BARRICK

COWAL

APPENDIX E
NOISE AND BLASTING IMPACT ASSESSMENT

COWAL GOLD MINE EXTENSION MODIFICATION

Resource Strategies

global environmental solutions

Cowal Gold Mine Extension Modification

Noise and Blasting Impact Assessment

Report Number 610.10052-R1

9 September 2013

Barrick (Cowal) Limited
PO Box 210
WEST WYALONG NSW 2671

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Cowal Gold Mine Extension Modification

Noise and Blasting Impact Assessment

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1 INTRODUCTION

1.1 Background

The Cowal Gold Mine (CGM) is located approximately 38 kilometres (km) north-east of West Wyalong in New South Wales (NSW) as shown on the Regional Location Plan (**Appendix A1**). Barrick (Cowal) Limited (Barrick) is the owner and operator of the CGM. Gold production commenced in 2005 and the extent of the existing/approved surface development is shown on the CGM Location Plan (**Appendix A2**) together with the proposed extension areas.

The mining method used at the CGM is typical of open pit mining operations. Waste rock (ie rock containing no commercial gold) and ore is broken through a routine sequence of in-pit drilling and blasting. Broken rock is loaded into large rear dump trucks using hydraulic excavators and is then hauled from the pit to be placed within the dedicated waste emplacements or, in the case of ore, direct to the primary crusher or run-of-mine (ROM) ore stockpile. Gold is extracted from the ore on-site using a conventional carbon-in-leach cyanide leaching circuit.

The Development Consent (DA 14/98) for the CGM has been modified on several occasions, the most recent being the April 2011 Modification (MOD 10).

Barrick is seeking approval under Section 75W of the NSW *Environmental Planning and Assessment Act, 1979* for the proposed Cowal Gold Mine Extension Modification (the Modification). The Modification would provide for the continuation and extension of operations at the existing CGM.

SLR Consulting Australia Pty Ltd has been engaged by Barrick to evaluate and assess the potential noise and blasting impacts associated with the Modification.

1.2 Assessment Requirements

This assessment has been guided by the relevant NSW guidelines and policies relating to potential noise and blasting impacts, as described below. This assessment has also considered the assessment requirements of the NSW Environment Protection Authority (EPA) for the Modification regarding noise and blasting impacts, as outlined in the EPA's letter dated 28 June 2013.

On-site Intrusive Construction Noise:

In accordance with the NSW Department of Environment, Climate Change and Water's (DECCW) interim policy "*Interim Construction Noise Guideline"* (ICNG) (DECCW, 2009) mine construction activities are generally considered to be integral to mining operations. Where relevant, construction works (eg southern and northern tailings storage facilities embankment lifts) have been modelled as a component of Modification daytime operational activities.

On-site Intrusive Noise Assessment:

Two modification operational scenarios were selected for modelling of potential noise emissions, namely Year 11 (2015) and Year 13 (2017).

An assessment of (construction and) mine operating noise impacts has been undertaken in accordance the "*NSW Industrial Noise Policy"* (INP) (Environment Protection Authority [EPA], 2000) and the associated INP Application Notes (EPA, 2013) which provides non-mandatory procedures for setting acceptable $L_{Aeq(15minute)}$ intrusive and $L_{Aeq(period)}$ amenity noise levels for various receiver areas and guidelines for assessing noise impacts from on-site (stationary) noise sources.

On-site Open Pit Blasting:

The method of ore and waste rock removal at the CGM is by drill and blasting techniques. The typical blast design details and the average blasting frequency (ie generally limited to one blast per day) for the Modification would remain unchanged.

The assessment of potential blasting impacts has been undertaken in accordance with the Australian and New Zealand Environment Council Committee's (ANZECC) "Technical Basis for Guidelines to Minimise Annoyance due to Blasting Overpressure and Ground Vibration" (ANZECC, 1990) for assessing potential annoyance from blast emissions during daytime hours, which is adopted by the EPA.

The assessment has also been guided by Australian Standard (AS) 2187.2-2006 "Explosive - Storage and use Part 2: Use of Explosives - Appendix J", which provides guidance on relevant procedures for assessing the blast-induced noise and vibration effects on buildings and their occupants. The EPA's "Assessing Vibration: A Technical Guideline" (Department of Environment and Conservation, 2006) does not address blast-induced effects.

Off-site Road Traffic Noise:

There would be no change to peak employment at the CGM for the Modification and no increase in deliverables or consumables to the CGM. As such, existing vehicle movements along the mine access routes to the site (for employees, major deliveries and heavy vehicles) including the primary mine access road from West Wyalong, as well as road traffic along mine access roads from Forbes and Condobolin are expected to remain unaltered by the Modification.

The assessment of potential off-site road traffic noise impacts has been previously undertaken (ie MOD 10) in accordance with the "NSW Environmental Criteria for Road Traffic Noise" (ECRTN) (EPA, 1999). However, this guideline has been recently superseded by the requirements the NSW Road Noise Policy [(RNP, DECCW 2011) and RNP Application Notes (EPA, 2013) which provides non mandatory procedures for setting acceptable L_{Aeq} noise levels on arterial, collector and local roads and guidelines for assessing noise impacts from off-site road traffic.

While the Modification would not result in any increase in annual traffic movements a road traffic noise assessment has been conducted for this assessment in accordance with the RNP.

2 EXISTING COWAL GOLD MINE

2.1 CGM Approvals

With respect to noise and blasting emissions, Barrick has approval to operate in accordance with the following consent and licence conditions:

- NSW Department of Planning and Infrastructure (DP&I) Development Consent (DA 14/98) (as modified) with the relevant sections shown as **Appendix B1**.
- NSW Environment Protection Authority (EPA) Environment Protection Licence (EPL) No 11912 anniversary date 23 December with the relevant sections shown as **Appendix B2**.

2.2 CGM Operating Noise Monitoring Summary

2.2.1 Noise Management Plan

Barrick implements a program of environmental noise monitoring and reporting in accordance with the "*Cowal Gold Mine Noise Management Plan*" (NMP) (Barrick, 2010) with the results presented in the CGM Annual Environmental Management Reports (AEMRs). The approved NMP describes the current mine operating noise management regime for the CGM, which includes off-site operator-attended monitoring and unattended noise logging (including digital audio sample recordings) together with an on-site Automatic Weather Station (AWS) and sample temperature gradient measurements coinciding with winter season noise surveys. In accordance with NMP Section 6.2, Barrick monitors noise emissions at the nearest residential receivers and bird breeding areas as presented in **Table 1** and shown on the Noise and Blast Monitoring Locations Plan (**Appendix C1**)**.**

Table 1 CGM Operating Noise Monitoring Summary

ID	Location	Receiver Type	Parameter	Frequency
NO2	Coniston	Privately owned Dwelling	Operator-attended monitoring and unattended noise logging including digital audio sample recordings	Every 6 months
NO5	Gumbelah			
NO7	Westlea			
NO8	McLintock			
NO3	Bird Breeding Area (South)	Wildlife area	Operator-attended monitoring and unattended noise logging	
NO4	Bird Breeding Area (North)	Wildlife area		
NO9	Boongarry	Privately owned Dwelling	Operator-attended monitoring	Supplementary as required
NO10	Cowal North			

Source: Barrick NMP

2.2.2 Operating Noise Monitoring Results 2010 to 2013

The daytime, evening and night-time $L_{Aeq(15minute)}$ intrusive mine noise levels at the measurement locations presented in **Table 1** between July 2010 and February 2013 are presented in **Table 2**, **Table 3**, and **Table 4**, respectively.

Measured daytime, evening and night-time intrusive noise levels were below the relevant residential receiver noise limits (refer **Appendix B1**) at all measurement locations except at NO7 Westlea where the measured daytime (morning) intrusive mine levels were above the noise limit of 41 dBA by up to 2 dBA on two occasions and 1 dBA on two occasions. According to Section 11.1.3 of the INP, monitored noise levels within 2 dBA of the statutory noise limit would not generally be considered a non-compliance. Furthermore, on both occasions the measured intrusive mine level of 43 dBA coincided with a wind speed of 4 m/s and therefore (technically) outside the assessable weather conditions for the CGM. As such, the monitored noise levels at NO7 Westlea above the noise limit of 41 dBA are not considered to represent non-compliances.

Table 2 Daytime Measured $L_{Aeq(15minute)}$ Intrusive Mine Level (dBA re 20 µPa)

ID	Location	Jul 10	Jan 11	Jul 11	Jan 12	May 12	July 12	Oct 12	Feb 13
NO2	Coniston	<30, <30	<30, n/a	<30, <30	<30, <30	-	<30, <30	-	<30, <30
NO5	Gumbelah	<30, n/a, <30	n/a, n/a	n/a, n/a	n/a, n/a	32, 31, 31[2], 34[2], <30[2], 38[2], 36[2], 36[2], 30[2], <30[2], 33[2], 33[2], 31[2], 37[2], 35[2]	<30, <30	-	<30, <30
NO7	Westlea	<30, <30 n/a, n/a	n/a. <30	n/a, <30	<30, <30	-	<30, n/a[1], 43[2], 39[2], 40[2], 40[2], 38[2], 38[2], 40[2], 42[2], 42[2],37[2]	<30, <30, 43[2], 40[2], 39[2], 39[2], 36[2], 41[2], 37[4], 39[4]	<30, <30
NO8	McLintock	31, 32	<30, <30	<30, <30	<30, <30	-	<30, <30	-	<30, <30
NO9	Boongarry	-	-	-	-	n/a	n/a[1], n/a[1]	-	-
NO10	Cowal North	-	-	-	-	<30, n/a, <30[2]	<30, <30	<30, <30	<30, <30
NO3	Bird Area (S)	<30, <30	31, 30	32, 33	<30, <30	-	35, 35	-	<30, <30
NO4	Bird Area (N)	<30, n/a	<30, <30	<33, <33	n/a, n/a	-	34, 34	-	<30, <30

Note 1: n/a - mine noise not discernible.
Note 2: Digital Audio Recordings Analysis.
Note 3: N/A - Mine noise emission not discernible.
dBA = A-weighted decibel.
µPa = Micropascal.

Table 3 Evening Measured $L_{Aeq(15minute)}$ Intrusive Mine Level (dBA re 20 µPa)

ID	Location	Jul 10	Jan 11	Jul 11	Jan 12	May 12	July 12	Oct 12	Feb 13
NO2	Coniston	38, 37	n/a, n/a	<30, <30	<30, <30	-	<30, 37	-	<30, <30
NO5	Gumbelah	n/a, n/a	<30, <30	31, 31	<30, <30	31, 33, 34[2], 35[2]	n/a[1], n/a[1]	-	<30, <30
NO7	Westlea	35, 35	n/a, n/a	n/a, n/a	<30, <30	-	<30, <30	<30, <30	<30, <30
NO8	McLintock	<30, <30	n/a, <30	<30, <30	<30, <30	-	<30, <30	-	<30, <30
NO9	Boongarry	-	-	-	-	<30, <30	-	-	-
NO10	Cowal North	-	-	-	-	n/a, n/a	<30, <30	<30	<34, <33
NO3	Bird Area (S)	-	-	-	<30, <30	-	-	-	-
NO4	Bird Area (N)	30, <30	-	-	n/a, n/a	-	-	-	-

Note 1: n/a - mine noise not discernible.
Note 2: Digital Audio Recordings Analysis.
Note 3: N/A - Mine noise emission not discernible.
dBA = A-weighted decibel.
µPa = Micropascal.

Table 4 Night-time Measured $L_{Aeq(15minute)}$ Intrusive Mine Level (dBA re 20 µPa)

ID	Location	Jul 10	Jan 11	Jul 11	Jan 12	May 12	July 12	Oct 12	Feb 13
NO2	Coniston	31, 32	<30, <30	<30, <30	<30, <30	-	35, 35	-	<30, <30
NO5	Gumbelah	<30, <30	<30, <30	<30, <30	<30, 31	36, 36, 35[2], 35[2], 35[2], 35[2], 35[2],34[2]	<30, <30	-	<30, <30
NO7	Westlea	n/a, n/a	<30, <30	<30, <30	33, 31	-	36, 34, 38[2]	<30, <30,	<30, <30
NO8	McLintock	30, 30	<30, <30	<30, <30	<30, <30	-	<30, 31	-	<30, <30
NO9	Boongarry	-	-		-	<30, <30	-	-	-
NO10	Cowal North	-	-		-	<30, n/a	31, 31	<30[3], <30[3]	<30, <30
NO3	Bird Area (S)	-	-	-	-	-	-	-	-
NO4	Bird Area (N)	<30, n/a	-	-	-	-	-	-	-

Note 1: n/a - mine noise not discernible.
Note 2: Digital Audio Recordings Analysis.
Note 3: N/A - Mine noise emission not discernible.
dBA = A-weighted decibel.
µPa = Micropascal.

2.2.3 Noise Complaints Record

A total of 24 noise-related complaints have been received during the 3 year period from April 2010 to July 2013 (ie since approval of the Modified Request [Mod 6]).

There was an increase in complaints in 2011 and 2012 in comparison to 2010, however, the majority of noise related complaints (72%) were received by one complainant. Investigations undertaken in response to each noise related complaint indicated that, for each case, the CGM was operating in accordance with the relevant noise limit.

2.3 CGM Blast Emissions Monitoring Summary

2.3.1 Blast Management Plan

Barrick implements a program of blast emissions monitoring and reporting in accordance with the "*Cowal Gold Mine Blast Management Plan*" (BMP) (Barrick, 2010) with the results presented in the CGM AEMRs. The approved BMP describes the current blast management regime for the CGM, which includes off-site ground vibration and airblast monitoring together with an on-site AWS. In accordance with BMP Section 5.1, Barrick monitors blast emissions at the nearest residential receivers and bird breeding areas as presented in **Table 5** and shown in **Appendix C1.**

Table 5 CGM Blast Monitoring Summary

ID	Location	Receiver Type	Parameter	Frequency
BM01	Gumbelah	Privately owned Dwelling	Ground vibration and airblast monitoring	Every blast
BM02	Hillgrove	Barrick owned Dwelling		
BM03	Coniston	Privately owned Dwelling		
BM04	Bird Breeding Area (North)	Wildlife area		
BM05	Bird Breeding Area (South)	Wildlife area		
BM06	Bird Breeding Area (East)	Wildlife area		

Source: Barrick BMP

2.3.2 Blast Emission Monitoring Results Year End June 2013

The measured daytime ground vibration and airblast levels at the residential receivers shown in **Table 5** for the 12 month period ending June 2013 are presented in **Table 6** for blasting between Monday to Saturday and **Table 7** for blasting on Sundays and Public Holidays. Measured daytime blast emissions were below the relevant residential receiver ground vibration and airblast limits (refer **Appendix B1**) for Monday to Saturday as well as Sundays/Public Holidays.

Table 6 Measured Daytime Blast Emissions Monday to Saturday Year end June 2013

	BM01 Gumbelah		BM02 Hillgrove[1]		BM03 Coniston	
	Vibration[2] (mm/s)	Airblast[3] (dBLpk)	Vibration[2] (mm/s)	Airblast[3] (dBLpk)	Vibration[2] (mm/s)	Airblast[3] (dBLpk)
Maximum	0.7	117	0.2	113	1.6	113
Minimum	0.1	82	0.1	88	0.1	82
50% Exceedance	0.1	92	0.1	94	0.1	92
5% Exceedance	0.1	105	0.1	108	0.1	104

Source: Barrick
Note 1: Barrick owned dwelling.
Note 2: Peak Vector Sum (PVS) Vibration Velocity (mm/s).
Note 3: dBLpk (decibels linear peak) re 20 µPa.

Table 7 Measured Daytime Blast Emission Sundays and Public Holidays Year end June 2013

	BM01 Gumbelah		BM02 Hillgrove[1]		BM03 Consiston	
	Vibration[2] (mm/s)	Airblast[3] (dBLpk)	Vibration[2] (mm/s)	Airblast[3] (dBLpk)	Vibration[2] (mm/s)	Airblast[3] (dBLpk)
Maximum	0.1	94	n/a	n/a	0.1	94
Minimum	0.1	82	n/a	n/a	0.1	82
50% Exceedance	0.1	92	n/a	n/a	0.1	88
5% Exceedance	0.1	94	n/a	n/a	0.1	94

Source: Barrick
Note 1: Barrick owned dwelling.
Note 2: Peak Vector Sum (PVS) Vibration Velocity (mm/s).
Note 3: dBLpk (decibels linear peak) re 20 µPa.

The *Cowal Gold Mine Independent Environmental Audit* (dated April 2013) summarises blast monitoring results for the period 2010 to 2013. It concluded that, based on the results of blast monitoring, blast overpressure and ground vibration levels were compliant with relevant residential receiver ground vibration and airblast limits (refer **Appendix B1**).

One blast overpressure level of 123 dBL (ie 3dBL above the 120dBL criteria) occurred on 5 July 2011 at monitoring site BM01 (located some 8.3 km from the blast). However, as a peak overpressure level of 107.5 dBL was recorded at the near field monitoring site BM05 (located some 1.1 km from the blast) it was concluded that the blast overpressure level of 123 dBL at BM01 was due to a localised anomaly associated with elevated background overpressure levels.

2.3.3 Blast Complaints Record

A total of 34 blast related complaints have been received during the 3 year period from April 2010 to July 2013 (ie since approval of the Modified Request [Mod 6]).

There was an increase in blast related complaints in 2011 and 2012 in comparison to 2010, however, the majority of blast related complaints (60%) were received by one complainant. Investigations undertaken in response to each blast related complaint indicated that, for each case, the CGM was operating in accordance with the relevant blasting limits.

2.4 CGM Traffic Noise Monitoring Summary

2.4.1 Noise Management Plan

As described above, Barrick implements a program of environmental noise monitoring and reporting in accordance with the "*Cowal Gold Mine Noise Management Plan*" (Barrick, 2010) with the results presented in the CGM AEMRs. The approved NMP describes the current mine traffic noise management regime for the CGM, which includes off-site operator-attended monitoring and unattended noise logging together with appropriate traffic counting devices coinciding with annual noise surveys.

In accordance with NMP Section 10.1, Barrick monitors mine traffic noise levels at three representative residential dwellings along the primary access route from West Wyalong to the CGM as presented in **Table 8** and shown on the Traffic Noise Monitoring Locations Plan (**Appendix C2**)**.**

Table 8 CGM Traffic Noise Monitoring Summary

ID	Location	ECRTN Road Classification	Offset Distance	Receiver Type	Parameter	Frequency
TN1	140 Ungarie Road, West Wyalong	Collector Road	30 m	Privately owned Dwelling	Operator-attended monitoring, unattended noise logging and traffic counts.	Annually
TN2	"Clairview" Residence, 56 – 86 Wamboyne Road	Local Road	45 m			
TN3	"Windstone" Residence, 648 Wamboyne Road	Local Road	150 m			

Source: Barrick NMP

2.4.2 Traffic Noise Monitoring Results 2011, 2012 and 2013

The measured daytime/evening and night-time peak hour traffic noise levels during monitoring conducted in 2011, 2012 and 2013 are presented in **Table 9**, **Table 10** and **Table 11**, respectively, for total traffic, non-mine traffic and mine generated traffic. The consented traffic noise limits (**Appendix B1**) are applicable to the mine generated traffic only.

Table 9 Measured $L_{Aeq(1hour)}$ Traffic Noise Levels January 2011 (dBA re 20 µPa)

ID	Daytime/Evening (afternoon) Peak Hour[1]				Night-time (early morning) Peak Hour[2]			
	Total traffic	Non-CGM traffic	CGM traffic	CGM Criteria[3]	Total traffic	Non-CGM traffic	CGM traffic	CGM criteria[3]
TN1	59	57	54	60	59	56	**56**[4]	55
TN2	52	45	51	55	54	44	**54**[5]	50
TN3	49	42	48	55	49	40	48	50

Note 1: Daytime/evening average weekday (afternoon) peak hour typically 1700 hours to 1800 hours.
Note 2: Night-time average weekday (early morning) peak hour typically 0600 hours to 0700 hours.
Note 3: Table 9 of Development Consent (DA 14/98) (as modified).
Note 4: Marginal exceedance 1 dBA to 2 dBA above relevant noise limit.
Note 5: Moderate exceedance 3 dBA to 5 dBA above relevant noise limit.

Table 10 Measured $L_{Aeq(1hour)}$ Traffic Noise Levels January/February 2012 (dBA re 20 µPa)

ID	Daytime/Evening (afternoon) Peak Hour[1]				Night-time (early morning) Peak Hour[2]			
	Total traffic	Non-CGM traffic	CGM traffic	CGM Criteria[3]	Total traffic	Non-CGM traffic	CGM traffic	CGM criteria[3]
TN1	60	59	53	60	59	57	**56**[4]	55
TN2	53	50	50	55	53	48	**52**[4]	50
TN3	50	47	46	55	45	39	43	50

Note 1: Daytime/evening average weekday (afternoon) peak hour typically 1700 hours to 1800 hours.
Note 2: Night-time average weekday (early morning) peak hour typically 0600 hours to 0700 hours.
Note 3: Table 9 of Development Consent (DA 14/98) (as modified).
Note 4: Marginal exceedance 1 dBA to 2 dBA above relevant noise limit.

Table 11 Measured $L_{Aeq(1hour)}$ Traffic Noise Levels February 2013 (dBA re 20 µPa)

ID	Daytime/Evening (afternoon) Peak Hour[1]				Night-time (early morning) Peak Hour[2]			
	Total traffic	Non-CGM traffic	CGM traffic	CGM Criteria[3]	Total traffic	Non-CGM traffic	CGM traffic	CGM criteria[3]
TN1	58	55	54	60	58	55	55	55
TN2	53	52	47	50	53	40	**53**[4]	50
TN3	48	41	47	55	49	37	48	50

Note 1: Daytime/evening average weekday (afternoon) peak hour typically 1700 hours to 1800 hours.
Note 2: Night-time average weekday (early morning) peak hour typically 0600 hours to 0700 hours.
Note 3: Table 9 of Development Consent (DA 14/98) (as modified).
Note 4: Moderate exceedance 3 dBA to 5 dBA above relevant noise limit.

