CLEANTEQ
Powering innovation

Syerston

MODIFICATION 4 ENVIRONMENTAL ASSESSMENT

Project

Appendix B

Noise and Blasting Assessment

RENZO TONIN & ASSOCIATES
inspired to achieve

Acoustics
Vibration
Structural Dynamics

SYERSTON PROJECT - MODIFICATION 4

Noise and Blasting Assessment

8 November 2017

Clean TEQ

TJ345-01F02 Report (r7).docx

30 1982 2012 ACOUSTIC EXCELLENCE
Sydney Melbourne Brisbane Gold Coast Kuwait
Renzo Tonin & Associates (NSW) Pty Ltd ABN 29 117 462 861
Level 1/418A Elizabeth St SURRY HILLS NSW 2010 | PO Box 877 STRAWBERRY HILLS NSW 2012
P (02) 8218 0500 F (02) 8218 0501 sydney@renzotonin.com.au www.renzotonin.com.au

Document details

Detail	Reference
Doc reference:	TJ345-01F02 Report (r7).docx
Prepared for:	Clean TEQ
Address:	12/21 Howleys Road Notting Hill VIC 3168
Attention:	John Hanrahan

Document control

Date	Revision history	Non-issued revision	Issued revision	Prepared	Instructed	Authorised
09.10.2017	Draft	0-1	2	WC		
16.10.2017	Second Draft	3-4	5-6	WC		MCH
27.10.2017	Final		7	WC		MCH

Contents

List of Tables

List of Figures

1 Introduction

Scandium21 Pty Ltd owns the rights to develop the approved Syerston Project (the Project), located approximately 350 kilometres (km) west-northwest of Sydney, near the village of Fifield, New South Wales (NSW). Scandium21 Pty Ltd is a wholly owned subsidiary of Clean TeQ Holdings Limited (Clean TeQ). Renzo Tonin & Associates was engaged by Clean TeQ to conduct an assessment examining the potential noise and blasting impacts of a proposed modification to the Project.

The issues addressed in this study include noise emissions from:

- construction activities;
- operational activities;
- blasting activities; and
- road traffic associated with the Project.

Noise impacts are assessed in accordance with a number of policies, guidelines and standards, including:

- NSW *Interim Construction Noise Guideline* (ICNG) (Department of the Environment and Climate Change, 2009);
- NSW *Industrial Noise Policy* (INP) (Environmental Protection Authority [EPA], 2000);
- *Voluntary Land Acquisition and Mitigation Policy – SSD Mining* (NSW Government, 2014);
- *Technical Basis for Guidelines to Minimise Annoyance Due to Blasting Overpressure and Ground Vibration* (Australian and New Zealand Environment Conservation Council [ANZECC], 1990); and
- NSW *Road Noise Policy* (RNP) (Department of Environment, Climate Change and Water, 2011)[1].

The work documented in this report was carried out in accordance with the Renzo Tonin & Associates Quality Assurance System, which is based on Australian Standard/New Zealand Standard ISO 9001. Appendix A contains a glossary of acoustic terms used in this report.

[1] This Policy has replaced the NSW *Environmental Criteria for Road Traffic Noise* (EPA, 1999).

2 Project Overview

2.1 Approved Project Overview

The Project is situated approximately 350 km west-northwest of Sydney, near the village of Fifield, NSW (Figure 1).

Development Consent DA 374-11-00 for the Project was issued under Part 4 of the NSW *Environmental Planning and Assessment Act, 1979* in 2001.

The approved Project includes the establishment and operation of the following (Figure 1):

- mine (including the processing facility);
- limestone quarry;
- rail siding;
- gas pipeline;
- borefields and water pipeline; and
- associated transport activities and transport infrastructure (e.g. the Fifield Bypass and road and intersection upgrades).

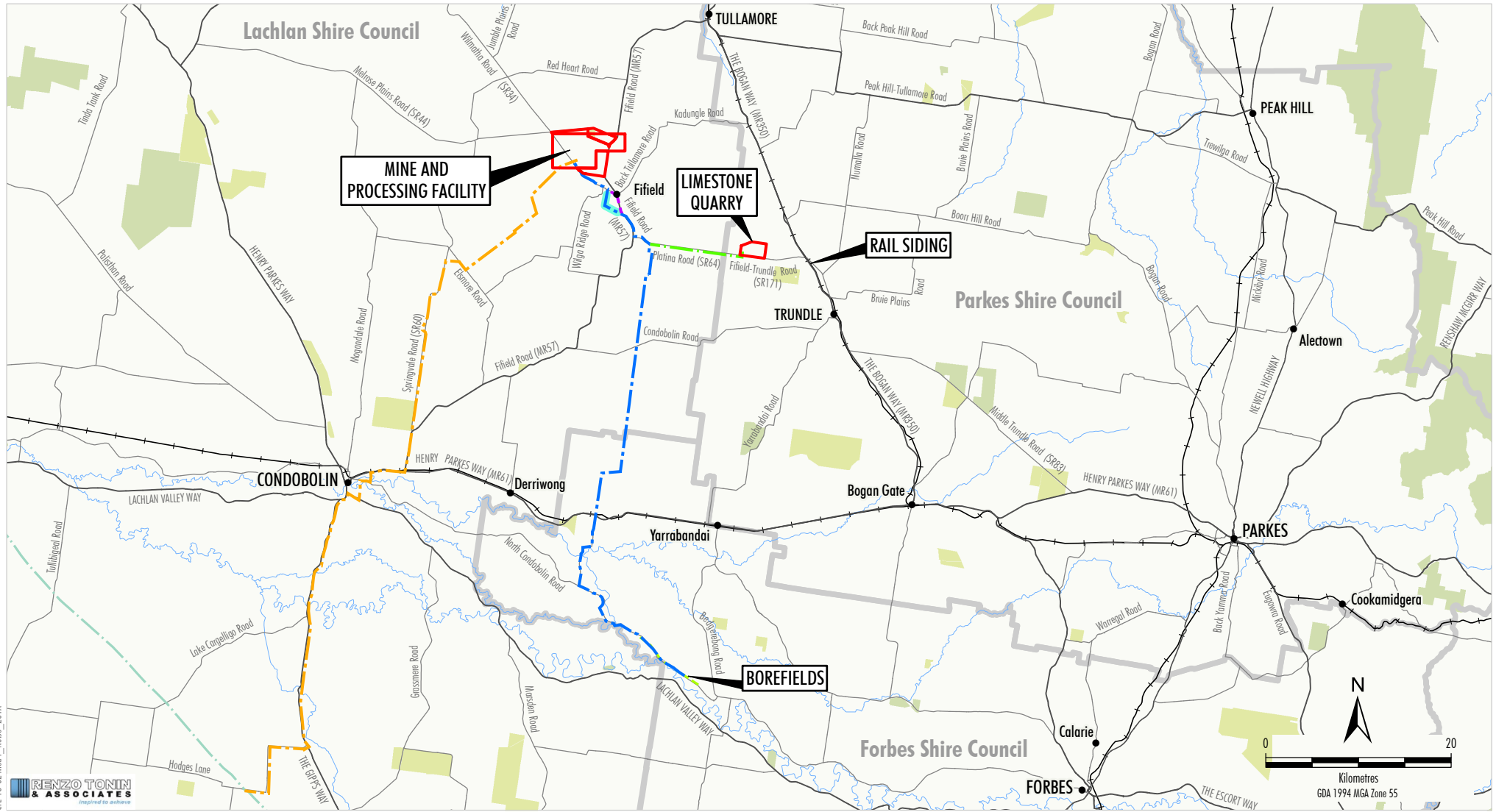
The Project includes an initial scandium oxide focussed production phase (the Initial Production Phase) prior to shifting to scandium oxide and nickel and cobalt precipitate production by developing the full Project (the Full Production Phase).

The Initial Production Phase is a smaller-scale operation compared to the Full Project Phase and would include preferentially mining scandium-rich areas of the Syerston deposit at a run-of-mine ore production rate of 100,000 tonnes per annum (tpa) to produce up to 1,000 tpa of nickel and cobalt metal equivalents, as either sulphide or sulphate precipitate products, and up to approximately 80 tpa of scandium oxide.

The Project would transition to the Full Production Phase once scandium-rich areas of the Syerston deposit are depleted or favourable market conditions prevail for larger scale nickel cobalt scandium production.

The mining and processing will then increase to allow for an autoclave feed rate of 2.5 million tonnes per annum (Mtpa) to produce up to 40,000 tpa of nickel and cobalt metal equivalents and up to approximately 180 tpa of scandium oxide.

Construction and operation of the mine and processing facility is approved 24 hours per day, seven days per week. Construction of the Project commenced in 2006 with the construction of some components of the borefields, however Project operations are yet to commence.



LEGEND

- National Park/Consevation Area
- State Forest
- Local Government Boundary
- Existing Gas Pipeline
- Mining Lease Application Boundary
- Approved Water Pipeline
- Approved Limestone Quarry Water Pipeline
- Approved Gas Pipeline
- Approved Borefield Infrastructure Corridor
- Modified Water Pipeline Alignment Option
- Approved Fifield Bypass

Source: Black Range Minerals (2000); NSW Department of Industry (2017); NSW Land & Property Information (2017); Office of Environment and Heritage NSW (2017)

CLEAN TEQ
Powering innovation

SYERSTON PROJECT MODIFICATION 4

Regional Location

Figure 1

2.2 Modification Overview

Clean TeQ has undertaken a Project Optimisation Study to identify opportunities to improve the overall efficiency of the Full Production Phase of the Project. The Modification involves the implementation of these opportunities and would include:

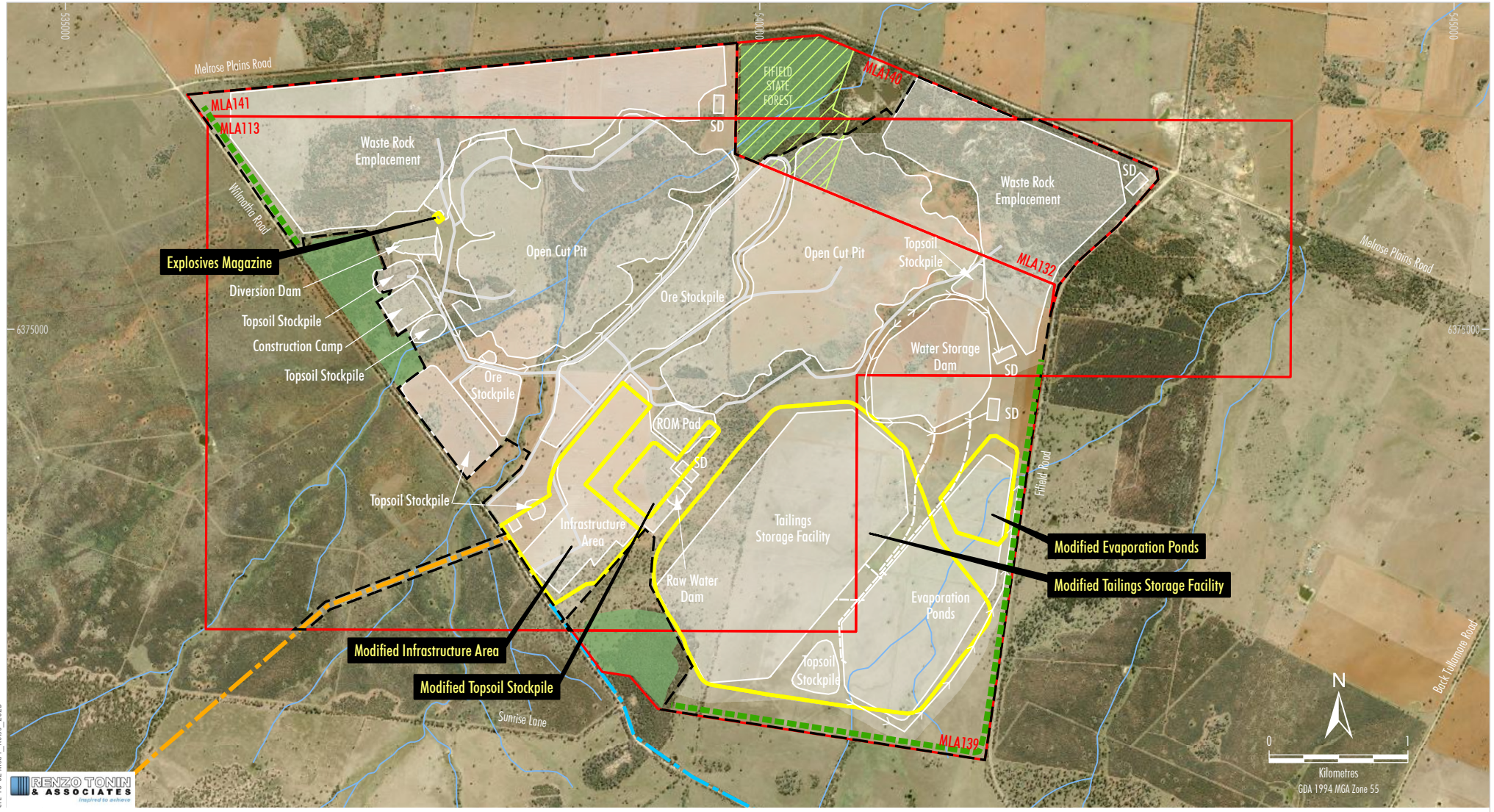
- mining in a more selective manner to initially increase the processing facility ore feed grade;
- addition of drilling and blasting at the mine site;
- adoption of the resin-in-pulp (RIP) processing method option (i.e. the counter current decantation processing method option is no longer proposed)[2];
- increased sulphur demand and sulphuric acid production to leach additional nickel, cobalt and scandium from the higher grade ore;
- increased limestone demand to neutralise the additional acid required in the acid leach circuit;
- addition of a crystalliser to the processing facility to extract ammonium sulphate from an existing waste stream for use as a fertiliser product;
- changes to process input and product road transport requirements;
- addition of a water treatment plant to the processing facility to recycle process water and minimise make-up water demand;
- increased tailings storage facility capacity to hold increased tailings volume due to the additional limestone required for acid neutralisation;
- reduced evaporation pond capacity due to the recycling of process water;
- relocation of mine infrastructure to avoid resource sterilisation and improve operational efficiency;
- addition of surface water extraction from the Lachlan River to improve water supply security;
- minor changes to borefield transfer station layout and water pipeline alignment;
- short-term road transport of water from the borefield to the mine site during the initial construction phase; and
- reduced gas demand as the increased sulphuric acid production would generate additional steam for power generation.

[2] The approved Project includes the option to use either the RIP or counter current decantation processing method.

The Modification would not involve changes to any aspects of the approved limestone quarry, rail siding or gas pipeline. The construction and operating hours (i.e. 24 hours per day, 7 days per week) would also be unchanged.

The general arrangement of the modified mine and processing facility is provided on Figure 2. Progressive general arrangements of the modified mine and processing facility are provided on Figures 3 to 6.

A detailed description of the Modification is provided in the main text of the Environmental Assessment.



CTL-16-02 Mod4_Noise_2028

RENZO TONIN & ASSOCIATES

LEGEND

- State Forest
- Mining Lease Application Boundary
- Approved Surface Development Area
- Approved Mine Footprint
- Diversion Structure
- Key Site Water Pipeline
- Approved Gas Pipeline
- Approved Water Pipeline
- Vegetation Screening
- Existing Open Woodland
- Modified Layout

Source: Black Range Minerals (2005); NSW Department of Industry (2017); NSW Land and Property Information (2017)

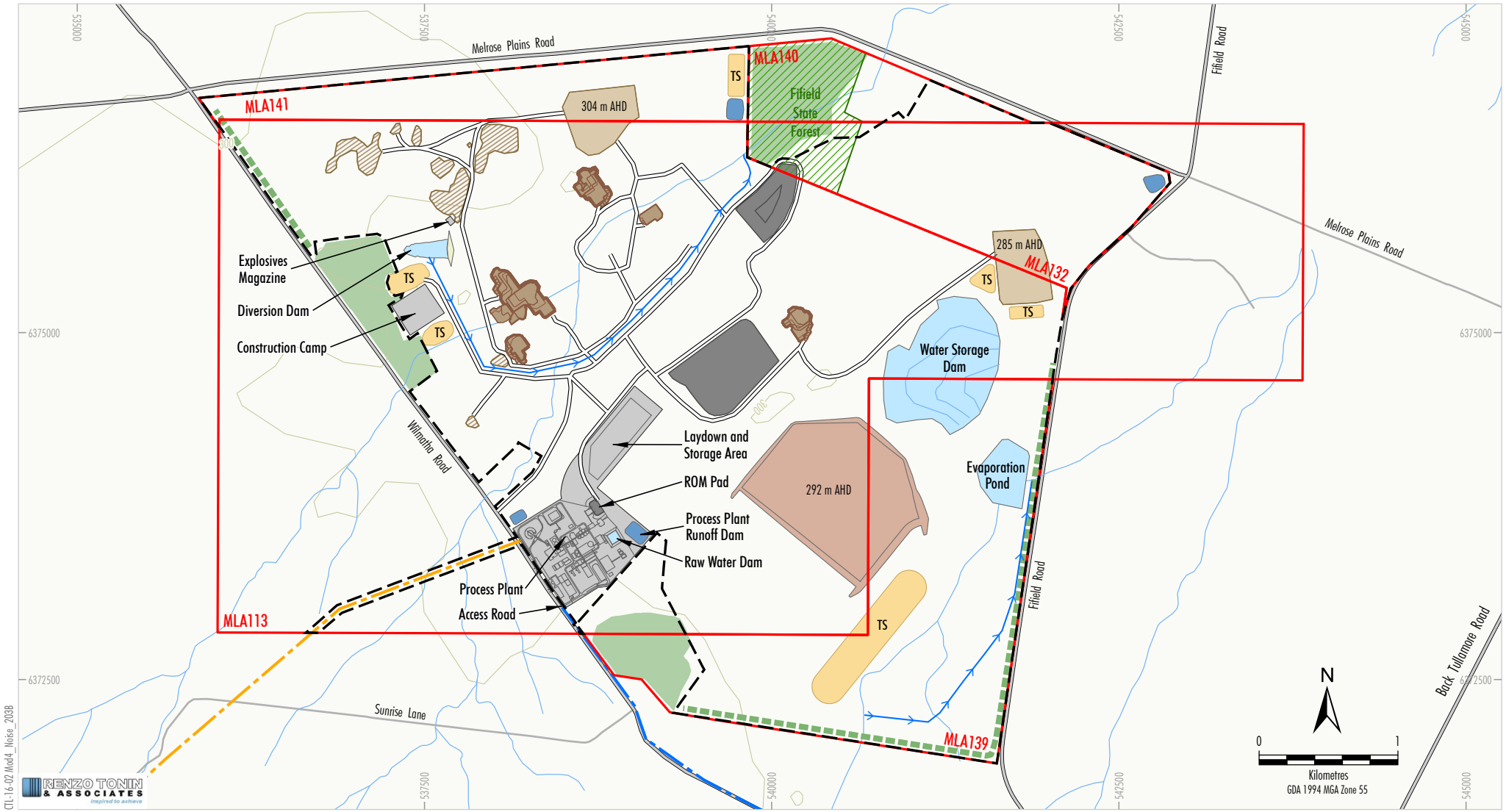
NSW Imagery: © Department of Finance, Services & Innovation (2017)

