	42.8	0.5	<43.4
R8	42.8	0.9	42.8	0.2	<43.4
R17	42.8	1.7	42.9	7.6	<43.4
R18	42.8	1.5	42.9	ND[3]	ND[3]
Criterion			**50**		**50**

[1] Daily varying regional background PM_{10} values used as recorded by the Bathurst AQMS in 2014 (See **Section 6.2.1**).
[2] As reported in the Extension Project AQIA for Scenario 3 - Proposed Scenario (SLR 2014).
[3] These receptor locations were not assessed in the Extension Project AQIA (SLR 2014).

Table 16 shows that the cumulative 24-hour average PM_{10} concentrations at all nominated residences/properties surrounding the Airly Pit Top are predicted to be well below the criterion of 50 µg/m^3.

It can be seen from **Table 16** that the incremental PM_{10} concentrations predicted at most receptors (ie aside from R3, R4, R7 and R8) are slightly lower than the incremental impacts predicted for the current approved operations in the Extension Project AQIA (SLR 2014) despite the proposed increase in the ROM throughput. This is due to updates in the emission factors, meteorological data and modelling methodology (ie wind speed dependent wind erosion emission rates). It is noted that despite the lower incremental impacts predicted at some receptors, the predicted cumulative impacts are similar. This is due to changes in the regional background PM_{10} levels used in this modelling study compared to the data used in the Extension Project AQIA (SLR 2014).

7.2.2 Annual Average PM_{10} Concentrations

Table 17 presents the incremental and cumulative annual average PM_{10} concentrations predicted at each of the identified receptors during the Modified Extension Project operations. These predictions are compared to the annual average criterion set out in the June 2019 consent for the site of 25 µg/m^3.

Also presented in the table for comparison, are the annual average PM_{10} concentrations predicted for the current approved operations in the Extension Project AQIA (SLR 2014). These predictions are compared to the annual average criterion used in the 2014 assessment of 30 µg/m^3 as that was the relevant criterion at the time of the extension project. These predictions are also well below the annual average criterion set out in the June 2019 consent for the site of 25 µg/m^3.

Contour plots of the predicted incremental increase in annual average PM_{10} concentrations for the for the Modified Extension Project operations in isolation are presented in **Appendix B**.

Table 17 Predicted Annual Average PM_{10} Concentrations

Receptor ID	Annual Average PM_{10} Concentrations (µg/m^3)				
	MOD 3			Current Approved Operations[2]	
	Regional Background[1]	Incremental Impact	Cumulative Impact	Incremental Impact	Cumulative Impact
R1	14.6	0.5	15.1	0.3	9.6
R2	14.6	1.3	15.9	0.7	10.1
R3	14.6	1.0	15.6	0.5	9.8
R4	14.6	0.8	15.3	0.3	9.7
R5	14.6	0.6	15.2	0.3	9.7
R6	14.6	0.2	14.8	ND[3]	ND[3]
R7	14.6	0.1	14.7	<0.1	<9.5
R8	14.6	<0.1	14.6	<0.1	<9.5
R17	14.6	0.2	14.8	0.1	9.5
R18	14.6	0.1	14.7	ND[3]	ND[3]
Criterion			**25**		**30**

[1] Regional background PM_{10} level recorded by the Bathurst AQMS in 2014 (See **Section 6.2.1**).
[2] As reported in the Extension Project AQIA for Scenario 3 - Proposed Scenario (SLR 2014).
[3] These receptor locations were not assessed in the Extension Project AQIA (SLR 2014).

Table 17 shows that the cumulative annual average PM_{10} concentrations at all nominated residences/properties surrounding the Airly Pit Top are predicted to be well below the criterion of 25 µg/m^3.

It can be seen from **Table 17** that the incremental annual average PM_{10} concentrations predicted at most receptors are slightly higher than the incremental impacts predicted for the current approved operations in the Extension Project AQIA (SLR 2014). This variation in the predicted incremental impacts is due to updates in the emission factors, meteorological data and modelling methodology (ie wind speed dependent wind erosion emission rates). The predicted cumulative impacts are also higher than those predicted for the current approved operations in the Extension Project AQIA (SLR 2014). This is due to changes in the regional background PM_{10} levels used in this modelling study compared to the data used in the Extension Project AQIA (SLR 2014).

7.3 $PM_{2.5}$

7.3.1 Maximum 24-Hour Average $PM_{2.5}$ Concentrations

Table 18 presents the maximum 24-hour average $PM_{2.5}$ concentrations predicted at each of the identified receptors during the Modified Extension Project. Contour plots of the predicted incremental increase in maximum 24-hour average $PM_{2.5}$ concentrations for the Modified Extension Project in isolation are presented in **Appendix B**.

Table 18 Predicted 24-Hour Average $PM_{2.5}$ Concentrations

Receptor ID	Maximum 24-Hour Average $PM_{2.5}$ Concentrations (µg/m³)				
	MOD 3			Current Approved Operations[2]	
	Regional Background[1]	Incremental Impact	Cumulative Impact	Incremental Impact	Cumulative Impact[3]
R1	18.8	0.6	18.9	1.4	NA
R2	18.8	0.8	19.1	1.4	NA
R3	18.8	0.9	19.0	0.8	NA
R4	18.8	0.6	18.9	0.6	NA
R5	18.8	0.5	19.1	0.7	NA
R6	18.8	0.3	18.9	ND[4]	ND[4]
R7	18.8	0.2	18.8	0.1	NA
R8	18.8	0.1	18.8	<0.1	NA
R17	18.8	0.2	18.9	<0.1	NA
R18	18.8	0.2	18.8	ND[4]	ND[4]
Criterion			**25**		**25**

[1] Daily varying background $PM_{2.5}$ values used estimated from PM_{10} concentrations recorded by the Bathurst AQMS in 2014 using a $PM_{10}/PM_{2.5}$ ratio of 0.44 (See **Section 6.2.2**).

[2] As reported in the Extension Project AQIA for Scenario 3 - Proposed Scenario (SLR 2014).

[3] Cumulative $PM_{2.5}$ concentrations not assessed in the Extension Project AQIA due to background data not being available.

[4] These receptor locations were not assessed in the Extension Project AQIA (SLR 2014).

While the June 2019 update of the consent did not include criteria for $PM_{2.5}$, the modelling results indicate that the cumulative 24-hour average $PM_{2.5}$ concentrations at all nominated residences/properties surrounding the Airly Pit Top are predicted to be well below the Ambient Air Quality NEPM and Approved Methods criterion of 25 µg/m³.

It can be seen from **Table 18** that the incremental $PM_{2.5}$ concentrations predicted at most receptors are slightly lower that the incremental impacts predicted for the current approved operations in the Extension Project AQIA (SLR 2014) despite the proposed increase in the ROM throughput. This is due to updates in the emission factors, meteorological data and modelling methodology (ie wind speed dependent wind erosion emission rates). Cumulative impacts were not predicted for $PM_{2.5}$ in the Extension Project AQIA (SLR 2014) due to unavailability of the background $PM_{2.5}$ concentrations. In the current assessment, the $PM_{2.5}$ levels are based on the monitored PM_{10} levels scaled according to the $PM_{2.5}$:PM_{10} levels recorded at Bathurst AQMS (see **Section 6.2.2**).

7.3.2 Annual Average $PM_{2.5}$ Concentrations

Table 19 presents the annual average $PM_{2.5}$ concentrations predicted at each of the identified receptors during the Modified Extension Project. Contour plots of the predicted incremental increase in annual average $PM_{2.5}$ concentrations for the Modified Extension Project in isolation are presented in **Appendix B**.

Table 19 Predicted Annual Average $PM_{2.5}$ Concentrations

Receptor ID	Annual Average $PM_{2.5}$ Concentrations ($\mu g/m^3$)				
	MOD 3			Current Approved Operations[2]	
	Regional Background[1]	Incremental Impact	Cumulative Impact	Incremental Impact	Cumulative Impact[3]
R1	6.4	0.1	6.5	<0.1	NA
R2	6.4	0.2	6.6	0.1	NA
R3	6.4	0.1	6.6	0.1	NA
R4	6.4	0.1	6.5	<0.1	NA
R5	6.4	0.1	6.5	<0.1	NA
R6	6.4	<0.1	<6.5	ND[4]	ND[4]
R7	6.4	<0.1	<6.5	<0.1	NA
R8	6.4	<0.1	<6.5	<0.1	NA
R17	6.4	<0.1	<6.5	<0.1	NA
R18	6.4	<0.1	<6.5	ND[4]	ND[4]
Criterion			**8**		**8**

[1] Regional background estimated from PM_{10} levels recorded by the Bathurst AQMS in 2014 using a PM_{10}/$PM_{2.5}$ ratio of 0.44 (See **Section 6.2.2**).
[2] As reported in the Extension Project AQIA for Scenario 3 - Proposed Scenario (SLR 2014).
[3] Cumulative $PM_{2.5}$ concentrations not assessed in the Extension Project AQIA due to background data not being available
[4] These receptor locations were not assessed in the Extension Project AQIA (SLR 2014).

While the June 2019 update of the consent did not include criteria for $PM_{2.5}$, the modelling results indicate that the cumulative annual average $PM_{2.5}$ concentrations at all nominated residences/properties surrounding the Airly Pit Top are predicted to be well below the Ambient Air Quality NEPM and Approved Methods criterion of 8 $\mu g/m^3$.

It can be seen from **Table 19** that the incremental annual average $PM_{2.5}$ concentrations predicted at most receptors are similar to the incremental impacts predicted for the current approved operations in the Extension Project AQIA (SLR 2014). Cumulative impacts were not predicted for $PM_{2.5}$ in the Extension Project AQIA (SLR 2014) due to unavailability of the background $PM_{2.5}$ concentrations. In the current assessment, the $PM_{2.5}$ levels are based on the monitored PM_{10} levels scaled according to the $PM_{2.5}$:PM_{10} levels recorded at Bathurst AQMS (see **Section 6.2.2**).

7.4 Dust Deposition Rates

Table 20 shows the annual average dust deposition rates predicted at each of the identified receptors during the Modified Extension Project. Contour plots of the predicted incremental increase in annual average dust deposition rates for the Modified Extension Project in isolation are presented in **Appendix B**.

Table 20 Predicted Annual Average Dust Deposition Rates

Receptor ID	Annual Average Dust Deposition Rate (g/m^2/month)				
	MOD 3			Current Approved Operations[2]	
	Regional Background[1]	Incremental Impact	Cumulative Impact	Incremental Impact	Cumulative Impact
R1	1.2	0.1	1.3	<0.1	<1.3
R2	1.2	0.1	1.3	<0.1	<1.3
R3	1.2	0.1	1.3	<0.1	<1.3
R4	1.2	0.1	1.3	<0.1	<1.3
R5	1.2	<0.1	<1.3	<0.1	<1.3
R6	1.2	<0.1	<1.3	ND[3]	ND[3]
R7	1.2	<0.1	<1.3	<0.1	<1.3
R8	1.2	<0.1	<1.3	<0.1	<1.3
R17	1.2	<0.1	<1.3	<0.1	<1.3
R18	1.2	<0.1	<1.3	ND[3]	ND[3]
Criterion			**4.0**		**4.0**

[1] Regional background estimated from dust deposition rates measured by the Airly Mine air quality monitoring programme (See **Section 6.1**).
[2] As reported in the Extension Project AQIA for Scenario 3 - Proposed Scenario (SLR 2014).
[3] These receptor locations were not assessed in the Extension Project AQIA (SLR 2014).

The results indicate that incremental and cumulative annual average dust deposition rates at all nominated residences/properties surrounding the Airly Pit Top are predicted to be well below the criterion of 2 g/m^2/month (incremental increase in dust deposition) and below 4 g/m^2/month (cumulative dust deposition).

Also, for comparison purposes only, the predicted impacts for the 'proposed scenario' in the Extension Project AQIA (SLR 2014) are also presented in **Table 20**. It can be seen that there is minimal variation in the predicted incremental and cumulative impacts between the Extension Project AQIA (SLR 2014) and the current assessment.

8 Greenhouse Gas Assessment

8.1 Background

8.1.1 The Greenhouse Effect

The greenhouse effect is a process that aids in heating the Earth's surface and atmosphere. It results from the fact that certain atmospheric gases, such as carbon dioxide, water vapour, and methane, are able to change the energy balance of the planet by absorbing longwave radiation emitted from the Earth's surface.

The amount of heat energy added to the atmosphere by the greenhouse effect is controlled by the concentration of GHGs in the Earth's atmosphere. Emissions of GHGs can result from natural or man-made (anthropogenic) sources. The separation of natural versus anthropogenic sources is complicated by the fact that natural processes may be manipulated by humans, resulting in increased emissions of GHGs.

Examples of natural sources include the decomposition or burning of plant material and emissions of methane from animal digestion processes. Emissions that occur as a result of human activities include the burning of fossil fuels, the use and leakage of refrigerants, and the use of fertilisers. The clearing of forest and other vegetation by humans also contributes to the greenhouse effect. Vegetation and soils typically act as a carbon sink, storing carbon dioxide that is absorbed through photosynthesis. When the land is disturbed, part of the stored carbon dioxide is emitted, through mechanisms such as burning or decomposition of vegetation etc., and re-enters the atmosphere.

8.1.2 Greenhouse Gases

A number of gases are involved in the human-caused enhancement of the greenhouse effect. These include:

- **Carbon dioxide** (CO_2): A minor but very important component of the atmosphere, CO_2 is released through natural processes such as respiration and volcanic eruptions and through human activities such as deforestation, land use changes, and burning fossil fuels.
- **Methane** (CH_4): A hydrocarbon gas produced both through natural sources and human activities, including the decomposition of wastes in landfills, agriculture (especially paddy rice cultivation), and ruminant digestion and manure management associated with domestic livestock. On a molecule-for-molecule basis, CH_4 is a far more active GHG than CO_2, but also one which is much less abundant in the atmosphere.
- **Nitrous oxide** (N_2O): A powerful GHG produced by soil cultivation practices, especially the use of commercial and organic fertilizers, fossil fuel combustion, nitric acid production, and biomass burning.
- **Chlorofluorocarbons** (CFCs): Synthetic compounds entirely of industrial origin used in a number of applications, but now largely regulated in production and release to the atmosphere by international agreement for their ability to contribute to destruction of the ozone layer.

For comparative purposes, non-CO_2 GHGs are awarded a “CO_2-equivalence” (CO_2-e) based on their contribution to the enhancement of the greenhouse effect. The CO_2-e of a gas is calculated using an index called the Global Warming Potential (GWP) which represents the combined effect of the differing times GHGs remain in the atmosphere and their relative effectiveness in absorbing outgoing infrared radiation.

The GWPs of relevance to this assessment, as taken from the IPCC's Fourth (AR4) and Fifth (AR5) Assessment Reports are presented in **Table 21**. The AR5 values (IPCC, 2013) are the most recent, but the AR4 values (IPCC, 2007) are also listed because they are currently used in Australia for inventory and reporting purposes.

Table 21 Global Warming Potentials

Gas	Chemical Formula	IPCC GWP (100 year horizon)	
		Fourth Assessment Report [1]	Fifth Assessment Report [2]
Carbon dioxide	CO_2	1	1
Methane	CH_4	25	28
Nitrous oxide	N_2O	298	265
Hydrofluorocarbons [3]	CH_2FCF_3	1,430	1,300
Sulphur hexafluoride	SF_6	22,800	23,500

1: (IPCC, 2007)

2: (IPCC, 2013)

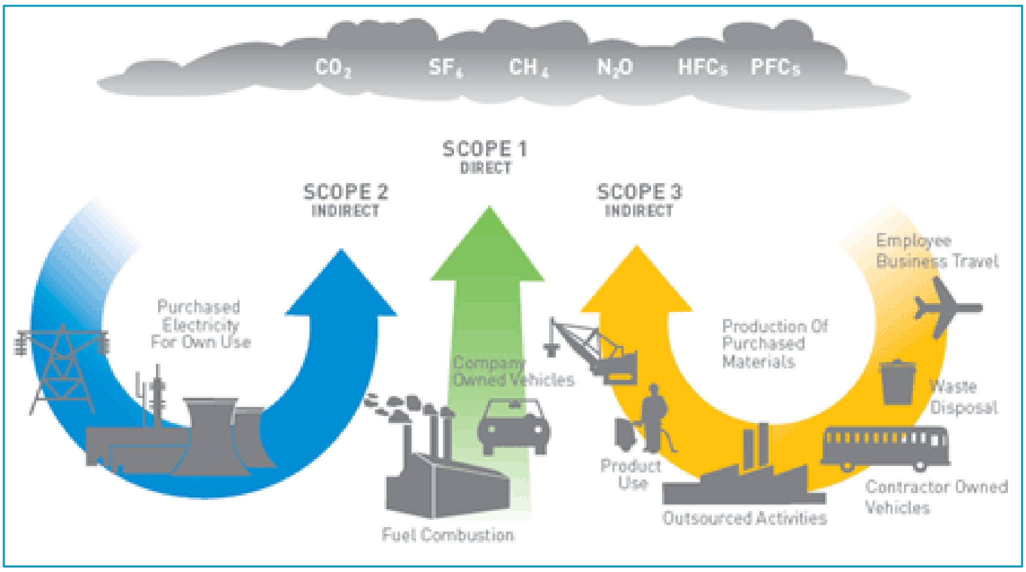
3: HFCs assumed to be HFC-134a

8.1.3 Scope Definition

Emissions of GHG can be termed as being *Scope 1, Scope 2* or *Scope 3*, and '*direct*' or '*indirect*' emissions (**Figure 14**). A discussion of what each Scope refers to, and how it relates to the Project is presented below.

The definitions below have been taken from the WRI and WBCSD GHG Protocol (WRI, 2004). These documents provide detailed information on the activities which should be included in each of the Scope 1, 2 and 3 boundaries. The definition of these boundaries allows the determination of those sources of GHG emissions which can be directly controlled by Centennial (Scope 1 and Scope 2), or those which Centennial would have some, but limited control over (Scope 3).

Figure 14 Scope 1, 2 and 3 GHG Emissions as Defined in the GHG Protocol Initiative



Source: WRI (2004)

Direct Emissions (Scope 1)

Direct emissions of GHG are termed Scope 1 emissions and are produced from sources within the boundary of an organisation and as a result of the organisation's activities. These direct emissions mainly arise from the following sources:

- Transportation of materials, products, waste or people e.g. the combustion of diesel in mobile equipment, including on-road and off-road vehicles and stationary equipment;
- Generation of electricity, heat and/or steam, e.g. the combustion of diesel in generators;
- Fugitive emissions, both intentional and unintentional, e.g. through the use of switchgear, methane from exposed coal, land clearing etc; and
- On-site waste management, e.g. solid and liquid waste management through landfill, sewage treatment, incineration etc.

Indirect Emissions (Scope 2)

Indirect emissions are generated in the wider economy as a consequence of an organisation's activities but are physically produced by the activities of another organisation.

The most important category of indirect emissions is from the consumption of purchased electricity (Scope 2 emissions). Scope 2 emissions relate to the GHG emissions from the generation of purchased electricity consumed in owned or controlled equipment or operations. In Australia, this is primarily from coal fired power generation.

Indirect Emissions (Scope 3)

Scope 3 indirect emissions are related to the upstream emissions generated in the extraction and production of fossil fuels and in the emissions from contracted/outsourced activities.

Scope 3 emissions are generally Scope 1 or 2 emissions for other companies. For example, in general, diesel use by contractors is a Scope 3 emission, yet is referred to as a Scope 1 emission in the GHG inventory of the contractor. Combustion of coal to produce electricity will result in a Scope 1 emission at the power station or a Scope 2 emission for industry or householders.

Scope 3 emissions may be, but are not required to be, reported as part of a project's GHG emissions assessment.

8.2 Relevant Legislation, Guidelines and Policies

8.2.1 The International Response to Climate Change

Intergovernmental Panel on Climate Change

The Intergovernmental Panel on Climate Change (IPCC) is the international body tasked with assessing scientific knowledge on climate change. It was established by the World Meteorological Organization (WMO) and the United Nations Environment Programme (UNEP) in 1988, and endorsed by the UN General Assembly, to provide policy makers with regular scientific assessments of climate change, its impacts and future risks, and the mitigation and adaptation options.

The first meeting of the IPCC was held in Geneva in 1988. Since it was established, the IPCC has prepared five assessment reports, which have provided key inputs into the international negotiations to tackle climate change. The Fifth Assessment Report was released by IPCC in March 2014 which considers new evidence of climate change based on independent analyses from observations of the climate system and includes refined estimates of impact probability.

Kyoto Protocol

The Kyoto Protocol is an international agreement linked to the United Nations Framework Convention on Climate Change (UNFCCC). The major feature of the Kyoto Protocol is that it sets binding targets for 37 industrialised countries and the European community for reducing GHG emissions. These targets amount to an average of five per cent reduction against 1990 levels over the five-year period 2008-2012.

Countries must meet their targets primarily through national measures to avoid, abate or offset GHG emissions. However, the Kyoto Protocol offers additional means of meeting targets through the following market-based mechanisms:

- Emissions trading: Gives corporations or individuals the opportunity to offset their GHG emission liability by purchasing Kyoto certified carbon credits generated by carbon emission reduction projects.
- Clean Development Mechanism (CDM): Where industrialised (or "Annex One" as defined in the Protocol) nations can implement Kyoto approved GHG reduction projects in developing nations (or "Non-Annex One" as defined in the Protocol) in order to generate Carbon Emission Reductions (CERs).
- Joint Implementation (JI): Allows developed (Annex One) nations to engage in emission reduction projects with other developed (Annex One) nations to generate CERs.

These mechanisms help stimulate investment in GHG-friendly actions and technologies and to meet emission targets in a cost effective manner. Comprehensive mechanisms have been set up under the UNFCCC that aim to ensure the validity and credibility of emissions avoidance, abatement and offset projects under the CDM and JI.

Paris Agreement

The Paris Agreement, from the 21st Conference of the Parties (COP21) in Paris in December 2015, sets in place a framework for all countries to take climate action from 2020, building on the existing international efforts in the period up to 2020. Key outcomes included:

- A global goal to hold average temperature increase to well below 2°C and pursue efforts to keep warming below 1.5°C above pre-industrial levels.
- All countries to set mitigation targets from 2020 and review targets every five years to build ambition over time.
- Robust transparency and accountability rules to provide confidence in countries' actions and track progress towards targets.
- Promoting action to adapt and build resilience to climate impacts.
- Financial, technological and capacity building support to help developing countries implement the Agreement.

The Greenhouse Gas Protocol Initiative

Greenhouse gas accounting and reporting principles are intended to underpin all aspects of GHG accounting and reporting. The five principles outlined below are consistent with the World Resources Institute/World Business Council for Sustainable Development (WRI/WBCSD) GHG Protocol Initiative (a globally adopted and leading GHG accounting strategy), and ISO 14064-1, 2, and 3 (GHG) guidelines (internationally accepted best practice). These principles are based on financial accounting and reporting standards and are taken from the GHG Protocol documentation (WRI, 2004).

The following outlines the basic requirements of any GHG assessment, as defined by WRI/WBCSD.

- **Relevance:** The relevance of a company's GHG report relates to the information which it contains. The information should allow stakeholders, both internal and external to the organisation, to make informed decisions about GHG management. An important aspect of relevance is the selection of appropriate boundary conditions which reflect the reality of the company's operations. The operation of the company, the purpose of the information and the needs of users will all inform the choice of the inventory boundary.
- **Completeness:** All relevant emission sources within the chosen inventory boundary need to be accounted for so that a comprehensive and meaningful inventory is compiled. WRI (2004) states that no materiality threshold (or minimum emissions accounting threshold) should be defined as this is not in line with the principle of completeness. However, if emissions are not able to be estimated or estimated at a sufficient level of quality, then these should be transparently documented and justified.
- **Consistency:** Consistency in an emissions inventory allows stakeholders to compare GHG emissions performance from year to year. This consistency also allows trends to be identified and performance against objectives and targets to be tracked. Any changes in the inventory (accounting approaches, boundaries, calculation methods) need to be transparently documented and justified.
- **Transparency:** All processes, procedures, assumptions and limitations of an inventory should be presented clearly and accurately. Information needs to be recorded, compiled and analysed in a way that enables internal reviewers and external auditors to verify the credibility of the inventory. Specific exclusions and inclusions are to be documented and justified, assumptions disclosed and appropriate references provided for the calculation methods applied and the data sources used. Transparency is essential in the production of a credible GHG inventory.
- **Accuracy:** Accuracy describes how close the estimates of GHG emissions are to the 'true' value. The accuracy of a GHG inventory should be sufficient for stakeholders to make decisions with reasonable assurance of the integrity of the reported information. Quality management measures should be implemented to maximise inventory accuracy.

Additional to the principles of GHG reporting, data materiality can be used to simplify the accounting process by omitting low level emission sources which do not make a significant contribution to overall Project emissions. Emissions which are within emission reporting errors or make up less than 5% or of the total Project emissions are deemed to be immaterial as their inclusion or omission does not have significant bearing on Project behaviours or processes (DoE, 2008)

8.2.2 Australian GHG Policy and Regulation

Australia ratified the Kyoto Protocol (the Protocol) in 2007 and as such made a commitment to reducing GHG emissions. In response to this ratification Australia adopted a number of Federal and State Government initiatives to achieve a reduction in GHG emissions to 5% below 2000 levels.

Ahead of the Paris Conference, countries were invited to submit indicative post-2020 targets, known as Intended Nationally Determined Contributions (INDCs). Australia's target is to reduce emissions by 26-28% below 2005 levels by 2030, which builds on the 2020 target of reducing emissions by 5% below 2000 levels.

Australia's targets are proposed to be achieved through a suite of policies to reduce emissions, encourage technological innovation and expand the clean energy sector.

National Greenhouse and Energy Reporting (NGER)

The NGER Act 2007 provides a single national framework for the reporting and dissemination of information about the GHG emissions, GHG projects, and energy use and production of corporations. It makes registration and reporting mandatory for corporations whose energy production, energy use or greenhouse gas emissions meet specified thresholds. Centennial reports emissions from the corporation on an annual basis, including those from Airly Mine, in accordance with the NGER Act.

National Greenhouse Accounts (NGA) Factors

The National Greenhouse Accounts (NGA) Factors document is prepared by the Department of the Environment and Energy (DEE) and is designed for use by companies and individuals to estimate greenhouse gas emissions. The NGA default emission factors listed in this document have been estimated by the DEE using the Australian Greenhouse Emissions Information System (AGEIS) and are determined simultaneously with the production of Australia's National Greenhouse Accounts. This promotes consistency between inventories at company or facility level and the emission estimates presented in the National Greenhouse Accounts. The methods used at the national level, and reflected in the NGA Factors document, are consistent with international guidelines and are subject to international expert review each year.

8.2.3 Centennial Climate Change Policy

Centennial recognises that climate change response is an important aspect of its business that presents both challenges and opportunities. Centennial believes GHG's can be reduced, mitigated and offset, and also that coal will remain a significant energy source in a carbon constrained future and as such, low emission technologies are essential. Consequently, Centennial is implementing a Climate Change strategy that combines strategic, operational, commercial and technical aspects of climate change. The strategy includes a Climate Change Policy and development of a GHG Management System. Centennial is pursuing actions to:

- Reduce GHG emissions through energy efficiency and fugitive emission abatement; and
- Accurately monitor fugitive emissions from underground coal mining operations.

8.3 Estimated GHG Emissions and Assessment

A quantitative GHG assessment has been performed to determine the potential impact of MOD 3 on the GHG emissions from Airly Mine. In accordance with standard practice, this assessment has been guided with reference to the requirements of the GHG Protocol and IPCC and Australian Government emission calculation methodologies.

The calculation of GHG emissions from MOD 3 has been performed in a five stage process:

- Definition of the Project boundary (**Section 8.3.1**)
- Identification of emission sources within the Project boundary (**Section 8.3.2**)
- Identification of activity data for each emission source (**Section 8.3.3**)

- Identification of emission calculation methodologies for each source (**Section 8.3.4**)
- Calculation of GHG emissions (**Section 8.3.5**)

8.3.1 Definition of the Project Boundary

The geographical and operational boundary set for the GHG assessment includes the Airly Mine underground workings, coal storage, handling and processing at the surface site. Fugitive emissions of CO_2 and CH_4 from the Airly Mine ventilation system are included, however any additional fugitive CH_4 emissions that arise during post-mining activities, such as transportation and stockpiling of the coal, due to the release of residual gases not released during the mining process, are not included to avoid any double-counting.

Airly Mine uses both Centennial-owned and Pacific National Trains to transport product coal to Newcastle Port and to the Eraring and Vales Point Power Stations. The Centennial trains are not owned by Airly Mine but by Centennial Coal Infrastructure and are operated by an external company, with the costs invoiced to Centennial. Delivery of the product coal has therefore been included as a Scope 3 emission source.

Up to 170 ML/year of water will also be imported from Charbon Colliery by rail for use at Airly Mine. GHG emissions associated with this activity have been included as Scope 3 emissions.

A range of other sources of Scope 3 GHG emissions associated with production of fuels used on site, staff transport, solid waste disposal and end use of the product coal have also been estimated, however emissions associated with international shipping of the coal has not been included due to uncertainties in the relevant activity data (destination, distance travelled, etc).

Boundaries of a GHG assessment can be chosen to include/exclude sources as long as the process of definition is transparent and the inventory for the selected boundary is as complete as possible (refer **Section 8.2.1**).

8.3.2 Identification of Emission Sources

The proposed changes to the Airly Mine operations associated with MOD 3 that have the potential to increase GHG emissions from the site have been identified as follows:

- Scope 1:
    - Increased diesel use in mining equipment due to the proposed increase in ROM throughput
    - Increased use of oils and greases in equipment due to proposed increase in ROM throughput
    - Increased ventilation system flowrate associated with the proposed increase in ROM throughput as well as the addition of panel and pillar equipment
- Scope 2:
    - Increased electricity consumption associated with the proposed increase in ROM throughput as well as the addition of panel and pillar equipment
- Scope 3:
    - Production and transport of additional diesel, greases and oil consumed at the site
    - Transmission losses associated with the additional electricity consumed at the site
    - Rail transport of additional product coal
    - Rail transport of water from Charbon Colliery

- Disposal of increased volumes of solid waste generated by the site
- Additional staff traffic movements due to the increase workforce
- End use (combustion) of the additional product coal produced

8.3.3 Activity Data

Projected activity data for the current approved and proposed MOD 3 operations have been estimated based on data provided by Centennial for historical operations at Airly Mine for the 2017/18 financial year, the approved and proposed min ROM production rates and activity data compiled for the GHG assessment performed by SLR in 2014 for the Extension Project (SLR, 2014).

The average ROM coal throughput for the 2017/18 financial year was 0.882 Mtpa and the amount of product coal produced was 0.838 Mtpa, giving a ROM:Product coal ratio of 95%. This ratio was used to estimate product coal throughputs for the current approved and proposed MOD 3 operations.

The activity data used in the calculations is shown in **Table 22**.

Table 22 Airly Mine GHG Emission Inventory Activity Data

Parameter	2017/2018 Financial Year	Current Approved	Proposed (MOD 3)
ROM coal throughput (Mtpa)	0.88	1.80	3.00
Product coal throughput (Mtpa)	0.84	1.71	2.85
Trains per day (annual average) for coal transport	0.98	2.0	3.0
Distance by rail to Newcastle Port (km)	420	420	420
Average distance by rail to Eraring/Vales Point PSs (km)	450	450	450
Percentage of coal to Newcastle Port (%)	40	40	70
Diesel consumption (kL/annum)	210	429	716
Oil consumption (kL/annum)	54	109	182
Grease consumption (kL/annum)	1.2	2.5	4.2
SF_6 charge (kg)	24	24	24
Ventilation gas flowrate (m^3/s)	185	285	416
CO_2 concentration in vent gas (%)	0.07	0.07	0.07
CH_4 concentration in vent gas (%)	0	0	0
Number of trains delivering water per annum (trips/annum)	0	0	217
Volume of water transported by rail (m^3/train)	0	0	780
Distance by rail to Charbon Colliery (km)	35	35	35
Electricity consumption (kWh/annum)	10,569,416	21,570,468	36,022,682
Number of Full Time Employees (FTE)	89	155	200
Percentage of staff on 5 day roster (%)	80	80	80
Percentage of staff on 3 day roster (%)	20	20	20
Percentage of staff from Lithgow (%)	50	50	50

Parameter	2017/2018 Financial Year	Current Approved	Proposed (MOD 3)
Percentage of staff from Kandos/Rylstone (%)	50	50	50
Distance from Lithgow (km)	48.8	49	49
Distance from Kandos/Rylstone (km)	55.9	56	56

8.3.4 Emission Factors

The emission factors used in the calculations for the estimates of Scope 1, 2 and 3 GHG emissions are presented in **Table 23**. These factors were sourced from the most recent NGA Factors Workbook (DEE, 2018).

In addition to the factors shown in **Table 23**, Scope 3 GHG emissions associated with the transport of product coal and water by rail have been calculated using two different approaches for comparison:

- Method 1: Diesel consumption by the trains was estimated based on the total tonnes-km travelled and a diesel usage factor of 3.2 L/1000 tkm sourced from the Aurizon 2015 Sustainability Report[1].
- Method 2: Based on the total tonnes-km travelled and an emission factor of 0.0054 kg CO2-e/tkm sourced from the GHG and Energy Assessment report prepared for the United Wambo Open Cut Coal Mine Project (Umwelt, 2016).

Table 23 GHG Emission Factors

Source/Activity	Energy Content Factor	Emission Factor		
		CO_2-e	SF_6	Units
Scope 1				
Diesel combustion – Stationary energy [1]	38.6 GJ/kL	70.2	-	kg CO_2-e/GJ
Petroleum based oils	38.8 GJ/kL	13.9	-	kg CO_2-e/GJ
Greases	38.8 GJ/kL	3.5	-	kg CO_2-e/GJ
SF_6 leakage	-	-	0.89	%
Scope 2				
Electricity consumption	-	0.82	-	kg CO_2-e/kWh
Scope 3				
Diesel consumption	38.6 GJ/kL	3.6	-	kg CO_2-e/GJ
Petroleum based oils consumption	38.8 GJ/kL	3.6	-	kg CO_2-e/GJ
Grease consumption	38.8 GJ/kL	3.6	-	kg CO_2-e/GJ
Electricity consumption	-	0.1	-	kg CO_2-e/kWh
Solid waste disposal	-	1.4		t CO_2-e/t waste
Coal combustion by end user	27 GJ/t	90.23	-	kg CO_2-e/GJ

[1] Section 2.2 of the NGA Factors workbook states "*No transport factors are provided for vehicles not registered for road use. Stationary energy factors for individual fuel types should be used in these cases.*"

[1] https://www.aurizon.com.au/media/aurizon/files/sustainability/sustainability%20reports/fy%202015%20sustainability%20report.pdf

To convert the volumetric flow of CO_2 from the ventilation shaft (in m^3) shown in **Table 22** to mass emissions (tonnes) of CO_2-e, the following conversion factor was used (DoE, 2008, p. 257):

- $CO_2 = 1.861 \times 10^{-3}$ tonnes CO_2-e/m^3

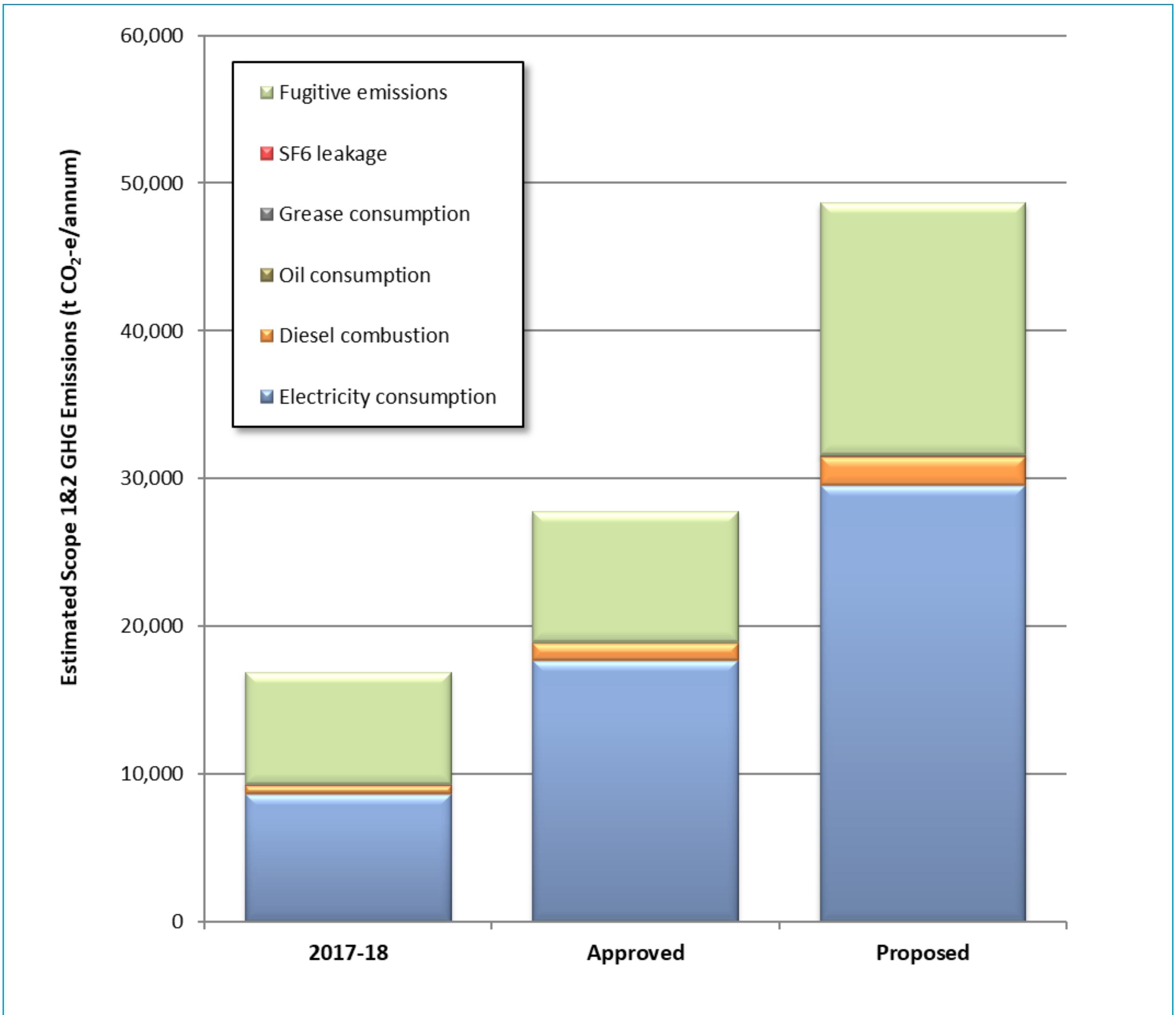
8.3.5 Estimated Emissions

The estimated annual GHG emissions for the proposed MOD 3 operations at Airly Mine are shown in **Table 24** and compared to the annual emission rates estimated for current and approved operations (based on the activity data shown in **Table 22**). A chart of the estimated Scope 1 and Scope 2 emissions is provided in **Figure 15** and details of the calculations are provided in **Appendix D**. The Scope 3 emissions associated with rail transport presented in **Table 24** have been estimated using the Method 1 approach as described in **Section 8.3.4**; this calculation gave estimates that were approximately 60% higher than Method 2, so they are presented for conservativeness (see **Appendix D** for Method 2 estimates).

