AUSTRALIAN ZIRCONIA LTD
(A wholly owned subsidiary of Alkane Resources Ltd)

Dubbo Zirconia Project

Noise and Vibration Impact Assessment

Prepared by

EMGA Mitchell McLennan

August 2013

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Noise and Vibration Impact Assessment

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Dubbo Zirconia Project

Final Draft

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Abbreviation or term	Definition
ABL	The assessment background level (ABL) is defined in the INP as a single figure background level for each assessment period (day, evening and night). It is the tenth percentile of the measured L_{90} statistical noise levels.
ANZECC	Australian and New Zealand Environment Conservation Council
AZL	Australia Zirconia Ltd
Day period[1]	Monday–Saturday: 7 am to 6 pm, on Sundays and public holidays: 8 am to 6 pm.
dB(A)	Noise is measured in units called decibels (dB). There are several scales for describing noise, the most common being the 'A-weighted' scale. This attempts to closely approximate the frequency response of the human ear.
DGRs	Director General Requirements
DP&I	Department of Planning and Infrastructure
DZP	The Dubbo Zirconia Project
EIS	Environmental Impact Statement
EMM	EMGA Mitchell McLennan Pty Limited
EP&A Act	*Environmental and Planning Assessment Act 1979* (NSW)
Evening period[1]	Monday–Saturday: 6 pm to 10 pm, on Sundays and public holidays: 6 pm to 10 pm.
ICNG	Interim Construction Noise Guideline
INP	Industrial Noise Policy
L_1	The noise level exceeded for 1% of the time.
L_{10}	The noise level which is exceeded 10% of the time. It is roughly equivalent to the average of maximum noise level.
L_{90}	The noise level that is exceeded 90% of the time. Commonly referred to as the background noise level.
L_{eq}	The energy average noise from a source. This is the equivalent continuous sound pressure level over a given period. The $L_{eq(15min)}$ descriptor refers to an L_{eq} noise level measured over a 15-minute period.
L_{max}	The maximum sound pressure level received during a measuring interval.
Night period[1]	Monday–Saturday: 10 pm to 7 am, on Sundays and public holidays: 10 pm to 8 am.
NVIA	Noise and Vibration Impact Assessment.
NMP	Noise Management Plan
EPA	The NSW Environment Protection Authority (formerly the Environment Protection Authority and the Department of Environment, Climate Change and Water).
PSNL	The project-specific noise levels (PSNL) are criteria for a particular industrial noise source or industry. The PSNL is the lower of either the intrusive criteria or amenity criteria.
RBL	The rating background level (RBL) is an overall single value background level representing each assessment period over the whole monitoring period. The RBL is used to determine the intrusiveness criteria for noise assessment purposes and is the median of the average background levels.
RING	Rail Infrastructure Noise Guideline.
RNP	Road Noise Policy
Sound power level (Lw)	A measure of the total power radiated by a source. The sound power of a source is a fundamental property of the source and is independent of the surrounding environment.
Temperature inversion	A meteorological condition where the atmospheric temperature increases with altitude.
the Proposal	Dubbo Zirconia Project
Vibration	A motion that can be measured in terms of its displacement, velocity or acceleration. The common unit for velocity is millimetres per second (mm/s).

Notes: 1. excludes road traffic noise where Day: 07.00 am to 10.00 pm; Night: 10.00 pm to 07.00 am.

Executive Summary

ES1 Introduction

EMGA Mitchell McLennan Pty Limited (EMM) has completed a noise and vibration assessment of emissions associated with the proposed Dubbo Zirconia Project ("the DZP") to be developed and operated by Australian Zirconia Ltd (AZL). The DZP is a greenfield site located near Toongi approximately 25 km south of Dubbo in the central west of NSW. A small scale open-cut mine is proposed for the mining and processing for rare metals, Zirconium and Niobium, and Rare Earth Elements (REE's).

The assessment considered the following noise-related aspects of the DZP:

- operations noise;
- sleep disturbance;
- construction related noise;
- traffic noise generated by the DZP;
- offsite rail noise emissions and vibration; and
- blasting overpressure and vibration.