CLEAN TEQ
Powering innovation

SYERSTON PROJECT MODIFICATION 4

Indicative Modified Mine and Processing Facility General Arrangement

Figure 2



CTL-16-02 Mod4_Noise_2038

RENZO TONIN & ASSOCIATES

LEGEND

- Mining Lease Application Boundary
- Approved Surface Development Area
- Open Cut Pit (Scandium Oxide)
- Open Cut Pit
- Waste Rock Emplacement
- Tailings Storage Facility
- TS Topsoil Stockpile
- Ore Stockpile
- Mine Infrastructure Area
- Sediment Dam
- Diversion Structure
- Gas Pipeline
- Water Pipeline
- Vegetation Screening
- Existing Open Woodland to be Maintained
- State Forest

Source: Black Range Minerals (2000); NSW Department of Industry (2017); NSW Land & Property Information (2017)

CLEAN TEQ
Powering innovation

SYERSTON PROJECT MODIFICATION 4

Modified Mine and Processing Facility Conceptual General Arrangement Year 1

Figure 3

CTL-16-02 Mod4_Noise_204B

RENZO TONIN & ASSOCIATES

LEGEND

- Mining Lease Application Boundary
- Approved Surface Development Area
- Open Cut Pit (Scandium Oxide)
- Open Cut Pit
- Waste Rock Emplacement
- Tailings Storage Facility
- TS Topsoil Stockpile
- Ore Stockpile
- Mine Infrastructure Area
- Sediment Dam
- Initial Rehabilitation
- Diversion Structure
- Gas Pipeline
- Water Pipeline
- Vegetation Screening
- Existing Open Woodland to be Maintained
- State Forest

Source: Black Range Minerals (2000); NSW Department of Industry (2017); NSW Land & Property Information (2017)

CLEAN TEQ
Powering innovation

SYERSTON PROJECT MODIFICATION 4

Modified Mine and Processing Facility Conceptual General Arrangement Year 6

Figure 4

LEGEND

- Mining Lease Application Boundary
- Approved Surface Development Area
- Open Cut Pit (Scandium Oxide)
- Open Cut Pit
- Waste Rock Emplacement
- Tailings Storage Facility
- TS Topsoil Stockpile
- Ore Stockpile
- Mine Infrastructure Area
- Sediment Dam
- Initial Rehabilitation
- Intermediate/Advanced Rehabilitation
- Diversion Structure
- Gas Pipeline
- Water Pipeline
- Vegetation Screening
- Existing Open Woodland to be Maintained
- State Forest

Source: Black Range Minerals (2000); NSW Department of Industry (2017); NSW Land & Property Information (2017)

CLEAN TEQ
Powering innovation

SYERSTON PROJECT MODIFICATION 4

Modified Mine and Processing Facility Conceptual General Arrangement Year 11

Figure 5

LEGEND

- Mining Lease Application Boundary
- Approved Surface Development Area
- Open Cut Pit (Scandium Oxide)
- Open Cut Pit
- Waste Rock Emplacement
- Tailings Storage Facility
- TS Topsoil Stockpile
- Ore Stockpile
- Mine Infrastructure Area
- Sediment Dam
- Initial Rehabilitation
- Intermediate/Advanced Rehabilitation
- Diversion Structure
- Gas Pipeline
- Water Pipeline
- Vegetation Screening
- Existing Open Woodland to be Maintained
- State Forest

Source: Black Range Minerals (2000); NSW Department of Industry (2017); NSW Land & Property Information (2017)

CLEAN TEQ
Powering innovation

SYERSTON PROJECT MODIFICATION 4

Modified Mine and Processing Facility Conceptual General Arrangement Year 21

Figure 6

3 Noise Sensitive Receivers

Land use in the local area is predominately agricultural operations (rural). The majority of properties surrounding the Project are privately owned and the remainder are either community properties or mine owned.

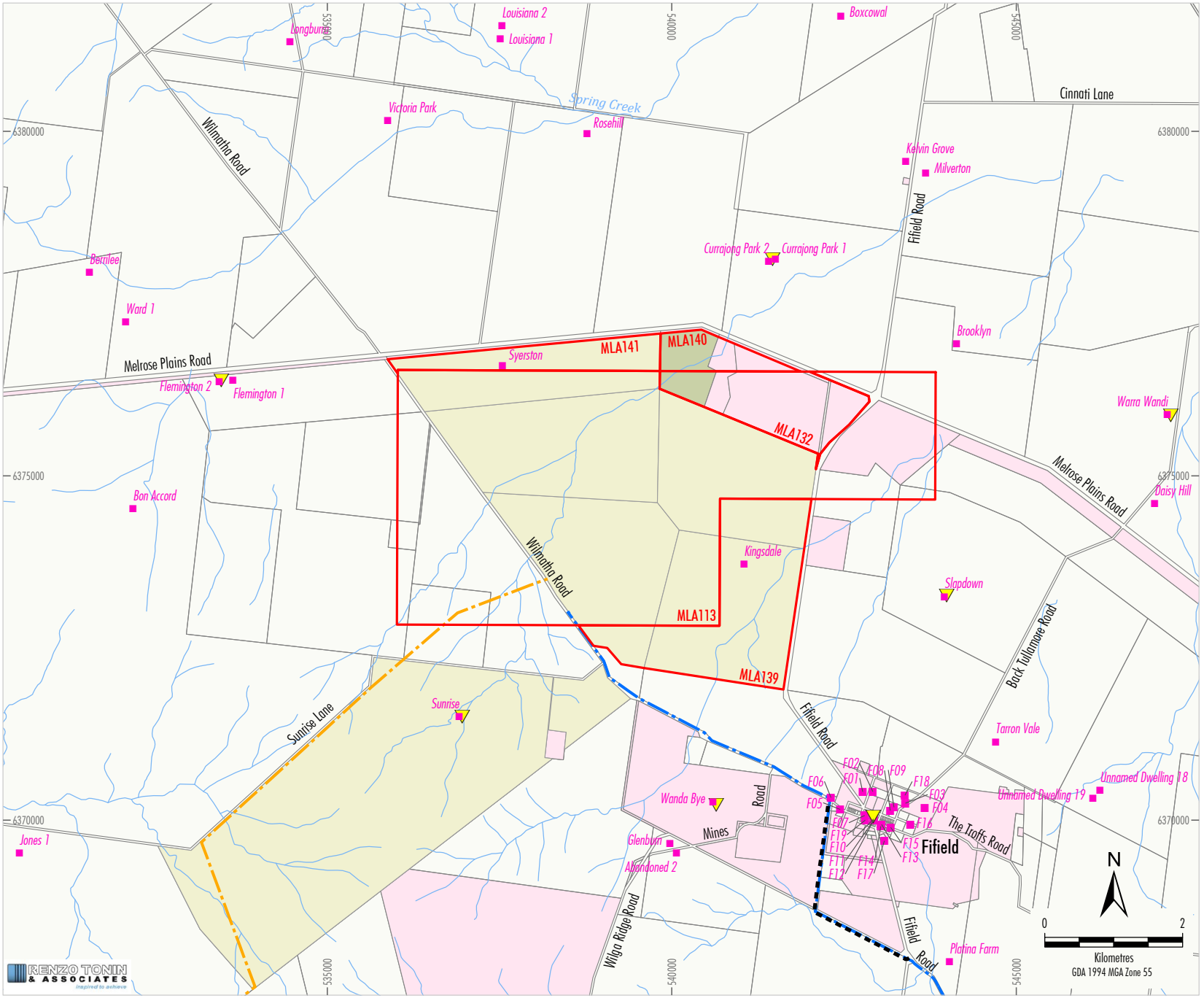
The noise sensitive receiver locations considered in this assessment are listed in Table 3.1 and shown on Figure 7.

Table 3.1 – Receiver Locations and Ownership Details

ID	Description	Easting	Northing	Ownership
M01	Longburra	534460	6381299	Private
M02	Victoria Park	535880	6380159	Private
M03	Ward 1	532074	6377231	Private
M04	Abandoned 2	540068	6369522	Private
M05	Berrilee	531549	6377952	Private
M06	Bon Accord	532179	6374519	Private
M07	Boxcowal	542455	6381666	Private
M08	Currajong Park 2	541407	6378116	Private
M09	Daisy Hill	547007	6374597	Private
M10	Glenburn	539974	6369660	Private
M11[1]	Kingsdale	541049	6373716	Mine-owned
M12	Louisiana 1	537510	6381346	Private
M13	Louisiana 2	537536	6381538	Private
M14	Platina Farm	544033	6367948	Private
M15	Sunrise	536914	6371503	Mine-owned
M16	Tarron Vale	544700	6371139	Private
M17	Jones 1	530531	6369523	Private
M18	-	546216	6370438	Private
M19	-	546115	6370320	Private
M20	-	546165	6367633	Private
M21	Warra Wandi	547194	6375889	Private
M22	Brooklyn	544134	6376913	Private
M23	Currajong Park 1	541505	6378145	Private
M24	Flemington 1	533630	6376389	Private
M25	Flemington 2	533432	6376363	Private
M26	Kelvin Grove	543396	6379565	Private
M27	Milverton	543687	6379393	Private
M28	Rosehill	538772	6379967	Private
M29	Slapdown	543958	6373248	Private
M30[1]	Syerston	537544	6376597	Mine-owned

ID	Description	Easting	Northing	Ownership
M31	Wanda Bye	540599	6370264	Private
M32	Fifield Town Hall	542918	6369990	Community
M33	Fifield Fire Station	542895	6369968	Community
M34	Fifield Hotel	542872	6370013	Private Business
M35	St Dympna's Catholic Church	542799	6370059	Community
F01	Fifield residences	542770	6370414	Private
F02		542918	6370415	Private
F03		543390	6370245	Private
F04		543672	6370175	Private
F05		542504	6370163	Private
F06		542310	6370326	Private
F07		542800	6370068	Private
F08		543170	6370138	Private
F09		543224	6370187	Private
F10		542932	6370017	Private
F11		542932	6370001	Private
F13		543045	6369937	Private
F14		543033	6369911	Private
F15		543178	6369894	Private
F16		543463	6369933	Private
F17		543086	6369700	Private
F18		543384	6370362	Private
F19		542808	6369999	Private

Notes: 1. These receivers would be removed to allow for the development of the mine and have therefore not been considered further.



LEGEND

- Mining Lease Application Boundary
- Approved Fifield Bypass
- Approved Gas Pipeline
- Approved Water Pipeline
- Clean TeQ Owned Land
- Crown Land
- Fifield State Forest
- Private Landholder
- Dwelling
- Modification 4 Background Monitoring Location (2016)

Source: Black Range Minerals (2000); NSW Department of Industry (2017); NSW Land & Property Information (2017)

CLEAN TEQ
Powering innovation

SYERSTON PROJECT MODIFICATION 4

Sensitive Receivers and Noise Monitoring Sites

Figure 7

CTL-16-02 Mod4_Noise_207C

4 Existing Acoustic Environment

Criteria for the assessment of operational and construction noise are usually derived from the existing noise environment of an area, excluding noise from the subject development.

Appendix B of the NSW EPA's INP outlines two methods for determining the background noise level of an area, being 'B1 – Long-term background noise method' and 'B2 – Short-term background noise method'. This assessment has used a combination of long-term and short-term noise monitoring.

As the noise environment of an area almost always varies over time, background and ambient noise levels need to be determined for the operational times of the proposed development. For example, in a suburban or urban area the noise environment is typically at its minimum at 3:00 am in the morning and at its maximum during the morning and afternoon traffic peak hours. The INP outlines the following standard time periods over which the background and ambient noise levels are to be determined:

- **Day:** 7:00 am - 6:00 pm Monday to Saturday and 8:00 am- 6:00 pm Sundays & Public Holidays.
- **Evening:** 6:00 pm - 10:00 pm Monday to Sunday & Public Holidays.
- **Night:** 10:00 pm - 7:00 am Monday to Saturday and 10:00 pm - 8:00 am Sundays & Public Holidays.

4.1 Noise Measurement Locations

Noise measurements are ideally carried out at the nearest or most potentially affected locations surrounding a development. An alternative, representative location should be established in the case of access restrictions or if a safe and secure location cannot be identified. Furthermore, representative locations may be established in the case of multiple receivers as it is usually impractical to carry out measurements at all locations surrounding a site.

The long-term and short-term noise measurement locations are outlined in Table 4.1 and shown on Figure 7. Short-term noise measurements were undertaken adjacent to the installed long-term noise monitor locations.

Table 4.1 – Noise Monitoring Locations

ID	Location	Description
L1	9 Wilmatha Fifield Road	• The noise monitor was located within the backyard along the northern boundary of the property. • The noise monitor was placed in the free-field. • The noise monitoring location is considered representative of receiver locations within the town of Fifield.
L2	Slapdown	• The noise monitor was located approximately 30 metres (m) from the dwelling. • The noise monitor was placed in the free-field. • The noise monitoring location is considered representative of receiver locations to the east of the Project.
L3	Wanda Bye	• The noise monitor was located at the end of the driveway and approximately 50 m from the nearest dwelling. • The monitor was placed in the free-field. • The noise monitoring location is considered representative of receiver locations to the south of the Project.
L4	Warra Wandi	• The noise monitor was located at the end of the driveway and approximately 45 m from the dwelling. • The noise monitor was placed in the free-field. • The noise monitoring location is considered to be representative of receiver locations to the north east and east of the Project.
L5	Currajong Park	• The noise monitor was located approximately 30 m from the main dwelling. • The noise monitor was placed in the free-field. • The noise monitoring location is considered to be representative of receiver locations to the north of the Project.
L6	Sunrise	• The noise monitor was located at the end of the driveway and approximately 35 m from the dwelling. • The noise monitor was placed in the free-field. • The noise monitoring location is considered to be representative of receiver locations to south west of the Project.
L7	Flemington	• The noise monitor was located approximately 30 m from the dwelling. • The noise monitor was placed in the free-field. • The noise monitoring location is considered to be representative of receiver locations to the west of the Project.

4.2 Long-Term Noise Monitoring Results

Long-term noise monitoring was carried out from Monday 5 December 2016 to Thursday 15 December 2016. The long-term noise monitoring methodology is detailed in Appendix B, and noise level-vs-time graphs of the data are included in Appendix C.

Table 4.2 presents the overall single Rating Background Levels (RBL) and representative ambient L_{eq} noise levels for each assessment period, determined in accordance with the INP.

Table 4.2 – Long-Term Noise Monitoring Results, dB(A)

Monitoring location	L_{A90} RBL			L_{Aeq} Ambient noise levels[4]		
	Day[1]	Evening[2]	Night[3]	Day[1]	Evening[2]	Night[3]
L1 – 9 Wilmatha Fifield Road	26	29	22	57	55	44
L2 – Slapdown	25	26	21	47	46	41
L3 – Wanda Bye	34	30	25	47	47	43
L4 – Warra Wandi	27	30	27	49	43	40
L5 – Currajong Park	28	26	21	52	47	45
L6 – Sunrise	27	26	22	44	43	41
L7 – Flemington[5]	37	40	37	45	47	43

Notes:
1. Day: 7:00 am - 6:00 pm Monday to Saturday and 8:00 am - 6:00 pm Sundays & Public Holidays.
2. Evening: 6:00 pm - 10:00 pm Monday to Sunday & Public Holidays.
3. Night: 10:00 pm - 7:00 am Monday to Saturday and 10:00 pm - 8:00 am Sundays & Public Holidays.
4. As required by the INP, the external ambient noise levels presented are free-field noise levels (ie. no façade reflection is incorporated).
5. There was presence of insect noise throughout the measurement duration.

The recorded RBLs for all seven (7) monitoring locations are approximately 30 A-weighted decibels (dB[A]) and below (with the exception of L7, which was affected by insect noise throughout the monitoring period), which is consistent with background noise levels expected for a rural region.

Background noise monitoring was previously conducted in 1999 as part of the original Syerston Project EIS. The recorded RBLs were found to be the same or lower than the previous monitoring results. Therefore, there have been no increases to background noise levels surrounding the Project since 1999.

For a conservative assessment of noise impacts from the Project, this assessment will adopt the minimum background noise levels nominated in the INP of 30 dB(A) for day, evening and night periods.

4.3 Short-term Noise Measurement Results

Short-term noise measurements were undertaken on Wednesday 14 December 2016 and Thursday 15 December 2016 during various day, evening and night periods, in order to supplement the long-term noise monitoring and provide a greater understanding of the surrounding noise environment.

The equipment used for noise measurements was a Brüel & Kjaer Type 2250 precision sound level analyser which is a Class 1 instrument having accuracy suitable for field and laboratory use. The instrument was calibrated prior and subsequent to measurements using a Brüel & Kjaer Type 4231 calibrator. No significant drift in calibration was observed. All instrumentation complies with AS IEC 61672.1 2004 *Electroacoustics - Sound Level Meters* and carries current National Association of Testing Authorities (NATA) certification (or if less than 2 years old, manufacturers certification).