Based on the results presented in **Table 9**, **Table 10** and **Table 11**, up to approximately eight dwellings located on Ungarie Road and up to four dwellings located on Wamboyne Road may experience marginal (1 to 2 dBA) or moderate (3 to 5 dBA) exceedances of the 55 dBA night-time (early morning) noise limit due to road traffic noise from mine generated traffic.

It is useful to note that the RNP states that an increase of 2 dB is considered to be a minor impact that would be barely perceptible to the average person.

2.4.3 Traffic Noise Complaints Record

No complaints in relation to traffic noise were received by Barrick during the 2011 to 2013 period.

Notwithstanding, Barrick entered into Agreements in September 2012 with residents who may potentially be affected by traffic noise attributable to the mine traffic. The Agreement letters were signed by each of the landowners notified, indicating acceptance of the conditions of Agreement, and the Director-General of DP&I was notified of the terms of agreement on 3 September 2012.

3 MODIFICATION OVERVIEW

3.1 Approved and Proposed Hours of Operation

The approved operating hours of the CGM are presented in **Table 12**. Generally, the Modification would not change the currently approved CGM operating hours (ie 24 hours per day, 7 days per week), however, tailings storage facilities embankment lifts would occur during the daytime only (**Table 12**).

Table 12 Approved CGM and Proposed Modification Hours of Operation

Operation	Description	Currently Approved CGM[1]	Modification
On-Site Operation	Construction works associated with tailings storage facilities embankment lifts	24 hours, 7 days per week	Daytime only (0700 hours to 1800 hours)
	Open pit and waste emplacement operations	24 hours, 7 days per week	Unchanged
	Ore handling, processing and stockpiling operations	24 hours, 7 days per week	Unchanged
Off-Site Operation	Road transport (medium and light vehicles)	24 hours, 7 days per week	Unchanged
	Road transport (heavy vehicles)	0700 hours to 2200 hours 7 Days per week (where practicable)	Unchanged

Note 1: As per Development Consent (DA 14/98) (as modified) refer **Appendix B1**.

3.2 General Construction and Operation

The general arrangement of the Modification has been designed to maximise the use of existing infrastructure at the CGM. The Modification general arrangements for Years 2015 and 2017 are shown in **Appendices D1 to D2**. The main activities associated with the Modification relevant to potential noise and blasting impacts would include:

- extension of the operational life of the CGM by an additional 5 years (ie until 2024);
- no change to ML 1535, and no requirement for additional mining lease tenement applications;
- continued development of open pit mining operations at the CGM, including expansion of the extent and depth of the existing open pit;
- an increase in the total quantities of waste rock, ore and tailings produced over the life of the mine;
- continued use of the existing mine fleet;
- an increase in total gold production to approximately 3.8 million ounces (Moz);
- no change to the existing process plant or its currently installed capacity to continue ore processing at a rate up to 7.5 Mtpa;
- continued and expanded development of the existing northern and southern waste rock emplacements within ML 1535 for placement of mined waste rock over the life of the CGM, including:
    - raising the maximum design height of the northern waste rock emplacement to 308 metres (m) Australian Height Datum (AHD);
    - raising the maximum design height of the southern waste rock emplacement to 283 m AHD; and

  - extension of the northern waste rock emplacement to the west with an additional disturbance footprint of approximately 39 hectares (ha);
- no change to the existing perimeter waste rock emplacement;
- continued and expanded development of soil stockpiles, the relocation of existing soil stockpiles and stockpiling of mineralised material (ie potentially commercial ore) within ML 1535;
- continued use of the existing tailings storage facilities for the deposition of tailings produced over the life of the CGM, including raising the maximum design height of:
  - the northern tailings storage facility to 248 m AHD; and
  - the southern tailings storage facility to 255 m AHD;
- construction of a new pump station on the eastern side of Lake Cowal to the improve the capacity/flow of the existing mine water supply pipeline, and associated diesel generator and access track;
- no change to the approved operating hours (ie 24 hours per day, seven days per week) of the CGM;
- no change to the existing peak CGM workforce numbers;
- an additional 5 years of workforce employment;
- no change to existing deliveries and consumables;
- no change to other supporting infrastructure and services; and
- no change to approved exploration activities.

It is noted that the Modification would not bring the mining operations at the CGM significantly closer to any privately owned receivers (ie all mining operations would continue to occur within ML 1535).

3.3 On-site Open Pit Blasting

The method of ore and waste rock removal at the CGM is by drill and blasting techniques. A mixture of ammonium nitrate and fuel oil (ANFO) (dry holes) and emulsion blends (wet holes) would be used at an average powder factor of approximately 0.8 kilograms per bank cubic metre (kg/bcm).

Existing CGM blast design parameters and management practices would remain unchanged by the Modification with the average frequency of blast events generally limited to one blast per day. Notwithstanding, potential impacts associated with blasting in the area of the extended open pit are assessed in this report.

3.4 Off-site Road Traffic Noise

The preferred primary access route to the CGM (for employees, major deliveries and heavy vehicles) is from West Wyalong via the existing mine access road shown on the Traffic Noise Monitoring Locations Plan (**Appendix C2**). Two additional preferred mine access routes used by employees to access the CGM from Forbes and Condobolin are also shown on the plan (**Appendix C2**). Light vehicles and Barrick operated shuttle buses for employees use all three routes.

Existing vehicle movements along the preferred access routes to the site (for employees, major deliveries and heavy vehicles) are expected to remain unaltered by the Modification as there would be no increase in the CGM workforce or consumables/deliveries for the Modification.

Off-site road traffic noise assessments have been previously undertaken and approved (ie MOD 10) in accordance with the ECRTN. However, this guideline has been recently superseded by the requirements the NSW RNP (and associated Application Notes) and therefore any potential traffic noise impacts have been reassessed in this report in accordance with the current policy.

3.5 Modification Site and Landownership

The CGM incorporating the Modification and surrounding receivers are shown on the Land Ownership and Dwelling Plan (**Appendix A3**). A summary of the nearest potentially affected receivers (including recreational receivers and bird breeding monitoring areas) are presented in **Table 13** including receiver type, Local Environment Plan zone, INP noise amenity zone, property reference and ground elevation.

Table 13 Nearest Potentially Affected Receivers

Receiver Type	LEP Zone	INP Noise Amenity Zone[1]	Property Reference	ENM Receiver Coordinates[5]		
				East (m)	North (m)	Elevation (m AHD)
Privately Owned	1(a) General Rural/Rural	Rural	Billabong	26782	564	206
			Bramboyne	9942	14614	262
			Bungabulla[4]	25229	8245	206
			Coniston[3]	14743	14922	221
			Cowal North[4]	21583	18391	206
			Foxham Downs	11902	3028	244
			Gumbelah[4]	25214	8662	206
			Hillview	2854	3262	243
			Koobah	29148	6086	206
			Lake Cowal[4]	24707	3762	206
			Lakeview	7982	10156	258
			Lakeview II	7855	9964	258
			Laurel Park[4]	11980	15736	239
			Goodwood[4,6]	27239	13384	206
			McLintock[3]	10628	11347	227
			Melrose	5011	2794	240
			Moora Moora	18235	24775	220
			The Glen[4]	15238	17262	226
			Thistleview	7516	7035	265
			Wamboyne I	10574	20709	238
			Wamboyne II	9895	18382	259
			Westella	8578	9983	252
			Westlea[3]	11986	6935	236
			Wilga Vale	10473	23266	233
Barrick Owned[2]	1(a) General Rural/Rural	Rural	Lake Cowal	21404	5172	209
			Lakeside	16004	15761	220
			Hillgrove	14025	5087	240
Lake Cowal	1(a) General Rural/Rural	Passive Recreation	Relocated Crown Reserve	19604	6072	208
Bird Breeding Area	n/a	n/a	Bird Breeding Area South (NO3)	19224	13503	206
			Bird Breeding Area North (NO4)	19629	17933	206

Note 1: See **Appendix E** for discussion on the use of Noise Amenity Zones.
Note 2: Barrick owned properties are listed for information purposes and not further considered in this assessment.
Note 3: Properties identified in the CGM Development Consent as being in the Noise Affectation Zone.
Note 4: Properties identified in the CGM Development Consent as being in the Noise Management Zone.
Note 5: To convert to MGA coordinates add 520,396 m E and add 6,267,628 m N.
Note 6: Goodwood property previously referred to as Mattiske.

4 EXISTING METEOROLOGICAL AND NOISE ENVIRONMENT

4.1 Meteorological Environment

4.1.1 Prevailing Winds

Section 5.3 of the INP, Wind Effects, states:

> *"Wind effects need to be assessed where wind is a feature of the area. Wind is considered to be a feature where source to receiver wind speeds (at 10 m height) of 3 m/s or below occur for 30 percent of the time or more in any assessment period in any season."*

An assessment of prevailing wind conditions was derived from the on-site AWS located within ML 1535. The dominant seasonal wind speeds and directions for the three year period (January 2010 to March 2013) are presented in **Appendix F1** for daytime (0700 hours to 1800 hours), evening (1800 hours to 2200 hours) and night-time (2200 hours to 0700 hours) in accordance with a methodology consistent with the requirements of the INP.

Based on the information provided in **Appendix F1**, prevailing winds are not considered a feature of any season during the daytime, evening and night-time periods, and therefore in accordance with the INP wind effects are not relevant to the site.

The results of this analysis are consistent with the previous assessment (ie Modified Request [Mod 6]) of potential noise impacts for the approved CGM.

4.1.2 Temperature Inversions

Section 5.2 of the INP, Temperature Inversions, states:

> *"Assessment of impacts is confined to the night noise assessment period (10.00 pm to 7.00 am), as this is the time likely to have the greatest impact - that is, when temperature inversions usually occur and disturbance to sleep is possible."*
>
> *"Where inversion conditions are predicted for at least 30% (or approximately two nights per week) of total night-time in winter, then inversion effects are considered to be significant and should be taken into account in the noise assessment".*

An assessment of atmospheric stability conditions has been prepared from the meteorological data set described above (**Appendix F1**). The winter evening and night-time frequency of occurrence of atmospheric stability classes are presented in **Table 14**, together with estimated Environmental Lapse Rates (ELR).

In accordance with Table E2 of the INP, the combined frequency of occurrence of moderate to strong (ie 1.5 to >4.0 degrees Celsius per hundred metres [^{o}C/100 m]) winter temperature inversions is greater than 30% during the combined evening and night-time period and therefore requires assessment (EPA, 2000). The daytime frequency of occurrence of moderate to strong winter temperature inversions is approximately 2% (ie much less than 30%).

The above meteorological analysis has been further supplemented by on-site direct temperature gradient field measurements. The mean of six direct temperature gradient measurement samples (carried out during winter noise monitoring surveys from 2005 to 2012) is presented as **Appendix F2**. The temperature gradient measurement methodology and results are presented in SLR Report 10-4111-R18 "*Cowal Gold Project Mine Operation Noise Monitoring July 2012*" (SLR, 2012) and summarised in **Table 15**.

Table 14 Atmospheric Stability Frequency of Occurrence - Winter Seasons 2010 to 2013

Stability Class	Frequency of Occurrence - Winter Season				Estimated ELR $^{o}C/100\ m^{1}$	Qualitative Description
	Daytime	Evening	Night	Evening & Night		
A	10.4%	0.0%	0.0%	0.0%	<-1.9	Lapse
B	9.6%	0.0%	0.0%	0.0%	-1.9 to-1.7	Lapse
C	24.5%	0.0%	0.0%	0.0%	-1.7 to-1.5	Lapse
D	43.9%	33.6%	39.7%	37.8%	-1.5 to-0.5	Neutral
E	9.5%	20.8%	17.7%	18.7%	-0.5 to 1.5	Weak Inversion
F	1.3%	23.9%	23.7%	23.8%	1.5 to 4.0	Moderate Inversion
G	0.8%	21.7%	18.9%	19.7%	>4.0	Strong Inversion
F+G	2.1%	45.7%	42.6%	43.5%	>1.5	Moderate to Strong

Note 1: $^{o}C/100$ m = Degrees Celsius per 100 metres.

Table 15 Typical Winter Season Temperature Inversion Profile

Daytime Period 0830 to 1700 hours	Afternoon Shoulder 1700 to 1800 hours	Evening Period 1800 to 2200 hours	Night-time Period 2200 to 0700 hours	Morning Shoulder 0700 to 0830 hours
Neutral condition or temperature lapse	Moderate temperature inversion	Strong temperature Inversion	Strong temperature Inversion	Moderate temperature inversion

The Environmental Noise Model (ENM) noise modelling meteorological parameters presented in **Table 16** are based on analysis of the AWS meteorological data set and direct temperature gradient field measurements. The observed winter season meteorological conditions at the CGM can be summarised as follows:

- Daytime: Generally unstable atmospheric conditions coinciding with temperature lapses and an absence of prevailing winds. However, moderate temperature inversions may develop in the late afternoon (1700 to 1800 hours) and dissipate in the early morning (0700 to 0830 hours), particularly during winter.
- Evening: Generally stable atmospheric conditions coinciding with strong temperature inversions in the absence of prevailing winds with minimal topographic characteristics to enhance drainage flows.
- Night-time: Generally stable atmospheric conditions coinciding with strong temperature inversions in the absence of prevailing winds with minimal topographic characteristics to enhance drainage flows.

While the INP indicates that temperature inversions are not relevant to assessment of impacts during the evening and daytime, based on the direct temperature gradient measurements moderate inversion conditions have been identified in daytime shoulder periods and strong inversion conditions occur during the evening, and are therefore included in this assessment.

The noise modelling meteorological parameters presented in **Table 16** are generally consistent with those adopted for the previous assessment (ie Modified Request [Mod 6]) of potential noise impacts for the approved CGM.

Table 16 Calm (Neutral) and Noise Enhancing Meteorological Modelling Parameters

Period (particularly Winter)	Meteorological Parameter	Air Temp	Relative Humidity	Wind Velocity[1]	Temperature Gradient
Daytime (0830 to 1700 hours)	Calm	12°C	64%	0 m/s	0°C/100 m
Late afternoon (1700 to 1800 hours) and early morning (0700 to 0830 hours)	Moderate Inversion	12°C	64%	0 m/s	3°C/100 m
Evening (1800 to 2200 hours)	Strong Inversion	10°C	70%	0 m/s	8°C/100 m
Night-time (2200 to 0700 hours)	Strong Inversion	8°C	80%	0 m/s	8°C/100 m

Note 1: Local topography is generally flat to undulating and drainage flows are not considered a feature of the area.

m/s = metres per second.

4.2 Noise Environment

Additional background noise monitoring to determine the Assessment Background Level (from which the Rating Background Level [RBL] is derived for assessment purposes) was not considered appropriate for the Modification given the existing operation of the approved CGM.

However, it is appropriate to review the pre-mine background noise data (in this case data from 1994 was used) to determine the relevant RBLs and noise amenity levels ($LA_{eq(period)}$) in accordance with the INP procedures. For INP assessment purposes, a 24-hour day is divided into three periods: day (0700 hours to 1800 hours); evening (1800 hours to 2200 hours); and night (2200 hours to 0700 hours).

4.2.1 Background Noise Monitoring 1994

Background noise surveys to characterise and quantify the background (ie prior to the development of the CGM) acoustical environment in the area surrounding ML 1535 were conducted in July and December 1994. Unattended noise loggers were positioned at “Coniston”, “Lakeside”, “Lake Cowal (Barrick)” and “Gumbelah”.

The unattended ambient noise logger data from each monitoring location together with the on-site weather conditions are presented in the “*Cowal Gold Project Environmental Impact Statement*” (North Limited, 1998). The background noise data was previously processed in accordance with the requirements of the *“Environmental Noise Control Manual”* (ENCM) (EPA, 1994) to determine the minimum repeated background noise levels as shown in **Table 17**.

Table 17 Background Noise Environment in 1994 (dBA re 20 µPa)

Property Reference	Winter[1] - Minimum Repeated $L_{A90(15minute)}$ Background Level		Summer[1] - Minimum Repeated $L_{A90(15minute)}$ Background Level	
	Daytime[2]	Night-time[2]	Daytime[2]	Night-time[2]
Coniston (NO2)	30	25	27	26
Lakeside (Barrick)	30	25	31	34
Lake Cowal (NO6) (Barrick)	30	25	30	25
Gumbelah (NO5)	29	27	31	32

Note 1: Measured noise levels less than 31 dBA may have a signal to noise ratio less than 5 dBA.

Note 2: Daytime/evening 0700 hours to 2200 hours and Night-time 2200 hours to 0700 hours (EPA, 1994).

The data shows that the background noise levels in the vicinity of the CGM were typically around 30 dBA (or less), consistent with a relatively remote rural environment comprising of agricultural and domestic activity together with seasonal fauna noise sources and with an absence of major industrial development and continuous transportation systems.

As was the case with the ENCM (and remains the case with the INP) where the background level is found to be less than 30 dBA, the background level is set to 30 dBA.

4.2.2 Ambient (CGM Operating) Noise Monitoring 2010 to 2013

In accordance with the CGM NMP, unattended noise logging has been carried out at selected privately owned dwellings on a regular basis since the commencement of construction and mining operations. The resulting noise data and on-site weather conditions have been processed in accordance with the requirements of the INP to derive the $L_{A90(15minute)}$ ambient (operating) noise levels (ie all noise sources inclusive of any mine noise) and are presented in **Table 18**.

Table 18 Ambient (CGM Operating) Noise Environment 2010 to 2013 (dBA re 20 µPa)

Receiver	Measured $L_{A90(15minute)}$ ambient noise levels (inclusive of any mine operating noise)																	
	July 2010			January 2011			July 2011			January 2012			July 2012			February 2013		
	D	E	N	D	E	N	D	E	N	D	E	N	D	E	N	D	E	N
Coniston (NO2)	25	23	23	-[2]	-	-	27	19	18	30	37	39	19	22	12	27	25	27
Gumbelah (NO5)	22	21	21	29	35	40	26	24	23	38	40	37	26	23	23	28	33	36
Lake Cowal (NO6) (Barrick)	-[2]	-	-	29	30	37	28	28	27	29	34	40	26	26	29	26	24	30
Westlea	31	35	32	29	30	33	28	25	24	25	28	31	28	26	26	36	38	39

Note 1: Daytime 0700 hours to 1800 hours, Evening 1800 hours to 2200 hours and Night-time 2200 hours to 0700 hours.
Note 2: Noise logger malfunction.

The monitoring of ambient (operating) noise levels indicates that current noise levels are sometimes above the background noise levels measured in 1994 particularly during summer (which is mainly due seasonal [insect] effects). Notwithstanding, the ambient background noise level for the proposed Modification has been assumed to be 30 dBA (in accordance with the INP, where the ambient level is found to be less than 30 dBA, the ambient level is set to 30 dBA) in order to provide for a conservative assessment.

4.2.3 Background Noise and Amenity Levels for INP Assessment Purposes

In view of the foregoing, the RBLs and noise amenity levels ($L_{Aeq(period)}$) in the absence of the existing CGM are presented in **Table 19**, which form the basis of establishing the project-specific noise levels (PSNLs).

Table 19 Background Noise and Amenity Levels for Assessment (dBA re 20 µPa)

Receiver	Property Name	Estimated RBL[1, 2] - All Noise Sources			Estimated $L_{Aeq(Period)}$[1, 2] Industrial Noise Only		
		Daytime	Evening	Night-time	Daytime	Evening	Night-time
Privately Owned	All residential dwellings	30	30	30	<44	<39	<34

Note 1: Estimated RBLs and noise amenity levels in the absence of the approved CGM's operation.
Note 2: Daytime 0700 hours to 1800 hours, Evening 1800 hours to 2200 hours and Night-time 2200 hours to 0700 hours.

4.3 Road Traffic Noise

The road traffic flow and noise measurement results from traffic noise monitoring conducted in February 2013 have been used to quantify the near-field total traffic noise adjacent to the primary mine access route to the CGM (for employees, major deliveries and heavy vehicles) as shown on Traffic Noise Monitoring Locations Plan (**Appendix C2**). The data were then processed in accordance with the requirements of the RNP to derive the total traffic noise levels presented in **Table 20**.

Table 20 Calculated L_{Aeq} Total Traffic Noise Levels February 2013 (dBA re 20 µPa)

ID	Location	Offset Distance	Daytime $L_{eq(15hour)}$[1]	Night-time $L_{eq(9hour)}$[1]
TN1	140 Ungarie Road, West Wyalong	30 m	59 dBA	54 dBA
TN2	"Clairview" Residence, 56 – 86 Wamboyne Road	45 m	52 dBA	50 dBA
TN3	"Windstone" Residence, 648 Wamboyne Road	150 m	46 dBA	43 dBA

Note 1: Total traffic noise inclusive of façade correction.

5 NOISE IMPACT ASSESSMENT PROCEDURE

5.1 Construction Noise Assessment Criteria

As discussed in **Section 3.3**, Modification construction works include the southern and northern tailings storage facilities embankment lifts and would be carried out during the daytime throughout the Modification life as required. In accordance with the EPA's ICNG, these construction works are generally considered integral with the general mining operations. Therefore the construction works associated with the southern and northern tailings storage facilities embankment lifts have been modelled as a component of Modification daytime operational activities in Years 11 and 13.

Discrete construction activities for the Modification would involve the construction of:

- Water storage dam, which would be located within ML 1535 (**Appendix A2**).
- The eastern pump station, which would be located on the eastern side of Lake Cowal (**Appendix A3**).

The water storage dam would be constructed using existing equipment (ie D10 Dozer) at the CGM over a period of approximately 3 months, and therefore, would be indistinguishable from ongoing mining operations.

The eastern pump station (and associated access track) would be located some 7 km from the closest point of ML 1535, and would be constructed during daytime hours only (0700 hours to 1800 hours) Monday to Friday and 0800 hours to 1300 hours on Saturday over a construction period of approximately 3 months using a small contractor construction fleet (ie 3 to 5 plant items at any one time).