The assessment has been undertaken in accordance with the following policies and guidelines:

- Environment Protection Authority (EPA) 2000, *NSW Industrial Noise Policy*;
- NSW EPA 2011, *Road Noise Policy (RNP)*;
- NSW Environment Protection Authority (EPA) 2013, *Rail Infrastructure Noise Guideline (RING)*.
- EPA February 2006, *Assessing Vibration: A Technical Guideline;*
- Australian and New Zealand Environment Conservation Council (ANZECC) 1990; *Technical basis for guidelines to minimise annoyance due to blasting overpressure and ground vibration;* and
- DECC 2009, *Interim Construction Noise Guideline (ICNG)*.

ES1.1 Overview of noise and blasting impact assessment

ES1.1.1 Operations

During night time and maximum prevailing wind conditions for all years of the DZP, no privately owned receptors that do not hold an agreement with AZL for property purchase are predicted to experience noise levels above the operational criterion of 35 dB(A).

Further, it is predicted that three receptors with a contractual agreement in place with AZL would experience noise levels above the operational criteria (i.e. >35 dB(A)). Three receptors with a contractual agreement in place with AZL are predicted to experience noise levels above the likely acquisition criteria (i.e. >40 dB(A)).

The vacant land assessment has identified that one receptor (Crown land) has been identified as likely to experience operational noise levels greater than the acquisition zone of 40 dB(A), $L_{eq(15\text{-min})}$ over 25% the land area. AZL has commenced negotiations with the Department of Primary Industries Catchments and Lands (DP1-C&L).

ES1.1.2 Sleep disturbance

Potential sleep disturbance impacts from operational maximum noise level events have been assessed and are expected to satisfy EPA criteria for the majority of private receptors. Noise modelling identified L_{max} noise levels associated with the rail loading to be above the strict sleep disturbance criteria at several receptors. Despite this, L_{max} noise levels from the rail spur remain below levels that are likely to awaken occupants based on well known international research (WHO, 1999) on sleep disturbance, provided in the EPA's RNP.

Notwithstanding, the Applicant commits to restricting train loading and unloading to after 6:00am and before 10:00pm unless rail pathing requires an overnight turn-around of trains. Additionally, to mitigate against potential sleep disturbing noise events, AZL commits to implementing and enforcing a *Noise Management Plan* which requires operators to avoid high impact events, e.g. between container and wagon.

ES1.1.3 Construction

Noise levels during construction will remain below the EPA's highly affected criteria of 75 dB(A) at the majority of receptors for all activities with the exception of the gas pipeline corridor, rail line upgrade and Obley Road upgrade. Noise management and mitigation measures are critical in reducing noise emissions when these three activities occur adjacent to receptors. Noise management measures including the completion of a *Construction Noise and Vibration Management Plan* (CNVMP) will be implemented to minimise construction noise impacts on the surrounding community.

ES1.1.4 Road traffic

Road traffic noise generated from DZP operations and construction is expected to comply with the EPA's RNP for privately owned receptors.

ES1.1.5 Offsite rail traffic

Transport options are yet to be finalised, however, there are two possibilities for rail usage. Option A assumes Toongi-Dubbo Rail Line would be dedicated to the DZP, therefore reagent deliveries and product dispatch would be managed based on operations at the DZP Site. Some of the reagents would be delivered to the DZP Site at Toongi using three trains per week on the Toongi-Dubbo rail line.

Option B assumes that reagents would be delivered by rail from the supplier to the Dubbo terminal on the Merrygoen (Newcastle) Rail Line. Trucks would be used to transport the reagents to DZP Site. Therefore, there is the potential for one train per day (two movements) to occur as a result of the DZP along the Merrygoen line.

Offsite train movements for Option A and Option B would meet the day and night criteria for receptors at distances of 15 m (and greater) from the track, and the L_{max} criterion (day and night) will be met for noise receptors situated 25 m (and greater) from the railway. Rail noise as a result of DZP would not increase existing L_{eq} levels by more than 2 dB(A), and no change to L_{max} levels is expected, satisfying the RING recommended increase goals.

Rail numbers for the Dubbo region were requested from ARTC although, not provided. Therefore, the existing off-site trains were conservatively assumed at three per day (i.e. six movements). It is anticipated that this level may be significantly higher, therefore this assessment should be considered a worst case scenario.

ES1.1.6 Blasting

Calculated blast overpressure and vibration levels identify that an MIC of 68 kg would satisfy the airblast overpressure criteria of 115 dB(L_{peak}) and ground vibration criteria of 5 mm/s at distances of greater than 450 m. It is noted that the closest privately owned receptor is located 2,200 m from potential blast locations. Therefore, it is predicted that based on a maximum MIC of 68 kg, blast overpressure and vibration levels would comply at all privately owned receptors.

