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Contents

11 Noise and Vibration

11.1 Introduction

This Chapter provides an assessment of the potential noise and vibration impacts of the revised Project.

This assessment includes:

- a description of the background noise environment including background noise monitoring results;

- local and regional meteorology that may affect noise levels;

- an overview of applicable noise and vibration criteria pertinent to the revised Project;

- noise modelling parameters including mining fleet numbers and mining equipment noise data;

- potential noise and vibration impacts at the nearest sensitive receptors from the mining operation;

- low frequency noise impacts from the mining operations;

- blasting noise and vibration impacts;

- noise impact from the proposed rail spur;

- road traffic noise impacts on public roads; and

- an overview mitigation measures for the revised Project to minimise the potential for impacts.

11.2 Existing Environment

This Section describes the existing noise and vibration environment of the revised Project site, the nearest sensitive receptors surrounding the revised Project and the local and regional meteorology that may affect noise levels.

11.2.1 Noise Sensitive Receptors

All noise sensitive receptors surrounding the revised Project site are residences. The noise sensitive receptors surrounding the revised Project site and the proposed rail spur are shown in **Figure 11-1**.
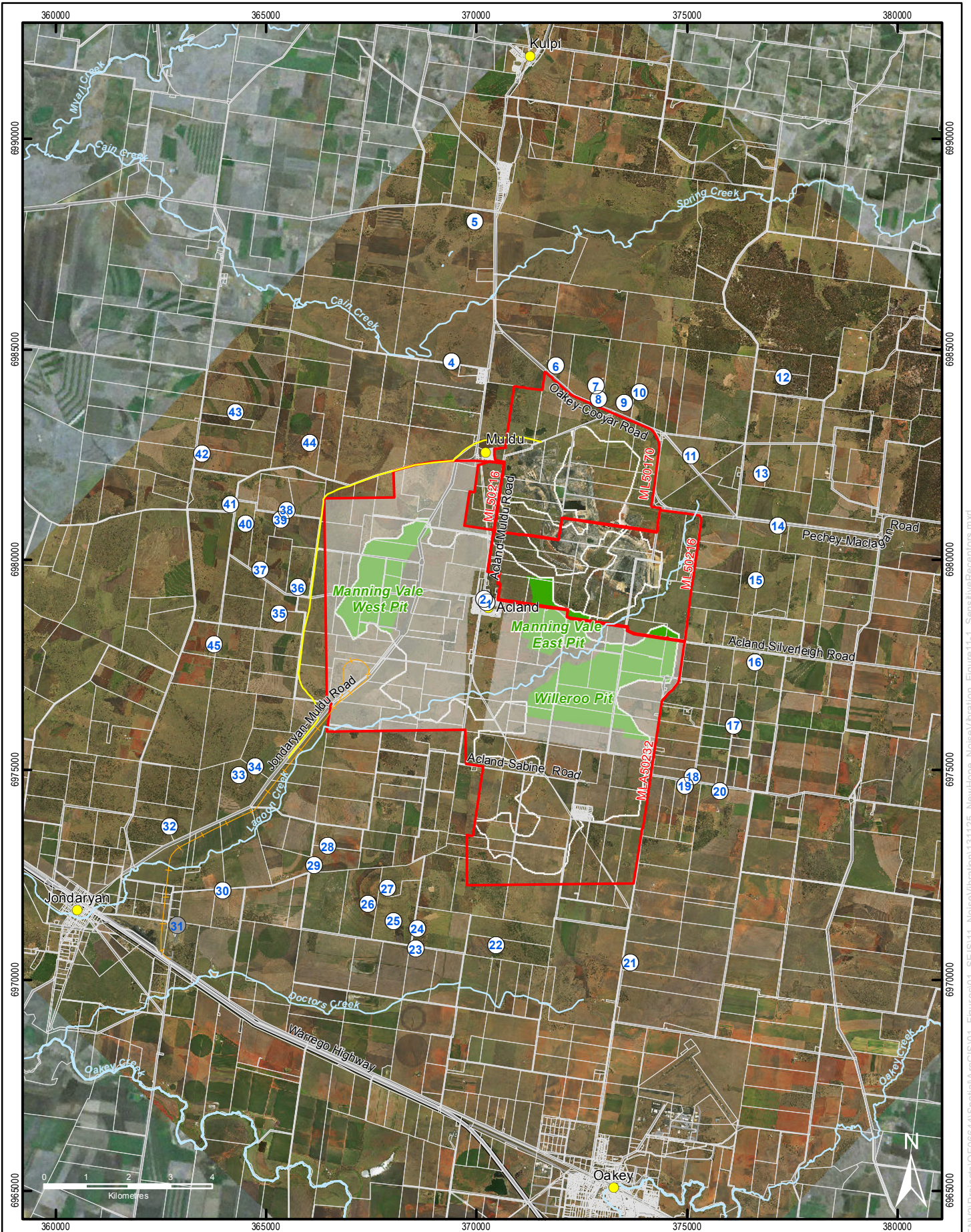
LEGEND

- ● Towns and Localities
- ○ Sensitive Receptor - Residential
- ● Sensitive Receptor - Commercial
- —— Jondaryan-Muldu Road Diversion
- —— Creeks

- ☐ Casdastre
- ☐ Mining Tenements
- ☐ Proposed Extent of Surface Rights Area
- ☐ Stage 3 Pit Areas

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Figure 11-1 - Sensitive Receptors

Scale 1:120,000 on A4
Projection: Australian Geodetic Datum - Zone 56 (AGD84)

11.2.2 Ambient Noise Level Monitoring

The ambient noise levels near the revised Project site are influenced by:

- current operations at the Mine including mobile and stationary equipment as well as blasting;
- agricultural activities such as ploughing;
- localised traffic movements; and
- air traffic from Oakey Army Aviation Centre.

Ambient noise level monitoring was carried out in various monitoring campaigns and locations around the revised Project site between 1996 and 2013, including areas surrounding the proposed mine pits, rail loading area and rail spur.

These campaigns include:

- Campaign 1: In August 1996 prior to commencement of mining at several locations surrounding the revised Project site by Huson & Associates;
- Campaign 2: In November 1998, also prior to commencement of mining, Ison Environmental Planners conducted background noise level monitoring at a single location approximately 1.8 km north of Acland, on the eastern side of the Acland-Muldu Road;
- Campaign 3: In March 2007 at five locations surrounding the revised Project site by SKM during mining operation; and
- Campaign 4: Between late December 2012 and early January 2013 during the shutdown period at the Acland township by David Moore and Associates.

The locations for the different monitoring campaigns are shown in **Figure 11-2**, which highlights noise level monitoring campaigns without mining activities as blue circles, and noise level monitoring campaigns with mining activities as yellow squares.
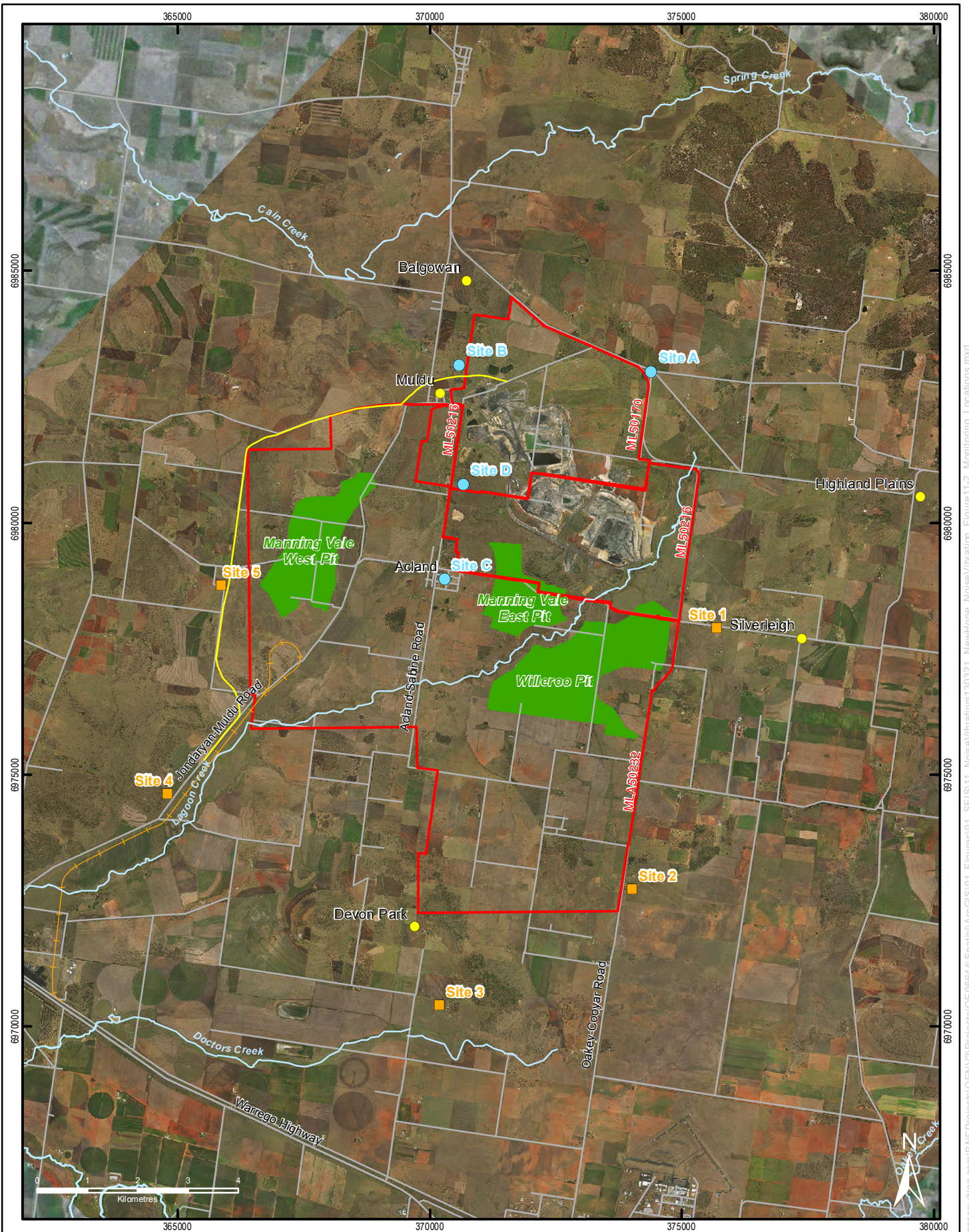
LEGEND

- ● Towns and Localities
- ■ Noise Monitoring Location (mining)
- ● Noise Monitoring Location (no mining)
- —— Jondaryan-Muldu Road Diversion
- —— Roads
- —— Creeks
- ☐ Cadastre
- ▭ Mining Tenements
- ▬ Stage 3 Pit Areas

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Figure 11-2 - Noise Monitoring Locations

Scale 1:100,000 on A4
Projection: Australian Geodetic Datum - Zone 56 (AGD84)

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Path: \\skmconsulting.com\BNE\Projects\QENV2\Projects\QE06644\Spatial\ArcGIS\01_Figures\01_Figures\01_SEIS\11_NoiseVibration130321_NewHope_NoiseVibration_Figure11-2_Monitoring_Locations.mxd

Produced: 4/09/2013

11.2.3 Ambient noise level monitoring results

A comparison of noise monitoring results from the different monitoring campaigns are shown in **Table 11-1** which shows the dates, descriptions of the noise environment, average L_{A90} and RBL dB(A) levels for the day (7am to 6pm), evening (6pm to 10pm), and night (10pm to 7am).

The L_{A90} metric is the noise level exceeded for 90% of the monitoring measurement interval time. The RBL is the tenth percentile of the L_{A90} and is commonly accepted as a measure of the background noise level.

A day to day breakdown of average noise levels for campaigns 2, 3, and 4 are shown in **Appendix G.7.1** (day to day data was not available for campaign 1). Graphs of continuous noise traces are also provided in **Appendix G.7.2** for campaign 3.

Table 11-1 Summary of Background Noise Level Monitoring Results

Campaign	Consultant	Date	Season	Mining activities	Description	Noise monitoring location	Monitoring results					
							L_{A90} dB(A)			RBL dB(A)		
							Day	Eve	Night	Day	Eve	Night
1	Huson & Associates	7 Aug to 10 Aug 1996, 16 Aug to 18 Aug 1996	Winter	No	Noise monitoring conducted at 3 locations around proposed mine. Noise environment included: ■ Infrequent aircraft and traffic noise, farm operations, barking dogs ■ Predominant noise source in the area attributed to birds, crickets and other fauna.	Site A	31	28	28	NA	NA	NA
						Site B	35	37	30	NA	NA	NA
						Site C	37	28	27	NA	NA	NA
2	Ison Environmental Planners	20 Nov to 27 Nov 1998	Autumn	No	Noise monitoring conducted at 1 location around proposed mine. Noise environment included: ■ Insects, Birds, Wind, Farming activities	Site D	36	42	34	34	37	31
3	SKM	1 Mar to 8 Mar 2007	Spring	Yes	Noise monitoring conducted around the mine at 5 locations. Noise environment influenced by: ■ Local and distant traffic ■ Insects, Birds, Rustling leaves	Site 1	33	34	29	29	31	26
						Site 2	37	41	38	33	38	33
						Site 3	35	38	34	31	36	30
						Site 4	32	36	29	27	34	25
						Site 5	37	40	33	33	36	30
4	David Moore and Associates	24 Dec 2012 to 1 Jan 2013	Summer	No	Noise monitoring at Acland township without mining activities (during the holiday mine shutdown period).	Site D	31	36	32	28	25	28

11.2.4 Attended Noise Level Measurements

Attended noise level measurements were taken at six locations around the current mining operations during the night time between 10pm on the 15 May 2013, and 3am on the 16 May 2013. The six measurement locations were:
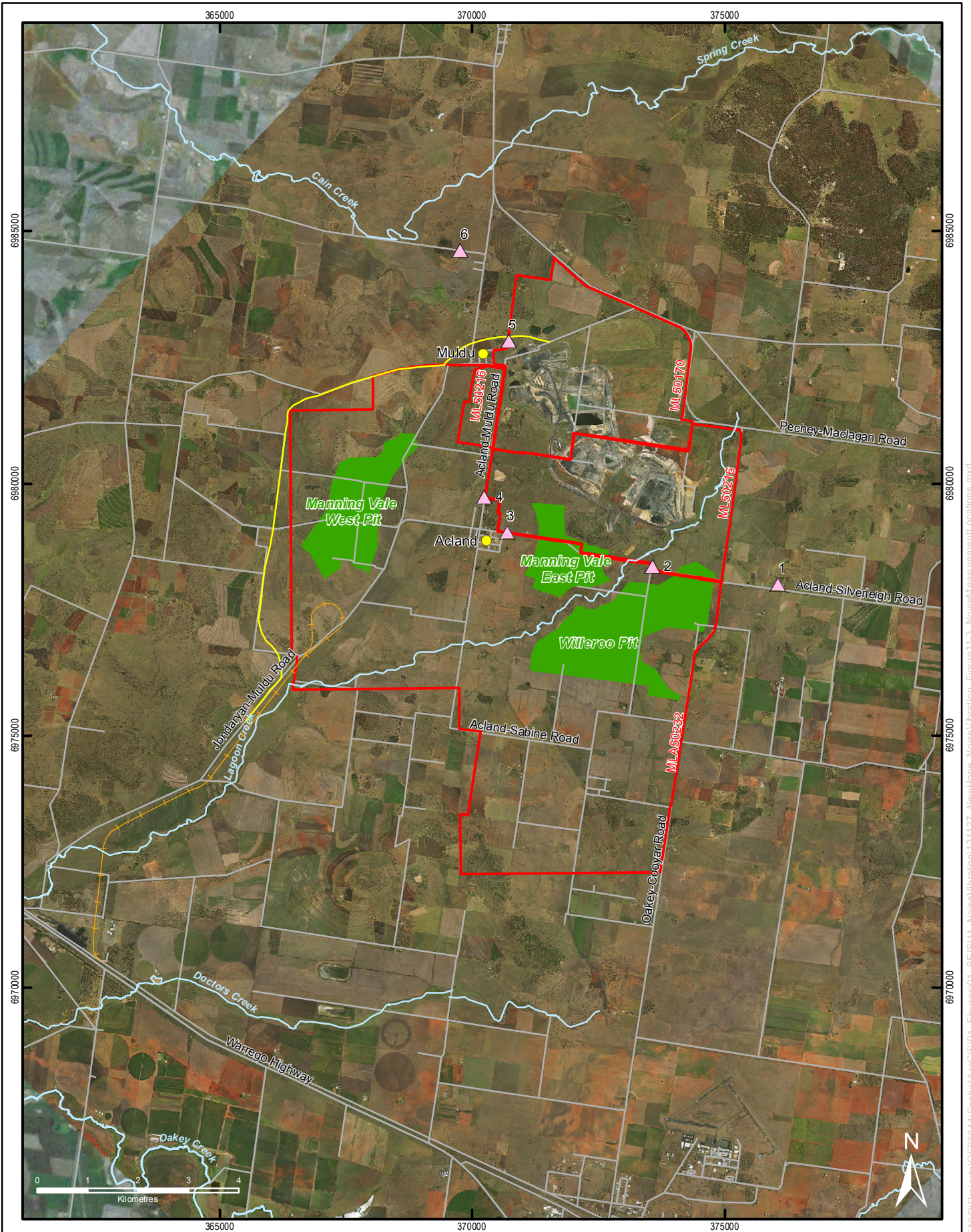
- Location 1: Located on Acland-Silverleigh Road to the east of the mine;

- Location 2: Located at the corner of Greenwood School Road and Acland Road;

- Location 3: Located on Acland Road, near Willam Street;

- Location 4: Located on Acland-Muldu Road, 200m north of the old Acland Museum;

- Location 5: Located on Muldu-Plainview Road, near Muldu House; and

- Location 6: Located on Balgowan Road to the northwest of the mine,

Three consecutive 10 minute measurements were taken at each location using a Larson Davis 831 Type 1 sound level meter, on fast time weighting. The measurement locations are shown in **Figure 11-3**.

During the noise level measurements at locations 3, 4 and 5, which are closer to Jondaryan-Muldu Road, it was noted that the noise levels were affected by noise from B-double trucks travelling to and from the Jondaryan Rail Loading Facility (JRLF).

At Locations 3, 4, and 5, noise from B-doubles was significant enough to mask noise from the mine itself, where noise levels with B-doubles were observed to be between 5 to 7 dB(A) higher than without the influence of B-doubles at these three locations.