Table 24 GHG Emission Inventory – Estimated Scope 1, 2 and 3 Emissions

Activity/Source	Estimated GHG Emissions (tonnes CO_2-e/annum)		
	2017/18 Financial Year	Current Approved	Proposed (MOD 3)
Scope 1			
Diesel combustion	570.0	1,163.4	1,938.9
Oil consumption	28.9	59.0	98.4
Grease consumption	0.2	0.3	0.6
SF6 leakage	4.9	4.9	4.9
Fugitive emissions	7,600.2	8,872.1	17,100.4
Sub-Total – Scope 1	***8,204.2***	***10,099.7***	***19,143.1***
Scope 2			
Electricity consumption	8,666.9	17,687.8	29,538.6
Sub-Total – Scope 1 + Scope 2	***16,871.1***	***27,787.5***	***48,681.7***
Scope 3			
Diesel combustion	29.2	59.7	99.4
Oil consumption	7.5	15.2	25.4
Grease consumption	0.2	0.3	0.6
Electricity consumption	1,056.9	2,157.0	6,832.1
Coal transport by rail	2,444.7	4,989.3	8,682.6
Water transport by rail	0.0	0.0	93.9
Staff commuting	606.6	1,059.5	1,367.2
Solid waste	305.8	446.6	576.3
Coal combustion - Australia	1,225,439.5	2,500,923.8	2,084,103.2
Coal combustion - Overseas	816,959.6	1,667,282.5	4,862,907.4
Sub-Total – Scope 3	***2,046,850.0***	***4,176,934.0***	***6,961,458.1***

Figure 15 Estimated Scope 1 and 2 Emissions



Based on information presented in **Table 24**, the annual Scope 1 and Scope 2 GHG emissions from MOD 3 operations are estimated to be 0.016 tonnes of CO_2-e per ROM tonne of coal produced (decreasing from 0.019 t CO_2-e/t ROM coal for the current approved operations).

The main contributors to the estimated annual Scope 1 and Scope 2 GHG emissions is electricity consumption, which accounts for 61% of the total estimated Scope 1 and Scope 2 emissions. Fugitive CO_2 emissions from the ventilation shaft are estimated to contribute 35% of the total combined Scope 1 and Scope 2 emissions. Diesel fuel consumption is estimated to account for only 4%.

8.3.6 Comparison to National and State Emission Inventories

Australia's net GHG emissions totalled 533.0 Mt CO_2-e in 2016 (Australian Greenhouse Emission Information System (DEE, 2016)). The energy sector accounted for over 81% of the total national emissions with energy generation through the combustion of fossil fuels accounting for 79% of the national energy sector emissions. Fugitive emissions accounted for approximately 11% of energy sector emissions.

The reported 2016 total NSW emissions of 130.3 Mt CO_2-e accounted for approximately 24% of national GHG emissions. The energy sector contributed 110.1 Mt CO_2-e which is approximately 85% of the state emission total. Fugitive emissions account for approximately 14% of NSW total energy sector emission total.

The contributions of the predicted annual Scope 1 and 2 emissions resulting from the proposed MOD 3 operations are detailed in **Table 25**. As can be seen, the emissions are a relatively small proportion of both the Australian and NSW total emissions, accounting for less than 0.01% of total Australian GHG production. As such, the relatively small amount of GHG emissions generated by MOD 3 will have an undetectable effect on global climate change.

Table 25 Project Emission Contribution to State and National Annual Emission Totals

	MOD 3 Scope 1 and 2	Total Emissions - 2016	
		Australia	NSW
MOD 3 Operations (tonnes CO_2-e/annum)	48,682	532,971,150	130,273,520
MOD 3 as a percentage of National/State inventory	-	0.009%	0.037%

8.4 Abatement and Avoidance of Emissions

Figure 15 highlights the significant contribution that electricity consumption makes to the GHG profile for the proposed MOD 3 activities, accounting for 61% of the total estimated Scope 1 and Scope 2 emissions. Fugitive CO_2 emissions from the ventilation shaft are estimated to contribute 35% of the total combined Scope 1 and Scope 2 emissions.

Airly Mine currently implements an Energy and Greenhouse Gas Management System that monitors and reports energy usage. Key performance indicators are tracked and include energy demand and GHG emissions per tonne of ROM coal produced.

As shown in **Table 24**, Airly Mine has relatively low GHG emission levels and implements a number of GHG emission reduction measures on site, including:

- Engineered mine and infrastructure design to improve energy efficiency;
- Regular maintenance of plant and equipment to minimise fuel consumption; and
- Consideration of energy efficiency in plant and equipment selection.

In addition to the above, Airly Mine has recently received development approval from Lithgow Council for the installation of a 2 MW solar farm (the Solar Project), to reduce its demand for electricity from the grid, and hence its carbon footprint (Umwelt, 2019). The Solar Project includes the installation of 5,000 400 W photovoltaic (PV) modules (panels) and connection of the solar system to the existing Airly Sub 1 substation. The panels will be located within the existing REA and the system will operate and supply power to the Airly Mine until such time that the REA is required for its approved purpose (at which time it can be relocated, subject to future planning approval requirements).

The Solar Project is expected to supply approximately 25% of the site's electricity consumption, hence in the long term the Scope 2 emissions will be lower than included in that presented in this report. The plant will also supply the grid with any electricity generated but not required at the site. As the 25% reduction is an approximate estimate only, the reduction in Scope 2 emissions has not been included in this assessment. Once the farm is operational, the reduction in purchased electricity will be tracked and the relevant data will be available for use in future GHG emission inventory calculations for the site.

9 Conclusions

SLR Consulting has been commissioned by Centennial Airly to perform an Air Quality Impact Assessment (AQIA) and Greenhouse Gas (GHG) Assessment for Modification 3 of the Extension Project (MOD 3).

MOD 3 involves the following proposed changes to the current approved operations at the site, relevant to the air quality and GHG impacts:

- an increase in the production rate from the approved 1.8 Mtpa to 3.0 Mtpa; and
- an increase in the movement of laden coal trains and water trains leaving the site from the approved average of 2 trains per day to 3 trains per day over any calendar year but maintaining the approved maximum 5 trains per day leaving the site on any day.

SLR previously completed the AQIA and GHG assessments for the Extension Project in April 2014 (SLR 2014). Emission estimation and dispersion modelling was conducted to predict off-site air quality impacts associated with particulate emissions from identified activities (including TSP, PM_{10}, $PM_{2.5}$ and dust deposition rates) for four distinct scenarios. The 'proposed infrastructure (1.8 Mtpa)' scenario in the Extension Project AQIA was approved and adopted by Centennial Airly as the operational scenario.

In this AQIA for MOD 3, only one operational scenario has been assessed, which is based on the 'Scenario 3 - normal operation of proposed infrastructure (1.8 Mtpa)' scenario in the Extension Project AQIA (SLR 2014), modified to reflect an increased coal throughput of 3 Mtpa. This scenario assumes that all the approved/proposed activities are being performed concurrently at their maximum proposed capacity. In reality, all proposed operations will not occur concurrently as has been assumed in this assessment, hence the results presented in this report should be viewed as conservative representation of the potential off-site impacts from MOD 3 of the Extension Project.

The air quality goals adopted for particulate matter in this study conform to current EPA and Federal air quality criteria, and are consistent with the criteria set out in the June 2019 update of the development consent.

Emission estimation and dispersion modelling was conducted to predict off-site air quality impacts associated with particulate emissions from identified activities (including TSP, PM_{10}, $PM_{2.5}$ and dust deposition rates). The modelling was performed using the CALPUFF model and site-representative, 3-dimensional meteorological data for the 2014 calendar year.

To enable an assessment of potential cumulative air quality impacts, regional background TSP, PM_{10} and $PM_{2.5}$ concentrations were derived based on PM_{10} monitoring data collected by the OEH monitoring station in Bathurst for the 2014 calendar year. Background dust deposition rates were estimated based on on-site monitoring data collected by Airly Mine.

It was concluded from the dispersion modelling exercise that the relevant short term and long term pollutant concentrations (for TSP, PM_{10} and $PM_{2.5}$) and dust deposition rates would be well below the respective NSW EPA criteria, including the more stringent criteria for annual average PM_{10}.

Based on the results of this assessment, it is concluded that incremental concentrations due to the activities proposed as part of MOD 3 are unlikely to result in any additional exceedances of the air quality Project criteria at the nearest sensitive receptors.

The assessment also considers emissions of Greenhouse Gases from the current and proposed Airly Mine operations and includes estimates of direct and indirect GHG emissions. This assessment concluded:

- The total direct (Scope 1) emissions from the proposed MOD 3 operations are estimated to be approximately 19,140 t CO_2-e/annum, while the estimated Scope 2 (electricity consumption) emissions are approximately 29,540 t CO_2-e/annum.
- Based on these estimates, the GHG intensity of the proposed MOD 3 operations is estimated to be 0.016 tCO_2-e/t ROM coal produced (Scope 1 and Scope 2), compared to 0.019 t CO_2-e/t ROM coal for the current approved operations.
- The total indirect (Scope 3) emissions from mining coal, transport and end use of the product coal are estimated to be 6,961,458 t CO_2-e/annum.
- Comparison of the estimated Scope 1 and 2 emissions with State and National GHG emission totals indicates that the GHG emissions from Airly mine operations are a relatively small proportion of both the Australian and NSW total emissions, accounting for less than 0.01% of total Australian GHG production.

Given the above, it is concluded that the relatively small amount of Scope 1 and Scope 2 GHG emissions generated by MOD 3 will have an undetectable effect on global climate change.

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APPENDIX A

DETAILED EMISSIONS INVENTORY

Emission Source	TSP EF	PM_{10} EF	$PM_{2.5}$ EF	Units	Emission Rate (m^3/s)	Area (ha)	VKT/day	Days per year	Hour per day	tonnes/h	Control Applied	Control Factor (%)	TSP Emission rate (kg/h)	PM_{10} Emission rate (kg/h)	$PM_{2.5}$ Emission rate (kg/h)	TSP Emissions (kg/y)	PM10 Emissions (kg/y)	PM2.5 Emissions (kg/y)
Material Handling																		
Coal tranfer point 1 - underground drift	0.00055	0.00026	0.00004	kg/t	N/A	N/A	N/A	365	24	791.7	Enclosed (on 3 sides)	70	0.1306	0.0618	0.0094	1,144	541	82
Coal tranfer point 2 - Emergency stockpile	0.00055	0.00026	0.00004	kg/t	N/A	N/A	N/A	365	24	791.7	Enclosed (on 3 sides)	70	0.1306	0.0618	0.0094	1,144	541	82
Coal tranfer point 3 - surface conveyor	0.00055	0.00026	0.00004	kg/t	N/A	N/A	N/A	365	24	791.7	Enclosed (on 3 sides)	70	0.1306	0.0618	0.0094	1,144	541	82
Coal tranfer point 4 - coal crusher	0.00055	0.00026	0.00004	kg/t	N/A	N/A	N/A	365	24	791.7	Enclosed (on 3 sides)	70	0.1306	0.0618	0.0094	1,144	541	82
Coal tranfer point 5 - from underground reclaimer	0.00055	0.00026	0.00004	kg/t	N/A	N/A	N/A	365	24	791.7	Enclosed (on 3 sides)	70	0.1306	0.0618	0.0094	1,144	541	82
Coal tranfer point 6 - pre train loading bin	0.00055	0.00026	0.00004	kg/t	N/A	N/A	N/A	365	24	791.7	Enclosed (on 3 sides)	70	0.1306	0.0618	0.0094	1,144	541	82
Coal tranfer point 7 - loading train loading bin	0.00055	0.00026	0.00004	kg/t	N/A	N/A	N/A	365	24	791.7	Enclosed (on 3 sides)	70	0.1306	0.0618	0.0094	1,144	541	82
Coal tranfer point 8 - CHPP	0.00055	0.00026	0.00004	kg/t	N/A	N/A	N/A	365	24	791.7	Enclosed (on 3 sides)	70	0.1306	0.0618	0.0094	1,144	541	82
Coal tranfer point 9 - ROM stockpile	0.00055	0.00026	0.00004	kg/t	N/A	N/A	N/A	365	24	791.7	Enclosed (on 3 sides)	70	0.1306	0.0618	0.0094	1,144	541	82
Loading Emergency stockpile - trucks dumping coal	0.00055	0.00026	0.00004	kg/t	N/A	N/A	N/A	365	24	791.7	Water Sprays	50	0.2176	0.1029	0.0156	1,906	902	137
FEL on Emergency stockpile	0.00055	0.00026	0.00004	kg/t	N/A	N/A	N/A	365	24	791.7	Water Sprays	50	0.2176	0.1029	0.0156	1,906	902	137
Bulldozer on Emergency stockpile	13.61	3.04	0.30	kg/hr	N/A	N/A	N/A	365	12	NA	None	0	13.613	3.039	0.299	59,624	13,310	1,312
Screening	0.00110	0.00037	0.00003	kg/t	N/A	N/A	N/A	365	24	791.7	Enclosed	70	0.2613	0.0879	0.0059	2,289	770	52
Primary Crusher	0.00060	0.00027	0.00005	kg/t	N/A	N/A	N/A	365	24	791.7	Enclosed	70	0.1425	0.0641	0.0119	1,248	562	104
Secondary Crusher	0.00060	0.00027	0.00005	kg/t	N/A	N/A	N/A	365	24	791.7	Enclosed	70	0.1425	0.0641	0.0119	1,248	562	104
Loading ROM stockpile	0.00055	0.00026	0.00004	kg/t	N/A	N/A	N/A	365	24	791.7	Water Sprays	50	0.2176	0.1029	0.0156	1,906	902	137
Bulldozer on ROM Coal stockpile	13.61	3.04	0.30	kg/hr	N/A	N/A	N/A	365	12	NA	None	0	13.613	3.039	0.299	59,624	13,310	1,312
Loading Product stockpile	0.00055	0.00026	0.00004	kg/t	N/A	N/A	N/A	365	24	791.7	Water Sprays	50	0.2176	0.1029	0.0156	1,906	902	137
Bulldozer on Product Coal	13.61	3.04	0.30	kg/hr	N/A	N/A	N/A	365	12	NA	None	0	13.613	3.039	0.299	59,624	13,310	1,312
Loading Trains	0.01400	0.00662	0.00100	kg/t	N/A	N/A	N/A	365	24	1046.9	Enclosed (on 3 sides)	70	4.3969	2.0796	0.3149	38,517	18,217	2,759
Road Haulage (Wheel Generated Dust)																		
Light vehicles movements	0.25	0.07	0.01	kg/VKT	N/A	N/A	6.6	365	24	NA	Water Sprays	50	0.8189	0.2280	0.0224	7,174	1,997	196
Heavy vehicle movements	5.30	0.83	0.22	kg/VKT	N/A	N/A	1.3	365	24	NA	Water Sprays	50	3.4907	0.5494	0.1418	30,578	4,813	1,242
Open Areas (Wind Erosion)																		
Product Stockpile	0.4	0.2	0.03	kg/ha/hr	N/A	3.75	N/A	365	24	NA	Water Sprays	50	Variable	Variable	Variable	6,570	3,285	307
ROM Stockpile	0.4	0.2	0.03	kg/ha/hr	N/A	0.75	N/A	365	24	NA	Water Sprays	50	Variable	Variable	Variable	1,314	657	61
Emergency Stockpile	0.4	0.2	0.03	kg/ha/hr	N/A	0.75	N/A	365	24	NA	Water Sprays	50	Variable	Variable	Variable	1,314	657	61
REA I	0.4	0.2	0.03	kg/ha/hr	N/A	16.8	N/A	365	24	NA	None	0	Variable	Variable	Variable	29,434	14,717	1,377
Coal Wagon surface (based on 15m x 3m, 50 cars)	0.4	0.2	0.03	kg/ha/hr	N/A	0.3015	N/A	365	24	NA	None	0	Variable	Variable	Variable	1,056	528	49
Ventilation Fan																		
Ventilation Fan (Angus Place monitoring report 610.12201)	0.6	0.04	0.03	mg/m^3	244.45	N/A	N/A	365	24	NA	None	0	0.528	0.035	0.026	4,625	308	231

APPENDIX B

VARIABLE EMISSION FILES – CALCULATION STEPS

A brief summary of the steps used in calculating the hourly varying emission rates for each source are presented below.

Step 1: Calculate annual average emission rate (kg/year) for FP, CM and RE

$FP_{annual} = PM_{2.5, annual}$	(FP) Fine Particulate – particulate of size less than 2.5 µm
$CM_{annual} = PM_{10,annual} – PM_{2.5, annual}$	(CM) Coarse Particulate – particulate of size between 10 µm and 2.5 µm
$RE_{annual} = TSP_{annual} - PM_{10,annual}$	(RE) Rest Particulate – particulate of size greater than 10 µm

Step 2: Identify the operating hours for each activity

Step 3: Classify the sensitivity of each type of activity to wind speed

- Wind insensitive: activities with emission factor that is independent of wind speed (e.g. blasting)
- Wind sensitive: activities with emission factor that is a function of $(\text{Wind speed}/2.2)^{1.3}$ (e.g. loading)
- Wind erosion: emission from exposed areas/stockpiles

Step 4: Identify the number of sources associated with each activity

- Note that each wind erosion source is modelled as an independent source.

Step 5: Calculate the hourly average emission rate for each activity per source

$FP_{AC,i,h} = \frac{FP_{annual,i} \times 1000}{N_{days} \times OH_i \times 3600 \times N_{s,i}} \times WSFactor_{i,h}$ $CM_{AC,i,h} = \frac{CM_{annual,i} \times 1000}{N_{days} \times OH_i \times 3600 \times N_{s,i}} \times WSFactor_{i,h}$ $RE_{AC,i,h} = \frac{RE_{annual,i} \times 1000}{N_{days} \times OH_i \times 3600 \times N_{s,i}} \times WSFactor_{i,h}$ For wind insensitive activities $WSFactor_{i,h} = 1$ For wind sensitive activities $WSFactor_{i,h} = \frac{\left(\frac{WS_h}{2.2}\right)^{1.3}}{\frac{\sum_{j=1}^{n}\left(\frac{WS_j}{2.2}\right)^{1.3}}{n}}$ For wind erosion activities $WSFactor_{i,h} = \frac{(WS_h)^3}{\frac{\sum_{j=1}^{n}(WS_j)^3}{n}}$	Where: $FP_{AC,i,h}$- Fine particulates emission rate for Activity i (g/s) at hour h $CM_{AC,i,h}$- Fine particulates emission rate for Activity i (g/s) at hour h $CM_{AC,i,h}$- Fine particulates emission rate for Activity i (g/s) at hour h OH_i-daily Operating hours (1- 24) for Activity i N_{days} -Number of days in the meteorological data file $N_{s,i}$ -Number of sources associated with Activity i WS_h-Wind speed at the hour n -number of hours in the meteorological data file

Note: If the activity was modelled as area source, the equation on the left column of the table needs to be divided by the area of that activity.

Step 5: Calculate hourly average emission rate for each source

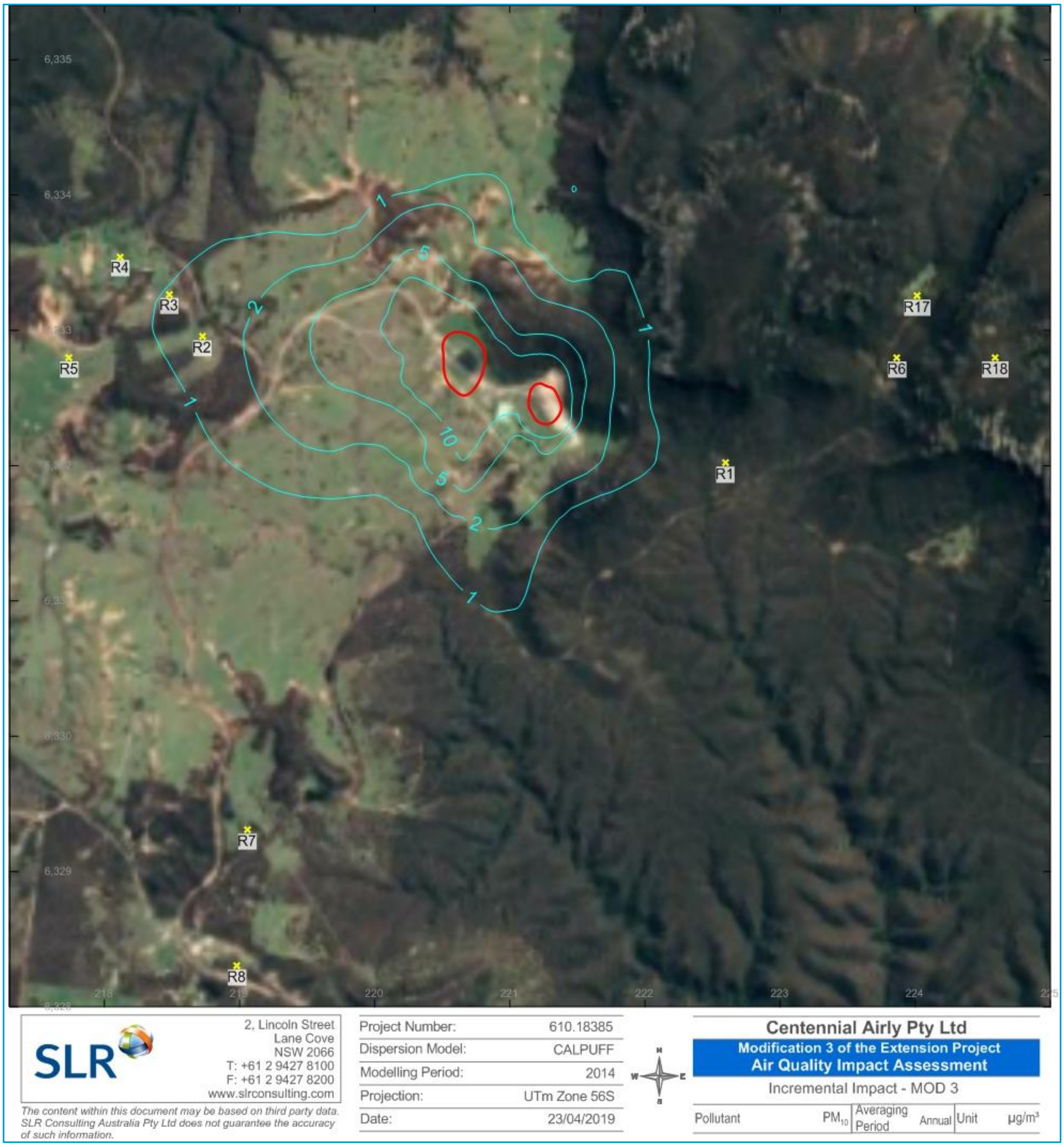
To calculate the emission rate for a particular source for a particular hour, add up the calculated emission rate for each activity associated with source.

For example, if Source 1 is associated with Activity 1, Activity 2 and Activity 3, then:

- $ER_{S1,h,FP} = FP_{AC,1,h} + FP_{AC,2,h} + FP_{AC,3,h}$
- $ER_{S1,h,CM} = CM_{AC,1,h} + CM_{AC,2,h} + CM_{AC,3,h}$
- $ER_{S1,h,RE} = RE_{AC,1,h} + RE_{AC,2,h} + RE_{AC,3,h}$

APPENDIX C

CONTOUR PLOTS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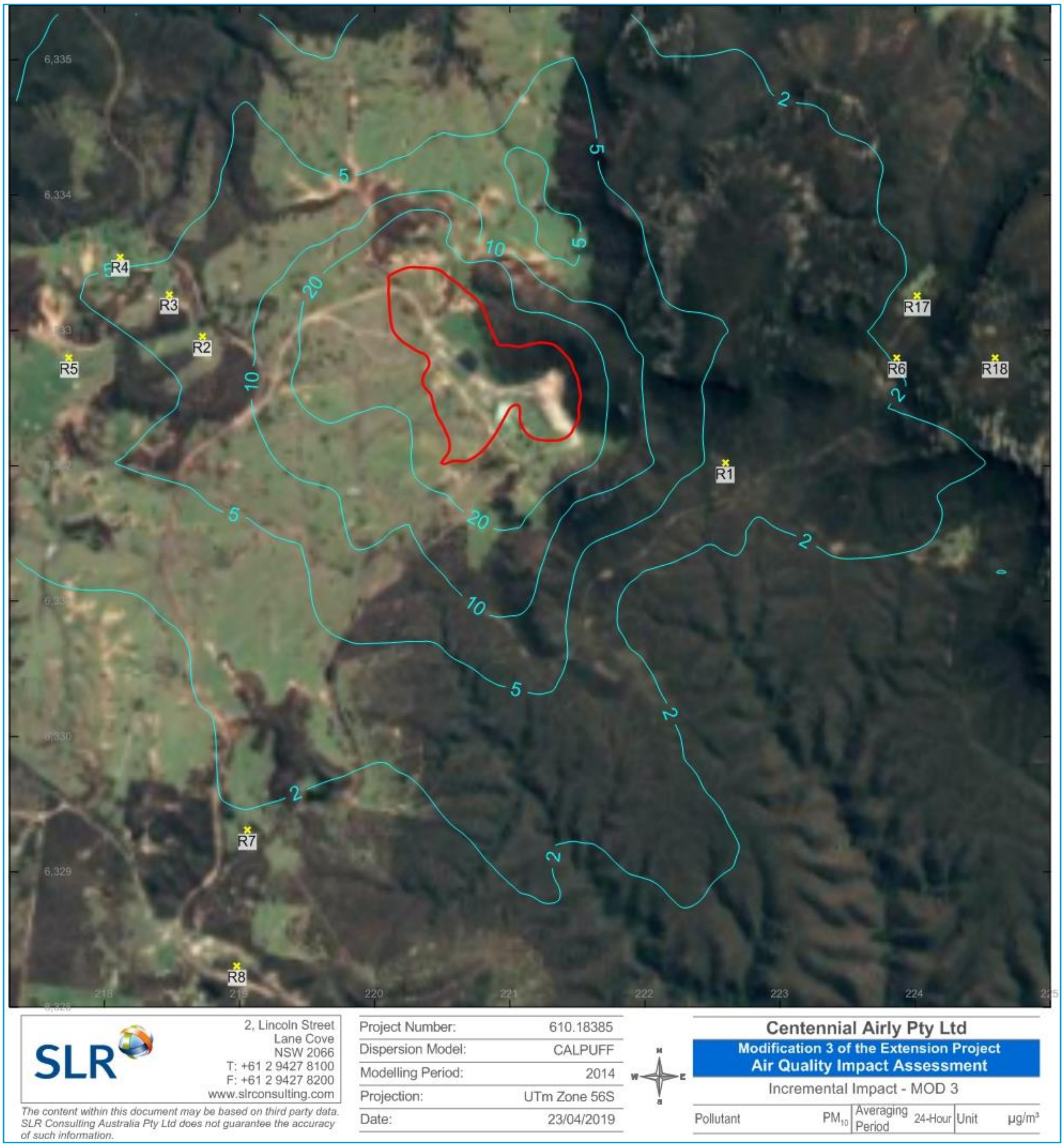
Projection: UTm Zone 56S
Date: 23/04/2019
Centennial Airly Pty Ltd
Modification 3 of the Extension Project
Air Quality Impact Assessment
Incremental Impact - MOD 3
Pollutant PM10
Averaging Period Annual
Unit µg/m³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Air Quality Impact Assessment
Incremental Impact - MOD 3
Pollutant PM_{10}
Averaging Period 24-Hour
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Air Quality Impact Assessment
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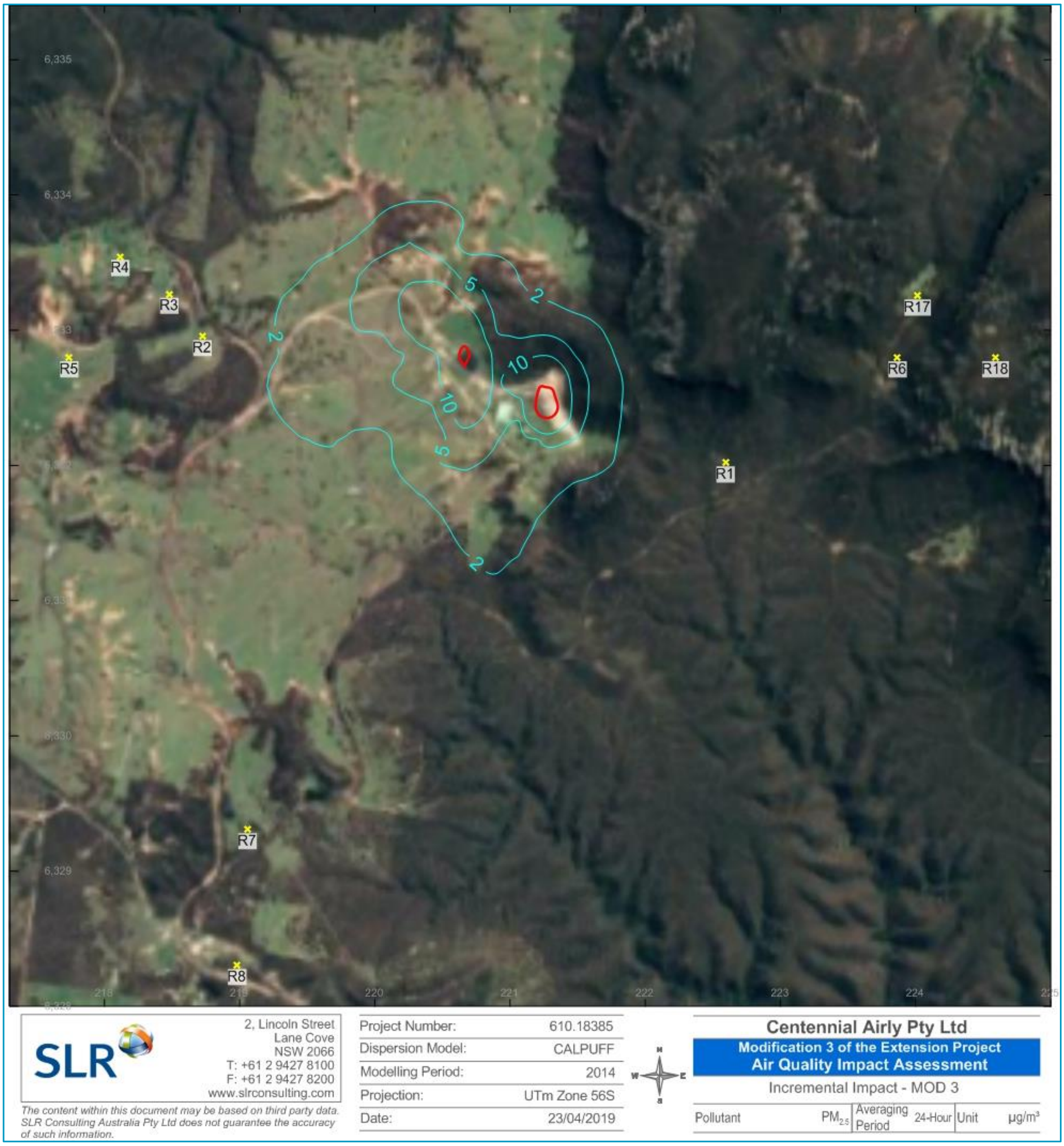
Pollutant PM2.5
Averaging Period Annual
Unit µg/m³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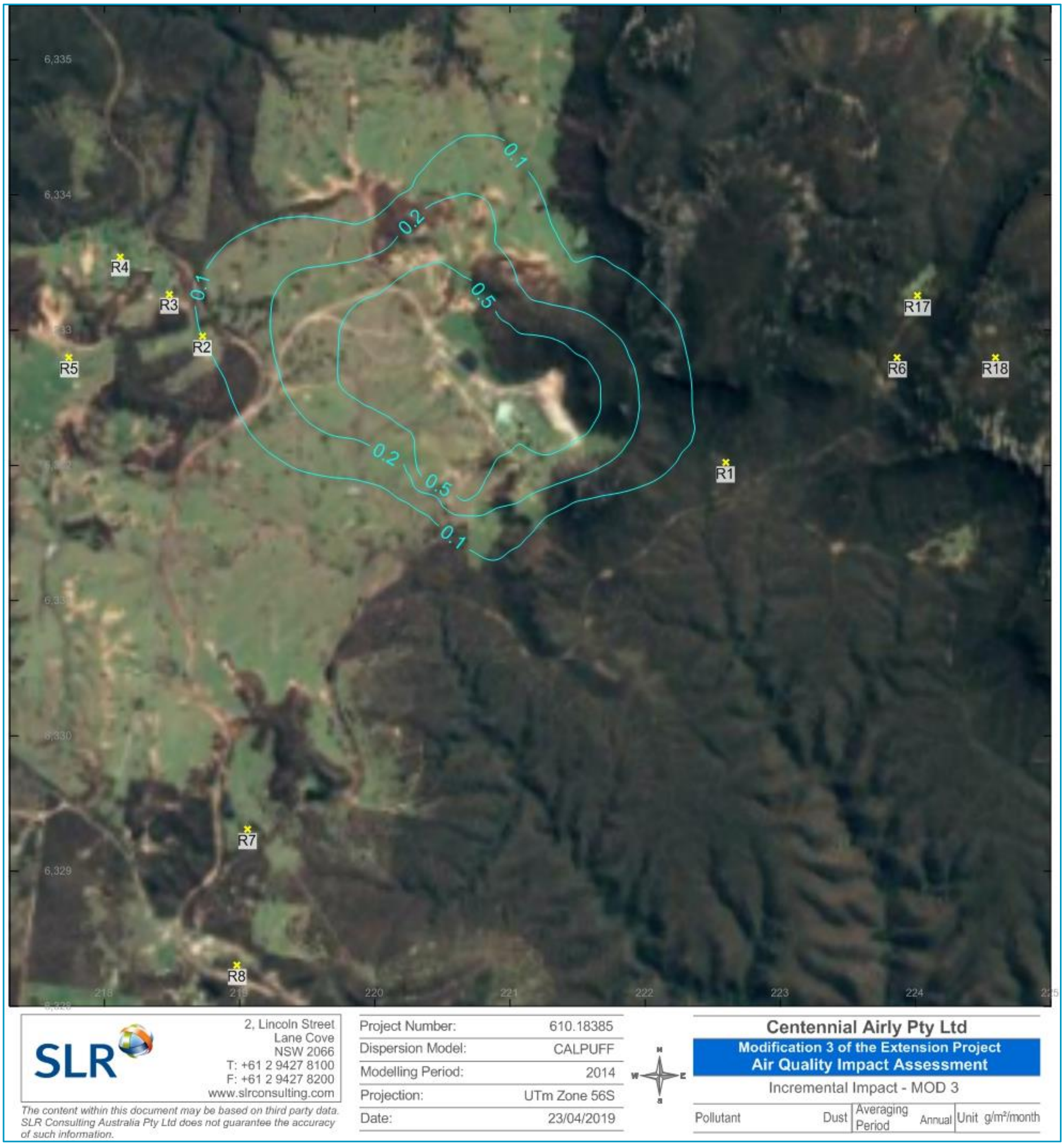
Pollutant $PM_{2.5}$ Averaging Period 24-Hour Unit µg/m³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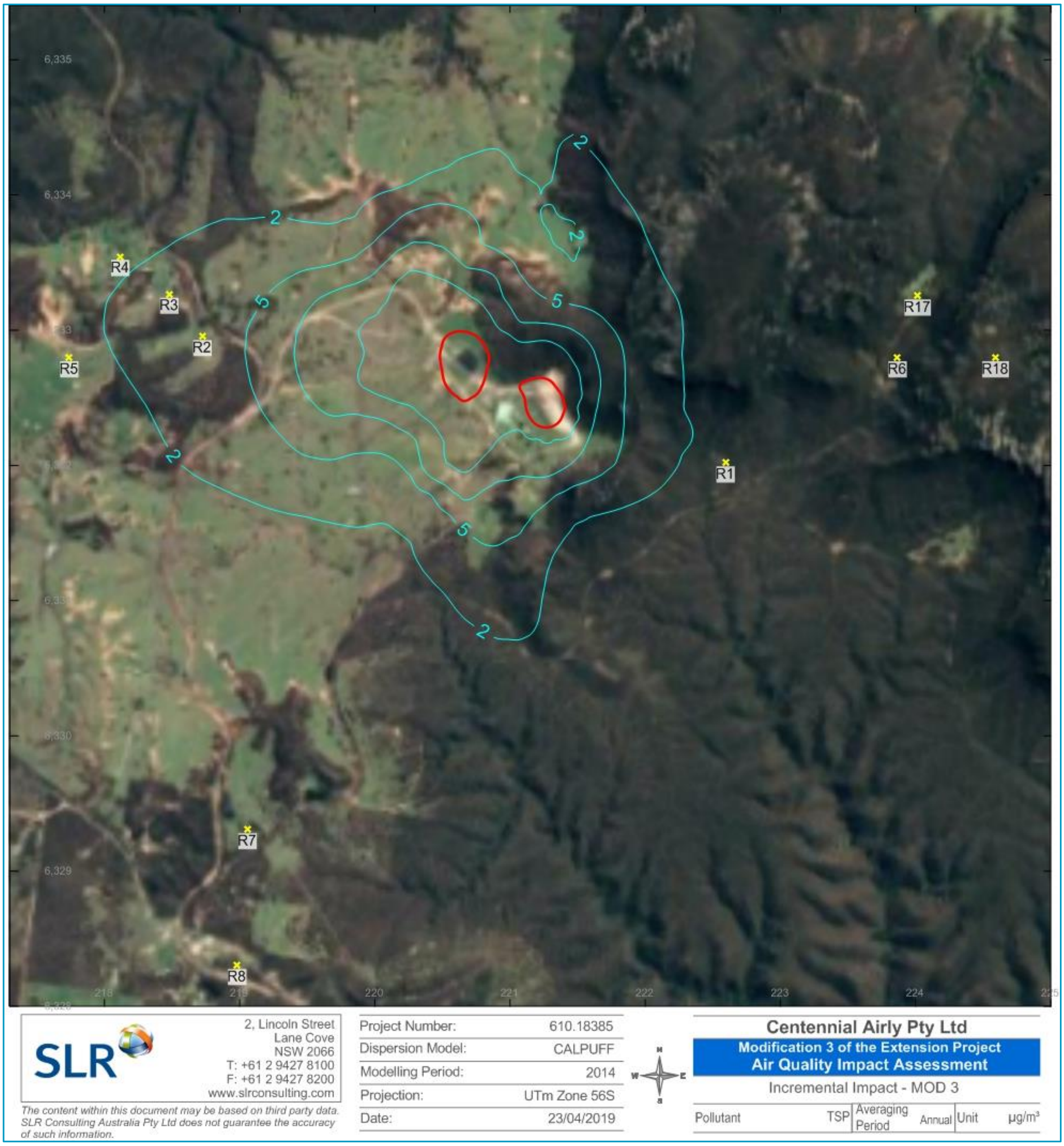
Incremental Impact - MOD 3
Pollutant Dust
Averaging Period Annual
Unit g/m²/month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Air Quality Impact Assessment
Incremental Impact - MOD 3
Pollutant TSP
Averaging Period Annual
Unit µg/m³