ES1.1.7 Rail vibration

A review of potential structural vibration has been completed for the Dundullimal Homestead, off Obley Road. The homestead is situated approximately 65 m from the Toongi-Dubbo rail line and vibration levels at this distance are expected to remain below 0.5 mm/s and satisfy the sensitive structural criteria of 3 mm/s.

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1 Introduction

EMGA Mitchell McLennan Pty Limited (EMM) has been engaged by RW Corkery & Co Pty Ltd to undertake a noise and vibration impact assessment (NVIA) for the proposed Dubbo Zirconia Project ("the DZP") to be developed and operated by Australian Zirconia Ltd (AZL).

The DZP is a greenfield site located near Toongi approximately 25km south of Dubbo in the central west of NSW (see **Figure 1**), where it is proposed to develop a small scale open-cut mine will be developed for mining and processing for rare metals, Zirconium and Niobium, and Rare Earth Elements (REE's). The proposed mining and processing operations are located over parts of six adjoining farm properties.

It is envisaged that the site establishment and construction phase would be completed within 24 months. The current predicted life of the DZP is 20 years (with potential to extend well beyond, subject to future development application and approval).

1.1 Director-General's Requirements

A summary of the Director-General's Requirements (DGRs) and relevant agency assessment requirements for the assessment of noise impacts from the DZP are summarised in **Table 1.1**. The table also shows their relevance to the assessment, comments/justification for their inclusion or exclusion in the assessment and where they have been addressed in this report.

Table 1.1 DGRs for Assessment of Noise Impacts

Authority/Agency	Requirements	Detailed assessment	Comments	Relevant report section
Department of Planning and Infrastructure (DP&I)	Construction noise impacts	√	Assessed	5.4
	Operational noise impacts	√	Assessed	5.1
	Off-site transport noise impacts	√	Assessed	5.5
	Reasonable and feasible mitigation measures	√	Provided	6.1.1
	Monitoring and management measures (real-time and attended)	√	Provided	6.2
Office of Environment and Heritage (OEH)	Rating background noise level (RBL), ambient noise levels	√	Default INP adopted	3.1
	Identify weather factors such as temperature inversions and other unusual features which influence noise	√	Assessed	4.1
	Identify noise sensitive locations such as residential properties and schools	√	Provided	2.1
	Sound power levels for all plant and equipment	√	Assessed	4.2
	Construction noise associated with DZP	√	Assessed	5.4
	Vibration from all DZP activities	√	Assessed	5.8
	Blasting impacts	√	Assessed	5.7
	Operational noise assessment criteria and sleep disturbance limit for the Site	√	Assessed	3.1/3.6
	Noise assessment including A-Weighted and C-Weighted noise	√	Assessed	3.4
	Cumulative noise impacts	√	Assessed	3.5
	Noise from increased road traffic	√	Assessed	3.8
	Noise from new or upgraded public roads	√	Assessed	3.8
	Noise from new or upgraded railways	√	Assessed	3.7
	Noise from increased rail traffic	√	Assessed	3.9