Post measurement analyses were carried out to exclude B-doubles and extraneous noise to estimate mine-only noise levels. Periods affected by noise from B-doubles as well as extraneous noise sources were tagged using the sound level meter's tagging feature, which allowed second by second tagging of measured noise levels and were subsequently removed from the measurement results.

365000 370000 375000

6985000 6980000 6975000 6970000

Spring Creek

Cain Creek

6

5

Muldu

ML 50218

Acland-Muldu Road

Manning Vale
West Pit

4

3

Acland

Manning Vale
East Pit

2

1

Acland-Silverleigh Road

Willeroo Pit

ML 50170

ML 50216

Pechey-Maclagan Road

Acland-Sabine Road

MLA 50232

Oakey-Cooyar Road

Jondaryan-Muldu Road

Lagoon Creek

Doctors Creek

Warrego Highway

Oakey Creek

0 1 2 3 4
Kilometres

N

LEGEND

⬤ Towns and Localities
▲ Monitoring Locations
— Jondaryan-Muldu Road Diversion
— Roads
— Creeks

☐ Cadastre
☐ Mining Tenements
☐ Stage 3 Pit Areas

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**Figure 11-3 - Attended Noise
Measurement Locations**

Scale 1:100,000 on A4
Projection: Australian Geodetic Datum - Zone 56 (AGD84)

Noise level measurement results including measured levels, estimated mining-only levels and observations are tabulated in **Table 11-2**.

Table 11-2 L$_{Aeq}$ Noise Measurement Results As Recorded and Filtered for Mine Noise Only (15 May 2013)

Location	Measurement Period	L$_{Aeq (10 mins)}$ sound pressure level dB(A)		Comments
		Measured level	Mine Noise Only	
Location1	First 10 min	46	42	Mining noise clearly audible. Mine noise low 40 dB(A). Car pass by ranges from 42 to 47 dB(A)
	Second 10 min	40	39	
	Third 10 min	44	37	
Location 2	First 10 min	41	39	Haul truck movement audible on nearest haul road, ranges from high 30 dB(A) to low 40 dB(A).
	Second 10 min	41	39	
	Third 10 min	42	41	
Location 3	First 10 min	35	26	Very quiet. B-double noise audible and dominant, ranges from high 30 to 40 dB(A). Noise from mine faintly audible in the absence of B-double noise.
	Second 10 min	35	30	
	Third 10 min	36	29	
Location 4	First 10 min	35	30	Similar noise environment to Location 3. B-double noise audible and dominant, up to 40 dB(A). Noise from mine faintly audible in the absence of B-double noise.
	Second 10 min	35	27	
	Third 10 min	37	30	
Location 5	First 10 min	48	42	Mine noise clearly audible. B-double noise dominant, mid 40 dB(A) to low 50 dB(A). Mine noise between 37 and 42 dB(A).
	Second 10 min	45	40	
	Third 10 min	44	42	
Location 6	First 10 min	39	35	Mine noise clearly audible mid 30 dB(A). Noise from B-doubles could not be distinguished from Mine noise.
	Second 10 min	38	35	
	Third 10 min	42	36	

From observations, the meteorological conditions during the measurements consisted of mostly calm cold conditions, with minor cloud cover. Data from the weather station at the Mine were also referred to in determining the meteorological conditions during the noise level measurement period. The following meteorological conditions were present during the noise level measurements:

- temperature inversion conditions (Pasquill-Gifford Stability Class F estimated using the sigma theta method. Only surface wind speed and direction were available for the estimate);

- calm, no wind;

- temperature 11°C; and

- humidity 81%.

11.3 Effects of Local Meteorology

The level of noise received by a receptor is affected by meteorological factors such as wind and atmospheric temperature inversion. Such factors may result in a receptor experiencing an increase in noise.

Planning for Noise Control Guideline prescribes that the prevailing and worst case meteorological conditions must be determined as part of the noise assessment. The guideline recommends assessing for adverse wind and temperature inversion if:

- there are wind speeds below 3 m/s blowing from the noise source in the direction of the receptor for 30 % of any day, evening or night assessment period, at any time throughout the year; or

- temperature inversion conditions occur for 30 % of the time during the winter night time (defined in this guideline as between 6 pm and 7 am).

The wind roses in **Chapter 9** show that winds are predominantly easterlies in the study area. Wind speeds of 2.9 m/s blowing towards sensitive receptors have been included in this assessment.

In addition, noise propagation can be exacerbated by the occurrence of temperature inversions which occur under stable atmospheric conditions represented by Pasquill-Gifford Stability Classes of F and G. This condition would typically occur at night time and it is considered as the worst case condition for noise propagation. Classes C, D, and E are considered as neutral conditions in noise modelling, while class A and B are considered as unstable atmospheric conditions.

The likely occurrence of stability classes B, C, D, E, and F in the revised Project site was simulated by meteorological modelling using meteorological data collected by the Bureau of Meteorology (BoM) at Oakey for year 2012. The likely occurrence of Stability Classes B, C, D, E, and F during the night time period are presented in **Figure 11-4** to **Figure 11-7**, which shows the number of hours each night (between 10pm and 7am) for each of the four seasons where these conditions are likely to be present. Stability Class A was not predicted to occur in the area.

Out of 365 nights of the year, 87% (313) of nights had at least one hour over which temperature inversion occurred. Broken down by seasons, the percentage of nights per season temperature inversion predicted to occur were; spring 88%; summer 74%; autumn 90%; winter 90%. The results below indicate that temperature inversion is likely to occur in the area and should be considered for this noise assessment.

Spring Nights (September to November)
Predicted Stability Class

Figure 11-4 Predicted Stability Class by Hour for Spring Nights

Summer Nights (December to February)
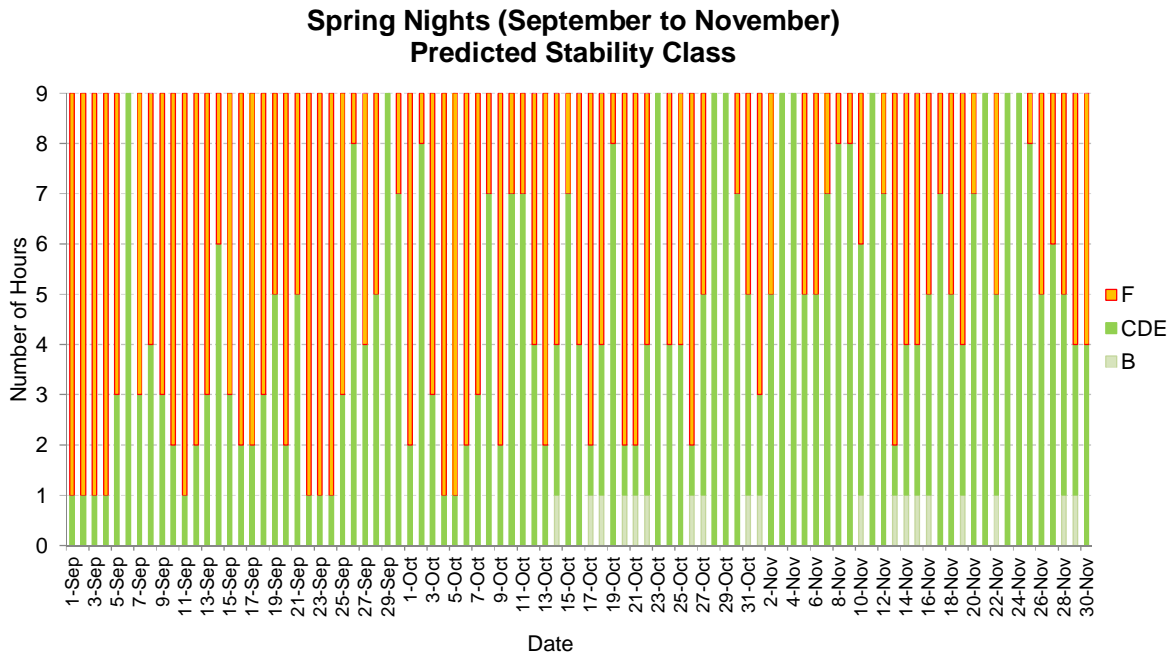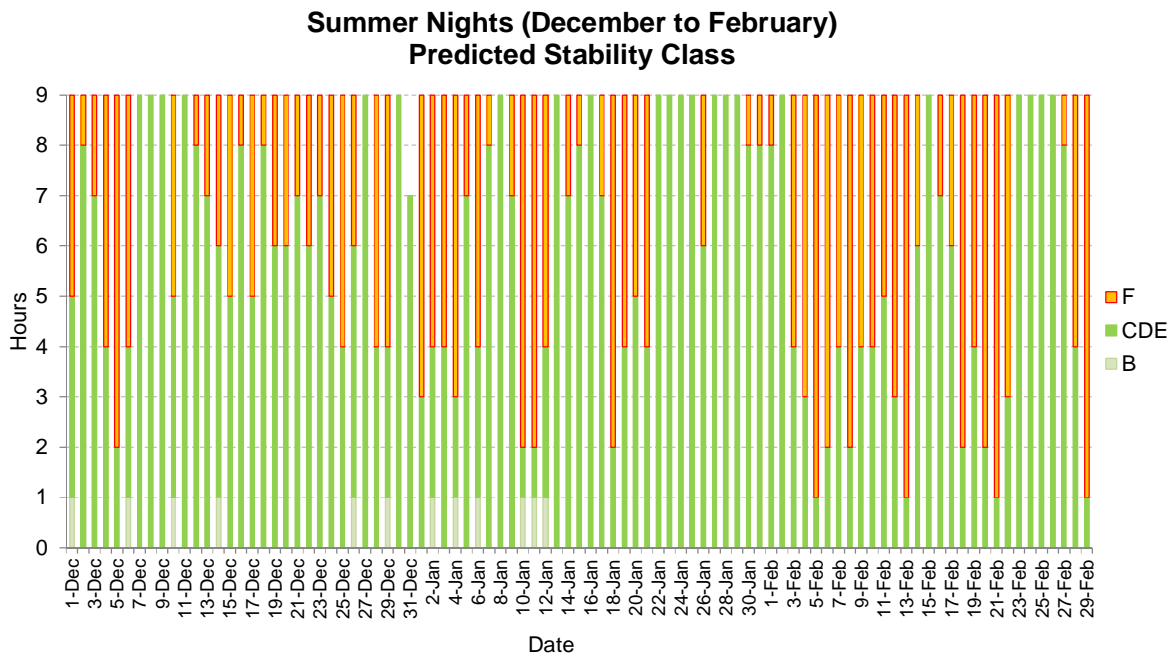**Predicted Stability Class**

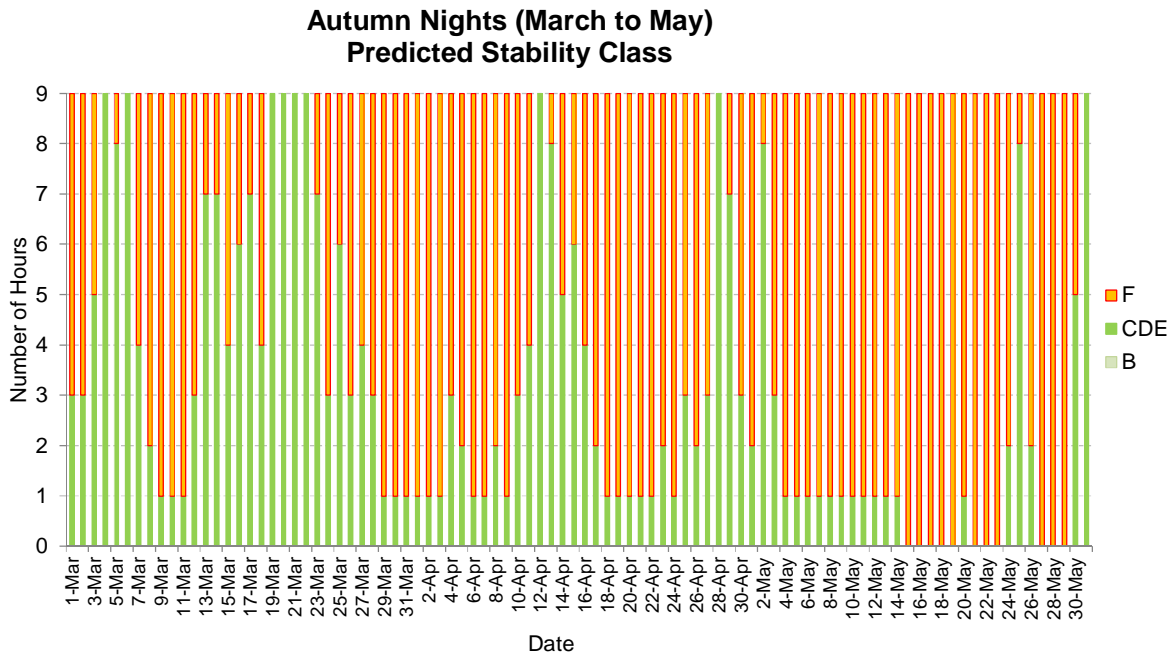**Figure 11-5 Predicted Stability Class by Hour for Summer Nights**

Figure 11-6 Predicted Stability Class by Hour for Autumn Nights
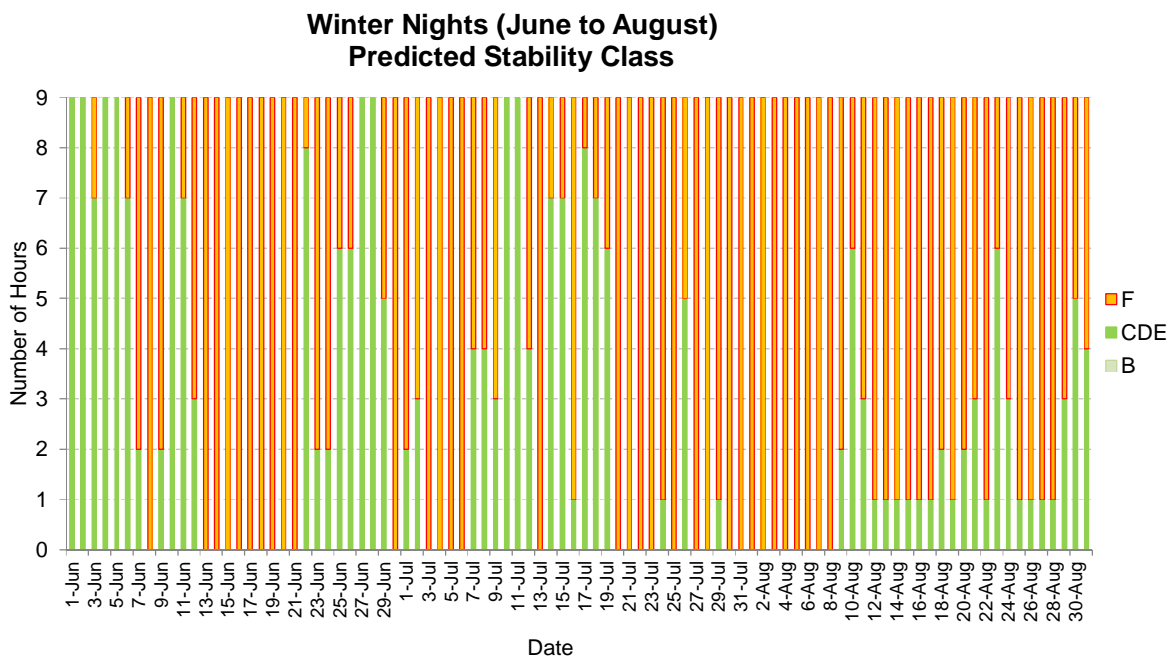

Figure 11-7 Predicted Stability Class by Hour for Winter Nights

11.4 Legislative Context

This section describes the construction and operational noise criteria applicable for this the revised Project.

Since the introduction of the *Environmental Protection Act 1994* (EP Act) by the Queensland Government, a number of supporting documents have been developed to assist in preventing adverse impacts on Queensland's acoustic environment. The current supporting documentation relevant to the revised Project, including legislation, guidelines and mining licence conditions are listed in **Table 11-3**.

These documents have been considered when setting noise assessment criteria, developing methodology, undertaking background noise level monitoring and in the modelling of proposed noise sources to assess the potential impact on sensitive receptors. Aspects of these documents relevant to the revised Project are discussed below.

Table 11-3 Applicable noise guidelines

Document Type	Document Name	Reference
Legislation	*Environmental Protection Act 1994*	State of Queensland (1994)
Policy	*Environmental Protection (Noise) Policy 2008* (EPP (Noise))	State of Queensland (2008)
Guideline	Guideline – Planning for noise control	DERM (2004d)
Guideline	Guideline – Noise and vibration from blasting	DERM (2006)
Standard	Australian Standard AS 2187.2-2006 Explosives – Storage and Use, Part 2 Use of Explosives	Standards Australia (2006)
Manual	Noise measurement manual	DERM (2000)
Guideline	Draft Guideline – Assessment of low frequency noise	DERM (2002)
Code	Code of Practice – Railway Noise Management	QR (2007)
Code	Road Traffic Noise Management: Code of Practice	QTMR (2008)

11.4.1 Environmental Protection Act 1994

The EP Act provides that construction noise from building work that makes audible noise should be limited to 6:30am to 6:30pm Monday to Saturday, unless otherwise authorised under an EA.

11.4.2 Environmental Protection (Noise) Policy 2008

Pursuant to the EP Act, environmental values to be enhanced and protected by the EPP (Noise) are:

■ the qualities of the acoustic environment that are conducive to protecting the health and biodiversity of ecosystems,

■ the qualities of the acoustic environment that are conducive to human health and wellbeing, including by ensuring a suitable acoustic environment for individuals to sleep, study and be involved in recreation, including relaxation and conversation, and

- the qualities of the acoustic environment that are conducive to protecting the amenity of the community.

The relevant acoustic quality objectives specified by EPP (Noise) is tabulated in **Table 11-4**.

Table 11-4 Acoustic quality objectives

Sensitive receptor	Time of day	Acoustic quality objectives (dB(A))			Environmental value
		$L_{Aeq,adj,1\ hr}$	$L_{A10,adj,1\ hr}$	$L_{A1,adj,1\ hr}$	
Dwelling (outdoors)	Daytime and evening	50	55	65	Health and wellbeing
Dwelling (indoors)	Daytime and evening	35	40	45	Health and wellbeing
Dwelling (indoors)	Night time	30	35	40	Health and wellbeing, in relation to the ability to sleep

The L_{A10} and L_{A1} indices are noise levels exceeded for 10% and 1% of the monitoring measurement interval time respectively. The L_{Aeq} level is the equivalent continuous sound level and has the same energy over the measurement interval as the fluctuating noise level.