The eastern pump station would be located on the same privately-owned property as the Goodwood dwelling (**Appendix A3**), and would only be constructed in agreement with the landowner of this property. Given this, Barrick would consult with the landowner of Goodwood regarding these daytime construction activities. The next closest private receiver (ie dwelling) would be located some 5 km away, and as such, daytime noise impacts from the small construction fleet are not expected to be perceivable at other private receivers. Given the above, a quantitative assessment of these construction activities is not considered necessary. Notwithstanding, standard mitigation measures (ie constructing within the proposed hours, shutting down equipment when not in use, maintaining equipment in good working order etc) would be implemented during this construction activity.

5.2 Mine Operating Noise Assessment Criteria

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 INP, the EPA has two broad objectives:

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

The INP prescribes detailed calculation routines for establishing PSNLs (ie $L_{Aeq(15minute)}$ intrusive criteria and $L_{Aeq(period)}$ amenity criteria) at potentially affected receivers for an industrial development. Ideally, the intrusive noise level should not exceed the background level by more than 5 dBA. Similarly, the noise amenity level should not exceed the specified INP "acceptable" or "maximum" noise level appropriate for the particular land use.

In addition, the DP&I has previously advised that the noise impacts on vacant land are assessed on a "case by case" basis. For assessment purposes in this report vacant land is defined as a lot which may be permitted to have (but does not yet have) a dwelling and is therefore a potentially sensitive receiver in accordance with the INP. In the absence of a specific dwelling (or a known approved building Development Application) noise impacts are determined where exceedances are predicted over 25% of the vacant land area.

In accordance with the INP's Chapter 2 Industrial Noise Criteria and associated Application Notes (15 February 2013), the PSNLs for the residential and other localities in the vicinity of the CGM are presented in **Table 21** for both intrusive noise and amenity. These criteria are nominated for the purposes of assessing potential noise impacts from the CGM incorporating the Modification.

Table 21 Project-specific Noise Assessment Criteria (dBA re 20 µPa)

Receiver	Land Use	Intrusive $L_{Aeq(15minute)}$[1]			Amenity $L_{Aeq(period)}$[1]		
		Day	Evening	Night	Day	Evening	Night
Existing Private Dwellings	Rural Residential[2]	35	35	35	50	45	40
Potential Private Dwellings	Rural Vacant Land[4]						
Lake Cowal	Passive Recreation	Intrusive noise not applicable			50 when in use[3]		

Note 1: Daytime 0700 hours to 1800 hours, Evening 1800 hours to 2200 hours, Night-time 2200 hours to 0700 hours.
Note 2: At the most-affected point within 30 m of the residential area.
Note 3: At the most-affected point within 50 m of the area boundary.
Note 4: Where exceedances are predicted over 25% of the vacant land area.

The intrusiveness criterion is met if the $L_{Aeq(15minute)}$ is less than or equal to the rating background level (RBL) plus 5 dBA, where the RBL is determined from monitoring data following the INP procedures discussed in **Section 4.2**. Thus, the most stringent PSNLs at rural residential receivers (and vacant land) would be the $L_{Aeq(15minute)}$ intrusiveness criterion.

The INP states that the PSNLs are based on preserving the amenity of at least 90% of the population living in the vicinity of industrial noise sources from the adverse effects of noise for at least 90% of the time. Provided the PSNLs are achieved, then most people would consider the resultant noise levels acceptable. In those cases where the PSNLs are not achieved, it does not automatically follow that all people exposed to the noise would find the noise unacceptable. In subjective terms, exceedances of the PSNLs can be described as follows:

- Negligible noise level increase <1 dBA - not noticeable by all people.
- Marginal noise level increase 1 dBA to 2 dBA - not noticeable by most people.
- Moderate noise level increase 3 dBA to 5 dBA - not noticeable by some people but may be noticeable by others.
- Appreciable noise level increase >5 dBA - noticeable by most people.

5.3 Sleep Disturbance Assessment Criteria

The EPA's INP Application Notes dated 15 February 2013 (refer **Appendix G**) recognise that the current $L_{A1(1minute)}$ sleep disturbance criterion of 15 dBA above the prevailing $L_{A90(15minute)}$ level is not ideal. The assessment of potential sleep disturbance is complex and not fully understood; however it is understood that the EPA believes that there is insufficient information to determine a suitable alternative criterion.

Appendix B (Technical Background to Road Traffic Noise Criteria) of the *Environmental Criteria for Road Traffic Noise* (EPA, 1999) contains a comprehensive review of research into to sleep disturbance and traffic noise. The review has been more recently updated in the NSW *Road Noise Policy* (DECCW, 2011) (Section 5.3 Sleep Disturbance) however the EPA's conclusion remains unchanged as follows:

(i) Maximum *internal* noise levels below 50 to 55 dBA are unlikely to cause awakening reactions; and

(ii) One or two noise events per night, with maximum *internal* noise level of 65 to 70 dBA, are not likely to affect health and wellbeing significantly.

It is noteworthy that conditions of approval generally include external noise limits. The internal noise levels (presented above) can be conservatively transposed to an external noise level by adding 10 dBA (or 12.5 dBA when measured 1 m from the dwelling facade). It follows, that an external $L_{A1(1minute)}$ noise criteria of 60 dBA would appear to be consistent with the current research in relation to this matter.

However, the EPA continues to review research on sleep disturbance as it becomes available and in the interim, the EPA suggests that the $L_{A1(1minute)}$ level of 15 dBA above the RBL is a suitable screening criterion for sleep disturbance for the night-time period. Therefore the night-time Sleep Disturbance Noise Levels (SDNL) would be $L_{A1(1minute)}$ 45 dBA.

The proposed night-time operation of the Modification is anticipated to involve a larger proportion of the mobile equipment being operated in repeatable routines and a relatively smaller proportion of continuous fixed plant. Noise emissions from the mobile equipment are typically variable, whereas fixed plant noise emissions are relatively continuous (or steady) levels. When mobile equipment and fixed plant operate simultaneously, some noise sources have the potential to emerge audibly above the overall mine noise.

The night-time 6-monthly operator-attended noise monitoring results (refer **Table 4**) have been reviewed to determine the mean difference between the intrusive $L_{Aeq(15minute)}$ and the corresponding $L_{A1(1minute)}$ noise levels. The results of night-time noise monitoring for the 3 year period to February 2013 are summarised in **Table 22** including the measured mean (mine-contributed) intrusive $L_{Aeq(15minute)}$ and the $L_{A1(1minute)}$ noise levels.

Table 22 Measured Night-time $L_{Aeq(15minute)}$ and $L_{A1(1minute)}$ Noise Levels (dBA re 20 µPa)

ID[1]	Location	Mean LAeq(15minute)	Mean LA1(1minute)	Mean Difference
NO2	Coniston	33	41	7.5
NO5	Gumbelah	35	42	7.7
NO7	Westlea	34	40	5.8
NO8	McLintock	30	37	7.0
NO10	Cowal North	31	37	5.5
Overall				**7.0**

Note 1: Refer to **Appendix A3** for land ownership details.

The measured results at locations NO2, NO5, NO7, NO8 and NO10 show a mean difference of 7 dBA between the (mine-contributed) intrusive $L_{Aeq(15minute)}$ and the $L_{A1(1minute)}$ noise levels and are therefore consistent with similar mining operations where the difference is typically <10 dBA. Hence, if the intrusive PSNLs (refer **Section 5.2** ie RBL plus 5 dBA) are achieved, then the SDNLs (ie RBL plus 15 dBA) would also be met. This relationship enables the noise assessment process to focus on the setting and assessment of INP-based intrusive noise and amenity levels which aim to minimise annoyance at noise sensitive receiver locations.

Notwithstanding the foregoing, the predicted $L_{A1(1minute)}$ night-time noise levels are presented in **Section 7** together with an assessment of potential sleep disturbance impacts from the CGM incorporating the Modification.

5.4 Low Frequency Noise Assessment Criteria

In accordance with the INP's Chapter 4 Modifying factor adjustments, where a noise source contains certain characteristics, such as a dominant low frequency content, the INP states that there is evidence to suggest that it can cause greater annoyance 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 PSNLs. In the case of low frequency (20 hertz [Hz] to 250 Hz) noise, the INP requires a 5 dB correction to be applied to the measured or predicted noise levels where the difference between the A and C weighted level is 15 dB (or more) at the receiver.

The night-time 6-monthly operator-attended noise monitoring results (refer **Table 4**) conducted by SLR during the 3 year period to February 2013 have been reviewed to determine any low frequency noise component from the current CGM mining operation at the three nearest potentially affected privately owned dwellings namely NO2 (Coniston), NO7 (Westlea) and NO8 (McLintock). The noise data were then analysed in accordance with the INP requirements to derive the intrusive $L_{eq(15minute)}$ A and C weighted noise levels of CGM operations coinciding with strong winter temperature inversions.

The measurement results at the three nearest potentially affected privately owned dwellings (ie NO2 [Coniston], NO7 [Westlea] and NO8 [McLintock]) show a mean difference between the (mine-contributed) intrusive $L_{Aeq(15minute)}$ and the $L_{Ceq(15minute)}$ noise levels that is below the INP's low frequency modifying threshold of 15 dB. Based on these operator-attended noise monitoring results, it is concluded that current CGM noise emissions do not contain "dominant low frequency content" in accordance with the INP's assessment procedures.

5.5 Operational Noise Impact Assessment Methodology

In view of the foregoing, **Table 23** presents the methodology for assessing the operating noise levels of the CGM incorporating the Modification against the intrusive PSNLs (**Table 21**) and $L_{A1(1minute)}$ SDNLs (**Table 22**).

Table 23 Modification Noise Impact Assessment (dBA re 20 µPa)

Assessment Source	Assessment Parameter	Assessment Criteria	Noise Management Zone[1]		Noise Affectation Zone
			Marginal	Moderate	
CGM incorporating the Modification	PSNL Intrusive	RBL plus 5 dBA	1 to 2 dBA above assessment criteria	3 to 5 dBA above assessment criteria	> 5 dBA above assessment criteria[2]
	PSNL Amenity	INP acceptable			
	SDNL $L_{A1(1minute)}$	RBL plus 15 dBA			

Note 1: Depending on the degree of predicted exceedance of the relevant assessment parameter potential noise impacts in the noise management zone could range from marginal to moderate (in terms of the perceived noise increase).

Note 2: Exposure to Modification noise levels greater than 5 dBA above the relevant PSNL and or SDNL may be considered unacceptable by some landowners.

For the purposes of assessing any potential impacts from the CGM incorporating the Modification, the noise management and affectation zones are further defined as follows.

Noise Management Zone

Depending on the degree of predicted exceedance of the PSNL and or SDNL (1 to 5 dBA), potential noise impacts in the noise management zone could range from marginal to moderate (in terms of the perceived noise increase). In addition to the noise mitigation measures included in the predictive modelling (**Section 6**), noise management procedures would include:

- Noise monitoring on-site and within the community.
- Prompt response to any community issues of concern.
- Refinement of on-site noise mitigation measures and operating procedures where practicable.

- Implementation of reasonable and feasible acoustical mitigation at receivers (which may include measures such as enhanced glazing, insulation and/or air-conditioning) at receivers where noise monitoring shows mine noise levels are 3 to 5 dBA above the relevant criteria.

Noise Affectation Zone

Exposure to project noise levels greater than 5 dBA above the relevant PSNL and or SDNL may be considered unacceptable by some landowners. These landowners are typically afforded rights for acquisition upon request in the relevant approval documentation. Management procedures for the Noise Affectation Zone would include:

- Discussions with relevant land owners to assess concerns and define responses.
- Implementation of reasonable and feasible acoustical mitigation at receivers (which may include measures such as enhanced glazing, insulation and/or air-conditioning) at receivers where noise monitoring shows mine noise levels are >5 dBA above the relevant criteria.
- Negotiated agreements with land owners where required.

5.6 Potential Effects of Noise on Bird Breeding and Wild Life Areas

A number of recent literature reviews have been conducted on the effects of noise on wildlife (Radle, 2007; Kaseloo, 2005; Institute for Environmental Monitoring and Research, 2001).

Noise can potentially impact certain fauna species, although studies on the effect of noise on wildlife have shown potential impacts are varied. Many studies have shown that fauna are well adapted to human activities and noise, while other studies have shown that noise can cause masking of vocalisation, physiological stress and changes in movement/patterns of behaviour (Radle, 2007; Kaseloo, 2005; Institute for Environmental Monitoring and Research, 2001).

The Modification is not expected to materially change existing CGM noise levels (**Section 7**), and on this basis, no additional impacts to fauna are expected due to noise associated with the Modification.

5.7 Existing CGM Development Consent Noise Limits

The existing CGM Development Consent (DA 14/98) contains noise impact assessment criteria, as shown in **Appendix B1** with an extract presented below with regard to Acquisition Upon Request and Noise Impact Assessment Criteria.

Acquisition Upon Request

(a) Upon receiving a written request for acquisition from the owner of any land listed in Table 6 following landholder notification in accordance with condition 11.1 of schedule 2, the Applicant shall acquire the land in accordance with the procedures in condition 11 of schedule 2.

Table 6: Land subject to acquisition upon request

Coniston
McLintock
West Lea

Note: To interpret the location referred to Table 6, see Appendix 3.

(b) If the noise generated by the development exceeds the criteria in Table 7 at any residence on privately-owned land, or on more than 25 percent of privately-owned land not located within Lake Cowal (as shown in Appendix 3), the Applicant shall, upon receiving a written request for acquisition from the landowner, acquire the land in accordance with the procedures in condition 11 of Schedule 2.

Table 7: Land acquisition criteria dB(A) $L_{Aeq\ (15min)}$

Location	*Day/Evening/Night*
All privately-owned land excluding the land listed in Table 6	*40*

Note: Noise generated by the project is to be measured in accordance with the relevant requirements, and exemptions (including certain meteorological conditions), of the NSW Industrial Noise Policy.

Noise Impact Assessment Criteria

(c) The Applicant shall ensure that the noise generated by the development does not exceed the noise impact assessment criteria in Table 8 at any residence on privately-owned land, or on more than 25 percent of privately-owned land not located within Lake Cowal, as shown in Appendix 3.

Table 8: Noise Impact Assessment Criteria dB(A) $L_{Aeq\ (15min)}$

Location	*Day/Evening/Night*
Bungabulla	*39*
Coniston	*44*
Cowal North	*38*
Gumbelah	*39*
Lake Cowal (non-Barrick)	*38*
Laurel Park	*39*
Mattiske	*36*
McLintock	*41*
The Glen	*38*
West Lea	*41*
All other residences	*35*

Notes:

- *To interpret the locations referred to in Table 8, see Appendix 3.*
- *Noise generated by the project is to be measured in accordance with the relevant requirements, and exemptions (including certain meteorological conditions), of the NSW Industrial Noise Policy.*
- *The noise limits do not apply if the Applicant has an agreement with the relevant owner/s of these residences/land to generate higher noise levels, and the Applicant has advised the Department in writing of the terms of this agreement.*

6 NOISE MODELLING METHODOLOGY

6.1 Noise Mitigation and Management Measures

6.1.1 Previous Assessment (MOD 10)

Barrick is obligated to manage noise levels from the CGM in accordance with the noise assessment criteria specified in Development Consent (DA 14/98) (as modified). For the existing CGM operation this has been achieved through the implementation of the NMP, as discussed in **Section 2.2.1**.

6.1.2 Modification Assessment (MOD 11)

The predictive modelling involved the investigation of feasible and reasonable noise mitigation measures, particularly in relation to night-time operations.

Preliminary noise modelling of scenarios representative of the maximum noise emissions from the CGM incorporating the Modification was conducted to identify potential worst case noise impacts. In addition to existing noise mitigation measures described in the existing NMP, a number of additional potential mitigation measures were investigated during the preliminary modelling, including:

- The development of noise bunds (ie tiered waste rock emplacements) to shield mobile equipment operating on the waste rock emplacements during adverse weather conditions (ie during strong temperature inversions).
- Locating mobile equipment on the eastern side of the waste rock emplacements (ie away from the closest receivers to the west of the CGM) during adverse weather conditions.
- Scheduling tailings storage facility embankment lift works to occur during the daytime only (ie between 0700 and 1800 hours).

The preliminary modelling indicated that, while the development of noise bunds would be effective during calm conditions, they would result in a very limited reduction (ie less than 1 dB reduction) in predicted noise levels at private receiver locations during adverse weather conditions. Similarly, locating the mobile equipment to the eastern side of the waste rock emplacements was also predicted to result in a very limited reduction in predicted noise levels at private receiver locations during adverse weather conditions. On this basis, the implementation of these mitigation measures was not considered by Barrick to be reasonable for the Modification.

Scheduling the tailings storage facility embankment lift works during the daytime only would reduce potential noise impacts associated with the CGM incorporating the Modification during the evening and night-time. This mitigation measure is considered by Barrick to be reasonable and feasible, and as such, was incorporated into the predictive modelling conducted for the Modification.

The existing CGM mobile equipment fleet would continue to be operated for the Modification (**Section 3**), and it would be cost prohibitive for Barrick to replace the existing fleet with a noise attenuated fleet for the Modification (ie the cost of replacement would be approximately $3.7 million per truck for up to 15 trucks). Barrick has investigated retrofitting the existing haul truck fleet with noise attenuation kits, however, the expected capital cost to retrofit the existing trucks is approximately $6 million, with ongoing operational costs associated with maintaining the effectiveness of the noise attenuation additional to this capital costs. Given that no increase in noise levels at private receiver locations is predicted due to the Modification (**Section 7**), Barrick does not consider the additional costs associated with fleet attenuation to be reasonable for the Modification.

Eastern Pump Station

The eastern pump station would be located on the same privately owned property as the Goodwood dwelling (**Appendix A3**), and would only be constructed in agreement with the landowner of this property. The next closest private receiver (ie dwelling) would be located some 5 km away.

The eastern pump station and associated diesel generator would be fully enclosed to mitigate potential noise impacts. Design specifications for the eastern pump station and associated diesel generator would limit noise generated by their operation to be $L_{eq(15minute)}$ 35 dBA at a distance of 100 m (ie such that cumulative noise from the CGM incorporating the Modification and the eastern pump station would be $L_{eq(15minute)}$ 35 dBA at the closest privately owned receiver). On this basis, the eastern pump station and associated diesel generator does not require inclusion in the operational noise model for the CGM incorporating the Modification.

6.2 Plant and Equipment Sound Power Levels

The potential for machinery to emit noise is quantified as the sound power level (SWL). At the receptor, the received noise is quantified as the sound pressure level (SPL). In general terms, any variation in the on-site plant and equipment SWLs will produce a similar variation in the off-site SPL at the receiver (eg an increase of 5 dBA in the SWL of equipment operating at a site may result in a corresponding 5 dBA increase in SPL of intrusive noise at the receiver, when averaged over the same 15 minute period).

The typical Modification plant and equipment fleet for the Years 10 to 13 of the CGM incorporating the Modification is presented in **Table 24** together with the SWLs from each item based on the current fleet and its achievable noise emission when maintained and operated in good order. As discussed in **Section 6.3**, the noise model including the mobile equipment and fixed plant emissions have been validated against field noise measurement results.

Following Year 13, the number of mobile fleet would decrease proportional to the decrease in annual waste rock production for the remainder of the life of the CGM incorporating the Modification.

The L_{Aeq} SWLs given for each item of mobile equipment do not include noise emissions which emanate from alarms or communication 'horns'. In the event that alarm noise is considered to be a source of disturbance, the alarm noise level should be checked against the appropriate Australian Standard and/or requirements and the necessary mitigating action taken to achieve an acceptable noise reduction without compromising safety standards.

Table 24 Typical Modification Fixed Plant and Mobile Equipment (dBA re 1 pW)

Fleet Item	Typical Plant and Equipment Availability[1]	SWL per item	SWL of Multiple Items[2]
	Years 10 to 13		Years 10 to 13
Fixed Plant			
Process Plant	1	124	124
Mining Fleet			
Hydraulic Excavator 994B (310t)	3	118	123
Haul Truck 789C (184t)	12	124	135
Haul Truck 785B (140t)	3	123	128
Wheel Loader 992D	2	117	120
Track Dozer D10N	4	121	127
Wheel Dozer 834H	1	115	115
Water Truck 777D	2	116	119
Grader 16H	2	115	118
Drills 165-200 mm	7	118	127
Excavator ancillary	2	118	121
Roller	1	109	109
Tailings Storage Facility Embankment Lift Fleet			
Dump Truck A40E Volvo (40t)	6	110	118
Scraper 627F (40t)	2	116	119
Grader 14G	1	114	114
Water Truck Volvo A40D	2	110	113
Compactor CAT 825	1	113	113
Track Dozer D8	1	118	118
Track Dozer D7	1	117	117
Excavator ZX850 (85t)	1	113	113
Total Site	**55**		**138 dBA**

Note 1: The number of fleet items utilised at any given time is subject to mechanical and usage availability (eg subject to shift changes and co-dependent fleet usage).

Note 2: SWL of multiple items (ie the SWL of 12 CAT 789C haul trucks is 135 dBA).

6.3 CGM Noise Model Validation

The CGM noise model was prepared using RTA Software's Environmental Noise Model (ENM for Windows, Version 3.06), a commercial software system developed in conjunction with the EPA. The acoustical algorithms utilised by this software have been endorsed by the ANZECC and all State Environmental Authorities throughout Australia as representing one of the most appropriate predictive methodologies currently available. ENM has been used for all major noise assessments at the CGM including the Environmental Impact Assessment Noise and Blasting report (1997), CGM E42 Modification (2008) and CGM E42 Modification - Modified Request Project (2009).