APPENDIX D

GHG EMISSION INVENTORY

		Parameter	Value			Units	Note	Factor	Units	Source	(tonnes CO2-e)		
			FY 2017/18	Approved	Proposed						2017-18	Approved	Proposed
	Activity data	ROM coal throughput	0.88	1.8	3.0	Mtpa	17/18 value is average of '17 and '18 ROM production from 2017 Annual Report						
	Activity data	Full Time Employees (FTE)	89	155	200	staff	17/18 value is from 2017 Annual Report (as at 31 Dec 2017)						
	Activity data	Distance by rail to Newcastle Port	366	366	366	km	Estimated from Googleearth						
	Activity data	Average distance by rail to Eraring/Vales Pt PSs	317	317	317	km	Estimated from Googleearth						
	Activity data	Distance by rail to Charbon	32	32	32	km	Estimated from Googleearth						
	Activity data	Percentage of coal to Newcastle Port	40	40	70	%	Provided by Centennial 19/10/18						
	Activity data	Average distance by rail	336	336	351	km/trip	Calculated						
	Activity data	Average trains per day of product coal	1.0	2.0	3.0	trips/day	Project descrption, current number scales down from approved by product coal throughput						
	Activity data	Trains per year (water)	0.0	0.0	217.0	trains	Provided by Centennial 11/04/19						
	Activity data	Quantity of water in each train	0.0	0.0	780.0	tonnes	Provided by Centennial 18/04/20						
	Activity data	CO2 concentration in vent gas	0.0700	0.0530	0.0700	%	From 2014 GHG assessment						
	Activity data	CH4 concentration in vent gas	0.0000	0.0000	0.0000	%	From 2014 GHG assessment						
	Activity data	Percentage of staff on 5 day roster	80	80	80	%	From 2014 GHG assessment						
	Activity data	Percentage of staff on 3 day roster	20	20	20	%	From 2014 GHG assessment						
	Activity data	Percentage of staff from Lithgow	50	50	50	%	From 2014 GHG assessment						
	Activity data	Percentage of staff from Kandos/Rylstone	50	50	50	%	From 2014 GHG assessment						
	Activity data	Distance from Lithgow	48.8	49	49	km	From 2014 GHG assessment						
	Activity data	Distance from Kandos/Rylstone	55.9	56	56	km	From 2014 GHG assessment						
	Activity data	Employee vehicle fuel efficiency	10	10	10	L/100km	From 2014 GHG assessment						
ESTIMATED EMISSIONS													
Scope	**Emission Source**	**Activity Data**						**Emission Factor**			**Estimated Emissions**		
1	Diesel use	Diesel consumption	210	429	716	kL/annum	Approved/proposed values scaled up based on ROM	70.2	kg CO2-e/GJ	NGA Factors Workbook, July 2018, Table 3 (Stationary/off-road)	570.0	1,163.4	1,938.9
1	Oil use	Oil consumption	54	109	182	kL/annum	Approved/proposed values scaled up based on ROM	13.9	kg CO2-e/GJ	NGA Factors Workbook, July 2018, Table 3	28.9	59.0	98.4
1	Grease use	Grease consumption	1.2	2.5	4.2	kL/annum	Approved/proposed values scaled up based on ROM	3.5	kg CO2-e/GJ	NGA Factors Workbook, July 2018, Table 3	0.2	0.3	0.6
1	SF6 use	SF6 charge	24	24	24	kg	Assumed no change	0.89%	by weight	NGA Factors Workbook, July 2018, Table 25	4.9	4.9	4.9
1	Fugitive emissions	Ventilation flowrate	185	285	416	m3/s	Extra 30 m3/s for panel and pillar equipment				7,600.2	8,872.1	17,100.4
TOTAL SCOPE 1											**8,204.2**	**10,099.7**	**19,143.1**
2	Electricity Use	Electricity consumption	10,569,416	21,570,468	36,022,682	kWh/annum	Approved and proposed values scaled up by ROM	0.82	kg CO2-e/kWh	NGA Factors Workbook, July 2018, Table 5 (NSW&ACT)	8,667	17,688	29,539
TOTAL SCOPE 2											**8,666.9**	**17,687.8**	**29,538.6**
3	Diesel use	Diesel consumption	210	429	716	kL/annum	as above	3.6	kg CO2-e/GJ	NGA Factors Workbook, July 2018, Table 40	29.2	59.7	99.4
3	Oil use	Oil consumption	54	109	182	kL/annum	as above	3.6	kg CO2-e/GJ	NGA Factors Workbook, July 2018, Table 40	7.5	15.2	25.4
3	Grease use	Grease consumption	1.2	2.5	4.2	kL/annum	as above	3.6	kg CO2-e/GJ	NGA Factors Workbook, July 2018, Table 40	0.2	0.3	0.6
3	Electricity use	Electricity consumption	10,569,416	21,570,468	36,022,682	kWh/annum	as above	0.1	kg CO2-e/kWh	NGA Factors Workbook, July 2018, Table 41 (NSW&ACT)	1,056.9	2,157.0	3,602.3
3	Coal transport by rail	Diesel consumption	902	1,841	3,204	kL/annum	Based on 3.2 L/1000tkm from Aurizon Sustainability Report 2015	70.2	kg CO2-e/GJ	NGA Factors Workbook, July 2018, Table 3 (Stationary/off-road)	2,444.7	4,989.3	8,682.6
3	Water transport by rail	Delivery of water from Charbon	0	0	35	kL/annum	Based on 3.2 L/1000tkm from Aurizon Sustainability Report 2016	70.2	kg CO2-e/GJ	NGA Factors Workbook, July 2018, Table 3 (Stationary/off-road)	0.0	0.0	93.9
3	Staff commuting	Fuel consumption	223	389	502	kL/annum	Using same methodology as 2014 GHG assessment, based on FTE	70.51	kg CO2-e/GJ	NGA Factors Workbook, July 2018, Table 4 (post-2004 vehicles, diesel)	606.6	1,059.5	1,367.2
3	Solid waste	Waste to landfill	218	319	412	tonnes/annum	Approved value from 2014 GHG assessment; Proposed value scaled up by FTE	1.4	t CO2/t waste	NGA Factors Workbook, July 2018, Table 44 (municipal solid waste)	305.8	446.6	576.3
3	Coal combustion - Australia	Product coal to Eraring/Vales Pt PS	503,011	1,026,563	855,469	tonnes/annum	Approved/proposed values scaled from ROM using same Product:ROM ratio as 17/18	90.23	kg CO2-e/GJ	NGA Factors Workbook, July 2018, Table 1 (bituminous)	1,225,439	2,500,924	2,084,103
3	Coal combustion - Overseas	Product coal to Newcastle Port	335,340	684,376	1,996,095	tonnes/annum	Approved/proposed values scaled from ROM using same Product:ROM ratio as 17/18	90.23	kg CO2-e/GJ	NGA Factors Workbook, July 2018, Table 1 (bituminous)	816,960	1,667,283	4,862,907
TOTAL SCOPE 3											**2,046,850.0**	**4,176,934.0**	**6,961,458.1**
3	Coal transport by rail	Product coal haulage by rail	281,937,441	575,388,731	1,001,326,954	tkm/annum	Approved/proposed values scaled from ROM using same Product:ROM ratio as 17/18	0.0054	kg CO2-e/tkm	GHG & Energy Assessment for United Wambo Open Cut Coal Mine Project, May 2016, Umwelt	1,522.5	3,107.1	5,407.2
3	Water transport by rail	Delivery of water from Charbon	0	0	10,832,640	tkm/annum	calculated	0	kg CO2-e/tkm	GHG & Energy Assessment for United Wambo Open Cut Coal Mine Project, May 2016, Umwelt	0.0	0.0	760,451.3

Constants

Diesel	38.6	GJ/kL	NGA Factors Workbook, July 2018, Table 3
Petroleum based oils	38.8	GJ/kL	NGA Factors Workbook, July 2018, Table 3
Petroleum based greases	38.8	GJ/kL	NGA Factors Workbook, July 2018, Table 3
Bituminous coal	27	GJ/t	NGA Factors Workbook, July 2018, Table 1
SF6 - GWP	22800		NGA Factors Workbook, July 2018, Appendix 1
CO2-e conversion factor for CO2	0.001861	tonnes CO2-e/m3	Tech Guidelines for the Estimation of GHG Emissions by Facilities in Aus, DoE 2018, p257

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APPENDIX – L

Economic Assessment

Airly Mine Extension Project

State Significant Development 5581
Modification 3
Economic Assessment

Centennial Airly Pty Limited

October 2019

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Contents

Abbreviations

ABS	Australian Bureau of Statistics
AIP	Aquifer Interference Policy
AUD	Australian dollar/s
BAU	Business-as-usual
CERD	Centre for Economic & Regional Development (NSW Government)
CPP	Coal Preparation Plant
DPC	Department of Premier & Cabinet (NSW Government)
DPIE	Department of Planning, Industry & Environment (NSW)
EA	Economic Assessment
ERP	Estimated Resident Population (ABS)
FTE	Full Time Equivalent
LCC	Lithgow City Council
LGA	Local Government Area
ML	Megalitre/s
Mtpa	Million tonnes per annum
MWRC	Mid-Western Regional Council
NPV	Net Present Value
p.a.	per annum
PTNL	Project Trigger Noise Level
PV	Present Value
REA	Reject Emplacement Area
REDS	Regional Economic Development Strategy
RNP	Road Noise Policy (NSW)
SA2	Statistical Area Level 2 (ABS)
SA3	Statistical Area Level 3 (ABS)
SA4	Statistical Area Level 4 (ABS)
SDNL	Sleep Disturbance Noise Level
SSD	State Significant Development
Tpa	Tonnes per annum
USD	United States dollar/s

1 Introduction

1.1 Purpose

This document presents an Economic Assessment (EA) in relation to a proposed modification at Centennial Coal's Airly Mine. Further detail on the mine and the modification are presented in Sections 1.2 and 1.3 respectively. Consequent to its status as a modification, the approach to preparation and presentation of this EA differs from a corresponding report for a major proposal. In this context, the approach to the EA is discussed in Section 2.

1.2 Background

Centennial Airly Pty Limited (Centennial Airly) is proposing to modify State Significant Development (SSD) 5581 consent, which granted approval to the Airly Mine Extension Project (the Project). The consent was granted under Section 4.38 (previously Section 89E) of the *Environmental Planning and Assessment Act 1979* (EP&A Act) on 15 December 2016 by the Planning Assessment Commission of NSW, as delegate of the Minister of Planning.

The consent allows mining operations at Airly Mine for a period of 20 years from the date of commencement, and rehabilitation to be undertaken after this period. The consent will lapse on 31 January 2037. The SSD 5581 consent has since been modified twice. Airly MOD 1 was modified under Section 4.55(1A) of the EP&A Act was approved in August 2018. Airly MOD 2 was approved in July 2019.

The Project is a controlled action (EBPC 2013/7076) pursuant to sections 130(1) and 133 of the *Environment Protection and Biodiversity Conservation Act 1999*. The approval EBPC 2013/7076 was granted on 18 May 2017 and has effect until 31 March 2047.

Airly Mine is located five (5) kilometres (km) northeast of the village of Capertee within the Lithgow Local Government Area, approximately 40 km north-northwest of Lithgow and approximately 171 km northwest of Sydney. The Project is on the northern fringe of the Western Coalfields and is partly located within the Mugii Murum-ban State Conservation Area.

The consent SSD 5581 allows for the operation of an underground coal mine using bord and pillar, partial extraction, and panel and pillar techniques. The consent allows for the construction and operation of surface infrastructure. It allows mining of coal from the Lithgow Seam at the rate of 1.8 million tonnes per annum (Mtpa). The mine is approved to operate 24 hours per day, seven days per week.

Airly Mine operates under Environment Protection Licence (EPL) 12374.

1.3 Description of the Modification

The major elements of the Modification are described as:

- an increase in the production rate from the approved 1.8 Mtpa to 3.0 Mtpa.
- an increase in workforce from the approved 155 FTE personnel to 200 FTE personnel.

- an increase in the average train movements from the approved 2 trains per day to 3 trains per day (but maintaining the approved maximum 5 trains per day) to allow all coal to be transported off site at the increased production rate.
- underground blasting or shot-firing activities for the removal of geological structures encountered within the mining areas.
- an amendment to the approved 20-year mine schedule for the increased production rate.

Table 1 presents a summary of key existing consent conditions, and the changes proposed under the Modification.

Table 1: Outline of proposed Modification changes to SSD 5581

Key Feature	Description of Approved Operations	Proposed Change
Project Life	Airly Mine is approved to carry out mining operations for a period of 20 years from the date of commencement (15 December 2016) with rehabilitation to be undertaken after the 20 years of mining. The expiry date for mining operations is 31 December 2037.	No change
Development Consent Boundary	Corresponds to the project application area boundary comprising Mining Lease ML1331 and Authorisation 232 (A232) with areas of 2,744 ha and 3,096 ha respectively, and a total 3,982 ha.	No change
Hours of Operation	24 hours per day, 7 days per week	No change
Employment	155 FTE personnel including contractors	200 FTE personnel
Mining Method and Mining Area	Underground mining using a combination of first workings and partial extraction mining methods, with the mining areas divided into five mining zones of varying mining systems to engineer the desired subsidence level for each zone. • Panel and Pillar Zone: • Cliff Line and First Workings Zone: • Partial Pillar Extraction Zone: • Shallow Zone: • New Hartley Shale Mine Potential Interaction Zone:	No change
ROM Coal Production	1.8 Mtpa	3.0 Mtpa
Coal Handling, Stockpiling and Processing	• A system of surface and underground conveyors constructed to operate at 500 tonne per hour (tph). • Three coal stockpiles: ○ a 30,000 tonne ROM Emergency Stockpile ○ a 200,000 tonne Product Coal Stockpile	No change

Table 1: Outline of proposed Modification changes to SSD 5581

Key Feature	Description of Approved Operations	Proposed Change
	○ a 40,000 tonne ROM Coal Stockpile (not yet established) in the vicinity of the CPP. • A CPP with a processing capacity of 500 tpa with water recycling facility is approved but is not constructed as yet.	
Coal Transport	• All product coal transported from the site by rail to domestic power stations and for export. • No more than an average of 2 laden trains leave the site each day over any calendar year • No more than 5 laden trains (10 train movements) per day leave the site on any day No more than 2 rail movements per day to receive water from Charbon Colliery	No change in coal destinations Increase in the average laden train to leave the site to 3 trains per day over a calendar year but maintain the approved maximum five (5) laden trains to leave the site on any day.
Reject Management	• Co-disposal REA for emplacement of fine and coarse reject materials. • REA capacity of 5.3 Mm^3 • Reject materials hauled from CPP to REA using trucks.	No change
Site Access	Mine Access Road off Glen Davis Road, 3 km from Capertee Village	No change
Mine Support Facilities	• Underground access and associated infrastructure • Engineering and services • Coal handling, preparation and transport infrastructure • Support services and administration at the Pit Top • Non- mine owned infrastructure	No change
Underground Water Management	A mine dewatering system, comprising pipelines, underground impoundment dams and pump stations, to pump mine inflows from the underground to the 109 ML Dirty Water Dam for storage and subsequent use as process water.	No change
Surface Water Management	• A system of water management structures comprising settling ponds, clean and dirty water diversion drains, allow separation and storage of clean and dirty water at the pit top, for use as process water. • Clean and dirty water dams comprise: ○ 109 ML Dirty Water Dam ○ 7 ML Dam	No change

Table 1: Outline of proposed Modification changes to SSD 5581

Key Feature	Description of Approved Operations	Proposed Change
	○ Train Loader Dam ○ REA Dam (not constructed) ○ 35 ML Discharge Dam • Three Licensed discharge points on EPL 1237- LDP001, LDP002, LDP003	
Process Water	Process water is obtained in priority order from the following site sources: • Mine inflows (when available) • Surface dams • Production Bore (Bore Licence Number 10BL603503) • Process water is sourced to up to 170 ML/year, on an as needs basis, from Charbon Colliery by rail.	No change
Mine Ventilation	Two electrically powered centrifugal fans (exhausting types), attached to the northern-most access adit at the pit top, draw fresh air from the remaining three access portals, through the workings, and vent the used air to the external atmosphere through the fans.	No change
Waste Management	Production (reject) and non-production waste (putrescibles and recyclables)	No change
Construction	• Construction of REA and CPP • Construction hours: ○ 7:00 am - 6:00 pm Monday to Friday ○ 8:00 am to 1:00 pm Saturdays ○ No construction work is to take place on Sundays or Public Holidays.	No change
Rehabilitation	Progressive and life of mine	No change
Exploration	Within ML1331 and A232	No change

1.4 Discussion of alternatives to the modification

The project alternatives are limited to grant of consent for the Modification and continuation of mining as currently approved under the SSD 5581 consent. For the purposes of this report, the latter is referred to as the base, or 'business as usual' (BAU) case. The principal differences between the two cases are described in the assumptions highlighted in Section 3. Effects related to the timing of production and subsequent flow of royalties, taxes etc. would remain as identified in the economic modelling of the SSD 5581 consent application in the BAU scenario. The additional employment positions identified in Table 1 would not become available if the Modification does not proceed. However, were consent obtained, the economic effect of the additional positions would be countered by the shorter duration of operations for the existing 155 FTE positions, as earlier extraction would result in earlier exhaustion of the resource and subsequent earlier decommissioning of the mine.

2 Approach

2.1 General principles

The Cost Benefit Analysis (CBA) and Local Effects Analysis (LEA) presented in this document have been prepared with reference to DPE *Guidelines for the economic assessment of mining and coal seam gas proposals* (2015) and the supporting *Technical Notes* (2018), referred to jointly hereafter as 'the guidelines'. As the proposed project is a modification, the approaches set out in the guidelines were not fully applicable in the development of this EA. Furthermore, Centennial Coal has developed internal policies with respect to disclosure of certain information. The treatments of these issues are presented in the following sections. However, the EA has been developed to comply with the guidelines to the extent practicable, given the limitations associated with the nature of the proposal.

2.2 Matters specific to the modification

This report adopts the assessments presented in respect of the SSD 5581 consent granted in 2015 as the BAU case. Consequential economic outcomes associated with the proposed modification to operating conditions are presented. Essentially, the modification relates to changes in certain operating parameters. However, there is no change to the major consent terms, most notably the physical extent of the mine lease area, the total reserves of coal to be mined and the approved mining period. There are also no major surface works associated with the modification. Four key aspects of the Modification which influence the magnitude of changes to the BAU assumptions are as follows:

- The proposed increase in the size of the workforce and the resultant direct and indirect economic effects of this;
- The need for certain environmental effects assessed in the BAU case to be reassessed, based on the increased rate of resource extraction and related potential changes to the timing and intensity of effects;
- Changes in the timing of realisation of other economic outcomes resulting from an accelerated rate of production;
- The application, where appropriate, of estimation principles and metrics indicated in the guidelines, which were promulgated subsequent to grant of SSD-5581.

Considering these factors and certain limitations in respect of project-related information Centennial Airly is prepared to publish (Section 2.3), a limited CBA for the modification is presented in this report. As the application is a modification to the existing consent, the approach taken is to identify the major variances between the economic assessment submitted for the SSD-5581 mine extension consent and the effects of the modification.

2.3 Non-disclosure of certain information

2.3.1 Exclusion of potentially commercially sensitive information

It is advised that, consistent with the approach adopted in respect of the original development consent application for SSD-5581, Centennial Airly maintains that the internal financial appraisal process and its outputs in respect of the Airly Mine operations and the proposed modification are highly commercially sensitive. Furthermore, the output of this financial modelling is of no consequence to consideration of third-party or externalised effects of the modification, which are the matters of interest in a possible public exhibition process to which an application such as the present proposal may be subject. As such, this material is considered by Centennial Airly as being unsuitable for presentation in a document which may be publicly exhibited. The publication of such information has the potential to jeopardise commercial negotiations and outcomes in which Centennial Airly may be involved at the time of publication of this information, particularly in respect of sales to domestic customers, most notably electricity generators. This information is excluded from this economic impact assessment on that basis, but can be made available to the relevant consent authorities as required.

2.3.2 Reporting of taxes other than NSW government royalties

The DPE guidelines (2015) include provision for reporting of federally levied corporate income taxes as a component of the economic benefit of projects, which has necessitated a review of method in terms of estimation of assessment of notional tax liability. Tax liability in respect of Centennial Airly comprises part of tax assessment by Centennial Coal Pty Ltd at aggregate level for the entire company, and not on the basis of individual operations. Therefore, Centennial Airly does not report corporate taxes as a stand-alone entity. Furthermore, given the extent of Centennial Coal's portfolio of operations and their varied performance in any given year, a proportional estimate of entire group tax liability (and thus return to government) cannot be validly attributed to individual operations. Even less so can a reliable assessment of taxes be made over the life of an individual project in the context of this complexity. As a result, corporate tax is not reported in this assessment. The necessary exclusion of this material will contribute to a conservative estimate of benefit, as ordinarily some component of tax paid by Centennial Coal would be returned to NSW.

There will be further economic benefit accruing to state, and local governments in the form of, for example, payroll tax and land rates respectively. These are not assessed in this report, however a discussion of the exclusion of some of these sources of public revenues is discussed in Annexure 1. Any differences in these effects are likely to be marginal and a result of changes in assessments of present values relating to the change in production schedules resulting from the modification, as opposed to material changes in scale.

3 Project economic analysis – Cost Benefit Analysis (CBA)

The CBA component of this analysis presents the state-level economic implications of the Modification. The LEA addresses the qualitative environmental and economic impacts, along with key economic aspects of the proposed modification, the effects of which are likely to be concentrated in the Lithgow LGA and those parts of the MWRC LGA near to Airly Mine.

Section 2.1 advises that a limited CBA is presented in this report. As the proposed modification does not involve, for example, construction of additional surface infrastructure, there are a number of effects that are not relevant for consideration, such as, for example, changes in visual amenity and biodiversity impacts associated with clearance of vegetation. This being the case, the CBA focuses on a comparison of relevant assessments presented in relation to the SSD-5581 consent, with changes that will be affected under the modification. The CBA data presented are present values (PV) and net present values (NPV) at an assumed discount rate of seven percent (7%) except as otherwise noted[1].

3.1 Estimation of economic benefit

The assessments presented in this report may differ to some extent to those presented in the SSD-5581 development consent application economic assessment, reflecting changes relating to application of DPIE's current guidelines and technical notes. One of the effects of these changes is that certain elements of the CBA, and a significant proportion of analyses in the Local Effects Analysis (LEA) are presented as qualitative assessments.

Material assumptions used in the SSD-5581 economic assessment, such as those relating to pricing, have been necessarily amended to facilitate valid comparison of the BAU and modification assessments. The project description (Table 1) provides detailed information on the changes proposed under the modification. Further changes to estimation assumptions have been adopted based on the content of the guidelines. Although these changes in assumptions may alter certain outcomes relative to those prepared in respect of the original consent, the critical issue is to establish the potential for differences as between the approved SSD-5581 and the outcomes under the proposed modification.

3.1.1 NSW government royalties

The majority of Airly Mine's coal output is sold as fuel to the Eraring (Origin Energy) and Vales Point (Delta Electricity) Power Stations. The balance of product is exported to overseas customers. The valuation of this output and related royalties is based on the pricing assumptions and forecasts and exchange rate assumptions presented in Annexure 3. The annexure also explains in detail the sensitivity-testing method employed in calculating the values and the presentation of an estimate based on internal company assumptions. The comparison of royalty assessments, and sensitivity ranges based on DPE and NSW Treasury mandated upper and lower bound discount rates of 4% and 10% is reported in Table 2.

[1] The economic appraisal principles employed herein are consistent with current DPE guidelines (December 2015), Technical Notes (April 2018) and NSW Treasury TPP07-6 Economic Appraisal Principles and Procedures Simplified, to the extent that these documents coincide.

It is noted the estimations for the SSD-5581 as approved or the BAU case and for Modification 3, are based on the independent coal price assumptions (KPMG, World Bank) provided in Annexure 3. The Modification 3 alternative has also been estimated using Centennial Coal's internal pricing assumptions, also provided in Annexure 3.

Table 2: Estimated royalties, Modification 3 and BAU alternatives (NPV)

Assessment	7% ($ million)	10% ($ million)	4% ($ million)
BAU	106.9	91.9	127.2
Modification 3	137.6	122.3	156.3
Modification 3 (internal price assumptions)	150.5	132.6	172.9

The difference between the BAU case and the two scenarios presented for the modification is a consequence of two factors. Firstly, as is observed elsewhere in this report, the modification will result in earlier resource recovery and realisation of the associated economic benefits. The shorter period of discounting acts to increase NPV. Secondly, due to the production schedule proposed under the BAU case, less of the remaining resource will be extracted, with the resultant reduction in economic benefit.

3.1.2 Impacts of additional employment (45 FTE)

The additional employment positions proposed under the modification are expected to result in economic benefit to new employees and their households. As is discussed in the LEA (Section 4), this is likely to have particular effect in the local and regional economies. Annexure 3 describes the bases for calculation of a 'labour surplus' which serves as an estimate of the additional disposable income that may be generated by the new positions. It is assumed that the additional employees will be locally based, as a result of which some proportion of this surplus will be disbursed in the local economy.

There are three factors affecting the scale of economic effects associated with employee incomes. As identified in Table 1, the overall driver of changes is the increase in production rate proposed under the modification. Table 3 presents the relevant employment-related factors and the key employment effect estimates based on those factors. Table 4 shows the labour surplus effects for each case, with the discount rate sensitivity measures also reported. The individual employee measures on which the estimates are based are an average total income of $189,885 for Airly employees (as at October 2018) and a labour surplus of $56,871 based on the two estimates derived in Annexure 1, which equate to a sensitivity range, albeit narrow. The latter figure is the mean of the two estimates presented in the annexure, as the difference between the two is not considered material.

Table 3: Summary of change in employment effects

Factor	2015 (base case)	2019 (modification)	Change
Number of FTE	155	200	45
Production schedule (years)	16	11	-5
Total wage/salary per annum ($M)	29.4	38.0	8.6
NPV wage/salary ($M)	287.4	293.7	6.3
Labour surplus per annum ($M)	8.8	11.4	2.6
NPV labour surplus ($M)	86.1	87.9	1.8

Table 4: Estimated labour surplus, Modification 3 and BAU alternatives (NPV)

Assessment	7% ($ million)	10% ($ million)	4% ($ million)
BAU (155 FTE)	92.1	77.8	111.5
Modification 3 (200 FTE)[2]	94.1	82.7	108.5

The increase in employment is likely to have generally positive effects. However, despite the magnitude of the FTE workforce increase (≈30%), the overall economic effects are modest. The increase in present value related to earlier realisation of employment-related economic benefit resulting from the briefer period of production is offset to some extent in practical terms by the longer-term employment required for the BAU case.

3.1.3 Summary of economic benefit

Table 5 summarises the main sources of economic benefit associated with the proposed modification. As has been noted, the variances in effect valuations are strongly influenced by differences between the longer production schedule supported by the SSD-5581 consent, the shorter schedule resulting from the higher annual output, and total production proposed in the modification.

Table 5: Estimate of economic benefit: Airly Mine Modification 3 (NPV@ 7%)

Economic Benefit & assumptions	SSD-5581 as approved ($million)	Modification 3 ($million)	Differential ($million)
NSW Government royalties (Assumed royalty rate: 7.2%[3])	106.9	137.6	+30.7
Labour surplus – direct positions (Refer to Annexure 2)	92.1	94.1	+2
Other Federal, State and Local government taxes, rates etc. (Refer to Annexure 1)	Not quantitatively estimated	Not quantitatively estimated	Not quantitatively estimated
Total economic benefit PV	**199.0**	**231.7**	**+32.7**

[2] Estimate also applicable to Modification 3 case using royalty estimate based on internal price assumptions.

[3] Deep underground coal (+400m) 6.2 per cent; **other underground coal 7.2 per cent**, open cut coal 8.2 per cent.

Table 6 presents the sensitivity ranges based on the mandated upper and lower discount rates.

Table 6: Estimated economic benefit, Modification 3 and BAU alternatives (NPV)

Assessment	7% ($ million)	10% ($ million)	4% ($ million)
BAU	199.0	169.7	238.7
Modification 3 (averaged independent price assumptions)	231.7	205.0	264.8
Modification 3 (Centennial internal price assumptions)	244.6	215.3	281.4

3.2 Estimation of quantified economic cost

3.2.1 Bases of effects valuation

As noted in Section 2.2, the estimates presented in this section were calculated taking into account certain changed valuation methods promulgated in the DPE guidelines (2015) and supporting technical notes (2018). As was disclosed in the discussion of the approach to this economic impact assessment, due to the limited nature of the proposed modification, the application of the guidelines is applied to the extent practicable. Population-based estimates have been adjusted to allow for calculations based on the Lithgow – Mudgee Statistical Area Level 3 (SA3), as mandated in the guidelines as the nominal locality (DPE, 2015:5).

It is noted that the DPE guidelines variously suggest qualitative or quantitative analysis of impacts, with quantitative assessments preferred to the extent that these can be validly derived. The valuations presented in this assessment are monetised estimates of these, principally estimated using a 'benefits transfer' method based on specialist assessments of the magnitude of impacts, and relevant valuation methodologies.

In relation to these valuations, four key points must be observed:

- Due to the nature of the modification and the absence of significant enabling capital works, in consultation with DPIE, Centennial Airly has determined that it is necessary to address the following potential environmental and related economic effects;
    - Air quality;
    - Greenhouse gas (GHG) emissions;
    - Noise and vibration;
    - Rail and road traffic effects;
    - Effects on water resources, specifically surface and groundwater.
- Where possible, valuation methodologies were derived from studies accessed through relevant government bodies and/or recommended in the DPE Technical Notes and other material identified in the development of those technical notes. This may be considered as placing some greater level of reliability on these studies.
- The identified valuation methodologies have been selected to as closely represent similar existing conditions relevant to the modification as was achievable. However, in

some instances the valuation methodologies are either more general, or related to projects of a different nature, but which retain some level of comparability.

- There remains an unquantified element of social impact, which chiefly relates to more localised effects. This may be described as the 'intrinsic value'[4] of these impacts or effects, as attributed by individual stakeholders. This aspect can be highly individualised and subjective and consequently may not be accurately quantified, as the estimation techniques applied, although based on valid methodologies, may not align with individual stakeholders' values. Although the estimates presented may represent one expression of these values, it must be recognised that there is some likelihood that stakeholders may consider effects to be of higher or lower magnitude. Matters relating to intrinsic value and other qualitative considerations are discussed further in the LEA (Section 4).

[4] E.g. James Marshall & Co. (2013).

Table 7: Effects valuation methods –biophysical and social/infrastructure impacts			
Description	**DPE Technical Notes guidance/other methodology/source of valuation mechanism**	**Valuation measure/unit**	**Comment on application**
Air quality	DPE Technical Note 5, Air Quality.	Qualitative assessment only	SLR (2019a) assessed that concentrations of PM_{10} and $PM_{2.5}$ are 'similar to the incremental impacts predicted for the current approved operations' (pp 46; 48). Assessed sensitive receptors: 8 residential, Airly Camping Ground & Nissen Hut, Genowlan Mountain (passive recreation sites) (SLR 2019a:20).
Groundwater / Surface Water	DPE Technical Note 6, Ground and Surface Water: 'Activities that are assessed as having impacts below designated thresholds are categorised by the [NSW Aquifer Interference Policy (AIP)] as '**Level 1: Acceptable'**. (2018:23)	Qualitative assessment only	Predicted conditions under the modification and approved conditions have been assessed using a recalibrated hydrogeological model. 'Residual groundwater impacts under both proposed and approved conditions are considered to be less than the Level 1 criteria under the NSW AIP' (GHD 2019a:iii). 'The potential impact of Modification 3 of the Airly Mine Extension Project on baseflow in Gap Creek and Genowlan Creek is expected to be slightly less than approved conditions and is therefore considered equivalent to the potential impacts of approved operations at Airly Mine. One surface water user downstream of Airly Mine's mining area on Genowlan Creek was identified. No measurable impacts on downstream surface water users are expected as a result of Modification 3 of the Airly Mine Extension Project'. (GHD 2019c:6).