Assuming windows are partially opened, with a 7 dB(A) noise level reduction between inside and outside (Based on *Planning for Noise Control Guideline*), the equivalent outdoor EPP (Noise) acoustic quality objectives are shown in **Table 11-5**.

Table 11-5 Equivalent outdoor acoustic quality objectives

Sensitive receptor	Time of day	Acoustic quality objectives (dB(A))			Environmental value
		$L_{Aeq,adj,1\ hr}$*	$L_{A10,adj,1\ hr}$*	$L_{A1,adj,1\ hr}$*	
Dwelling (equivalent outdoor)	Daytime and evening	42	47	52	Health and wellbeing
	Night time	37	42	47	Health and wellbeing, in relation to the ability to sleep

* adj - adjusted for tonality and impulsiveness

Noise from mining activities is continuous and varied in noise level with excursions around the mean. For this assessment, noise from the mining equipment is assessed using the $L_{Aeq,adj,1\ hr}$ acoustic quality objective and the criteria are shown in **Table 11-6** .

Table 11-6 EPP (Noise) criteria for this assessment

Sensitive receptor	Time of day	Acoustic quality objectives (dB(A))
		$L_{Aeq,adj,1\ hr}$
Dwelling (equivalent outdoor)	Daytime and evening	42
	Night time	37

* adj - adjusted for tonality and impulsiveness

11.4.3 Noise and Vibration from Blasting Guideline

The *Noise and Vibration from Blasting Guideline* (EPA 2006) specifies recommended human comfort criteria for:

- airblast overpressure level;
- ground vibration peak particle velocity; and
- times of blasting

The times of blasting and, airblast overpressure and vibration limits for blasting are summarised in **Table 11-7**.

Table 11-7 Airblast overpressure and vibration limits in sensitive places

Blast parameter	Time and Limits
Blasting times	Monday to Friday 9am - 3pm Saturday 9am – 1pm. Blasting should not generally take place on Sundays or public holidays
Air blast overpressure level dB(Lin) Peak	115 dB (Lin) peak for 9 out of any 10 consecutive blasts, regardless of the interval between blasts. Any single blast must not exceed 120 db (linear).
Vibration (mm/sec)	5mm/s for 9 out of any 10 consecutive blasts. Any single blast must not exceed 10mm/s.

* Blasting not permitted on public holidays and Sundays

For the heritage listed former Acland No.2 Colliery, there is no blasting vibration criteria for heritage listed site in Queensland. DEHP advises compliance with the human comfort criteria above would also ensure protection of heritage listed site.

11.4.4 The Planning for Noise Control Guideline

The *Planning for Noise Control Guideline* (EPA 2004) provides a framework for the assessment of operational noise emitted from industrial, commercial and mining operations, and is intended for noise planning purposes. The guideline is aimed at addressing the control and prevention of noise impact and addresses the following three aspects:

- preventing background noise creep (noise levels creeping higher and higher over time);
- containing and minimising variable noise; and
- avoiding sleep disturbance.

Planning Noise Levels

The calculations for the design criteria for sensitive receptors using the lowest noise levels from the SKM noise monitoring results are shown in **Table 11-8**.

Table 11-8 Planning noise level calculation for a sensitive receptor with the lowest noise monitoring results

Residence South	Day	Evening	Night
Rating Background Level (RBL)	27	34	25
Acceptable (measured) L_{A90} *	27	34	25
Recommended L_{A90} (Table 1^,Rural Residential) *	35	30	25
Differences	-8	4	0
Adjustment to background (Table 2^)	5	-10	-10
Maximum Planning Level L_{A90}*	32	25	25
Existing L_{Aeq} from industrial noise source	0	0	0
PNL (Table 3^, Category Z1)	40	35	30
Differences (Table 4^)	-40	-35	-30
Maximum PNL (Table 4^), $L_{Aeq,\ 1hour}$	PNL40	PNL35	PNL30
Specific level $L_{Aeq1hour}$ dB(A)	(32+3) = 35	(25 + 3) = 28	(25 + 3) = 28

*Noise levels that are below 25 dB(A) are corrected to the threshold level of 25 dB(A)
^ Tables from *Planning for Noise Control Guideline* (EPA 2004)

Sleep Disturbance Criteria

Research from WHO shows that as a rule, in planning for short-term or transient noise events, for good sleep over eight hours, the indoor sound pressure level measured as a maximum instantaneous value should not exceed approximately L_{Amax} 45 dB(A) more than 10-15 times per night. The corresponding external noise level, assuming partially closed windows, would be L_{Amax} 52 dB(A) measured in free field (EPA 2004).

11.4.5 The Assessment of Low Frequency Noise Guideline

The *Assessment of Low Frequency Noise Guideline* (draft) (EPA 2002) is intended to address low frequency noise emitted from industrial premises, commercial premises and mining and extractive

operations. The intent of the guideline is to accurately assess annoyance and discomfort to persons at noise sensitive places caused by noise with a frequency of 2 Hz to 200 Hz.

Items such as boilers, pumps, transformers, cooling fans, compressors, oil and gas burners, electrical installations, diesel engines, asynchronous motors, ventilation and air conditioning equipment, wind turbulence, trucks, locomotives and large chimney resonance are potential sources of high level low frequency noise having content less than 200 Hz.

These sources display a spectrum that characteristically shows a general increase in sound pressure level with a decrease in frequency. Annoyance due to low frequency noise can be high even though the A-weighted level is relatively low.

Where an unbalanced noise emission occurs, the overall sound pressure level inside residences should not exceed 50 dB(Lin) to avoid complaints of low frequency noise annoyance. This requirement is based on experimental evidence and on field annoyance data. If the internal noise level exceeds 50 dB(Lin) and the dB(Lin) measurement exceeds the A-weighted measurement by more than 15 dB, further assessment would be required.

With open windows, the difference between the external and internal noise levels are approximately 5 dB(Lin), resulting in an equivalent external criteria of 55 dB(Lin).

11.4.6 QR Code of Practice for Railway Management 2007

The QR Code of Practice for Railway Management 2007 provides the following noise objectives at noise sensitive receptors for noise associated with rail activity on existing rail networks:

- 87 dB(A) L_{Amax};
- 65 dB(A) $L_{Aeq(24\ hour)}$

The environmental nuisance provisions under the EP Act do not apply to noise from the ordinary use of rail transport infrastructure (Schedule 1, EP Act).

11.4.7 Road Traffic Noise Management: Code of Practice

The TMR Code of Practice for Road Traffic Noise Management 2008 provides a noise limit of $L_{A10\ (18hr)}$ 68 dB(A) at noise sensitive receptors for existing roads and road upgrades.

11.4.8 Summary of Noise and Vibration Criteria

A summary of noise and vibration criteria that are applicable in this study are tabulated in **Table 11-9**.

Table 11-9 Summary of Noise and Vibration Criteria

Noise and vibration type	Criteria	Period	Levels dB(A)
Operational mining noise (all noise sources)	EPP(Noise)	Daytime and evening	$L_{Aeq,adj,1\ hr}$ 42
		Night time	$L_{Aeq,adj,1\ hr}$ 37
	Planning for Noise Control Guideline's Planning Noise Level (PNL)	Daytime	$L_{Aeq,\ 1hour}$ 35
		Evening	$L_{Aeq,\ 1hour}$ 28[#]
		Night time	$L_{Aeq,\ 1hour}$ 28
	Planning for Noise Control Guideline's Sleep Disturbance Criteria	Night time	L_{Amax} 52
Construction noise during daytime	N/A	Daytime	N/A
	Not audible	Night time	N/A
Blasting noise	Noise and vibration from Blasting Guideline	Monday to Friday 9am-3pm, Saturday 9am-1pm	115 db (Lin) peak for 9 out of any 10 consecutive blasts, regardless of the interval between blasts Any single blast must not exceed 120 db
Blasting vibration	Noise and vibration from Blasting Guideline		5mm/s for 9 out of any 10 consecutive blasts Any single blast must not exceed 10mm/s
Rail Traffic Noise	Queensland Rail Code of Practice – Railway Noise Management	24 hours	$L_{Aeq\ (24\ hour)}$ 65 L_{Amax} 87
Road Traffic Noise	Main Roads Code of Practice - Road Traffic Noise Management	Between 6am and midnight	$L_{A10\ (18hr)}$ 68 dB(A)
Low Frequency Noise impact from mining operation	Draft Guideline – Assessment of low frequency noise	24 hours	L_{eq} 55 (Lin) outdoors
			if L_{eq} (Lin) is >55, dB(Lin) & dB(A) difference <15

11.5 Consideration of Noise Constraints and Mine Operating Scenarios

NAC identified that noise generated from mining operations was a key constraint for the revised Project based on the mine plan and proximity of sensitive receptors to mining activities. A range of different mining scenarios were identified and noise modelling was undertaken to assess the feasibility of implementing these scenarios onsite.

A number of operating scenarios were investigated and noise modelling exercises were carried out, with the aim to assist in developing a mining operation that would demonstrate best practice and comply with legislative noise limits while achieving a feasible and viable mining operation.

The noise modelling exercises and operational scenarios investigated include the:

- effect of replacing the excavator (noisier equipment) with a loader (quieter equipment) to achieve the same output;
- viability of night time operation in Manning Vale East pit with regards to complying with EPP (Noise) night time criteria;
- comparison of conveyor versus haul truck options;
- feasibility of using existing equipment (not noise attenuated);
- use of a mixture of noise attenuated and existing equipment; and
- use of noise attenuated equipment.

The noise modelling exercises were undertaken with the SoundPLAN 7.2 modelling software. For the purpose of presenting the differences in sound power levels (SWL) between existing and noise attenuated equipment, the SWL of existing and noise attenuated excavators, track dozers, loaders and rear dump trucks are tabulated in **Table 11-10**.

Table 11-10 Sound Power Levels (SWL) of existing and attenuated equipment

Item	Existing equipment sound power level dB(A)	Attenuated equipment sound power level dB(A)
350 t and 500 t Excavator	124	118
900kW Loader	117	114
180 t and 220 t Rear Dump Truck	115	112
50 t to 100 t Track Dozer	115	113

A summary of the investigated scenarios and the noise modelling results are tabulated in **Table 11-11**.

Table 11-11 Summary of the Investigated Scenarios and the Noise Modelling Results

Scenario	(1) Effect of Replacing Excavator with Loader	(2) Viability of Night Time Operation in Manning Vale East pit	(3) Comparison of Conveyor versus Haul Truck	(4) Existing versus Attenuated Equipment	(5) Mixture of Equipment versus Attenuated Equipment
Period	Day	Night	Day/Night	Day/Night	Night
Pits	All 3	All 3	3 (day) 2 (night)	3 (day) 2 (night)	All 3
Equipment	Excavators, track dozers, loaders and rear dump trucks are attenuated.	Excavators, track dozers, loaders and rear dump trucks are attenuated.	Attenuated rear dump trucks compared to open and unmitigated conveyors.	Excavators, track dozers, loaders and rear dump trucks are attenuated.	Excavators, track dozers, loaders and rear dump trucks are attenuated in all three pits versus excavators, track dozers, loaders and rear dump trucks are attenuated in Manning Vale East pit plus existing equipment at the other two pits.
Results	0 to 0.6 dB(A) lower at sensitive receptors with loader	Between 0 and 6 dB(A) higher at sensitive receptors compared to only two pits operating	Between 2 and 8 dB(A) higher with conveyor at sensitive receptors	Between 4 and 6 dB(A) higher with existing equipment at sensitive receptors	Up to 6 dB(A) lower with attenuated excavators, track dozers, loaders and rear dump trucks in all three pits

Results from the noise modelling exercises and operating scenarios investigated show that:

- noise levels would be up to 6 dB(A) lower at the noise sensitive receptors if the noisier equipment including excavators, track dozers, loaders and rear dump trucks are noise attenuated;

- replacing the excavators with loaders reduces noise levels at the noise sensitive receptors by up to 0.6 dB(A);

- to comply with legislative noise limits in EPP (Noise), limited mining operation could be allowed in the Manning Vale East pit during the night time; and

- noisier equipment including excavators, track dozers, loaders and rear dump trucks will need to be noise attenuated to achieve compliance with legislative noise limits in EPP (Noise).

These critical findings have assisted in developing the mine plan, mining fleet and operational schedule for the revised Project. However, noise modelling also show even by implementing all the measures above, the predicted noise levels from the mining operation will still exceed the *Planning for*

Noise Control Guideline's PNL at a number of noise sensitive receptors. The DEHP has acknowledged that a PNL of 28 dB(A) is an inappropriate level for practical compliance purposes. Furthermore, a large number of mines and industries in Queensland would not comply with a PNL of 28 dB(A). PNL therefore have not been considered in this noise assessment for the revised Project.

The EPP $L_{Aeq,adj,1\,hr}$ criteria are considered 'conservative' as it is based on research results from the World Health Organisation (WHO) with the aim to prevent sleep disturbance.

The noise investigations confirmed the importance of adopting a best-practice approach to noise management for the revised Project. The implications for the proposed mining operations for the revised Project are:

- noisier equipment including excavators, track dozers, loaders and rear dump trucks will need to be attenuated to meet noise objectives; and
- mining operations within the Manning Vale East pit will need to be varied or limited during the night time period to meet noise objectives (i.e. depending on ambient conditions).

Reasonable measures to minimise noise from mining operations have been incorporated into development of the revised Project. The noise and vibration assessment for mining operations for the revised Project are presented in **Section 11.7**. The predicted noise levels are considered the lowest noise levels that can be reasonably achieved for a feasible and viable mining operation.

11.6   Noise Impact Assessment for Construction

This section discusses the potential construction noise impact of the revised Project.

Construction is planned to commence in 2015. The revised Project construction activities include the construction of the:

- upgrade of the CHPP Precinct;
- new MHF;
- construction of a new 8km rail spur and balloon loop from Jondaryan onto MLA 50232
- upgrade of the MIA;
- new TLF; and
- diversion of the Jondaryan-Muldu Road around the Manning Vale West mining area

Construction is expected to last up to 26 months, with the majority of construction work expected to occur between 2015 and 2017. Construction of the associated infrastructure is proposed to be conducted between 6 am to 6 pm, Monday to Saturday with Sunday available for overtime on specialist tasks.

There are currently no construction noise criteria under Queensland legislation.

Construction work will only occur during daytime hours. Due to the proposed construction hours and the separation distances (minimum 400 m) between construction activities and the sensitive receptors, noise impact from construction activities will be minimal.

11.7 Noise and Vibration Impact Assessment for Mining Operations

This section assesses noise from the mining operation against the noise criteria determined in **Section 11.4**. The assessment includes:

- a description of the noise modelling methodology used for the noise predictions;

- a listing of equipment sound power levels (SWL) used for the noise modelling;

- a description of the various operational scenarios investigated to assist in developing a viable mining operation that complies with legislative noise limits;

- a prediction of noise levels at noise sensitive receptors and assessment against EPP (Noise) and *Planning for Noise Control Guideline's* sleep disturbance criteria;

- a prediction of airblast overpressure and vibration levels from blasting; and

- a prediction of low frequency noise at noise-sensitive receptors and assessment against the *Assessment of Low Frequency Noise Guideline* (EPA 2002);

- off-site road traffic noise impacts on public roads and the proposed private haul road;

- rail noise impact from the proposed rail spur; and

- description of the effects of noise on local wildlife/fauna.

11.7.1 Noise modelling methodology

This section details the noise modelling methodology for the revised Project.

The revised Project will develop three additional resource areas within MLA 50232 – Manning Vale East, Manning Vale West and Willeroo. As the locations of the mine pits and working areas change over the life of the revised Project, the noise levels at the noise sensitive receptors during the early, middle and final stages of the revised Project life have been predicted. The three stages modelled are for mining operations in year 2019, 2023 and 2029.

A three dimensional noise model was developed using SoundPLAN 7.2 software to predict the mining noise levels around the revised Project. The CONCAWE noise propagation algorithms and methodology has been used in this assessment and is suitable for predicting mining project noise emissions. Model validation shows, implementation of CONCAWE algorithms within the SoundPLAN model results in a prediction accuracy of ± 3 dB(A) within a distance of approximately 2.5 km.