SLR conducts regular routine and investigative noise monitoring at the CGM enabling the CGM ENM to be updated and validated and to reflect as-built noise emissions, as follows:

- On-site noise measurements to determine fixed plant SWLs were conducted on 30 January 2008. Noise measurement procedures were guided by the requirements of AS 1217.7-1985 "*Acoustics - Determination of Sound Power Levels Part 7 Survey Method*".
- Preliminary predictive noise modelling was previously conducted for comparison with field noise monitoring results, in particular, when mine noise levels were elevated due to mine operations and or during adverse meteorological conditions.

- Field noise monitoring results from the past 3 years were added to the validation database which resulted in no change to the previous noise model calibration factor (of 3 dBA) which has been included in the Modification assessment (while noting that the validation outcomes are generally consistent with field measurement and modelling results from similar large scale resource developments).
- The digital terrain was updated to extend receiver area coverage as well as incorporating the proposed Modification mine plans and significant mobile equipment and fixed plant.

The two operational noise modelling scenarios (described below) include all existing and proposed plant items operating concurrently to simulate the overall maximum energy equivalent (ie $L_{Aeq(15minute)}$) intrusive noise level. A large proportion of the mobile equipment is operated in repeatable routines and a relatively smaller proportion of the emissions emanate from continuous fixed plant items.

6.4 Noise Modelling Scenarios

In accordance with INP requirements, the Modification description was reviewed to determine representative scenarios to assess potential noise impacts. Scenarios representing typical operations of the Modification in Year 11 (2015) and Year 13 (2017) were selected. Justification for these scenarios is provided below.

Year 11 Operations:

Year 11 operations represent the year of maximum material (ie ore and waste) mined during the life of the modified CGM. As such, Year 11 is representative of the maximum mobile equipment fleet that would be used during the life of the modified CGM. In Year 11, active waste emplacement would occur on both the northern waste emplacement (at a height of up to 293 m AHD) and southern waste emplacement (at its maximum elevation of approximately 283 m AHD).

All mining operations were modelled as occurring 24 hours per day, with the exception of tailings storage facility embankment lift works which would occur during the daytime (0700 hours to 1800 hours) only. As there is the potential for tailings storage facility embankment lift works to occur on either the northern or southern tailings storage facility, construction works on both tailings storage facilities were considered in the modelling, with the worst case resultant noise impact presented in **Section 7**. Notwithstanding, construction works would only occur on one of the tailings storage facilities at any given time.

The modelling considered potential impacts associated with Year 11 operations under both lake-full (worst-case) and lake-empty conditions.

Year 13 Operations:

Year 13 operations represent the final year during the life of the modified CGM where the maximum mobile equipment fleet is expected to be used. Following Year 13, the waste to ore ratio would improve, and the number of mobile fleet would decrease proportionally with the decrease in total material mined. In Year 13, active waste emplacement would occur on the northern waste emplacement only.

As with the Year 13 scenario, the modelling considered construction works on both tailings storage facilities, as well as lake-full and lake-empty conditions.

7 MINE OPERATING NOISE IMPACT ASSESSMENT

7.1 Modification Operation Year 11

The predicted $L_{Aeq(15minute)}$ intrusive noise levels for Year 11 during daytime, evening and night-time operation whilst Lake Cowal is full at the nearest residential receiver areas are presented in **Table 25** together with the night-time sleep disturbance $L_{A1(1minute)}$ noise levels. The lake full scenario has been assessed in order to provide for a conservative assessment of noise impacts, simulating less noise attenuation from the lake surface when full of water by comparison with the empty lake bed.

A summary of the privately owned dwellings and vacant land with predicted exceedances of the PSNLs and SDNLs are given in **Section 7.3** for Year 11. Similarly, a summary of the privately owned dwellings with predicted exceedances of the CGM Consented Noise Limits are given in **Section 7.4** for Year 11.

The Year 11 night-time $L_{Aeq(15minute)}$ intrusive noise contours under strong temperature inversion are presented as **Appendix H1**. Note, the calculation of the noise contours involves numerical interpolation of a noise level array. This means that in some cases the contour locations presented in **Appendix H1** differ from the values presented in **Table 25**.

Table 25 Year 2015 Intrusive $L_{Aeq(15minute)}$ and $L_{A1(1minute)}$ Noise Levels (dBA re 20 µPa)

Receiver Area	Property	Day-Calm (0830 - 1700 hours)[1]	Day shoulder-Moderate Inversion (0700 – 0830 and 1700 – 1800 hours)[1]	Evening/Night/ Daytime Strong Inversion (1800 – 0700 hours)[1]	Approved Noise Limit	Night-time Strong Inversion (2200 – 0700 hours)[1] $L_{A1(1min)}$
Privately Owned	Billabong	19 (16)[2]	27 (25)[2]	29 (27)[2]	35	36
	Bramboyne	24	34	**36**[3,6,7]	35	43
	Bungabulla	28 (23)[2]	33 (31)[2]	**36**[3] (34)[2]	39	43
	Coniston	29	**36**[3]	**41**[5]	44	**48**[4]
	Cowal North	23 (20)[2]	31 (29)[2]	33 (32)[2]	38	40
	Foxham Downs	22	31	34	35	41
	Gumbelah	28 (23)[2]	34 (31)[2]	**36**[3] (34)[2]	39	43
	Hillview	11	18	22	35	29
	Koobah	23 (18)[2]	29 (26)[2]	31 (28)[2]	35	38
	Lake Cowal	26 (21)[2]	32 (29)[2]	34 (32)[2]	38	41
	Lakeview	25	33	34	35	41
	Lakeview II	23	32	34	35	41
	Laurel Park	25	34	**37**[3]	39	43
	Goodwood	23 (20)[2]	30 (28)[2]	32 (31)[2]	36	39
	McLintock	32	**38**[4]	**39**[4]	41	**46**[3]
	Melrose	12	20	25	35	32
	Moora Moora	16 (15)[2]	26 (24)[2]	28 (26)[2]	35	35
	The Glen	22	33	**36**[3]	38	43
	Thistleview	19	26	27	35	34
	Wamboyne I	16	25	28	35	35
	Wamboyne II	18	29	31	35	38
	Westella	26	33	35	35	42
	Westlea	33	**38**[4]	**40**[4]	41	**47**[3]
	Wilga Vale	12	22	26	35	33
Lake Cowal	Relocated Crown Reserve	31 (30)[2]	38 (37)[2]	42 (42)[2]	50	n/a
Bird Breeding Area	Bird Breeding Area South	32 (31)[2]	38 (38)[2]	43 (43)[2]	n/a	n/a
	Bird Breeding Area North	23 (23)[2]	32 (31)[2]	34 (34)[2]		

Note 1: Daytime, evening and night-time meteorological parameters as described in **Table 16**.
Note 2: Predicted intrusive noise emission with lake empty for receivers located on the opposite side of Lake Cowal to the CGM.
Note 3: Marginal Noise Management Zone 1 to 2 dBA above PNSL 35 dBA or DSNL 45 dBA.
Note 4: Moderate Noise Management Zone 3 to 5 dBA above PNSL 35 dBA or DSNL 45 dBA.
Note 5: Noise Affectation Zone > 5 dBA above PNSL 35 dBA or DSNL 45 dBA.
Note 6: Marginal Exceedance of existing CGM Consented Noise Limit.
Note 7: Bramboyne not included as a receiver location in previous noise assessment.

7.2 Modification Operation Year 13

The predicted $L_{Aeq(15minute)}$ intrusive noise levels for Year 13 during daytime, evening and night-time operation whilst Lake Cowal is full at the nearest residential receiver areas are presented in **Table 26** together with the night-time sleep disturbance $L_{A1(1minute)}$ noise levels. As for the Year 11 modelling scenario, the lake full scenario has been assessed in order to provide for a conservative assessment of noise impacts, simulating less noise attenuation from the lake surface when full of water by comparison with the empty lake bed.

A summary of the privately owned dwellings and vacant land with predicted exceedances of the PSNLs and SDNLs are given in **Section 7.3** for Year 13. Similarly, a summary of the privately owned dwellings with predicted exceedances of the CGM Consented Noise Limits are given in **Section 7.4** for Year 13.

The Year 13 night-time $L_{Aeq(15minute)}$ intrusive noise contours under strong temperature inversion are presented as **Appendix H2**. Note, the calculation of the noise contours involves numerical interpolation of a noise level array. This means that in some cases the contour locations presented in **Appendix H2** differ from the values presented in **Table 26**.

Table 26 Year 2017 Intrusive $L_{Aeq(15minute)}$ and $L_{A1(1minute)}$ Noise Levels (dBA re 20 µPa)

Receiver Area	Property	Day-Calm (0830 - 1700 hours)[1]	Day shoulder-Moderate Inversion (0700 - 0830 and 1700 - 1800 hours)[1]	Evening/Night/Daytime Strong Inversion (1800 - 0700 hours)[1]	Approved Noise Limit	A Night-time Strong Inversion (2200 - 0700 hours)[1] $L_{A1(1min)}$
Privately Owned	Billabong	17 (17)[2]	27 (26)[2]	29 (28)[2]	35	36
	Bramboyne	25	34	**36**[3,6,7]	35	43
	Bungabulla	24 (23)[2]	32 (30)[2]	35 (34)[2]	39	42
	Coniston	29	35	**41**[5]	44	**48**[4]
	Cowal North	22 (19)[2]	30 (27)[2]	33 (30)[2]	38	40
	Foxham Downs	21	31	34	35	41
	Gumbelah	24 (23)[2]	32 (30)[2]	35 (34)[2]	39	42
	Hillview	12	18	23	35	30
	Koobah	19 (18)[2]	28 (27)[2]	30 (29)[2]	35	37
	Lake Cowal	22 (20)[2]	31 (30)[2]	33 (32)[2]	38	40
	Lakeview	24	33	35	35	42
	Lakeview II	23	33	35	35	42
	Laurel Park	25	33	**37**[3]	39	43
	Goodwood	21 (20)[2]	29 (27)[2]	31 (30)[2]	36	38
	McLintock	32	**38**[4]	**39**[4]	41	**46**[3]
	Melrose	13	21	26	35	33
	Moora Moora	14 (13)[2]	24 (23)[2]	27 (25)[2]	35	33
	The Glen	22	32	**36**[3]	38	43
	Thistleview	19	26	28	35	35
	Wamboyne I	15	24	27	35	34
	Wamboyne II	19	28	30	35	37
	Westella	26	33	35	35	42
	Westlea	32	**37**[3]	**40**[4]	41	**47**[3]
	Wilga Vale	12	20	25	35	32
Lake Cowal	Relocated Crown Reserve	27 (27)[2]	37 (37)[2]	42 (41)[2]	50	n/a
Bird Breeding Area	Bird Breeding Area South	31 (29)[2]	37 (36)[2]	41 (41)[2]	n/a	n/a
	Bird Breeding Area North	22 (21)[2]	30 (29)[2]	34 (33)[2]		

Note 1: Daytime, evening and night-time meteorological parameters as described in **Table 16**.
Note 2: Predicted intrusive noise emission with lake empty for receivers located on the opposite side of Lake Cowal to the CGM.
Note 3: Marginal Noise Management Zone 1 to 2 dBA above PNSL 35 dBA or DSNL 45 dBA.
Note 4: Moderate Noise Management Zone 3 to 5 dBA above PNSL 35 dBA or DSNL 45 dBA.
Note 5: Noise Affectation Zone > 5 dBA above PNSL 35 dBA or DSNL 45 dBA.
Note 6: Marginal Exceedance of existing CGM Consented Noise Limit.
Note 7: Bramboyne not included as a receiver location in previous noise assessment.

7.3 Modification Noise Impact Assessment

7.3.1 Privately Owned Receivers

A summary of the privately owned receivers with predicted intrusive $L_{Aeq(15minute)}$ noise level exceedances of the PSNLs and $L_{A1(1minute)}$ exceedances of the SDNLs are presented in **Table 27** and **Table 28** for Years 11 and 13.

Table 27 Privately Owned Receivers[1] with Intrusive PSNL Exceedances

Assessment Period	Noise Management Zone		Noise Affection Zone
	1 dBA to 2 dBA above PSNL 35 dBA	3 dBA to 5 dBA above PSNL 35 dBA	> 5 dBA above PSNL 35 dBA
Daytime calm period: 0830 to 1700 hours	nil	nil	nil
Daytime Shoulder periods: 0700 to 0830 hours and 1700 to 1800 hours Moderate Inversion	Coniston[2]	McLintock[2] Westlea[2]	nil
Evening and Night-time periods: 1800 to 0700 hours Strong Inversion	Bramboyne Bungabulla[3] Gumbelah[3] Laurel Park[3] The Glen[3]	McLintock[2] Westlea[2]	Coniston[2]

Note 1: Refer to **Appendix A3** for land ownership details.
Note 2: Properties identified in the existing CGM Development Consent as being in the Noise Affectation Zone.
Note 3: Properties identified in the existing CGM Development Consent as being in the Noise Management Zone.

Table 28 Privately Owned Receivers[1] with Night-time $L_{A1(1minute)}$ SDNL Exceedances

Assessment Period	Noise Management Zone		Noise Affection Zone
	1 dBA to 2 dBA above SDNL 45 dBA	3 dBA to 5 dBA above SDNL 45 dBA	> 5 dBA above SDNL 45 dBA
Night-time	McLintock[2] Westlea[2]	Coniston[2]	nil

Note 1: Refer to **Appendix A3** for land ownership details.
Note 2: Properties identified in the existing CGM Development Consent as being in the Noise Affectation Zone.
Note 3: Properties identified in the existing CGM Development Consent as being in the Noise Management Zone.

Noise levels for the CGM incorporating the Modification are predicted to comply with relevant Development Consent noise limits are all privately-owned receivers, with the exception of Bramboyne (**Table 25** and **26**).

To date, Bramboyne has not been identified as a receiver at the location shown in **Appendix H** in any CGM assessment, and as such, noise levels were not previously predicted at this location (ie Bramboyne was previously identified at the location of Wamboyne II shown in **Appendix H**). The revised locations of Bramboyne and Wamboyne II were identified during community consultation.

The predicted intrusive noise level at Bramboyne for the CGM incorporating the Modification is 36 dBA (**Table 25** and **26**). As no material increase in noise levels due to the Modification is predicted at other receiver locations (**Table 25** and **26**), no material change increase in noise levels is expected at Bramboyne.

Three privately owned receivers (Coniston, McLintock and Westlea) were identified as being in the Noise Affectation Zone for the approved CGM (**Table 27**). Based on predicted noise levels for the CGM incorporating the Modification, Coniston would remain in the Noise Affectation Zone, while McLintock and Westlea would be in the Noise Management Zone (**Table 27**).

Seven privately owned receivers (Bungabulla, Gumbelah, Laurel Park, The Glen, Cowal North, Goodwood [formerly referred to as Mattiske] and Lake Cowal [non-Barrick]) were identified as being in the Noise Management Zone for the approved CGM (**Table 27**). For the CGM incorporating the Modification, Cowal North, Goodwood and Lake Cowal (non-Barrick) are no longer identified as being within the Noise Management Zone as predicted intrusive noise levels at these receivers are 35 dBA or less (**Table 25** and **26**).

Based on predicted noise impacts for the CGM incorporating the Modification, Bungabulla, Gumbelah, Laurel Park and The Glen would remain in the Noise Management Zone (**Table 27**). Bramboyne would also be in the Noise Management Zone (**Table 27**).

Three receivers (Coniston, McLintock and Westlea) are identified as being in the Noise Management Zone for the CGM incorporating the Modification due to predicted sleep disturbance noise impacts. Each of these receivers is identified as being within the Noise Affectation or Noise Management Zone for the CGM incorporating the Modification due to predicted intrusive noise impacts.

7.3.2 Privately Owned Vacant Land

As discussed in **Section 5.2**, the DP&I has previously advised that noise impacts on vacant land are assessed on a "case by case" basis. **Table 29** identifies those properties for Years 11 and 13 where exceedences of the intrusive noise level is predicted for more than 25% of vacant land located outside of Lake Cowal.

Table 29 Privately Owned Vacant Land[1] with Intrusive PSNL Exceedances

Assessment Period	Noise Management Zone	Noise Affection Zone
	1 dBA to 5 dBA above PSNL 35 dBA	> 5 dBA above PSNL 35 dBA
Evening and Night-time periods: 1800 to 0700 hours Strong Inversion	14 (Spackman), 37 (Duskidge Pty Ltd)	-

Note 1: Refer to **Appendix H** for noise contour figures.

7.3.3 Crown Reserve Noise Amenity

Noise amenity levels during the daytime, evening and night-time at the Relocated Crown Reserve are predicted to be below the passive recreation amenity criteria of 50 dBA.

7.3.4 Bird Breeding and Wild Life Area

The predicted results also indicate that the maximum intrusive noise level at the closest monitored bird breeding area (Bird Breeding Area South [NO3]) would be 43 dBA and ranging to approximately 34 dBA in northern areas of Lake Cowal. Given the proposed continuation of noise and bird behaviour monitoring in accordance with the "*Cowal Gold Project Flora and Fauna Management Plan"* (Barrick, 2003), as well as the contingency measures in place in the event that assessment and monitoring results indicate that adverse impacts are occurring on fauna in accordance with the "*Flora and Fauna Management Plan"* (Barrick, 2003), noise emissions from the CGM incorporating the Modification would be unlikely to significantly impact any fauna species.

7.4 Existing CGM Development Consent Noise Limits

A summary of the privately owned receivers with predicted intrusive noise levels exceedances of the existing CGM Consented Noise Limits are presented in **Table 27** for Years 11 and 13.

Noise levels for the CGM incorporating the Modification are predicted to comply with relevant Development Consent noise limits are all privately-owned receivers, with the exception of Bramboyne.

As described above, to date, Bramboyne has not been identified as a receiver at the location shown in **Appendix H** in any CGM assessment, and as such, noise levels were not previously predicted at this location. However, as no material increase in noise levels due to the Modification is predicted at other receiver locations (**Table 25** and **26**), no material change increase in noise levels is expected at Bramboyne.

Table 30 Privately Owned Receivers[1] with Intrusive CGM Consented Noise Limit Exceedances

Assessment Period	1 dBA to 2 dBA above Noise Limit	> 2 dBA above Noise Limit
Daytime calm period: 0830 to 1700 hours	nil	nil
Daytime Shoulder periods: 0700 to 0830 hours and 1700 to 1800 hours Moderate Inversion	nil	nil
Evening and Night-time periods: 1800 to 0700 hours Strong Inversion	Bramboyne	nil

Note 1: Refer to **Appendix A3** for land ownership details.

8 BLAST EMISSIONS IMPACT ASSESSMENT

8.1 Blasting Assessment Criteria

8.1.1 Australian Standard Criteria

AS 2187: Part 2-2006 "*Explosives - Storage and Use - Part 2: Use of Explosives*" provides guidance in assessing blast-induced ground (and structural) vibration and airblast effects on buildings and their occupants is presented in detail in Appendix J of AS 2187.

Recommended vibration limits are generally 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 limits are presented in Appendix J Tables J5.4(A) and J5.4(B) AS 2187, respectively.

In relation to building damage airblast criteria AS 2187: Part 2-2006 Appendix J J5.4(B) recommends a maximum airblast of 133 dBpk.

The applicable building damage vibration criteria AS 2187: Part 2-2006 Appendix J 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 minimal risk for a named effect is usually taken as a 95% probability of no effect. 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 discussion a conservative vibration damage assessment criterion of 12.5 millimetres per second (mm/s) peak component particle velocity (PCPV) would be applicable to all privately owned residential dwellings.

8.1.2 Human Comfort Noise and Vibration Criteria

Ground vibration and airblast 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 ANZECC *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 level for airblast is 115 dB Linear.
- The level of 115 dB Linear may be exceeded on up to 5% of the total number of blasts over a period of 12 months. The level should not exceed 120 dB Linear at any time.
- The recommended maximum for ground vibration is 5 mm/s, Peak Vector Sum (PVS) vibration velocity. It is recommended however, that 2 mm/s (PVS) be considered as the long-term regulatory goal for the control of ground vibration.
- The PVS level of 5 mm/s may be exceeded on up to 5% of the total number of blasts over a period of 12 months. The level should not exceed 10 mm/s at any time.

- Blasting should generally only be permitted during the hours of 0900 hours to 1700 hours Monday to Saturday, where practicable. Blasting should not take place on Sundays and public holidays.

The ANZECC criteria are generally consistent with AS 2187: Part 2-2006 Appendix J Tables J4.5(A) and J5.4(A) with respect to vibration and airblast human comfort respectively.

8.1.3 Potential Effects of Blast Emissions on Bird Breeding and Wild Life Areas

Ground vibration and airblast has the potential to disturb routine activities of vertebrate fauna, particularly birds. For example, disruptions to normal breeding and behaviour patterns may result from birds taking flight as a result of the blasting stimulus (ie blast noise and/or vibration) (North Limited, 1998).

The "*Cowal Gold Project 2005 Annual Environmental Management Report*" (Barrick, 2006) includes a summary of bird observations during the first ten blasts at the CGM. The observation was overseen by Dr Peter Gell from the Geographical and Environmental Studies Department of the University of Adelaide. Dr Peter Gell has been involved in monitoring and reporting on waterbird populations and breeding activities at Lake Cowal since 1992 and has completed over 45 surveys during that time. The four fauna specialists who conducted the monitoring found that there was no abrupt change in the behaviour of any bird species to any blast and no evidence that any bird perceived any blast (Gell, 2005).

8.1.4 Existing CGM Development Consent Blast Emission Limits

The existing CGM Development Consent (DA 14/98) contains blasting impact assessment criteria, as shown in **Appendix B1** with an extract presented below.

Blasting Impact Assessment Criteria

(a) The Applicant shall ensure that blasting at the project does not exceed the criteria in Table 5.