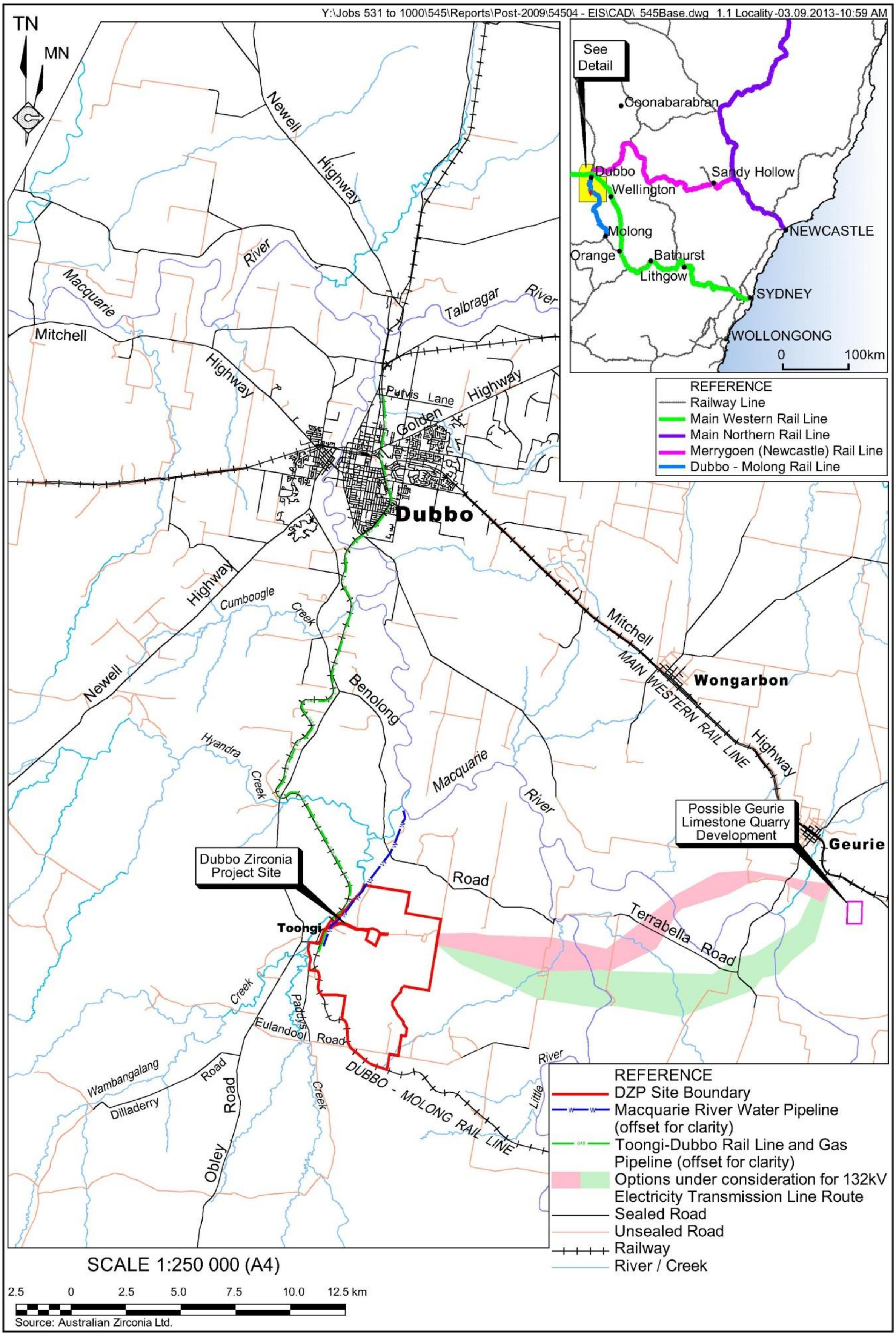
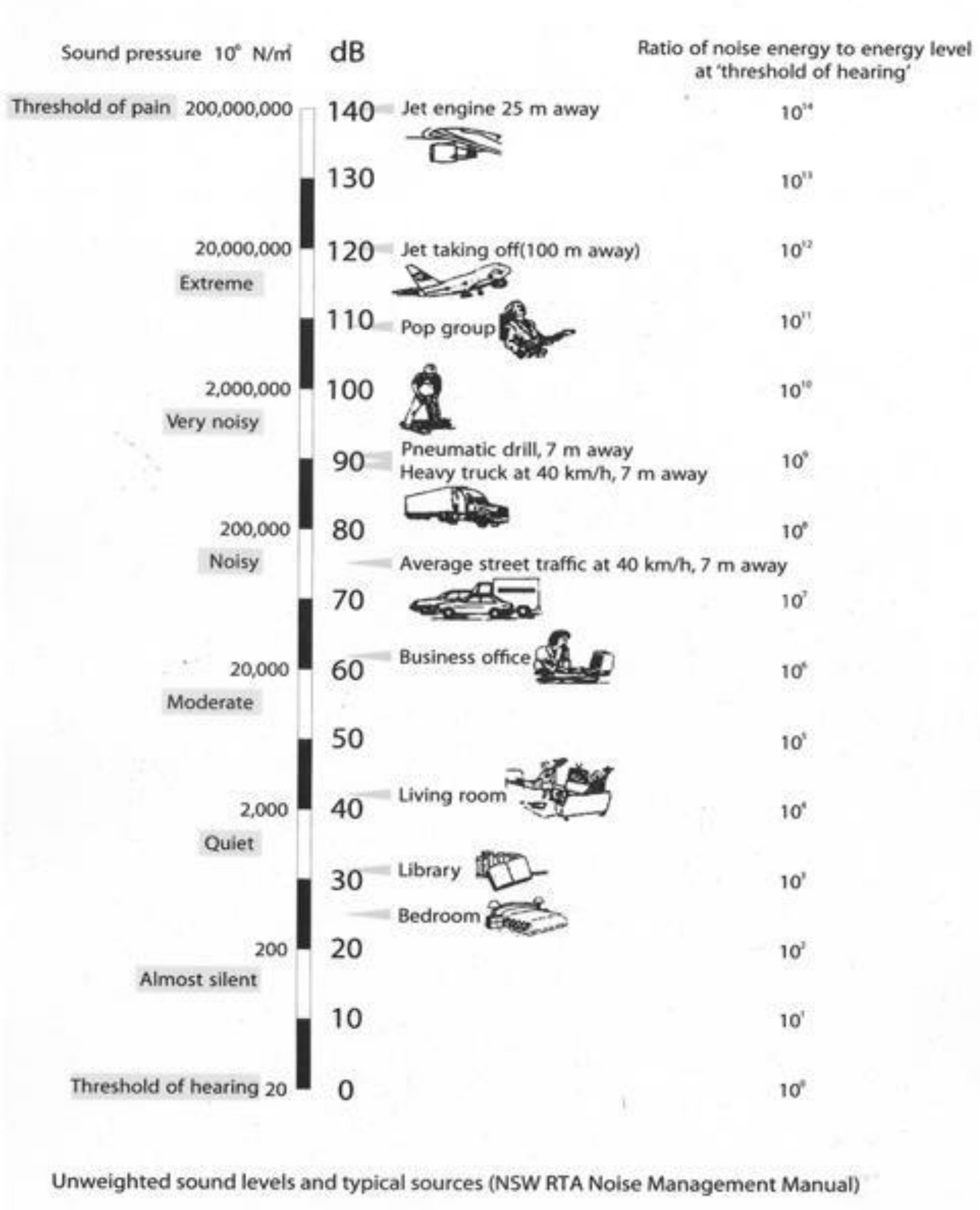