The site topography, the locations of the mining pits and noise sensitive receptors for the three modelling scenarios are shown in **Figure 11-8** to **Figure 11-10**.
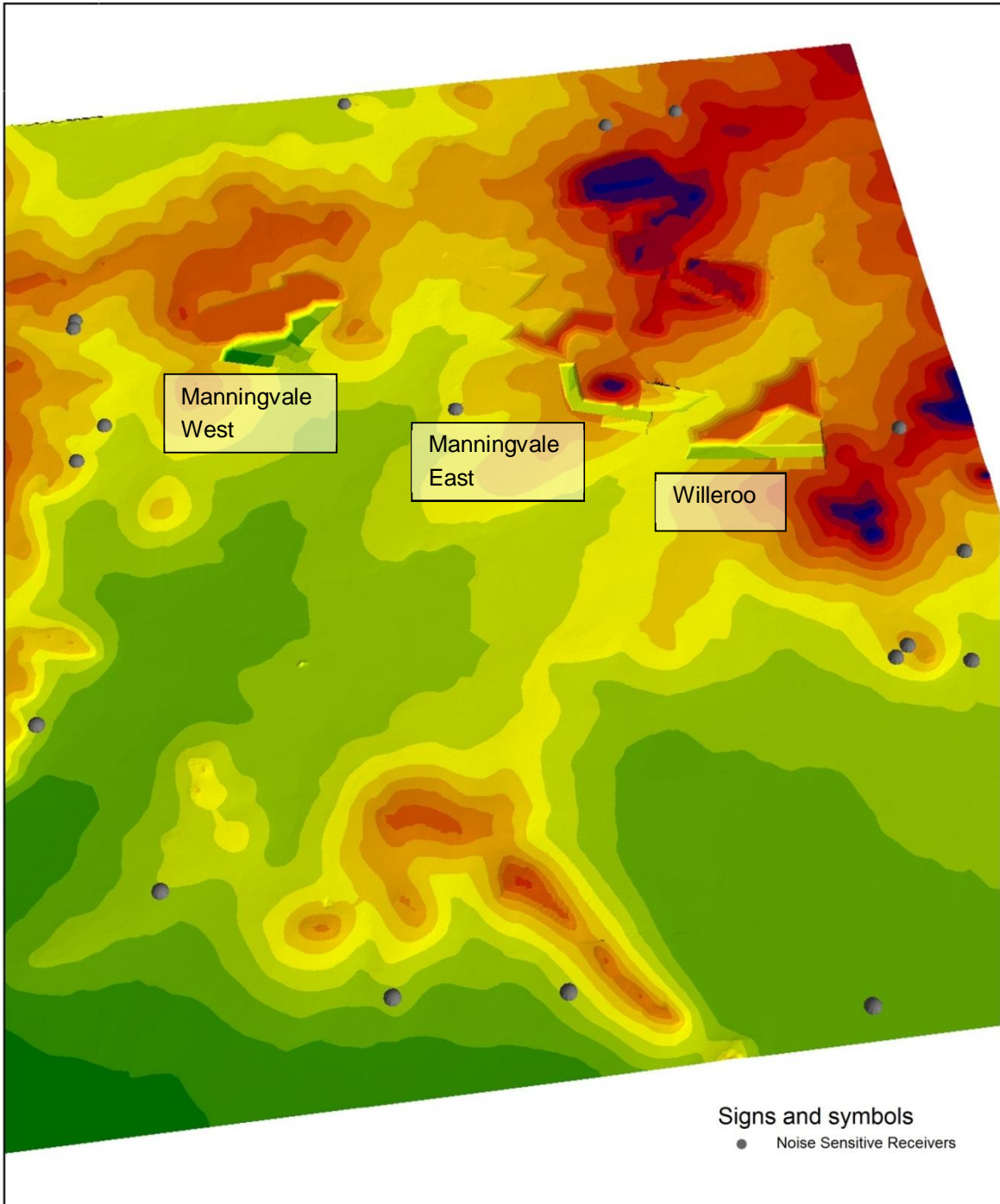
Figure 11-8 Topography, mine pit locations and sensitive receptor locations for 2019
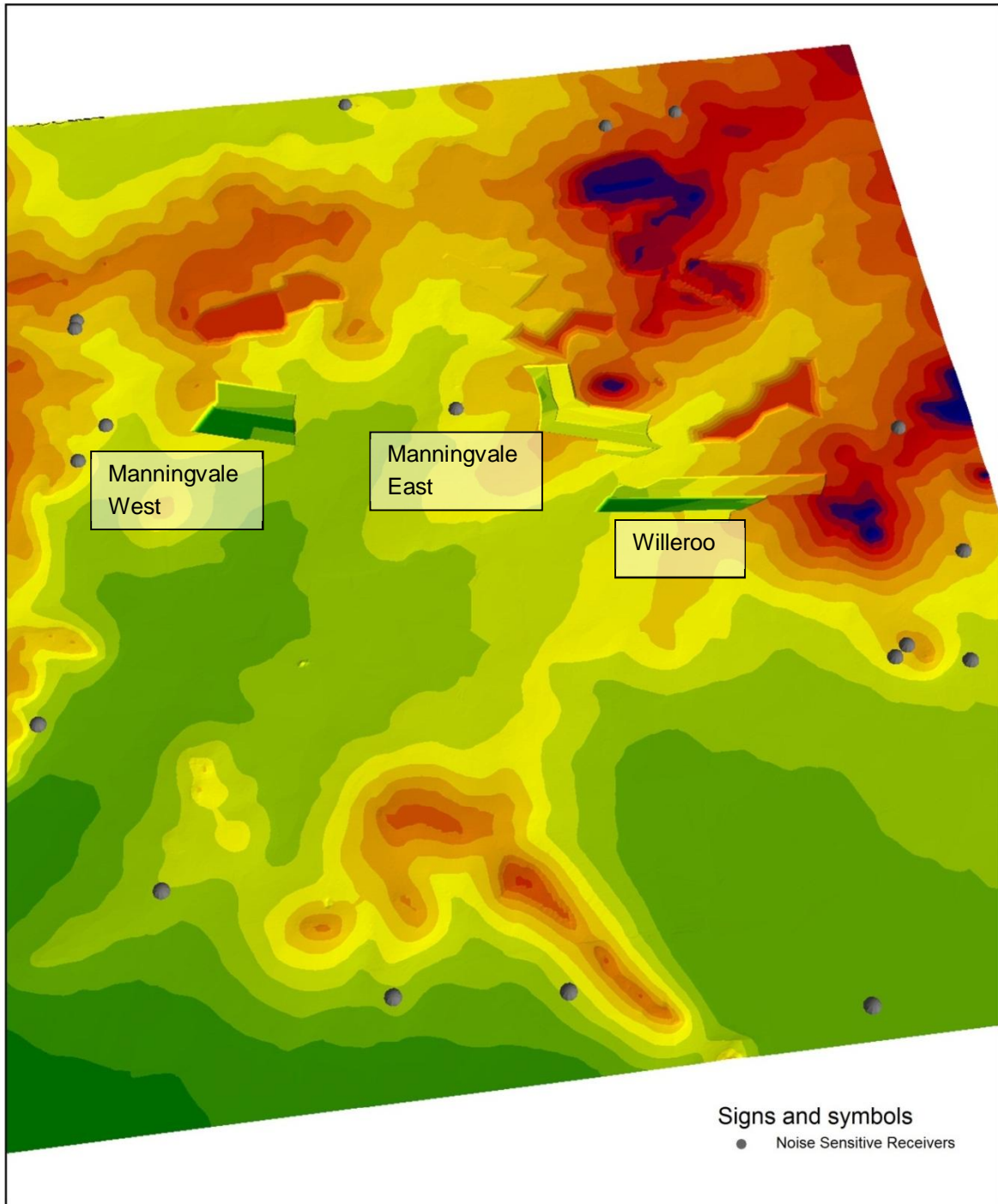
Figure 11-9 Topography, mine pit locations and sensitive receptor locations for 2023
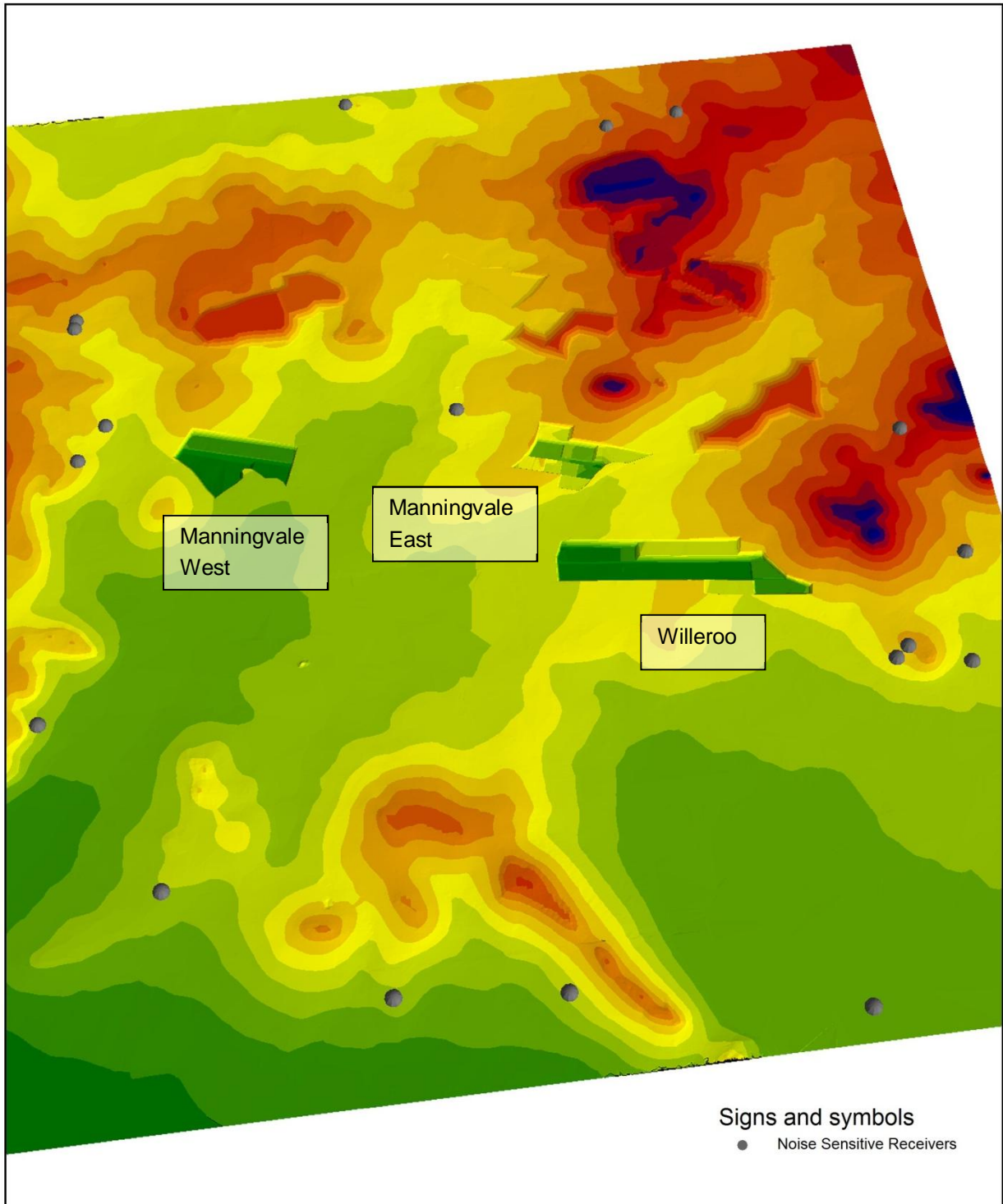
Figure 11-10 Topography, mine pit locations and sensitive receptor locations for 2029

Mining activities will typically be conducted either on a six day, 24 hour basis or a seven day, 24 hour basis depending on the mining schedule and the type of mining equipment used. The CHPP activities

will be conducted on a seven day, 24 hour basis. Certain mining related activities such as blasting will only be undertaken during daylight hours and will not generally be carried out on Sundays or public holidays. Conducting mining operations on a 24 hour basis is standard practice in Queensland, with various measures in place to ensure a safe operation. The TLF will operate on a seven day, 24 hr basis. Train operations will also occur on a seven day, 24 hr basis.

The level of noise at nearby receptors will vary depending on the location and elevation of the noise sources, the intervening topography, including hills, bunds and pit walls, prevailing meteorology and the distance between the source and receptor.

Noise levels at noise sensitive receptors can increase by up to 10 dB(A) under adverse meteorological conditions (such as temperature inversions or wind in the direction of the receptor) and decrease up to 10 dB(A) under unfavourable propagation conditions.

Meteorological data shows that the Stability Class 'F' condition (which is favourable for noise propagation) is significant during the late evening and night time around the revised Project site.

Overall Operational Noise (L_{Aeq})

The overall operational noise modelling has been based on the assumption that not all of the proposed mining equipment will be operating at maximum engine speed or load. Some equipment may not be operational or may be in idle mode at various times during the operation. A -2 dB(A) correction have been applied to the equipment SWL to account for the average noise levels (L_{Aeq}) from mining activities.

For each of stages of the revised Project life, noise levels under the following three operational and meteorological conditions have been predicted.

- Day time and evening operations with all three mining pits operating - worst case meteorology conditions of Stability Class F with a 2.9 m/s wind in the direction of the noise sensitive receptors. (Stability Class F condition is not present during day time. However, this scenario has been predicted to account for stability Class F conditions in the late evening when all three pits are operating; Modelling shows stability Class D noise levels are approximately 4 to 6 dB(A) lower than stability Class F levels).

- Night time operation with only Manning Vale West and Willeroo Pits operating, calm with no wind and neutral condition of stability D.

- Night time operation with only Manning Vale West and Willeroo Pits operating, worst case meteorology conditions of Stability Class F with a 2.9m/s wind in the direction of the noise sensitive receptors.

There will be a short period of time during the start of the revised Project when limited activities will occur at the existing Mine. The cumulative noise impacts from both the revised Project and the existing Mine have been modelled in the year 2019 scenario.

Maximum Operational Noise (L_{AMax})

The aim of the maximum operational noise modelling is to predict a realistic worst case instantaneous maximum noise level from the mining operation. It has been assumed that whilst a large number of

items of equipment will be operating at average engine speed, some mobile and fixed equipment will be operating at maximum engine speed or load. The following operational scenario has been modelled which is considered conservative and is unlikely to occur on a regular basis.

- A worst case scenario of a haul truck dumping coal into an empty RoM bin (Noise level highest when RoM bin is empty).
- A water truck, wheel dozer and a track dozer operating at maximum engine speed.
- Two rear dump trucks in proximity to the Manning Vale West pit and Willeroo pit, respectively, operating at maximum engine speed.
- Two side tipping trucks travelling at maximum engine speed along the haul route in close proximity to the noise sensitive receptors.
- The rest of the equipment fleet operating at average engine speed.
- Worst case meteorological condition of Stability Class F with a 2.9 m/s wind in the direction of the noise sensitive receptors with both the Manning Vale West and Willeroo Pits operating.

11.7.2 Mining Fleet and Equipment SWL

Noise attenuated excavators, track dozers, loaders and rear dump trucks will be utilised for the mining operations. The mining fleet incorporated in the noise model during the early, middle and final stages of the revised Project life and their associated sound power levels (SWL) are presented in **Table 11-12**. Equivalent equipment sound pressure levels at various distances based on distance attenuation are presented in **Table 11-13**.

Table 11-12 Mining Equipment for the Revised Project and Typical Sound Power Levels

Item	Quantity of equipment			L_{Aeq} Sound power level dB(A)
	Year 2019	Year 2023	Year 2029	
500 t Excavator	1	1	1	118
350 t Excavator	2	2	2	118
900 kW Loader	3	4	4	114
220 t Rear Dump Truck	7	7	7	112, L_{Amax} 120 dB(A)
180 t Rear Dump Truck	15	19	20	112, L_{Amax} 120 dB(A)
Side Tipping Truck	4	4	4	112, L_{Amax} 120 dB(A)
100 t Track Dozer	12	12	12	113, L_{Amax} 121 dB(A)
65 t Track Dozer	2	2	2	113, L_{Amax} 121 dB(A)
50 t Track Dozer	1	1	1	113, L_{Amax} 121 dB(A)
100 t Wheel Dozer	3	3	3	117, L_{Amax} 122 dB(A)
50 t Drilling Rig	2	2	2	118
140 kL Water Truck	1	1	1	115, L_{Amax} 120 dB(A)
55 kL Water Truck	2	2	2	115, L_{Amax} 120 dB(A)
400 kW Grader	2	2	2	110
220 kW Grader	2	2	2	110,

Item	Quantity of equipment			L_{Aeq} Sound power level dB(A)
	Year 2019	Year 2023	Year 2029	
CHPP including ROM hopper	3	3	3	119, L_{Amax} 125 dB(A)
Conveyor system at MHF and between CHPP and MHF				78 per meter
Stacker at MHF	2	2	2	104
Reclaimer at MHF	1	1	1	109 including 5dB(A) impulsiveness correction

Table 11-13 Equivalent equipment sound pressure levels at various distances based on only distance attenuation

Item	L_{Aeq} Sound power level dB(A)	Equivalent Sound Pressure level at various distances dB(A)		
		500m	1000m	5000m
500 t Excavator	118	53	47	33
350 t Excavator	118	53	47	33
900 kW Loader	114	49	43	29
220 t Rear Dump Truck	112	47	41	27
180 t Rear Dump Truck	112	47	41	27
Side Tipping Truck	112	47	41	27
100 t Track Dozer	113	48	42	28
65 t Track Dozer	113	48	42	28
50 t Track Dozer	113	48	42	28
100 t Wheel Dozer	117	52	46	32
50 t Drilling Rig	118	53	47	33
140 kL Water Truck	115	50	44	30
55 kL Water Truck	115	50	44	30
400 kW Grader	110	45	39	25
220 kW Grader	110	45	39	25
CHPP including ROM hopper	119	54	48	34
Conveyor system at MHF and between CHPP and MHF (per metre)	78	13	7	0
Stacker at MHF	104	39	33	19
Reclaimer at MHF	109	53	47	33

Note: Actual sound pressure levels would be lower than those indicated in the table due to other attenuation factors including ground attenuation, air absorption, screening effect from topography

The equipment sound power level data is derived from various sources including manufacturer supplied data and previous field measurements of similar operating equipment. Whilst the actual sound power levels can vary, the levels used in the model are indicative of the likely level when proper maintenance and operating procedures are followed.

11.7.3 Operational Noise Modelling Results

This section presents the noise modelling results for the early, middle and final stages of the revised Project life.

Assessment of predicted noise levels against EPP (Noise) criteria for selected sensitive receptors during mining operations for the revised Project are presented in **Table 11-14** The sensitive receptors selected in **Table 11-14** are those with the greatest potential for noise impacts. Assessment of predicted noise levels against the *Planning for Noise Control Guideline's* sleep disturbance criteria for selected sensitive receptors during mining operations for the revised Project are presented in **Table 11-15** The modelling results are also presented in the form of noise contour maps in **Figure 11-11** to **Figure 11-22**.