Within Fifield, background noise was dominated by traffic on Wilmatha Fifield Road and environmental noise within the township. Background noise at other rural residences was dominated by environmental noise and distant traffic. A summary of the short-term measurement results is presented in Appendix D.

5 Meteorology

Certain meteorological conditions may increase noise levels by focusing sound-wave propagation paths at a single point. Such refraction of sound waves occur during temperature inversions (atmospheric conditions where temperatures increase with height above ground level) and where there is a wind gradient (that is, wind velocities increasing with height) with wind direction from the source to the receiver.

Temperature inversions occurring within the lowest 50 m to 100 m of atmosphere can affect noise levels measured on the ground. Temperature inversions are most commonly caused by radiative cooling of the ground at night leading to the cooling of the air in contact with the ground. This is especially prevalent on cloudless nights with little wind. Air that is somewhat removed from contact with the ground will not cool as much, resulting in warmer air aloft than nearer the ground.

Similarly, when significant wind exists, the conditions can significantly affect noise levels at receptor points downwind of a noise source. This would depend however, on the particular direction and the velocity of the wind at that time. It should also be noted that although wind can raise noise emission levels as perceived from a downstream assessment point, background noise also tends to increase as a result of increased wind activity. This often causes masking of potential increases in intrusive noise.

The NSW EPA's INP recommends that project noise criteria are to apply under weather conditions characteristic of an area. These conditions may include calm, wind and temperature inversions. In this regard, the increase in noise that results from atmospheric temperature inversions and wind effects may need to be assessed. The noise levels predicted under characteristic meteorological conditions for each receiver are then compared with the criteria, to establish whether the meteorological effect will cause a significant impact.

The NSW EPA's INP permits two approaches for assessing these effects: use of default parameters and use of site-specific parameters.

- With using default parameters, general meteorological values are used to predict noise levels, foregoing detailed analyses of site-specific meteorological data. This approach assumes that meteorological effects are conservative, in that it is likely to predict the upper range of increases in noise levels. Actual noise levels may be less than predicted.
- The use of site-specific parameters is a more detailed approach, which involves analysing site meteorological data to determine whether inversion and/or wind effects are significant features warranting assessment. Where assessment is warranted, default parameters are available for use in predicting noise or, where preferred, measured values may be used instead. The use of site-specific parameters provides a more accurate prediction of noise increases due to meteorological factors, however, is more costly especially if suitable site data is unavailable and long-term meteorological monitoring is required. Existing weather data may be used, provided the site is within a radius of 30 km of the collection point and in the same topographical basin.

For this assessment, the more detailed approach using site-specific meteorological parameters was conducted. Weather data, provided by Ramboll Environ, was taken from the Condobolin Airport Automatic Weather Station for the year 2015.

While this weather station is outside the radius provided in the INP (approximately 40 km southwest of the Project), this is the closest Bureau of Meteorology weather station to the Project. Given the relatively uncomplicated regional terrain, this weather station would be considered to be in the same topographical basin, and suitable for determining prevailing weather conditions for modelling purposes.

5.1 Temperature Inversions

Appendix C of the INP describes the following procedure for assessing the increase in noise caused by temperature inversions:

- Do an initial screening test to determine whether there is the potential for significant increases to noise levels due to inversions to warrant further assessment. That is, will the development operate during the night-time assessment period of 10:00 pm to 7:00 am, and if so, will the noise increase significantly (by more than 3 decibels [dB] as per Table D1 in Appendix D of INP)?
- Determine extent of impact in terms of percent (%) occurrence of inversions where there is the potential for inversions to increase noise levels for the locality being assessed. Where inversions are predicted for more than 30% of the total night-time (or approx. 2 nights per week) during winter (i.e. months of June, July and August), these are considered to be significant and should be accounted for in the noise assessment.
- Predict noise levels using default or site-specific parameters to determine the increase in noise levels expected due to inversions. The default parameters are:
  - non-arid areas (mean rainfall >500 millimetres per annum [mm pa]); 3 degrees Celsius (^{o}C)/100 m temperature inversion strength and 2 metres per second (m/s) at 10 m height drainage-flow wind from source to receiver where applicable.
  - arid and semi-arid areas (mean rainfall <500 mm pa); 8^{o}C/100 m temperature inversion strength and 1 m/s at 10 m height drainage-flow wind from source to receiver where applicable.
- Assess impact to determine whether the increased noise levels due to inversions will affect receivers in the vicinity of the development. The predicted increased noise levels are compared with the project's noise criteria to determine if any exceedances or noise impacts are expected.

Assessment of impacts from temperature inversions is confined to the night-time period of 10:00 pm to 7:00 am, as this is the time likely to have the greatest impact on amenity of nearby residences. As the Project operates at night-time, there is potential for noise impact due to inversions, and further consideration of these effects is required.

Following the procedure above, the likelihood of temperature inversion occurrence was determined based on Pasquill-Gifford stability classes for the winter night-time periods in the weather data. A summary of the likelihood of temperature inversions for night-time is presented in Table 5.1 below.

Table 5.1 – Winter Night-time Temperature Inversion (TI) Likelihood, %

Season	Pasquill-Gifford Stability Class							TI Likelihood (F+G)
	A	B	C	D	E	F	G	
Winter	0.0	0.0	0.0	16.2	44.2	33.3	6.3	39.6

The results above indicate that the F class temperature inversions are above the 30% occurrence threshold nominated in the INP for the night-time period, and therefore, temperature inversions will need to be considered in the assessment for the night-time period. In accordance with Section 5.2 of the INP, temperature inversions are only assessable during the night-time period.

5.2 Wind Effects

Gradient wind differs from the drainage-flow wind associated with temperature inversions. Drainage-flow wind is the localised drainage of cold air under the influence of the local topography, and travels in one direction only (direction of decreasing altitude). Gradient wind is the regional wind determined by synoptic factors (e.g. high and low-pressure systems).

Unlike temperature inversions, gradient winds may cause impacts during any assessment period, (day, evening and night), and not just the night period.

The INP specifies a procedure for assessing the significance of wind effects, and a default wind speed to be used in the assessment where these effects are found to be significant. The procedure requires that wind effects 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 0.5 to 3 m/s occur for 30% of the time or more in any assessment period (day, evening and night) in any season. Winds with velocities less than 0.5 m/s (calm conditions) and greater than 3 m/s (at 10 m height), are not included in the calculations of wind occurrence.

Therefore, there are two ways to assess wind effects:

- Use available wind data or wind roses to determine the frequency of occurrence and wind speed, taking into account the various components of wind that are relevant.
- Simply assume that wind is a feature of the area (foregoing the need to use wind data or wind roses).

In accordance with the INP, where there is 30% or more occurrence of wind speeds between 0.5 m/s and 3 m/s (source-to-receiver component), then the highest wind speed is used (below 3 m/s) instead of the default. Where there is less than a 30% occurrence of wind between 0.5 m/s and 3 m/s (source-to-receiver component), wind is not included in the noise-prediction calculations.

Analysis of the wind data was undertaken using the EPA's Noise Enhancement Wind Analysis program to determine if wind is a 'feature' of the area as defined by the INP. The program determines whether there are prevailing source-to-receiver wind conditions. The results of the analysis are presented in Table 5.2 below.

Table 5.2 – Percentage of Wind Records (0.5 to 3 m/s) from Subject Site to Receiver, %

Direction	Summer			Autumn			Winter			Spring		
	Day	Eve	Night	Day	Eve	Night	Day	Eve	Night	Day	Eve	Night
N	5.9	6.9	7.8	3.9	6.0	5.0	4.8	11.4	5.1	5.0	9.6	7.3
NNE	7.2	10.0	10.7	4.7	8.7	6.4	6.1	14.7	6.6	4.9	12.4	9.6
NE	8.4	14.7	17.0	5.4	12.8	10.5	6.8	17.1	11.6	5.1	15.1	15.6
ENE	8.1	13.6	23.1	7.6	14.1	14.9	8.6	17.9	14.7	4.2	14.0	19.9
E	8.5	11.1	23.1	8.8	13.6	16.4	9.1	11.4	14.4	6.8	11.5	18.1
ESE	8.4	9.2	21.2	10.1	10.3	13.9	9.2	7.3	11.6	6.4	9.9	15.3
SE	6.9	7.8	14.4	11.1	7.1	10.0	11.0	5.7	7.7	7.2	8.0	9.8
SSE	5.7	6.7	7.0	7.1	4.9	4.7	7.2	3.0	3.9	6.1	7.4	5.0
S	8.6	10.6	7.8	12.5	10.1	6.8	14.1	10.3	4.2	9.4	14.8	6.6
SSW	6.6	11.1	7.6	11.7	14.9	11.7	16.1	14.9	5.2	10.7	14.6	7.9
SW	5.5	9.2	8.6	10.8	17.1	13.5	15.3	18.8	9.5	9.2	14.0	10.9
WSW	4.3	7.5	10.1	11.5	18.2	20.3	14.0	22.8	20.2	9.6	17.0	15.0
W	4.0	5.8	9.4	8.5	17.7	22.8	9.8	20.9	23.4	8.2	14.0	15.3
WNW	3.5	3.9	8.5	6.0	12.5	17.9	6.9	15.8	22.1	5.9	10.4	13.7
NW	3.9	3.1	6.7	5.6	8.2	15.8	5.6	10.9	18.2	4.7	8.5	10.6
NNW	4.3	4.4	4.8	3.8	6.0	8.0	4.8	7.9	8.6	5.2	6.3	7.0

Notes Bold denotes greater than 30% occurrence of wind scenario.

The results above indicate that there is no greater than 30% occurrence of winds between 0.5 m/s and 3 m/s (source-to-receiver component) for certain scenarios. Therefore, there are no prevailing wind conditions in accordance with the INP, and wind effects are not considered in this assessment.

5.3 Summary of Meteorological Assessment Conditions

Based on the findings in Section 5.1 and Section 5.2, Table 5.3 below presents a summary of the meteorological conditions considered for the operational noise computer modelling.

Table 5.3 – Summary of Meteorological Assessment Conditions

Period	Meteorological Assessment Condition
Day	Calm
Evening	Calm
Night	Calm
	F Class Inversion

6 Criteria

6.1 Construction Noise

The NSW ICNG provides guidelines for assessing noise generated during the construction phase of developments.

The key components of the guideline that are incorporated into this assessment include:

- Use of L_{Aeq} as the descriptor for measuring and assessing construction noise.

NSW noise policies, including the INP, RNP and Rail Infrastructure Noise Guideline (RING) (EPA, 2013a) have moved to the primary use of L_{Aeq} over any other descriptor. As an energy average, L_{Aeq} provides ease of use when measuring or calculating noise levels since a full statistical analysis is not required as when using, for example, the L_{A10} descriptor.

- Application of reasonable and feasible noise mitigation measures.
- As stated in the ICNG, a noise mitigation measure is feasible if it is capable of being put into practice, and is practical to build given the project constraints.
- Selecting reasonable mitigation measures from those that are feasible involves making a judgement to determine whether the overall noise benefit outweighs the overall social, economic and environmental effects.

The ICNG provides two methods for assessment of construction noise, being either a quantitative or a qualitative assessment. A quantitative assessment is recommended for major construction projects of significant duration, and involves the measurement and prediction of noise levels, and assessment against set criteria. A qualitative assessment is recommended for small projects with a duration of less than three weeks and focuses on minimising noise disturbance through the implementation of reasonable and feasible work practices, and community notification.

Given the scale and duration of the construction works proposed for the Project (i.e. greater than six months), a quantitative assessment is carried out herein, consistent with the ICNG.

Table 6.1, reproduced from the ICNG, sets out the Noise Management Levels (NMLs) and how they are to be applied for residential receivers.

Table 6.1 – Noise Management Levels at Residential Receivers

Time of Day	Management Level $L_{Aeq\ (15\ min)}$	How to Apply
Recommended standard hours: Monday to Friday 7 am to 6 pm Saturday 8 am to 1 pm No work on Sundays or public holidays	Noise affected RBL + 10 dB(A)	The noise affected level represents the point above which there may be some community reaction to noise. Where the predicted or measured LAeq (15 min) is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level. The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.
	Highly noise affected 75 dB(A)	The highly noise affected level represents the point above which there may be strong community reaction to noise. Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account: • times identified by the community when they are less sensitive to noise (such as before and after school for works near schools, or mid-morning or mid-afternoon for works near residences • if the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
Outside recommended standard hours	Noise affected RBL + 5 dB(A)	A strong justification would typically be required for works outside the recommended standard hours. The proponent should apply all feasible and reasonable work practices to meet the noise affected level. Where all feasible and reasonable practices have been applied and noise is more than 5 dB(A) above the noise affected level, the proponent should negotiate with the community. For guidance on negotiating agreements see section 7.2.2 of the ICNG.

Source: ICNG (Department of the Environment and Climate Change, 2009).

Based on the above ICNG requirements, Table 6.2 presents the construction NMLs established for the nearest noise sensitive residential receivers based upon the noise monitoring outlined in Section 4.

As described in Section 2.2, the construction activities relevant to the modified Project (i.e. at the mine and processing facility) would be conducted 24 hours per day, seven days per week. The construction activities would therefore be conducted both within and outside of the recommended standard construction hours.

Table 6.2 – Construction Noise Management Levels at Residential Receivers

Receiver Location	L_{A90} RBL[1]			NML $L_{Aeq(15min)}$		
	Day	Evening	Night	Day	Evening	Night
All Residential Receivers	30	30	30	40	35	35

Notes: 1. RBLs have adopted the minimum background noise levels nominated in the INP as long term background noise levels were recorded at approximately 30 dB(A) and below (refer to Section 4.2).

The Fifield Hotel (receiver M34) is assumed to have a permanent caretaker's residence on the property and is considered to be a residential receiver.

Table 6.3 sets out the ICNG NMLs for other noise sensitive receiver locations. As identified for residential receivers, a 'highly affected' noise objective of $L_{Aeq(15min)}$ 75 dB(A) is also adopted for all noise sensitive receivers, with exceedances addressed as described in Table 6.1.

Table 6.3 – Noise Management Levels at Other Noise Sensitive Land Uses

Land Use	Where Objective Applies	Management Level $L_{Aeq\ (15\ min)}$
Classrooms at schools and other educational institutions	Internal noise level	45 dB(A)
Hospital wards and operating theatres	Internal noise level	45 dB(A)
Places of worship	Internal noise level	45 dB(A)
Active recreation areas	External noise level	65 dB(A)
Passive recreation areas	External noise level	60 dB(A)
Community centres	Depends on the intended use of the centre.	Refer to the 'maximum' internal levels in AS2107 for specific uses.
Commercial premises	External noise level	70 dB(A)
Industrial premises	External noise level	75 dB(A)

Notes: NMLs apply when receiver areas are in use only.

It is noted that as a general rule, building structures would typically provide a minimum of 10 dB(A) reduction from external noise levels to internal noise levels, with windows opened sufficiently for fresh air ventilation. Therefore, the equivalent external management levels for the Fifield Town Hall (receiver M32) and St Dympna's Catholic Church are **55 dB(A)**.

The Fifield Fire Station (receiver M33) is considered to be a commercial premise.

6.2 Operational Noise

Operational noise from the Project is assessed in accordance with the INP. The INP is used as a guide by the EPA for setting statutory limits in licences for scheduled noise sources.

The INP has two components:

- Controlling intrusive noise impacts in the short term for residences.
- Maintaining noise level amenity for particular land uses for residences and other land uses.

6.2.1 Intrusive Noise Impacts

According to the INP, the intrusiveness of a noise source may generally be considered acceptable if the equivalent continuous (energy-average) A-weighted level of noise from the source (represented by the L_{Aeq} descriptor) does not exceed the background noise level measured in the absence of the source by more than 5 dB(A). The intrusiveness criterion is only applicable to residential type receivers and is summarised as follows:

- **$L_{Aeq,15minute} \leq$ RBL plus 5 dB(A).**

Table 6.4 presents the intrusiveness criteria established for the nearest noise sensitive residential receivers based upon the noise monitoring outlined in Section 4.

Table 6.4 – Intrusiveness Criteria

Receiver Location	L_{A90} RBL[1]			Intrusiveness Criteria $L_{Aeq(15min)}$		
	Day	Evening	Night	Day	Evening	Night
All Residential Receivers	30	30	30	35	35	35

Notes: RBL levels have adopted the minimum background noise levels nominated in the INP as long term background noise levels were recorded at approximately 30 dB(A) and below (refer to Section 4.2).

The Fifield Hotel (receiver M34) is assumed to have a permanent caretaker's residence on the property and is considered to be a residential receiver.

6.2.2 Protecting Noise Amenity

The amenity criteria are determined in accordance with Chapter 2 of the INP. The INP recommends base acceptable noise levels for various receivers, including residential, commercial, industrial receivers and sensitive receivers such as schools, hospitals, churches and parks. These base noise criteria are then lowered by up to 10 dB depending on the extent of existing industrial noise impact upon the receiver (if applicable). Higher levels of existing industrial noise therefore result in stricter amenity criteria applied to any new industrial development. In this way the cumulative impacts of existing and known future industrial noise sources are minimised.

To limit continuing increases in noise levels, the maximum ambient noise level within an area from industrial noise sources should not normally exceed the acceptable noise levels specified in Table 2.1 of the INP, the applicable parts of which are reproduced in Table 6.5 below.

It is noted that as a general rule, building structures would typically provide a minimum of 10 dB(A) reduction from external noise levels to internal noise levels, with windows opened sufficiently for fresh air ventilation. Therefore, the equivalent external management levels for the town hall and places of worship are **45 dB(A)** and **50 dB(A)**, respectively.