Description	Methodology/Source of Valuation mechanism	Valuation measure/unit	Comment on application
Site Water Balance	DPE Technical Note 6, Ground and Surface Water.	Qualitative assessment only	'The proposal is not expected to result in an increase in the frequency or magnitude, nor a deterioration of water quality, of potential discharges. Given the recommended mitigation and management measures, no measurable change in the potential impacts on Airly Creek, downstream water users, or cumulative impacts are expected with respect to surface water. Water balance modelling indicates that the approved importation of up to 170 ML/year of water from Charbon Colliery is sufficient to meet process water requirements of the proposed production increase' (GHD 2019b:ii), except in a dry year. Three surface water users downstream from Airly Mine pit top were identified on Coco Creek. Impacts to these users will be negligible.
Greenhouse gas (GHG)	DPE Technical Note 9, Greenhouse Gas Emissions (2018:44).	$11.90 per tonne average abatement price	SLR (2019a) assessed comparative annual GHG emissions as 10,099.7 p.a. (BAU) and 19,143.1 p.a.(modification) .Based on estimated production schedules, totals are 171,694 tonnes over 17 years (BAU) and 210,574 over 11 years (modification).

Description	Methodology/Source of Valuation mechanism	Valuation measure/unit	Comment on application
Noise	DPE Technical Note 3, Noise (2018:12).	Qualitative assessment only	'Noise levels from the modelled operational scenarios are predicted to be below the relevant PTNL/SDNL and SSD 5581 criteria at all privately-owned residential assessment locations under all considered meteorological conditions' (SLR 2019b:28). Compliance also predicted at Airly Gap and the Nissen Hut (2019b:28). 'Notwithstanding, given that predicted noise levels from the Project are significantly below the Project Amenity LAeq(15minute) noise level (Table 11 of report) any cumulative noise impacts would be considered negligible.' (2019b:28). The average $L_{Aeq(15hour)\ (day\ time)}$ and $L_{Aeq(9hour)\ (night\ time)}$ noise levels would increase by up to 1.8 dB on the Wallerawang-Gwabegar Railway between Airly Mine and Wallerawang, however will comply with the trigger levels in the *Rail Infrastructure Noise Guideline* and John Holland Rail's EPL 13421 noise limits (SLR 2019b:17). The modification will meet the Road traffic noise levels from the existing and proposed traffic volumes comply with the *Road Noise Policy* noise criteria at the nearest affected receiver on Glen Davis Road during the day and night-time periods. Assessed sensitive receptors: 8 residential, Airly Camping Ground & Nissen Hut, Genowlan Mountain (passive recreation sites) (SLR 2019b:12).

Description	Methodology/Source of Valuation mechanism	Valuation measure/unit	Comment on application
Traffic (rail)	DPE Technical Note 8, Transport Impacts	Qualitative assessment only Rail related noise impacts addressed in Noise assessment	'The impact on the Wallerawang-Gwabegar rail line will be an increase of average daily trains travelling on the line from two to three trains, with a maximum of five trains per day. Additionally, the proposal will result in a marginal increase of trains utilising the Main Western Rail line. The impact of this increase is evaluated to be negligible and easily accommodated within the existing network capacity' (Barnson 2019).
Traffic (road)	DPE Technical Note 8, Transport Impacts	Qualitative assessment only Traffic related noise impacts addressed in Noise assessment	'The only impact of the Project on the existing traffic environment would be due to an increase in staff numbers and therefore vehicle trips. It has been determined that the existing road infrastructure and intersections have sufficient capacity and satisfy regulations to accommodate the increased traffic volumes' (Ason 2019:22).

3.2.2 Effects valuation

With the exception of a material increase in GHG (Scope 1 and Scope 2) emissions, the remainder of the specialist biophysical and infrastructure impact assessments relevant to the modification report potential impacts that are assessed as not meeting materiality thresholds in terms of presenting quantitative assessments for the respective impacts.

The limited scale of some effects is largely a function of the inter-temporal changes associated with the proposed higher annual production limit and consequent briefer duration of mining operations. This effectively results in a temporal redistribution of these potential impacts, rather than an operationally driven impact and results in minor differences, as is evidenced by the material in Table 8.

With the noted exception of GHG, other effects that are directly altered by the modification are traffic and rail movements and their potential for related impacts. However, these are also assessed as not being material changes compared to the existing approval, based on system capacity and continuing compliance with maximum approved movements.

In relation to the effects that are not considered material, DPE guidelines indicate qualitative assessment of these impacts. As the potential for impacts is largely contained to geographic areas immediate to Airly Mine, these qualitative assessments are undertaken in the subsequent LEA. Based on the material in Table 7, the monetised economic impact estimates are summarised in Table 8.

Table 8: Estimate of environmental effects: Airly Mine Modification 3[5]

	SSD-5581 Approval[6] **(≈ $)**	**Modification 3 (≈ $)**	**Differential (≈ $)**
	PV @ 7%	**PV @ 7%**	**PV @ 7%**
GHG emissions[7]	3,559,086	5,180,605	+1,621,519
Air quality	292,964	243,411	-49,553
Water (**surface water & groundwater)**[8]	18,668,358	15,510,714	-3,157,644
Noise	1,663,628	1,382,235	-281,393
Traffic (rail & road)	0	0	0
Total PV	24,184,036	$22,316,966	-1,867,070
Total PV (rounded)	**$24.2 million**	**$22.3 million**	**-$1.9 million**

[5] The estimates in this table are shown in full to display differences between estimates below the '000 level.
[6] Assumes the residual mine life based on current production schedule assumptions.
[7] Based on the annual estimates produced in the SLR Air Quality Assessment (2019a),
[8] Based on estimates derived using the benefits transfer method adopted in the SSD-5581 consent application.

Notwithstanding an increased value estimated for Scope 1 and 2 GHG emissions, the overall effect of the modification is a reduction in the total quantitative valuation of environmental effects. However, as is recognised in DPE's guidelines, the qualitative aspects of these assessments are important to developing a balanced assessment, and are discussed in greater detail in the LEA. Quantified total economic costs, with discount rate-based sensitivity parameters are shown in Table 9.

Table 9: Summary of economic cost, Modification 3 and BAU alternatives (NPV)

Assessment	7% ($ million)	10% ($ million)	4% ($ million)
BAU	24.2	20.3	29.6
Modification 3[9]	22.3	19.5	25.9

3.3 Summary CBA estimation

Combining the estimates presented in Sections 3.1 and 3.2, Table 10 presents outcomes for the three scenarios, including that based on internal pricing assumptions.

Table 10: CBA scenario summaries (NPV)

Assessment	7% ($ million)	10% ($ million)	4% ($ million)
BAU			
Total economic benefit	199.0	169.7	238.7
Quantified economic cost	24.2	20.3	29.6
Net economic benefit	174.9	149.4	209.1
Modification 3			
Total economic benefit	231.7	205.0	264.8
Quantified economic cost	22.3	19.5	25.9
Net economic benefit	**209.4**	**185.5**	**238.9**
Modification 3 (internal price assumptions)			
Total economic benefit	244.6	215.3	284.4
Quantified economic cost	22.3	19.5	25.9
Net economic benefit	222.3	195.8	255.5
Increase in NPV Modification 3 vs BAU	**34.5**	36.1	29.8

The additional quantified economic benefit of the modification when compared with the approved BAU case is $34.5 million. The underlying reasons for this greater value were identified in Section 3.1.1. This estimate is adopted as forming the quantitative element of the economic assessment and is considered further in the context of qualitative assessments developed in the LEA (Section 4).

[9] Estimate also applicable to Modification 3 case using royalty estimate based on internal price assumptions.

4 Economic effects analysis – Local Effects Analysis (LEA)

The LEA component of this economic assessment considers the potentially more apparent economic effects of the proposed modification, from the local and regional perspectives. This involves consideration of the environmental effects which were assessed quantitatively in Section 3, placing these in the qualitative, local and regional context. Similarly, relevant elements of economic benefit that particularly accrue to the local and regional communities are discussed, some of which, particularly the 'labour surplus' estimated in Section 3, are also likely to be of greatest effect in the context of the region. The data presented are applied to establishing the extent to which the regional and local communities and economies are able to absorb the addition of 45 FTE employees and their households and their collective effects.

4.1 Regional economic profile

4.1.1 Local government economic development strategies

In conjunction with the Centre for Economic and Regional Development (CERD) within the NSW Government Department of Premier and Cabinet (DPC), both LCC and MWRC have developed Regional Economic Development Strategies (REDS). The involvement of CERD in this process provides a consistent approach to development of such strategies and ensures alignment with broader state and regional planning strategies and priorities.

4.1.1.1 LCC REDS 2018-2022

The LCC REDS recognises the importance of coal mining to the regional economy and that at some future point the region will need to transition to a post-mining economy. Coal mining is identified as the largest contributor to gross regional product (GRP). Consistent with the GRP data, the mining industry is the largest regional exporter, and considering relative scale, is also the largest importer. It is the second largest industry by employment and is recognised as a key endowment and economic driver for the economy more broadly.

4.1.1.2 MWRC REDS 2018-2022

The MWRC REDS describes a different emphasis on the coal mining industry in the LGA. The regional industry is in a growth stage, which contrasts with the assessed LCC LGA situation. Although MWRC has been traditionally a more agriculture-focused regional economy, the increasing importance of mining is evident in the report. Mining employment increased by 30% between 2011 and 2016, with the industry now being the largest sector by number employed. As identified in Table 15, approximately 59% of the current Airly workforce resides in the MWRC LGA.

4.1.1.3 Comment on regional economic development effects

Coal mining is expected to remain as a key element of regional economic stimulus and contribution in both LGAs. Table 15 reports that approximately 93% of the existing Airly workforce is resident in the MWRC and Lithgow LGAs. Employee households and mining firm trade with local and regional businesses are both significant sources of economic activity and strength in the two LGAs.

4.1.2 Economic and employment metrics

4.1.2.1 Headline economic data

Table 11: Headline economic indicators LCC & MWRC LGAs[10]

Economic metric	LCC value	MWRC value
Gross Regional Product (GRP)	≈ $1.27 billion	≈ $2.03 billion
Population (2018 ERP)	21,636	25,086
Local businesses	1,313	2,537
Employed residents	7,797	8,540
Coal mining employment (FTE)	947	1,831
Unemployment rate[11]	7.2%	5.4%

4.1.2.2 Industry structure – employment by industry

Table 12: Employment by industry: ABS Census 2016 (% of total)[12]

Industry	LCC LGA	MWRC LGA	SA2	SA3	NSW
Agriculture, forestry & fishing	2.7	9.0	7.4	6.8	2.2
Mining	11.1	17.5	31.2	14.4	0.9
Manufacturing	4.8	4.1	2.4	4.3	5.9
Electricity, gas, water & waste services	4.1	1.0	10.9	2.3	0.9
Construction	5.3	6.8	7.1	6.0	8.4
Wholesale trade	2.1	2.0	1.1	2.1	3.1
Retail trade	9.3	10.6	3.6	10.0	10.0
Accommodation & food services	8.8	8.1	9.2	8.3	7.1
Transport, postal & warehousing	4.2	2.3	3.1	3.2	4.7
Information media & telecommunications	0.7	0.7	0.4	0.7	2.2
Financial and insurance services	2.1	1.0	0.2	1.5	5.0
Rental, hiring & real estate services	1.4	1.2	0.9	1.2	1.8
Professional, scientific & technical services	2.6	3.4	1.8	3.0	8.1
Administrative & support services	2.9	2.4	2.0	2.6	3.5
Public administration & safety	12.2	4.1	2.3	7.6	5.9
Education & training	7.4	7.5	5.8	7.7	8.3
Health care & social assistance	10.5	9.6	3.3	10.0	12.5
Arts & recreation services	0.7	1.1	0.8	0.9	1.5
Other services	3.4	4.7	2.2	4.1	3.7

4.1.2.3 Key observations

- The data demonstrate the importance of the mining industry in the LCC and MRWC LGAs when compared with NSW as a whole. The Lithgow Region SA2 is particularly reliant on mining employment. This clearly has further implications for the economic

[10] Data sources: LCC Economic Profile, citing NIEIR and ABS, (2018); ABS (2019); ABS Cat No. 8165.0 (2019); REMPLAN MWRC Economic Profile (2018).Updated September 2019

[11] LCC/i.d. 2019: https://economy.id.com.au/lithgow/unemployment; MWRC/REMPLAN 2019: https://www.economyprofile.com.au/midwestern/trends/unemployment.

[12] ABS advises that small random adjustments are made to all cell values in source data to protect confidentiality. Classifications 'Inadequately described' and 'Industry of Employment not stated' excluded from this table.

structure of the regional economies, in terms of supporting industries and businesses that also rely on the presence and scale of the mining industry.

- Electricity gas, water and waste services are also comparatively over-represented compared with NSW, particularly in Lithgow and the Lithgow Region SA. This emphasises the interdependencies between the regional mining and electricity generation industries.
- Table 13 displays the proportions of the total workforce employed specifically in coal mining for the four SA2 divisions (two each in LCC and MWRC) and the SA3. The table also presents the distribution of the workforce within the LGA, as between the SA2s comprising each.

Table 13: Proportion of workforce employed in coal mining, 2016 Census (%)

	Lithgow SA2	Lithgow Region SA2	Mudgee East SA2	Mudgee West SA2	SA3
% SA2	8.3	7.7	8.5	11.3	10.9
% LGA	60.4	39.6	15.9	84.1	-

- The distribution of mining employees is more even in the LCC LGA than in the MWRC LGA. The latter is a product of population distribution, and the presence of several comparatively large mines in the northern/western parts of MWRC LGA. Conversely, the mines in LCC LGA are more closely geographically located.
- Coal mining is the largest single employing industry in each of these geographic areas, with the exception of Mudgee East (beef cattle farming).
- When supporting industries are considered in addition to these data, the importance of coal mining to the regional economies is further emphasised.

4.1.2.4 Industry structure – occupation

Table 14: Comparison of mining & local/regional occupational groups 2016 Census

Occupation	Mining LCC %	LCC %	SA2 %	SA3 %	NSW %
Managers	5.7	9.4	11.6	12.8	13.5
Professionals	7.6	12.2	11.9	12.7	23.6
Technicians & Trades Workers	31.0	17.5	17.2	17.1	12.7
Community & Personal Services Workers	0.4	12.9	13.0	11.1	10.4
Clerical & Administrative Workers	3.2	13.2	12.8	11.4	13.8
Sales Workers	0.0	8.4	7.2	8.7	9.2
Machinery Operators & Drivers	49.5	12.5	13.4	12.4	6.1
Labourers	2.3	12.1	11.2	12.1	8.8

4.1.2.5 Key observations

- As may be expected given the nature of the industry, technicians and trades workers, and machinery operators and drivers are over-represented in the Lithgow mining-specific employment category, when compared with general workforce data for the larger populations.
- At LGA, SA2 and SA3 levels, employment structure is relatively consistent, particularly compared with NSW, which has a distinctively different structure, featuring a much larger proportion of professionals, and comparatively low proportions of the mining-related occupations noted above.
- The relatively small proportion of labourers working in the mining industry demonstrates that mining-related employment generally involves skilled labour.

4.1.2.6 Residential distribution of the mining workforce

The following table compares data from the LCC employment report (mining) and internal employee residence data. In effect this compares the distribution of the total Lithgow mining workforce[13], with that for the Airly Mine workforce. The comparison should be interpreted as indicative only, as the two data sets are based on different, although comparable, geographic areas.

Table 15: Mining workforce residential distribution

LGA/SLA[14]	SLA (LCC report data) %	LGA (Airly Mine data) %
Bathurst	8.2	4.0
Blayney	0.3	-
Blue Mountains	6.5	-
Cabonne	0.3	-
Campbelltown	0.3	-
Coffs Harbour	0.3	-
Gosford	0.5	-
Hawkesbury	0.4	-
Lake Macquarie	0.5	1.3
Lithgow	**79.7**	**34.6**
Mid-Western	**1.2**	**58.7**
Oberon	0.5	-
Orange	-	1.3
Penrith	0.3	-
Wollongong	0.3	-

[13] The LCC LGA mining workforce is assumed here, as it is less dispersed than MWRC in terms of the locations of employing mines. The larger mines in northern/western MWRC are predominantly open cut.
[14] The report uses the terminology SLA (Statistical Local Area), however the current terminology is SA2.

4.1.2.7 Key observations – workforce distribution

- The Airly workforce is distinguished from the Lithgow mining employee workforce due to the larger concentration of the Airly workforce residing in the eastern/southern part of the MWRC LGA, particularly the centres of Rylstone (≈ 25%) and Kandos (≈ 19%). However, this is consistent with the relative proximity of the mine to each of these centres and to Lithgow, the other settlement in which employees are concentrated. Approximate road distances[15] between Airly Mine and the three centres are:
  - Lithgow: ≈ 53km;
  - Kandos: ≈ 55km;
  - Rylstone: ≈ 60km.
- In total, 93.3% of the population resides within the three SA2s nearest to and including the mine (Lithgow, Lithgow Region and Mudgee East).
- The data demonstrate that the mining workforce is regionally based. As a consequence, much of the social and economic activity of the workforce takes place in the local and regional areas, further contributing to the socioeconomic functioning of these areas.
- The retention of mining employee incomes in the region is economically significant, particularly through comparing mining employee incomes with overall median personal and employee incomes for the LGA, SA2 and SA3 (Table 16). The higher incomes in mining employment encourage increased expenditure in the local and regional economies in which these employees live, when compared to population medians.

Table 16: Weekly gross personal income data comparison

Description	Income ($/week)
Median personal income (Lithgow LGA – Census 2016)	$510
Median personal income (Lithgow Region SA2 – Census 2016)	$542
Median personal income (Lithgow-Mudgee SA3 – Census 2016)	$529
Median employee income (LCC LGA, 2016)[16]	$897
Median employee income (MWRC LGA, 2016)[17]	$857
Drillers, Miners, Shotfirers (Dept. of Employment Job Outlook 2019 data)[18]	$2,500
Earthmoving Plant Operators	$1,491
Geologists, Geophysicists and Hydrogeologists	$2,192
Mining Engineers	$3,118
Safety Inspectors	$1,876

[15] Google Maps 2017: https://www.google.com.au/maps
[16] ABS Data by Region – derived as median employee income ($46,628)/ 52 weeks = $896.69.
[17] ABS Data by Region – derived as median employee income ($44,567)/ 52 weeks = $857.06.
[18] Selected occupational examples for brevity.

4.2 Assessment of socioeconomic effects of the modification

4.2.1 Effects on local and regional supply chain and contractor businesses

As is the case with the state-wide economic effects assessed in the CBA, the most significant changes in impacts on businesses in the local and regional economies which trade with Centennial Airly are timing related. The shorter duration of the production period is likely to result in more business activity taking place sooner, which generally would be regarded positively by business operators. The trade-off to this is that the opportunity to do business with Airly Mine will cease earlier than would be the case under the BAU scenario. The complexities surrounding the variance in the mid- to long-term aims of relevant businesses, and other confounding factors, render an accurate assessment of how such businesses would perceive these two options, and what their preferences are, difficult to assess. However, applying the simple assumption of the 'time value of money', it is notionally valid to assume that many businesses would prefer the modification circumstance on that basis.

An indicative assessment of Airly Mine's commercial activity in the region is presented in Table 17. The data represent a typical year of transactions under the existing SSD-5581 consent. As stated above, approval of the modification would result in some intensification of such activity.

Table 17: Regional & NSW supplier transaction & contractor engagement data[19]

Measure	Regional	NSW
Supplier transactions		
Number of companies	85	281
Total transaction value	$2,724,925	$34,481,538
Contractor engagements		
Number of companies	60	-
Number of individual employees	140	-
Total Hours	8,440	-
FTE contractor employees[20]	5	-

4.2.2 Employment effects

There are three factors affecting the scale of economic effects associated with employee incomes. As identified in Table 1, the overall driver of changes is the increase in production rate proposed under the modification. Table 13 presents the relevant employment-related factors and the key employment effect estimates based on those factors. The individual employee measures on which the estimates are based are an average total income of $189,885 for Airly employees (as at October 2018) and a labour surplus of $56,871 based on the estimates derived in Annexure 1. The latter figure is the mean of the two estimates presented in the annexure, as the difference between the two is not considered material.

[19] Supplier data is for FY2015-2016. Contractor engagements are nominally for CY 2015.
[20] Based on 35-hour week and 52 weeks. Estimate rounded from actual 4.6 FTE.

It is also noted that the most recently reported ABS annual median employee income (wage and salary) for the LCC and MWRC LGA (2016)[21] was 46,628 p.a. and $44,567 p.a. respectively, and the corresponding means, $56,652 p.a. and $57,633 p.a. It is noted that the mean employee incomes are only marginally higher than the estimated labour surplus (or potential net economic benefit) associated with Airly employees' incomes. Given the differential between mine employee incomes and those for broader population levels, the residual contribution to the economy is greater than would be the case for most other forms of employment in the regions.

A further qualitative measure of these effects is the application of household size data to the number of positions at the mine. This results in an estimate of the *total* number of LGA residents who are likely to directly benefit from employment at the mine. Two estimates of household size are applied. The first is the average household size for the LGA derived from ABS Census 2016 Census data of 2.4 people per household for the SA3. Bearing in mind the older population profile for the region, with consequently more household without children and or single person households, and the fact that households that are active in the workforce are more likely to have both a younger age profile and children residing in the household, a second estimate is also applied. In the absence of specific data for Airly Mine, recent Springvale Mine survey output determined an average household size of 3.1 which is adopted in this analysis, and which reflects the assumptions stated above.

Table 18: Estimate of direct beneficiaries residing in employee households

	Current (155 FTE)	Proposed (200 FTE)	Differential (45 FTE)
@ 2.4 people/household	372	480	108
@ 3.1 people/household	481	620	139

Employment at the mine may currently support an estimated 372 to 481 residents in the region. An expansion of employment by 45 FTE may see a further 108 to 139 residents added to the estimate of direct beneficiaries in employee households.

4.2.3 Community contributions

Airly Mine also provides direct support to a number of community organisations and events in the region. These are generally restricted to the immediate area, as Centennial Coal's other regional operations, particularly Springvale Mine, make similar contributions in the Lithgow area, immediate to that mine.

In the most recent financial year data available, the following organisations received financial support from Airly Mine:

- Capertee Public School;

[21] Most recent ABS Regional Statistics data (2019). As the majority of the current workforce resides in MWRC, figures for that LGA were used. The corresponding figures for LCC LGA are $46,682 (median) and $56,652 (mean).

- Henbury Sport & Recreation Club Limited;
- Kandos High School;
- Kandos Public School;
- PCYC Mudgee;
- Rylstone District Pony Club;
- Rylstone Public School;
- Rylstone Streetfeast Incorporated.

It is noted that the mine provides recurrent funding to a number of these organisations/events. These contributions are important to these organisations and their members, students, staff etc., given the relatively small population of the region, and the limited opportunities for alternative fundraising activity.

In addition to these corporate contributions, it is considered likely that Airly Mine employees also make community contributions, particularly through activities such as volunteering in the community. Although internal survey data has not been generated at this point for Airly Mine, recent workforce research at Springvale Mine provides an indication of these community contributions. The research found that 161 respondents (approximately 62 percent of respondents) reported a total 288 involvements with various service, community, sports, social and cultural organisations in the areas in which they reside. If this were the case in respect of the additional 45 FTE employees, this would result in 28 employees engaging in approximately 50 community-based activities.

The engagement of employees in voluntary organisations such as the Rural Fire Service, State Emergency Service and NSW Fire and Rescue warrant particular consideration. At relevant times these involve a commitment on the part of both the employee and the employer, in terms of employees' enforced absence from the workplace whilst on such duties.

4.2.4 Potential cumulative effects of increased employment at Airly Mine

4.2.4.1 Regional distribution of skilled labour pool

Centennial operations ordinarily employ some apprentices, trainees and other workers who are inexperienced in the underground mining industry. However, more generally, skilled workers who may be drawn from the regional labour force are a recruitment focus. The following analyses assesses the scale of the regional labour pool in the context of the requirement for an additional 45 FTE workers. It is noted that at the time of preparation of this report, a detailed schedule of the assumed make-up of the new 45 FTE positions (e.g. proportions of trades, miners etc.) was not available.

4.2.5 ABS data

Table 19 describes the regional labour force distributed across the Lithgow LGA (LCC LGA), Lithgow – Mudgee SA3 (LMSA3) and the Central West NSW SA4 (CWSA4), based on ABS 2016 Census data. Assumptions used for this analysis are:

- 45 additional FTE employees;

- The proportion of relevant occupations currently employed in the mining industry (managers, professionals and technicians and trades workers). A detailed allocation of the proposed positions has not been established at this point, however the significant majority of these would be production-related, therefore the principal focus is on the technicians and trade workers occupational group;
- The proportion of relevant occupations currently employed in other industries that might notionally provide relevantly skilled employees (agriculture, forestry and fishing; manufacturing; electricity, gas, water and waste services; and construction);
- The proportion of all relevant occupations currently employed in the workforce.

Table 19 presents data for selected occupations as described in these assumptions. Table 20 displays the total mining workforce (all occupational groups) for each area.

Table 19: Geographic distribution of relevant occupations by industry of employment (ABS data 2019)

Industry	Managers			Professionals			Technicians & Trades Workers		
	LCCLGA	LMSA3	CWSA4	LCCLGA	LMSA3	CWSA4	LCCLGA	LMSA3	CWSA4
Mining	49	133	289	53	166	462	236	726	1,431
Agriculture, Forestry & Fishing	140	786	5,321	3	14	166	7	68	400
Manufacturing	43	106	726	18	48	309	137	266	1,485
Electricity, Gas, Water and Waste Services	25	29	99	36	35[22]	110	150	190	443
Construction	34	111	645	17	29	111	152	397	2,188
Total, selected industries	**291**	**1,165**	**7,080**	**127**	**2,064**	**1,158**	**682**	**1,647**	**5,947**
TOTAL – ALL INDUSTRIES	**755**	**2,280**	**12,901**	**1,071**	**14,775**	**14,002**	**1,205**	**2,89**	**11,681**

[22] As reported in data (theoretically this should not be lower than for the LGA, however ABS data carries the following caveat: *'Please note that there are small random adjustments made to all cell values to protect the confidentiality of data'*.

Table 20: ABS mining industry data, all occupational groups

Occupation	LCC LGA	LMSA3	CWSA4
Managers	49	133	289
Professionals	53	166	462
Technicians & Trade Workers	236	726	1,431
Community & Personal Service Workers	0	0	21
Clerical & Administrative Workers	22	100	216
Sales Workers	0	4	15
Machinery Operators & Drivers	425	1,260	2,119
Labourers	22	84	175
Inadequately described/not stated	11	30	53
Total	**819**	**2,501**	**5,257**

Data source: ABS 2019

A significant proportion of the mining workers residing in the LGA would be current Centennial employees, based at the various mines and supporting sites in the area[23]. Accordingly, if the required 45 FTE employees were to be sourced from the SA3 or the SA4 more broadly, the proportion of those workers to the various workforce assessments presented in Tables 19 and 20 are presented in Table 21.

Table 21: Proportions of additional positions to current occupational groups

Occupational/geographic category	45 FTE as proportion of (≈ %)
Technicians & trades workers – mining SA3 (Table 23)	6
Technicians & trades workers – mining SA4 (Table 23)	3
Technicians & trades workers – selected industries SA3 (Table 23)	3
Technicians & trades workers – selected industries SA4 (Table 23)	<1
Mining employees, all occupational groups, SA3 (Table 24)	2
Mining employees, all occupational groups, SA4 (Table 24)	<1

Data source: ABS 2019

4.2.6 NSW Minerals Council survey data

The NSW Minerals Council (NSWMC) commissioned a survey report (2018)[24] which investigated the economic effects of the mining industry in the state. Clearly, direct employment and its effects comprised an element of the report. Figure 1 describes the mining workforce distribution across the SA3 (Lithgow and Mid-Western Regional Council [MWRC] LGAs combined). Figure 2 includes data for these LGAs and the mining workforce in the Orange LGA, which can be interpreted as approximating the SA4[25]. Table 22 provides the survey counts on which the figures are based and an assessment of the proportion of the workforce in each LGA that the 45 FTE positions comprise if all positions were filled from each LGA.

[23] Analysis of Centennial internal employee data for 2017 enumerated 530 employees from all Centennial Western operations as residing in the Lithgow LGA.
[24] NSW Minerals Council: NSW Mining Industry Expenditure Impact Survey 2016/17. April 2018. Lawrence Consulting.
[25] The NSWMC report did not identify employees in other SA4 LGAs such as Bathurst and Blayney. It is assumed that this was due to small counts in such areas.

Figure 1

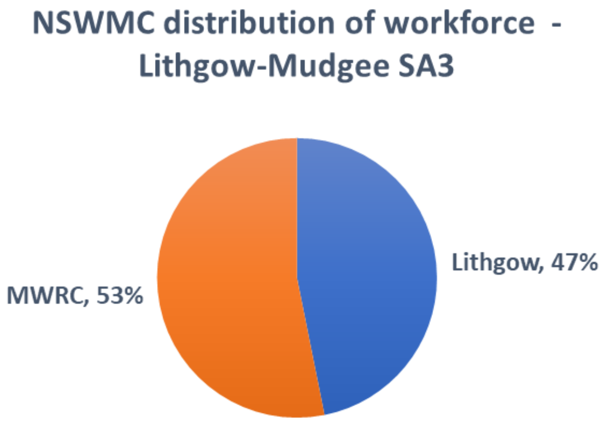

Figure 2

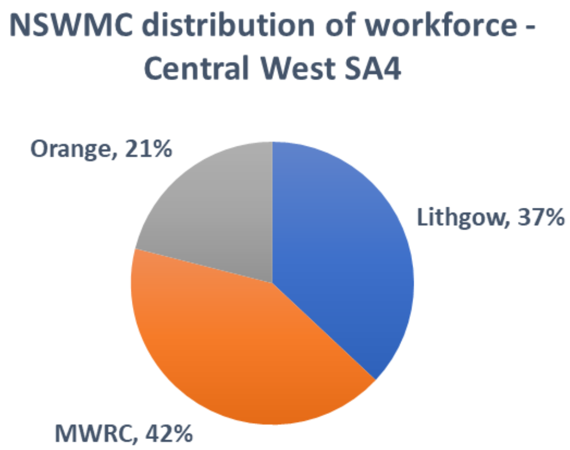

Table 22: NSWMC survey employee counts – Central West NSW LGAs

LGA	Number of employees	45 FTE (≈ % of total mining workers in LGA)
Lithgow	1,330	3.4
Mid-Western	1,509	3
Orange	757	6
TOTAL	**3,596**	**1.3**

4.2.7 Summary of labour pool assessments

The various datasets examined above establish that the additional positions represent a modest increase over, and potentially correspondingly modest draw on, the existing pool of potential skilled labour in the immediate and surrounding regions. Unemployment rates for LCC and MWRC LGAs (Table 11) also suggest that there may be some unused or underutilised capacity in the regional labour force. The key figures in summary are drawn from Tables 21 and 22, being that the additional labour requirement represents between 1% and 1.3% of the existing regional mining workforce. It is assessed that on this basis, the additional positions can be absorbed without causing any material disruption or distortion to local or regional labour markets.

4.2.8 Regional effects of additional employee incomes

As presented in the CBA, the addition of 45 FTE employees will create additional disposable income, part of which is likely to be disbursed in the regional economy (Table 4). This amounted to approximately $94 million over the life of the mine, as it would stand under the proposed modification which is valued at approximately $2 million more than for the BAU case. Expenditure of this additional disposable income will support business activity and employment across the spectrum of the local and regional economies. This is particularly recognised in respect of the Lithgow LGA (LCC REDS, refer to Section 4.1.1.1 of this report).

4.2.9 Cumulative effects of labour increases at other regional operations

Centennial Coal has concurrently made application for a modification including an increase of 100 FTE in the approved labour force for Clarence Colliery. Considering this and the current application, there is a potential combined increase in mining employment of 145 FTE in the region.

Based on the two total regional mining workforce assessments presented in Tables 19 and 20, the total increase as a proportion of this labour force is 2.8% (ABS data) and 4% (NSWMC data) respectively. Taking into consideration the labour market characteristics and conditions discussed in respect of the current application, it is assessed that the cumulative effects of the two applications would not result in undue disruption to, or distortion of, regional labour markets. In view of the potential for additional disposable income becoming available for expenditure in the local and regional economies (as presented in the CBA for this application), the economic effects are likely to be positive.

4.3 Potential effects on housing demand

4.3.1 Income & housing-related data

Table 23 presents a summary of regional housing data for the LGA, Lithgow Region SA2 and Lithgow-Mudgee SA3. The data on the existing workforce (Section 4.1.2.6) indicate a largely resident workforce. The regional communities have relatively high proportions of home ownership (combination of outright ownership and purchasing/mortgaged) when compared with NSW as a whole. This is to be expected in the context of the much larger state population, with its more diverse circumstances and housing needs. Generally however, the data demonstrate that the population is relatively stable, with financial and resultant broader ties to the region.

Table 23: Demographic profile: income data & housing-related data

	LGA $	SA2 $	SA3 $	NSW $
Income				
Median weekly personal income	510	542	529	664
Median weekly household income	1,328	1,426	1,375	1,780
Median weekly family income	984	1,123	1,054	1,486
% households < $650 gross p.w.	31.2	27.2	29.0	19.7
% households > $3000 gross p.w.	9.5	11.2	10.3	18.7
Housing tenure	**%**	**%**	**%**	**%**
Owned outright	41.8	45.7	40.0	32.2
Owned with a mortgage	29.3	35.3	29.7	32.3
Rented	24.6	15.0	26.1	31.8
Housing costs	**$**	**$**	**$**	**$**
Median monthly mortgage repayment	1,387	1,517	1,517	1,986
Median weekly rent	230	200	245	380
Dwelling count	**Count**	**Count**	**Count**	**N/A**
Occupied private dwellings	7,859	2,871	17,125	-
Unoccupied private dwellings	1,051	423	2,850	-

Data source: ABS 2016 Census

The counts of occupied and unoccupied private dwellings are of specific interest in assessing the impacts of the increased workforce proposed in the modification. Based on current direct and contractor employee residential origins, Centennial Airly anticipates that the additional employees will be approximately evenly distributed between residence in the LCC and MWRC LGAs (i.e. 50% in each LGA). On this basis, Table 24 includes an assessment of the potential demand of 45 employees (assumed as 45 additional households) on the existing housing stock for these areas. For the purposes of the assessment the distribution is assumed as 23 households in LCC and 22 in MWRC.

Table 24: Potential housing demand effects LCC & MWRC, 45 FTE

	LCC	MWRC
Additional FTE = (1 dwelling per FTE)	23	22
Unoccupied private dwellings (2016)	1,051	1,660
% of excess dwelling stock required	2.2%	1.3%

Table 24 indicates that there is existing housing stock capacity to absorb the increase in employment. Furthermore, the scenario presented in Table 24 is the maximum demand that might be generated, given that, as discussed in assessing regional workforce capacity (Section 4.2), there is some prospect that the additional positions may be filled from within the existing regional labour force (i.e. current residents).

4.3.2 Cumulative effect

As was observed in relation to the potential labour force implications of the modification, the concurrent application for an increase of 100 FTE at Clarence Colliery may notionally increase the potential housing demand effects. The economic assessment material presented in relation to that modification assumed that these employees are likely to reside in the LCC LGA. Combining these potential residents with the assessment in Table 24, maximum additional demand on unoccupied housing stock in LCC would be approximately 11.7% of existing excess capacity as at 2016 Census. Generally, it is apparent that there is sufficient capacity within regional housing markets to absorb demand associated with both proposed modifications.

4.4 Demand for key services

As is identified in Table 18, the additional 45 FTE proposed under the modification may result in a population increase of the order of 108 to 139 residents, based on the two estimates of people per household in the table. Such a population increase may create additional demand for services such as health and education, a significant proportion of which are publicly provided. Most recent Estimated Resident Population (ERP) figures are shown in Table 25. Assuming the residential distribution of households assumed in Table 24, and the average of the two estimates above (≈ 124 additional residents, therefore 63 new residents in Lithgow and 61 in MWRC), the proportional increase in population is also assessed. The proportional increases in population cannot be considered as material in the context of regional capacity to manage associated additional demand on publicly and privately provided services. If the cumulative effect of employment increases at Clarence Colliery discussed in Section 4.3.2 in respect of housing demand are also taken into consideration, it is assessed that there is also capacity to accommodate the cumulative demand resulting from both projects.