Table 11-14 Assessment of predicted noise levels against EPP (Noise) criteria at selected sensitive receptors

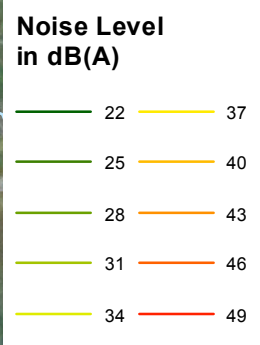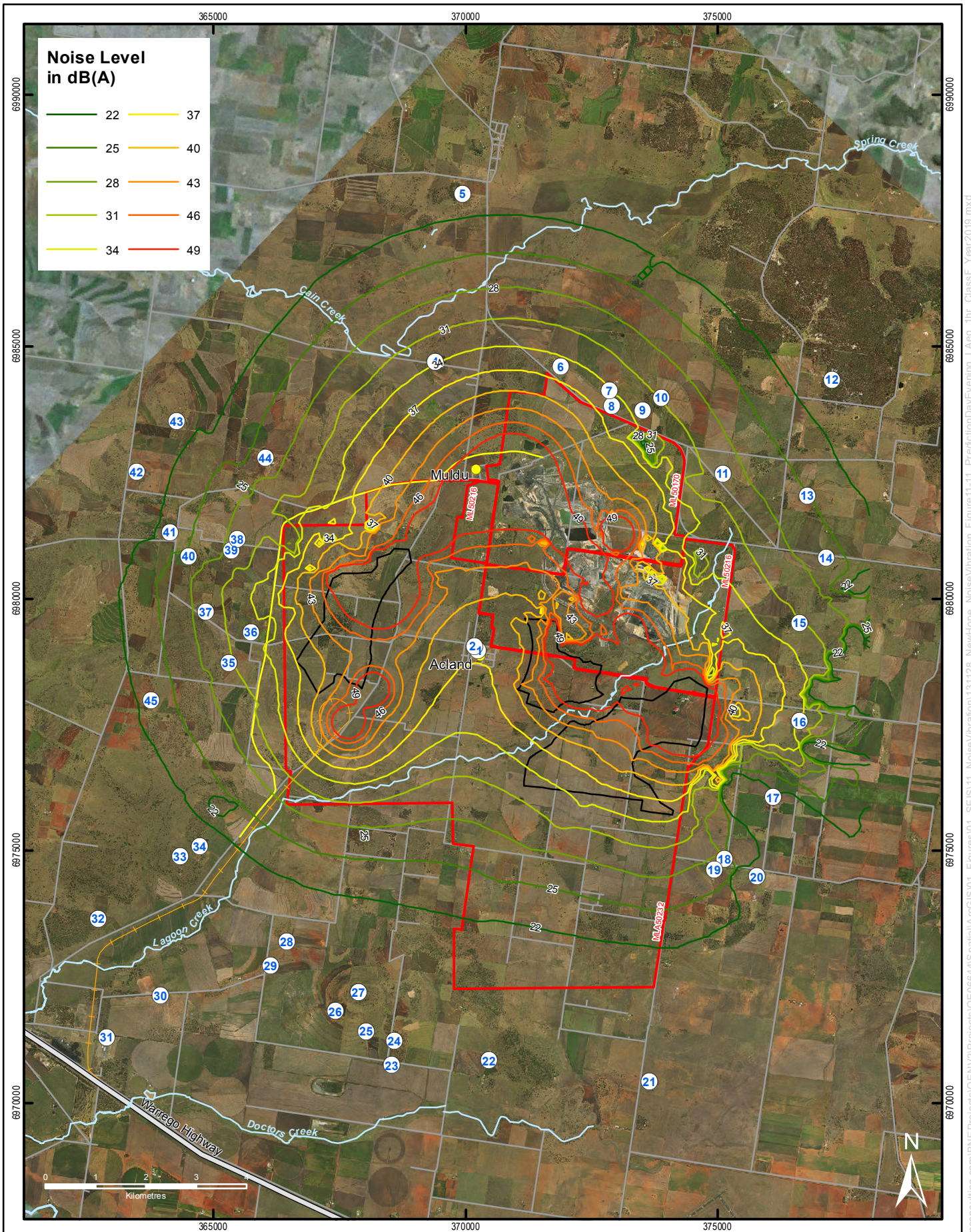| Scenario	Daytime and Evening, Stability Class F			Night time operations, Stability Class D			Night time operations, Stability Class F		
Receiver	2019	2023	2029	2019	2023	2029	2019	2023	2029
1	38	41	42	32	32	31	37	37	37
2	39	40	40	32	32	31	37	37	37
4	34	34	34	28	28	28	34	33	33
6	35	35	35	30	30	30	35	35	35
7	34	35	34	28	29	28	34	34	33
8	35	35	35	29	30	29	35	35	34
9	33	33	32	26	27	26	32	32	32
16	34	31	27	28	24	20	33	29	26
35	31	33	33	26	27	27	31	33	33
36	34	35	36	28	30	31	34	35	36
Noise Criteria	$L_{Aeq,adj,1\,hr}$ 42dB(A)			$L_{Aeq,adj,1\,hr}$ 37dB(A)			$L_{Aeq,adj,1\,hr}$ 37dB(A)		

Predicted noise levels within 2 dB of the EPP (Noise) criteria have highlighted

Table 11-15 Assessment of Predicted Night Time LAmax Stability Class F Noise Levels Against Planning for Noise Control Guideline's Sleep Disturbance Criteria

Scenario	Night Time L_{Amax} Stability Class F		
Receiver	2019	2023	2029
1	43	44	43
2	45	45	44
4	37	37	37
6	39	39	39
7	37	38	37
8	38	39	38
9	36	36	35
16	37	34	33
35	37	40	38
36	38	41	40
Noise Criteria	L_{Amax} 52dB(A)		

Modelling results are tabulated in **G.7.3 Table 1** to **Table 4**, which provide the predicted noise levels against the criteria from EPP (Noise) and *Planning for Noise Control Guideline's* sleep disturbance criteria at each sensitive receptor during operations for each of the three stages of the revised Project life.

Actual daytime stability Class D noise levels are approximately 4 to 6 dB(A) lower than the 'daytime and evening stability Class F' levels indicated in the tables and noise contour maps.

Noise Level in dB(A)

— 22	— 37		
— 25	— 40		
— 28	— 43		
— 31	— 46		
— 34	— 49		

Spring Creek

Cain Creek

Muldu

Acland

Lagoon Creek

Doctors Creek

Warrego Highway

Kilometres
0 1 2 3 4

N

LEGEND

- ● Towns and Localities
- ○ Sensitive Receptor
- ┿ Rail Spur
- — Roads
- — Creeks
- — Jondaryan-Muldu Road Diversion
- ▭ Mining Tenements
- ▭ Stage 3 Pit Areas

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NEW ACLAND COAL MINE STAGE 3 PROJECT

Figure 11-11 - Predicted Day and Evening LAeq, adj,1 hr Stability Class F Noise Levels in year 2019

Scale 1:100,000 on A4
Projection: Australian Geodetic Datum – Zone 56 (AGD84)

Noise Level in dB(A)

—— 22	—— 37
—— 25	—— 40
—— 28	—— 43
—— 31	—— 46
—— 34	—— 49

LEGEND

- ● Towns and Localities
- ○ Sensitive Receptor
- ┼ Rail Spur
- —— Roads
- —— Creeks
- —— Jondaryan-Muldu Road Diversion
- ▭ Mining Tenements
- ▭ Stage 3 Pit Areas

NEW HOPE GROUP

SKM
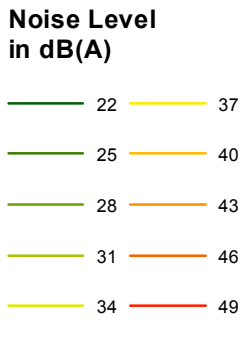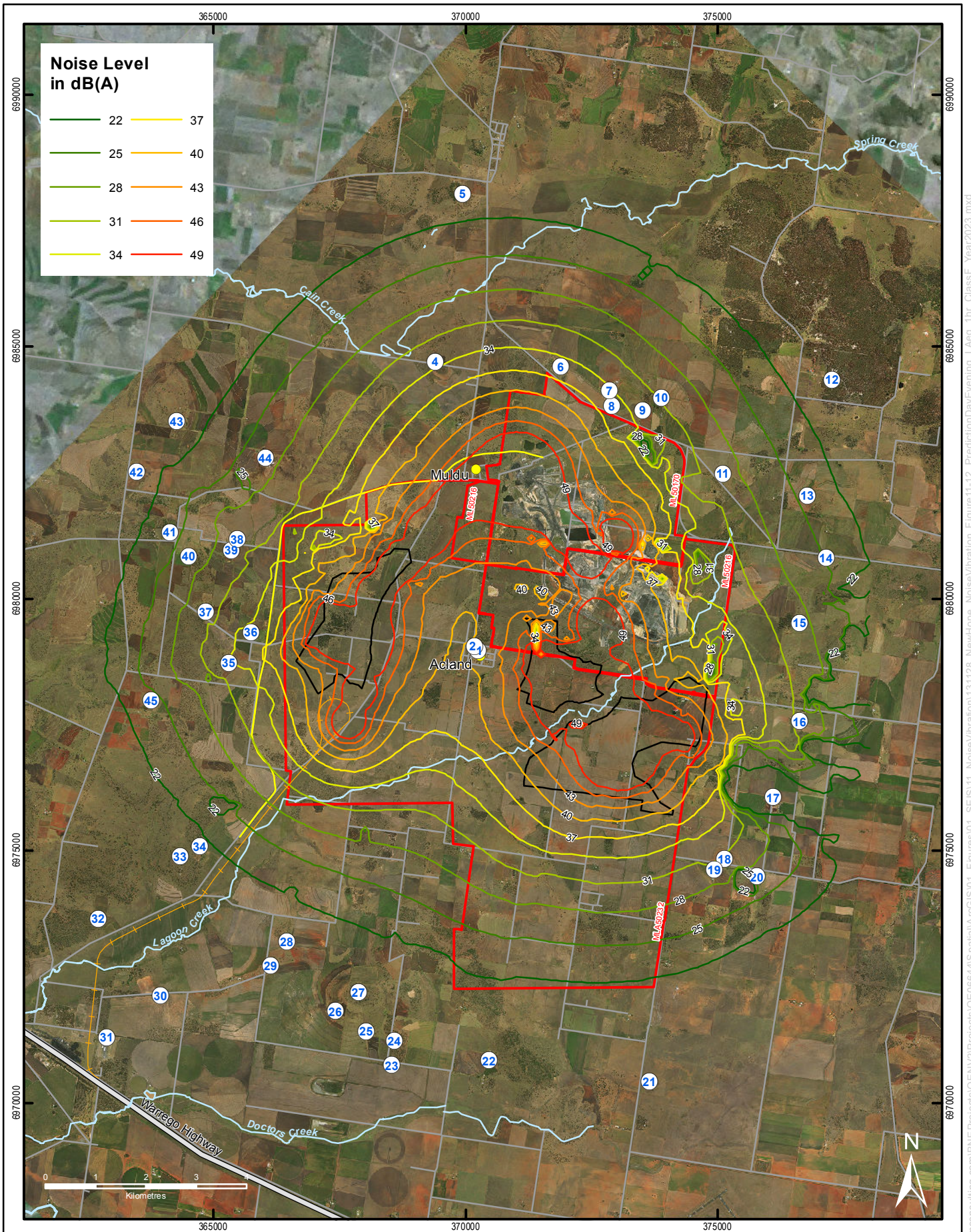
NEW ACLAND COAL MINE STAGE 3 PROJECT

Figure 11-12 - Predicted Day and Evening LAeq, adj,1 hr Stability Class F Noise Levels in year 2023

Scale 1:100,000 on A4
Projection: Australian Geodetic Datum – Zone 56 (AGD84)

Produced: 28/11/2013

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Figure 11-13 - Predicted Day and Evening LAeq, adj,1 hr Stability Class F Noise Levels in year 2029

Noise Level in dB(A)

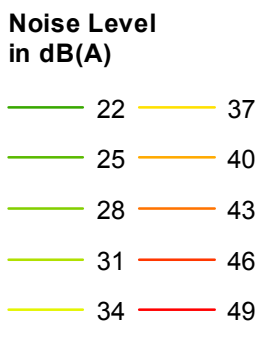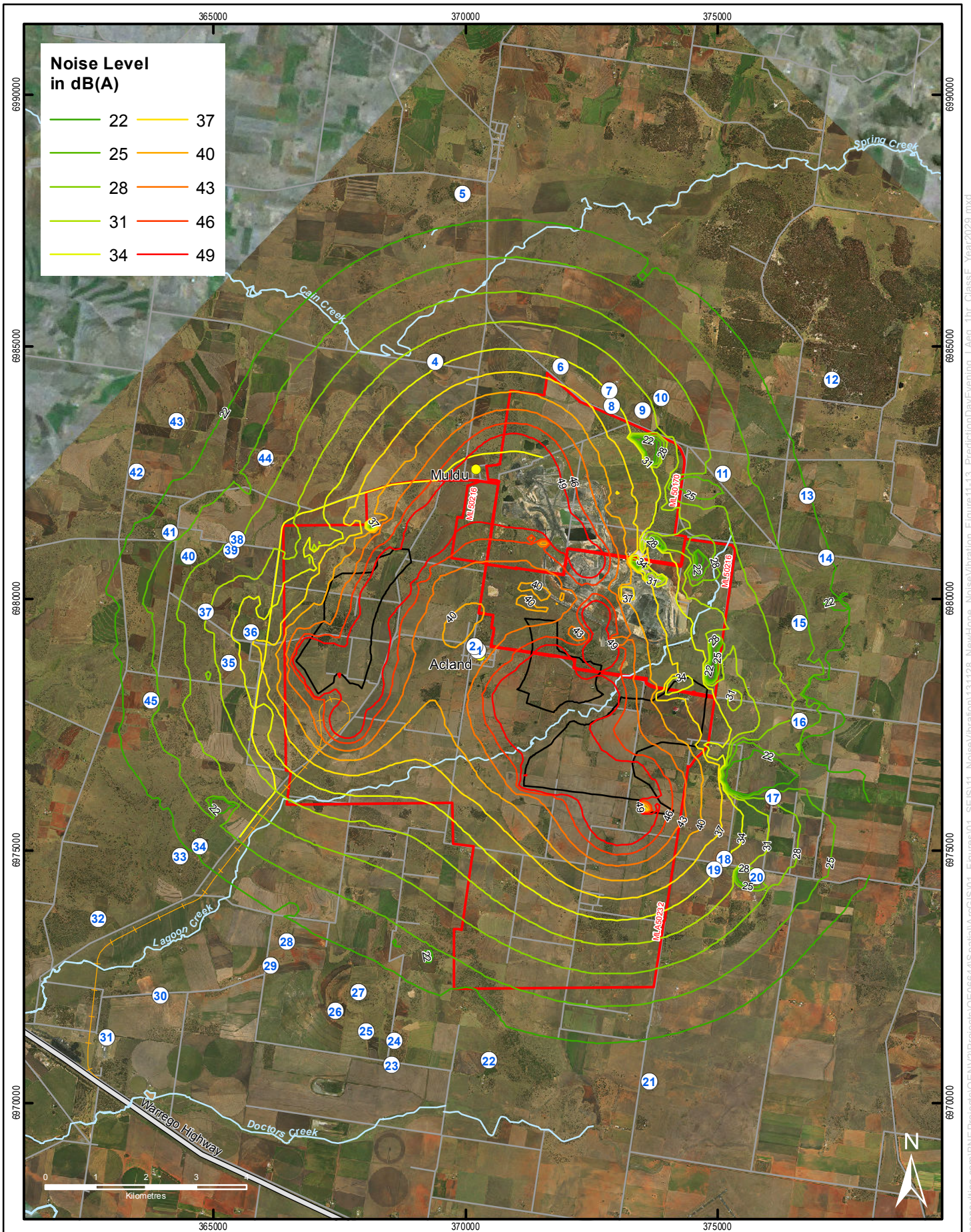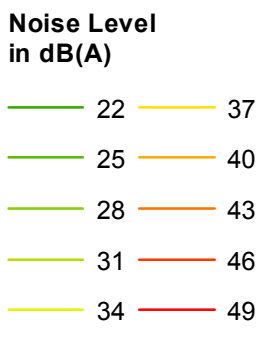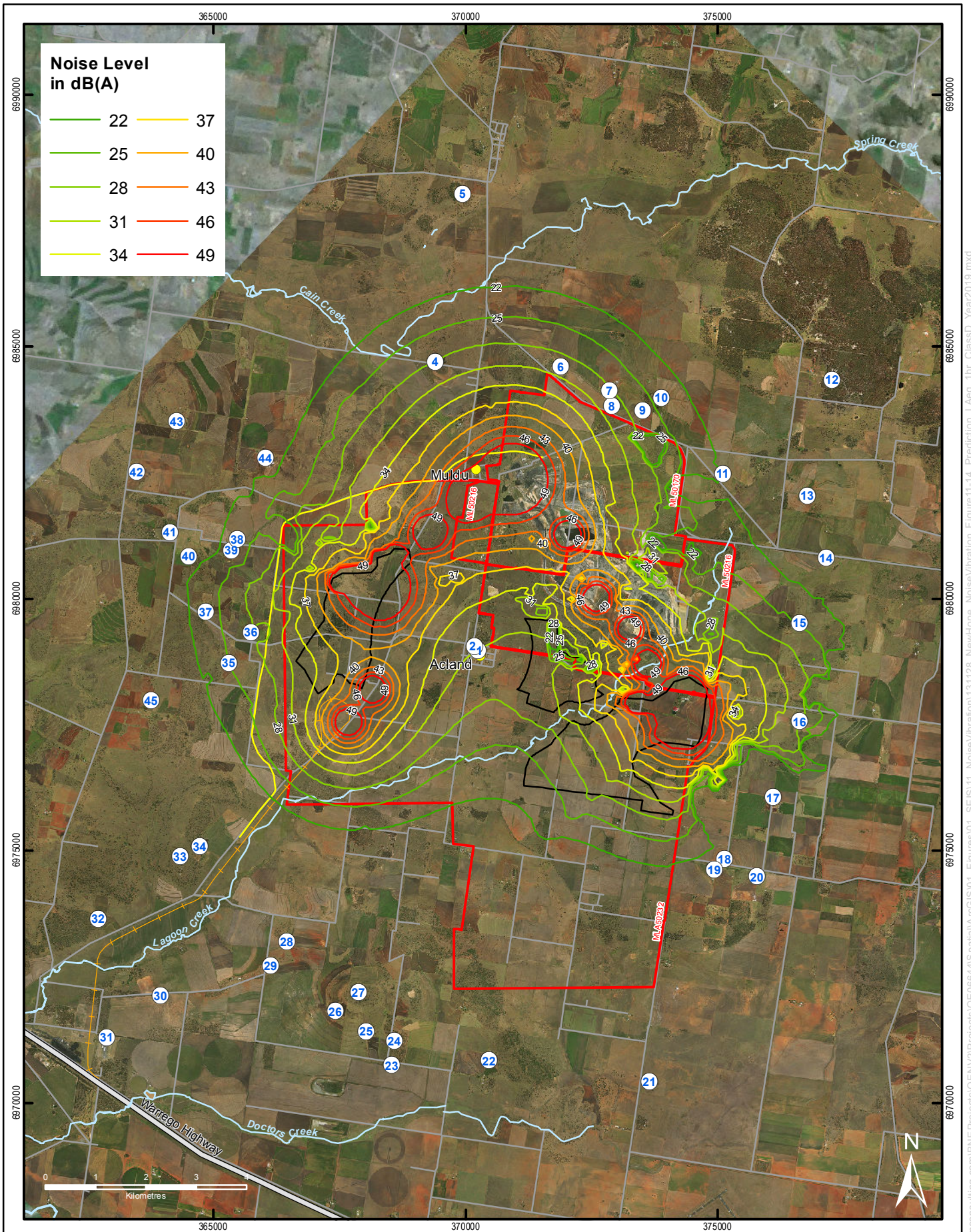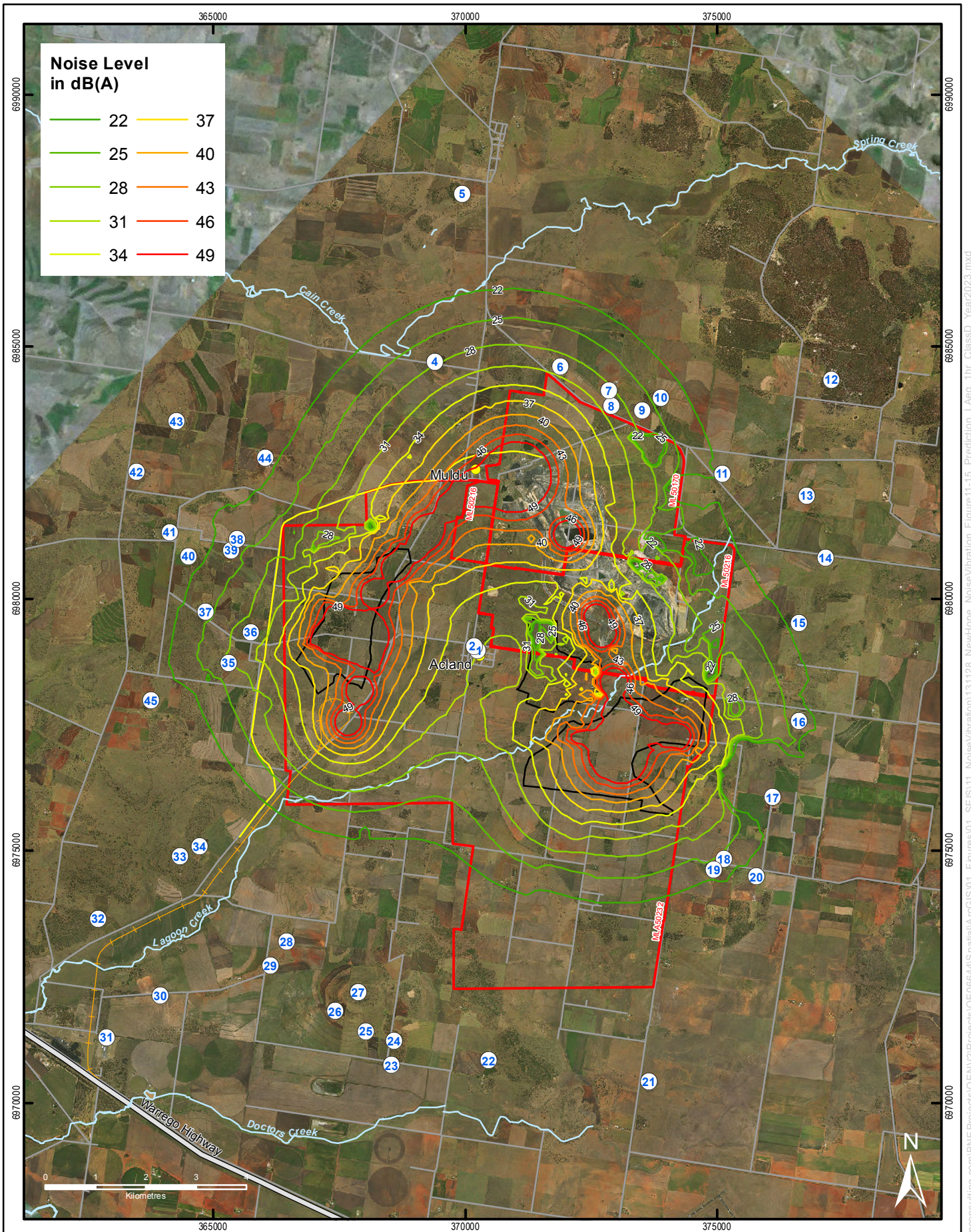|			
22		37	
25		40	
28		43	
31		46	
34		49	