Table 6.5 – Amenity Criteria – Recommended L_{Aeq} Noise Levels from Industrial Sources

Type of Receiver	Indicative Noise Amenity Area	Time of Day	Recommended $L_{Aeq(Period)}$ Noise Level	
			Acceptable	Recommended Maximum
Residence	Rural	Day	50	55
		Evening	45	50
		Night	40	45
School classrooms – internal	All	Noisiest 1 hour period when in use	35	40
Hospital ward	All	Noisiest		

Type of Receiver	Indicative Noise Amenity Area	Time of Day	Recommended $L_{Aeq(Period)}$ Noise Level	
			Acceptable	Recommended Maximum
- internal		1 hour period	35	40
- external			50	55
Place of worship – internal	All	When in use	40	45
Area specifically reserved for passive recreation (e.g. National Park)	All	When in use	50	55
Active recreation area (e.g. school playground, golf course)	All	When in use	55	60
Commercial premises	All	When in use	65	70
Industrial premises	All	When in use	70	75

Notes:
1. Daytime 7.00 am - 6.00 pm; Evening 6.00 pm - 10.00 pm; Night-time 10.00 pm - 7.00 am.
2. On Sundays and Public Holidays, Daytime 8.00 am - 6.00 pm; Evening 6.00 pm - 10.00 pm; Night-time 10.00 pm - 8.00 am.
3. The L_{Aeq} index corresponds to the level of noise equivalent to the energy average of noise levels occurring over a measurement period.

6.2.3 Project Specific Noise Levels

In accordance with the INP, noise impact should be assessed in terms of both intrusiveness and amenity. Based on the background and ambient noise monitoring carried out at the nearest affected receiver locations, the Project Specific Noise Levels (PSNLs) are outlined in Table 6.6 below.

Table 6.6 – Project Specific Noise Levels

Locality	Land Use	Intrusiveness, $L_{Aeq,15min}$, dB(A)			Amenity, $L_{Aeq,period}$, dB(A)		
		Day	Evening	Night	Day	Evening	Night
Privately Owned Land	Rural Residential	35	35	35	50	45	40
Any	Fifield Town Hall	N/A	N/A	N/A	External 50 dB(A) when in use		
Any	St Dympna's Catholic Church	N/A	N/A	N/A	External 50 dB(A) when in use		
Any	Fifield Fire Station	N/A	N/A	N/A	External 65 dB(A) when in use		

Notes:
1. RBL levels have adopted the minimum background noise levels nominated in the INP as long term background noise levels were recorded at approximately 30 dB(A) and below.
2. Residential locations have been categorised as 'Rural'.

It is noted the PSNLs are consistent with the noise criteria present in Development Consent DA 374-11-00, with the exception of the Currajong Park property, which has criteria of 35 dB(A) during the day, 39 dB(A) during the evening and 40 dB(A) at night.

Once the Project is operational, monitoring results would be assessed against the INP, or policy that supersedes this policy (e.g. the finalised draft Industrial Noise Guideline), with respect to modifying factors (including for low frequency noise). If noise generated by the Project is found to contain annoying characteristics (such as dominant low frequency content), the appropriate modifying factor would be applied to measured Project noise levels and assessed against noise criteria.

6.2.4 Voluntary Land Acquisition and Mitigation Policy

The INP states that the intrusiveness and amenity criteria have been selected to protect 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 criteria in the INP are achieved, then it is unlikely that most people would consider the resultant noise levels excessive.

In those cases when the PSNLs are not, or cannot be achieved, then it does not automatically follow that those people affected by the noise would find the noise unacceptable. In subjective terms, exceedances of the PSNLs are described in the NSW Government's (2014) *Voluntary Land Acquisition and Mitigation Policy – SSD Mining* and reproduced in Table 6.7 below.

Table 6.7 – Characterisation of Noise Impacts & Potential Treatments

Residual Noise Exceeds INP Criteria By	Characterisation of Impacts	Potential Treatment
0-2 dB(A) above the PSNL	Impacts are considered to be **negligible**	The exceedances would not be discernible by the average listener and therefore would not warrant receiver based treatments or controls
3-5 dB(A) above the PSNL in the INP but the development would contribute less than 1 dB to the total industrial noise level	Impacts are considered to be **marginal**	Provide mechanical ventilation/comfort condition systems to enable windows to be closed without compromising internal air quality/amenity.
3-5 dB(A) above the PSNL in the INP and the development would contribute more than 1 dB to the total industrial noise level	Impacts are considered to be **moderate**	As for marginal impacts but also upgraded facade elements like windows, doors, roof insulation etc. to further increase the ability of the building façade to noise levels.
>5 dB(A) above the PSNL in the INP	Impacts are considered to be **significant**	Provide mitigation as for moderate impacts and see voluntary land acquisition provisions below.

Furthermore, the policy also presents information regarding the requirements for voluntary mitigation and voluntary acquisition. A consent authority can apply voluntary mitigation and voluntary land acquisition rights to reduce:

- *Operational noise impacts of a development on privately owned land; and*
- *Rail noise impacts of a development on privately owned land near non-network rail lines (private rail lines), on or exclusively servicing industrial sites (see Appendix 3 of the RING);*

But not:

- *Construction noise impacts, as these impacts are shorter term and can be controlled;*
- *Noise impacts on the public road or rail network; or*
- *Modifications of existing developments with legacy noise issues, where the modification would have beneficial or negligible noise impacts. In such cases, these legacy noise issues should be addressed through site-specific pollution reduction programs under the Protection of the Environment Operations Act 1997.*

Voluntary Mitigation Rights

A consent authority should only grant voluntary mitigation rights:

- *If the noise generated by the development would be equal to or greater than 3 dB(A) above the INP project-specific noise level at any residence on privately-owned land; or*
- *If the development would increase the total industrial noise level at any residence on privately-owned land by more than 1 dB(A), and noise levels at the residence are already above the recommended amenity criteria in Table 2.1 of the INP; or*
- *If the development includes a private rail line and the use of that private rail line would cause exceedances of the recommended acceptable levels in Table 6 of Appendix 3 of the RING by greater than or equal to 3 dB(A) at any residence on privately-owned land*

All noise levels must be calculated in accordance with the INP or RING (as applicable).

The selection of mitigation measures in cases when the PSNLs are not, or cannot be, achieved, should be guided by the potential treatments identified in Table 6.7.

Voluntary Land Acquisition Rights

A consent authority should only grant voluntary land acquisition rights where:

- *The noise generated by the development would be more than 5 dB(A) above the Project specific noise level at any residence on privately-owned land; or*
- *The noise generated by the development would contribute to exceedances of the recommended maximum noise levels in Table 2.1 of the INP on more than 25% of any privately owned land, and a dwelling could be built on that land under existing planning controls; or*
- *If the development includes a private rail line and the use of that private rail line would cause exceedances of the recommended maximum criteria in Table 6 of Appendix 3 of the RING at any residence on privately-owned land.*

All noise levels must be calculated in accordance with the INP or RING (as applicable).

6.2.5 Cumulative Noise Levels

For cumulative noise levels, the INP amenity criteria is applicable as it is intended to control the total noise level at a receiver location from all industrial or mining developments (Table 3.1). The cumulative noise levels are therefore assessed against the amenity criteria nominated in Table 6.5.

It is noted there are no other industrial noise sources in the vicinity of the Project that would contribute to cumulative noise levels.

6.2.6 Sleep Disturbance

Noise emanating from the Project has been assessed for its potential to disturb sleep at residential receivers. The NSW EPA (2013b) has made the following policy statement with respect to 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 INP does not specifically address sleep disturbance from high noise level events.*
>
> *Research on sleep disturbance is reviewed in the NSW Road Noise Policy. 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 EPA recognised that current sleep disturbance criterion of an $L_{A1, (1\ minute)}$ not exceeding the $L_{A90, (15\ minute)}$ by more than 15 dB(A) is not ideal. Nevertheless, as there is insufficient evidence to determine what should replace it, the EPA 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 $L_{A1, (1\ minute)}$, 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 NSW Road Noise Policy. 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 10:00 pm and 7:00 am); and*
> - *whether there are times of day when there is a clear change in the noise environment (such as during early morning shoulder periods).*
>
> *The $L_{A1, (1\ minute)}$ descriptor is meant to represent a maximum noise level measured under 'fast' time response. EPA will accept analysis based on either $L_{A1, (1\ minute)}$ or $L_{A, (Max)}$."*

The policy states that a sleep disturbance criterion of $L_{A1, (1\ minute)} \leq L_{A90,15minute} + 15$ dB(A), should be used as a first step 'guide' as it is 'not ideal' and 'where it is not met, a more detailed analysis is required'. That detailed analysis includes a reference to the research material contained in the RNP in the assessment of the subject proposal.

The RNP contains a summary of the findings of world-wide research undertaken on sleep disturbance from noise up until the time when this publication was produced. It summarises all of the research with the following statement:

"From the research on sleep disturbance to date it can be concluded that:

- *maximum internal noise levels below 50-55 dB(A) are unlikely to awaken people from sleep*
- *one or two noise events per night, with maximum internal noise levels of 65-70 dB(A), are not likely to affect health and wellbeing significantly."*

Therefore, from the above research a 50-55 dB(A) maximum internal noise level would be equivalent to approximately 65-70 dB(A) maximum noise level outside a bedroom window. These external noise limits are in line with the noise limits described by Griefahn [Acoustics Australia vol 20 No 2 August 1992 pp 43-47] and the RNP which address sleep disturbance.

In summary, the sleep disturbance criteria described in policies described above are used for the purpose of noise impact assessment for this study, however due consideration is also given to the RNP research findings in setting an appropriate 'upper' limit.

The sleep disturbance criteria described in the NSW policies and research referred to above is used for the purpose of noise impact assessment for this study and is summarised in Table 6.8 below.

Table 6.8 – Sleep Disturbance Criteria

Receiver	Sleep disturbance criteria, 10:00 pm - 7:00 am, $L_{A1, (1\ minute)}$	
	$L_{A90(15min)}$ + 15	Upper limit
All residential	30 + 15 = **45 dB(A)**	**65 dB(A)**

6.3 Blasting

6.3.1 Residential Receivers

Blasting produces ground-borne vibration and air blast over pressure, both of which can cause discomfort, and at higher levels, damage to property.

The *ANZECC Technical Basis for Guidelines to Minimise Annoyance Due to Blasting Overpressure and Ground Vibration* (1990) have been adopted by the EPA and establish ground vibration and airblast overpressure criteria for potentially affected locations.

The blast charge configuration should be selected to ensure that EPA goals are not exceeded. Before blasting can commence at a site, critical locations should be identified and appropriate measures taken to limit over pressure and vibration to acceptable levels. Blasts should initially be monitored at these locations to ensure that predicted over pressure and vibration levels are not exceeded.

The recommended goals for blasting are based on NSW EPA's *Environmental Noise Control Manual* guidelines (EPA, 1994). These state that:

"Blasting operations should in most cases be confined to the periods Mondays to Saturdays, 9am to 3pm. Blasting outside of those times should be approved only where blasting during the preferred

times is clearly impracticable, and should then be limited in number. Blasting at night should be avoided unless it is absolutely necessary."

Table 6.9 presents the criteria for blast over pressure and ground vibration for the control of blasting impact on residential premises.

Table 6.9 – Criteria for the Control of Blasting Impact at Residences

Day	Time of Blasting	Blast Over Pressure Level, dB(Lin)	Ground Vibration, peak particle velocity, (mm/sec)
Monday to Saturday	9:00 am – 3:00 pm	115	5
Monday to Saturday	6:00 am – 9:00 am, 3:00 pm – 8:00 pm	105	2
Sunday, Public Holiday	6:00 am – 8:00 pm	95	1
Any day	8:00 pm – 6:00 am	95	1

Notes: mm/sec = millimetres per second.

In addition, any exceedance above a blast over pressure of 115 dB(Lin) should be limited to not more than 5% of the total number of blasts in a 12 month period. On these infrequent occasions a maximum limit of 120 dB(Lin) should not be exceeded at any time.

Ground vibration above 5 mm/sec should also be limited to not more than 5% of the total number of blasts in a 12 month period. On these infrequent occasions a maximum limit of 10 mm/sec should not be exceeded at any time.

For assessment of structural damage due to airblast over pressure, Australian Standard AS 2187.2-2006 *Explosives – Storage, Transport and Use – Part 2 Use of Explosive* recommends a 133 dB(Lin) level as a safe level that will prevent structural/architectural damage from airblast over pressure. The limiting criteria for the control of airblast over pressure impact at residences presented in Table 6.9 are more stringent than the AS 2187.2-2006 structural damage limits. If compliance with the limiting criteria is achieved then compliance with the structural damage criteria is also achieved. Therefore the structural criteria from airblast over pressure for residences are not considered further from herein.

For assessment of structural damage due to ground vibration, AS 2187.2-2006 recommends frequency dependent criteria taken from British Standard BS 7385-2 and the United States Bureau of Mines RI 8507. In practice, the limiting criteria for the control of ground vibration impact at residences presented in Table 6.9 are more stringent than the AS 2187.2-2006 structural damage limits.

If compliance with the limiting criteria is achieved then compliance with the structural damage criteria is also achieved. Therefore, the structural criteria from ground vibration for residences are not considered further from herein.

6.3.2 Development Consent Conditions for Blasting at Limestone Quarry

Development Consent DA 374-11-00 for the Project allows for blasting activities to be undertaken at the limestone quarry. Blasting at the limestone quarry is allowed between 9:00 am and 5:00 pm Monday to Saturday, inclusive, with the blasting criteria in Table 6.10 below.

Table 6.10 – Development Consent Blasting Criteria, dB(A)

Location	Airblast overpressure (dB(lin peak))	Ground vibration (mm/s)	Allowable exceedance
Residence on privately owned land	120	10	0%
	115	5	5% of total blasts over any 12 month period

It is noted that the Development Consent blasting criteria for the limestone quarry are similar to the nominated criteria in Table 6.9 for the period 9:00 am and 3:00 pm Monday to Saturday, except it allows an extension of the hours from 3:00 pm to 5:00 pm.

6.4 Road Traffic Noise

Noise impact from the potential increase in traffic on the surrounding road network due to construction and operational activities is assessed against the RNP. The RNP sets out criteria to be applied to particular types of road and land uses. These noise criteria are to be applied when assessing noise impact and determining mitigation measures for sensitive receivers that are potentially affected by road traffic noise associated with the construction and operation of the subject site, with the aim of preserving the amenity appropriate to the land use.

Table 6.11 sets out the assessment criteria for residences, to be applied to particular types of projects, road category and land use. These criteria are for assessment against facade corrected noise levels when measured in front of a building facade. The surrounding road network potentially impacted by the Project traffic consists of roads classified as sub-arterial roads.

GTA Consultants (author of the Syerston Project Modification 4 Road Transport Assessment [2017]) has concurred with the designation of these roads (i.e. as sub-arterial roads). In Table 6.11 below and in accordance with the RNP, freeways, arterial roads and sub-arterial roads are grouped together and attract the same criteria.

Table 6.11 – Road Traffic Noise Assessment Criteria for Residential Land Uses

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

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.

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

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 traffic noise impact from the 'land use development with potential to generate additional traffic on existing road' would need to also comply with the 'Relative Increase Criteria' as discussed in Section 2.4 of the RNP. The relative increase criteria are to be applied to the external areas of existing residential and sensitive land uses impacted upon by traffic noise.

The relative increase criteria as set out in the RNP applicable to the Project are reproduced in Table 6.12 below.

Table 6.12 – Relative Increase Criteria

Type of Development	Total Traffic Noise Level Increase, dB(A)
Land use development with the potential to generate additional traffic on existing road	Existing traffic $L_{Aeq(period)}$ + 12 dB (external)

7 Construction Noise Assessment

7.1 Construction Noise Modelling Scenario

The construction noise modelling scenario is based on the initial phase commencing in Year 1 of the Project.

In accordance with Condition 1, Schedule 3 of Development Consent DA 374-11-00, surface construction activities would occur 24 hours per day, seven days per week.

7.2 Construction Noise Sources

The Sound Power Levels (SWLs) of plant likely to be used during the construction activities have been determined based on manufacturer's specifications, or other available information including Renzo Tonin & Associates' database of noise levels and previous studies.

Modifying factor adjustments, as per Section 4 of the INP, has been considered for all proposed plant and equipment. Based on Renzo Tonin & Associates' experience, noise from all proposed plant and equipment, individually and in combination were determined not to exhibit tonal, low-frequency, impulsive, and/or intermittent characteristics. Therefore, no modifying factors corrections are required.

A summary of plant and equipment included in the noise modelling for the construction scenarios, and relevant SWLs, is provided in Table 7.1.

Table 7.1 – Indicative Construction Plant and Equipment Fleet List and SWLs

Plant Item	Specification	SWLs, dB(A) re. 1pW (per Item)	Number of Items
Grader	-	114	2
Front End Loader	966	112	3
Scraper	-	111	3
Franna Crane	-	110	1
Watercart	777F WT	110	2
Dozer	D10	109	1
Roller	-	109	2
Truck	20t	109	12
Small Excavator	-	107	2
Service Truck	-	105	1
Light Vehicle	-	88	20

The total SWL for the construction plant and equipment is 125 dB(A) and is the same as the total SWL used in the EIS assessment for construction noise.

7.3 Noise Modelling Methodology

Noise emissions from the various plant and equipment listed in Table 7.1 were calculated to the nearest and potentially most affected residential receiver locations identified in Section 3. Noise emissions were determined by modelling the noise sources, receiver locations, topographical features of the intervening area and recommended noise control treatments, using the Environmental Noise Model (ENM) computer program. ENM is a noise modelling program developed by Renzo Tonin which calculates the contribution of each noise source at each specified receptor point and allows for the prediction of the total noise from a site. ENM is endorsed by the EPA and its environmental noise predictions have been verified on many past occasions using noise monitoring measurements in the field.

Noise levels were calculated at the nearest affected residential locations considering the worst case scenario of all plant operating simultaneously.

7.4 Predicted Construction Noise Levels

Table 7.2 below presents predicted construction noise levels for Year 1 at the nearest potentially affected receivers. Construction noise contours are presented in Appendix E. With regard to noise contours, the calculation involves numerical interpolation from a series of calculations to specific points within a regular spaced grid, 1.5 m above ground level. The noise contours are estimates of the predicted noise levels, and the contour values may differ slightly from equivalent calculations at individual residences.