Table 25: ERPs 2018 – LCC & MWRC LGAs

LGA	ERP (2018)	% Δ
LCC	21,636	0.3
MWRC	25,086	0.24

4.5 Economic effects of operational impacts

The CBA included monetised assessments of potential changes in the timing and intensity of environmental effects of modified operations at Airly Mine. Some of these effects notionally may have broader impacts. However, there is a more elevated potential for certain effects to have localised impacts.

4.5.1 Identified/potential local effects

Summary assessment conclusions for environmental effects that are assessed as likely to be impacted by the modification are presented in Table 7. As is the case with the monetised CBA assessments in Table 8, these are based on establishing the potential for changed outcomes between operations under the existing consent and the modification respectively.

These assessments conclude that potential effects, with the exception of GHG emissions, will remain within existing approved operating conditions. Consequently, it is assessed as being unlikely that any quantifiable, material change in effects is likely to be experienced by the identified sensitive residential receptors, occasional users of the two identified passive recreation sites, or other occasional visitors to the area.

4.5.2 Community perceptions of effects

Notwithstanding the assessments referred to in Section 4.5.1, the perceptions of the local community, and in particular residents of the identified sensitive receptor properties, may perceive a greater potential for effects resulting from the modification, as is discussed in terms of the subjective, 'intrinsic value' that may be ascribed to certain environmental assets (refer to Section 3.2.1).

As is the case with the CBA elements of the modification and other forms of potential impacts, although the modification may result in certain impacts occurring over a shorter production period, cessation of such effects will also occur earlier under the modification. This being the case, there is likely to be some moderating effect in terms of the net effects of the modification, including from the perspective of resident and other stakeholder perceptions.

These matters are addressed in greater detail in the Social Impact Assessment (SIA) prepared for the modification, including with particular regard to aspects of stakeholder perceptions addressing the relevant SIA guidelines. As is identified in the SIA, compliance with ongoing consent conditions and the implementation of the recommended project-specific mitigation measures, such as those presented in the specialist assessments of effects, will serve to reduce the risk of material impacts occurring. Despite this, concerns may still be held by some stakeholders. In addition to mitigation and risk treatment initiatives for relevant effects, ongoing engagement with the community is also a necessary component of managing the potential for such perceived effects. Centennial Airly has established mechanisms in place to meet this requirement.

5 Conclusion

From the quantitative perspective, as principally presented in the CBA component of this economic assessment, it is assessed as being likely that, on balance, the proposed modification will result in positive economic benefit for the state, and local and regional areas in which Airly Mine is located. Despite the possibility that the modification may result in higher annual production yield, while remaining within existing life of mine consent parameters, the principal source of this increase in economic benefit relates to the timing of when such benefit will eventuate. There are apparent trade-offs between shorter (modification) and longer (approved SSD-5581) production periods, however standard assessment practices indicate a more favourable outcome in the modification scenario.

Due to its relatively limited scope, the sources of potential change in environmental effects of the modification are correspondingly limited. These are assessed as likely to remain within consent conditions. However, the most proximate residents to the site and the proposed operations may perceive risk or experience of effects relating to the modification.

Compliance with conditions, adaptive management practices and ongoing consultation with local stakeholders may serve to address such concerns.

Localised economic effects, like those likely to result more broadly, are chiefly a result of changes in the timing of realisation of such economic effects. Although the current approval has also been previously assessed as being economically beneficial at this level, there is some prospect of marginal increases in the level of economic benefit that may accrue in the region, chiefly predicated on the changed timing of benefit realisation.

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Annexure 1

Treatment of economic effects of taxation components

As discussed in Section 3.4.1, a comparative assessment of the economic contribution of various Federal, State and Local government taxes, rates and charges is excluded from this analysis. The reasons for this approach essentially relate to changes in methodological assumptions, some of which are necessitated by clarifications provided in the DPE guidelines. In essence, the guidelines in particular indicate that tax components be treated separately, whereas they were previously presented on the basis of a combined internal estimate. These are described below.

Corporate taxes (Federal)

The DPE guidelines include provision for reporting of federally levied corporate income taxes as a component of the economic benefit of projects[26], which has necessitated a review of method in terms of estimation of assessment of notional tax liability. Tax liability in respect of Centennial Airly comprises part of tax assessment by Centennial Coal Pty Ltd at aggregate level for the entire company, and not on the basis of individual operations. Therefore, Centennial Airly does not report corporate taxes as a stand-alone operation. Furthermore, given the extent of Centennial Coal's portfolio of operations and their varied performance in any given year, a proportional estimate of entire group tax liability cannot be validly attributed to individual operations. Even less so can a reliable assessment of taxes be made over the life of an individual project in the context of this volatility. As a result, corporate tax is not reported in this assessment. The necessary exclusion of this material will contribute to a conservative estimate of benefit, as ordinarily some component of tax paid by Centennial Coal would be returned to NSW.

NSW State Government taxes and Local Government rates, local authority charges etc.

The treatment of State-levied taxes varies. The DPE guideline notes '*that a new mine will also pay other taxes, such as payroll tax and personal income tax. The majority of these taxes will have been generated without the project, as people would have been employed elsewhere*'. As it is recognised in the EA that some proportion of the new workers may represent a reallocation of the existing regional labour pool, DPE's assumption is apposite to the current assessment. Accordingly, these taxes are excluded from the analysis in the EA. Other state taxes and local government rates and charges are not anticipated to change as a result of the modification, as consent boundaries etc. remain unchanged.

The combined effect of the exclusion of these items does not negate the fact that they comprise part of the beneficial outcomes of the Modification. Rather, their exclusion should be considered as resulting in a conservative estimate, albeit in the form of a relatively small change.

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[26] Calculated as a population-based proportional return to NSW.

Annexure 2

Labour surplus estimation

Internal data on the residential status of Airly Mine employees indicates that the workforce is largely resident in the immediate region (refer to Table 9). As a result, mobility in terms of alternative employment may be somewhat constrained, as transaction costs associated with relocation may be a barrier (e.g. Coulson and Fisher 2009). Furthermore, recent internal research into Centennial Coal Company's nearby Springvale Mine indicates that there is a range of significant personal, family and social ties to the region, based on the long time in residence that is typical for that workforce. This further detracts from any simplified expectation that employees can leave the area and find alternative work without incurring significant financial/economic and social costs. Given the similarities in workforce profile suggested by internal data for the Airly Mine, the same constraints are assumed as applying for this workforce.

This being the case, attempts to apply more generalised assumptions to a regional area in relation to which suitable alternative employment is not geographically convenient are problematic and may not effectively capture the full range and scale of the effects of these factors. The assessment method presented below permits calculation of the residual or surplus economic contribution (labour surplus) of employees of Airly Mine, taking into account alternative employment outcomes. The approach taken is to adopt a 'reservation wage' and compare this to the assumed wage level for ongoing employment, producing an estimate of 'labour surplus'. The reservation wage is derived as:

$$\mathbf{RW = (1 - p)AW + pB}$$

Where:

RW = reservation wage;

p = probability of a worker remaining unemployed and thus claiming unemployment (Newstart Allowance) benefit. The Australian Government Job Outlook website[27] was referenced to obtain information to inform an assumption on this probability. Findings for relevant occupations are included in Table A2.

[27] Information current at August 2019.

Table A2: Job outlook information

Identifier	Occupation	Unemployment	Employment growth	$/week (median)	$ annualised
1	Drillers, Miners & Shot Firers	lower	stable	2,500	130,000
2	Mine Deputies[28]	lower	stable	2,812	146,224
3	Mining Engineers	lower	decline	3,118	162,136
4	Other Construction and Mining Labourers	average	moderate	1,683	87,516
5	Geologists, Geophysicists & Hydrogeologists	lower	very strong	2,192	113,984
6	Production Managers	lower	moderate	2,258	117,416
7	Earthmoving Plant Operators	lower	stable	1,491	77,532

Four categories (1, 2, 3 and 5) were used as a basis for assessing probability of unemployment. This was on the basis that a review of task for each indicated that these were most specific to underground mining employment. Other categories included a significant element of employment in other industries, which dilutes the earnings metric in particular, as it relates to mining. For the four relevant categories, the average weekly income was $2,656 ($138,112 annualised). Incidence of unemployment is assumed as average, therefore, the unemployment rate for NSW may be considered as reflecting the likelihood of a displaced employee being unable to find work. At June 2019, the unemployment rate for NSW was 4.6 percent. Adopting this rate can be considered as conservative, as it does not allow for the constraints on employee mobility discussed above. It also does not recognise the inherently low labour mobility in the black coal industry reported by the Productivity Commission (1998), which found that voluntary labour turnover rates were less than half the average for all industries, thus indicating scarcity of alternative employment positions. For the purposes of recognising the higher level of unemployment in the region, an estimate is also provided based on the unemployment rate (Central West SA4) reported at June 2019 of 4.5%.

AW = assumed alternate wage. In this instance the alternate wage is assumed as the median wage for the mining sector as determined in the preceding material, which was $2,656 per week ($138,112 annualised).
B = Newstart Allowance. The benefit is assumed at partnered level, $501.70 per fortnight (each)[29] annualised ($26,088).

[28] Included in the occupational group 'Other Building and Engineering Technicians'.
[29] Australian Government Department of Human Services website (2019). Partnered rate assumed as this is consistent with internally generated workforce demographic data, applied for one partner. Allowance updated 20 March 2019.

Therefore, the reservation wage would be alternatively:

$$(0.954 \times \$138{,}112) + (0.046 \times \$26{,}088) \therefore$$
$$\$131{,}758 + \$1{,}200 = \mathbf{\$132{,}958}$$

OR

$$(0.955 \times \$138{,}112) + (0.45 \times \$26{,}088) \therefore$$
$$\$131{,}897 + \$1{,}174 = \mathbf{\$133{,}071}$$

The assumed wage rate at the time of preparation of the economic impact assessment was the average wage at the mine, which was **$189,885** at October 2018, as most recently reported. Consequently, the difference, and the labour surplus value assumed for estimation of the employment effects in the Lithgow & MWRC LGAs is **$56,927 (Estimate 1)** and **$56,814 (Estimate 2)**.

The NPV estimates for total wages and salaries and labour surplus estimated on the assumptions generated above (including sensitivity discount rate estimates) are presented in Figure A1.

Figure A1

Total wages/salaries (NPV)	NPV 7%	NPV 10%	NPV 4%
2015 approval (BAU)	$287,352,888	$236,091,761	$358,062,095
2019 modification	$293,653,580	$250,995,552	$348,200,768
Labour surplus (NPV)	**NPV 7%**	**NPV 10%**	**NPV 4%**
2015 approval (BAU)	$92,086,450	$77,780,352	$111,529,068
2019 modification	$94,105,599	$82,690,401	$108,457,466

Annexure 3

Coal price assumptions and royalty calculation

The price assumptions presented in Table A3.1 are based on two independent forecasts of thermal coal pricing, formulated by the World Bank, and KPMG. The latter is a consensus forecast based on a survey of price forecasts from contributors described as 'various research databases and broker reports (KPMG 2019). Centennial Coal's pricing assumptions based on its own market analyses are also included in the assumptions.

As is industry practice, all prices are initially presented in USD. These were converted to AUD using the exchange rate current at July 2019 (concurrent with issue of the KPMG data) and at the long-term average exchange rate USD/AUD. This was established by determining the average monthly exchange rate for the period 31 January 2000 to 31 July 2019 (= USD 0.7821 [0.78 assumed]), based on Reserve Bank of Australia (RBA) data.

The KPMG data assume a fixed 'long-term' price assumption commencing 2024, which has been adopted for all subsequent years. World Bank data are presented to 2022, with outyear prices nominated for 2025 and 2030. Intervening years were calculated by distributing change between these years equally across the intervening years. Pricing for years beyond 2030 was assumed as fixed at the 2030 estimate. Centennial provided price assumptions to 2025, with the 2025 valuation assumed for all outyears. This price assumption is materially higher than the upper range of the independent outyear estimates (+ ≈18%). As a result, assessments based on these prices are reported separately.

Table A3.1: Coal Price forecasts 2019 – 2030 USD (nominal)/ AUD[30] per metric tonne

	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
World Bank USD	94.0	90.0	86.4	83.0	79.8	76.6	73.5	70.8	68.1	65.4	62.7	60.0
World Bank AUD	138.2	135.0	127.0	122.0	117	112.6	108.1	104.1	100.1	96.1	92.2	88.2
DIIS USD	95.0	78.0	73.0									
DIIS AUD	139.7	114.7	107.3									
KPMG USD[31]	95.0	89.0	80.5	80.0	76.0	72.5	72.5	72.5	72.5	72.5	72.5	72.5
KPMG AUD	139.7	131.0	118.5	117.8	111.9	106.7	106.7	106.7	106.7	106.7	106.7	106.7
USD AVE	94.5	89.5	83.5	81.5	77.9	74.6	73	71.7	70.3	69.0	67.6	66.3
RBA AVE AUD[32] (A)	139[33]	114.7	107.1	104.5	99.9	95.6	93.6	91.9	90.1	88.5	86.7	85
RBA WB AUD (B)	138.2	115.4	110.8	106.4	102.3	98.2	94.2	90.8	87.3	83.8	80.4	76.9
RBA KPMG AUD (C)	139.7	114.1	103.2	102.6	97.4	92.9	92.9	92.9	92.9	92.9	92.9	92.9
(A)-25%[34]	111.2	91.8	85.7	83.6	79.9	76.5	74.9	73.5	72.1	70.8	69.4	68
(B)-25%	110.6	92.3	88.6	85.1	81.8	78.6	75.4	72.6	69.8	67.0	64.3	61.5
(C)-25%	111.8	91.3	82.6	82.1	77.9	74.3	74.3	74.3	74.3	74.3	74.3	74.3
CEY (AUD)	109.6	82	90	87	86	86	88	88	88	88	88	88

[30] Calculated 3 August 2019.
[31] Median of reported 16 contributors
[32] Based on RBA monthly exchange rates, 31 January 2000 to 31 July 2019 = USD 0.7821 (0.78 assumed)
[33] Assumes average of World Bank/KPMG as price is considered 'actual'.
[34] Assumed high ash discount of 25%

The price projections shaded in orange assume 100% ROM production. As Airly product is sold as ROM, a 'Assumed High Ash Discount' of 25% is deducted from the price per tonne. This discounted price is that used for the economic assessment. These prices are shaded blue.

Royalty calculation

The prices presented in Table A3.1 were then applied to assumed production, with appropriate provision for levies and allowances, to generate royalty value for each scenario. The NPVs for the royalty scenarios modelled are presented in Figure A3.1.

Figure A3.1

Scenario	Total saleable volume	NPV @ 7%	NPV @ 10%	NPV @ 4%	
2015 Approval Case (1.8Mtpa)	28,930,000	$124,582,243	$95,782,485	$167,144,511	
2015 residual (1.8Mtpa)	26,010,000	$144,956,812	$120,196,638	$179,072,120	
2015 residual @ 2019 WB/KPMG Ave $	30,600,000	$107,800,226	$92,658,817	$128,222,849	
2015 residual @ RBA WB $	30,600,000	$105,040,951	$90,748,874	$124,206,842	BAU lower
2015 residual @ RBA KPMG $	30,600,000	$108,870,498	$93,151,614	$130,178,963	BAU upper
2015 residual @ CEY $	30,600,000	$120,189,695	$101,859,544	$145,114,382	CEY
3Mtpa (2015 $)	30,600,000	$203,953,646	$177,844,477	$236,784,513	
3Mtpa (World Bank $)	33,600,000	$137,430,948	$122,417,202	$156,033,982	
3Mtpa (KPMG consensus $)	33,600,000	$137,798,671	$122,257,026	$157,170,150	Mod lower
3Mtpa (Ave WB/KPMG $)	33,600,000	$137,614,810	$122,337,114	$156,602,066	Mod upper
3Mtpa (CEY $)	33,600,000	$150,527,278	$132,613,716	$172,926,230	CEY

The upper and lower bounds for the BAU and modification cases (as indicated in the figure) were then used to run a 1000-iteration random number generator simulation (equating a 'Monte Carlo' simulation of the same parameters) to generate a mean value and 95% confidence interval for each scenario. The outputs are presented below.

2015 BAU residual case (1.8Mtpa)

7% discount rate

Sim Mean	106951077
Sim Std Dev	1102542.4
CI Lower	106882741
CI Upper	107019413

10% discount rate

Sim Mean	91914676
Sim Std Dev	689738.86
CI Lower	91871925
CI Upper	91957426

4% discount rate

Sim Mean	127192532
Sim Std Dev	1714498.2
CI Lower	127086266
CI Upper	127246747

2019 modification case (3.0 Mtpa)

7% discount rate

Sim Mean	137615045
Sim Std Dev	107101.5
CI Lower	137608407
CI Upper	137621683

10% discount rate

Sim Mean	122338138
Sim Std Dev	45398.643
CI Lower	122335324
CI Upper	122339571

4% discount rate

Sim Mean	156328631
Sim Std Dev	162935.71
CI Lower	156318532
CI Upper	156338730

The resultant simulation means are those presented in Section 3 of this EA. It is submitted that the process reported in this annexure represents an appropriate sensitivity testing approach in respect of validating the values reported.

APPENDIX – M

Social Impact Assessment

Airly Mine Modification 3

Social Impact Assessment

October 2019

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF PLATES

1. INTRODUCTION

1.1 Overview

This Social Impact Assessment (SIA) has been prepared in relation to the proposed Modification to Airly Mine's (Airly) State Significant Development consent (SSD 5581) that was granted on 15 December 2016. Consent SSD 5581 allows for the operation of an underground coal mine using partial extraction techniques. The consent allows mining of coal from the Lithgow Seam at the rate of 1.8 million tonnes per annum (Mtpa). The mine is approved to operate 24 hours per day, seven days per week, for a period of 20 years from the date of commencement, and rehabilitation to be undertaken after this period. The consent will lapse on 31 January 2037.

Airly Modification 3 comprises the following elements:

1. Increase Run of Mine (ROM) coal production from 1.8mtpa to 3.0mtpa.
2. Increase employee numbers from the currently approved 155 fte to 200 fte personnel.
3. An amendment to the approved 20 year mine schedule for the increased production rate.
4. Due to the increase in coal production an increase in the movement of laden coal trains and water trains leaving the site from the approved average of 2 trains per day to 3 trains per day over any calendar year but maintaining the approved maximum 5 trains per day leaving the site on any day.
5. The ability to use explosives if geological structures, for example igneous rock dykes, intersect some underground mining areas and require removal in order to continue mining. The mining equipment currently used will not cut through these geological structures.

There is no proposal to change the approved mining technique or the mine design philosophy to achieve the proposed increase in production. The proposed modification does not include any physical works or significant changes to the existing underground mine operation and surface activities.

Since SSD 5581 was granted, the consent has been modified two times. Airly Modification 1 was modified under Section 4.55(1A) of the EP&A Act was approved in August 2018 allows:

1. pillar splitting and quartering operations in areas that are downslope of cliffs in the Partial Pillar Extraction Zone before the four panels beneath Mount Airly and extracted; and
2. second workings within the 26.5 degree angle of draw plus 50 metres from the limit of the New Hartley Shale historic workings (as opposed to the limit of the interaction zone).

Airly Modification 2 allows Airly to receive up to 170 ML/year of water by rail from Charbon Colliery. This modification was sought due to there being insufficient process water to meet operational requirements. Modification 2 was approved in July 2019.

This SIA has been prepared by James Marshall, Group Manager Stakeholder Engagement, Centennial Coal in accordance with the Social Impact Assessment Guideline for State significant mining, petroleum production and extractive industry development September 2017. James Marshall has over twenty years' experience in the social planning sector with experience in local government (10 years), the NGO sector (5 years) and as a private consultant (7 years). During this time expert advice and support has been provided in relation to:

- Strategic social planning;
- Social Impact Assessment;
- Community and Stakeholder Engagement;
- Safer by Design (CPTED);
- Mediation;
- Community and Social Research;
- Feasibility Studies; and
- Urban Design and Master Planning.

James Marshall joined Centennial Coal in July 2015,

1.2 Rationale for Modification 3

The rationale for the proposed increase in tonnage from 1.8 Mtpa to 3 Mtpa is to increase the net Present Value (NPV) of Airly Mine. The mine will achieve the increased production through a combination of:

(i) the proposed increase in workforce

(ii) the installation and operation of additional underground mining equipment

(iii) an improved strategy for underground mining equipment utilisation and availability.

Currently one set of panel and pillar mining equipment is operational within the approved Panel and Pillar mining zone. Having two sets of panel and pillar (miniwall) equipment underground means the next panel area to be extracted can be pre-installed with the second miniwall equipment prior to the completion of the current panel area being extracted. The changeover period between panels will be reduced to five days (usually takes four to five weeks). Only one panel and pillar equipment will be operated at a time.

Airly needs flexibility in its staffing hence the increase in employment. The increased workforce will also assist with increasing productivity in each shift.

The additional train movements are required to move the coal offsite and therefore not necessitating the need to increase the coal stockpile size.

Table 1 presents a summary of key existing consent conditions, and the changes proposed under the Modification.

Table 1: Outline of Proposed Modification changes to SSD 5581

Key Feature	Description of Approved Operations	Proposed Change
Project Life	20 years from date of commencement (15 December 2016) with expiry date of 16 December 2036.	No change
Development Consent Boundary	Corresponds to the project application area boundary comprising Mining Lease ML1331 and Authorisation 232 (A232) with areas of 2,744 ha and 3,096 ha respectively, and a total 3,982 ha.	No change
Hours of Operation	24 hours per day, 7 days per week	No change
Employment	155 FTE personnel including contractors	200 FTE personnel
Mining Method and Mining Area	Underground mining using a combination of first workings and partial extraction mining methods, with the mining areas divided into five mining zones of varying mining systems to engineer the desired subsidence level for each zone. • Panel and Pillar Zone • Cliff Line and First Workings Zone • Partial Pillar Extraction Zone • Shallow Zone • New Hartley Shale Mine Potential Interaction Zone (first workings only). Restrictions on mining are as per Condition 1 of Schedule 3	No change
ROM Coal Production	1.8 Mtpa	3.0 Mtpa
Coal Handling, Stockpiling and Processing	• A system of surface and underground conveyors constructed to operate at 500 tonne per hour. • Three coal stockpiles: ○ a 30,000 tonne ROM Emergency Stockpile ○ a 200,000 tonne Product Coal Stockpile ○ a 40,000 tonne ROM Coal Stockpile (not yet established) in the vicinity of the CPP. • A CPP with a processing capacity of 500 tonne per hour with water recycling facility is approved but is not constructed as yet.	No change
Coal Transport	• All product coal transported from the site by rail to domestic power stations and for export. • No more than an average of 2 laden trains leave the site each day over any calendar year • No more than 5 trains (10 train movements) per day leave the site on any day • No more than 1 water train (2 movements) is received from Charbon Colliery on any day.	• No change in coal destinations • Increase in the trains to leave the site to an average of 3 trains per day over a calendar year but maintaining the approved maximum 5 trains leaving the site on any day.
Reject Management	• Co-disposal REA for emplacement of fine and coarse reject materials. • REA capacity of 5.3 Mm^3 • Reject materials hauled from CPP to REA using trucks.	No change

Key Feature	Description of Approved Operations	Proposed Change
Site Access	Mine Access Road off Glen Davis Road, 3 km from Capertee Village	No change
Mine Support Facilities	• Underground access and associated infrastructure • Engineering and services • Coal handling, preparation and transport infrastructure • Support services and administration at the Pit Top • Non- mine owned infrastructure	No change
Underground Water Management	A mine dewatering system, comprising pipelines, underground impoundment dams and pump stations, to pump mine inflows from the underground to the 109 ML Dirty Water Dam for storage and subsequent use as process water.	No change
Surface Water Management	• A system of water management structures comprising settling ponds, clean and dirty water diversion drains allow separation and storage of clean and dirty water at the pit top, for use as process water. • Clean and dirty water dams comprise: ○ 109 ML Dirty Water Dam ○ 7 ML Dam ○ Train Loader Dam ○ REA Dam (not constructed) ○ 35 ML Discharge Dam • Three Licensed discharge points on EPL 12374: LDP001, LDP002, LDP003	No change
Process Water	• Process water is obtained in priority order from the following site sources: • Mine inflows (when available) • Surface dams • Production Bore (Bore Licence Number 10BL603503) Process water is sourced to up to 170 ML/year, on an as needs basis, from Charbon Colliery by rail.	No change.
Mine Ventilation	Two electrically powered centrifugal fans (exhausting types), attached to the northern-most access adit at the pit top, draw fresh air from the remaining three access portals, through the workings, and vent the used air to the external atmosphere through the fans.	No change
Waste Management	Production (reject) and non-production waste (putrescibles and recyclables)	No change
Construction & Exploration	• Construction of REA and CPP • Construction hours: ○ 7:00 am - 6:00 pm Monday to Friday ○ 8:00 am to 1:00 pm Saturdays ○ No construction work is to take place on Sundays or Public Holidays.	No change
Rehabilitation	Progressive and life of mine	No change
Exploration	Within ML1331 and A232	No change

1.3 Information Used to Inform this Report

Information that has been used to inform the potential social impacts arising from the Project include:

- Review of project design.
- Review of specialist reports for Airly MOD 3 and the Airly Mine Extension Project.
- Review of previous consultations and impacts arising from the Airly Mine Extension Project.
- Compilation and understanding of social and demographic profile of the community.
- Site visits to understand the areas of affectation and how the specialist reports relate to these areas of affectation.
- Consultation with the Airly Community Consultative Committee (CCC) representatives and members of the local community.
- Consultation with project team members

2. AIRLY MINE HISTORY

Airly Mine is located five (5) kilometres (km) northeast of the village of Capertee within the Lithgow Local Government Area, approximately 40 km north-northwest of Lithgow and approximately 171 km northwest of Sydney. The Project is on the northern fringe of the Western Coalfields and is partly located within the Mugii Murum-ban State Conservation Area.

A coal exploration program was carried out in 1984 consisting of 24 boreholes and field surveys of the old Torbane Colliery workings. The program established the economic significance and the extent of the coal resource in the region.

In 1987, a bulk sample operation was established to verify the initial exploration data and to determine appropriate underground mining sections and methods. This bulk sample was completed over six months and produced 26,000 tonnes of coal. All coal was loaded onto trucks and transported to the Western Main Colliery, situated at Blackmans Flat, where it was tested for coal quality and washability.

Airly was granted Development Consent DA162/91 on 14 April 1993 by the then Minister for Planning for the development of an underground coal mine following a Commission of Inquiry held in 1993. The development consent allows Airly to extract up to 1.8 million tonnes per annum (Mtpa) of run of mine (ROM) coal. Condition 2 in Schedule 2 of DA162/91 limits the duration of the consent to 21 years from the granting of Mining Lease ML1331. Given that the ML1331 was granted on 12 October 1993, DA162/91 is due to expire on 12 October 2014.

Centennial Coal Company Limited (Centennial Coal) purchased Airly from Novacoal Australia Pty Limited on 30 December 1997. On 26 April 1998, Centennial Coal commenced works at Airly in preparation for a trial mine. A small bulk sample was delivered to Mount Piper Power Station in June 1998. This material was won during the formation of the initial contractors' hardstand area. The Trial Mine Phase commenced in early December 1998 with regular transport of product coal to Mount Piper Power Station.

Development Approval (DA 162/91) was modified in 1999 to allow up to 500,000 tonnes per annum (tpa) to be transported by road for a period of two years. This period lapsed on 30 June 2002.

In mid 2008, Centennial Coal commenced detailed planning for the future development and operation of the mine. A contract was signed in February 2009 for the construction of the rail loop and permanent infrastructure to support the mine beyond the Trial Mine Phase and into its permanent operational phase. Construction of the rail loop and surface coal handling infrastructure commenced in March 2009.

First coal production for the purposes of developing the main portals and roadways to the underground mine occurred on the 14th December 2009. Coal won from the portal and roadway development was temporarily stockpiled within the box cut area and utilised for the commissioning of the surface conveyor infrastructure. The site surface conveyors were completed and commissioned in March 2010 with the first train load of coal leaving the Airly site destined for Port Kembla for export to Korea on the 22nd April 2010.

Production was gradually increased during 2011 in line with the completion of Stage 1 construction of the mine infrastructure with the completion of the mine ventilation fans and surface to underground trunk conveyor. Due to market conditions, falling coal prices and the quality of the coal Airly was placed in Care and Maintenance in December 2012. Environmental monitoring continued at the site throughout this period and a Project team has coordinated the preparation of the Environmental Impact Statement (EIS) for the Project. Airly recommenced operations in March 2014. Figure 1 shows the regional context of Airly Mine and Figure 2 the Airly Mine Project Boundary.

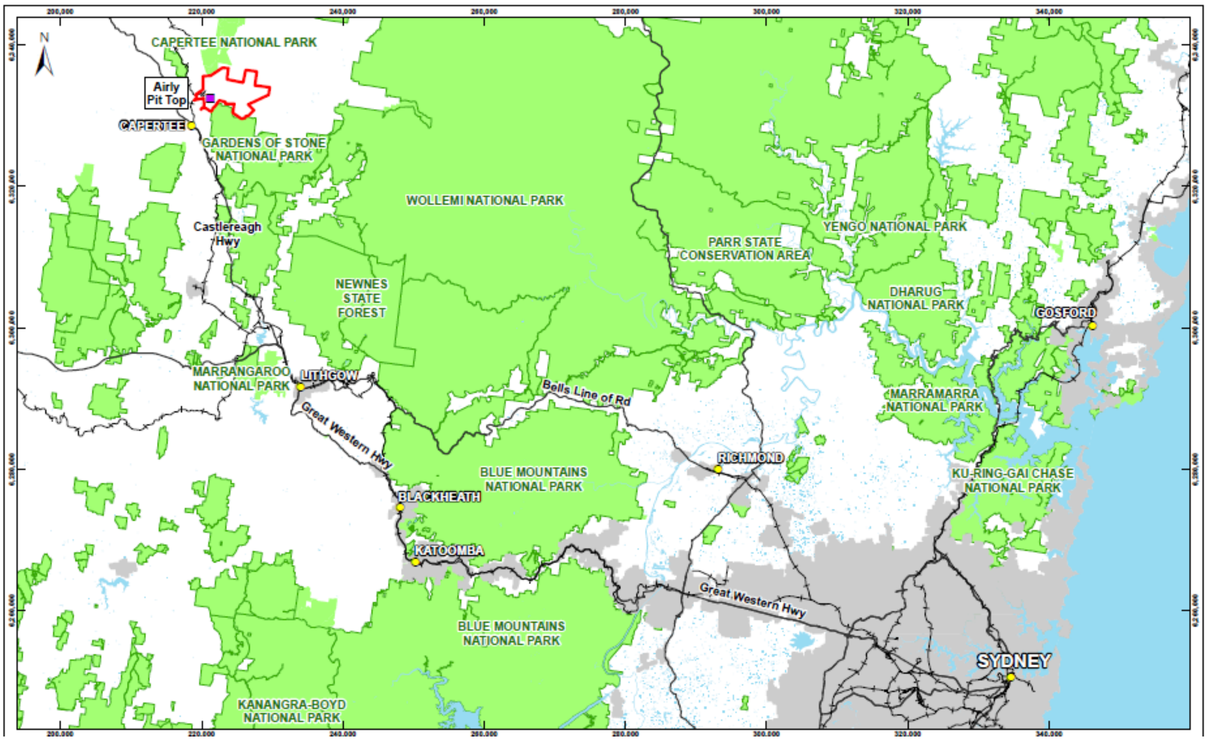


Figure 1: Airly Mine Regional Context.

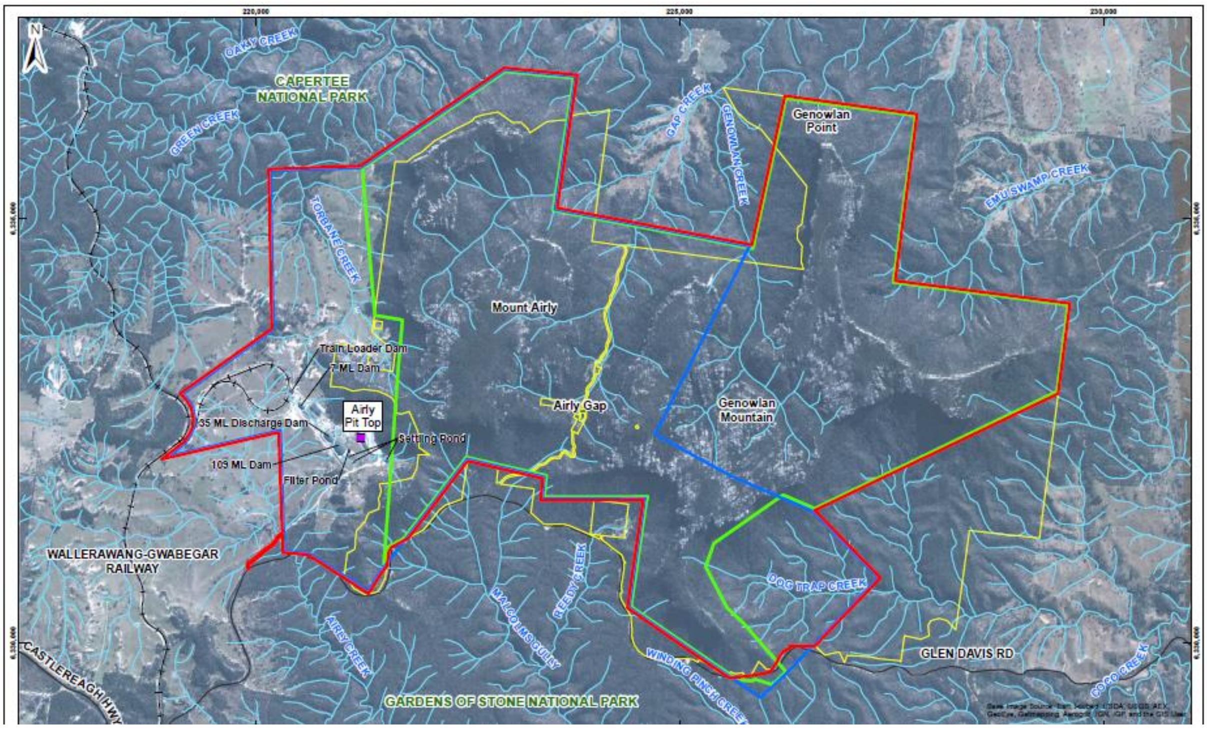


Figure 2: Airly Mine Lease Area

Plate 1: Airly Administration Building

Plate 2: Airly Surface Facility

Plate 3: Airly Coal Handling Infrastructure

3. COMMUNITY PROFILE

3.1 Overview

The Lithgow Local Government Area (LGA) covers an area of approximately 4,551 square kilometres extending from the Capertee and Wolgan Valleys in the north, Little Hartley in the east, Hampton-Tarana in the south and Meadow Flat in the west. The vision for the LGA was developed in collaboration with the community and adopted by Lithgow City Council in 2006, setting a vision for the next 20 years and providing a framework for the current Local Environment Plan (LEP). The overarching vision statement is:

A centre of Regional excellence that:

- *Encourages community growth and development.*

- *Contributes to the efficient and effective management of the environment, community and economy for present and future generations.*

The following vision statements were developed to support the overarching vision statement of the LGA:

- Community: We retain, respect and strengthen both our overall sense of community, and the unique linked communities of groups, rural areas, villages and towns that make up the Lithgow LGA.
- Transport: Providing a choice of effective public and private transport options for those who live, work and visit our community.
- Employment: Developing and embracing diverse job opportunities for all ages and abilities.
- Heritage: Celebrating, protecting and sustaining our unique industrial and natural heritage, its cultural landscapes and its built heritage.
- Education: Progressing to a "learning city of excellence" with a broad range of formal and non-formal education services.
- Health: Creating a healthy community providing opportunities and facilities for a healthy lifestyle.
- Environment: Balancing, protecting and enhancing our diverse environmental elements, both natural and built, for the enjoyment and support of both current and future generations.
- Arts and Culture: Supporting, celebrating and expanding a diversity of cultural and creative adventures that explore and discover the richness in our society.
- Youth: Providing suitable entertainment and recreational facilities; education and employment opportunities and lifestyle choices for our valuable community of young people.

The majority of the LGA town or village population is located in the Lithgow urban area. The LGA supports two other small towns: Wallerawang and Portland. Both towns are located north-west of Lithgow, with Wallerawang being 13 kilometres away and Portland 24 kilometres away from Lithgow. Lithgow is the dominant urban and main administrative centre within the LGA. It has the largest population and greatest range of services. Portland and Wallerawang are small towns which provide services to meet the needs of their local population.

The villages within the LGA provide variable services to their respective surrounding communities and to those people who reside within the village. Given the lack of basic services generally found in these small villages, residents and visitors would rely on the broader range of services and facilities on offer, in the small towns and the nearby centres of Lithgow, Bathurst or Rylstone. The LGA's settlement hierarchy can be described in Table 2.