Table 5: Blasting impact assessment criteria

Location	***Time of Blasting***	***Airblast overpressure (dB(Lin Peak))***	***Ground vibration (mm/s)***	***Allowable exceedance***
Residence on privately owned land	*Any time*	*120*	*10*	*0%*
	Day	*115*	*5*	*5% of the total number of blasts over a period of 12 months*
	Evening	*105*	*2*	
	Night	*95*	*1*	
	Sundays and Public holidays (24 Hrs)	*95*	*1*	

8.2 Proposed Open Pit Blasting Practices

Assessment of the potential ground vibration and airblast emissions arising from overburden and ore blasting has been based on the existing indicative CGM blast design parameters presented in **Table 31** which generally represent a continuation of the currently approved blasting practices that would also be employed for the CGM incorporating the Modification. As discussed in **Section 3.3**, blast sizes would generally remain unchanged for the Modification. However, potential blast impacts associated with the expanded open pit have been assessed.

Table 31 Indicative Blast Design Parameters

Blast Design Parameter	Typical Dimension	Range
Number of Holes	350	200 to 500
Number of Rows	9	3 to 12
Hole Diameter	165 mm	115 to 200 mm
Hole Inclination (to vertical)	0	0 to 20°
Bench Height	9 m	5 to 18 m
Burden	4.4 m	3 to 6 m
Spacing	5.3 m	4 to 7 m
Subdrill	1.3 m	0.6 to 1.8 m
Stemming Depth	3.6 m	3 to 4.5 m
Delay Timing	Nonel	N/A
Column Explosive	Emulsion	ANFO/Slurry/Emulsion
Powder Factor	0.82 kg/bcm	0.60 to 1.00 kg/bcm
MIC	172 kg	50 to 350 kg

ANFO = ammonium nitrate fuel oil.
° = degree.
MIC = maximum instantaneous charge.

To determine the blast emissions levels at the nearest potentially affected receivers, the Modification design parameters have been adopted and the ground vibration and airblast levels predicted using the relevant formula based on AS 2187.2-2006. The relevant formulae are as follows:

$$PVS\ (50\%) = 1{,}140*(R/Q^{1/2})^{-1.60}$$
$$PVS\ (5\%) = 3{,}272*(R/Q^{1/2})^{-1.60}$$
$$SPL\ (50\%) = 164.4 - 24*(\log(R) - \tfrac{1}{3}\log(Q))$$
$$SPL\ (5\%) = 173.4 - 24*(\log(R) - \tfrac{1}{3}\log(Q))$$

where,

PVS = Peak Vector Sum vibration velocity (mm/s)
SPL = Peak airblast noise level (dB Linear)
R = Distance between charge and receiver (m)
Q = Charge mass per delay (kg)

8.3 Predicted Ground Vibration and Airblast Levels

Using the blast emission site laws described above, ground vibration and airblast levels were predicted at the nearest potentially affected receivers, as presented **Table 32**, for the CGM incorporating the Modification (refer **Appendices D1 to D2**) for a maximum MIC 350 kg and a minimum MIC 50 kg.

Table 32 Predicted Vibration and Airblast Emissions (MIC 350 kg)

Receiver Area	Property	Nearpoint Distance (m)	Ground Vibration[1] (mm/s)		Airblast[2] (dBLpk re 20 µPa)		Ground Vibration[1] (mm/s)		Airblast[2] (dBLpk re 20 µPa)	
			MIC 350 kg		MIC 350 kg		MIC 50 kg		MIC 50 kg	
			50%	5%	50%	5%	50%	5%	50%	5%
Privately Owned	Billabong	12964	0.0	0.1	86	95	0.01	0.02	79	88
	Bramboyne	8578	0.1	0.2	90	99	0.01	0.04	83	93
	Bungabulla	7516	0.1	0.2	92	101	0.02	0.05	85	94
	Coniston	4989	0.1	0.4	96	105	0.03	0.09	89	**98**[1]
	Cowal North	8474	0.1	0.2	90	99	0.01	0.04	84	93
	Foxham Downs	9116	0.1	0.2	90	99	0.01	0.03	83	92
	Gumbelah	7404	0.1	0.2	92	101	0.02	0.05	85	94
	Hillview	16406	0.0	0.1	83	93	0.00	0.01	77	86
	Koobah	11909	0.0	0.1	87	96	0.01	0.02	80	89
	Lake Cowal	9245	0.1	0.2	89	99	0.01	0.03	83	92
	Lakeview	9708	0.1	0.1	89	98	0.01	0.03	82	91
	Lakeview II	9850	0.1	0.1	89	98	0.01	0.03	82	91
	Laurel Park	7477	0.1	0.2	92	101	0.02	0.05	85	94
	Goodwood	9693	0.1	0.1	89	98	0.01	0.03	82	91
	McLintock	7051	0.1	0.2	92	101	0.02	0.05	85	95
	Melrose	14686	0.0	0.1	85	94	0.01	0.02	78	87
	Moora Moora	13909	0.0	0.1	85	94	0.01	0.02	78	88
	The Glen	6830	0.1	0.3	93	102	0.02	0.05	86	95
	Thistleview	10724	0.0	0.1	88	97	0.01	0.03	81	90
	Wamboyne I	12121	0.0	0.1	87	96	0.01	0.02	80	89
	Wamboyne II	10801	0.0	0.1	88	97	0.01	0.03	81	90
	Westella	9129	0.1	0.2	90	99	0.01	0.03	83	92
	Westlea	6581	0.1	0.3	93	102	0.02	0.06	86	95
	Wilga Vale	14324	0.0	0.1	85	94	0.01	0.02	78	87
Lake Cowal	Relocated Crown Reserve	4260	0.2	0.6	97	107	0.04	0.12	91	100
Bird Breeding Area	Bird Breeding Area South (NO3)	3054	0.3	0.9	101	110	0.07	0.20	94	103
	Bird Breeding Area North (NO4)	7324	0.1	0.2	92	101	0.02	0.05	85	94

Note 1: PVS (mm/s).
Note 2: dBLpk re 20 µPa.
Note 3: Predicted 3 dB exceedance of the daytime Sunday/Public Holiday human comfort criteria of 95 dBLpk.

8.4 Modification Blasting Impact Assessment

8.4.1 Privately Owned Receivers

With a blast MIC of 350 kg, the predicted ground vibration and airblast levels are below the most stringent structural damage criterion of 12.5 mm/s and 133 dBLpk at all privately owned receivers.

Similarly, with a blast MIC of 350 kg, the predicted 5% exceedance ground vibration and airblast levels are below the daytime (exclusive of Sundays/Public Holidays) human comfort criteria of 5 mm/s and 115 dBLpk at all privately owned receivers.

Furthermore, with a blast MIC of 50 kg, the predicted 5% exceedance ground vibration and airblast levels are below the daytime Sundays/Public Holidays human comfort criteria of 1 mm/s and 95 dBLpk at all privately owned receivers, except at Coniston. The predicted airblast level at Coniston of 98 dBLpk is moderately (3 dB) above the criterion. However as discussed in **Section 2.3**, the existing CGM airblast monitoring results show that the (actual) measured airblast levels (on Sundays/Public Holidays) are below human comfort criterion of 95 dBLpk at Coniston.

Barrick would continue to conduct blasting on a Sunday/Public Holidays only in accordance with relevant blast criteria. Blast monitoring would continue at Coniston to confirm that compliance with blast criteria is maintained. Should blast monitoring indicate that blast overpressure is approaching the criteria of 95 dBLpk, blast sizes would be modified (eg MIC would be reduced).

8.4.2 Bird Breeding and Wild Life Area

The predicted results indicate that the maximum airblast level at the closest monitored bird breeding area (Bird Breeding Area South [NO3]) would be 110 dB. Given the proposed continuation of blast and bird behaviour monitoring in accordance with the "*Cowal Gold Project Flora and Fauna Management Plan"* (Barrick, 2003), as well as the contingency measures in place in the event that assessment and monitoring results indicate that adverse impacts are occurring on fauna, Modification blasting would be unlikely to significantly impact any fauna species.

Similarly, the predicted results indicate that the maximum airblast level would remain below the lowest livestock behaviour reaction noise level of 125 dB (refer **Section 8.1.4**) at distances of 750 m or greater from the blast site.

8.5 Existing CGM Development Consent Blast Emission Limits

The existing CGM Consented Blast Emission Limits are equivalent to ANZECC's *Technical Basis for Guidelines to Minimise Annoyance due to Blasting Overpressure and Ground Vibration* guideline (refer to **Section 8.1.2**) and therefore the assessment outcome is the same as that presented in **Section 8.4.1**.

9 ROAD TRAFFIC NOISE IMPACT ASSESSMENT

9.1 Traffic Noise Criteria

9.1.1 Existing CGM Development Traffic Noise Limits

As discussed in **Section 2.4**, Barrick has implemented a program of traffic noise monitoring and reporting in accordance with the CGM NMP and the results are presented in the CGM AEMRs. Traffic Noise Criteria in accordance with the NMP, Section 3.2, are as follows:

> *In accordance with Consent Conditions 6.4(d), Barrick will take all reasonable and feasible measures to ensure that traffic noise generated by the CGM does not exceed the criteria in Table 1.*

Table 1 Traffic Noise Impact Assessment Criteria dB(A) $L_{Aeq(1hour)}$

Road	***Day/Evening***	***Night***
Ungarie Road	*60*	*55*
Wamboyne Road, Blow Clear Road, Carrawandool-Warro Road, Burcher Road, Condobolin Road, Lake Cowal Road	*55*	*50*

Note 1: Traffic noise generated by the project is to be measured in accordance with the relevant procedures in DECCW's Environmental Criteria for Road Traffic Noise.

> *As described in DECCW's Environmental Criteria for Road Traffic Noise, if the local authorities identify all or part of the mine access routes as being a "principal haulage route", then the traffic noise impact assessment criteria for the route/s would match those for collector roads, recognising the intent that they carry a different level and mix of traffic to local roads. Accordingly, the relevant traffic noise impact assessment criteria for these routes would be:*
>
> - *Day/Evening - $L_{Aeq(1hour)}$ 60 dB(A); and*
> - *Night-time - $L_{Aeq(1hour)}$ 55 dB(A).*

In relation to CGM traffic noise exceedances, NMP Section 13 states that:

> *"In accordance with Consent Condition 11.2, if the results of the noise investigations (Sections 6 and 10) identify that noise impacts generated by the CGM are greater than the impact assessment criteria (Section 3), except where a negotiated agreement has been entered into in relation to that impact, then Barrick will, within two weeks of obtaining the monitoring results, notify the Director-General of the DoP, the affected landowners and tenants (including tenants of mine-owned properties) accordingly, and provide quarterly monitoring results to each of these parties until the results show that the development is complying with the criteria in Sections 3.1 and 3.2."*

9.1.2 NSW Environmental Criteria for Road Traffic Noise

As stated above, traffic noise generated by the existing CGM is to be measured in accordance with the relevant procedures in the ECRTN. Previous assessments of potential traffic noise impacts have been undertaken in accordance with the ECRTN where Ungarie Road was classified as a collector road and Wamboyne and Blow Clear Roads were classified as local roads. The consented traffic noise limits for the existing CGM are therefore generally consistent with the requirements of the ECRTN in relation to land use developments with the potential to create additional traffic on collector and local roads.

It is noted however, that the Roads & Maritime Services (RMS) current vehicle travel restriction routes identify both Ungarie Road and Wamboyne Road as designated heavy vehicle routes (ie 4.6 m high vehicle and or up to 25 m B-Double) and are therefore generally consistent with the ECRTN's classification of "principal haulage routes". Hence, according to the ECRTN, the applicable criteria for a local road (ie Wamboyne and Blow Clear Roads) classified as a "principal haulage route" should be consistent with the criteria for a collector road (ie Ungarie Road) which as stated above is:

- *Day/Evening - $L_{Aeq(1hour)}$ 60 dB(A); and*
- *Night-time - $L_{Aeq(1hour)}$ 55 dB(A).*

9.1.3 NSW Road Noise Policy

As discussed in **Section 1.2**, the ECRTN has now been superseded and replaced by the RNP and associated Application Notes dated 15 February 2013 (refer **Appendix I1**). The RNP identifies noise "assessment" and "relative increase" criteria. These criteria aim to maintain an acceptable level of road traffic noise associated with new road projects, road redevelopment projects and traffic-generating developments.

The RNP adopts a new classification scheme for assessing noise impacts on an existing road network. In accordance with the RNP, previously classified collector roads (ie Ungarie Road) are now classified as sub-arterial roads. The RNP retains the classification of "principal haulage route" recognising that they can carry a different level and mix of traffic to local roads. Hence, the applicable criteria for a local road (ie Wamboyne and Blow Clear Roads) classified as a "principal haulage route" is the same as a sub-arterial road as presented in **Table 33**.

Table 33 Road Traffic Noise Assessment Criteria for Residential Land Uses (dBA re 20 µPa)

Road	Type of Project and Land Use	Total Traffic Noise Criteria[1]	Relative Increase Criteria
Ungarie Road Wamboyne Road Blow Clear Road	Land use developments generating additional traffic on sub-arterial roads and local roads classified as a principal haulage route.	Daytime 60 $L_{Aeq(15hour)}$	Existing $L_{Aeq(15hour)}$ plus 12 dBA
		Night-time 55 $L_{Aeq(9hour)}$	Existing $L_{Aeq(9hour)}$ plus 12 dBA

Note 1: Daytime 0700 hours to 2200 hours, Night-time 2200 hours to 0700 hours.

It is noted that the NSW RNP Application Notes state that the relative increase criteria are primarily intended to protect existing quiet areas, being areas that are 12 dB or more below the relevant noise assessment criterion that applies day or night, from excessive changes in amenity due to noise from additional traffic.

In relation to situations where exceedances of the road traffic noise assessment criteria are predicted, the RNP relevantly provides:

> *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'.*

In practice, noise level increases of less than 2 dBA are generally achieved when the percentage increase to the existing light and heavy traffic is no greater than 60%. The RNP describes a number of steps for applying the criteria. In general accordance with these steps, this assessment has:

- Identified a study area, consistent with the CGM NMP Section 10.1.3 (Figures 4 and 5) as the Mine Access Route (ie Ungarie, Wamboyne and Blow Clear Roads) with the adjacent residential dwellings as presented in **Appendices I2** and **I3**.
- Tabulated 2013 road traffic flows within the study area due to, non-mine traffic, total traffic and the existing (approved) CGM traffic.
- Identified the relative contribution from the existing (approved) CGM traffic in total traffic noise and determined the relative increase in total traffic noise from the Modification incremental traffic.

9.2 Existing Road Traffic Noise Impact Assessment

As presented in **Section 4.3**, the road traffic flow and noise measurement results from traffic noise monitoring conducted in February 2013 have been used to quantify the near-field total traffic noise adjacent to the primary mine access route to the CGM (for employees, major deliveries and heavy vehicles) as shown on Traffic Noise Monitoring Locations Plan (**Appendix C2**). The data were then processed in accordance with the requirements of the RNP to derive the total traffic noise levels presented in **Table 34**.

Table 34 Calculated L_{Aeq} Total Traffic Noise Levels February 2013 (dBA re 20 µPa)

ID	Location	Offset Distance	Daytime $L_{eq(15hour)}$[1]	Night-time $L_{eq(9hour)}$[1]
TN1	140 Ungarie Road, West Wyalong	30 m	59 dBA	54 dBA
TN2	"Clairview" Residence, 56 – 86 Wamboyne Road	45 m	52 dBA	50 dBA
TN3	"Windstone" Residence, 648 Wamboyne Road	150 m	46 dBA	43 dBA

Note 1: Total traffic noise inclusive of façade correction.

The 2013 total traffic noise has been used to calculate the nominal off-set distances from Ungarie, Wamboyne and Blow Clear Roads to meet the daytime and night-time total traffic noise criteria (refer **Table 33**) as presented in **Table 35**.

Table 35 Nominal Off-set Distance to Meet the Total Traffic Noise Criteria

ID	Location	Offset Distance	Daytime $L_{eq(15hour)}$[1]	Night-time $L_{eq(9hour)}$[1]
TN1	140 Ungarie Road, West Wyalong	23 m	60 dBA	-
		23 m	-	55 dBA
TN2	"Clairview" Residence, 56 – 86 Wamboyne Road	10 m	60 dBA	-
		17 m	-	55 dBA
TN3	"Windstone" Residence, 648 Wamboyne Road	11 m	60 dBA	-
		19 m	-	55 dBA

Note 1: Total traffic noise inclusive of façade correction.

Based on the 2013 total traffic noise, all residential dwellings in the study area have total traffic noise below daytime criteria of $L_{eq(15hour)}$ 60 dBA and night-time criteria of $L_{eq(9hour)}$ 55 dBA.

9.3 Modification Road Traffic Noise Impact Assessment

The 2013 road traffic flows on Ungarie, Wamboyne and Blow Clear Roads are presented in **Table 36** along with the existing CGM and Modification traffic. For the purposes of noise impact assessment the daytime and night-time traffic flows are shown, together with the relative (contribution) percentage from the existing CGM traffic and the relative (percentage) increase from the Modification incremental traffic.

Table 36 Ungarie, Wamboyne and Blow Clear Roads 2013 Traffic Flows

Time Period	Non Mine 2013[1]	Total Traffic 2013[2]	Existing CGM 2013[3]	Modification Increment[4]
Ungarie Road				
Daytime 15 hour traffic	1070	1242	172 (14%)	0
Night-time 9 hour traffic	100	209	109 (52%)	0
Wamboyne Road				
Daytime 15 hour traffic	204	367	163 (44%)	0
Night-time 9 hour traffic	13	136	123 (91%)	0
Blow Clear Road				
Daytime 15 hour traffic	194	364	170 (47%)	0
Night-time 9 hour traffic	14	136	122 (90%)	0

Note 1: 2013 non-mine traffic flow ie exclusive of the existing CGM traffic.
Note 2: 2013 total traffic flow ie inclusive of the of the existing CGM traffic.
Note 3: 2013 existing CGM - values in parentheses represent the CGM as a percentage of the 2013 total traffic flow.

As the Modification is not expected to change traffic movements generated by the CGM, total traffic noise at all residential dwellings in the study area would remain unchanged for the Modification. Hence no residential dwellings adjacent to the Mine Access Route (ie Ungarie, Wamboyne and Blow Clear Roads) are predicted to exceed the relative increase criteria and daytime criteria of $L_{eq(15hour)}$ 60 dBA and night-time criteria of $L_{eq(9hour)}$ 55 dBA due to the Modification.

10 SUMMARY OF FINDINGS

10.1 Construction Impact Assessment

Modification construction works include the southern and northern tailings storage facilities embankment lifts and would be carried-out during the daytime through-out the Modification life as required. In accordance with the EPA's ICNG, Modification construction works are generally considered integral with the general mining operations. Therefore the construction works associated with southern and northern tailings storage facilities embankment lifts have been modelled as a component of the CGM incorporating the Modification daytime operational activities in Years 11 and 13.

10.2 Noise Assessment Criteria

10.2.1 Operating Assessment Criteria

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 INP, the EPA has two broad objectives:

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

The INP prescribes detailed calculation routines for establishing Project Specific Noise Levels (PSNLs) (ie $L_{Aeq(15minute)}$ intrusive criteria and $L_{Aeq(period)}$ amenity criteria) at potentially affected receivers for an industrial development. Ideally, the intrusive noise level should not exceed the background level by more than 5 dBA. Similarly, the noise amenity level should not exceed the specified INP "acceptable" or "maximum" noise level appropriate for the particular land use.

In accordance with the INP's Chapter 2 Industrial Noise Criteria and associated Application Notes dated 15 February 2013, the PSNLs for the residential and other localities in the vicinity of the CGM are presented in **Table 37** for both intrusive noise and amenity. These criteria are nominated for the purposes of assessing potential noise impacts from the CGM incorporating the Modification.

Table 37 Project-specific Noise Assessment Criteria (dBA re 20 µPa)

Receiver	Land Use	Intrusive $L_{Aeq(15minute)}$[1]			Amenity $L_{Aeq(period)}$[1]		
		Day	Evening	Night	Day	Evening	Night
Existing Private Dwellings	Rural Residential[2]	35	35	35	50	45	40
Potential Private Dwellings	Rural Vacant Land[4]						
Lake Cowal	Passive Recreation	Intrusive noise not applicable			50 when in use[3]		

Note 1: Daytime 0700 hours to 1800 hours, Evening 1800 hours to 2200 hours, Night-time 2200 hours to 0700 hours.
Note 2: At the most-affected point within 30 m of the residential area.
Note 3: At the most-affected point within 50 m of the area boundary.
Note 4: Where exceedances are predicted over 25% of the vacant land area.

The intrusiveness criterion is met if the $L_{Aeq(15minute)}$ is less than or equal to the RBL plus 5 dBA, where the RBL is determined from monitoring data following the INP procedures discussed in **Section 4.2**. Thus, the most stringent PSNLs at rural residential receivers (and vacant land) would be the $L_{Aeq(15minute)}$ intrusiveness criterion.

10.2.2 Sleep Disturbance Assessment Criteria

The INP Application Notes dated 15 February 2013 suggest that the $L_{A1(1minute)}$ level of 15 dBA above above the RBL is a suitable screening criterion for sleep disturbance for the night-time period. Therefore the night-time SDNL would be $L_{A1(1minute)}$ 45 dBA for assessing potential sleep disturbance from the CGM incorporating the Modification.

10.2.3 Noise Impact Assessment Methodology

Table 38 presents the methodology for assessing the CGM incorporating the Modification operating noise levels against the intrusive PSNLs (**Table 21**) and $L_{A1(1minute)}$ SDNLs (**Table 22**).

Table 38 Modification Noise Impact Assessment (dBA re 20 µPa)

Assessment Source	Assessment Parameter	Assessment Criteria	Noise Management Zone[1]		Noise Affectation Zone
			Marginal	Moderate	
Modification	PSNL Intrusive	RBL plus 5 dBA	1 to 2 dBA above assessment criteria	3 to 5 dBA above assessment criteria	> 5 dBA above assessment criteria[2]
	PSNL Amenity	INP acceptable			
	SDNL $L_{A1(1minute)}$	RBL plus 15 dBA			

Note 1: Depending on the degree of predicted exceedance of the relevant assessment parameter potential noise impacts in the noise management zone could range from marginal to moderate (in terms of the perceived noise increase).