Table 7.2 – Predicted Construction Noise Levels at Nearest Potentially Affected Receivers ($L_{Aeq(15minute)}$)

ID	Description	Construction Noise Management Level, dB(A)		Predicted Construction Noise Levels for Year 1, dB(A)	
		Standard Hours	Outside Standard Hours	Day	Evening, Night
		Privately-owned Dwellings			
M01	Longburra	40	35	<20	<20
M02	Victoria Park	40	35	<20	<20
M03	Ward 1	40	35	<20	<20
M04	Abandoned 2	40	35	23	26
M05	Berrilee	40	35	<20	<20
M06	Bon Accord	40	35	<20	<20
M07	Boxcowal	40	35	<20	<20
M08	Currajong Park 2	40	35	27	29
M09	Daisy Hill	40	35	<20	<20
M10	Glenburn	40	35	22	25
M12	Louisiana 1	40	35	<20	<20
M13	Louisiana 2	40	35	<20	<20
M14	Platina Farm	40	35	<20	<20
M16	Tarron Vale	40	35	<20	<20
M17	Jones 1	40	35	<20	<20
M18	-	40	35	<20	<20
M19	-	40	35	<20	<20
M20	-	40	35	<20	<20

ID	Description	Construction Noise Management Level, dB(A)		Predicted Construction Noise Levels for Year 1, dB(A)	
		Standard Hours	Outside Standard Hours	Day	Evening, Night
M21	Warra Wandi	40	35	<20	<20
M22	Brooklyn	40	35	20	22
M23	Currajong Park 1	40	35	26	29
M24	Flemington 1	40	35	<20	<20
M25	Flemington 2	40	35	<20	<20
M26	Kelvin Grove	40	35	<20	21
M27	Milverton	40	35	<20	<20
M28	Rosehill	40	35	20	22
M29	Slapdown	40	35	22	25
M31	Wanda Bye	40	35	27	30
M34	Fifield Hotel	40	35	<20	21
F01	Fifield residences	40	35	20	23
F02		40	35	<20	21
F03		40	35	<20	21
F04		40	35	<20	<20
F05		40	35	22	25
F06		40	35	21	24
F07		40	35	<20	21
F08		40	35	<20	<20
F09		40	35	<20	<20
F10		40	35	<20	21
F11		40	35	<20	<20
F13		40	35	<20	<20
F14		40	35	<20	<20
F15		40	35	<20	<20
F16		40	35	<20	<20
F17		40	35	<20	<20
F18		40	35	<20	<20
F19		40	35	<20	<20
Community Building					
M32	Fifield Town Hall	55[1]		<20	<20
M33	Fifield Fire Station	70[1]		<20	<20
M35	St Dympna's Catholic Church	55[1]		<20	21
Mine-owned Dwellings					
M15	Sunrise	40	35	21	23

Notes 1. When in use

From Table 7.2, it can be seen that predicted construction noise levels at all residential receivers were found to comply with the construction NMLs for all time periods. Construction noise levels at Fifield Town Hall (receiver M32), Fifield Fire Station (receiver M33) and St Dympna's Catholic Church (receiver M35) were also reviewed against the relevant ICNG NMLs. These predicted noise levels were found to comply with the ICNG NMLs.

8 Operational Noise Assessment

8.1 Operational Noise Modelling Scenarios

The Modification would consist of three distinct production phases and the scenarios selected for operational noise modelling were:

- Year 6 – the year of commencement of utilisation of maximum operational fleet.
- Year 11 – maximum operational fleet with the north-western waste emplacement at maximum height of 320 m Australian Datum Height (AHD) and the north-eastern waste emplacement at maximum height of 305 m AHD.
- Year 21 – maximum operational fleet with the north-western waste emplacement at maximum height of 330 m AHD and the north-eastern waste emplacement at maximum height of 315 m AHD.

8.2 Operational Noise Sources

The SWLs of plant likely to be used during the operation of the Project have been determined based on manufacturer's specifications, or other available information including Renzo Tonin & Associates database of noise levels and previous studies.

Modifying factor adjustments, as per Section 4 of the INP, have been considered for all proposed plant and equipment. Noise from all proposed plant and equipment, individually and in combination were determined not to exhibit tonal, low-frequency, impulsive, and/or intermittent characteristics. Therefore, no modifying factors corrections are required.

A summary of plant and equipment included in the operational noise modelling and relevant SWLs are provided in Table 8.1.

Table 8.1 – Indicative Operational Plant and Equipment List and SWLs

Plant Item	Specification	SWL dB(A) re. 1pW (per Item)	Number of Items			Period of Use
			Year 6	Year 11	Year 21	
Process Plant	-	124	1	1	1	Day, Evening, Night
Front End Loader	992K	117	1	1	1	Day, Evening, Night
Haul Truck	777D	117	7	7	7	Day, Evening, Night
Rockbreaker	CAT336DL	117	1	1	1	Day, Evening, Night
Tractor	773F	117	1	1	1	Day, Evening, Night
Excavator	EX1200	116	4	4	4	Day, Evening, Night
Drill Rig	M6290	114	2	2	2	Day, Evening, Night
Grader	16M	114	2	2	2	Day, Evening, Night
Compactor	CP64	110	1	1	1	Day, Evening, Night

Plant Item	Specification	SWL dB(A) re. 1pW (per Item)	Number of Items			Period of Use
			Year 6	Year 11	Year 21	
Franna Crane	-	110	1	1	1	Day, Evening, Night
Integrated Tool Carrier	950H	110	1	1	1	Day, Evening, Night
Integrated Tool Carrier	980H	110	1	1	1	Day, Evening, Night
Watercart	777F	110	2	2	2	Day, Evening, Night
Dozer	D10	109	4	4	4	Day, Evening, Night
Roller	825H	109	1	1	1	Day, Evening, Night
Service Truck	-	105	4	4	4	Day, Evening, Night
Forklift	MHT-X	103	1	1	1	Day, Evening, Night
Elevated Work Platform	-	98	1	1	1	Day, Evening, Night
Light Vehicle	-	88	20	20	20	Day, Evening, Night

The total SWL for the operational plant and equipment is 129 dB(A) and is 1 dB(A) lower than the total SWL used in the EIS assessment.

8.3 Noise Modelling Methodology

Noise emissions from the various plant and equipment listed in Table 8.1 were calculated to the nearest and potentially most affected residential receiver locations. Noise emissions were determined by modelling the noise sources, receiver locations, topographical features of the intervening area and recommended noise control treatments, using the ENM program.

Noise levels were calculated at the nearest affected residential locations considering the worst case scenario of all plant operating simultaneously. As a further exercise, the noise levels resulting from adverse meteorological conditions, potentially increasing noise emissions at the nearest residences, were computed using the ENM program. These occurrences are expected to be infrequent based on typical weather patterns for the study area and present extreme cases.

Where feasible and reasonable, mitigation measures have been introduced into the proposal to reduce potential noise emissions from the modified Project. The iterative steps undertaken are described below:

1. Preliminary noise modelling of scenarios representative of the maximum noise emissions from the modified Project to identify the potential for noise exceedances (Appendix F).

2. Evaluation of various combinations of noise management and mitigation measures to assess their relative effectiveness.

3. Review of the effectiveness of these measures and assessment of their feasibility by Clean TeQ.

4. Adoption of management and mitigation measures to appreciably reduce noise emissions associated with the Project.

The preliminary noise modelling indicated that in the absence of additional noise mitigation measures, intrusive noise levels at privately-owned dwellings could, with adverse meteorological conditions (i.e. Category F temperature inversion conditions at night), range up to 7 dB(A) above the PSNLs (Appendix F).

Privately-owned dwellings on four properties (M08 and M23 [Currajong Park], M22 [Brooklyn], M29 [Slapdown] and M31 [Wanda Bye]) were predicted to experience moderate or significant exceedances of the PSNLs (i.e. greater than or equal to 3 dB[A] above the PSNLs).

Potential noise management and mitigation measures that would achieve a reduction in Project noise levels under adverse meteorological conditions of up to 7 dB(A) were evaluated with respect to the feasibility of implementing the measures for the modified Project. These measures included significant operational shutdowns and attenuation of a number of major mobile equipment.

While technically feasible, measures to achieve up to a 7 dB(A) reduction at the most-affected receivers were then evaluated in light of the relative costs and benefits that would arise, including potential residential amenity benefits and corresponding capital and operating costs.

Modelling and evaluation of a range of potential noise mitigation benefits, capital and operating costs of mitigation and impacts on related modified Project metrics was undertaken. From this it was identified by Clean TeQ that an appreciable noise reduction of up to 5 dB(A) could be reasonably achieved *albeit* at significant operating cost to Clean TeQ, by modifying mining operations at night during Category F temperature inversion conditions.

To provide a noise reduction of up to 5 dB(A), significant modifications to mining operations at night during Category F temperature inversions would be required, such as ceasing overburden emplacement operations on the north-eastern waste emplacement as well as other constraints to mining operations.

The resulting achievable maximum intrusive noise levels of up to 37 dB(A) would be only marginally above the night-time PSNL of 35 dB(A), and well below the maximum consented noise limit previously approved (i.e. 40 dB[A] at night at the Currajong Park property).

Given the considerable operating costs associated with significantly modifying mining operations during adverse meteorological conditions, Clean TeQ will seek to enter into negotiated agreements with the owners of the four properties with predicted moderate and significant exceedances in accordance with the NSW Government's (2014) *Voluntary Land Acquisition and Mitigation Policy – SSD Mining*. Clean TeQ may also seek to purchase these properties.

If negotiated agreements were to be put in place with the owners of the four properties, or these properties were to become mine-owned, significant modifications to mining operations would not be considered reasonable, and modifications to mining operations would be less significant, with a noise reduction of less than 5 dB(A) (e.g. ceasing operation of a small number of noisy equipment such as drills, moving such equipment to more sheltered areas, or avoiding the use of intermittently operating auxiliary equipment).

However, if negotiated agreements (or purchase agreements) with the owners of the four properties are not achieved, or are only achieved for a subset of the four properties, Clean TeQ would significantly modify mining operations at night during Category F temperature inversions as required to reduce noise levels by up to 5 dB(A).

8.4 Predicted Operational Noise Levels

Table 8.2 below presents predicted operational noise levels for Year 6, Year 11 and Year 21, at the nearest potentially affected receivers.

The results presented in Table 8.2 assume that negotiated agreements (or purchase agreements) are not achieved with the owners of the four properties, and therefore significant modifications to mining operations are required at night during Category F temperature inversion conditions.

For the purposes of modelling, the following significant modifications to mining operations have been assumed during Category F temperature inversions conditions at night:

- Ceased overburden emplacement operations on the north-eastern waste emplacement.
- Ceased operation of a drill in the eastern pit.
- Ceased operation of an intermittently operated item of plant near the MIA (tractor).

A number of residential receivers were found to exceed the PSNL with the assumed mitigation measures in place, as shown in Table 8.2. All community/commercial receivers were found to comply with the PSNL. A summary of the properties with PSNL exceedances during the operational phase are presented in Table 8.3.

There are no privately-owned properties predicted to experience marginal, moderate or significant exceedances above the PSNL with the implementation of the assumed mitigation measures. Receivers M04 [Abandoned property], M08 and M23 [Currajong Park], M10 [Glenburn], M22 [Brooklyn], M28 [Rosehill], M29 [Slapdown] and M31 [Wanda Bye] are predicted to experience negligible exceedances above the PSNL with the assumed mitigation measures in place and are not considered further as per NSW Government (2014) policy.

Receiver M15 is a property that is owned by Clean TeQ with a moderate exceedance above the PSNL predicted in Year 21.

Mitigated operational noise contours, which incorporate the assumed mitigation measures described above, are presented in Appendix G.

With regards to noise contours, the calculation involves numerical interpolation from a series of calculations to specific points within a regular spaced grid, 1.5 m above ground level. It is noted that the noise contours are estimates of the predicted noise levels, and the contour values may differ slightly from equivalent calculations at individual residences.

Table 8.2 – Predicted Operational Noise Levels at Nearest Potentially Affected Receivers ($L_{Aeq(15minute)}$)

ID	Description	PSNL, dB(A)			Predicted Operational Noise Levels, dB(A)								
					Year 6			Year 11			Year 21		
		Day	Evening	Night	Day	Evening and Night		Day	Evening and Night		Day	Evening and Night	
					Calm	Calm	F-Class Inversion	Calm	Calm	F-Class Inversion	Calm	Calm	F-Class Inversion
Privately-owned Dwellings													
M01	Longburra	*35*	*35*	*35*	<20	<20	28	21	21	29	22	22	30
M02	Victoria Park	*35*	*35*	*35*	21	21	32	25	25	33	25	25	34
M03	Ward 1	*35*	*35*	*35*	<20	<20	27	<20	20	26	22	22	30
M04	Abandoned 2	*35*	*35*	*35*	22	23	34	24	25	**36**	24	26	**36**
M05	Berrilee	*35*	*35*	*35*	<20	<20	26	<20	<20	26	20	20	29
M06	Bon Accord	*35*	*35*	*35*	<20	<20	24	20	21	27	21	21	30
M07	Boxcowal	*35*	*35*	*35*	<20	<20	24	24	24	30	26	25	28
M08	Currajong Park 2	*35*	*35*	*35*	32	34	**37**	34	34	**37**	**37**	**37**	**37**
M09	Daisy Hill	*35*	*35*	*35*	<20	<20	24	26	26	30	27	27	29
M10	Glenburn	*35*	*35*	*35*	21	23	34	24	25	**36**	25	25	**36**
M12	Louisiana 1	*35*	*35*	*35*	22	22	32	25	25	32	25	25	31
M13	Louisiana 2	*35*	*35*	*35*	21	22	32	25	25	32	26	25	31
M14	Platina Farm	*35*	*35*	*35*	<20	<20	23	<20	<20	21	<20	<20	22
M16	Tarron Vale	*35*	*35*	*35*	20	21	28	25	26	31	26	27	32
M17	Jones 1	*35*	*35*	*35*	<20	<20	<20	<20	<20	<20	<20	<20	21
M18	-	*35*	*35*	*35*	<20	<20	<20	<20	<20	<20	21	21	23
M19	-	*35*	*35*	*35*	<20	<20	20	<20	20	23	22	21	26
M20	-	*35*	*35*	*35*	<20	<20	<20	<20	<20	<20	<20	<20	<20
M21	Warra Wandi	*35*	*35*	*35*	<20	<20	24	26	26	29	27	26	28
M22	Brooklyn	*35*	*35*	*35*	27	28	34	35	35	34	**36**	35	33
M23	Currajong Park 1	*35*	*35*	*35*	32	33	**36**	34	34	**37**	**37**	**37**	**37**
M24	Flemington 1	*35*	*35*	*35*	20	20	28	23	25	31	25	25	32
M25	Flemington 2	*35*	*35*	*35*	<20	<20	28	23	24	30	24	24	32
M26	Kelvin Grove	*35*	*35*	*35*	23	25	29	29	29	33	29	29	31
M27	Milverton	*35*	*35*	*35*	23	25	29	30	29	34	32	31	32
M28	Rosehill	*35*	*35*	*35*	23	24	34	26	27	**36**	27	27	34
M29	Slapdown	*35*	*35*	*35*	25	27	33	32	33	**36**	32	33	**36**

ID	Description	PSNL, dB(A)			Predicted Operational Noise Levels, dB(A)								
					Year 6			Year 11			Year 21		
		Day	Evening	Night	Day	Evening and Night		Day	Evening and Night		Day	Evening and Night	
					Calm	Calm	F-Class Inversion	Calm	Calm	F-Class Inversion	Calm	Calm	F-Class Inversion
M31	Wanda Bye	*35*	*35*	*35*	24	26	**36**	26	28	**37**	27	28	**36**
M34	Fifield Hotel	*35*	*35*	*35*	20	22	27	22	24	28	24	25	26
F01	Fifield Residences	*35*	*35*	*35*	22	24	32	25	26	33	27	27	34
F02		*35*	*35*	*35*	22	24	31	24	25	30	26	27	33
F03		*35*	*35*	*35*	20	22	30	23	25	29	25	26	31
F04		*35*	*35*	*35*	<20	21	28	23	24	30	25	25	31
F05		*35*	*35*	*35*	22	25	33	26	27	34	26	27	33
F06		*35*	*35*	*35*	22	24	33	25	26	33	26	27	33
F07		*35*	*35*	*35*	20	22	27	23	24	28	24	25	26
F08		*35*	*35*	*35*	<20	21	27	22	24	28	25	25	29
F09		*35*	*35*	*35*	20	22	28	23	24	29	25	25	30
F10		*35*	*35*	*35*	20	22	27	23	24	29	25	25	29
F11		*35*	*35*	*35*	20	22	27	23	24	29	24	25	28
F13		*35*	*35*	*35*	20	22	27	22	23	27	24	24	27
F14		*35*	*35*	*35*	<20	21	26	22	23	27	23	24	26
F15		*35*	*35*	*35*	<20	20	25	21	22	26	23	23	24
F16		*35*	*35*	*35*	<20	20	26	22	22	25	23	24	28
F17		*35*	*35*	*35*	<20	21	28	22	23	26	23	23	27
F18		*35*	*35*	*35*	20	22	29	24	25	29	25	26	31
F19		*35*	*35*	*35*	20	21	27	23	23	27	24	24	27
	Community Building												
M32	Fifield Town Hall	*50 when in use*			20	22	27	22	24	29	24	24	27
M33	Fifield Fire Station	*65 when in use*			20	22	27	23	24	28	24	25	28
M35	St Dympna's Catholic Church	*50 when in use*			20	22	27	23	24	28	24	25	28
	Mine-owned Dwellings												
M15	Sunrise	*35*	*35*	*35*	28	30	**37**	29	31	**37**	30	31	**38**

Notes:
1. Green denotes a **negligible** exceedance of 0-2 dB(A) above the PSNL.
2. Orange denotes a **marginal** exceedance of 3-5 dB(A) above the PSNL.
3. Red denotes a **significant** exceedance of >5 dB(A) above the PSNL.

Table 8.3 – Summary of Privately-owned Dwellings with PSNL Exceedances

Zone	Exceedance Level	Maximum Predicted Noise Level		
		Year 6	Year 11	Year 21
Noise Management Zone	Negligible 0-2 dB(A) above PSNL	M08, M23, M31	M04, M08, M10, M23, M28, M29, M31	M04, M08, M10, M22 M23, M29, M31
	Moderate 3-5 dB(A) above PSNL	-	-	-
Noise Affectation Zone	Significant >5 dB(A) above PSNL	-	-	-

From review of the operational noise contours in Appendix G, it can be seen that no property experiences exceedance of the recommended maximum noise levels in Table 2.1 of the INP (Night - 45 dB[A]) on more than 25% of the property (i.e. any land where there is an existing dwelling or where a dwelling could be built under existing planning controls).