Table 2: Lithgow LGA's settlement hierarchy

Classification	Population Size	Example in the Lithgow LGA
Town	5,000 to 15,000 people	Lithgow
Small Towns	1,000 to 5000 people	Portland, Wallerawang
Villages	Less than 250 people and zoned village in the LEP	Capertee, Cullen Bullen, Tarana and Rydal
Rural Communities	Dispersed population with no specific commercial centre of services.	Ben Bullen, Glen Davis, Glen Alice, Hartley, Hampton, Marrangaroo

Source: Lithgow Land Use Issues Paper

3.2 Rural Interface

The rural areas within the LGA are defined by an array of physical characteristics. Cleared grazing land is evident across many parts of the area. Heavily vegetated areas of high scenic and environmental quality are also prevalent across the LGA, including a number of National Parks, featuring rugged bushland, high ridges, steep escarpments and valleys (e.g. Wolgan and Capertee Valleys) and lookouts.

A large proportion of the rural areas are inter-mixed with both grazing and environmental attributes creating a diverse character to the rural landscape. This also includes plantations and native Forestry which is both an economic and environmental asset in the rural areas. Industrial activity and infrastructure is also evident throughout the rural parts of the LGA, particularly coal mining and power station activities.

The larger settlements of Lithgow, Portland and Wallerawang have a mainly agricultural / scenic edge to their urban areas, which has acted as a boundary to future development. However, rural-residential development has emerged creating a transition between the urban and rural areas in these centres.

The town of Lithgow is also typical of the rural/urban interface in the LGA, with environmentally sensitive hill slopes surrounding the urban areas, providing a highly significant natural asset at the northern, eastern and south-eastern edges of the town. Emerging residential development within South Bowenfels and future urban development in the West Bowenfels/Marrangaroo area is an example of the gradual transition and merging of the rural and urban areas.

The villages of Capertee, Cullen Bullen, Tarana and Rydal are all characterised by agricultural/rural land uses at the edge of the settlement area (and in some cases reaching into it). There is no gradual transition in character or 'buffer' between the two areas. The rural communities are very much a part of the rural area within which they are situated. There is generally no defined 'town edge' to these communities, with the settlements basically comprising several buildings within the broader agricultural landscape. Examples include Ben Bullen, Glen Davis, Glen Alice, Hartley and Hampton.

According to the 2016 ABS Census, the Lithgow LGA population on Census night was 21,090. The majority of the population live in Lithgow urban area (11,530 people), Wallerawang (2,059 people) and Portland (1,944 people). The remainder of the population live across the smaller villages and rural localities across the LGA.

A major change to Lithgow's population and settlement occurred in rural areas. According to the Lithgow Land Use Strategy (LUS) between 1996 and 2009 over 55% (699 in total) of all dwelling approvals has occurred within rural areas. This has increased the population in these areas by approximately 1,678 persons over this time. Population migration data indicates that the trend towards rural living is usually from people moving from outside of the LGA, seeking alternative lifestyle choices or securing land to be used as a place to visit on weekends and holiday periods. The intent of the current LEP is to address this by consolidating urban development, including in-fill, rather than allow the rural expansion to continue.

3.3 Lithgow Local Government Area and Surrounding Regions[1]

Key demographic information for the Lithgow LGA and the Australian Bureau of Statistics (ABS) Lithgow Region Statistical Areal Level 2 (SA2) and Lithgow – Mudgee Statistical Area Level 3 (SA3) are compared with corresponding NSW data in the following sections. The SA3 data are particularly relevant, in the context of the proximity of the mine to the LGA boundary between Lithgow City Council (LCC) and the neighbouring Mid-Western Regional Council (MWRC) LGA, immediately to the north. The geographic extents of the areas are identified in Figure 3.

It is noted that the LCC LGA incorporates the Lithgow Region SA2 and the Lithgow SA2. The latter is largely concentrated around the township of Lithgow and its immediate surrounds. The Lithgow Region SA2 comprises approximately 39% of the LGA population and includes the area extending to the boundary with the MWRC LGA, which incorporates the Airly Mine site itself. It is noted that generally, in order to facilitate greater consistency in the subsequent analyses, the MWRC LGA and the SA3 are preferred to the Mudgee Region East SA2, which directly abuts the Lithgow Region SA2.

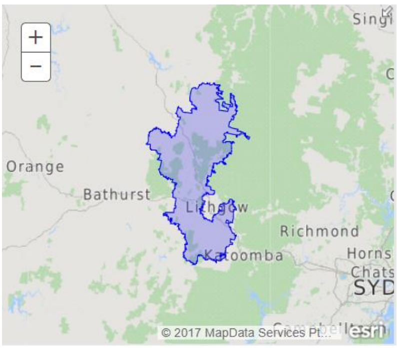
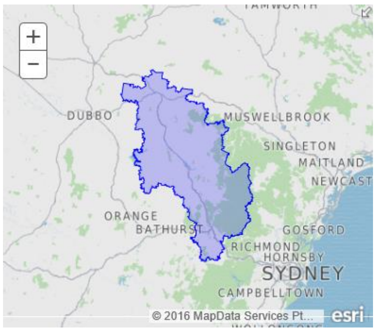
		
Lithgow LGA	**Lithgow Region SA2**	**Lithgow-Mudgee SA3**

Figure 3: Lithgow and Lithgow-Mudgee Statistical Areas (Source: ABS Census Data 2016)

[1] Aigis Group (December 2018) Airly Socio-economic Profile

3.3.1 Personal characteristics

Table 3: Demographic profile; personal characteristics

	LCC (%[2])	SA2 (%)	SA3 (%)	NSW (%)
Population	**21,090**	**8,262**	**46,612**	**7,480,228**
Male	50.7	51.0	50.5	49.3
Female	49.3	49.0	49.5	50.7
Median Age	**45 years**	**46 years**	**44 years**	**38 years**
< 15 years	17.0	17.4	18.8	18.5
15-29 years	16.5	14.5	15.8	19.5
30- 44 years	16.2	15.7	16.6	20.6
45-64 years	28.2	31.7	27.7	25
≥ 65 years	22.0	20.6	21.1	15.9
Ancestry (top responses)[3]				
Australian	32.3	33.4	34.0	22.9
English	29.9	30.2	29.9	23.3
Irish	8.4	8.1	8.4	7.5
Scottish	8.3	7.7	7.3	5.9
German	2.4	2.4	2.7	-
Chinese	-	-	-	5.2
Aboriginal/Torres Strait Islander	5.7	5.0	5.6	2.9
Born in Australia	79.7	77.8	80.3	65.5
Parents' country of birth				
Both parents born overseas	11.4	11.1	10.3	37.0
Father only born overseas	5.3	5.2	4.7	6.1
Mother only born overseas	3.2	2.8	3.4	4.3
Both parents born in Australia	67.5	67.7	69.7	45.5
Language				
English (only spoken at home)	84.9	85.4	86.1	68.5
Non-English language (spoken at	5.1	4.2	4.6	26.5

[2] Highlighted data excepted.

[3] Census form included option of reporting two (2) ancestries, therefore responses do not reconcile with population counts.

home)				
Legally registered relationship status				
Married	45.4	50.1	47.0	48.7
Separated	3.8	4.0	4.0	3.1
Divorced	10.7	10.3	10.2	8.4
Widowed	7.0	5.6	6.9	5.4
Never married	33.1	30.0	31.9	34.4
Religious affiliation				
Catholic	24.0	24.4	24.5	24.7
No religion (so described)	22.6	21.8	22.2	25.1
Anglican	20.6	22.0	24.5	15.5
Not stated	13.8	14.9	12.9	9.2
Uniting Church	6.2	5.7	4.6	-
Islam	-	-	-	3.6

Key observations

- The balance of male and female residents locally and regionally is approximately inverse to that for NSW. It is noted that the national measures are identical to those for NSW, which is typical of such larger population agglomerations.
- The local and regional populations are on average older than that of NSW. Each area has a significantly higher median age than the state, generally lower proportions of the younger age cohorts, and markedly higher proportions of persons aged 65 years and older;
- The LGA, SA2 and SA3 populations are also less ethnically diverse, with around 80% of people born in Australia, compared to approximately 65% for NSW. Local and regional residents are also more likely to have parents born in Australia. The most common foreign ancestries in the LGA, SA2 and SLA are British and Irish. For the NSW population, there is evidence of a larger Asian population, which is not apparent in the LGA, SA2 and SA3.
- The LGA, SA2 and SA3 have markedly larger proportions of Aboriginal and/or Torres Strait Islander residents than NSW in total.
- The larger proportions of widowed residents are consistent with the older populations in the LGA and SA3. However, the SA2 is relatively consistent with the NSW measure.
- Generally, differences between the local and regional populations and NSW are also apparent for language and religious affiliation data. These further emphasise the relative homogeneity of the LGA, SA2 and SA3 populations.

3.3.2 Household composition characteristics

Table 4: Demographic profile: families & household composition

	LGA %	SA2 %	SA3 %	NSW %
Couple without children	42.2	44.9	42.5	36.6
Couple with child(ren)	37.2	38.7	39.0	45.7
One parent with child(ren)	19.3	14.9	17.2	16.0
Other family	1.3	1.4	1.3	1.7
Family households	65.0	71.5	66.8	72.0
Single/lone person households	32.6	26.2	30.6	23.8
Group households	2.4	2.3	2.6	4.2
Average people/household (count)	2.3	2.4	2.4	2.6

Key observations

- The LGA, SA2 and SA3, have larger proportions of couple *without* children families, and also more single/lone person households. These data are consistent with their older age profiles, with presumed larger proportions of 'empty-nester' households and widowed households. These conclusions are also consistent with the registered relationship status data (Table 3).
- Higher proportions of single parent families and single/lone person households are also consistent with higher proportions of separated or divorced persons (Table 3).
- Households in the LGA, SA2 and SA3 are on average smaller than for NSW. This outcome is likely to be influenced by the older population characteristics discussed above.

3.3.3 Income & housing-related data

Table 5: Demographic profile: income data & housing-related data

	LGA $	SA2 $	SA3 $	NSW $
Income				
Median weekly personal income	510	542	529	664
Median weekly household income	1,328	1,426	1,375	1,780

Median weekly family income	984	1,123	1,054	1,486
% households < $650 gross p.w.	31.2	27.2	29.0	19.7
% households > $3000 gross p.w.	9.5	11.2	10.3	18.7
Housing tenure	**%**	**%**	**%**	**%**
Owned outright	41.8	45.7	40.0	32.2
Owned with a mortgage	29.3	35.3	29.7	32.3
Rented	24.6	15.0	26.1	31.8
Housing costs	**$**	**$**	**$**	**$**
Median monthly mortgage repayment	1,387	1,517	1,517	1,986
Median weekly rent	230	200	245	380

Key observations

- Incomes in the LGA and SLA are significantly lower than state averages. The SA2 also has lower income levels, but these are generally higher than for the LGA and SA3. Housing costs, which represent a significant element of cost of living, are lower on average for all three regional areas than across the state more broadly.
- Outright ownership of homes is notably higher for the local and regional areas, and rented accommodation lower. The higher rates of home ownership are interpreted as being consistent with the older populations in the LGA, SA2 and SA3.
- Rented accommodation is particularly low in the SA2, which might be considered as typical of such rural areas. It is noted that rented accommodation in the Lithgow SA2 is 30.2% (ABS 2016), significantly higher than for the entire LGA, indicating that the majority of rented housing is concentrated in the more urbanised area of Lithgow itself, as may be expected.

3.3.4Population growth projections

NSW Government Department of Planning and Environment (DPE) population projections for Lithgow LGA and surrounding LGAs are presented in Table 6.

Table 6: NSW DPE average annual population change projections 2011-2036

Lithgow	2011-16	2016-21	2021-26	2026-31	2031-36
Average Annual Population Growth	0.2%	0.1%	-0.1%	-0.2%	-0.4%

Mid-Western Regional					
Average Annual Population Growth	0.9%	0.6%	0.4%	0.3%	0.2%

A small decline in projected population for LCC LGA is offset by growth of similar magnitude in the MWRC LGA. Considered jointly, population is anticipated to remain relatively stable.

3.4 Surrounding Communities

The district was occupied by the Wiradjuri people prior to European settlement. The first European in the immediate vicinity was James Blackman who journeyed north from his depot at what is now Wallerawang towards Mudgee in 1821. Blackmans Flats and Blackmans Crown still bear his name.

Sir John Jamison, a wealthy grazier and entrepreneur, established a large cattle station known as 'Capita' in the 1820s. The Corlis and Gallagher families fled Ireland's potato famine and took up land in the valley in the late 1840s. Both established enormous sheep properties focused on wool-growing and exerted a great influence over the valley.

In 1851 a 48 kilogram gold nugget was discovered in the area and other finds were then made on the Turon River and nearby creeks. This greatly increased traffic on the Mudgee Road (now Castlereagh Highway) and inns began to appear. Capertee village sprang from one such inn - James Shervey's, which was known to be in existence at Capertee camp by 1870. A post office opened in 1875 though, by 1880, there were still no more than a dozen buildings in the village.

The railway arrived from Wallerawang in 1882, and then a pre-fabricated school building was established in 1883. The railway enabled the exploitation of the area's known mineral resources - coal, limestone and oil shale. The latter was discovered on the future site of Glen Davis in 1873. The first mining tunnel at that site was established in 1881 and other mines began to open around Capertee in the 1890s, including one on Blackmans Crown. Capertee benefited from the economic activity although there was little development other than the opening of a police station, lock-up and courthouse.

Two other small villages soon sprang up around the new mines; Airly Village, about 8 kilometres east of Capertee and Torbane which acquired a railway siding. By 1898 about 200 men were working on the Torbane project. It is estimated that between 1896 and 1903, 140,000 tons of oil shale were extracted. For shelter the miners used caves formed by erosion in the sandstone cliffs. Shale production went into decline around 1903 and closed in approximately 2013. During the Great Depression, refugees fleeing the high rents and unemployment of the cities built mud huts and camped along the Turon River. After the works at Newnes closed effectively down in 1928 agitation increased for a reopening of the Capertee works as it was the only source of oil in Australia.

3.4.1 Capertee

Capertee is located 186 km north-west of Sydney and 44 kilometres north of Lithgow on the Castlereagh Highway and has a population of 145 people (Capertee State Suburb: 2016 ABS Census). Lithgow City Council undertook a consultation with the Capertee and surrounding community in March 2006 when preparation of the LUS which identified the following values and aspirations.

- Ensuring that the more remote areas still feel part of the LGA (not be so Lithgow town centric).
- Including political representation of remote areas within Lithgow LGA.
- Encouraging sustainable development that provides jobs without ruining the natural environment.
- Encouraging an entrepreneurial approach to the area, that respects local values, and at an appropriate scale.
- Improving infrastructure and services.
- Promoting the area for sustainable tourism/eco-tourism.

There are a small amount of facilities and services in Capertee that include:

Community facilities: police and fire services; school; war memorial community hall; local park and play/rest area; Country Link bus stop.

Retail and commercial facilities/services: service station, includes general store selling incidental goods; hotel.

3.4.2 Glen Davis and Glen Alice

Glen Davis and Glen Alice are located along the Glen Davis Road. Glen Davis is located to the east of Capertee in the northern part of the LGA and is accessed by a partially unsealed road. This rural community is set in the Capertee Valley, surrounded by grazing and farming country under the backdrop of steep escarpment and ranges. There are no facilities or services apart from a camping ground and community hall.

Glen Davis is an old shale mining town on the Capertee River with the first mining tunnel being established in 1881. The town later became the basis of the major mining enterprise which opened in 1938. A town of some 2500 people developed around the mine, which was named Glen Davis after the Davis Gelatine interests who headed the mining consortium. The operation closed down in 1952 due to high costs and the increasingly small output. What remains today are crumbling furnace ruins, retorts and collapsed shafts.

Glen Davis has a picnic-barbecue-camping area with an amenities block and a privately run museum with displays relating to the town and shale mining history. It is usually only open on weekends and entry is free.

Glen Alice is located to the north-west of Glen Davis, in the northern part of the LGA. Development within Glen Alice consists of a public school, church and community hall. A public park, with tables, chairs and toilets is located adjacent to the community hall. The function of this rural community appears to be to cater for the surrounding agricultural and pastoral properties, as well as providing a stop-over point for travellers who may use this road as an alternate route between Capertee and Rylstone and Mudgee.

In the 1970s, 100 acre subdivisions commenced as a viable option for people wanting smaller yet productive farms. These landholders were referred to as 'blockies'. The appeal for this type of landholding was because the land was viable for limited agriculture / primary production and existing famers on larger properties had access to a supply of labour without having to establish board / accommodation. For the 'blockie' landholder, this was a supplementary source of income. It is stated that in these early days many 'blockies' were from the surrounding region; access to cars meant that places like Capertee Valley were no longer isolated and travel to the major centres (i.e. Mudgee and Lithgow) was possible. Later the demand for these blocks shifted towards people seeking a tree change with land being used for hobby farms, limited agricultural pursuits and as lifestyle blocks (weekend / retirement retreats).

Evidence of subdivision is found throughout the Capertee Valley from Capertee through to Glen Davis, Glen Alice and Bogee. Today, landholders of this area include long standing residents (multi generation) some of whom use the land for agricultural purposes and have extensive knowledge of the area's history, land characteristics and features of the locality; land holders who live permanently on their properties for lifestyle, tourism and limited agricultural activities and some who are not permanent residents of the area who use their properties for weekend and holiday retreats.

Landholders have a very strong connection to the area and environment, who can be described as being custodians of the land. The neighbouring process, activities to preserve and protect the environment is both strong and a major focus of the community. The intrinsic values that are collectively held by the community are stated to be under threat by the very presence of the mine.

Plate 4: Royal Hotel, Capertee

Plate 5: Views Across The Capertee Valley

Plate 6: Rock Pagodas Mount Airly

Plate 7: Cliff Features

Plate 8: Genowlan Point

Plate 9: Mount Airly

Plate 10: Disused Shop at Glen Davis

Plate 11: Glen Davis Camp Ground

3.4.3 Kandos and Rylstone

Kandos and Rylstone are located within the Midwestern Region Council area. The area is commonly referred to at the Mudgee Region due to the strong identity of the Mudgee area due to its high aesthetic value, wine growing and general tourism that attracts over 500,000 visitors each year. The Mudgee Region is located just over 3 hours from Sydney in Central West NSW and has a resident population of 24,829 people (2016 census). The major towns and centres are Mudgee, Gulgong, Kandos and Rylstone. The major industries for the region are mining, agriculture (including viticulture), construction, retail and tourism.

The Mid-western Region Community Plan "Towards 2030" identifies the following themes as being important to the community:

1. Looking after our community
2. Protecting our natural environment
3. Building a strong local economy
4. Connecting our region
5. Good government.

Kandos and Rylstone are located approximately 40 and 50 kilometres respectively to the north of Capertee. Kandos has historically been an industrial town supporting the cements works and Charbon Colliery. The Kandos Cement Works ceased operations in September 2011 and Charbon Colliery had ceased all operations (underground and open cut mining) in 2015 and is now undergoing rehabilitation. Kandos is now emerging as a post industrial town with growth in the art, culture and tourism sectors. Kandos museum has been a driver for change promoting tourism to the town. The museum was also instrumental in securing government funding for the opening of the rail line from Kandos to Rylstone further supporting the areas tourism focus. It is worthy to note that the Kandos Museum features on the front page of the NSW Governments Create NSW, Cultural Infrastructure Plan 2025+. Furthermore Rylstone has an agricultural focus and acts as a small centre for the surrounding community. The town has also an established tourism market due to its rural character and historic street scape. Both communities have a very defined rural interface with development located within a clear settlement boundary. Day to day and weekly shopping needs can be met across both Kandos and Rylstone however most services and facilities will be accessed in Mudgee, Lithgow or Bathurst.

3.4.4 Population Characteristics Surrounding Communities

The population characteristics of Capertee, Glen Alice, Glen Davis, Kandos and Rylstone are summarised in Tables 7 and 8.

Table 7: General population characteristics: ABS Census 2011 - 2016

	Capertee		Glen Alice		Glen Davis		Kandos		Rylstone		NSW
	2011	2016	2011	2016	2011	2016	2011	2016	2011	2016	2016
Population (count)	372	145	No data[4]	59	288	115	1,284	1,315	874	920	-
Male (%)	54	52.4	-	49.1	51.4	51.8	48.9	50.9	47.6	49.2	49.3
Female (%)	46	47.6	-	50.9	48.6	48.2	51.1	49.1	52.4	50.8	50.7
Aboriginal and/or Torres Strait Islander (%)	5.9	6.7	-	No data[5]	3.1	7.9	4.4	5.0	1.9	4.0	2.9
Median age (years)	48	49	-	51	51	50	45	52	49	50	38
Average people per household (count)	2.1	2	-	1.3	2.3	2.1	2.2	2	2.2	2.2	2.6

- Given that Glen Alice was incorporated into Glen Davis in the 2011 Census output (refer to footnote 1), the total population for the combined area (2016) is 174 people, compared with 288 in 2011, a decline in population of approximately 40%.
- There was a very large population decline reported for Capertee (≈ 60%) between the two Censuses however this is attributed to the change in the statistical area boundary. The two larger townships of Kandos and Rylstone experienced modest population increases (approximately 2% and 5% respectively).
- Common features across each settlement are the significantly older populations, and smaller household sizes, when compared with NSW. Given the very small populations of each settlement, these are the most distinctive features of the settlements.
- Capertee, Glen Davis and Kandos have larger proportional representations of male residents, which is atypical of larger populations.
- There are proportionally larger ATSI populations for each of the settlements, with the exception of Glen Alice (as noted); however this must be considered in the context of the small total population counts.

[4] 2011 Census data for Glen Alice and Glen Davis were combined.

[5] ABS Census website (2019) notes: Due to the small population for this area (Glen Alice), limited information has been provided.

Table 8: Other distinctive population characteristics: ABS Census 2011 - 2016

	Capertee		Glen Alice		Glen Davis		Kandos		Rylstone		NSW
	2011	**2016**	**2011**	**2016**[6]	**2011**	**2016**	**2011**	**2016**	**2011**	**2016**	**2016**
Age distribution											
Aged 65 years & over (%)	21.9	21.9	No data[7]	18.6	23.1	19.8	25.2	27.7	23.7	28.3	16.3
Marital status											
Registered marital status – divorced	15.4	24.1	-	15.2	12.9	12.9	12.2	13.5	9.7	13.8	8.4
Registered marital status – never married	32.1	20.7	-	23.9	23.7	23.5	33.0	32.2	25.4	28.5	34.4
Educational attainment											
Educational attainment – bachelor's degree & above	8.2	2.7	-	20.0	9.1	9.8	12.1	4.5	11.2	11.1	23.4
Educational attainment - Year 9 or below	18.9	19.5	-	6.5	11.0	7.3	27.1	19.9	20.6	12.2	8.4
Educational attainment - not stated	27.2[8]	21.2	-	37.0[9]	9.7	24.4	26.2	19.0	16.5	14.7	10.3
Ancestry - country of birth											
Country of birth – Australia (%)	80.4	75.6	-	63.4[10]	82.6	71.8	85.4	78.9	87.6	81.8	65.5
Both parents born in	78.0	60.8	-	45.7	73.6	56.2	77.7	67.4	81.8	70.9	45.4

[6] Some data reported for Glen Alice were calculated directly from the Census data tables, as they were not reported in the 'Quickstat' profile due to the small population.
[7] 2011 Census data for Glen Alice were combined with Glen Davis.
[8] Non-school qualification only. 2016 combines school and non-school educational attainment.
[9] Data for highest year of school completed. Educational attainment (non-school qualification) not stated was 56.7%.
[10] Country of birth not stated was 30.5% of the population.

Australia (%)											
Language											
English only spoken at home (%)	89.3	84.4	-	88.6[11]	88.9	77.8	93.1	84.7	95.1	91.2	68.5
	Capertee		**Glen Alice**		**Glen Davis**		**Kandos**		**Rylstone**		**NSW**
	2011	**2016**	**2011**	**2016**	**2011**	**2016**	**2011**	**2016**	**2011**	**2016**	**2016**
Employment status - individuals											
Employment status – worked full time (%)	54.8	45.2	-	27.6	55.4	71.9	51.4	42.7	57.0	56.9	59.2
Employment status – worked part time (%)	31.9	37.1	-	17.2	34.7	28.1	27.9	34.9	30.9	30.8	29.7
Occupation											
Occupation – labourer	17.5	23.2	-	20.0	15.2	24.2	13.2	17.9	11.3	11.3	8.8
Industry of employment											
Industry of employment – coal mining	12.9	-	-	0	6.1	0	14.4	7.5	13.2	12.5	0.6
Income											
Median weekly income - personal ($)	393	437	-	530	350	412	342	420	412	474	664
Median weekly income - family ($)	949	871	-	1,292	833	866	807	917	1,271	1,136	1,780

[11] Language spoken at home not stated was 40.7% of the population.

Median weekly income - household ($)	715	756	-	1,125	636	664	614	698	836	856	1,486
Employment status – couple families											
Employment status – couple families, both not working (%)	19.7	31.8	-	0	29.6	43.8	42.9	48.1	28.6	33.3	21.0
Housing tenure											
Housing tenure – owned outright (%)	54.4	57.1	-	38.5	51.6	61.9	44.2	47.6	47.4	47.7	32.2
Housing tenure – owned with mortgage (%)	24.5	19.6	-	0	28.2	31.0	21.1	18.7	28.5	24.6	32.3
	Capertee		**Glen Alice**		**Glen Davis**		**Kandos**		**Rylstone**		**NSW**
	2011	**2016**	**2011**	**2016**	**2011**	**2016**	**2011**	**2016**	**2011**	**2016**	**2016**
Families											
Family composition - Couple family without children	51.0	44.0	-	-[12]	55.8	31.8	40.3	46.5	51.4	49.6	36.6
Family composition - Couple family with	31.2	29.6	-	-	36.4	68.2	34.6	30.8	34.7	30.3	45.7

[12]Random adjustments to data render available counts unusable.

children											
Households											
Household composition – single or lone person (%)	29.9	38.2	-	37.5	37.9	53.7	37.9	42.8	31.8	31.8	23.8
Household income <$600 (2011), <$650 (2016) gross p/w (%)	43.7	36.7	-	18.8	44.6	53.8	49.1	44.4	36.9	34.7	19.7

- Based on country of birth measures and language spoken at home, the populations are largely homogenous compared with NSW.
- The older population profile when compared to NSW, which is apparent based on median age (Table 3), is further emphasised by the noticeably larger proportion people 65 years and older in the region. This is evident for each area, but is particularly apparent in the two larger settlements. The proportion has also increased markedly between 2011 and 2016, suggesting quite rapid overall ageing of these populations, although other data suggests that this may be a consequence of migration of additional older households into the larger settlements, particularly Rylstone. The generally lower proportions of people who have never married is also indicative of less young people being resident in each area.
- High rates of divorced persons and single or lone person households are also atypical of larger populations. These have increased in Kandos and Rylstone, which may be associated with a concurrent increase in the proportion of males in both towns.
- Reporting of educational attainment is distinguished by the large regional representation of 'not stated' responses for each area, although no causal inference can be drawn based on the available data.

3.4.5 Observations by settlement

Capertee: Capertee appears to have experienced very significant outmigration, with the resident population having declined by around 60% over this period however there are changes to the statistical boundaries affecting the census data. However based on the data comparisons alone, there is some variance across indicators including a large decline in mining employment, with concurrent decreases in full time employment and an apparent outmigration of skilled labour (as exemplified by the proportional increase in labourers and decline in educational attainment). It is likely that the decrease in median family income is also associated with this change. Large proportional increases in lone or single person households and couple households in which both partners were not working are also indicative of an outmigration of the working-age population.

Glen Davis: The most apparent effects in Glen Davis are the sharp decline in population (-40%) and the decline in mining employment. As observed for Capertee, relevant metrics also suggest that the latter has manifested in generally negative changes in workforce composition, as particularly demonstrated by the increased proportion of labourers (implying lower proportions of skilled workers) and an increase in the proportion of relatively low-income households.

Kandos: There have been increases in the demographic indicators of an ageing population in Kandos. Kandos experienced a decline in coal mining employment of 62.5% over this period (48 employees in 2011, 18 in 2016). A concurrent increase in the proportion of unskilled workers (labourers), decrease in the proportion of persons with tertiary qualifications (down from 12.1% to 4.5%) and an increase in the proportion of lower-income households, are each likely to be associated with this structural change.

Rylstone: Rylstone has clearly been the most resilient settlement in the region. The majority of measures have remained relatively stable. There has been an increase in the number of households in which both partners are not working, from which it may be inferred that some households from other parts of the region may have retired in the township. Given the much smaller decrease in mining employment, this may also have influenced the decrease in median weekly family income.

4. ASSESSMENT OF SOCIO-ECONOMIC EFFECTS OF AIRLY MINE

4.1 Employment effects

Airly Mine is currently approved to employ 155 FTE positions and this proposal, if approved, will bring the total approved workforce to 200 FTE. The following analysis (Table 9) describes the economic contribution to the region for both of these scenarios.

Table 9: Estimate of labour surplus/regional employment contribution (p.a.)

	Current (155 FTE) $M	Proposed (200 FTE) $M	Differential (45 FTE) $M
Regional U/e rate	6.7	8.6	1.9
NSW U/e rate	6.3	8.1	1.8

Based on these two estimates, employment at Airly Mine results in a residual contribution to the regional economy of around $6.5 million per year. An increase in employment as indicated would result in the additional contribution of almost $2 million per year to the regional economy.

It is also noted that the most recently reported ABS annual median employee income (wage and salary) for the SA3 (2015) was $43,665 p.a., and the average $56,027 p.a. Given the differential between mine employee incomes and these broader population levels, the residual contribution to the economy is greater than would be the case for most other forms of employment in the region.

A further qualitative measure of these effects is the application of household size data to the number of positions at the mine. This results in an estimate of the *total* number of LGA residents who are likely to directly benefit from employment at the mine. Two estimates of household size are applied. The first this the average household size for the LGA derived from ABS Census 2016 Census data (refer to Table 4), of 2.4 people per household for the SA3. Bearing in mind the older population profile for the region, with consequently more household without children and or single person households, and the fact that households that are active in the workforce are more likely to have both a younger age profile and children residing in the household, a second estimate is also applied. In the absence of specific data for Airly Mine, recent Springvale Mine survey output determined an average household size of 3.1 which is adopted in this analysis, and which reflects the assumptions stated above.

Table 10: Estimate of direct beneficiaries residing in employee households

	Current (155 FTE)	Proposed (200 FTE)	Differential (45 FTE)
@ 2.4 people/household	372	480	108
@ 3.1 people/household	481	620	140

Employment at the mine currently supports an estimated 372 to 481 residents in the region. An expansion of employment by 45 FTE would see a further 108 to 140 residents added to the estimate of direct beneficiaries in employee households.

4.2 Contractor & supply chain effects

As is identified in the LCC EDS, 'Lithgow's economic base is heavily structured around the Mining and Energy sectors' (2015:74). Evidently there is significant economic activity among local businesses that provide labour, goods and services to the mining operations such as Airly Mine. Table 11 provides a summary of indicators of the extent of this additional activity in the region. The assessment is based on internal data for the most recent corporate financial year for the mine, and includes transactions with businesses in the LCC and MWRC areas specifically. The table also includes data on activity with all businesses nominally located in NSW.

Table 11: Regional & NSW supplier transaction & contractor engagement data[13]

Measure	Regional	NSW
Supplier transactions		
Number of companies	85	281
Total transaction value	$2,724,925	$34,481,538
Contractor engagements		
Number of companies	60	-
Number of individual employees	140	-
Total Hours	8,440	-
FTE contractor employees[14]	5	-

The mine contributed around $2.7 million and $34.5 million to the regional and state economies respectively in this financial year. Providing for inflation etc., this is consistent with operational performance over time, as the mine operates within fixed consent parameters. An alternative interpretation of the assessment of 5 FTE, is that on average, each of the 140 individual contractor employees worked approximately 1.7 weeks at Airly Mine during this financial year.

The key figures of 85 supplier companies, 60 contractor companies and 140 individual contract workers demonstrate the extent to which the mine's operations stimulate further, broadly-distributed economic activity across the region. In a comparatively small and undiversified regional economy, these transactions have significant economic impact.

[13] Supplier data is for FY2015-2016. Contractor engagements are nominally for CY 2015.

[14] Based on 35 hour week and 52 weeks. Estimate rounded from actual 4.6 FTE.

4.3 Direct Community Contributions

Airly (along with Springvale and Angus Place) makes an annual contribution of three cents per saleable tonne of coal a "Community Contribution" to Lithgow City Council. This Community Contribution will be capped at $200,000 annually and the funds allocated to long-term community activities and projects agreed by both parties and reported publicly. For the 2018 – 2019 financial year the funds were used for the Adventure Playground; scholarships for young people and children and Lithgow Library Homework Zone.

Airly Mine also provides direct support (financial and in-kind) to a number of community organisations and events in the region. These are generally restricted to the immediate area, as Centennial Coal's other regional operations, particularly Springvale Mine, make similar contributions in the Lithgow area, immediate to that mine. In the most recent financial year data, the following organisations received support from Airly Mine:

- Capertee Public School;
- Capertee Progress Association;
- Henbury Sport & Recreation Club Limited;
- Kandos High School;
- Kandos Public School;
- PCYC Mudgee;
- Rylstone District Pony Club;
- Rylstone Public School;
- Rylstone Streetfeast Incorporated.

It is noted that the mine provides recurrent funding to a number of these organisations/events. These contributions are important to these organisations and their members, students, staff etc., given the relatively small population of the region, and the limited opportunities for alternative fundraising activity.

In addition to these corporate contributions, Airly Mine employees also make community contributions, particularly through activities such as volunteering in the community. Although internal survey data has not been generated at this point for Airly Mine to determine the extent of this activity, recent workforce research at Springvale Mine provides an indication of these community contributions. The research found that 161 respondents (approximately 62 percent of respondents) reported a total 288 involvements with various service, community, sports, social and cultural organisations in the areas in which they reside.

The engagement of employees in voluntary organisations such as the Rural Fire Service, State Emergency Service and NSW Fire and Rescue warrant particular consideration. At relevant times these involve a commitment on the part of both the employee and the employer, in terms of employees' enforced absence from the workplace whilst on such duties.

4.4 Indirect Economic Effects

The NSW Minerals Council (NSWMC) publishes periodic assessments of the economic effects of the mining industry in NSW. The most recent report, *NSW Mining Industry Expenditure Impact Survey 2016/17* (April 2018) profiles mining in NSW regions and LGAs in which mining activity occurs. The

NSWMC report also includes estimates for the indirect effects on output, employment and value added, based on multipliers calculated for each area. The relevant multipliers for Centennial Coal's western operations are presented in Tables 12 and 13[15].

Table 12: NSWMC Mining Expenditure Impact Survey 2016-2017 Implied Multipliers – NSW Central West

Measure	Direct	Indirect effects	Implied Type II (Total multipliers)
Output ($M)	573	1,283	2.239
Value Added ($M)	573	688	1.201
Employment (FTE)	3,549	8,552	14.925[16]

Table 13: NSWMC Mining Expenditure Impact Survey 2016-2017 Implied Multipliers – Central West LGAs

LGA	Value Added	Employment
Lithgow	1.204	24.007
Mid-Western Regional	1.185	20.337

The NSWMC report discusses the methodological limitations inherent in the calculation and use of multipliers. However, those calculated in the NSWMC report are based on specific data for the region and can thus be assumed as presenting an upper-bound estimate of the scale of derived economic effects flowing from operations at Airly Mine. It is evident that there are significant effects, in the context of these relatively small regional economies.

4.4.1 Residential Distribution of the Mining Workforce

The following table compares data from the LCC employment report (mining) and internal employee residence data. In effect this compares the distribution of the total Lithgow mining workforce, with that for the Airly Mine workforce. The comparison should be interpreted as indicative only, as the two data sets are based on different, although comparable, geographic areas.

[15] The NSWMC report does not directly report the calculated multipliers. The multipliers presented have been derived from the assessments presented in the report.

[16] The employment multiplier is derived as the number of positions created/supported/maintained for each additional $1 million in mining industry output. It is not derived from the employment counts/estimates presented in the table.