LEGEND

- Towns and Localities
- Sensitive Receptor
- Rail Spur
- Roads
- Creeks
- Jondaryan-Muldu Road Diversion
- Mining Tenements
- Stage 3 Pit Areas

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Figure 11-14 - Predicted Night LAeq, adj,1 hr Stability Class D Noise Levels in year 2019

Scale 1:100,000 on A4
Projection: Australian Geodetic Datum – Zone 56 (AGD84)

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Produced: 28/11/2013

Noise Level in dB(A)

22	37
25	40
28	43
31	46
34	49

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Figure 11-15 - Predicted Night LAeq, adj,1 hr Stability Class D Noise Levels in year 2023

Scale 1:100,000 on A4
Projection: Australian Geodetic Datum – Zone 56 (AGD84)

LEGEND

- Towns and Localities
- Sensitive Receptor
- Rail Spur
- Roads
- Creeks
- Jondaryan-Muldu Road Diversion
- Mining Tenements
- Stage 3 Pit Areas

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Produced: 28/11/2013

Noise Level in dB(A)

22	37
25	40
28	43
31	46
34	49

LEGEND

- Towns and Localities
- Sensitive Receptor
- Rail Spur
- Roads
- Creeks
- Jondaryan-Muldu Road Diversion
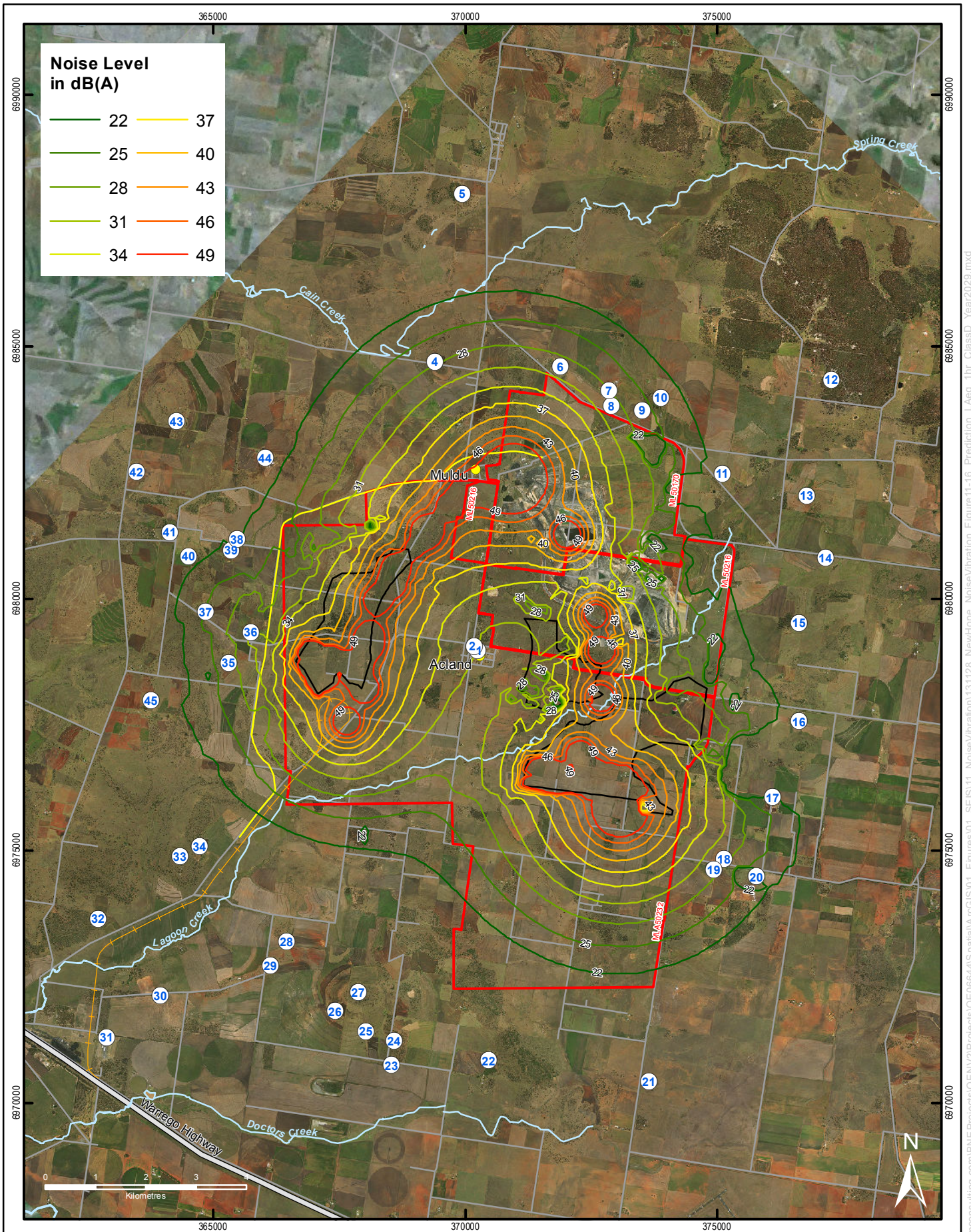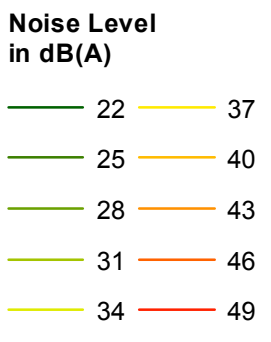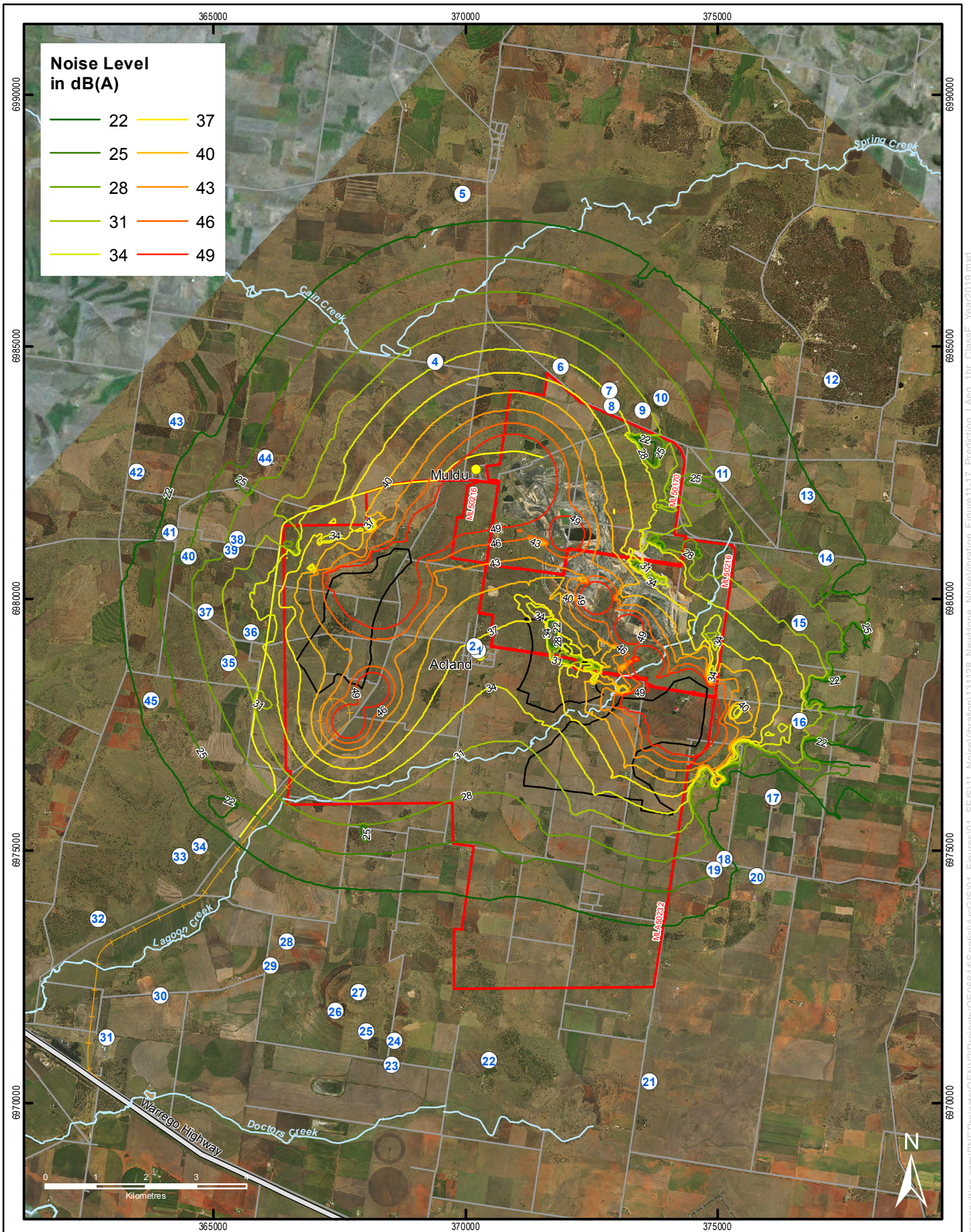- Mining Tenements
- Stage 3 Pit Areas

NEW ACLAND COAL MINE STAGE 3 PROJECT

Figure 11-16 - Predicted Night LAeq, adj,1 hr Stability Class D Noise Levels in year 2029

Scale 1:100,000 on A4
Projection: Australian Geodetic Datum – Zone 56 (AGD84)

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Produced: 28/11/2013

Noise Level in dB(A)

22	37
25	40
28	43
31	46
34	49

LEGEND

- Towns and Localities
- Sensitive Receptor
- Rail Spur
- Roads
- Creeks
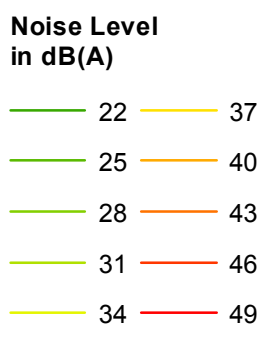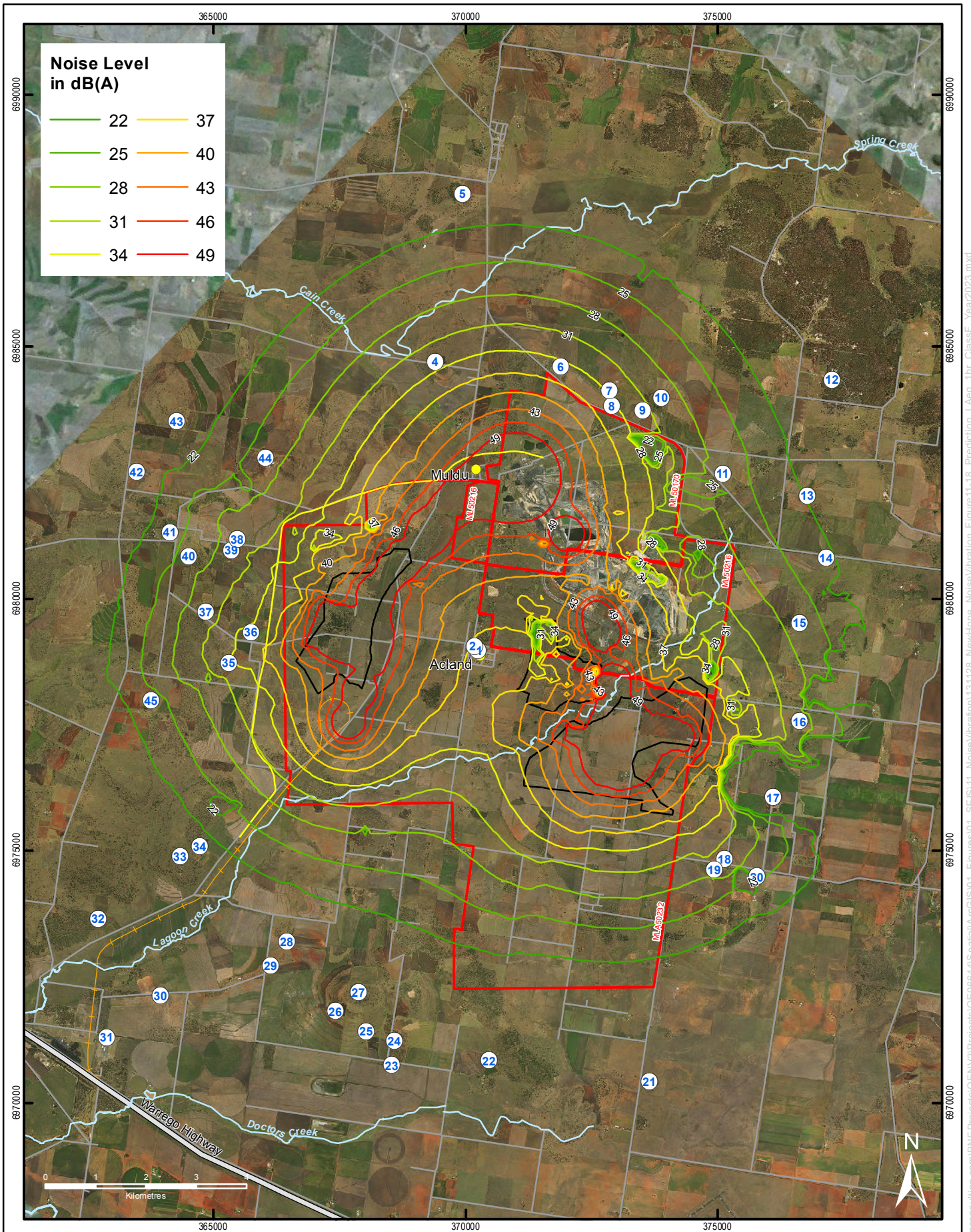- Jondaryan-Muldu Road Diversion
- Mining Tenements
- Stage 3 Pit Areas

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Figure 11-17 - Predicted Night LAeq, adj,1 hr Stability Class F Noise Levels in year 2019

Scale 1:100,000 on A4
Projection: Australian Geodetic Datum – Zone 56 (AGD84)

Noise Level in dB(A)