It should be noted that this assessment is conservative because the contours in Appendix G are $L_{Aeq(15minute)}$ noise levels, while the recommended maximum mine levels in the INP are averaged over the whole period.

8.5 Amenity Noise Levels

The following receivers were identified that require assessment against the INP Amenity criteria:

- Receiver M32 – Fifield Town Hall.
- Receiver M33 – Fifield Fire Station.
- Receiver M35 – St Dympna's Catholic Church.

Whilst the predicted operational noise levels presented in Section 8.4 for these receivers are $L_{Aeq(15\ minute)}$ noise levels as required by the intrusiveness criterion, rather than $L_{Aeq(period)}$ noise levels as required by the amenity criteria (Section 6.2.2), it is noted that an assessment against the intrusiveness criteria is more conservative than an assessment against the amenity criteria. Therefore, from a review of the predicted operational noise levels for the above receivers, it is evident that the relevant criteria in Section 6.2.2 would be met at these receiver locations.

8.6 Sleep Disturbance

The potential for sleep disturbance from the Project's night-time operations has been based on the noise modelling methodology described in Section 8.3. The proposed operational plant and equipment and their corresponding typical L_{Amax} SWLs used for the prediction of sleep disturbance are presented in Table 8.4.

Table 8.4 – Sleep Disturbance Sound Power Levels (L_{Amax})

Plant Item	Quantity	L_{Amax} SWL, dB(A)
Process Plant	1	124
Front End Loader	1	120
Haul Truck	7	120
Rockbreaker	1	125
Tractor	1	120
Excavator	4	119
Drill Rig	2	117
Grader	2	119
Compactor	1	116
Franna Crane	1	116
Integrated Tool Carrier	1	116
Integrated Tool Carrier	1	116
Watercart	2	116
Dozer	4	116
Roller	1	110
Service Truck	4	116

Based on the SWLs presented above, Table 8.5 presents the predicted night time L_{Amax} noise levels at the nearest affected residential receivers. The maximum noise level predictions take into account the meteorological assessment conditions nominated in Section 5.3 for the night-time period and presented values are the highest L_{Amax} noise levels predicted over all meteorological conditions.

Table 8.5 – Predicted Sleep Disturbance Noise Levels at Nearest Affected Residential Receivers (L_{Amax})

ID	Description	Sleep disturbance criteria (10:00 pm - 7:00 am)		Predicted Sleep Disturbance Level L_{Amax}		
		$L_{A90(15min)}$ + 15	Upper limit	Year 6	Year 11	Year 21
Privately-owned Dwellings						
M01	Longburra	*45*	*65*	32	33	34
M02	Victoria Park	*45*	*65*	35	37	38
M03	Ward 1	*45*	*65*	31	30	34
M04	Abandoned 2	*45*	*65*	36	38	38
M05	Berrilee	*45*	*65*	29	29	33
M06	Bon Accord	*45*	*65*	27	31	34
M07	Boxcowal	*45*	*65*	28	33	32
M08	Currajong Park 2	*45*	*65*	41	41	42
M09	Daisy Hill	*45*	*65*	27	33	32
M10	Glenburn	*45*	*65*	36	38	38
M12	Louisiana 1	*45*	*65*	36	36	35
M13	Louisiana 2	*45*	*65*	35	35	34
M14	Platina Farm	*45*	*65*	25	24	25

ID	Description	Sleep disturbance criteria (10:00 pm - 7:00 am)		Predicted Sleep Disturbance Level L_{Amax}		
		$L_{A90(15min)}$ + 15	Upper limit	Year 6	Year 11	Year 21
M16	Tarron Vale	*45*	*65*	31	34	35
M17	Jones 1	*45*	*65*	20	22	25
M18	-	*45*	*65*	22	23	26
M19	-	*45*	*65*	23	27	29
M20	-	*45*	*65*	21	20	23
M21	Warra Wandi	*45*	*65*	28	32	32
M22	Brooklyn	*45*	*65*	37	38	39
M23	Currajong Park 1	*45*	*65*	39	41	41
M24	Flemington 1	*45*	*65*	31	35	35
M25	Flemington 2	*45*	*65*	31	34	35
M26	Kelvin Grove	*45*	*65*	32	37	36
M27	Milverton	*45*	*65*	33	37	36
M28	Rosehill	*45*	*65*	38	39	38
M29	Slapdown	*45*	*65*	37	39	39
M31	Wanda Bye	*45*	*65*	38	40	39
M34	Fifield Hotel	*45*	*65*	30	30	30
F01	Fifield Residences	*45*	*65*	35	36	37
F02		*45*	*65*	33	34	36
F03		*45*	*65*	32	32	34
F04		*45*	*65*	32	34	34
F05		*45*	*65*	35	37	37
F06		*45*	*65*	35	37	37
F07		*45*	*65*	30	31	29
F08		*45*	*65*	29	31	32
F09		*45*	*65*	30	32	33
F10		*45*	*65*	30	32	32
F11		*45*	*65*	29	32	31
F13		*45*	*65*	29	29	30
F14		*45*	*65*	29	29	29
F15		*45*	*65*	28	28	28
F16		*45*	*65*	29	29	31
F17		*45*	*65*	30	29	30
F18		*45*	*65*	31	32	34
F19		*45*	*65*	30	30	30
Mine-owned Dwellings						
M15	Sunrise	*45*	*65*	39	40	41

From Table 8.5, predicted noise levels for all receivers were found to comply with the nominated criteria for all operational years.

9 Blasting

9.1 Proposed Blasting Activities

During operations, small blasts would be required to fracture the harder overburden material (i.e. typically at depths greater than 25 m) prior to its excavation and removal. Blast sizes with a maximum instantaneous charge (MIC) of approximately 380 kg Ammonium Nitrate Fuel Oil (ANFO) equivalent would be used as required.

9.2 Blasting Assessment Methodology

9.2.1 Air Blast Over Pressure

The distance limits relating to air blast over pressure have been determined using the following formula derived from blasting measurements undertaken by Renzo Tonin & Associates from previous projects in the Hunter Valley region.

$$P = 167 + 6.5\log_{10} Q - 23\log_{10} R$$

where

P = pressure, in kilopascals

Q = effective charge mass per delay or MIC in kilograms

R = distance between charge and point of measurement in metres

9.2.2 Ground Vibration

The distance limits relating to ground vibration have been determined using the formula in Australian Standard AS 2187.2-1993 *Explosives – Storage, Transport and Use – Part 2 Use of Explosive*. It is noted that although AS 2187.2-1993 has been superseded by AS 2187.2-2006, AS 2187.2-1993 presents information for estimating free face blasting in hard or highly structured rock in additional to the estimation method for free face blasting in 'average field conditions'. Therefore estimation of ground vibration is based upon AS 2187.2-1993, which states:

$$V = K\left(\frac{R}{Q^{1/2}}\right)^{-1.6}$$

where

V = ground vibration as peak particle velocity in mm/sec.

K = constant related to site and rock properties for estimation purposes. K = 500 for free face blasting in hard or highly structured rock and K = 1140 for free face blasting in 'average field conditions'.

R = distance between charge and point of measurement in metres.

Q = effective charge mass per delay or MIC in kilograms.

9.3 Blasting Impact Assessment

Based on the blasting assessment methodology in Section 9.2, the impacts from blasting activities to the nearest receivers are present in Table 9.1 below

Table 9.1 – Blasting Impact Assessment

ID	Description	Distance from Blasting Activity (m)	Blast Over Pressure Level, L_{peak} (dB(lin))	Ground Vibration, PPV (mm/sec)	
				Hard Rock	Average Rock
	Privately-owned Dwellings				
M01	Longburra	7,186	95	0.04	0.09
M02	Victoria Park	5,424	98	0.06	0.14
M03	Ward 1	7,036	95	0.04	0.09
M04	Abandoned 2	5,747	97	0.06	0.13
M05	Berrilee	7,730	94	0.03	0.08
M06	Bon Accord	6,856	96	0.04	0.10
M07	Boxcowal	6,669	96	0.04	0.10
M08	Currajong Park 2	2,969	104	0.16	0.37
M09	Daisy Hill	6,353	96	0.05	0.11
M10	Glenburn	5,621	98	0.06	0.13
M12	Louisiana 1	5,845	97	0.05	0.12
M13	Louisiana 2	6,025	97	0.05	0.12
M14	Platina Farm	8,019	94	0.03	0.07
M16	Tarron Vale	5,735	97	0.06	0.13
M17	Jones 1	10,418	91	0.02	0.05
M18	-	7,321	95	0.04	0.09
M19	-	7,323	95	0.04	0.09
M20	-	9,371	92	0.03	0.06
M21	Warra Wandi	6,540	96	0.05	0.10
M22	Brooklyn	3,834	101	0.11	0.24
M23	Currajong Park 1	3,023	104	0.16	0.36
M24	Flemington 1	5,354	98	0.06	0.14
M25	Flemington 2	5,547	98	0.06	0.13
M26	Kelvin Grove	5,108	98	0.07	0.15

ID	Description	Distance from Blasting Activity (m)	Blast Over Pressure Level, L_{peak} (dB(lin))	Ground Vibration, PPV (mm/sec)	
				Hard Rock	Average Rock
M27	Milverton	5,127	98	0.07	0.15
M28	Rosehill	4,292	100	0.09	0.20
M29	Slapdown	3,828	101	0.11	0.24
M31	Wanda Bye	4,972	99	0.07	0.16
F01	Fifield Residences	5,252	98	0.06	0.15
F02		5,312	98	0.06	0.14
F03		5,676	97	0.06	0.13
F04		5,875	97	0.05	0.12
F05		5,388	98	0.06	0.14
F06		5,171	98	0.07	0.15
F07		5,583	98	0.06	0.13
F08		5,670	97	0.06	0.13
F09		5,650	97	0.06	0.13
F10		5,681	97	0.06	0.13
F11		5,696	97	0.06	0.13
F13		5,696	97	0.06	0.13
F14		5,800	97	0.06	0.13
F15		5,819	97	0.05	0.13
F16		5,894	97	0.05	0.12
F17		5,985	97	0.05	0.12
F18		6,033	97	0.05	0.12
F19		5,570	98	0.06	0.13
	Community Building				
M34	Fifield Hotel	5,661	97	0.06	0.13
	Mine-owned Dwellings				
M15	Sunrise	4,639	99	0.08	0.18

From Table 9.1, the ground vibration impacts from blasting activities for all receivers will be within the nominated criteria for all time periods. The blast over pressure impacts from blasting activities for all receivers will be within the nominated criteria during the period from Monday to Saturday, between 6:00am and 8:00pm. Therefore, blasting activities should be limited to within these times.

9.4 Blasting Minimum Distance Limits

Based on the blasting assessment methodology in Section 9.2 the minimum distance limits, from blasting activities to the nearest receivers, to comply with blasting criteria for ground vibration are presented in Table 9.2 The minimum distance limits have been determined for both air blast over pressure and ground vibration (free face blasting in 'hard or highly structured rock' and free face blasting in 'average field conditions').

Table 9.2 - Minimum Distance Limits to Comply with Blasting Air Blast Over-Pressure and Ground Vibration Limits

Day	Time of Blasting	Minimum Distance Limits, m		
		MIC = 380 kg		
		Air Blast Over Pressure	Ground Vibration - Hard Rock	Ground Vibration - Average Conditions
Monday to Saturday	9:00 am – 3:00 pm	977	347	580
Monday to Saturday	6:00 am – 9:00 am, 3:00 pm – 8:00 pm	2,659	615	1,029
Sunday, Public Holiday	6:00 am – 8:00 pm	7,236	948	1,586
Any day	8:00 pm – 6:00 am	7,236	948	1,586

10 Road Traffic Noise Assessment

A Road Transport Assessment for the Modification was prepared by GTA Consultants (2017). The modified Project operational traffic would be consistent through the life of the modified Project and the year 2027 was selected as a future assessment scenario by GTA Consultants (2017).

The Road Transport Assessment (GTA Consultants, 2017) identified six road locations for forecasting future traffic volumes to determine the impact on the traffic volumes carried by the surrounding road network for the year 2027. Table 10.1 presents the future day (7:00 am to 10:00 pm) and night (10:00 pm to 7:00 am) total traffic for the Modification, the approved Initial Production Phase and the approved Full Production Phase on the six surrounding road locations, including a breakdown of light and heavy vehicles.

Table 10.1 – Traffic Volumes

Road	Total Traffic (vehicles per day)					
	Day (7:00 am – 10:00 pm)			Night (10:00 pm - 7:00 am)		
	Light	Heavy	Total	Light	Heavy	Total
Year 2027 Modification						
1. The Bogan Way north of Trundle	473	135	608	138	40	178
2. Fifield Road north of Platina Road	409	208	617	207	88	295
3. Fifield-Trundle Road west of The Bogan Way	207	108	316	126	52	178
4. Platina Road east of Fifield Road	207	145	353	126	71	197
5. Wilmatha Road west of Slee Street	236	139	375	207	77	284
6. Slee Street in Fifield	406	207	613	206	85	291
Year 2027 Approved Initial Production Phase						
1. The Bogan Way north of Trundle	393	105	498	33	15	48
2. Fifield Road north of Platina Road	269	100	370	50	24	73
3. Fifield-Trundle Road west of The Bogan Way	116	16	133	32	0	32
4. Platina Road east of Fifield Road	116	39	157	32	12	43
5. Wilmatha Road west of Slee Street	71	26	97	51	14	65
6. Slee Street in Fifield	266	100	366	49	20	69
Year 2027 Approved Full Production Phase						
1. The Bogan Way north of Trundle	420	92	512	123	27	150
2. Fifield Road north of Platina Road	315	207	522	159	88	247
3. Fifield-Trundle Road west of The Bogan Way	165	57	222	100	28	128
4. Platina Road east of Fifield Road	165	117	282	100	58	158
5. Wilmatha Road west of Slee Street	150	136	286	132	75	207
6. Slee Street in Fifield	312	206	518	158	85	243

Based on the traffic volumes in Table 10.1, and the nearest distance from each of the six road locations to residential receivers, the predicted traffic noise levels at the worst affected receiver locations are predicted for the year 2027 and compared against the approved Full Production Phase traffic in Table 10.2. If the predicted traffic noise levels at the closest residential receiver meets the proposed criteria then the criteria would be met at all other residential receivers along the same road.

Table 10.2 – Predicted Day $L_{Aeq, 15hour}$ and Night $L_{Aeq, 9hour}$ Traffic Noise Levels

Road	Distance to Nearest Receiver, m	Day $L_{Aeq, 15hour}$ (dB[A]) (7:00 am – 10:00 pm)			Night $L_{Aeq, 9hour}$ (dB[A]) (10:00 pm - 7:00 am)		
		Total Traffic	Approved Traffic[1]	Differ -ence	Total Traffic	Approved Traffic[1]	Differ -ence
1. The Bogan Way north of Trundle	22	56	54	1.2	53	51	1.2
2. Fifield Road north of Platina Road	35	54	54	0.3	53	53	0.3
3. Fifield-Trundle Road west of The Bogan Way	200	41	39	2.3	41	39	2.1
4. Platina Road east of Fifield Road	52	52	51	0.9	51	50	0.9
5. Wilmatha Road west of Slee Street	16	53	53	0.3	53	53	0.4
6. Slee Street in Fifield	11	57	57	0.2	55	55	0.2

Notes: 1. Full Production Phase traffic. A comparison against the approved Initial Production Phase traffic is provided in Appendix H.

From Table 10.2, the daytime $L_{Aeq\ 15hour}$ traffic noise levels predicted for receivers along all six road locations are within the RNP $L_{Aeq\ 15hour}$ noise criterion of 60 dB(A) for year 2027. The 2 dB(A) relative increase criteria is exceeded for receivers along road location '3. Fifield-Trundle Road west of The Bogan Way', however predicted $L_{Aeq\ 15hour}$ traffic noise levels for the Modification are 19 dB(A) below the RNP noise criterion of 60 dB(A).

From Table 10.2, the night time $L_{Aeq\ 9hour}$ traffic noise levels for receivers along all six road locations are within the RNP $L_{Aeq\ 9hour}$ noise criterion of 55 dB(A) for year 2027. The 2 dB(A) relative increase criteria is exceeded for receivers along road location '3. Fifield-Trundle Road west of The Bogan Way', however predicted $L_{Aeq\ 9hour}$ traffic noise levels for the Modification are 14 dB(A) below the RNP noise criterion of 55 dB(A).

From Table 10.2, the noise level change between the approved Project and the Modification scenarios are small at all receiver locations, well below 12 dB. There are no locations where the Modification would cause an increase of more than 12 dB over the approved scenario noise levels. The Modification therefore complies with the relative increase criteria.

11 Conclusion

11.1 General

- The Project includes an Initial Production Phase focussed on scandium oxide production prior to shifting to the Full Production Phase for scandium oxide and nickel and cobalt precipitate production. Clean TeQ has undertaken a Project Optimisation Study to identify opportunities to improve the overall efficiency of the Full Production Phase of the Project and the Modification involves the implementation of these opportunities.
- A background noise survey for the Project has been conducted and the RBLs, determined in accordance INP methodology, were found to be consistent with what is expected of a rural region. For day, evening and night periods the minimum RBL of 30 dB(A) as nominated in the INP has been adopted to allow for a conservative assessment.
- An analysis of noise enhancement from adverse meteorological conditions has been conducted in accordance with the INP based upon meteorological data collected at the nearby Condobolin meteorological station. Wind enhancement was not found to be a feature of the area but temperature inversions were included in the operational noise modelling. Noise modelling for the operational phase was undertaken under a varied set of adverse meteorological conditions.

11.2 Project Construction Noise

- Project construction activities at the surface would occur 24 hours per day, seven days per week.
- The construction scenario was assessed for Year 1 coinciding with the initial construction of the Project.
- All surrounding receivers were found to comply with the ICNG criteria.