Note 2: Exposure to the CGM incorporating the Modification noise levels greater than 5 dBA above the relevant PSNL and or SDNL may be considered unacceptable by some landowners.

10.2.4 Noise Mitigation Measures

Barrick is obligated to manage noise levels from the CGM in accordance with the noise assessment criteria specified in Development Consent (DA 14/98) (as modified). For the existing CGM operation this is been achieved through the implementation of the NMP, as discussed in **Section 2.2.1**.

For the Modification, Barrick would schedule tailings storage facility embankment lift works to occur during daytime only (0700 and 1800 hours) to reduce potential noise impacts during the evening and night.

10.3 Modification Operating Noise Impact Assessment

10.3.1 Privately Owned Receivers and Vacant Land

A summary of the privately owned receivers and vacant land with predicted intrusive $L_{Aeq(15minute)}$ noise level exceedances of the PSNLs and $L_{A1(1minute)}$ exceedances of the SDNLs are presented in **Table 39**.

One privately owned received was identified as being in the Noise Affectation Zone for the CGM incorporating the Modification (**Table 39**). By comparison, three privately owned receivers were identified as being within the Noise Affectation Zone for the approved CGM.

Seven privately owned receivers were identified as being within the Noise Management Zone for the CGM incorporating the Modification (**Table 39**). By comparison, seven privately owned receivers were identified as being within the Noise Management Zone for the approved CGM.

Only one privately owned receiver was predicted to have noise levels exceeding existing Development Consent noise limits. This receiver (Bramboyne) was not identified as a receiver location in the previous assessments for the CGM (ie for the Modified Request).

10.3.2 Existing CGM Development Consent Noise Limit Assessment

The predicted intrusive $L_{Aeq(15minute)}$ noise levels comply with the CGM Consented Noise Limits at all privately owned receivers, except at Bramboyne. The predicted intrusive $L_{Aeq(15minute)}$ noise level of 36 dBA is marginally (1 dBA) above the consented noise limit of 35 dBA during strong temperature inversions. It is noted that Bramboyne was not included as a receiver location in the previous noise assessments for the CGM.

Table 39 Summary of Criteria Exceedances at Privately Owned Receivers[1] and Vacant Land

Exceedance Range	**1 to 2 dBA above PSNL**	**3 to 5 dBA above PSNL**	**> 5 dBA above PSNL**
Intrusive LAeq(15minute)	Bramboyne Bungabulla[3] Gumbelah[3] Laurel Park[3] The Glen[3]	McLintock[2] Westlea[2]	Coniston[2]
Exceedance Range	**1 to 2 dBA above SDNL**	**3 to 5 dBA above SDNL**	**> 5 dBA above SDNL**
Sleep Disturbance LA1(1minute)	McLintock[2] Westlea[2]	Coniston[2]	-
Exceedance Range	**1 to 5 dBA above PSNL**		**> 5 dBA above PSNL**
Vacant Land Intrusive LAeq(15minute)	14 (Spackman), 37 (Duskidge Pty Ltd)		-

Note 1: Refer to **Appendix A3** for land ownership details.
Note 2: Properties identified in the CGM Development Consent as being in the Noise Affectation Zone.
Note 3: Properties identified in the CGM Development Consent as being in the Noise Management Zone.

10.3.3 Crown Reserve Noise Amenity

Noise amenity levels during the daytime, evening and night-time at the Relocated Crown Reserve are predicted to be below the passive recreation amenity criteria of 50 dBA.

10.4 Blasting Impact Assessment

10.4.1 Privately Owned Receivers

There would be no change to the existing blast design parameters at the CGM for the Modification. Notwithstanding, potential blast impacts have been assessed for the extended open pit.

With a blast MIC of 350 kg, the predicted ground vibration and airblast levels are below the most stringent structural damage criterion of 12.5 mm/s and 133 dBLpk at all privately owned receivers.

Similarly, with a blast MIC of 350 kg, the predicted 5% exceedance ground vibration and airblast levels are below the daytime (exclusive of Sundays/Public Holidays) human comfort criteria of 5 mm/s and 115 dBLpk at all privately owned receivers.

With a blast MIC of 50 kg, the predicted 5% exceedance ground vibration and airblast levels are below the daytime Sundays/Public Holidays human comfort criteria of 1 mm/s and 95 dBLpk at all privately owned receivers, except at Coniston. The predicted airblast level at Coniston of 98 dBLpk is moderately (3 dB) above the criterion of 95 dBLpk, however, as discussed in **Section 2.3**, the existing CGM airblast monitoring results show that the (actual) measured airblast levels (on Sundays/Public Holidays) are below human comfort criterion of 95 dBLpk at Coniston (emphasizing the conservative basis of this blast emission assessment).

Barrick would continue to conduct blasting on a Sunday/Public Holidays only in accordance with relevant blast criteria. Blast monitoring would continue at Coniston to confirm that compliance with blast criteria is maintained. Should blast monitoring indicate that blast overpressure is approaching the criteria of 95 dBLpk, blast sizes would be modified (eg MIC would be reduced).

10.4.2 Existing CGM Development Consent Blast Emission Limits

The existing CGM Consented Blast Emission Limits are equivalent to ANZECC's *Technical Basis for Guidelines to Minimise Annoyance due to Blasting Overpressure and Ground Vibration* guideline (refer to **Section 8.1.2**) and therefore the assessment outcome is the same as that presented in **Section 10.4.1**.

10.5 Traffic Impact Assessment

10.5.1 Traffic Noise Criteria

As discussed in **Section 1.2**, the ECRTN has now been superseded and replaced by the RNP and associated Application Notes dated 15 February 2013. The RNP adopts a new classification scheme for assessing noise impacts on an existing road network. In accordance with the RNP, previously classified collector roads (ie Ungarie Road) are now classified as sub-arterial roads. The applicable criteria for a local road (ie Wamboyne and Blow Clear Roads) classified as a "principal haulage route" is the same as a sub-arterial road as presented in **Table 40**.

Table 40 Road Traffic Noise Assessment Criteria for Residential Land Uses (dBA re 20 µPa)

Road	Type of Project and Land Use	Total Traffic Noise Criteria[1]	Relative Increase Criteria
Ungarie Road Wamboyne Road Blow Clear Road	Land use developments generating additional traffic on sub-arterial roads and local roads classified as a principal haulage route.	Daytime 60 $L_{Aeq(15hour)}$	Existing $L_{Aeq(15hour)}$ plus 12 dBA
		Night-time 55 $L_{Aeq(9hour)}$	Existing $L_{Aeq(9hour)}$ plus 12 dBA

Note 1: Daytime 0700 hours to 2200 hours, Night-time 2200 hours to 0700 hours.

10.5.2 Existing Road Traffic Noise

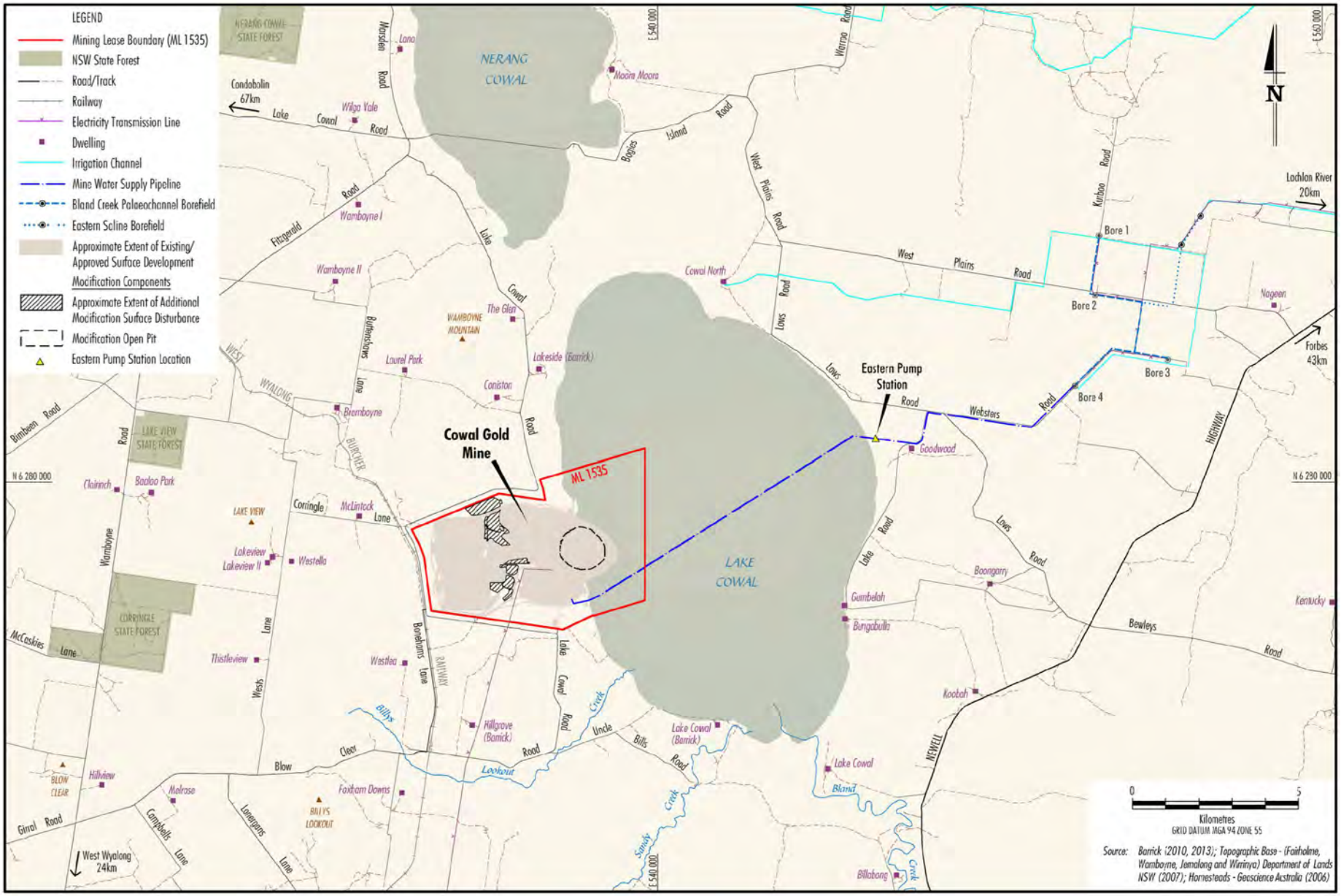
Based on the 2013 total traffic noise, all residential dwellings in the study area have total traffic noise below daytime criteria of $L_{eq(15hour)}$ 60 dBA and night-time criteria of $L_{eq(9hour)}$ 55 dBA.

10.5.3 Modification Road Traffic Noise

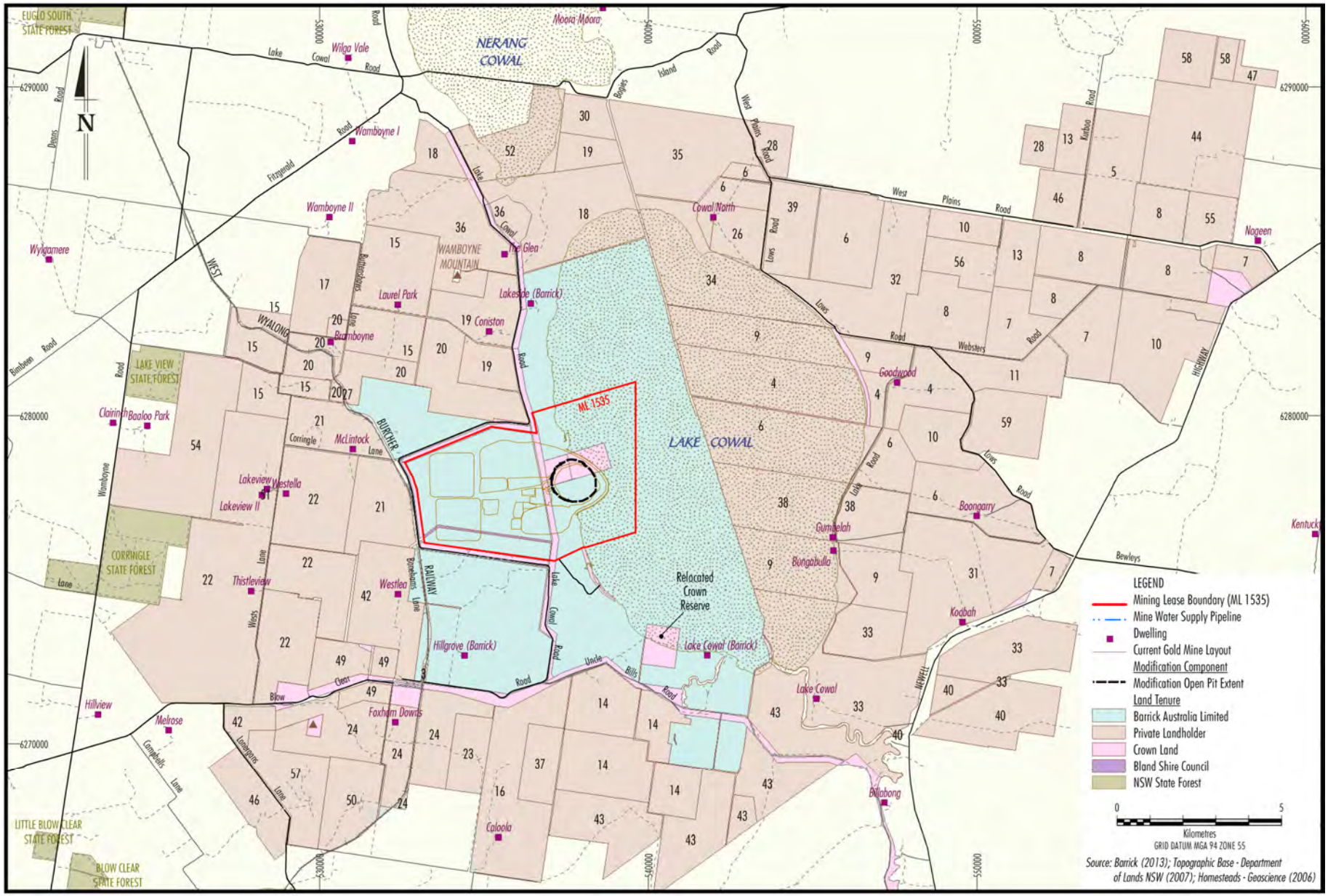
As the Modification is not expected to change traffic movements generated by the CGM, total traffic noise at all residential dwellings in the study area would remain unchanged for the Modification. Hence no residential dwellings adjacent to the Mine Access Route (ie Ungarie, Wamboyne and Blow Clear Roads) are predicted to exceed the relative increase criteria and daytime criteria of $L_{eq(15hour)}$ 60 dBA and night-time criteria of $L_{eq(9hour)}$ 55 dBA due to the Modification.

REGIONAL LOCATION PLAN

CGM LOCATION PLAN



LAND OWNERSHIP AND DWELLING PLAN



6.3 Blasting and Vibration

Blasting Impact Assessment Criteria

(a) The Applicant shall ensure that blasting at the project does not exceed the criteria in Table 5.

Table 5: Blasting impact assessment criteria

Location	Time of Blasting	Airblast overpressure (dB(Lin Peak))	Ground vibration (mm/s)	Allowable exceedance
Residence on privately owned land	Any time	120	10	0%
	Day	115	5	5% of the total number of blasts over a period of 12 months
	Evening	105	2	
	Night	95	1	
	Sundays and Public holidays (24 Hours)	95	1	

Blast Management Plan

(b) The Applicant shall prepare and implement a Blast Management Plan for the project in consultation with DECCW and to the satisfaction of the Director-General. This plan must be submitted to the Director-General for approval by the end of July 2010 and include provisions to:

(i) evaluate blasting impacts on, and demonstrate compliance with the blasting criteria in this approval for privately-owned residences and structures;

(ii) implement best blasting practice to:
- protect the safety of people, property, public infrastructure, and livestock; and
- minimise disturbance to bird breeding. and

(iii) ensure that blast monitoring data is assessed regularly, and that operations are relocated, modified and/or stopped as required to ensure compliance with the relevant blast criteria.

Public Notice

(c) The Applicant shall advise residents within two (2) kilometres of the active mining area of future blasting events on a monthly basis, and of any changes to monthly programs.

(d) Upon written request of the owner of any dwellings located within two (2) kilometres of the active mining area, the Applicant shall arrange at its own costs, for the inspection by a technically qualified person agreed to by both parties, to record the material condition of any structure on such property within 14 days of receipt of the request. The Applicant shall supply a copy of any inspection report, certified by the person who undertook the inspection, to the relevant property owner within fourteen (14) days of receipt of the report.

6.4 Noise

Acquisition Upon Request

(a) Upon receiving a written request for acquisition from the owner of any land listed in Table 6 following landholder notification in accordance with condition 11.1 of schedule 2, the Applicant shall acquire the land in accordance with the procedures in condition 11 of schedule 2.

Table 6: Land subject to acquisition upon request

Coniston
McLintock
West Lea

Note: To interpret the location referred to Table 6, see Appendix 3.

(b) If the noise generated by the development exceeds the criteria in Table 7 at any residence on privately-owned land, or on more than 25 percent of privately-owned land not located within Lake Cowal (as shown in Appendix 3), the Applicant shall, upon receiving a written request for acquisition from the landowner, acquire the land in accordance with the procedures in condition 11 of Schedule 2.

Table 7: Land acquisition criteria dB(A) $L_{Aeq\ (15min)}$

Location	Day/Evening/Night
All privately-owned land excluding the land listed in Table 6	40

Note: Noise generated by the project is to be measured in accordance with the relevant requirements, and exemptions (including certain meteorological conditions), of the NSW Industrial Noise Policy.

Noise Impact Assessment Criteria

(c) The Applicant shall ensure that the noise generated by the development does not exceed the noise impact assessment criteria in Table 8 at any residence on privately-owned land, or on more than 25 percent of privately-owned land not located within Lake Cowal, as shown in Appendix 3.

Table 8: Noise Impact Assessment Criteria dB(A) $L_{Aeq\ (15min)}$

Location	Day/Evening/Night
Bungabulla	39
Coniston	44
Cowal North	38
Gumbelah	39
Lake Cowal (non-Barrick)	38
Laurel Park	39
Mattiske	36
McLintock	41
The Glen	38
West Lea	41
All other residences	35

Notes:

- To interpret the locations referred to in Table 8, see Appendix 3.
- Noise generated by the project is to be measured in accordance with the relevant requirements, and exemptions (including certain meteorological conditions), of the NSW Industrial Noise Policy.
- The noise limits do not apply if the Applicant has an agreement with the relevant owner/s of these residences/land to generate higher noise levels, and the Applicant has advised the Department in writing of the terms of this agreement.

Traffic Noise Impact Assessment Criteria

(d) The Applicant shall take all reasonable and feasible measures to ensure that the traffic noise generated by the project does not exceed the traffic noise impact assessment criteria in Table 9.

Table 9: Traffic noise criteria dB(A) $L_{Aeq\ (1\ hour)}$

Road	Day/Evening	Night
Ungarie Road	60	55
Wamboyne Road, Blow Clear Road, Carrawandool-Warroo Road, Burcher Road, Condobolin Road, Lake Cowal Road	55	50

Note: Traffic noise generated by the project is to be measured in accordance with the relevant procedures in OEH's Environmental Criteria for Road Traffic Noise.

(e) Truck movements for material delivery purposes will be restricted as far as practicable to the day and evening periods.

Additional Noise Mitigation Measures

(f) Upon receiving a written request from:

- the landowner of the properties in Table 6 (unless the landowner has requested acquisition);
- the landowner of the properties identified as:
  - Bungabulla;
  - Gumbelah;
  - Laurel Park;
  - The Glen;
  - Cowal North; and
  - Lake Cowal (non-Barrick); or
- the landowner of privately-owned land where subsequent operational noise monitoring shows the noise generated by the project exceeds the noise limits in Table 8 by more than:
  - 1 dB(A), in the case of the location identified as Mattiske; and
  - 2 dB(A), in the case of all other locations;

the Applicant shall implement additional noise mitigation measures such as double glazing, insulation, and/or air conditioning at any residence on the land in consultation with the landowner.

In the event that other landowners consider that noise at their dwelling which is located along the mine access road between the Mid-Western Highway and the mine site, is in excess of the relevant criteria in Table 9, and the Director-General, in consultation with the OEH, is satisfied that an investigation is required, the Applicant shall upon receipt of a written request:

- appoint a qualified independent person to undertake direct discussions with the landowners affected to ascertain their concerns and to plan and implement an investigation to quantify the impact and determine the sources of the effect, and
- where the project is identified as the cause/source bear the cost of the independent investigation and if exceedences are identified implement additional noise mitigation measures such as double glazing, insulation, and/or air conditioning at any residence on the land in consultation with the landowner. These additional mitigation measures shall be approved by BSC prior to implementation

These additional mitigation measures must be reasonable and feasible.

If, within 3 months of receiving this request from the landowner, the Applicant and the landowner cannot agree on the measures to be implemented, or there is a dispute about the implementation of these measures, then either party may refer the matter to the Director-General for resolution.

At least 3 months prior to increasing the mobile equipment fleet as described in the EA, the Applicant shall notify the following landowners that they may be entitled to receive additional noise mitigation measures, to the satisfaction of the Director-General:

- Bungabulla;
- Gumbelah;
- Laurel Park;
- The Glen;
- Cowal North; and
- Lake Cowal (non-Barrick).

Noise Management Plan

(g) The Applicant shall prepare and implement a Noise Management Plan for the project in consultation with OEH and to the satisfaction of the Director-General. This plan must be submitted to the Director-General for approval by the end of July 2010 and include provisions to:

(i) evaluate noise impacts on privately-owned residences
(ii) demonstrate compliance with the noise impact assessment criteria in Table 8;
(iii) implement all reasonable and feasible noise mitigation measures;
(iv) investigate ways to reduce the noise generated by the project, including:
- off-site road noise; and
- noise levels which may result in sleep disturbance and disturbance to bird breeding behaviour; and

(v) report on these investigations and the implementation and effectiveness of these measures in the AEMR.