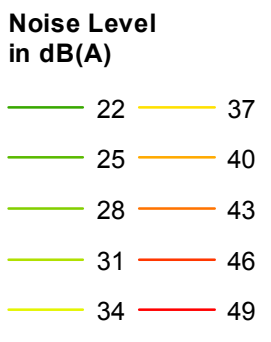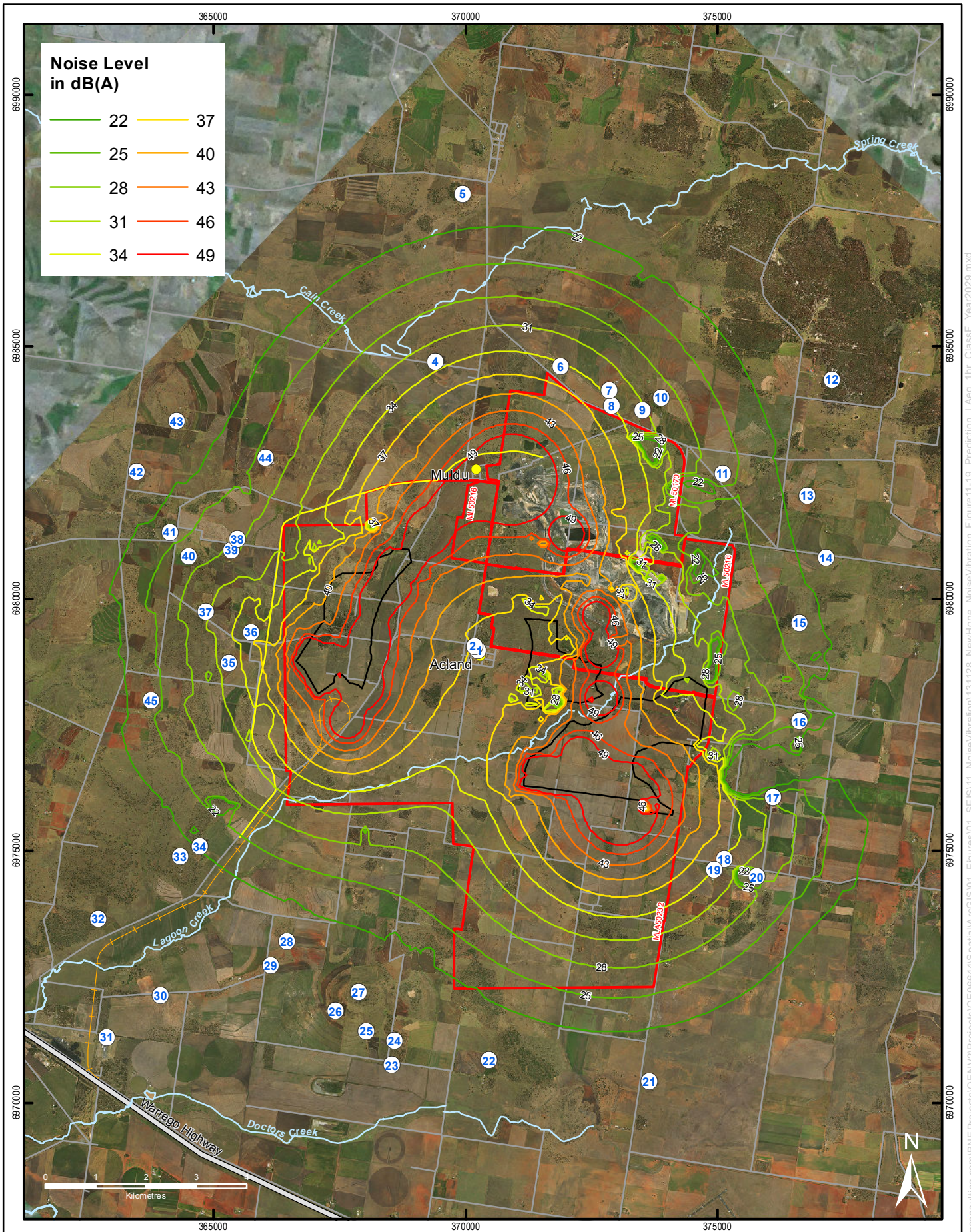|			
— 22	— 37		
— 25	— 40		
— 28	— 43		
— 31	— 46		
— 34	— 49		

LEGEND

- Towns and Localities
- Sensitive Receptor
- Rail Spur
- Roads
- Creeks
- Jondaryan-Muldu Road Diversion
- Mining Tenements
- Stage 3 Pit Areas

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**NEW ACLAND COAL MINE
STAGE 3 PROJECT**

**Figure 11-18 - Predicted Night LAeq,
adj,1 hr Stability Class F Noise Levels
in year 2023**

Scale 1:100,000 on A4
Projection: Australian Geodetic Datum – Zone 56 (AGD84)

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Produced: 28/11/2013

Figure 11-19 - Predicted Night LAeq, adj,1 hr Stability Class F Noise Levels in year 2029
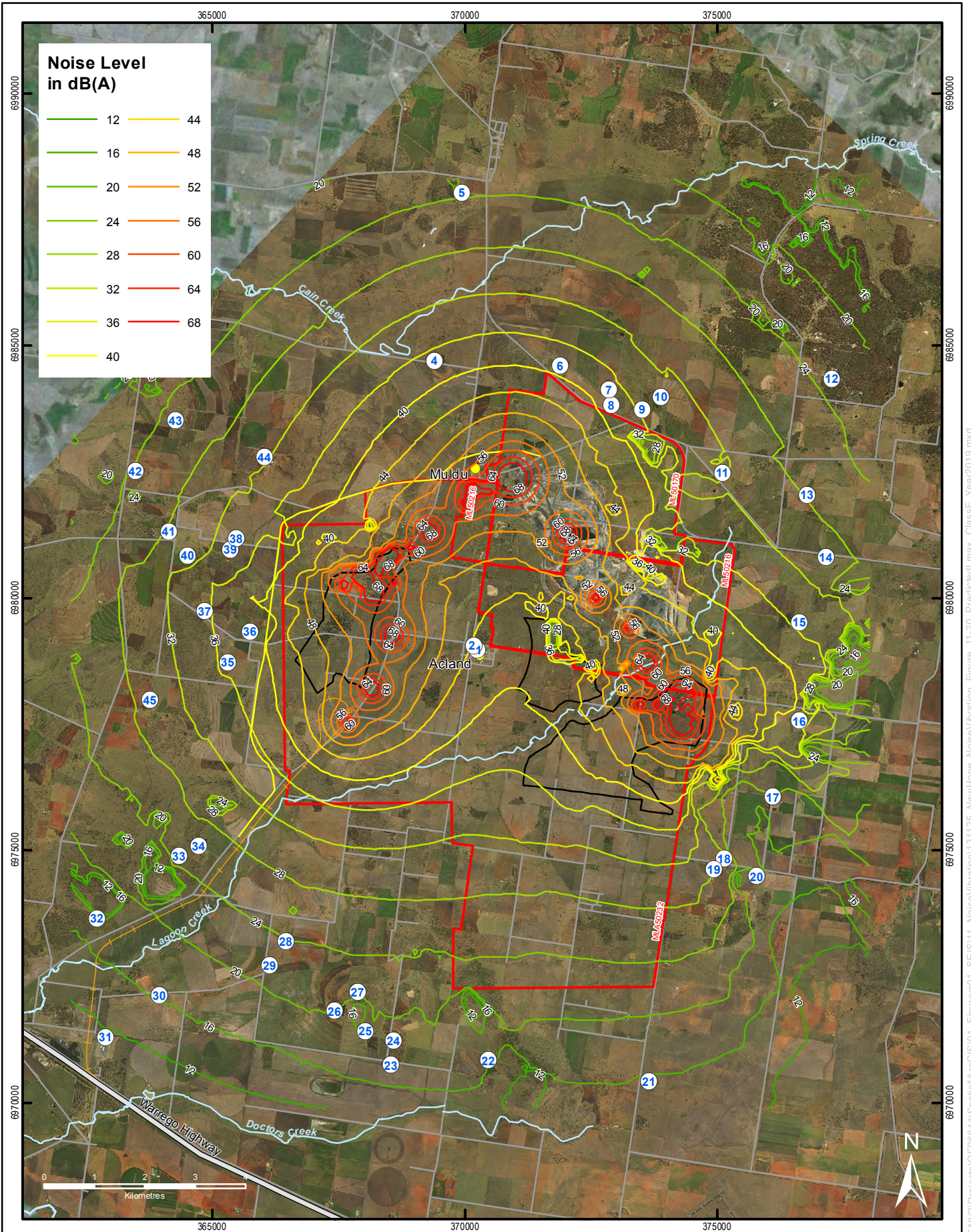
NEW ACLAND COAL MINE
STAGE 3 PROJECT

LEGEND

- Towns and Localities
- Sensitive Receptor
- Rail Spur
- Roads
- Creeks
- Jondaryan-Muldu Road Diversion
- Mining Tenements
- Stage 3 Pit Areas

Noise Level in dB(A)

22	37
25	40
28	43
31	46
34	49

Scale 1:100,000 on A4
Projection: Australian Geodetic Datum – Zone 56 (AGD84)

NEW HOPE GROUP

SKM

Path: \\skmconsulting.com\BNEProjects\QE06644\SpatialArcGIS\01_Figures\01_SEIS\11_NoiseVibration\131128_NewHope_NoiseVibration_Figure11-19_Prediction_LAeq_1hr_ClassF_Year2029.mxd

Produced: 28/11/2013

Figure 11-20 - Predicted LAmax Noise Levels in year 2019 (Stability Class F)

Noise Level in dB(A)

— 12	— 44
— 16	— 48
— 20	— 52
— 24	— 56
— 28	— 60
— 32	— 64
— 36	— 68
— 40	

LEGEND
- ● Towns and Localities
- ○ Sensitive Receptor
- Rail Spur
- Roads
- Creeks
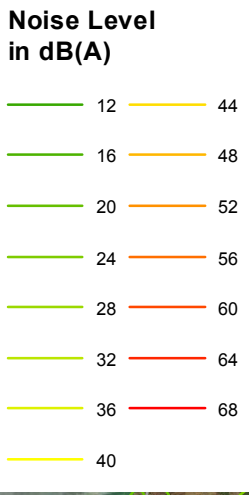- Jondaryan-Muldu Road Diversion
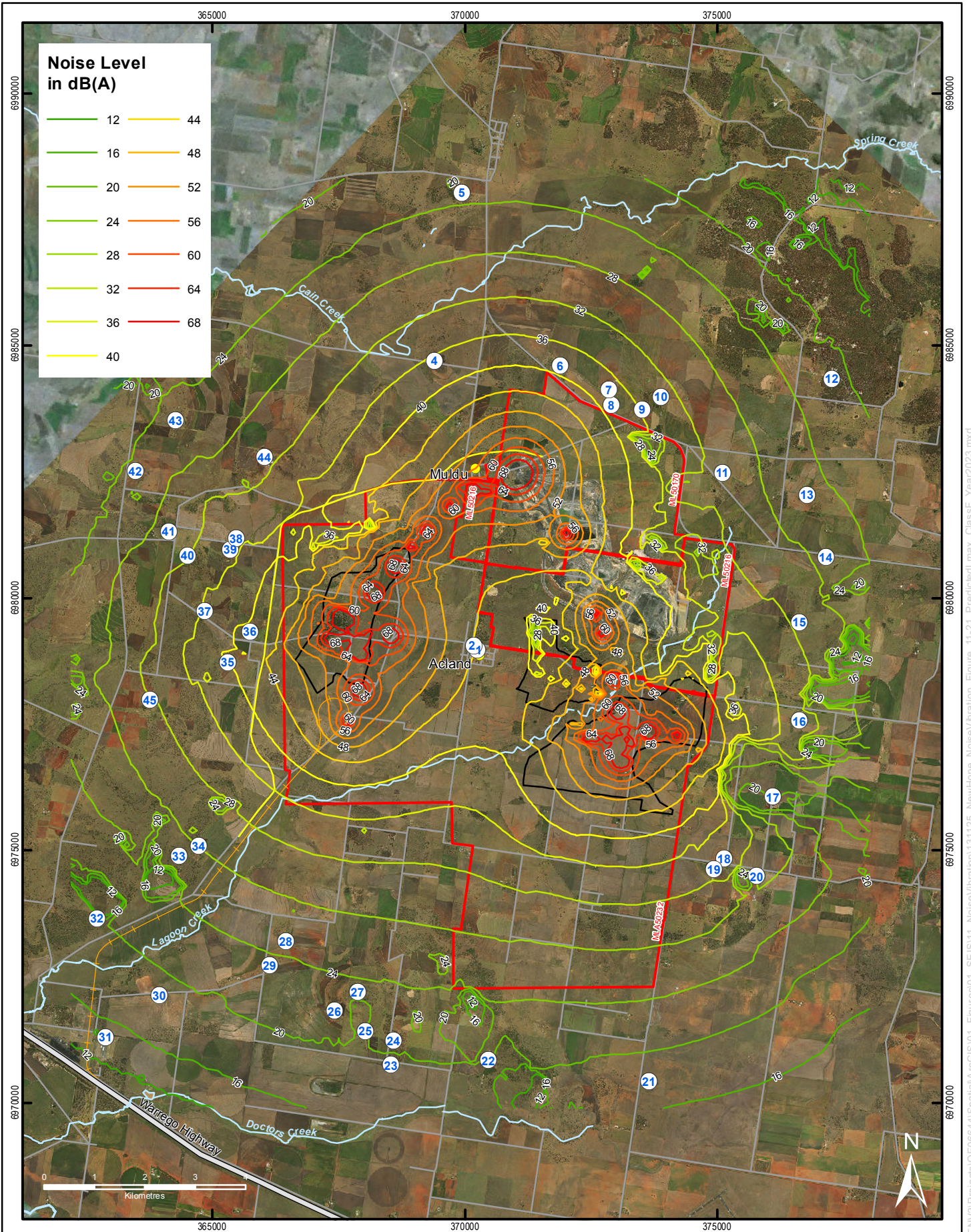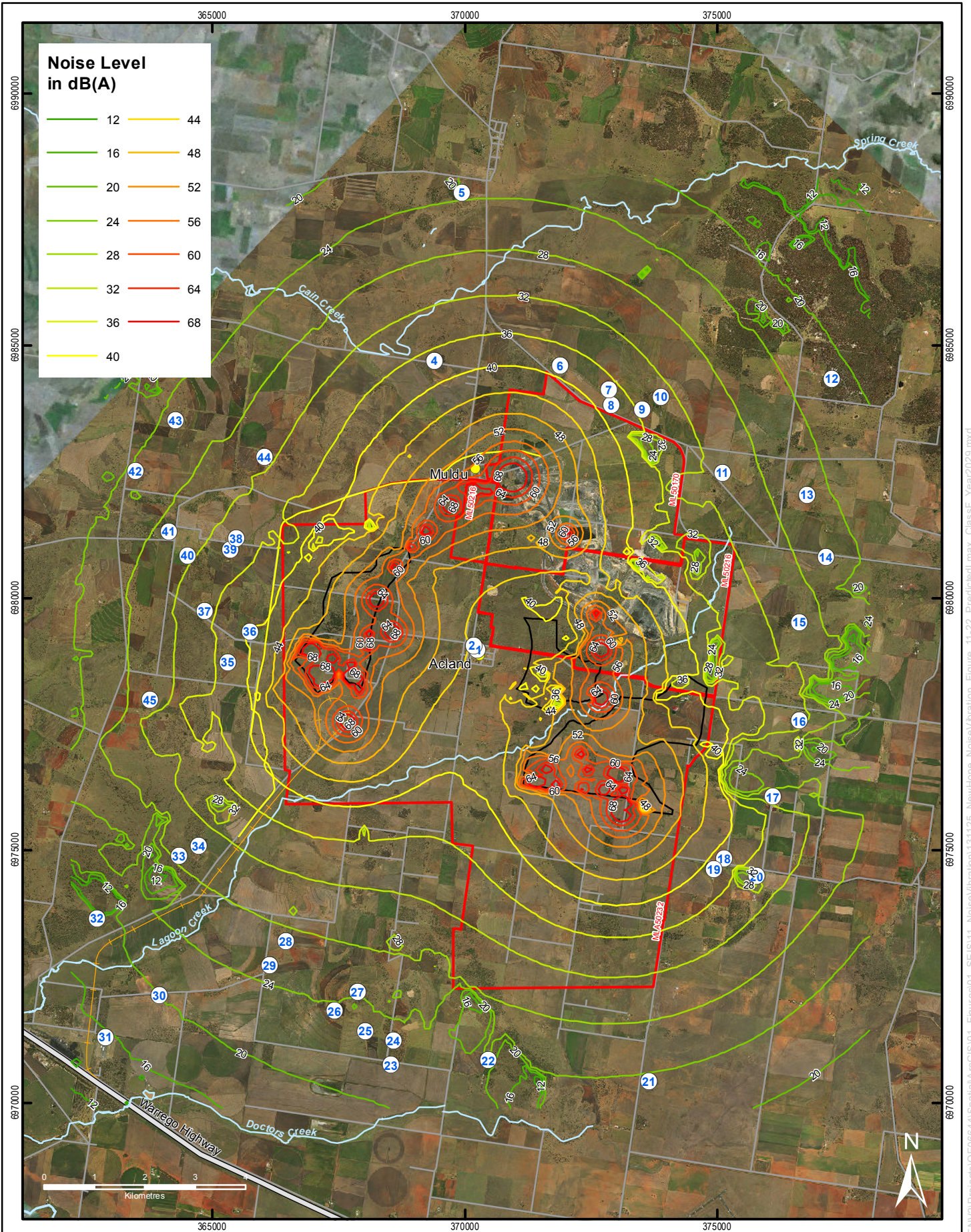- ▭ Mining Tenements
- ▭ Stage 3 Pit Areas

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**NEW ACLAND COAL MINE
STAGE 3 PROJECT**

**Figure 11-21 - Predicted LAmax
Noise Levels in year 2023
(Stability Class F)**

Scale 1:100,000 on A4
Projection: Australian Geodetic Datum – Zone 56 (AGD84)

Noise Level in dB(A)

12	44
16	48
20	52
24	56
28	60
32	64
36	68
40	

LEGEND

- ⬤ Towns and Localities
- ◯ Sensitive Receptor
- ┼ Rail Spur
- ── Roads
- ── Creeks
- ── Jondaryan-Muldu Road Diversion
- ▭ Mining Tenements
- ▭ Stage 3 Pit Areas

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NEW ACLAND COAL MINE STAGE 3 PROJECT

Figure 11-22 - Predicted LAmax Noise Levels in year 2029 (Stability Class F)

Scale 1:100,000 on A4
Projection: Australian Geodetic Datum – Zone 56 (AGD84)

Produced: 27/11/2013

Path: I:\QENV2\Projects\QED6644\SpatialArcGIS\01_Figures\01_SEIS\11_NoiseVibration\131125_NewHope_NoiseVibration_Figure_11-22_PredictedLmax_ClassF_Year2029.mxd

11.7.4 Assessment of the Operational Noise Modelling Results

Overall Operational Noise (L_{Aeq})

This section assesses the overall operational noise modelling results for the early, middle and final stages of the revised Project life at each sensitive receptor against the criteria from EPP (Noise).

By implementing noise management and mitigation measures including reduced night time operation (only two pits operating at night when weather predictions or noise monitoring dictate) and using attenuated equipment (noise attenuation of noisier equipment including excavators, track dozers, loaders and rear dump trucks), the predicted noise levels from the mining operation will meet the EPP (Noise) $L_{Aeq,adj,1\,hr}$ daytime, evening and night time criteria during both neutral and worst case temperature inversion conditions at all noise sensitive receptors over the life of the revised Project.

Modelling results show the most dominant noise sources at noise sensitive receptors 1 and 2 include the CHPP, excavators from Manning Vale East and West pits, rear dump trucks and side tipping trucks to and from the train loading facility.