11.3 Project Operational Noise

- Operational scenarios were considered for Year 6, Year 11 and Year 21 coinciding with the commencement of utilisation of maximum operational fleet and subsequent significant stages of development of the north-eastern and north-western emplacements.
- Following the implementation of feasible and reasonable mitigation measures, eight (8) privately owned receivers are predicted to experience negligible (i.e. 1 to 2 dB[A]) exceedances of the PSNL.
- In accordance with the NSW Government's *Voluntary Land Acquisition and Mitigation Policy – SSD Mining* (NSW Government, 2014), such exceedances would not be discernible by the average listener and would not warrant receiver based treatments or controls.

- All receivers are predicted to experience night-time L_{Amax} noise below the sleep disturbance screening criteria.

11.4 Project Blasting Activities

- Blasting activities are proposed for the operational phase of the Project. Blasting impacts from both blast over pressure and ground vibration have been assessed.
- Predicted ground vibration levels at all receivers are within the criteria for all time periods.
- Predicted blast over pressure levels at all receivers are within the criteria for the period from Monday to Saturday, between 6:00am and 8:00pm.
- Blasting activities should be limited to Monday to Saturday, between 6:00am and 8:00pm.

11.5 Project Road Traffic Noise

- Road traffic noise was assessed for the year 2027 and six major road locations of the surrounding road network, as determined by the Road Transport Assessment for the modified Project (GTA Consultants, 2017).
- Predicted road traffic noise at all locations for all periods were found to comply with the RNP criteria.

References

1. Australian and New Zealand Environment Conservation Council (1990) *Technical Basis for Guidelines to Minimise Annoyance Due to Blasting Overpressure and Ground Vibration*.
2. Australian Standard 2187.2-1993 (1993) *Explosives – Storage, Transport and Use – Part 2 Use of Explosives*.
3. Australian Standard 2187.2-2006 (2006) *Explosives – Storage, Transport and Use – Part 2 Use of Explosives*.
4. Department of Environment, Climate Change and Water (2011) *NSW Road Noise Policy*.
5. Department of Environment and Climate Change (2009) *NSW Interim Construction Noise Guideline*.
6. Environment Protection Authority (1994) *NSW Environmental Noise Control Manual*.
7. Environment Protection Authority (1999) *NSW Environmental Criteria for Road Traffic Noise*.
8. Environment Protection Authority (2000) *NSW Industrial Noise Policy*.
9. Environment Protection Authority (2013a) *NSW Rail Infrastructure Noise Guideline*.
10. Environment Protection Authority (2013b) *Application Notes – NSW Industrial Noise Policy*. Available at http://www.epa.nsw.gov.au/noise/applicnotesindustnoise.htm
11. Griefahn (1992) *Acoustics Australia vol 20 No 2 August 1992* pp 43-47.
12. GTA Consultants (2017) *Syerston Project Modification 4 Road Transport Assessment*.
13. New South Wales Government (2014) *Voluntary Land Acquisition and Mitigation Policy – SSD Mining*.

APPENDIX A Glossary of Terminology

The following is a brief description of the technical terms used to describe noise to assist in understanding the technical issues presented.

Adverse weather	Weather effects that enhance noise (that is, wind and temperature inversions) that occur at a site for a significant period of time (that is, wind occurring more than 30% of the time in any assessment period in any season and/or temperature inversions occurring more than 30% of the nights in winter).
Ambient noise	The all-encompassing noise associated within a given environment at a given time, usually composed of sound from all sources near and far.
Assessment period	The period in a day over which assessments are made.
Assessment point	A point at which noise measurements are taken or estimated. A point at which noise measurements are taken or estimated.
Background noise	Background noise is the term used to describe the underlying level of noise present in the ambient noise, measured in the absence of the noise under investigation, when extraneous noise is removed. It is described as the average of the minimum noise levels measured on a sound level meter and is measured statistically as the A-weighted noise level exceeded for ninety percent of a sample period. This is represented as the L_{90} noise level (see below).
Decibel [dB]	The units that sound is measured in. The following are examples of the decibel readings of every day sounds: 0 dB The faintest sound we can hear 30 dB A quiet library or in a quiet location in the country 45 dB Typical office space. Ambience in the city at night 60 dB CBD mall at lunch time 70 dB The sound of a car passing on the street 80 dB Loud music played at home 90 dB The sound of a truck passing on the street 100 dB The sound of a rock band 115 dB Limit of sound permitted in industry 120 dB Deafening
dB(A)	A-weighted decibels. The A-weighting noise filter simulates the response of the human ear at relatively low levels, where the ear is not as effective in hearing low frequency sounds as it is in hearing high frequency sounds. That is, low frequency sounds of the same dB level are not heard as loud as high frequency sounds. The sound level meter replicates the human response of the ear by using an electronic filter which is called the "A" filter. A sound level measured with this filter switched on is denoted as dB(A). Practically all noise is measured using the A filter.
Frequency	Frequency is synonymous to pitch. Sounds have a pitch which is peculiar to the nature of the sound generator. For example, the sound of a tiny bell has a high pitch and the sound of a bass drum has a low pitch. Frequency or pitch can be measured on a scale in units of Hertz or Hz.
Impulsive noise	Having a high peak of short duration or a sequence of such peaks. A sequence of impulses in rapid succession is termed repetitive impulsive noise.
Intermittent noise	The level suddenly drops to that of the background noise several times during the period of observation. The time during which the noise remains at levels different from that of the ambient is one second or more.
L_{Max}	The maximum sound pressure level measured over a given period.
L_{Min}	The minimum sound pressure level measured over a given period.
L_1	The sound pressure level that is exceeded for 1% of the time for which the given sound is measured.
L_{10}	The sound pressure level that is exceeded for 10% of the time for which the given sound is measured.

L_{90}	The level of noise exceeded for 90% of the time. The bottom 10% of the sample is the L90 noise level expressed in units of dB(A).
L_{eq}	The "equivalent noise level" is the summation of noise events and integrated over a selected period of time.
Reflection	Sound wave changed in direction of propagation due to a solid object obscuring its path.
Sound	A fluctuation of air pressure which is propagated as a wave through air.
Sound absorption	The ability of a material to absorb sound energy through its conversion into thermal energy.
Sound level meter	An instrument consisting of a microphone, amplifier and indicating device, having a declared performance and designed to measure sound pressure levels.
Sound pressure level	The level of noise, usually expressed in decibels, as measured by a standard sound level meter with a microphone.
Sound power level	Ten times the logarithm to the base 10 of the ratio of the sound power of the source to the reference sound power.
Tonal noise	Containing a prominent frequency and characterised by a definite pitch.

APPENDIX B Long-term Noise Monitoring Methodology

B.1 Noise Monitoring Equipment

A long-term unattended noise monitor consists of a sound level meter housed inside a weather resistant enclosure. Noise levels are monitored continuously with statistical data stored in memory for every 15-minute period.

Long term noise monitoring was conducted using the instrumentation listed in Table B.1.

Table B.1 – Long Term Noise Monitoring Instrumentation

Description	Type	Octave band Data	Logger Location(s)
RTA05 (NTi Audio XL2)	Type 1	1/1 & 1/3	L1, L2, L3
RTA07 (NTi Audio XL2, with low noise microphone)	Type 1	1/1 & 1/3	L4, L5, L6, L7

Notes: All meters comply with AS IEC 61672.1 2004 "Electroacoustics - Sound Level Meters" and designated either Type 1 or Type 2 as per table, and are suitable for field use.

The equipment was calibrated prior and subsequent to the measurement period using a Brüel & Kjaer Type 4231 calibrator. No significant drift in calibration was observed.

B.2 Meteorology During Monitoring

Measurements affected by extraneous noise, wind (greater than 5 metres per second) or rain were excluded from the recorded data in accordance with the New South Wales Industrial Noise Policy. Determination of extraneous meteorological conditions was based on data from the Condobolin Airport Automatic Weather Station over the monitoring period.

B.3 Noise vs Time Graphs

Noise almost always varies with time. Noise environments can be described using various descriptors to show how a noise ranges about a level. In this report, noise values measured or referred to include the L_{10}, L_{90}, and L_{eq} levels. The statistical descriptors L_{10} and L_{90} measure the noise level exceeded for 10% and 90% of the sample measurement time. The L_{eq} level is the equivalent continuous noise level or the level averaged on an equal energy basis. Measurement sample periods are usually ten to fifteen minutes. The Noise -vs- Time graphs representing measured noise levels, as presented in this report, illustrate these concepts for the broadband dB(A) results.

APPENDIX C Long-term Noise Monitoring Results

APPENDIX D Short-term Noise Monitoring Results

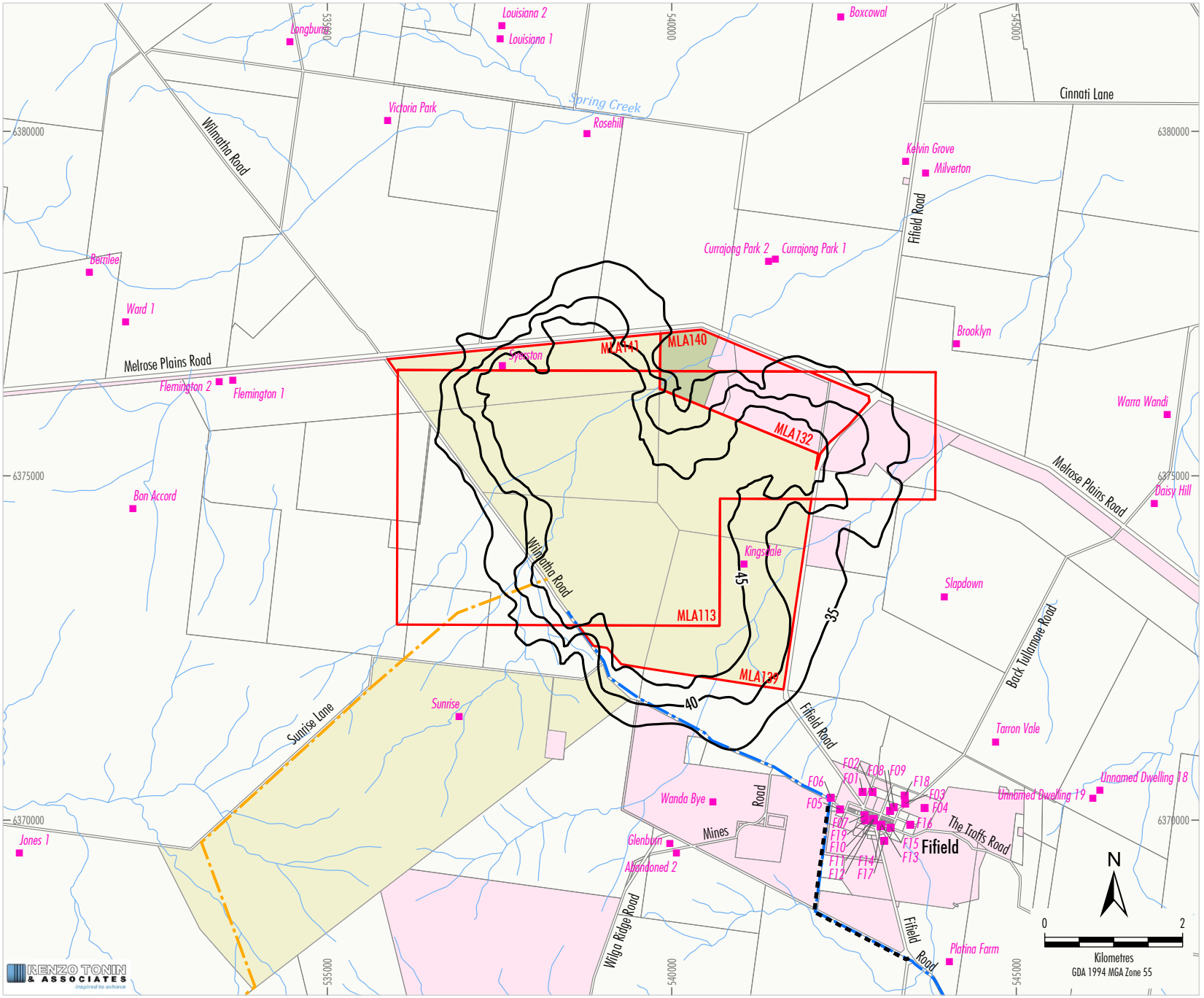
Table D.1 – Short-Term Noise Monitoring Results, dB(A)

Location	Period /Time	Measured noise level, dB(A)		Comments on measured noise levels
		L_{Aeq}	L_{A90}	
L1 – 9 Wilmatha Fifield Road	Day 14/12/2016 5:30 pm – 5:45 pm 5:45 pm – 6:00 pm	 39 39	 46 49	Background noise dominated by traffic on Wilmatha Fifield Road and environmental noise within the Township. Light rain during evening measurement period.
	Evening 14/12/2016 6:00 pm – 6:15 pm 6:15 pm – 6:30 pm	 34 35	 46 43	
	Night 15/12/2016 1:00 am – 1:15 am	 24	 42	
L2 – Slapdown	Day1 15/12/2016 11:00 am – 11:15 am 11:15 am – 11:30 am	 29 27	 37 39	Background noise dominated by environmental noise, distant harvesting activities and distant traffic.
	Evening 14/12/2016 9:45 pm – 10:00 pm	 34	 35	
	Night 14/12/2016 10:00 pm – 10:15 pm	 34	 35	
L3 – Wanda Bye	Day1 15/12/2016 11:00 am – 11:15 am 11:15 am – 11:30 am	 37 38	 42 42	Background noise dominated by environmental noise and distant traffic. On site sheep farming activities occur during the day time. Light rain during evening measurement period.
	Evening 14/12/2016 6:45 pm – 7:00 pm 7:15 pm – 7:30 pm	 32 32	 42 45	
	Night 15/12/2016 12:30 am – 12:45 am	 29	 34	
L4 – Warra Wandi	Day1 15/12/2016 11:00 am – 11:15 am 11:15 am – 11:30 am	 26 29	 43 46	Background noise dominated by environmental noise and traffic on Fifield Kadungle Road. Light rain during evening measurement period.
	Evening 14/12/2016 9:15 pm – 9:30 pm	 42	 44	
	Night 1/152/2016 10:30 pm – 10:45 pm	 43	 49	
L5 – Currajong Park	Day1 15/12/2016 11:00 am – 11:15 am 11:15 am – 11:30 am	 29 29	 38 38	Background noise dominated by environmental noise and distant traffic. On site sheep farming activities occur during the day time. Light rain during evening measurement period.

Location	Period /Time	Measured noise level, dB(A)		Comments on measured noise levels
		L_{Aeq}	L_{A90}	
	Evening 14/12/2016 8:45 pm – 9:00 pm	24	59	
	Night 14/12/2016 11:00 pm – 11:15 pm	22	45	
L6 - Sunrise	Day1 15/12/2016 11:00 am – 11:15 am 11:15 am – 11:30 am	28 34	44 51	Background noise dominated by environmental noise and distant traffic. Light rain during evening measurement period.
	Evening 14/12/2016 7:30 pm – 7:45 pm 7:45 pm – 8:00 pm	36 33	46 39	
	Night 15/12/2016 12:00 am – 12:15 am	35	37	
L7 - Flemington	Day1 15/12/2016 11:00 am – 11:15 am 11:15 am – 11:30 am	40 40	42 42	Background noise dominated by environmental noise and traffic on Melrose Gillenbine Road. Presence of insect noise throughout measurement periods. Light rain during evening measurement period.
	Evening 14/12/2016 8:15 pm – 8:30 pm	37	42	
	Night 14/12/2016 11:30 pm – 11:45 pm	40	44	

Notes: Due to inclement weather conditions, attended measurements could ne be conducted during the site visit. Presented results are based on the audio recording from the long term noise monitor for a period of clear weather.