Table 14: Mining workforce residential distribution

LGA/SLA[17]	SLA (LCC report data) %	LGA (Centennial data) %
Bathurst	8.2	4.0
Blayney	0.3	-
Blue Mountains	6.5	-
Broken Hill	-	-
Cabonne	0.3	-
Campbelltown	0.3	-
Coffs Harbour	0.3	-
Gosford	0.5	-
Hawkesbury	0.4	-
The Hills	-	-
Lake Macquarie	0.5	1.3
Lithgow	**79.7**	**34.6**
Mid-Western	**1.2**	**58.7**
Oberon	0.5	-
Orange	-	1.3
Penrith	0.3	-
Queensland	-	-
Sydney	-	-
Wollongong	0.3	-

4.4.2 Key observations

- The Airly workforce is distinguished from the Lithgow mining employee workforce due to the larger concentration of the Airly workforce residing in the eastern part of the MWRC LGA, particularly the centres of Rylstone (≈ 25%) and Kandos (≈ 19%). However, this is consistent with the relative proximity of the mine to each of these centres and Lithgow. Approximate road distances[18] between Airly Mine and the three centres are:
  - Lithgow: ≈ 53km;

[17] The report uses the terminology SLA (Statistical Local Area), however the current terminology is SA2.

[18] Google Maps 2017: https://www.google.com.au/maps

  - Kandos: ≈ 55km;
  - Rylstone: ≈ 60km.
- In total, 93.3% of the population resides within the three SA2s nearest to and containing the mine (Lithgow, Lithgow Region and Mudgee East).
- The data demonstrate that the mining workforce is regionally-based. As a consequence, much of the social and economic activity of the workforce takes place in the local and regional areas, further contributing to the socioeconomic functioning of these areas.
- The retention of mining employee incomes in the region is economically significant, particularly through comparing mining employee incomes with overall median personal and employee incomes for the LGA, SA2 and SA3 (Table 10). The higher incomes in mining employment encourage increased expenditure in the local and regional economies in which these employees live, when compared to population medians.

5. AIRLY MINE EXTENSION PROJECT: PREVIOUS CONSULTATION

5.1 Overview

The Airly Mine Extension Project (AMEP) team undertook consultation via the Airly Mine Special Monitoring Committee (SMC) and facilitated broader community consultation by the way of technical sessions throughout and prior to the completion and lodgement of the Environmental Impact Statement (EIS). Additional consultation was also undertaken outside of the SMC via other established forums such as the Capertee and District Progress Association and directly with landholders. Newsletters were prepared and distributed directly to land holders, via the Centennial Airly web page, employees and to other community organisations. In addition to the Projects consultation a Social Impact Assessment (SIA) was prepared. The SIA process for the Project followed a long-term approach to consultation and engagement which included:

- direct engagement with residents / landholders to identify individual and collective values of the area;
- consultation with specialist consultants;
- numerous site visits; and
- participation in, and observation of, Centennials own stakeholder engagement strategies to understand who is engaged in the process, why and key areas of enquiry. This includes observing the SMC and attendance at the four community technical sessions.

SIA consultation was undertaken to understand the values that landholders have in relation to the area via face to face meeting to explore the following general themes: how residents came to live in the area (or visit their property for weekend / retreats); what attracted people to the area and what they like; and what factors would adversely impact on their values and lifestyle. These conversations provide an opportunity to hear the community’s knowledge of the valley and its people.

It was clear that there was widespread concern about the AMEP (summarised below) which remain relevant to the community.

- Surface and groundwater impacts have been raised as a key area of concern from surrounding landholders, especially in the Glen Davis and Glen Alice, Bogee areas. It has been often stated that water in these areas is scarce and there is fear that the limited access to groundwater will be threatened (quality and quantity) by the Project which will in-turn have an adverse impact on the areas agriculture

- Impact of subsidence on surface features on the area, for example cliff lines and items of cultural heritage value.
- Loss of rural amenity due to noise, deposited dust, visual impacts, lights and traffic.
- Adverse impact on the areas tourism.
- Adverse impact on flora and fauna.
- Loss of property values.
- The potential for irreversible damage to the environment if the mine does not perform as it is intended (i.e. polluted water discharge into Airly Creek; damage to surface features such as cliffs due to subsidence; loss of groundwater).
- The lack of benefit for the broader community as the project will not employ local people and will therefore not generate local spending; participation in social / community activities, contribute to the school population etc.
- The unnecessary risk to the environment due to the perceived lack of financial viability of the Project.
- The area has high conservation value and the community with an interest in the Project are not limited to landholders.

5.2 Technical Sessions

Four technical sessions were facilitated by the Project for the purpose of providing the community with the opportunity for further and more detailed discussion in relation to issues that were raised during stakeholder engagement. The technical sessions aimed to provide an opportunity to understand the environmental assessment process, key specialist studies that were required, the methodology of each specialist study and findings. Furthermore, questions / concerns raised were incorporated into the final specialist studies. The technical session topics are summarised below.

Technical Session 1 Topics: Mine design; Subsidence Impact Assessment and Ground and Surface Water Assessment. Areas of discussion included:

- The impact of subsidence on ground and surface water within the Project Application Area and surrounding properties.
- The stability of the mine workings post mining and the long term impact of subsidence.
- Water in-flow into mine workings post mining and the impact on the surrounding catchment.
- The use of water on site and the impact on the surrounding catchment.

Technical Session 2 Topics: Aquatic Ecology; Biodiversity – Flora and Fauna; and Cultural Heritage Assessment. Key areas of discussion included:

- A review of aquatic ecology studies carried out to date and the likely impacts from mining on aquatic ecology. Impacts from subsidence, and mine discharge were discussed.
- Impacts on flora and fauna systems from mining activities.
- Presentation of the findings of the cultural heritage studies and the likely impacts from mining on European and Aboriginal heritage.

- Sharing of local knowledge regarding flora and fauna and Aboriginal and European cultural heritage sites.
- Ongoing monitoring of aquatic ecology; biodiversity and cultural heritage sites during the life of the mine.

Technical Session 3 Topics: Visual Amenity; Air Quality; Noise and Vibration and Final Landform (rehabilitation). Key areas of discussion included:

- The accuracy of predictions made in the specialist reports.
- Has the impact of dust into the Capertee Valley due to westerly winds been fully considered?
- Potential noise impact from the operation of the mine.

Technical Session 4 Topics: Provided an overview of the Airly Mine Extension Project, specialist consultants topics presented to date through the community information sessions and, how feedback has been considered and incorporated into the EIS. Presented information relating to the Social and Economic Impact Assessment.

5.3 Submissions Received AMEP

The AMEP generated a range of submissions from special interest groups and community. A summary of the submissions (sourced from DPE: Secretary's Environmental Assessment Report: 2015: 18 – 20) is below.

Birdlife Australia identified the Capertee Valley as an 'Important Bird Area' featuring at least 216 species and comprising the most important breeding area for the Regent Honeyeater; listed as a critically endangered species under both the EPBC Act and TSC Act. It also highlighted the presence of threatened bird species on the site, lack of identification of Needle-leaf Mistletoe (*Amyema cambagei*) and subsidence impacts to cliffs, pagodas and rock features potentially affecting the Sooty Owl and Rockwarbler and other impacts to habitat. It also stated that it does not support the use of biodiversity offsets.

The **Blue Mountains Conservation Society** expressed concerns regarding the need to preserve the values of the Mugii Murum-ban SCA, application of the precautionary principle to the management of the SCA, downstream water impacts on the GBMWHA from mine-water discharges, excessive coal extraction rates (> 50%), subsidence impacts on pagodas, cliffs, deep canyons and gullies and subsidence impacts on the historic ruins of the former New Hartley Mine.

The **Colo Committee** highlighted the significance of the geodiversity of the area and stated that the precautionary principle should apply to ensure the protection of its values. The Committee's key concern is the percentage of coal to be extracted under pagodas, slot canyon areas, high cliffs and the talus slopes that support these cliffs and that the EIS fails to give assurances that Centennial's commitment to extract no more than 50% of coal would be maintained. Other points included: extraction under the oil shale ruins should be limited to first workings only; thoroughness of the flora surveys and inadequate consideration of the risk of extinction of the *Pultenaea*, pagoda description inaccuracies and slot canyon misrepresentation; impacts on surface and groundwater systems; misleading greenhouse gas information and failure to identify an Aboriginal art site.

The **Colong Foundation for Wilderness** advised that whilst it did not have an 'in-principle' objection, the Airly proposal was misleading and should be revised and resubmitted for exhibition. The Mod 3 extension should also be reviewed and cliff lines, mine heritage, pagodas and the Grotto and Valley of the Kings should be defined as sensitive features and protected from subsidence movements. The environmental protection zones from the 1993 consent should not be reduced and Centennial should ensure an ongoing water supply to visitors if surface water sources are impacted by mining. The water management system should separate clean and dirty water streams and discharges to Airly Creek should achieve a neutral or beneficial effect on water quality and downstream ecology. The EPL should be revised to regulate a larger number of pollutants, the REA should be screened from Glen Davis Road, noise levels should be below background and any proposals for surface operations in the SCA should be made available for public comment.

The **Capertee Valley Environment Group Inc** (CVEG) and the **Capertee Valley Alliance Inc** (CVA) jointly engaged the Environmental Defenders Office (EDO) who in turn commissioned consultants to review the EIS. These reviews formed part of CVEG and CVA's submissions in objection and included an aquatic ecology review by Dr Alison Hunt, comments on coal extraction rates, impacts to pagodas, comments on *Pultenaea* and Aboriginal heritage by Dr Haydn Washington, comments on noise from John Bassett, reviews of surface water assessment by Andrew Marr and Dr Ian Wright, subsidence and groundwater comments from Pells Consulting and Dr Andrea Broughton and a copy of The Australia Institute's submission on the economic impact assessment.

In addition, CVEG objected to impacts on the GBMWHA including the Gardens of Stone and Wollemi NPs; impacts on threatened species and ecological communities including bats; significant landscapes and water resources. CVEG was also concerned with adverse social and economic impacts on quality of life, tourism and recreational activities in the Capertee Valley. CVA's additional comments included that the EIS contained significant omissions, inadequacies and defects with respect to environmental, social and economic aspects. Furthermore, that heritage items associated with the former New Hartley Mine were listed by the National Trust and that the mine posed an unacceptable risk and was not in the public interest.

The **Greater Blue Mountains World Heritage Area Advisory Committee** objected to the Airly proposal on the basis that it would significantly damage the Mugii Murum-ban SCA and may impact the adjoining World Heritage area. A greater level of detail should be provided to enable a full understanding of the proposed development, together with all measures that would be taken to ensure the quality of any mine-water discharges. It was concerned about the likely deleterious impacts on fauna and biodiversity should highly saline mine-water effluent be allowed to flow into Airly Creek, the Gardens of Stone NP and the GBMWHA. Water effluent should be treated to a level consistent with the receiving watercourse. The Committee opposed extraction of two-thirds of the coal under the SCA which it judged would threaten pagodas, slot canyons and internal cliffs and called for half of the coal resource to be left in the ground to protect the biodiversity and geodiversity of Airly and Genowlan mesas. It also opposed the 30% extraction of coal under 120 m cliffs such as Genowlan Point and 60% extraction of coal under steep talus slopes. Past mine heritage should also be protected.

The **Running Stream Water Users Association** objected to the proposal based on potential impacts to water resources including baseflows to the Grotto and other seeps and springs. The dependence of Capertee Valley agricultural businesses on water was not given sufficient consideration in the EIS in light of potential impacts and there is a lack of detail around extraction rates which should be limited to 50% beneath the SCA. Additional inadequacies identified in the EIS included failures in identifying the significance of heritage items associated with the former New Hartley Mine and tourism, misrepresentation of slot canyons and details about how the REA would be managed.

The Australia Institute's (TAI) submission specifically commented on the economic impact assessment in the EIS. TAI stated that the assessment does not follow relevant government guidelines for economic assessment, overstates the value of the project by more than $100 million, incorrectly counts wages as a benefit and withholds major costs and benefits such as capital, operating and coal sales revenue. TAI also questions the validity of the studies relied on for the evaluation of environmental costs and states that the assessment does not allow a proper assessment of jobs generated and royalties claimed by Centennial.

Three special interest group submissions in support were received on behalf of **Westfund**, **Henbury Sport & Recreation Club Ltd** and **Mark Lilley Plant Hire Pty Limited**. These submissions stated that the Airly proposal would support local jobs in the context of declining regional employment in mining, manufacturing and the government services sector; and would in turn generate positive flow-on effects for the community. Westfund's submission included an attachment highlighting the contribution of the mining and power generation industries to the local and regional economy as well as social benefits to the community. The other two submissions drew attention to adverse impacts to local communities in the event of a potential closure if the project was not supported.

121 of the 155 community submissions supported the project, primarily on the grounds of its:

- continued direct and indirect employment opportunities in the local and regional area;
- broader economic benefits for the community, particularly to local businesses and services that rely on spending by Airly or its employees;
- continued support for regional community, schools, sporting groups and charities; and
- previous good environmental performance.

Some submissions also noted that there would be an adverse socio-economic impact on the local community if the Airly proposal was not supported and the mine closed down. It was also suggested that this impact would be significant in light of other recent mine closures, such as Angus Place Colliery which was placed on care and maintenance in November 2014.

34 of the 155 community submissions objected to the project on the basis of:

- adverse groundwater impacts on alluvium, colluvium and deeper aquifers that supply agriculture and other land uses in the Capertee Valley and reductions in base flows to the Grotto, springs and seeps;
- downstream impacts in the Gardens of Stone NP, GBMWHA and associated Wollemi NP and on aquatic ecology and other flora and fauna as a result of mine-water discharges into Airly Creek;
- adverse impacts on the growing tourism industry in the Capertee Valley, which is a globally renowned bird watching location and which includes mining heritage near Airly village and other recreational activities such as camping and bush walking and bed and breakfast establishments;
- subsidence impacts on the visually significant cliff lines, steep slopes and pagodas, slot canyons and internal cliffs and watercourses adversely affecting the values of the Mugii Murum-ban SCA;
- adverse impacts on threatened species and EECs, in particular, the *Pultenaea*, potential bat habitat in the old mine workings of the New Hartley Mine and overhangs on the cliff lines;

- the EIS being inadequate, containing repetitive content, failing to clearly describe the percentage of coal proposed to be extracted in the mine plan and only identifying the old mine workings of the New Hartley mine to be of local significance despite listing on the register of the National Trust;
- excessive coal extraction proposed despite Centennial's commitment to extract only 50% of the available resource;
- subsidence impacts on historically significant mine infrastructure associated with the New Hartley Mine; and
- adverse impacts on the conservation values of the Mugii Murum-ban SCA, which is recommended to be added to the GBMWHA following the completion of mining.

Additional grounds for objection raised on a less frequent basis included visual impacts from the pit top infrastructure and proposed REA; lack of socio-economic benefits to the community; potential noise, dust and contamination impacts; increased traffic on local roads; intergenerational equity of resource use and conservation; overseas profits and impact on property values.

6. AIRLY MODIFICATION 3 CONSULTATION

6.1 Overview

Consultation in relation to Airly Modification 3 commenced December 2017. Stakeholders representing neighbouring and nearby landholders, local business representatives and locally based contractors were provided an overview of the modification with their responses summarised as follows:

- clarification required regarding whether a second portal will be constructed;
- positive response regarding additional employment and business benefits that may arise;
- neighbouring resident had heard train movements through Capertee; and
- no specific issues were raised in relation to the proposal.

In addition to the dissemination of material to stakeholders, an ordinary meeting of the Airly Community Consultative Committee (CCC) was held on Wednesday 17 January. Capertee Valley Alliance (CVA) had circulated the presentation to members and responses were tabled and read out at the CCC meeting. The feedback from the CVA is below (note: formatting changes have been made and names omitted):

Before passing on community feedback from the valley, it should be pointed out that there are two quite distinct sections of our "community": Those "upstream" e.g. Lithgow, Capertee, Kandos Rylstone - who benefit from the employment the mine creates. And, the "downstream" residents of the Capertee Valley - where I live - Glen Davis, Glen Alice, Bogee, who are food producers, or work in tourism, and are more concerned about environmental impacts - especially water.

In spite of Airly's announcement happening right before xmas, many people have contacted me (and, surprisingly, quite a few who haven't been involved in previous community consultations) and asked that I pass on their views-

We had one person strongly ***in favour*** *of Airly's plans for increasing coal production:*

This is jobs and wealth for Australia. We should embrace progress and the benefits that it brings to our country and our children.

Some were outraged:

Why is it that we go thru a lengthy approval process only to have them come back with a request to expand further only months later?

It is tactics... something they do on a regular basis as they know they will ultimately have government approval - operandi modus! If they get approval, which is on the cards, it makes the operation a hell of a lot more viable for Banpu.
They know the tide is turning & they will push for max. extraction for max profit in short term.

This mine should be closed or fazed out. An increase in production is a nonsense.

This is outrageous … the audacity of the owners of Airly to apply for Consent to increase their mining quota.

3rd generation farmer: Of course I am concerned about any sort of expansion at the mine, so is my family. It is so typical of these businesses to go back on their word; to them we are insignificant and as the saying goes money talks. They would be greasing someone's palm in to get things passed.

People have come to the valley for a quiet and peaceful life. We purchased our property, knowing the mine was to go ahead but not at the larger scale of extraction as they are wanting now. We would like to offer our support, and will put in submissions if required. No person should have to spend their time fighting battles that our elected governments should fight for us. It is exhausting and to be honest I think the mines and other developers prey on the general public to get too tired to fight anymore.

Noise

Our Property is part of Genowlan Mt, and we are already affected by rumbling noise when we are there.

Part of my work entails recording bird calls and at certain times when the conditions are "right" it's impossible for me to record because of the background noise from the mine, even though I live considerable distance away.

Subsidence

There was a pagoda failure over to the east of Baal Bone colliery, might be an idea to check that they are not going to mine under the pagodas at Airly and that they are still planning to use bord and pillar.

A couple of geology questions, is the material coming from the Lithgow seam or one of the younger but shaley seams? The latter would have more spoil.

Visual amenity

The bright lights were never meant to be on all the time at night as it is the entrance to the Capertee Valley and takes away from the ambience. This is not a good look for tourism - many of our guests arrive at night and this is the first thing they see.

Confusion re the washery

Are they washing the coal at Airly, or are they planning to cover the loads?

And as for a wash house we all know that it will have a devastating effect on our water table. Just let me know what you want me to do I will be around through the holidays.

An important thing will be to have it absolutely in writing that they are not going to have a coal washery?

The real teeth in the control of these coal mines are in the "Coal Washing and its Tailings Dams" using the EPA rules and regulations has more teeth than all the meetings you attend.

All coal mines wash coal some do it to produce low ash content coal to meet Japanese import and emission's standards in Japan, the others do it to reduce dust during transport by road and rail to comply with NES EPA standards.

There are EPA Standards relating to the onsite coal washery and their tailing dam storage both for long and short term management of them.

Here is the EPA site for NSW https://www.epa.nsw.gov.au/ your-environment/recycling-and-reuse/resource-recovery-framework/ current-orders-and-exemption

There are 2 orders and 2 excerptions directly related to a coal washery and its washed waste. Please read them and you will see that AIRLY Mine will need to include these into their expansion plans to address the current and long term storage of this washed waste.

Water generally

I think of primary concern is the impact on the water system flowing through the valley, already under stress. They want to bring a lot more machinery into the mine for the extra extraction, employment up to 200, more trains on the railway line & maybe look at a washery, something they said they would never do.

Probably worth emphasising there appears to be a significant decrease in the water system now. This modification will mean more water taken out & will result in more significant impact

The key here is water ...... more coal more water used!

I intended to send you this re Airly Creek, being EC readings to date. Note that measurements have trended upwards over the past 12 months (from an EC of 2000 to 4000). Airly Creek needs testing We did make a presentation at a public Landcare meeting, re Coco Creek lack of flow. We need to follow up on this.

I was referring to comments made by several people RE Coco Creek in particular & on the creeks round Glen Alice/Bogee way e.g. Genowlan which does not even run now after heavy rain.

I am only aware of the comparison made by Mrs XXXX who lived at The Kurrajongs before 1997 & how she commented RE the many picnics they had by the banks of the regularly flowing Coco where they would catch eels Apart from that I have noticed the erratic behaviour of Coco. I had chased the problem back to Baal Bone years ago & approached Centennial (how naive I was back then). But now of course we have Airly in the mix!

We must not allow this to occur without getting a compulsory and mandatory testing and measuring of the underground water levels and quality throughout the valley. If we do not do this we will have no reliable benchmark for future impacts.

I suggest at least 20 bores are annually tested and monitored at a cost to the mining company by an independent agency. The location of the bores to be agreed. This is imperative when we consider that if the recent run of dry weather is anything to go by with all surface water having *dried up then we all rely for stock and domestic purposes on the bores. Without them the valley will become a desert.*

In conclusion

It appears that the biggest concern is water. How can we work with the community to allay their fears? If we can create a monitoring system together that the community understands, and that addresses their concerns about pollution, salinity, flow, and the affect on ground water and aquifers, then we can make real steps towards cooperative best practice. Without this we enter into a adversarial system, which wastes resources - both environmental and human.

Extra note: From reading the above it would appear that, in spite of all the effort put in, Centennial Airly doesn't seem to have had much success in winning community trust. From this you could conclude that what has been done in the past hasn't worked. I believe we could redesign the community consultation and technical sessions in such a way that they would be more meaningful to all involved, and would be happy to help do this – please contact me if you are interested to discuss this further!

6.2 Response to Airly MOD 3 Consultation

It is evident from the above feedback that the concerns and issues raised during the consultation for the AMEP have not been addressed and a high level of distrust remains. The SIA for the AMEP made the following statement summarising the community's fears:

Despite the AMEP resulting in minimal change to the existing character of the area, the AMEP has resulted in a high degree of angst across the community, evident from the consultation process and feedback arising from the community technical sessions. Despite there being no adverse impact to the social amenity within and surrounding the PAA, it was expected that these concerns will continue and this has in fact been the case as demonstrated by the concerns relating to ground and surface water impacts remaining high.

The key social impact arising from the Project is related to the high regard the surrounding community have for the environment. The presence of the Project, regardless of the actual physical change represents a loss of the connection to the environment which the community hold in high regard. This is because many landholders have become the new custodians of the land demonstrated by their knowledge of, and connection to, the area.

With this in mind, the limited impact of Airly Modification 3 over and above what is already approved is irrelevant given the level of angst that remains within the community.

7. SCOPING OF POTENTIAL SOCIAL IMPACTS

As stated in Section 1, Airly Modification 3 consists of the following elements:

1. Increase Run of Mine (ROM) coal production from 1.8mtpa to 3.0mtpa.
2. Increase employee numbers from the currently approved 155 fte to 200 fte personnel.
3. An amendment to the approved 20 year mine schedule for the increased production rate.
4. Due to the increase in coal production an increase in the movement of laden coal trains and water trains leaving the site from the approved average of 2 trains per day to 3 trains per day over any calendar year but maintaining the approved maximum 5 trains per day leaving the site on any day.

5. The ability to use explosives if geological structures, for example igneous rock dykes, intersect some underground mining areas and require removal in order to continue mining. The mining equipment currently used will not cut through these geological structures.

Table 15: Airly Modification 3: Social Impact Scoping Assessment.

Project Component	Assumption	Potential Direct Social Impact / Opportunities Considered	Duration	Likelihood (unmitigated)	Impact	Impact Type
Continuation of Operations	Airly continues to supply coal primarily for domestic power generation	Energy security for NSW.	Long-term	Almost certain	Positive	Direct
		Surety of employment for existing workforce.	Long-term	Almost certain	Positive for Lithgow and Mid-western LGA's	Direct
Community Contribution Fund	Exiting contribution of three cents per saleable tonne of coal produced from Airly, Springvale and Angus Place Mines to a maximum of $200,000 per annum.	Support for program, service and infrastructure across the Lithgow LGA.	Long-term	Almost certain	Positive	Direct
Introduction of a new workforce (45 FTE employees).	Exiting employment / labour profile expected to remain (58.7% MWRC and 34.6% LCC) due to historical employment profile	Local spend benefits Ongoing support of local business, services, volunteering activities creating positive social capital.	Long-term	Almost certain	Positive	Direct
Subsidence	No change to approved mine design or method so no change to existing approved subsidence level	NIL Impact – impacts have been previously assessed and approved	NA	NA	NA	NA
Water Management	No change to on site surface water management systems required for this Mod	NIL Impact – impacts have been previously assessed and approved	NA	NA	NA	NA

Project Component	Assumption	Potential Direct Social Impact / Opportunities Considered	Duration	Likelihood (unmitigated)	Impact	Impact Type
Groundwater	No change to approved mine design or method so no change to existing approved groundwater impacts	NIL Impact – impacts have been previously assessed and approved	NA	NA	NA	NA
Surface water	No change to approved mine design or method so no change to existing approved surface water impacts	NIL Impact – impacts have been previously assessed and approved	NA	NA	NA	NA
Traffic impact on Glen Davis Road	Increase in road traffic expected along Castlereagh Highway into Glen Davis Road from west (MWRC) and east (LCC).	Negligible change to traffic flow	Long-term	Almost certain	Neutral	Direct
Coal transportation	Increased noise due to additional rail movements	Within approved maximum number of train movements per day.	Long-term	Almost certain	Neutral	Direct

8. IMPACT ASSESSMENT

8.1 Technical Assessment Summary

Technical assessments have been completed to understand the potential environmental impacts. The reports and findings are summarised in Table 16.

Table 16: Summary of Technical Assessments and Findings.

Description	Comment on application
Air quality (SLR)	SLR (2019a) assessed that concentrations of PM_{10} and $PM_{2.5}$ are 'similar to the incremental impacts predicted for the current approved operations' (pp 46; 48). Assessed sensitive receptors: 8 residential, Airly Camping Ground & Nissen Hut, Genowlan Mountain (passive recreation sites) (SLR 2019a:20).
Groundwater / Surface water(GHD)	Predicted conditions under the modification and approved conditions have been assessed using a recalibrated hydrogeological model. 'Residual groundwater impacts under both proposed and approved conditions are considered to be less than the Level 1 criteria under the NSW AIP' (GHD 2019a). 'The potential impact of Modification 3 of the Airly Mine Extension Project on baseflow in Gap Creek and Genowlan Creek is expected to be slightly less than approved conditions and is therefore considered equivalent to the potential impacts of approved operations at Airly Mine. One surface water user downstream of Airly Mine on Genowlan Creek was identified. No measurable impacts on downstream surface water users are expected as a result of Modification 3 of the Airly Mine Extension Project' (GHD 2019c:6)
Site water balance (GHD)	'The proposal is not expected to result in an increase in the frequency or magnitude, nor a deterioration of water quality, of potential discharges. Given the recommended mitigation and management measures, no measurable change in the potential impacts on Airly Creek, downstream water users, or cumulative impacts are expected with respect to surface water. Water balance modelling indicates that the approved importation of up to 170 ML/year of water from Charbon Colliery is sufficient to meet process water requirements of the proposed production increase' (GHD 2019b:ii), except in a dry year. Three surface water users downstream from Airly Mine pit top were identified on Coco Creek. Impacts to these users will be negligible.
Greenhouse gas (SLR)	SLR (2019a) assessed comparative annual GHG emissions as 10,099.7 p.a. (BAU) and 19,143.1 p.a. (modification). Based on estimated production schedules, totals are 171,694 tonnes over 17 years (BAU) and 210,574 over 11

Description	Comment on application
	years (modification).
Noise (SLR)	'Noise levels from the modelled operational scenarios are predicted to be below the relevant PTNL/SDNL and SSD 5581 criteria at all privately owned residential assessment locations under all considered meteorological conditions' (SLR 2019b:25). Compliance also predicted at Airly Gap and the Nissen Hut (2019b:29). 'Given that predicted noise levels from the Project are significantly below the Project Amenity noise level, any cumulative noise impacts would be considered negligible' (2019b:25). 'A comparison of existing and proposed operating average rail movements indicates that the average $L_{Aeq(15hour)\ (day\ time)}$ and $L_{Aeq(9hour)\ (night\ time)}$ noise levels would increase by up to 1.8 dB on the Wallerawang-Gwabegar Railway between Airly Mine and Wallerawang, however will comply with the trigger levels in the *Rail Infrastructure Noise Guideline* and John Holland Rail's EPL 13421 noise limits. (2019b:29). Assessed sensitive receptors: 8 residential, Airly Camping Ground & Nissen Hut, Genowlan Mountain (passive recreation sites) (SLR 2019b:10). Road traffic noise levels from the existing and proposed traffic volumes comply with the *Road Noise Policy* noise criteria at the nearest affected receiver on Glen Davis Road during the day and night-time periods.
Traffic (rail) (Barnson)	'The impact on the Wallerawang-Gwabegar rail line will be an increase of average daily trains travelling on the line from two to three trains, with a maximum of five trains per day. Additionally, the proposal will result in a marginal increase of trains utilising the Main Western Rail line. The impact of this increase is evaluated to be negligible and easily accommodated within the existing network capacity' (Barnson 2019).
Traffic (road) (Barnson)	'The only impact of the Project on the existing traffic environment would be due to an increase in staff numbers and therefore vehicle trips. It has been determined that the existing road infrastructure and intersections have sufficient capacity and satisfy regulations to accommodate the increased traffic volumes' (Barnson (2019)).
Economic (Aigis Group)	'On balance, the proposed modification will result in positive economic benefit for the state, and local and regional areas in which Airly Mine is located' (Aigis Group: 2019: 37).

8.2 Surrounding Community

The impact of Airly mine on the surroundings was assessed in the Airly MEP EIS and approved in SSD 5581. Modification 3 is not proposing any new infrastructure and there will not be any impact on the visual amenity, the cultural heritage and biodiversity values of the area. No changes to the mine design philosophy, the mining footprint of any changes to the five mining zones are proposed. The production rate and hence the mining intensity will increase and subsidence will develop quicker than in the 1.8 Mtpa scenario. However, subsidence will not increase and will continue to fall within the approved maximum subsidence limit of 125 mm.

Groundwater impacts due to the increased production rate have in fact been assessed to be lesser than previously assessed and approved in SSD 5581. No changes are proposed in the existing water management at the pit top will occur. The noise, vibration and air quality impacts of the Project as modified will meet all the relevant criteria and therefore amenity of the surrounding areas will not be impacted. The assessment outcomes show that, with the exception of greenhouse gas emissions, no further impact than that already assessed and approved. On that basis, the modification results in no potential further changes to the amenity of the area. Greenhouse gas emissions, which will have impact on a broader scale, will increase only marginally (0.01%) when compared against the of total Australian GHG production, and will have undetectable effect on global climate change.

Impacts from subsidence (such as cliff failure), visual amenity and impacts to tourism and the general way of life are also of great concern. The proposed modification will not have any further subsidence impacts than currently approved as there is no proposal to change the mine design and the mining will continue to meet performance measures included in SSD 5581. As such, no impacts on visual amenity of the geodiversity and no subsequent impacts on tourism in the area will occur.

It is recognized, however that the community hold the environment in very high regard and regardless of the limited impact of the proposed modification on the surroundings, the community are concerned about the environmental risk arising from Airly Mine operations. Community concerns on surface and groundwater resources are particularly high given that if there is an adverse impact it is the ‘downstream community’ who have the most to lose given they rely on groundwater for activities which include productive farms and lifestyle pursuits. In this case, the downstream properties would be regarded as being valueless. Impacts from subsidence (such as cliff failure), visual amenity and impacts to tourism and the general way of life are also of great concern.

8.3 Personal and Property Rights

No direct impacts on privately owned property have resulted in the operation of Airly Mine to date. Since the grant of SSD 5581, there have been no exceedances in relation to the amenity of the area (noise and dust). The air quality and noise impact assessments have concluded the Project as modified will meet the relevant criteria in SSD 5581 at all identified sensitive receptors. As such, no further impacts on privately owned property are likely to occur.

There are no restrictions to the Mugii Murum-ban SCA currently. The mine design philosophy approved in SSD 5581 is conservative, and the Modification 3 is not proposing to alter this. Subsidence impacts to the overlying geodiversity will not change as a result of Modification 3. The mine will continue to meet the performance measures for natural, cultural heritage and built features included in SSD 5581. As a result, there will be no changes to land use characteristics within the Project Application Area.

In summary, there are no requirements to acquire property to mitigate against amenity impacts because:

- the Project's impacts, as modified, will remain largely within the impacts already approved SSD 5581;
- there are no changes to land use; and
- there are no access restrictions (brought about by mining) to land within the Mugii Murum-ban SCA, and this will not change due to the proposed modification.

8.4 Culture

The potential for impacts on Aboriginal cultural values, community identity, (which is tied to sense of place), and appreciation of environmental qualities from the Project was assessed in the relevant Airly MEP EIS technical assessments. The impacts of Modification 3 on the cultural values of the area has been again considered in the SIA. No items of cultural significance (Aboriginal and European heritage) will be impacted by the proposed modification given no surface disturbance will be required. There will be no impacts to freehold access to groups who have cultural heritage connection to the land. This has been demonstrated by Aboriginal cultural heritage site survey inspections undertaken as per the Aboriginal Cultural Heritage Management Plan whereby pre and post mining surveys are undertaken in partnership with Registered Aboriginal Parties (RAPs). Due to the limited level of subsidence there has been no impact to any registered site within the Project area. All site surveys findings are recorded and survey reports are provided to RAP's for review and comment.

8.5 Community

8.5.1 Population and Housing

Changes to population and housing as reflected in the 2011 and 2016 census periods relate to boundary changes of the statistical areas rather than changes to the population characteristics of the Capertee and Glen Davis / Glen Alice community structure.

Kandos on the other hand has experienced a change in community. Kandos has experienced increases in the demographic indicators of an ageing population. Kandos experienced a decline in coal mining employment of 62.5% over this period (48 employees in 2011, 18 in 2016). Other structural change indicators comprised:

- a concurrent increase in the proportion of unskilled workers (labourers);
- a decrease in the proportion of persons with tertiary qualifications (down from 12.1% to 4.5%);
- an increase in the proportion of lower-income households.

Based on historical trends the EA has assumed that 50% of the new 45 FTE personnel is likely to be already resident in the Kandos and Rylstone areas and Mudgee LGA. The EA however assumed the worst-case scenario and assessed the migration of the 45 FTE personnel into the region in the proposed modification will occur. The assessment confirmed that even with the 100% in-migration the existing housing in the region will accommodate the modest increase of 45 personnel however it is not anticipated that this scenario will eventuate.

8.5.2 Community Identify and Sense of Place

There is a strong sense of identity and sense of place within the area. This has been evident since Centennial Coal's interest in Airly Mine and the community was specifically identified during consultation for the Airly MEP. Regardless of the limited impact of Airly Mine, the community holds the area in very high regard and undertakes steps to protect and conserve the environment. This is evident via local community-based activities, involvement on organisation such as the Capertee Valley Landcare, local tourism etc.

The consultation undertaken for the Airly MEP EIS in 2014 and the preparation of the EIS (James Marshall & Co. August 2014) found that there was widespread concern about the Project. Issues raised at that time remain relevant to the community. This is again discussed in the SIA prepared for Modification 3. The SIA notes that, despite the Project's minor environmental impact footprint, the Project has resulted in a high degree of angst across the community, which is evident from the consultation undertaken for the proposed modification.

The SIA concludes the key social impact arising from the Project is related to the high regard the surrounding community have for the environment. The presence of the Project, regardless of its actual minor environmental impact footprint, represents a loss of the connection to the environment which the community hold in high regard. This is because many landholders have become the new custodians of the land demonstrated by their knowledge of, and connection to, the area (refer to Section 6.2 of the SIA).

The continued concern of the impact of the Project by the community is regardless of the technical assessment outcomes presented at technical sessions and at CCC meetings. The outcomes of the majority of the technical assessments demonstrate, other than the greenhouse gas emissions, the Project as modified will result in lesser environmental impacts (groundwater, surface water) or will meet the relevant criteria in the current consent (noise, air quality). Mine design philosophy or approved subsidence impacts will not change.

The economic assessment demonstrates the Project as modified will result in positive economic benefits to the community and the region. The increase in workforce will result in economic benefits relating to the additional workforce's household consumption and investment activities in the LCC and MWRC LGAs and surrounds. There are also likely to be qualitative social benefits associated with the involvement of the additional workforce households in a wide range of community-based activities which will be an enhancement of Airly Mine's current contributions to social engagement and community cohesion in the region.

8.6 Access to Services and Infrastructure

The EA has assessed the worst-case scenario of 100% in-migration of the 45 personnel from outside the region. The assessment showed the proportional increases in population will be minor in the context of regional capacity, and existing services and infrastructure in the region will be able to manage associated additional demand on publicly and privately provided services. It is likely however that the proposed 45 FTE personnel will already be resident in the region, and that based on historical trends 50% of the personnel will be drawn from the LCC and MWRC LGAs as there is an existing mining workforce in both these LGAs.

8.7 Health and Wellbeing

Modification 3 will not result in adverse material impacts to health and wellbeing as evidenced by the outcomes presented in the technical assessments, specifically the air quality and noise assessments.

Increased employment at Airly Mine would contribute to individual and household well-being for the new employees and their families and contribute positively to economic development

8.8 Decision Making Systems

Airly Mine regularly holds CCC meetings and provides operational information on the mine and engages with the community on the environmental aspects of the Project, including provision of environmental monitoring results and data. The monitoring information are provided to the community on request, and are also available from the Airly Mine's website, and as *Annual Review* reports. This practice of involving the community in the mine's operations and ongoing review of environmental monitoring data will continue.