For the closest noise sensitive receptors located to the north of the revised Project site, the most dominant noise sources include the CHPP, conveyors and loaders.

For the closest noise sensitive receptors located to the west of the revised Project site, the most dominant noise sources include excavators from Manning Vale West pit, CHPP, rear dump truck and side tipping trucks.

For the closest noise sensitive receptors located to the east of the revised Project site, the most dominant noise sources include excavators and rear dump trucks.

The EPP (Noise) $L_{Aeq,adj,1\,hr}$ criteria are considered 'conservative' as it is based on research results from the World Health Organisation (WHO) with the aim to prevent sleep disturbance.

In general, it should be noted that the noise modelling is a 'snap shot' of the mining activities and cannot account for the variation in noise levels at sensitive receptors. Noise levels at sensitive receptors are primarily dependent upon three variables:

- the area of the mine being operated;
- the depth the equipment is operating in the mine pit; and
- the meteorological conditions at the time.

Noise sources change location and mine pit depth as new mine pit sections are opened and others are completed. Combined with variations in meteorology, a dominant noise source at one receptor at one time may be inaudible to that receptor at another time. For example, haul trucks indicated by modelling to be a dominant noise source whilst on the haul roads are relatively quiet when operating in the mine pit.

Details of general noise mitigation measures and complaints management procedures are discussed in **Section 11.8**.

Maximum Operational Noise (L$_{AMax}$)

This section assesses the maximum operational noise modelling results for the early, middle and final stages of the revised Project life at each sensitive receptor against *Planning for Noise Control Guideline's* sleep disturbance criteria.

The maximum operational noise level from the mining operation is predicted to range between L$_{Amax}$ 11 dB(A) at noise sensitive receptors 31 and L$_{Amax}$ 45 dB(A) at noise sensitive receptor 2. The maximum operational noise levels at the noise sensitive receptors will therefore meet the *Planning for Noise Control Guideline's* sleep disturbance criterion of L$_{Amax}$ 52 dB(A) during the worst case temperature inversion condition at all noise sensitive receptors over the life of the revised Project.

11.7.5 Cumulative Noise Impact

There will be a short period of time during the start of the revised Project when limited activities will occur at the existing Mine.

The cumulative noise impact from both the revised Project and the existing Mine during the early stage of the revised Project life has been predicted for the year 2019 scenario and is found to comply with the EPP (Noise) criteria.

11.7.6 Low frequency noise assessment

The assessment of low frequency noise is a two-step process. The first step is to check if the un-weighted sound pressure level inside the residences exceeds 50 dB(Lin). If the un-weighted sound pressure level inside the residences exceeds 50 dB(Lin), the second step is to check if the un-weighted sound pressure level exceeds the A-weighted sound pressure level by more than 15 dB. If the difference is more than 15dB then further assessment is required.

The predicted un-weighted modelling results are tabulated in **Appendix G.7.4 Table 1** to **Table 9**. These show the predicted un-weighted noise level at each sensitive receptor during operations under the revised Project's three modelling scenarios. The un-weighted noise levels from the mining operation will comply with the low frequency noise criterion.

11.7.7 Airblast overpressure and vibration

Blasting will be used to loosen in-situ overburden to allow more efficient operation of the excavators. Ground borne vibration and air blast overpressure due to blasting have potential to impact amenity and damage buildings and infrastructure. The distance between nearest sensitive receptors and overburden blasting for the revised Project is expected to be greater than 1,000 m.

Estimations of potential blasting levels have been made using equations outlined in *Australian Standard 2187.2-2006,* as shown in **Table 11-16**.

Table 11-16 Blast vibration and over pressure equations

Parameter	Equation
Ground borne vibration (V), mm/s	$V = 1140 \left(\dfrac{R}{Q^{1/2}} \right)^{-1.6}$
Air blast overpressure (P), kPa	$P = K_a \left(\dfrac{R}{Q^{1/3}} \right)^{-1.45}$

Where:

R = effective distance from blast location (m)

Q = effective charge mass per delay (MIC) (kg)

K = site constant between 10 and 100 for confined blasts

A key determining factor for both ground vibration and air blast overpressure impacts from explosives blasting is the maximum charge mass per delay (MIC) used in blasting. The maximum allowable MIC has been estimated using the equations as per **Table 11-16**, and these are shown below for ground borne vibration and air blast overpressure.

For ground borne vibration, the allowable MIC to comply with the blasting criterion of 5 mm/s are summarised below in **Table 11-17** for various distances ranging from 1,000 m up to 2,500 m.

Table 11-17 Calculated MIC (kg) allowable to comply with ground vibration criteria

Distance from blasting (m)	MIC allowable (kg)
1,000	1,129
1,500	2,540
2,000	4,515
2,500	7,054

For air blast overpressure, a 'K' value of between 10 and 100 was used to estimate the allowable MIC to comply with the air blast overpressure criteria of 115 dB(lin). These values are summarised below in **Table 11-18** for various distances ranging from 1,000 m up to 2,500 m.

Table 11-18 Calculated MIC (kg) allowable to comply with overpressure criteria

Distance from blasting (m)	MIC allowable for K = 10 (kg)	MIC allowable for K = 100 (kg)
1,000	792	7
1,500	2,673	23
2,000	6,335	54
2,500	12,375	106

Blasting for the revised Project's operations will occur approximately eight times per week during daylight hours. Indicative blasting parameters for the revised Project are presented in **Table 11-19**.

Table 11-19 Indicative Blasting Parameters for the Project

Parameter	Value	Parameter	Value
Average burden depth	Range from 2 m to 55 m	Blasting hole diameter	229 mm
Frequency of blasting	8 times per week	Stemming height	1.6 m to 5.5 m
Average area	2,250 m^2	Maximum mass charge per hole (MIC)	Up to 2,446 kg
No. of holes	281 to 402	Explosive type	Flexigle, Fortis, Fortan, Aqua-Charge, ANFO

From **Table 11-17** and **Table 11-18** it can be seen that a maximum MIC of 2,446 kg may be possible at a distance of 1,500 m or more from sensitive receptors with appropriate stemming. However, at distances of less than 1,500 m, reduced MIC may be employed in multiple pass blasting to comply with the blasting criteria (where, for example, the top half the overburden is blasted in the first pass, and the second half of the overburden is blasted in a second pass).

Compliance with the blasting vibration criteria would ensure protection of heritage listed former Acland No.2 Colliery.

Apart from blasting, vibration levels from mining operations would be minimal at a distance of 100 m or more. Due to the distance between the mining areas and the sensitive receptors being greater than 100 m, the vibration impact from other mining activities at the nearest sensitive receptors will be minimal. Vibration impact from other mining operations has not been assessed as part of this EIS.

11.7.8 Road Traffic Noise

The road traffic noise impacts during the construction phase and operational phase of the revised Project have been estimated based on the traffic data in **Chapter 13**. Traffic data including the "background" traffic volume and the additional traffic volumes during the construction and operational phases are tabulated in **Table 11-20** and **Table 11-21**.

Table 11-20 Traffic data (vpd) for the construction phase – Year 2016

Scenario	Road	2016 background traffic (vpd)	Additional traffic (vpd)	Total traffic (vpd)
Construction phase	Jondaryan-Sabin Road	810	160	970
	Oakey – Cooyar Road	3520	100	3620

Table 11-21 Traffic data for the operational phase - Year 2017 (Opening Year)

Scenario	Road	2016 background traffic (vpd)	Additional traffic (vpd)	Total traffic (vpd)
Operational phase	Jondaryan-Sabin Road	810	200	1010
	Oakey – Cooyar Road	3720	220	3940

Table 11-20 and **Table 11-21** show that the future traffic volume on the Jondaryan–Sabine and Oakey–Cooyar Roads will be reasonably low. As noise sensitive receptors in the study area are located more than 30 m from the road, the predicted noise level at this distance can be taken as the worst case noise level for these receptors. At a distance of 30 m, the traffic noise levels from the Oakey–Cooyar and Jondaryan–Sabine Roads are estimated to be $L_{A10,18-hour}$ 60 dB(A) and 54 dB(A), respectively, which comply with the $L_{A10,18-hour}$ 68 dB(A) traffic noise criteria. The traffic noise levels due to the increase in production would therefore not exceed the relevant criteria at any time.

In addition, the increase in traffic noise levels due to additional traffic from the revised Project are predicted to be less than 1 dB(A) and are unlikely to be perceived by sensitive receptors.

11.7.9 Rail Traffic Noise

NAC is planning to construct a new 8 km rail spur and balloon loop for the revised Project. The new rail spur and balloon loop for a large portion of its route is planned to run immediately adjacent to the existing Jondaryan-Muldu Road reserve.

At the proposed rail tonnage an average of 11 trains per day will travel to Brisbane each day. A three dimensional noise model was developed using SoundPLAN 7.2 to predict the rail noise levels. The Nordic algorithm, implemented within the SoundPLAN model has been used in the assessment. L_{Amax} and L_{Aeq} noise levels along the rail spur were predicted using train information provided by NAC and noise data provided by Queensland Rail. The information is shown in **Table 11-22**.

Table 11-22 Train information and noise data

Train Type	Lmax @ 25 m	SEL @ 25 m dB(A)	No of locomotives	Train length	Train Speed
Diesel	77 dB(A) (Notch 1) 94 dB(A) (Notch 8)	75 dB(A) (Notch 1) 97 dB(A) (Notch 8)	2	655m	Below 5 km/hr along the rail spur and loop

The location of the proposed new rail spur and the noise sensitive receptors are shown in **Figure 11-1**. The nearest residence, noise sensitive receptor 31, is located approximately 400 m from the proposed rail line.

Rail noise levels at noise sensitive receptors within 500 m from the rail spur have been predicted and the results are tabulated in **Table 11-23**.

Rail noise levels from the rail spur are predicted to be well below the Queensland Rail Code of Practice – Railway Noise Management's L_{Amax} 87 dB(A) and $L_{Aeq (24hr)}$ 65 dB(A) noise criteria.

Rail noise levels at noise sensitive receptors within 500m from the rail spur

Table 11-23 Predicted noise levels at noise sensitive receptors within 500 m from rail spur

Receptor	L_{Amax} dB(A)	$L_{Aeq (24hr)}$ dB(A)	Criteria
31	56	46	
32	54	47	L_{Amax} 87dB(A)
33	51	44	$L_{Aeq (24hr)}$ 65 dB(A)
34	55	47	

11.7.10 Impacts on Animals

Research into the effects of noise on animals is relatively scarce but it is believed that the effects may be similar to those observed in humans (Environment Australia, 1998). Noise may adversely affect wildlife by interfering with communication, masking the sounds of predators and prey and causing stress or avoidance reactions.

Studies have shown the reaction to noise can vary from species to species, including those that are known to have adapted to human activity. Environment Australia (1998) suggests that unusual noise, in combination with close proximity visual stimulation, is enough to disturb any animal, including humans. In addition, any sudden and unexpected intrusion, whether acoustic or of another nature, may also produce a startle or panic reaction.

Studies of the impact of the sonic boom on domestic and wild animals show that these species are unaffected by repeated booms and farmers have reported birds actually perching on scare guns after only a couple of days operation (Environment Australia, 1998).

It has been found that an animal's initial reaction to a new noise source is fright and avoidance but if other sensory systems are not stimulated (for instance optical or smell), the animal learns quite quickly to ignore the noise source, particularly when it exists in the presence of humans.

General noise and blasting at the Mine has been occurring since 2002 and 2004, respectively. Therefore, noise impact from the additional mine pits on domestic or wild local and migratory species will be reduced. Local piggeries have operated in close proximity to the Mine and have not reported any mine related impacts. Koalas also continue to range around the Acland area despite the Mine's presence. NAC has also successfully conducted cattle grazing trials within the Mine's rehabilitation areas without any deleterious effects from mine noise.

In addition, previous extensive clearing of vegetation in the revised Project site for agricultural purposes has reduced the amount of available habitat, and as a result, has minimised the potential for impact by the Project's operational noise on local wildlife.

11.8 Mitigation Measures for Mining Operations

This Section discusses practical measures to minimise noise and vibration impacts from the mining operations. The noise management and mitigation measures presented in this Section minimise noise emissions from the operation of the revised Project while maintaining a feasible and viable mining operation. The proposed approach to noise management is consistent with best practice environmental management for noise from mining operations.

By implementing noise management and mitigation measures including reduced night time operation (only two pits operating at night in adverse weather or atmospheric conditions) and using attenuated equipment (including excavators, track dozers, loaders and rear dump trucks), the predicted noise levels from the mining operation will achieve noise level consistent with the EPP (Noise) $L_{Aeq,adj,1 hr}$ criteria of 42 dB(A) in daytime and evening hours, and 37 dB(A) in night time hours at all noise sensitive receptors.

The following mitigation measures are proposed by NAC as commitments to reduce the revised Project's potential noise impact.

- NAC will establish a real-time noise monitoring network, which will be used in conjunction with a weather forecasting system and an adaptive management process, to proactively relocate, reduce or stop noisier mining operations.

- NAC has developed a Noise and Vibration Management Plan (NVMP) for the revised Project. The NVMP will be administered as an accompanying document to the revised Project's Plan of Operations. A copy of the NVMP is provided in **Appendix J.11**.

- Based on ambient conditions (climate and the current mine plan)and feedback from the real-time noise monitoring (warning and alarm protocols), NAC may be required to limit or stop mining operations in the Manning Vale East pit during the night time period. This requirement is based on the noise assessment work completed for the revised Project's EIS.

- NAC will ensure noisier mining equipment, including excavators, track dozers, loaders and rear dump trucks, is fully attenuated. This requirement is based on the noise assessment work completed for the revised Project's EIS.

- Where possible, NAC will schedule noisier operations in-pit at night or during daylight hours only. For example, dumping of overburden and dozer activity on overburden dumps at or above ground surface may be restricted during night periods (10pm to 7am).

- If no suitable or acceptable noise amelioration solutions are available for a particular noise issue, NAC will negotiate in good faith with all affected property owners for property purchase or by agreement implement some other form of amicable arrangement (e.g. acoustic treatment of the dwelling, relocation or replacement of the dwelling at another suitable location, relocation of the landowner to another living arrangement for the period of the issue or any other suitable innovative solution). NAC would be responsible for all reasonable costs associated with any agreed solution to a noise issue. In the event agreement cannot be reached, NAC will enter into mediation with the affected party and employ the services of a third party to facilitate this process

- NAC will ensure proper maintenance and operational procedures will be undertaken to minimise noise emissions from equipment, including proper servicing and maintenance of exhaust systems on mine equipment.

- NAC will implement its Noise and Vibration Management Plan as presented in **Appendix J.11** to minimise the risk of noise complaints from nearby sensitive receptors to the revised Project. All complaints received in relation to the revised Project's operation will be managed as outlined in NAC's Local Stakeholder Engagement Plan as presented in **Appendix J.18**. NAC's approach to complaints management is based on the key principles of timeliness, sensitivity, fairness and impartiality, and confidentiality. NAC is committed to open communication with its local stakeholders and active complaint resolution when issues or concerns are raised about its mining operations.

- If a complaint is received and/or a noise issue is identified by investigation, NAC will modify mining operations until a satisfactory solution for the noise issue is developed and implemented.

- NAC will ensure all complaints will be investigated to determine the source of the nuisance noise. Where appropriate, noise monitoring will be conducted at the affected residence, and as required, noise amelioration solutions will be investigated and implemented by agreement. NAC has purchased a specialist noise logger that can be placed at a complainant's residence for a length of time to record the problem periods. This equipment will be maintained and the results will be interpreted by a qualified professional.

- Where practicable, NAC using the mine planning process will utilise topsoil and other dumps as noise barriers between active mine operations and nearby noise receptor locations.

- NAC will continue to utilise broad band alarms instead of reverse beepers on all mobile equipment.

- NAC will continue to limit the speed of heavy vehicle traffic on haul roads.

- NAC will continue its current proactive monthly noise monitoring program and will expand its coverage around the revised Project site.

- NAC will continue its proactive assessment of possible noise attenuation options for both mobile or stationery noise emitting equipment. Noise emissions with tonal, impulsive and/or intermittent characteristics will be targeted for noise attenuation.

For the management of airblast overpressure and vibration, the following measures will be adopted for the revised Project.

- Field data will be used to best determine blast conditions and the type of stemming required for the area.

- In the event of a blast issue, the maximum instantaneous charge of subsequent blasts will be reduced using delays, reduction of hole diameter, etc. (i.e. until the blast issue is resolved).

- In the event of a blast issue, the burden and spacing of subsequent blasts will be changed by altering the drilling pattern and/or delay layout, or altering the hole inclination (i.e. until the blast issue is resolved).;

- The stemming depth and type will be adequate for each blast event.

- Blast events will only be conducted during favourable weather conditions.

- The monitoring of blasts will continue at the nearest sensitive receptors based on the interpretation of pre-blast weather data.

- The practice of advising near neighbours will continue in advance of each blast. All new near neighbours surrounding the Project site will be proactively invited to join the blast notification contact list.
- A qualified professional with suitable experience will be responsible for the Project's blast management.
- All blast complaints will be investigated in a timely manner to determine the extent of the issue. Where appropriate, blast monitoring will be conducted at the affected residence, and as required, blast mitigation solutions will be investigated and implemented by agreement.

11.9   Conclusion

The noise and vibration impact of the revised Project has been assessed. A computer noise model was developed using SoundPLAN version 7.2 to predict the noise levels during different stages of the mining operations.

By implementing noise management and mitigation measures including reduced night time operation and using attenuated equipment (noise attenuation of noisier equipment including excavators, track dozers, loaders and rear dump trucks), the predicted noise levels from the mining operation will meet the EPP (Noise) $L_{Aeq,adj,1\ hr}$ at all noise sensitive receptors over the life of the revised Project.

The maximum operational noise level from the mining operation is predicted to meet the Planning for Noise Control's sleep disturbance criterion of L_{Amax} 52 dB(A) during the worst case temperature inversion condition at all noise sensitive receptors over the life of the revised Project.

The cumulative noise impact from both the revised Project and the existing Mine during the early stage of the revised Project's life has been predicted and assessed in the year 2019 scenario and is found to comply with the EPP (Noise) criteria.

The un-weighted noise levels from the revised Project's mining operation are predicted to comply with the low frequency noise criteria.

The airblast overpressure and vibration impacts from blasting can be managed to achieve acceptable levels at the sensitive receptors surrounding the revised Project.

Road and rail traffic noise impacts have been assessed and are found to comply with the TMR and QR criteria, respectively.

Recommendations are provided to minimise the revised Project's potential noise and vibration impacts and to ensure nuisance levels at nearby sensitive receptors are kept to a practical minimum.