APPENDIX E Construction Noise Contours


LEGEND
Mining Lease Application Boundary
Approved Fifield Bypass
Approved Gas Pipeline
Approved Water Pipeline
Clean TeQ Owned Land
Crown Land
Fifield State Forest
Private Landholder
Dwelling
Noise Contour, $L_{Aeq(15\ minute)}$, dB(A)
Source: Black Range Minerals (2000); NSW Department of Industry (2017); NSW Land & Property Information (2017)
MLA141
MLA140
MLA132
MLA113
MLA139
45
40
35
Melrose Plains Road
Wilmatha Road
Fifield Road
Cinnati Lane
Spring Creek
Sunrise Lane
Back Tullamore Road
The Troffs Road
Wilga Ridge Road
Mines Road
Fifield
Longburn
Louisiana 2
Louisiana 1
Boxcowal
Victoria Park
Rosehill
Kelvin Grove
Milverton
Currajong Park 2
Currajong Park 1
Brooklyn
Berrilee
Ward 1
Syerston
Flemington 2
Flemington 1
Warra Wandi
Daisy Hill
Bon Accord
Kingsdale
Slapdown
Sunrise
Tarron Vale
Unnamed Dwelling 18
Unnamed Dwelling 19
Wanda Bye
Glenburn
Abandoned 2
Jones 1
Platina Farm
F01
F02
F03
F04
F05
F06
F07
F08
F09
F10
F11
F12
F13
F14
F15
F16
F17
F18
F19
535000
540000
545000
6380000
6375000
6370000
N
0
2
Kilometres
GDA 1994 MGA Zone 55
RENZO TONIN & ASSOCIATES
CLEAN TEQ
Powering innovation
SYERSTON PROJECT MODIFICATION 4
Night Construction
Noise Contours, $L_{Aeq(15\ minute)}$, dB(A)
Year 1
Figure E.1
CTL-16-02 Mod4_Noise_208C

APPENDIX F Predicted Unmitigated Operational Noise Levels

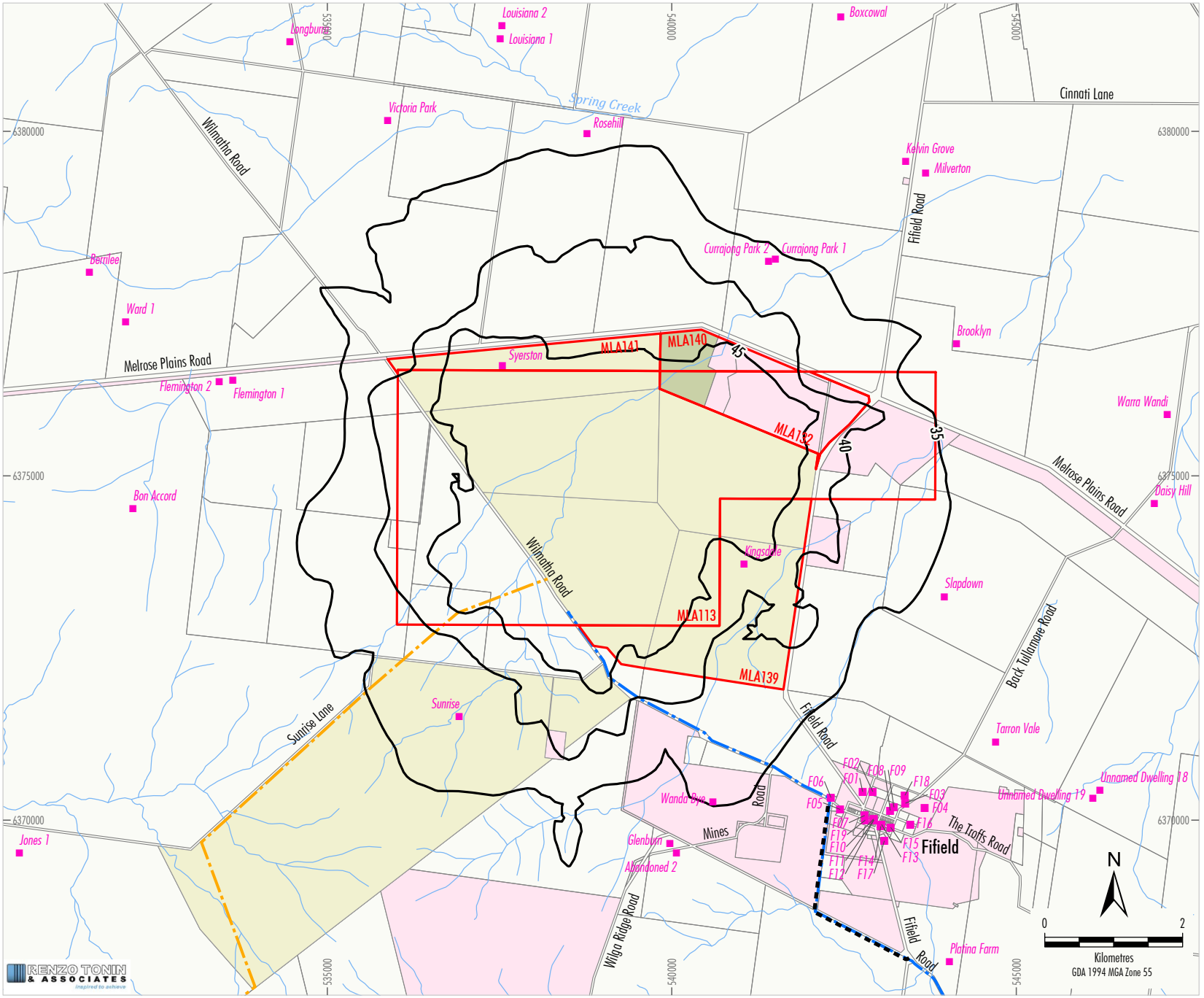
Table E.1 – Predicted Unmitigated Operational Noise Levels at Nearest Potentially Affected Receivers ($L_{Aeq(15minute)}$)

ID	Description	PSNL, dB(A)			Predicted Operational Noise Levels, dB(A)								
					Year 6			Year 11			Year 21		
		Day	Evening	Night	Day	Evening and Night		Day	Evening and Night		Day	Evening and Night	
					Calm	Calm	F-Class Inversion	Calm	Calm	F-Class Inversion	Calm	Calm	F-Class Inversion
Privately-owned Dwellings													
M01	Longburra	35	35	35	<20	<20	28	21	21	30	22	22	31
M02	Victoria Park	35	35	35	21	21	32	25	25	34	25	25	35
M03	Ward 1	35	35	35	<20	<20	27	<20	20	27	22	22	31
M04	Abandoned 2	35	35	35	22	23	35	24	25	**36**	24	26	**36**
M05	Berrilee	35	35	35	<20	<20	26	<20	<20	27	20	20	30
M06	Bon Accord	35	35	35	<20	<20	24	20	21	28	21	21	31
M07	Boxcowal	35	35	35	<20	<20	26	24	24	32	26	25	31
M08	Currajong Park 2	35	35	35	32	34	**40**	34	34	**42**	**37**	**37**	**42**
M09	Daisy Hill	35	35	35	<20	<20	26	26	26	33	27	27	33
M10	Glenburn	35	35	35	21	23	35	24	25	**37**	25	25	**36**
M12	Louisiana 1	35	35	35	22	22	33	25	25	33	25	25	32
M13	Louisiana 2	35	35	35	21	22	32	25	25	33	26	25	32
M14	Platina Farm	35	35	35	<20	<20	23	<20	<20	23	<20	<20	24
M16	Tarron Vale	35	35	35	20	21	29	25	26	33	26	27	34
M17	Jones 1	35	35	35	<20	<20	<20	<20	<20	<20	<20	<20	22
M18	-	35	35	35	<20	<20	21	<20	<20	25	21	21	27
M19	-	35	35	35	<20	<20	21	<20	20	27	22	21	28
M20	-	35	35	35	<20	<20	<20	<20	<20	20	<20	<20	22
M21	Warra Wandi	35	35	35	<20	<20	26	26	26	33	27	26	32
M22	Brooklyn	35	35	35	27	28	**36**	35	35	**42**	**36**	35	**42**
M23	Currajong Park 1	35	35	35	32	33	**40**	34	34	**42**	**37**	**37**	**41**
M24	Flemington 1	35	35	35	20	20	28	23	25	32	25	25	33
M25	Flemington 2	35	35	35	<20	<20	28	23	24	31	24	24	32
M26	Kelvin Grove	35	35	35	23	25	32	29	29	**36**	29	29	35
M27	Milverton	35	35	35	23	25	32	30	29	**37**	32	31	**36**
M28	Rosehill	35	35	35	23	24	34	26	27	**37**	27	27	35
M29	Slapdown	35	35	35	25	27	35	32	33	**39**	32	33	**39**

ID	Description	PSNL, dB(A)			Predicted Operational Noise Levels, dB(A)								
					Year 6			Year 11			Year 21		
		Day	Evening	Night	Day	Evening and Night		Day	Evening and Night		Day	Evening and Night	
					Calm	Calm	F-Class Inversion	Calm	Calm	F-Class Inversion	Calm	Calm	F-Class Inversion
M31	Wanda Bye	35	35	35	24	26	**36**	26	28	**38**	27	28	**37**
F01	Fifield Residences	35	35	35	22	24	32	25	26	35	27	27	**36**
F02		35	35	35	22	24	31	24	25	32	26	27	34
F03		35	35	35	20	22	30	23	25	31	25	26	33
F04		35	35	35	<20	21	29	23	24	32	25	25	33
F05		35	35	35	22	25	33	26	27	35	26	27	35
F06		35	35	35	22	24	33	25	26	35	26	27	35
F07		35	35	35	20	22	28	23	24	31	24	25	30
F08		35	35	35	<20	21	28	22	24	30	25	25	32
F09		35	35	35	20	22	29	23	24	31	25	25	32
F10		35	35	35	20	22	28	23	24	31	25	25	31
F11		35	35	35	20	22	28	23	24	31	24	25	31
F13		35	35	35	20	22	28	22	23	30	24	24	30
F14		35	35	35	<20	21	27	22	23	30	23	24	30
F15		35	35	35	<20	20	27	21	22	29	23	23	29
F16		35	35	35	<20	20	27	22	22	29	23	24	30
F17		35	35	35	<20	21	29	22	23	29	23	23	30
F18		35	35	35	20	22	30	24	25	31	25	26	33
F19		35	35	35	20	21	28	23	23	30	24	24	30
Community Building													
M32	Fifield Town Hall	50 when in use			20	22	28	22	24	31	24	24	30
M33	Fifield Fire Station	65 when in use			20	22	28	23	24	31	24	25	31
M34	Fifield Hotel	35	35	35	20	22	28	22	24	31	24	25	30
M35	St Dympna's Catholic Church	50 when in use			20	22	28	23	24	31	24	25	31
Mine-owned Dwellings													
M15	Sunrise	35	35	35	28	30	**37**	29	31	**38**	30	31	**38**

Notes:
1. **Green** denotes a **negligible** exceedance of 0-2 dB(A) above the PSNL.
2. **Orange** denotes a **marginal** exceedance of 3-5 dB(A) above the PSNL.
3. **Red** denotes a **significant** exceedance of >5 dB(A) above the PSNL.

APPENDIX G Mitigated Operational Noise Contours



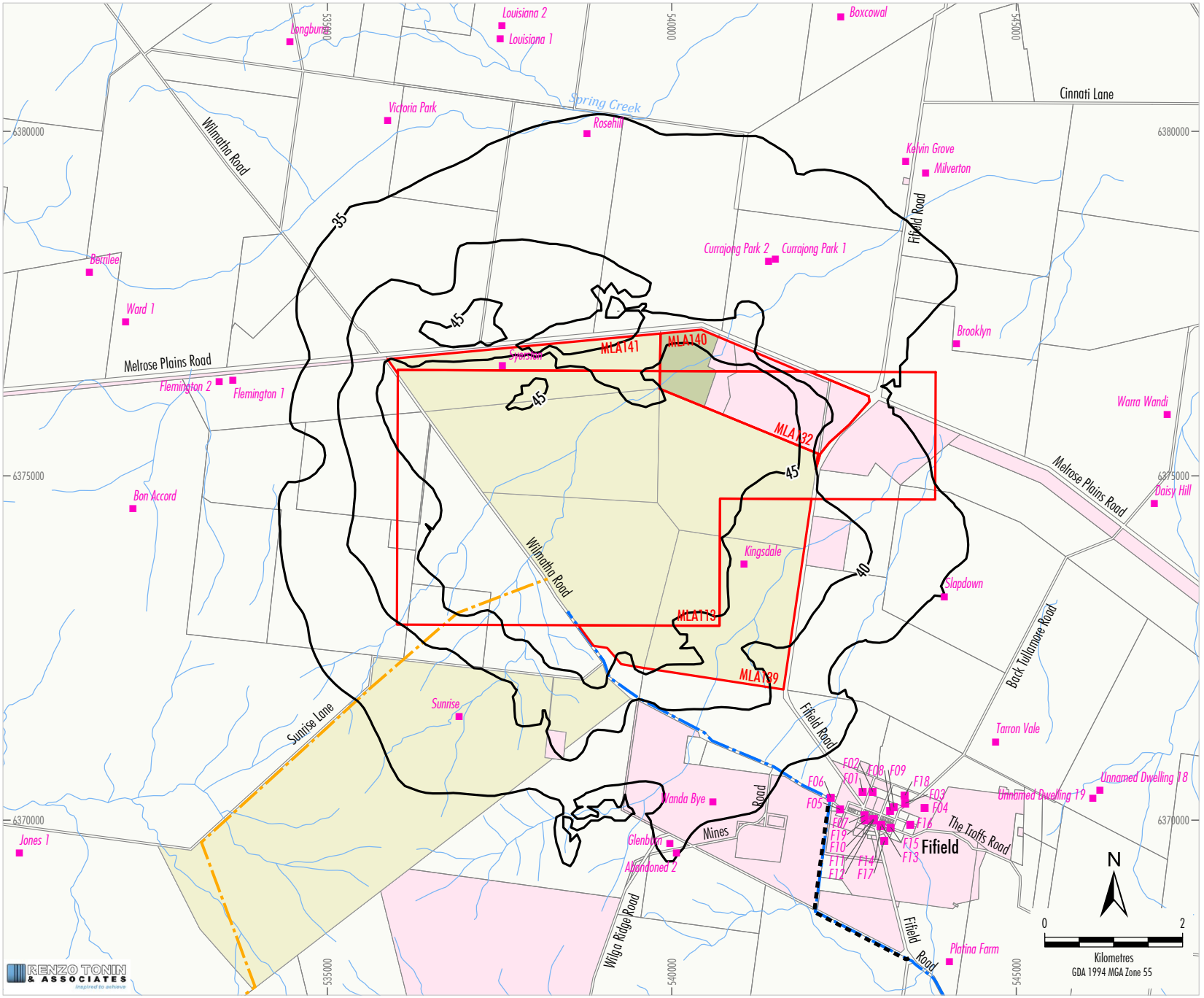
CTL-16-02 Mod4_Noise_209B

CLEAN TEQ
Powering innovation

SYERSTON PROJECT MODIFICATION 4

Night with Temperature Inversion - Intrusive Noise Contours, $L_{Aeq(15\ minute)}$, dB(A) Year 6

Figure G.1



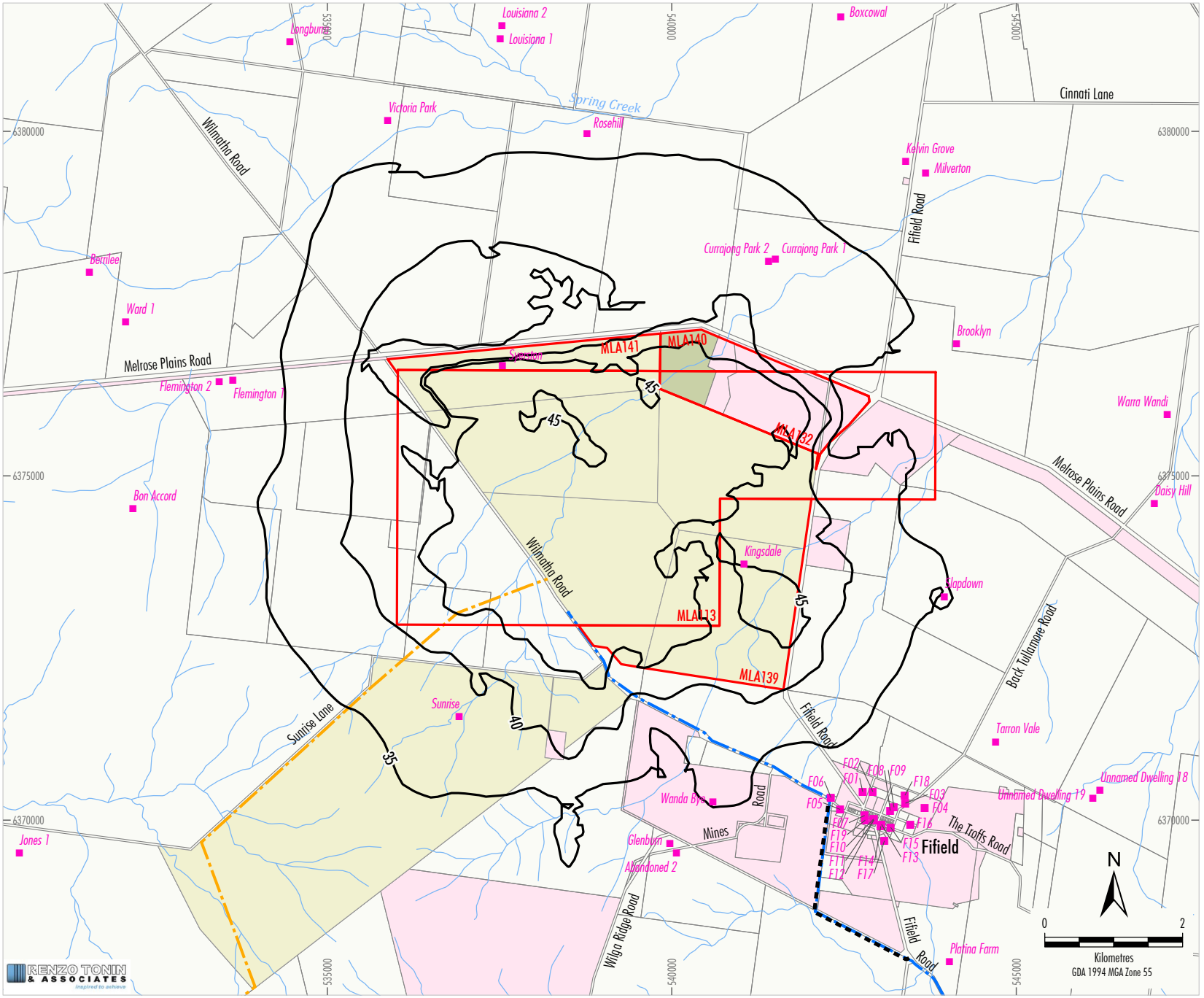
CLEAN TEQ
Powering innovation

SYERSTON PROJECT MODIFICATION 4

Night with Temperature Inversion - Intrusive Noise Contours, $L_{Aeq(15\ minute)}$, dB(A) Year 11

Figure G.2

CTL-16-02 Mod4_Noise_210B



CLEAN TEQ
Powering innovation

SYERSTON PROJECT MODIFICATION 4

Night with Temperature Inversion - Intrusive Noise Contours, $L_{Aeq(15\ minute)}$, dB(A) Year 21

Figure G.3

CTL-16-02 Mod4_Noise_211B

APPENDIX H Road Traffic Noise Results

Table G.1 – Predicted Day $L_{Aeq, 15hour}$ and Night $L_{Aeq, 9hour}$ Traffic Noise Levels

Road	Distance to Nearest Receiver, m	Day $L_{Aeq, 15hour}$ (7:00 am – 10:00 pm)		Night $L_{Aeq, 9hour}$ (10:00 pm - 7:00 am)	
		Total Traffic	Approved Traffic[1]	Total Traffic	Approved Traffic[1]
1. The Bogan Way north of Trundle	22	56	55	53	48
2. Fifield Road north of Platina Road	35	54	51	53	47
3. Fifield-Trundle Road west of The Bogan Way	200	41	35	41	29
4. Platina Road east of Fifield Road	52	52	47	51	44
5. Wilmatha Road west of Slee Street	16	53	46	53	46
6. Slee Street in Fifield	11	57	54	55	49

Notes: 1. Initial Production Phase traffic. A comparison against the approved Full Production Phase traffic is provided in Section 10.