EXTRACT FROM ENVIRONMENT PROTECTION LICENCE No 11912 (AS MODIFIED)

L4 Noise limits

L4.1 Noise generated from the premises must not exceed criteria outlined in Table 1 at any residence on privately owned land, or on more than 25 per cent of privately owned land not located within Lake Cowal as shown on the plan Appendix 3 of the Cowal Gold Mine development consent DA 14/98, as modified from time to time.

Table 1

Location	Day/Evening/Night dB(A) LAeq(15 minutes)
Bungabulla	39
Coniston	44
Cowal North	38
Gumbelah	39
Lake Cowal (non-Barrick)	38
Laurel Park	39
Mattiske	36
McLintock	41
The Glen	38
West Lea	41
All other residences	35

Note: Where LAeq means the equivalent continuous noise level -the level of noise equivalent to the energy-average of noise levels occurring over a measurement period.

L4.2 Noise generated from the premises is to be measured in accordance with the relevant requirements and exemptions of the "NSW Industrial Noise Policy".

L4.3 The noise criteria identified in condition L4.1 apply under meteorological conditions of temperature inversion conditions of up to 8.0°C/100 metres and wind speed up to 1 metre per second at 10 metres above ground level.

The 1 metre per second drainage-flow wind applies where the development is at higher altitude than the residential receiver, with no intervening higher ground. These criteria will not apply during rainfall.

L5 Blasting

L5.1 The overpressure level from blasting operations at the premises at residences on privately owned land, when measured at the locations defined in condition M7.1 must not exceed 120 dB (Lin Peak) at any time at any noise sensitive locations. Error margins associated with any monitoring equipment used to measure this are not to be taken into account in determining whether or not the limit has been exceeded.

L5.2 The overpressure level from blasting operations at the premises at residences on privately owned land, when measured at the locations defined in condition M7.1 must not exceed 115dB (Lin Peak) during the day for more than five per cent of the total number of blasts over a period of 12 months.

The overpressure level from blasting operations at the premises at residences on privately owned land, when measured at the locations defined in condition M7.1 must not exceed 105dB (Lin Peak) during the evening for more than five per cent of the total number of blasts over a period of 12 months.

The overpressure level from blasting operations at the premises at residences on privately owned land, when measured at the locations defined in condition M7.1 must not exceed 95dB (Lin Peak) at night or on Sundays and public holidays (24 hours) for more than five per cent of the total number of blasts over a period of 12 months.

Error margins associated with any monitoring equipment used to measure this are not to be taken into account in determining whether or not the limit has been exceeded.

L5.3 Ground vibration peak particle velocity from the blasting operations at the premises at residences on privately owned land, when measured at the locations defined in condition M7.1 must not exceed 10 mm/sec at any time. Error margins associated with any monitoring equipment used to measure this are not to be taken into account in determining whether or not the limit has been exceeded.

L5.4 Ground vibration peak particle velocity from the blasting operations at the premises at residences on privately owned land, when measured at the locations defined in condition M7.1 must not exceed 5 mm/sec during the day for more than five per cent of the total number of blasts over a period of 12 months.

Ground vibration peak particle velocity from the blasting operations at the premises at residences on privately owned land, when measured at the locations defined in condition M7.1 must not exceed 2 mm/sec during the evening for more than five per cent of the total number of blasts over a period of 12 months.

Ground vibration peak particle velocity from the blasting operations at the premises at residences on privately owned land, when measured at the locations defined in condition M7.1 must not exceed 1 mm/sec at night and on Sundays and public holidays (24 hours) for more than five per cent of the total number of blasts over a period of 12 months.

Error margins associated with any monitoring equipment used to measure this are not to be taken into account in determining whether or not the limit has been exceeded.

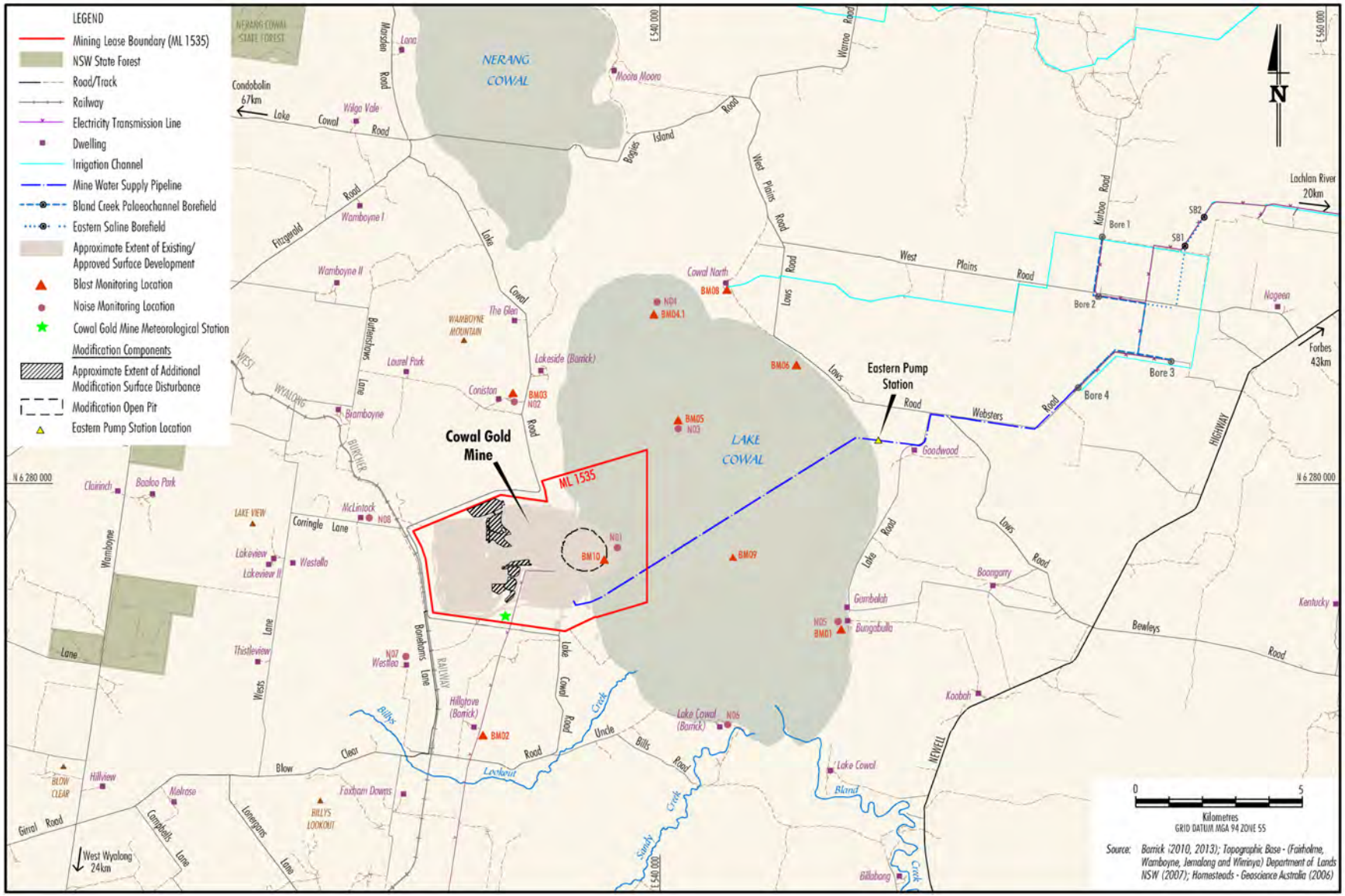
M7 Blasting

M7.1 To determine compliance with condition(s) L5.1, L5.2, L5.3 and L5.4:

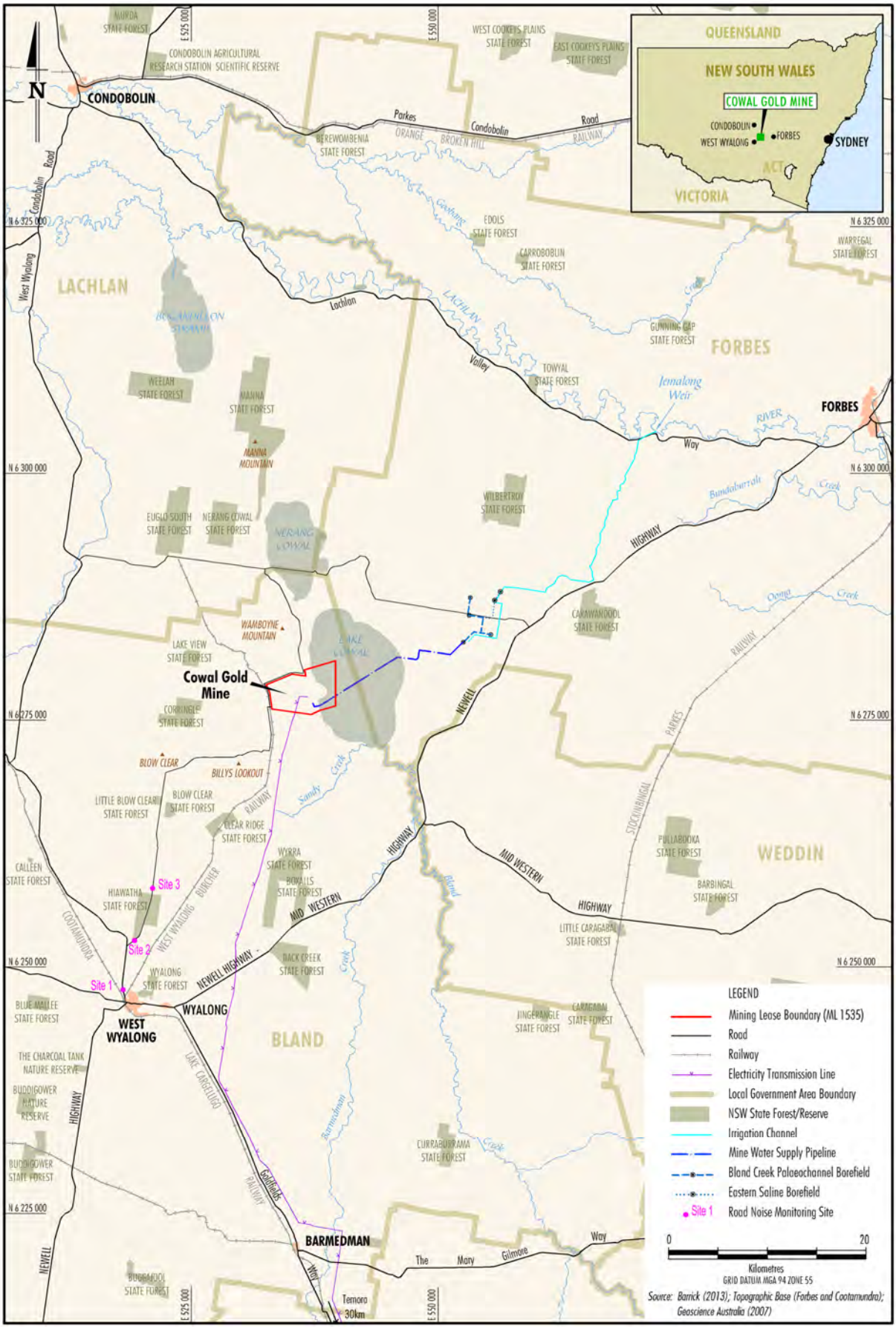
(a) Airblast overpressure and ground vibration levels must be measured at near by residences labeled as “BM01”, ‘BM02” and “BM03”, at bird breeding areas labeled as “BM04” and “BM05”, and at the general monitoring site “BM06” in Figure 2 ‘Blast Monitoring Locations’ of the revised “Cowal Gold Project Blast Management Plan” received by EPA on the 01.06.2010 and on EPA file LIC07/2610-08 for all blasts carried out in or on the premises; and

(b) Instrumentation used to measure the airblast overpressure and ground vibration levels must meet the requirements of Australia Standard AS 2187.2-2006.

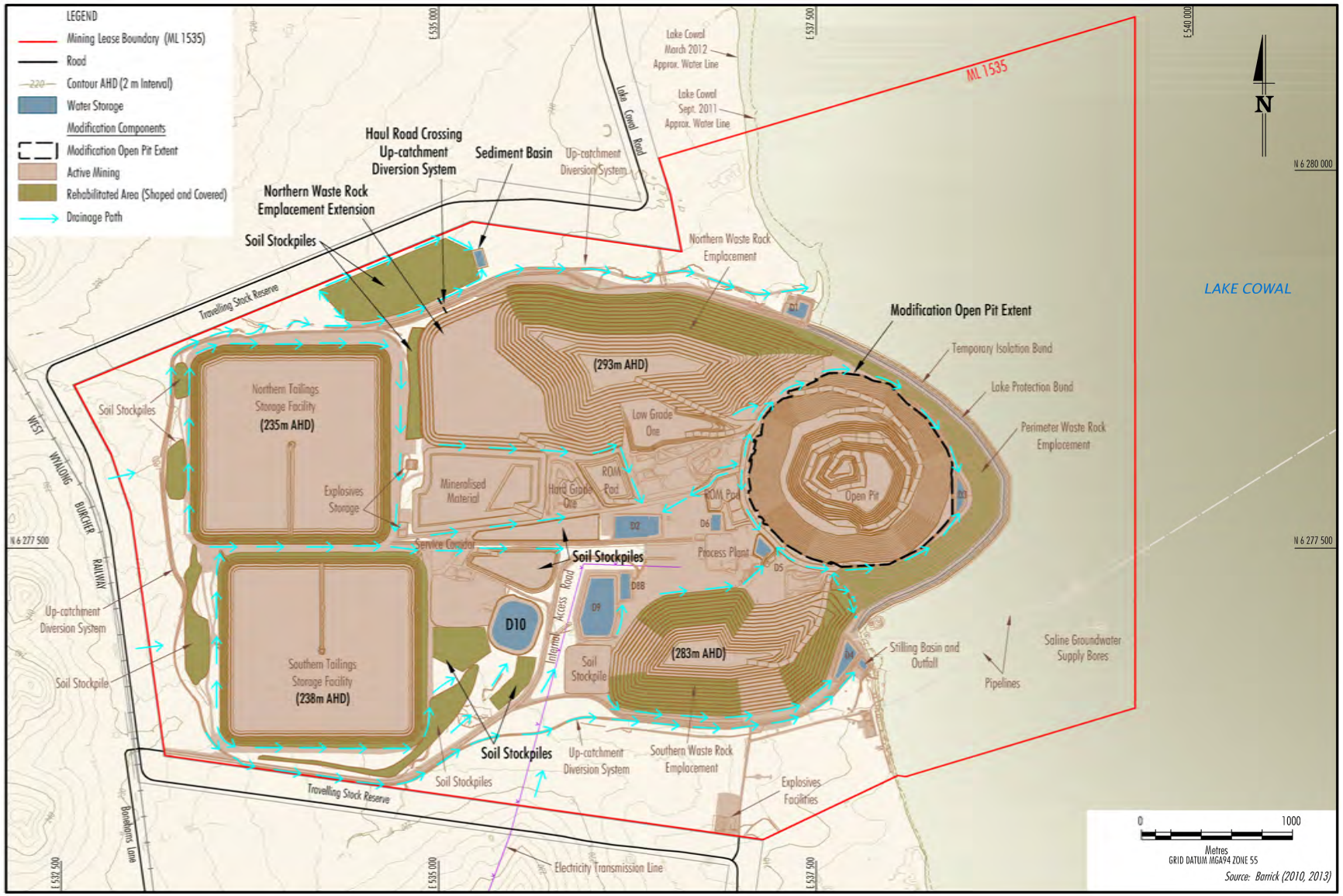
NOISE AND BLASTING MONITORING LOCATIONS PLAN



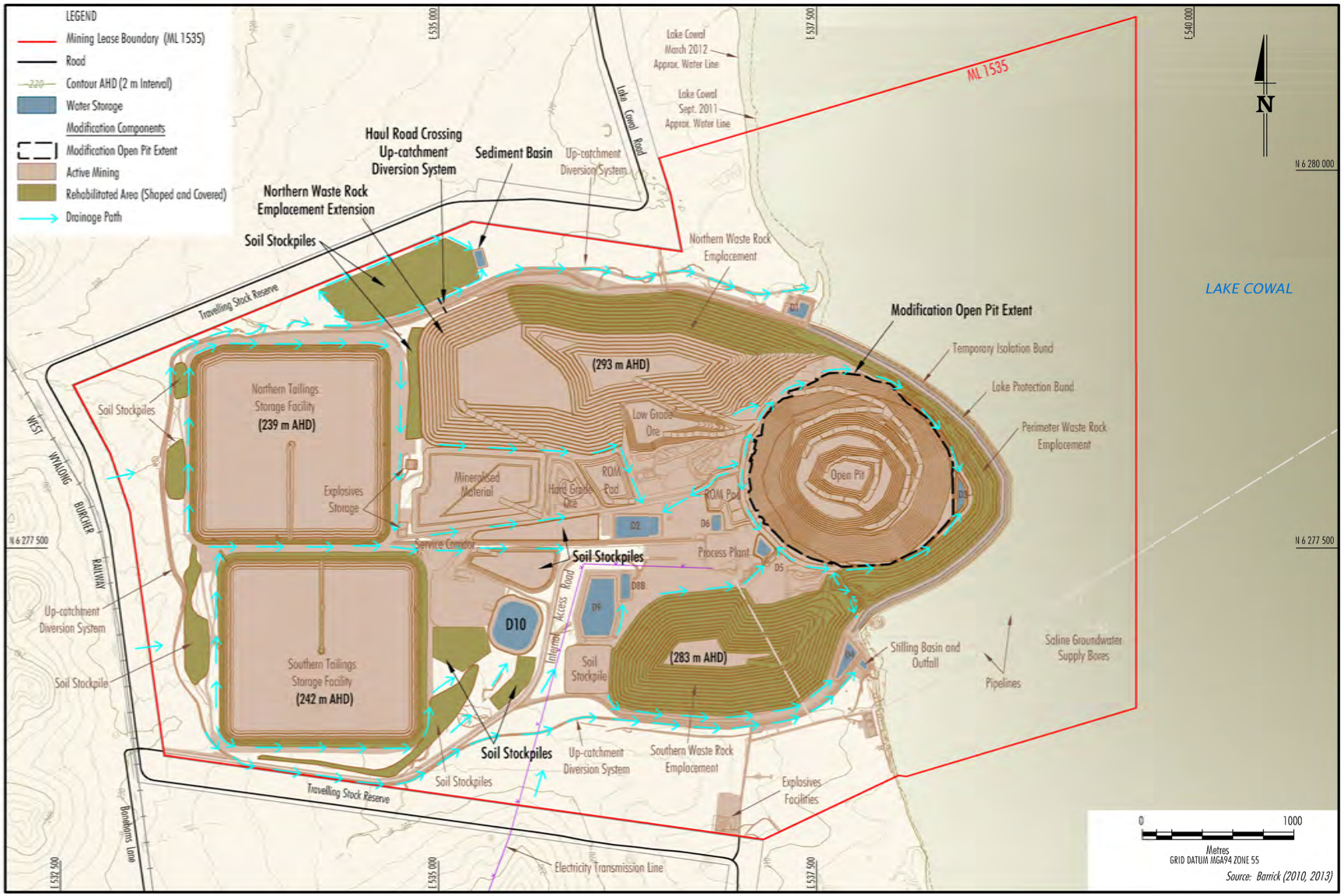
TRAFFIC NOISE MONITORING LOCATIONS PLAN



PROJECT GENERAL ARRANGEMENT YEAR 11



PROJECT GENERAL ARRANGEMENT YEAR 13



EPA INP NOISE AMENITY ZONES

The NSW Industrial Noise Policy (INP, 2000) prescribes detailed calculation routines for establishing Project-specific $L_{Aeq(period)}$ amenity (ie non-transport related) criteria for a development at potentially affected receivers. The INP's noise amenity criteria are dependent on establishing the appropriate noise amenity zone (ie rural, suburban, urban etc) and the existing industrial noise level which are then used in conjunction with the Table 2.1 and Table 2.2 of the INP respectively.