Airly Mine has recently consulted with the Capertee Valley community to identify and establish additional downstream groundwater monitoring; notwithstanding the existing groundwater monitoring is undertaken in accordance with the approved Water Management Plan. This consultation is in response to the community's ongoing concerns that mining at Airly Mine has the potential to impact on the regional Devonian aquifer that supplies majority of the bores, despite the groundwater assessments for Airly MEP EIS (GHD, 2014), Airly Modification 2 (GHD, 2019) and Modification 3 (GHD, 2019) demonstrating negligible, if any, hydraulic connectivity between the overlying local aquifers with the potential to be impacted by mining activities and the regional Devonian aquifer.

Despite the limited scope of modification 3 and subsequent limited impact over and above the approved project it was agreed via the Airly CCC to hold a series of workshops / open meetings to focus on the key areas of concern. The first session (open to the public) was held on 23 October 2018 and focussed on water with the following topics being addressed.

- Overview of surface water features at Airly Mine and the surface monitoring program.
- Overview of the groundwater features at Airly Mine and the groundwater monitoring program.
- Summary of monitoring results to date and demonstrated that there has been no exceedances of the predictions made within the EIS.
- Overview of the water balance and groundwater model.
- Nil water discharge and full compliance with water monitoring to-date for 2018.
- Site tour of Airly Mine's pit top infrastructure area and water management areas, Airly Creek Riparian Project Area, and groundwater monitoring bore ARP11 located in Airly Gap.

There was general discussion about Airly Mine's influence on ground water throughout the presentation. The following actions arose from the meeting:

1. Liaise with Capertee Valley community to identify and establish downstream groundwater monitoring to assist understand interaction of Airly with ground water resource (lower aquifer).
2. To provide further clarification relating to the potential interaction of the Airly's workings with Lower Devonian Strata (including influence of fracture zones).

The community requested, and Airly Mine agreed, the review of the existing groundwater monitoring by an independent hydrogeologist (ZOIC Environmental) at the mine's cost. The two actions from the October 2018 Water Workshop were addressed in relation to:

- The regional geology and groundwater systems in relation to Airly operations and downstream groundwater users;
- Description of Airly's lineament and fault zones in relation to potential groundwater impacts was provided.

In relation to the additional downstream groundwater monitoring a meeting was held on 9 January 2019 to discuss the scope of this strategy as follows:

- Regional geological and groundwater system overview;
- Proposed monitoring locations;
- Limitations and constraints from the proposed monitoring program;

Members agreed that whilst the proposed private groundwater monitoring programed had obvious limitations and relied on accurate landholder and neighbouring meter data, the overall program seemed reasonable and should be pursued. The community suggested ZOIC be engaged to independently review the groundwater monitoring included in the Water Management Plan to:

- Provide comments around the selection process for the proposed monitoring network.
- Undertake an analytical suite (field parameters need to be analysed also Sampling methodology).
- Consider climate change as a potential external factor that should be considered; rainfall patterns and associated bore response should be discussed and included in ongoing review of the program.
- Discussion of any proposed contingency plan.
- Discussion on sampling rate.

The ZOIC report (draft dated 19 September 2019) states:

Zoic consider that water level monitoring of the private abstraction bores with the intent of trying to gauge impacts from Airly is difficult and likely to be fruitless. Abstraction from the bore itself will impact local groundwater levels, local recharge from adjacent creeks and rainfall will have far larger impacts upon water levels such that any potential impacts would be indistinguishable. This, coupled with the existing monitoring network in place around Airly and the noted geological barrier to groundwater flow into Devonian aged rocks (Shoalhaven Group) indicates that any impact to groundwater levels would be picked up long before reaching outside of the mining lease and likely be of such a small magnitude to not be measurable.

Where water level monitoring may occur, GHD have indicated that pressure transducers will be utilised for continuous water level monitoring, it is recommended that these be set for six hourly readings for direct comparison with the existing monitoring network hydrographs, be barometrically compensated and calibrated to quarterly manual dip levels and depict local rainfall for interpretation purposes.

All monitoring locations should be surveyed to ensure comparability against the overall monitoring network.

The proposed monitoring locations identified in the ZOIC report are:

Based upon this review it is considered that monitoring be broken into the three creeks above with:

- *The currently monitored well Nioka capturing monitoring within Dog Trap Creek.*
- *GW800787 is the first recommendation for monitoring Genowlan Creek as it is the most upgradient well. GW027536 or GW112527 are considered viable alternatives.*
- *GW072237 is the first recommendation for monitoring within Emu Swamp Creek with GW102743 a less viable alternative. If these wells are not viable then other adjacent drainage lines might be also be considered (GW021670 or GW102755).*

Final selection of wells would also be dependent upon current well condition, accessibility into the well for equipment for the required monitoring, or an operational pump that has an outlet suitable for water quality sampling.

The review has been undertaken and findings presented to the Airly CCC on 15 October. Airly Mine has agreed to the additional monitoring (and the cost) at select registered groundwater bores, the results from which will be independently reviewed and reported to the Airly CCC and Capertee community in a plain English format at the time of the completion of the Annual Review.

8.9 Fears and Aspirations

As noted above, despite the Project's minimal to negligible environmental impacts, the availability of monitoring data from a number of years and technical assessments the community still has concerns about the Project. The technical assessments demonstrate that, other than the greenhouse gas emissions, the assessed impacts of the Project as modified will continue to fall within the relevant criteria or meet the SSD 5581 consent conditions.

Notwithstanding, it is likely the community's issues on the Project's existence in the area would continue however it is noted that the outcome of the Airly CCC meeting held on 15 October demonstrated a positive result for all stakeholders. The limited scope of the modification 3 is not the issue but rather there is an ongoing fear of the environmental impact (in particular water) from Airly mine's operations. This will be managed via the strategy outlined above along with ongoing consultation with the community. With this in mind, the mine has performed as stated in the current consent.

9. SOCIAL RISK ASSESSMENT

A social risk assessment has been undertaken (refer Table 17) and takes into account the findings of the technical assessments and ongoing community concerns in relation to the potential impact on groundwater. While the overall social impact risk of the modification is low, the ongoing concerns relating to ground water impacts has been allocated a high risk rating due to the concerns and fears raised by the downstream community. .

Table 17: Social Risk Assessment

			Consequence Level				
			1	**2**	**3**	**4**	**5**
			Minimal	Minor	Moderate	Major	Catastrophic
Likelihood Level	**A**	Almost certain	A1	A2	A3	A4	A5
	B	Likely	B1	B2	B3	B4	B5
	C	Possible	C1	C2	C3	C4	C5
	D	Unlikely	D1	D2	D3	D4	D5
	E	Rare	E1	E2	E3	E4	E5
Social Risk Rating							
	Low		Moderate		High		Extreme

Source: Adapted from SIA Guidelines

Table 18: Social Risk Rating

Social Impact	Social Risk	Justification
Traffic	C1	Traffic Impact Assessment states existing infrastructure has adequate capacity
Subsidence	B1	No change to what is existing / approved
Economic	B2	Economic benefits are largely realized by the current operations
Water (surface / ground)	A5	The limited scope of Airly Modification 3 results in no change to the predicted surface and ground water predictions. Given the increased production, and impacts will remain as assessed however will now happen earlier. However given the high degree of angst and the impact on downstream water users should the predictions be incorrect, the impact is given the highest risk rating.

10. SOCIAL IMPACT MANAGEMENT

A Social Impact Management Plan for Airly Mine must address the ongoing concerns raised by the community, in particular ground and surface water impact. This is of particular importance because of the range of concerns raised by the community (particularly those described as the downstream community of Glen Davis and Glen Alice). Ongoing dialogue and consultation must focus on the downstream community regardless of the likelihood of impact. As agreed at the Airly CCC on 15 October 2019, the following will be implemented.

1. The additional groundwater monitoring be undertaken as soon as practical and in accordance with the sampling method described in the ZOIC report.
2. To achieve effective consultation and engagement with the downstream community it is proposed that at least one CCC meeting be held each year in Glen Alice thus facilitating greater participation by residents. This meeting is to focus on the Airly Mine Annual Review in order to outline the mine's performance against consent criteria.
3. Airly CCC are to be notified of all monitoring results, including the additional ground water monitoring, when available so the community have an opportunity to review and discuss at subsequent CCC meetings.
4. An annual summary report of mine performance is to be provided in the form of a newsletter and distributed to residents living in the Capertee, Glen Davis and Glen Alice (and surrounds) communities.
5. The importation of water from Charbon Colliery is to form part of the Airly and Charbon / Inglenook CCC report and include volume imported against the permissible maximum amount of up to 170 ML/year.

11. SUMMARY AND CONCLUSIONS

Airly Modification 3 primarily proposes elements to increase coal production by the use of a second set of panel and pillar equipment to reduce production downtime and increase the number of day's coal extraction will occur. Because of the limited scope of this modification the impacts already assessed remain largely unchanged from the approved Project and the mine will continue to operate within existing approved limits.

However despite the limited impact, Airly Modification 3 has resulted in a high degree of angst across the community, evident from the consultation process and feedback from the community. The level of angst relating to surface and groundwater indicate that a social license has not been achieved with some sections of the community, in particular the described downstream community who rely on the regional aquifer as their water source. With this in mind, additional engagement with the community on all areas of the mines performance and in particular ground and surface water impacts has been proposed and agreed to. The inclusion of additional groundwater monitoring will provide an additional monitoring regime that may act as a safeguard for far field effects of the mine.

Additional staffing allows for flexibility to increase its staff establishment should the need arise but does not necessarily reflect the actual number of people employed at any one time. It is expected that the future staffing profile remain as it has historically and draw people from the Lithgow and

Mid Western LGAs and on that basis there are no additional demands on existing services and facilities. The mine will continue to make a positive economic and social contribution to the community via employee spending and participation in social and cultural activities within the community, which Airly mine personnel actively support and participate in.

The limited scope of Airly Modification 3 does not pose any far field effects that require acquisition or negotiated agreements with private landholders. There are no restrictions to Mt Airly and no impact to the Mugii Murum-ban state conservation area or the items of cultural heritage within the SCA. In summary the limited scope of Airly Modification 3 results in:

- no requirement to purchase property as a means of managing impact on social amenity;
- no impact on surrounding land use or viability of agricultural production;
- no significant change to the economic profile of the community except for the potential for incidental economic benefit via localised spending;
- no change to the social fabric of the area; and
- no change to how residents or visitors utilise the area.

12. References

Aigis Group 2018: Socioeconomic Profile of Airly Mine Operations. December 2018

Aigis Group 2019: Airly Mine Extension Project Modification 3 Economic Assessment. October 2019

Barnson 2019: Rail Impact Assessment – Airly Mine Extension Project. September 2019

Department of Planning and Environment 2015: Preliminary Environmental Assessment. August 2015: pp18 - 20

GHD 2019: Centennial Airly Pty Ltd, Airly Mine Mod 3 Groundwater Impact Assessment. October 2019

GHD 2019: Centennial Airly Pty Ltd, Airly Mine Modification 3 Site Water and Salt Balance Assessment. October 2019

GHD 2019: Airly Mine Extension Project - Modification 3 Baseflow impact assessment - Genowlan and Gap Creek. October 2019

James Marshall & Co, (2014) Airly Mine Extension Social Impact Assessment

Lithgow City Council/i.d. community 2019. Economic Profile website

< https://economy.id.com.au/lithgow >

Lithgow City Council Land Use Strategy 2010 – 2030 (adopted 31 October 2010)

< http://archive.lithgow.nsw.gov.au/lus/Land//Strategy >

Mid-Western Regional Council/REMPLAN 2019. Economic Profile website

< https://www.economyprofile.com.au/midwestern/trends/unemployment >

Mid-Western Regional Council: Community Plan Towards 2030.

SLR Consulting 2019. Air Quality Impact Assessment and Greenhouse Gas Assessment. August 2019

SLR Consulting 2019b. Noise Impact Assessment. October 2019

ZOIC Environmental 2019: External Review of Proposed Monitoring of Selected Landholder Wells, Airly Mine. September 2019

13. Appendices

13.1 Authors Declaration

Submission of Social Impact Assessment

Prepared under Section 4.55(1A) of the *NSW Environmental Planning and Assessment Act 1979*

Social Impact Assessment prepared by:

Name:	James Marshall
Position:	Group Manager Stakeholder Engagement
Qualifications:	BA (Sociology)
	Adv. DIP (Business Administration)
Company:	Centennial Coal Company Limited
Address:	Level 18, 1 Market Street, Sydney, NSW, 2000

Development Application:

Proponent Name:	Centennial Mandalong Pty Limited
Proponent Address:	Level 18, 1 Market Street, Sydney NSW, 2000
Development Description:	Airly Mine Modification 3

Declaration:

I hereby certify that I have prepared the contents of this document and to the best of my knowledge:

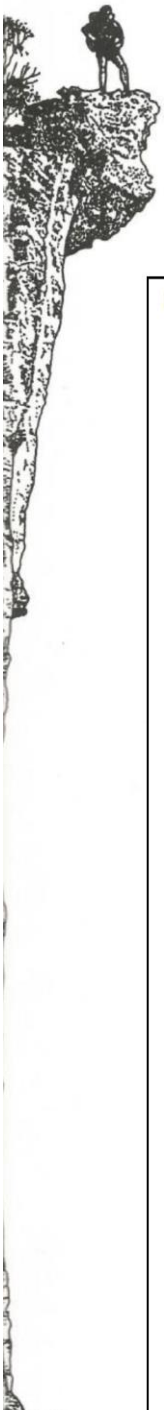
- It contains all available information that is relevant to the environmental assessment of the proposed development to which the document relates; and
- It is true in all material particulars and does not, by its presentation or omission of information, materially mislead.

Name: James Marshall (Centennial Coal Company Limited)

Signature: JMarshall

Date: 19 October 2019

13.2 The Colo Committee Response

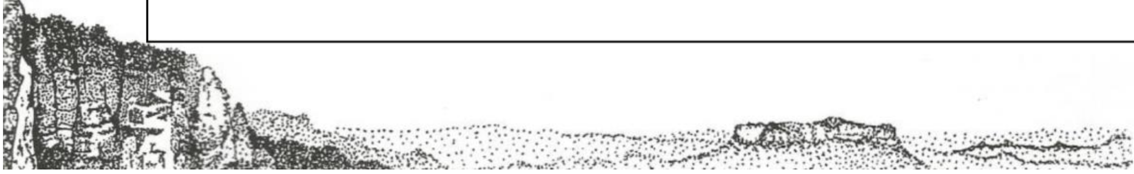


The Colo Committee

Chairperson: Rodney Falconer; **Hon. Secretary:** Dr Haydn Washington
C/O 2515 Nullo Mountain Road, Nullo Mountain, NSW, 2849;
Email: haydnwashington@bigpond.com

Re Community Consultative Committee Jan 17th, I would note the following:

- Through the Colo Committee I have been promoting the protection of what is now Mugii Murum-ban SCA **since 1980**, and originally raised the idea of a SCA with Centennial Coal, which at that time was supported by the company.
- The Colo Committee lobbied for and then attended the 1994 Airly Commission of Inquiry in Lithgow, making major submissions.
- Colo and Colong had a dialogue with Centennial Coal, where they committed to ***mining only have the coal*** on the mesas to protect its unique environment. We praised them at that time for such a commitment.
- The price of coal then dropped and Centennial's foreign owners required that **two thirds of coal be extracted** (so the verbal assurance given to environment groups was 'just words').
- Since then I have attended at least two PACs re Airly, especially arguing for greater protection of Genowlan Point and its critically endangered *Pultenaea sp. Genowlan Pt* and its endangered ecological community (heathland). **The vast majority of community groups making submissions to the PACs argued for greater protection of the biodiversity and geodiversity of these mesas.**
- However, **both PACs ignored such scientifically-based concern**, hence it is clear now that both Centennial and the NSW government and its Department of Planning are **neither interested in effective community dialogue nor in protection of the State's unique natural heritage**.
- The current proposal is for an increase from 1.8 mtpa to 3 mtpa, **almost doubling the amount of coal being mined**. This is ill advised from a climate change consideration, especially given that current rapid climate change is predicted to hit Australia harder than other areas: https://www.theguardian.com/environment/2015/jan/26/climate-change-will-hit-australia-harder-than-rest-of-world-study-shows .
- Rather than **submit a new EIS - as the government should have mandated**, this is seeking to be done by 'sleight of hand' through modifying permission, and **the CCC is being asked to rubber stamp this**. This virtual doubling of coal is **almost certain to lead to cutting corners in terms of environmental protection**, leading to greater than predicted subsidence and cliff falls. Indeed it may lead to the collapse of the unique Genowlan Point and its biodiversity and geodiversity.



- For the record, **the Colo Committee and the Colong Foundation for Wilderness *oppose* the upgrade to 3 million tonnes a year,** both on climate change grounds and on environmental protection grounds for an area that the Greater Blue Mountains World Heritage Advisory Committee argues should be added to the World Heritage Area because of its unique biodiversity and geodiversity. I personally strongly oppose such an upgrade being done behind the scenes.
- However, neither Centennial, nor the NSW government, seem to be ***listening to majority community*** opinion. Accordingly the 'Community Consultative Committee' has failed, as I do not believe anybody is listening.

Accordingly, given my pressing writing commitments I will not be attending on Jan 17th. Please pass this letter on to the Department of Planning.

Yours Faithfully,

Haydn Washington

Dr Haydn Washington
Environmental Scientist
Hon. Sec. Colo Committee

13.3 Email Received 18 January 2018 (Capertee Valley Resident)

Firstly thank you for allowing us to attend the CCC meeting as a visitor today 17th January 2018 held at Airly Mine.

The information presented clearly indicate that 2017 Airly Mine only produce approximately ½ of its current 1.8Mt PA approved output, this questions why are you requesting expansion to 3.0Mt PA?

We have grave concerns and therefor formally object to the expansion of Centennial Coal Airly Mine.

The 2017 results presented clearly indicated that with its reduced production level the following occurred:

1. *Toxic waste escaped from its retention dam due to a single storm rain/hail event of 24mm in November 2017. (There needs to be ZERO toxic waste discharged into the Valley creeks and river systems).*

2. *Due to the current drought condition with rain falls of less than 500mm per Year and reduced production it would appear the current mine practices and infrastructure are not able to prevent waste escapes.*

   With the proposed mine expansion how would you plan to ensure zero toxic waste escape into the Valley creeks and river systems when your own records indicate that in 1950 rain fall for that year was 1500mm, that flood event decimated the shale oil refinery at Glenn Davis 7th February 1950 .

3. *Centennial Coal Airly Mine already has approval to install and operate a "Coal Washery" currently not implemented by the low production and coal quality, this approval was based on 1.8Mt production limits.*

   For the expanded production to 3.0Mt PA output the provision of a Coal Washery needs to be totally removed from the current approved expansion option and definitely remove explicitly in any future capacity expansion approval process. The basis of our objections are: The limited water available required to run this Washery also the very high level of solid and liquid waste generated by it.

4. *The Capertee valley is totally reliant on Rain and Ground water for its survival, the ailing Glenn Davis water pipe line only supplies a very small number of property owners and cannot and will not be expanded*

   Using very large amounts of ground water for washing coal in an existing or expanded mining operation is absolute insanity as you cannot eat coal, the limited amount of water in the valley is needed for food production and human survival of those who have chosen the valley as a home.

   We look forward to the next phases of this project.

13.4 Email Received 19 January 2018 (Capertee Valley Resident)

David King
Airly Technical Services Manager
PO Box 201
Wallerawang NSW 2845
david.king@centennialcoal.com.au

RE: Airly Mine (SSD5581) Modification Community Feedback to assist Dept. of Planning to consider Application to Secretary's Environmental Assessment Requirements (SEARS)

I note that in ML 1331 it is reported full compliance within noise and dust limits. Subsidence within 29 mm compliance and actually 10mm and zero impacts on biodiversity and heritage matters. I'd like to know how the zero impacts on biodiversity and heritage matters are recorded and ascertained.
Modification requests:

1. Increase production from 1.8Mt to 3.0Mt per annum. This increase will lead to a four year reduction in mine life. Currently 0.852Mt mined per annum.

2. Increase in employees from 155 to 200

3. Increase in trains daily from 2 to 3. Currently averaging less than one train/day

- What impact will this have on residents, landowners, farms and commercial operations along the rail line on increased trains from 1 per day to 3 per day?
- Are train wagons covered to minimise dust pollution? It would seem at minimum cost that covering the wagons would decrease noise and dust pollution.
- It is noted that currently the average # of trains/day is less than 1/day with modification sought to increase this to 3/day. The reason given for this low number of trains was difficulty getting adequate trains required. How is this going to be changed? I think an increase in the size of stockpile will follow the increase in production, especially if the current problem in unavailability/unreliability of trains continues.

Centennial Coal has said there will be no change to Stockpile or reject emplacement area size (REA). How is this possible if there is an increase from 0.852Mt per annum to 3.0Mt? There must be an equivalent increase in REA size, because there will be an increase in total reject amount.

How can noise and dust generation not increase if production and output go from 0.852Mt pa to 3.0Mt pa? Noise abatement and dust suppression and monitoring must be increased and improved.
An ongoing problem as I see it is the lack of dust monitors down in the Capertee Valley. Given that the prevailing winds in the valley are NW to westerlies most of the year, any dust event is going to impact the valley which is situated to the East and South East of Airly Mine. Any dust entering the

valley will fall to the valley floor spreading north and south and into the river system which flows into Putty River then the Hawkesbury/Nepean River system and on into the Sydney river basin.

I'd like to raise the issue of #1 importance to the residents and landowners in the Capertee Valley; it is the possible loss of water, both in quantity and /or quality. There is currently no flow in the Capertee River, even after rain events. This outcome is one impact feared and predicted by the local population if Mt Airly sunk the deep bores and conducted underground mining. We need Centennial Coal Airly Mine to make public the results of water monitoring they have been required to carry out in their conditions of approval. The public needs to see the readings from Centennial Coal's boreholes and those of surrounding properties, especially the readings of quality and quantity of water from Coco Creek, Gap Creek, Airly Creek, Crown Creek and the Capertee River in the Capertee Valley.

I would like to draw your attention to the surface water management rain event at LDP3. With a downfall of just 24.6mm the system in place to prevent readings over those allowed occurred, as reported. This is an alarm warning. If it can happened that we have an overflow and discharge at such a low rainfall it alarms me that there is not levees, containment walls or a further system of dams further down the flowline. This needs to be addressed as a priority.

Thank you for the opportunity to respond to this modification application.

13.5 Airly Community Consultative Committee Minutes

Airly CCC Minutes Extraordinary Meeting: 15 January 2019

http://data.centennialcoal.com.au/domino/centennialcoal/cc205.nsf/File.xsp?documentId=5A8721FDD8596591CA2583CC00017DBA

Airly CCC Minutes: 23 October 2018 (Water Info Session)

http://data.centennialcoal.com.au/domino/centennialcoal/cc205.nsf/File.xsp?documentId=A13F16E2884DA9FDCA2583680021CCE4

Airly CCC Minutes: 24 July 2018

http://data.centennialcoal.com.au/domino/centennialcoal/cc205.nsf/File.xsp?documentId=6B7F0DC00B365D00CA2582E8000F9474

Airly CCC Minutes: 17 January 2018

http://data.centennialcoal.com.au/domino/centennialcoal/cc205.nsf/File.xsp?documentId=8F712A61FE12F0BBCA258278000BA241

13.6 ZOIC Report (19 September 2019)

ZOIC Environmental Pty Ltd
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19 September 2019

Sam Price
Environment and Community Coordinator Airly Mine
Centennial Airly Pty Limited
Glen Davis Road
Capertee NSW 2846

Via email: sam.price@centennialcoal.com.au
cc: rickandalex@skymesh.com.au

Dear Sam,

Re: External Review of Proposed Monitoring of Selected Landholder Wells, Airly Mine

1 Introduction

Zoic Environmental Pty Ltd (Zoic) is pleased to provide Centennial Airly Pty Limited (Airly) with this letter report to provide an external review of a proposed groundwater monitoring program for community wells located adjacent to Airly Mine north east of Capertee NSW.

Centennial Coal is in the process of expanding their production and as part of the process, to allay community concerns, have agreed to undertake some ground water monitoring on private wells, downstream of their operations, which Zoic understand Centennial Coal have agreed to do using GHD as their consultants. The proposed work is outside of regulatory requirements and additional to the required monitoring network which has been developed to ensure groundwater impacts are maintained within the limits as set out within the third party reviewed groundwater model which indicates no impact to groundwater in Devonian aged rocks that are hydraulically disconnected from the coal seams that Airly mine.

Airly have also indicated they will cover the cost for a second opinion from a separate Hydrogeologist on the proposed monitoring program and results. Zoic provided a proposal on 10 May 2019 which was approved by Airly on 24 July 2019.

The proposed work was to involve an initial review of the proposed program including any information provided by GHD outlining their justification for well selection (including why wells were disregarded). In addition:

- GHD will provide details of the proposed sampling methodology taking onto account well and pump configuration (this includes the proposed water level monitoring)
- It is assumed that a contingency plan is proposed for expanding the proposed sampling, this would include increased sampling or expanding the network.

- Have preferential pathways been identified in the numerical model for the mine or worse case migration rate?

Subsequent discussions with Sam Price of Airly has indicated that Zoic will limit the scope to provide feedback on recommended locations and discussion on the proposed water level and water quality sampling proposed for input into the submission for the mine expansion. Further discussions around interpretation and contingency plans will be raised during the annual review of collated data.

2 Scope of Work

Zoic's scope of work has involved review of the available information and submission of this short letter report outlining comments/suggestions for consideration. This included:

- Comments around the selection process for the proposed monitoring network.
- Sampling methodology for the water level monitoring and discussion of justification for water level monitoring.
- Analytical suite- define the full suite of analytes including field parameters.
- Sampling methodology- likely to be bailer or similar.

3 Discussion and Recommendations

It is understood that Nioka well has historically been sampled on a quarterly basis and GHD have indicated that quarterly sampling of the additional landholder wells would coincide with this schedule. Zoic consider this arrangement to be suitable for the proposed programme.

3.1 Proposed Sampling Locations

Attached are selected sheets from a presentation to the community in January 2019 one of which defines the geological and hydrogeological conceptual site model as a cross section. This indicates that the mine is located in strata geologically younger (Illawarra Coal Measures) than the surrounding area where the proposed landholder well monitoring is to occur (Lower Devonian aged rocks) with the Shoalhaven Group present between the two units. Therefore direct dewatering of the surrounding area comprised of Devonian aged rocks is not considered likely to occur with any impact to the groundwater in the Devonian aged rocks likely to be related to structural discontinuities (faulting) through the Shoalhaven Group potentially allowing poorer quality water to migrate into the Devonian aged rocks. Mining through faults to date has not observed any increase in groundwater inflows as noted in the attachments.

A map outlining the licensed wells that GHD have noted are potentially available for the monitoring programme based upon undefined works is attached from the January 2019 presentation. Review of these locations indicates that the following three creeks drain the Approved Development Consent Area and have potentially accessible licensed monitoring wells along their alignments:

- Genowlan Creek;
- Emu swamp Creek; and
- Dog Trap Creek.

Based upon this review it is considered that monitoring be broken into the three creeks above with:

- The currently monitored well Nioka capturing monitoring within Dog Trap Creek.

- GW800787 is the first recommendation for monitoring Genowlan Creek as it is the most upgradient well. GW027536 or GW112527 are considered viable alternatives.
- GW072237 is the first recommendation for monitoring within Emu Swamp Creek with GW102743 a less viable alternative. If these wells are not viable then other adjacent drainage lines might be also be considered (GW021670 or GW102755).

Final selection of wells would also be dependent upon current well condition, accessibility into the well for equipment for the required monitoring, or an operational pump that has an outlet suitable for water quality sampling

3.2 Sampling Method - Water Levels

Zoic consider that water level monitoring of the private abstraction bores with the intent of trying to gauge impacts from Airly is difficult and likely to be fruitless. Abstraction from the bore itself will impact local groundwater levels, local recharge from adjacent creeks and rainfall will have far larger impacts upon water levels such that any potential impacts would be indistinguishable. This, coupled with the existing monitoring network in place around Airly and the noted geological barrier to groundwater flow into Devonian aged rocks (Shoalhaven Group) indicates that any impact to groundwater levels would be picked up long before reaching outside of the mining lease and likely be of such a small magnitude to not be measurable.

Where water level monitoring may occur, GHD have indicated that pressure transducers will be utilised for continuous water level monitoring, it is recommended that these be set for six hourly readings for direct comparison with the existing monitoring network hydrographs, be barometrically compensated and calibrated to quarterly manual dip levels and depict local rainfall for interpretation purposes.

All monitoring locations should be surveyed to ensure comparability against the overall monitoring network.

3.3 Sampling Method – Laboratory Analysis

No discussion has been provided by GHD for the proposed sampling methodology. If the well is operational, the pump may be run for a sufficient time to ensure representative samples are collected. Otherwise other methods such as bailers or hydrasleeves can be considered where access allows. The use of hydrasleeves is recommended for sampling as they provide effective, quick, discrete sampling without the requirement for purging that bailers or other methods require. Hydrasleeves can also be reinstalled following each monitoring round in preparation for the next monitoring round. Where insufficient water is present for hydrasleeves, bailers would be required.

3.4 Proposed Analytical Suite

GHD have indicated to the community that quarterly sampling and submission of samples for laboratory analysis would be undertaken. The proposed analytical suite included pH, Electrical Conductivity (EC), major ions and dissolved metals. Zoic recommend the following suite:

- Dissolved heavy metals (Al, As, Ba, Cd, Cr, Cu, Pb, Mn, Ni, Zn, Bo, Fe), NOTE: These require field filtering and preservation).
- Major cations and anions (Alkalinity, Ca, Mg, Na, K, SO4, Cl, Br).
- pH and EC.

- Fluoride.

Nutrients (nitrogen and phosphorous species) are not considered necessary as surrounding landuses would confound interpretation and likely be significant contributors to regional nutrient loads in groundwater.

4 Limitations

This report has been prepared for use by the Client who commissioned the works in accordance with the project brief only, and has been based in part on information obtained from the Client and other parties. The findings of this report are based on the scope of work outlined in Section 2. The report has been prepared specifically for the Client for the purposes of the commission, and use by any nominated third party in the agreement between Zoic and the Client. No warranties, express or implied, are offered to any third parties and no liability will be accepted for use or interpretation of this report by any third party (other than where specifically nominated in an agreement with the Client).

This report relates to only this project and all results, conclusions and recommendations made should be reviewed by a competent person with experience in environmental investigations, before being used for any other purpose. This report should not be reproduced without prior approval by the Client, or amended in any way without prior approval by Zoic.

Subject to the scope of work, Zoic's assessment was limited strictly to identifying typical environmental conditions associated with the subject property area and does not include evaluation of any other issues.

Changes to the subsurface conditions may occur subsequent to the investigations described herein, through natural processes or through the intentional or accidental addition of contaminants. The conclusions and recommendations reached in this report are based on the information obtained at the time of the investigation.

This report does not comment on any regulatory obligations based on the findings. This report relates only to the objectives stated and does not relate to any other work conducted for the Client.

The absence of any identified hazardous or toxic materials on the site should not be interpreted as a guarantee that such materials do not exist on the site.

All conclusions regarding the site are the professional opinions of the Zoic personnel involved with the project, subject to the qualifications made above. While normal assessments of data reliability have been made, Zoic assumes no responsibility or liability for errors in any data obtained from regulatory agencies, statements from sources outside of Zoic, or developments resulting from situations outside the scope of this project.

Zoic is not engaged in environmental assessment and reporting for the purpose of advertising sales promoting, or endorsement of any client interests, including raising investment capital, recommending investment decisions, or other publicity purposes. The Client acknowledges that this report is for its exclusive use.

5 Closure

Should you have any queries or wish to discuss any points, please do not hesitate to contact the undersigned.

Yours sincerely,

Joshua Lloyd
Senior Hydrogeologist
Zoic Environmental Pty Ltd

Attachments: Attachment A – GHD PowerPoint Presentation

APPENDIX – N

BDAR Waiver Request Table 1

Table 1: Effect on biodiversity values from Airly Mine SSD 5581 Modification 3

Biodiversity values	Meaning	Relevant or NA* (✓or NA)	Modification interaction with biodiversity values
Vegetation integrity	Degree to which the composition, structure and function of vegetation at a particular site and the surrounding landscape has been altered from a near natural state	NA	The proposed modification does not seek new infrastructure installation and hence no land disturbance and no vegetation clearing would be required. The Project as modified will use existing infrastructure within the disturbance footprint that was approved in the Airly Mine Extension Project (AMEP) EIS and the original development consent DA 162/91. The impacts of the Project on the vegetation integrity and biodiversity value of the area were assessed in the AMEP EIS. The proposed modification will neither increase nor reduce these assessed potential impacts.
Vegetation abundance	Occurrence and abundance of vegetation at a particular site	NA	The proposed modification does not seek new infrastructure installation and hence no land disturbance and no vegetation clearing would be required. The Project as modified will use existing infrastructure that was approved in the AMEP EIS. The AMEP EIS shows the mapped vegetation communities. The impacts of the Project on the vegetation abundance of the area were assessed in the EIS. The proposed modification will neither increase nor reduce these assessed potential impacts.
Habitat suitability	Degree to which the habitat needs of threatened species are present at a particular site	NA	Given no vegetation clearing or land disturbance is required for the proposed modification, there will be no impacts on the existing habitats of threatened species. The AMEP EIS showed the locations of the threatened flora species and the locations of the identified fauna species and discusses the site's habitat suitability for the threatened species. The site's operations are mainly concentrated at the already established pit top, which has disturbed areas (void of any vegetation) and remnant vegetation or communities. The proposed modification will not result in a loss of habitat for threatened species or habitat connectivity of remnant vegetation or communities.
Threatened species abundance	Occurrence and abundance of threatened species or threatened ecological communities, or their habitat, at a particular site	NA	The AMEP EIS showed the locations of the threatened flora species and the locations of the identified fauna species and discusses the abundance of the threatened species and habitat availability for these species. The impact of the Project on threatened species was assessed in the AMEP EIS. The site's operations are mainly concentrated at the already established pit top, which has disturbed areas (void of any vegetation) and remnant vegetation or communities. Given that no vegetation clearing and no land disturbance is required for the proposed modification, there will be no increase or reduction of impacts on threatened species or threatened ecological community abundance.

Biodiversity values	Meaning	Relevant or NA* (✓or NA)	Modification interaction with biodiversity values
Habitat connectivity	Degree to which a particular site connects different areas of habitat of threatened species to facilitate the movement of those species across their range	NA	The proposed modification will utilise existing infrastructure and new infrastructure will not be required. The site's operations are mainly concentrated at the already established pit top, which has disturbed areas (void of any vegetation) and remnant vegetation or communities. Given that no vegetation clearing or land disturbance are proposed, the modification will not increase or reduce impacts on the existing habitat connectivity for threatened species or connectivity between remnant vegetation and communities. Movement of threatened species within the pit top will not be impacted by the proposed modification.
Threatened species movement	Degree to which a particular site contributes to the movement of threatened species to maintain their lifecycle	NA	The modification will not alter the existing vegetation or communities at the pit top where the Airly Mine's operations are mainly undertaken. The modification will impact on the habitat connectivity (already discussed above) and thus will not impact on the movement of threatened species to maintain their lifecycle. In this regard, the modification will neither increase nor reduce impacts on threatened species movement that maintains the species' lifecycle compared to the approved impacts.
Flight path integrity	Degree to which the flight paths of protected animals over a particular site are free from interference	NA	The Project as modified will continue to use the existing infrastructure. Therefore, the modification will neither increase nor reduce the existing impacts on the flight path integrity.
Water sustainability	Degree to which water quality, water bodies and hydrological processes sustain threatened species and threatened ecological communities at a particular site	NA	There is no proposal to alter the existing water management or the hydrological characteristics of the Airly Mine pit top in the proposed modification. Given that there will be no alteration of the natural or man-made water bodies or hydrological processes, there will be no impacts on threatened ecological communities that are sustained by these water bodies. The mine design philosophy at Airly Mine is not proposed to be changed from the conservative and low subsidence impact approach that was assessed and approved in SSD 5581. Therefore, the geodiversity, watercourses and threatened species and endangered ecological communities will continue to be protected. The groundwater and surface water impacts assessed in the Modification Report are lesser or equal to approved impacts on water quality and flows in watercourses. Given the above, the proposed modification will neither increase nor reduce impacts on water sustainability for threatened species or threatened ecological communities.

**Provide reasoning against any NA recorded against any values where it is not relevant (e.g. if the site does not support any natural vegetation or habitat; Site is in a highly urbanized or industrial setting).*