Section 2.2.1 of the INP, Notes to Support the Noise Level Tables, states:

> ***Rural*** *- means an area with an acoustical environment that is dominated by natural sounds, having little or no road traffic. Such areas may include:*
>
> *- an agricultural area, except those used for intensive agricultural activities*
> *- a rural recreational area such as resort areas*
> *- a wilderness area or national park*
> *- an area generally characterised by low background noise levels (except in the immediate vicinity of industrial noise sources).*
>
> *This area may be located in either a* ***rural***, ***rural-residential, environment protection zone or scenic protection zone****, as defined on a council zoning map (Local Environmental Plan (LEP) or other planning instrument).*
>
> ***Suburban*** *- an area that has local traffic with characteristically intermittent traffic flows or with some limited commerce or industry. This area often has the following characteristics:*
>
> *- decreasing noise levels in the evening period (1800-2200); and/or*
> *- evening ambient noise levels defined by the natural environment and infrequent human activity.*
>
> *This area may be located in either a rural, rural-residential or residential zone, as defined on an LEP or other planning instrument.*
>
> ***Urban*** *- an area with an acoustical environment that:*
>
> *- is dominated by 'urban hum' or industrial source noise*
> *- has through traffic with characteristically heavy and continuous traffic flows during peak periods*
> *- is near commercial districts or industrial districts*
> *- has any combination of the above,*
>
> *where 'urban hum' means the aggregate sound of many unidentifiable, mostly traffic-related sound sources.*

The INP's Application Notes dated July 2006 supersedes the INP's Section 2.2.1 with respect the application of the Urban Industrial Interface and states:

> ***Urban/Industrial Interface -*** *this area may be located in either a rural, rural-residential or residential zone as defined on an LEP or other planning instrument, and also includes mixed land-use zones such as mixed commercial and residential uses.*
>
> *The urban/industrial interface category in the INP recognises that the availability of noise mitigation measures might be limited for existing premises where residences are close to existing industries.*
>
> *The urban/industrial interface amenity category applies only for existing situations (that is, an existing receiver near an existing industry) and only for those receivers in the immediate area surrounding the existing industry, that is, the region that extends from the boundary of the existing industry to the point where the noise level of the existing industry (measured at its boundary) has fallen by 5 decibels.*
>
> *For new developments of a limited nature (such as an extension to existing process or plant or when replacing part of an existing process or plant with new technology) on existing sites (where the urban/industrial amenity category applies) then the urban/industrial amenity category is the appropriate amenity category for the new development.*

CGM SITE SPECIFIC WEATHER CONDITIONS JANUARY 2010 TO MARCH 2013

Table 1: Seasonal Frequency of occurrence Wind Speed Intervals - Daytime

Period	Calm (<0.5 m/s)	Wind Direction ±45°	Wind Speed		
			0.5 to 2 m/s	2 to 3 m/s	0.5 to 3 m/s
Summer	0.2%	NE	3.4%	13.2%	16.7%
Autumn	1.9%	ENE	8.6%	11.3%	19.9%
Winter	1.9%	E	8.7%	7.5%	16.2%
Spring	0.3%	NE	4.1%	10.1%	14.3%

Table 2: Seasonal Frequency of occurrence Wind Speed Intervals - Evening

Period	Calm (<0.5m/s)	Wind Direction ±45°	Wind Speed		
			0.5 to 2 m/s	2 to 3 m/s	0.5 to 3 m/s
Summer	2.4%	ESE	10.5%	8.2%	18.7%
Autumn	3.6%	SSW	10.3%	14.4%	24.8%
Winter	4.2%	WSW	16.1%	11.0%	27.1%
Spring	3.1%	S	7.7%	12.0%	19.7%

Table 3: Seasonal Frequency of occurrence Wind Speed Intervals - Night-Time

Period	Calm (<0.5m/s)	Wind Direction ±45°	Wind Speed		
			0.5 to 2 m/s	2 to 3 m/s	0.5 to 3 m/s
Summer	2.2%	SE	6.9%	8.8%	15.7%
Autumn	7.4%	SSE	13.7%	11.8%	25.5%
Winter	7.7%	WSW	15.1%	11.3%	26.3%
Spring	5.7%	WSW	9.1%	7.1%	16.1%

Table 4: Summary

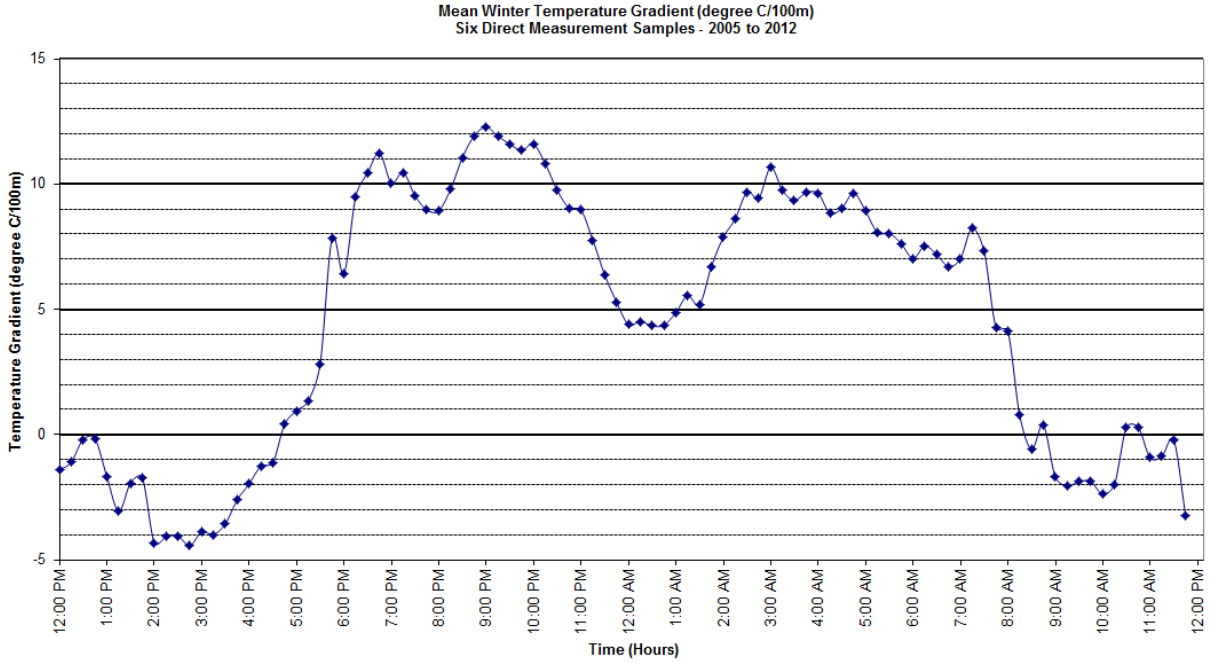
Season	Winds ±45° 3m/s with Frequency of Occurrence 30%		
	Daytime	Evening	Night-Time
Summer	Nil	Nil	Nil
Autumn	Nil	Nil	Nil
Winter	Nil	Nil	Nil
Spring	Nil	Nil	Nil

Table 5: Frequency of Occurrence of Atmospheric Stability Classes - Evening and Night-time

Stability Class	Frequency of Occurrence				Estimated ELR°C/100 m	Qualitative Description
	Summer	Autumn	Winter	Spring		
A	0.0%	0.0%	0.0%	0.0%	<-1.9	Lapse
B	0.0%	0.0%	0.0%	0.0%	-1.9 to -1.7	Lapse
C	0.0%	0.0%	0.0%	0.0%	-1.7 to -1.5	Lapse
D	61.7%	41.8%	37.8%	49.2%	-1.5 to -0.5	Neutral
E	14.6%	19.8%	18.7%	18.8%	-0.5 to 1.5	Weak inversion
F	16.6%	21.8%	23.8%	20.8%	1.5 to 4	Moderate inversion
G	7.1%	16.6%	19.7%	11.2%	>4.0	Strong inversion
F+G	23.7%	38.4%	43.5%	32.0%	>1.5	Moderate and Strong

Note: ELR (Environmental Lapse Rate).

CGM SITE SPECIFIC MEAN TEMPERATURE GRADIENT WINTER 2005 to 2012



EPA INP APPLICATION NOTE FOR SLEEP DISTURBANCE

Peak noise level events, such as reversing beepers, noise from heavy items being dropped or other high noise level events, have the potential to cause sleep disturbance. The potential for high noise level events at night and effects on sleep should be addressed in noise assessments for both the construction and operational phases of a development. The NSW Industrial Noise Policy (INP) (New South Wales [NSW] Environmental Protection Agency [EPA], 2000) does not specifically address sleep disturbance from high noise level events.

The NSW Department of Environment, Climate Change and Water (DECCW) reviewed research on sleep disturbance in the *NSW Environmental Criteria for Road Traffic Noise* (ECRTN) (EPA, 1999). This review concluded that the range of results is sufficiently diverse that it was not reasonable to issue new noise criteria for sleep disturbance.

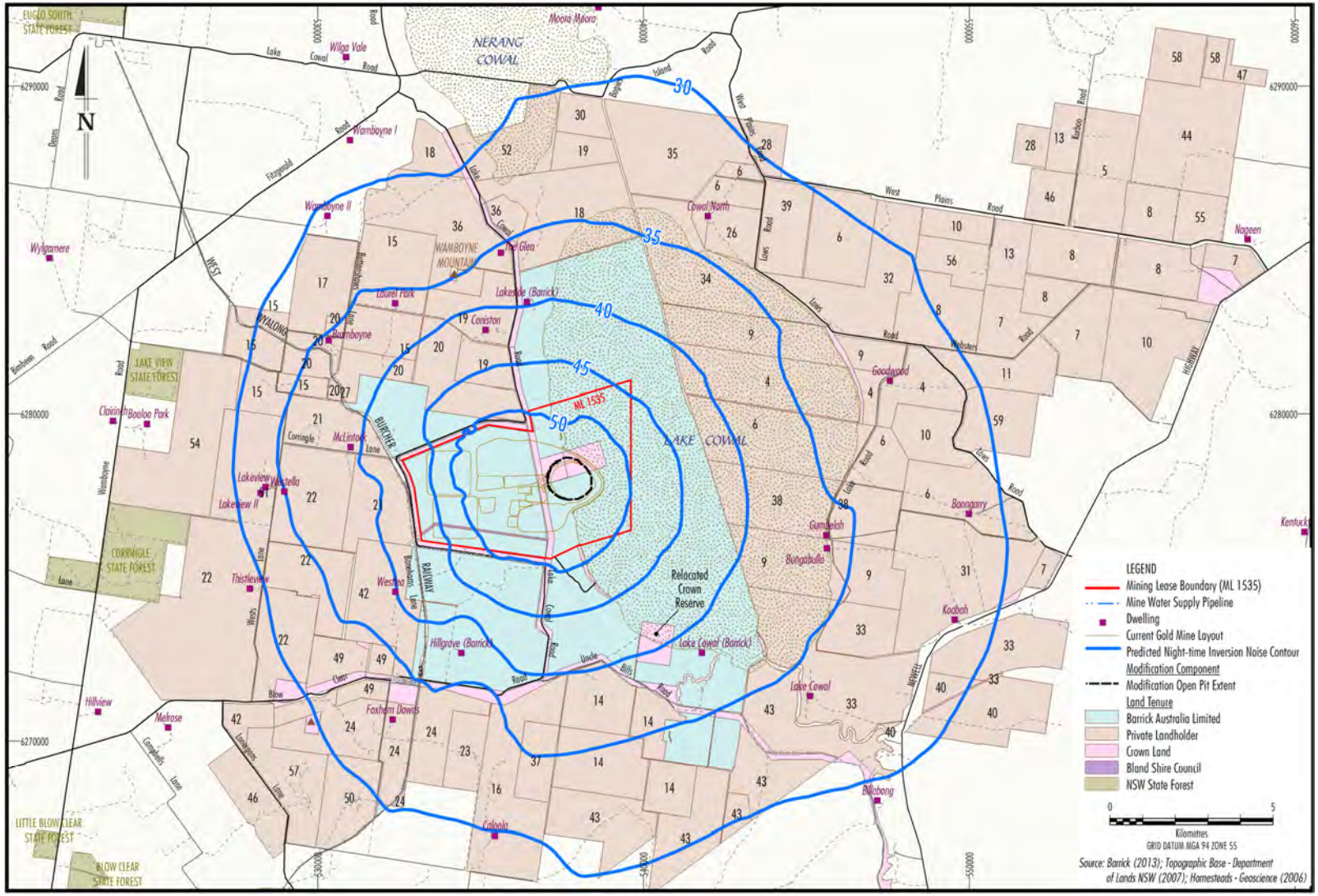
From the research, the DECCW recognised that current sleep disturbance criterion of an $L_{A1(1minute)}$ not exceeding the $L_{A90(15minute)}$ by more than 15 A-weighted decibels (dBA) is not ideal. Nevertheless, as there is insufficient evidence to determine what should replace it, the DECCW will continue to use it as a guide to identify the likelihood of sleep disturbance. This means that where the criterion is met, sleep disturbance is not likely, but where it is not met, a more detailed analysis is required.

The detailed analysis should cover the maximum noise level or $L_{A1(1minute)}$, that is, the extent to which the maximum noise level exceeds the background level and the number of times this happens during the night-time period. Some guidance on possible impact is contained in the review of research results in the appendices to the ECRTN. Other factors that may be important in assessing the extent of impacts on sleep include:

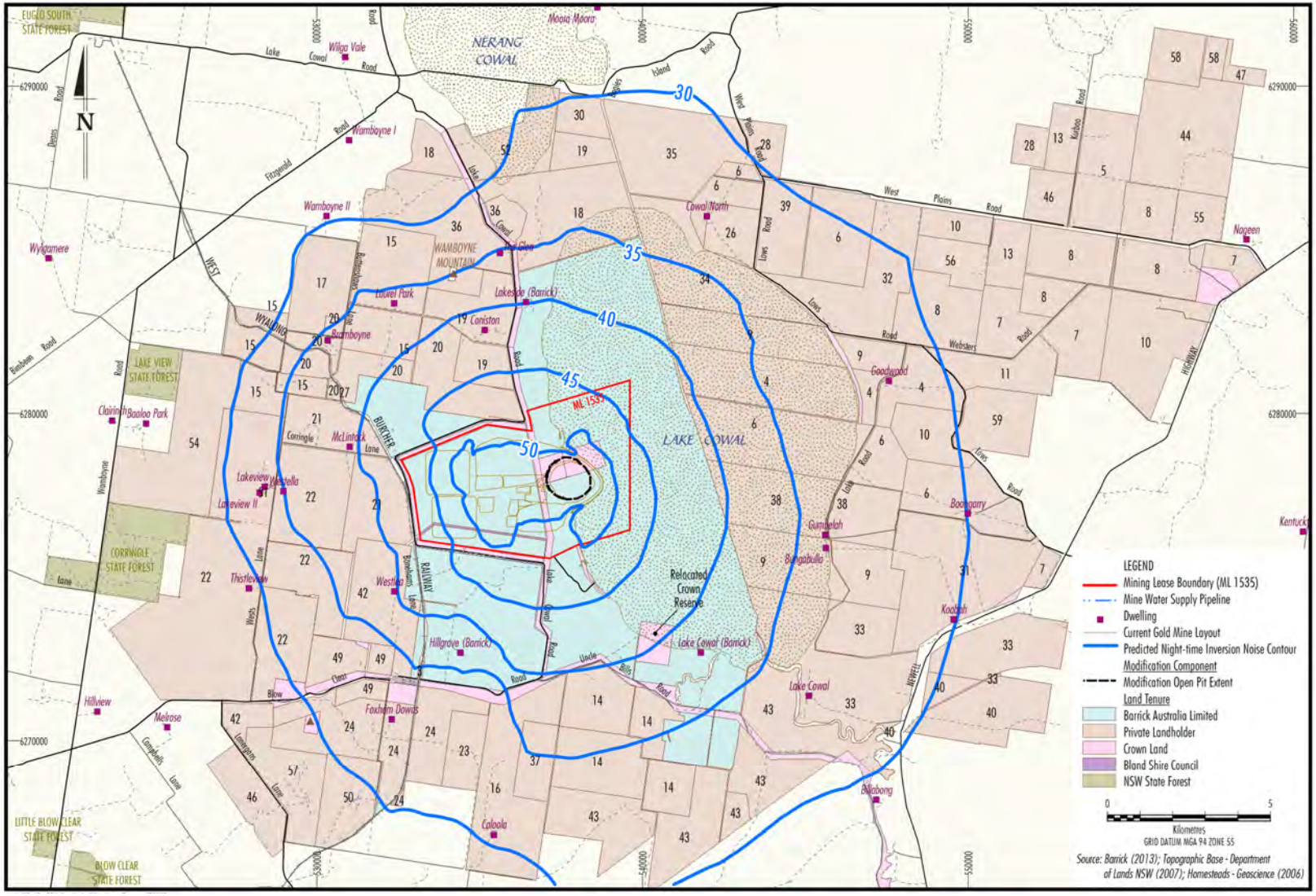
- How often high noise events will occur.
- Time of day (normally between 2200 hours and 0700 hours).
- Whether there are times of day when there is a clear change in the noise environment (such as during early morning shoulder periods).

The $L_{A1(1minute)}$ descriptor is meant to represent a maximum noise level measured under “fast” time response. DECC will accept analysis based on either $L_{A1(1minute)}$ or L_{Amax}.

NIGHT-TIME YEAR 11 LAEQ(15MINUTE) INTRUSIVE NOISE CONTOUR
(8^0C/100 M TEMPERATURE INVERSION)



NIGHT-TIME YEAR 13 LAEQ(15MINUTE) INTRUSIVE NOISE CONTOUR
(8^0C/100 M TEMPERATURE INVERSION)



NSW Road Noise Policy - application notes

Relative increase criteria (see Section 2.4 of RNP)

The last paragraph in Section 2.4 (page 15) states: 'The relative increase criteria are primarily intended to protect existing quiet areas from excessive changes in amenity due to noise from a road project'.

'Quiet area' is intended to mean areas 'that are 12 dB or more below the relevant noise assessment criterion that applies day or night'. The relative increase criteria are intended to apply to 'noise from a road project' or 'noise from a land use development with the potential to generate additional traffic'.

The first sentence in the last paragraph should therefore be read to mean: 'The relative increase criteria are primarily intended to protect existing quiet areas, being areas that are 12 dB or more below the relevant noise assessment criterion that applies day or night, from excessive changes in amenity due to noise from additional traffic.'

Applying the assessment criteria to additional traffic on existing roads generated by land use developments (see Section 3.4.1 of RNP)

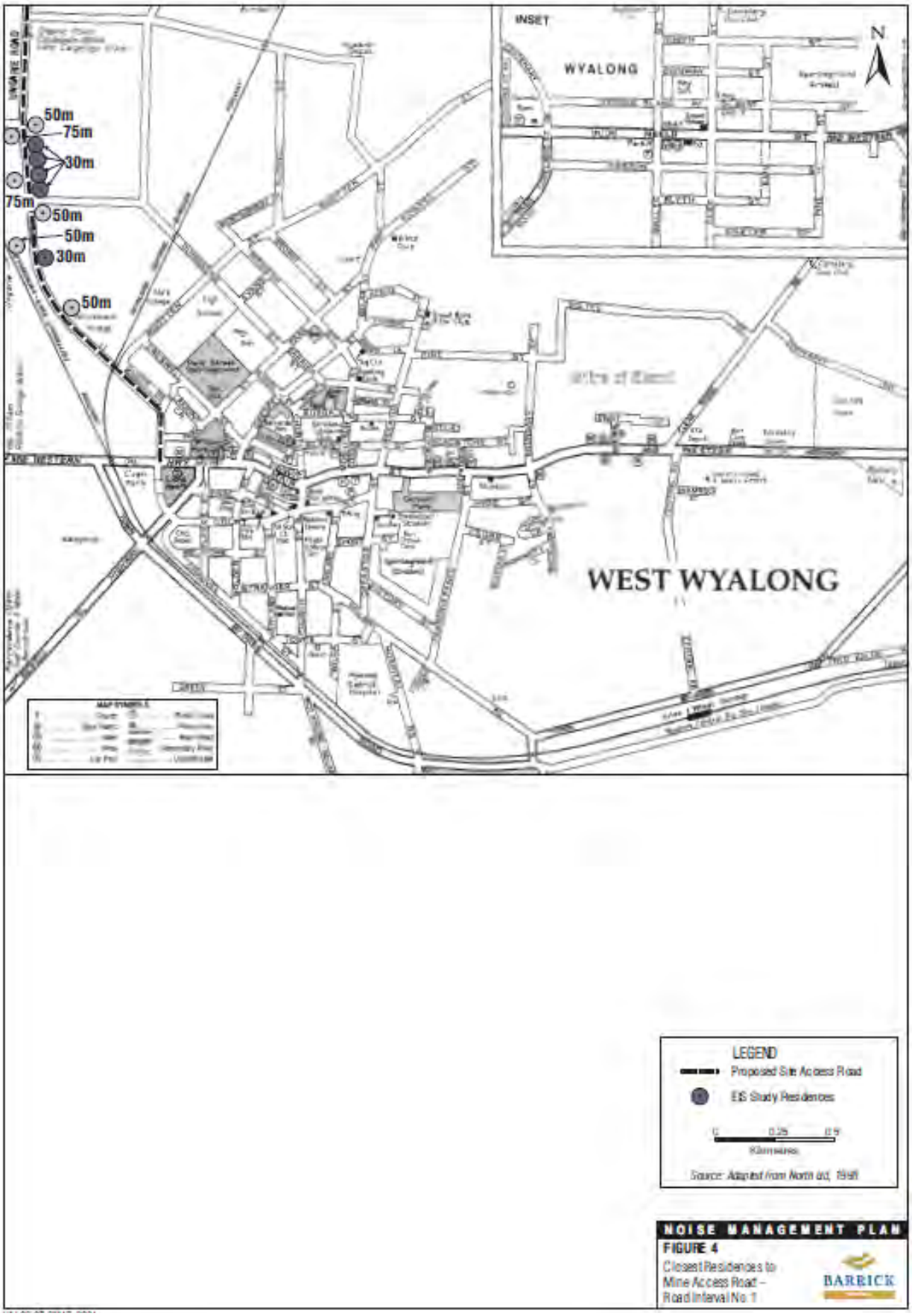
The second paragraph in Step 4 states: 'For existing residences and other sensitive land uses affected by **additional traffic on existing roads generated by land use developments**, any increase in the total traffic noise level should be limited to 2 dB above that of the corresponding "no build option".'

The policy provides for this 2 dB increase if the relevant assessment criteria identified in Step 2 is not achievable after the feasible and reasonable mitigation measures noted in Step 3 have been considered. The 2 dB increase applies to both the relevant day and night assessment criteria.

The second paragraph in Step 4 should therefore be read to mean: 'After taking Steps 1 to 3, 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 as a result of the development should be limited to 2 dB above that of the noise level without the development. This limit applies wherever the noise level without the development is within 2 dB of, or exceeds, the relevant day or night noise assessment criterion.'

Where cumulative impacts from road traffic-generating developments are likely, Section 3.5 notes that planning authorities should use strategic planning policies to minimise exposure to unacceptable noise levels.

CLOSEST RESIDENCES TO MINE ACCESS ROAD - ROAD INTERVAL NO. 1 (NMP Figure 4)



CLOSEST RESIDENCES TO MINE ACCESS ROAD - ROAD INTERVAL NO. 2 (NMP Figure 5)