Figure 1 Locality Plan

1.2 Common noise levels

Examples of common noise levels encountered on a daily basis are provided in



Source : RTA Environmental Noise Management Manual (RTA, 2001)

Figure 2 Noise Scale

It is useful to have an appreciation of decibels, the unit of noise measurement. **Table 1.2** gives some practical indication of what an average person perceives about changes in noise levels.

Table 1.2 Perceived Change in Noise

Change in sound level (dB)	Perceived change in noise
3	just perceptible
5	noticeable difference
10	twice (or half) as loud
15	large change
20	four times as loud (or quarter) as loud

1.3 Description of the DZP

1.3.1 Project Overview and Application Area

The DZP would comprise a small scale open cut mine supplying approximately 1Mt of ore containing rare metals (zirconium and niobium) and rare earth elements (REE's) (including hafnium and tantalum) to a processing plant annually (18 million tonnes of ore over a period of up to 20 years). The land on which the proposed open cut, processing plant and associated facilities for the management of waste generated by these activities is collectively referred to as the DZP Site.

The Proposal also incorporates the following four component areas (see **Figure 3**).

- Upgrade and reactivation of the Toongi to Dubbo Section of the Dubbo-Molong Rail Line. AZL also proposes to construct a pipeline to deliver compressed natural gas (CNG) from the Central West Pipeline operated by APA Group within the 'Toongi-Dubbo Rail Line and Natural Gas Pipeline Corridor';
- Construction of a water pipeline to deliver up to 4.05GL of water from the Macquarie River to the processing plant (referred to hereafter as the Macquarie River Water Pipeline).
- Upgrades, including minor realignment, creek crossing upgrade and pavement strengthening, of the public road network (Toongi Road and Obley Road).
- Construction of a 132kV electricity transmission line (ETL) from a sub-station to the southwest of Geurie to the DZP Site. The construction of this ETL is to be assessed separately under Part 5 of the EP&A Act.

Excluding the 132kV ETL, the component areas identified above comprise the DZP Application Area.

The following provides an overview of the activities to be undertaken within each of these areas.

1.3.2 DZP Site Operations

The following provides an overview of principal components and activities to be undertaken on the DZP Site (and illustrated on **Figure 3**).

- Extraction of approximately 19.5Mt of ore at a maximum rate of 1.1Mt per year from a shallow open cut developed to a maximum depth of 32m (355m AHD) (remaining above the groundwater table).

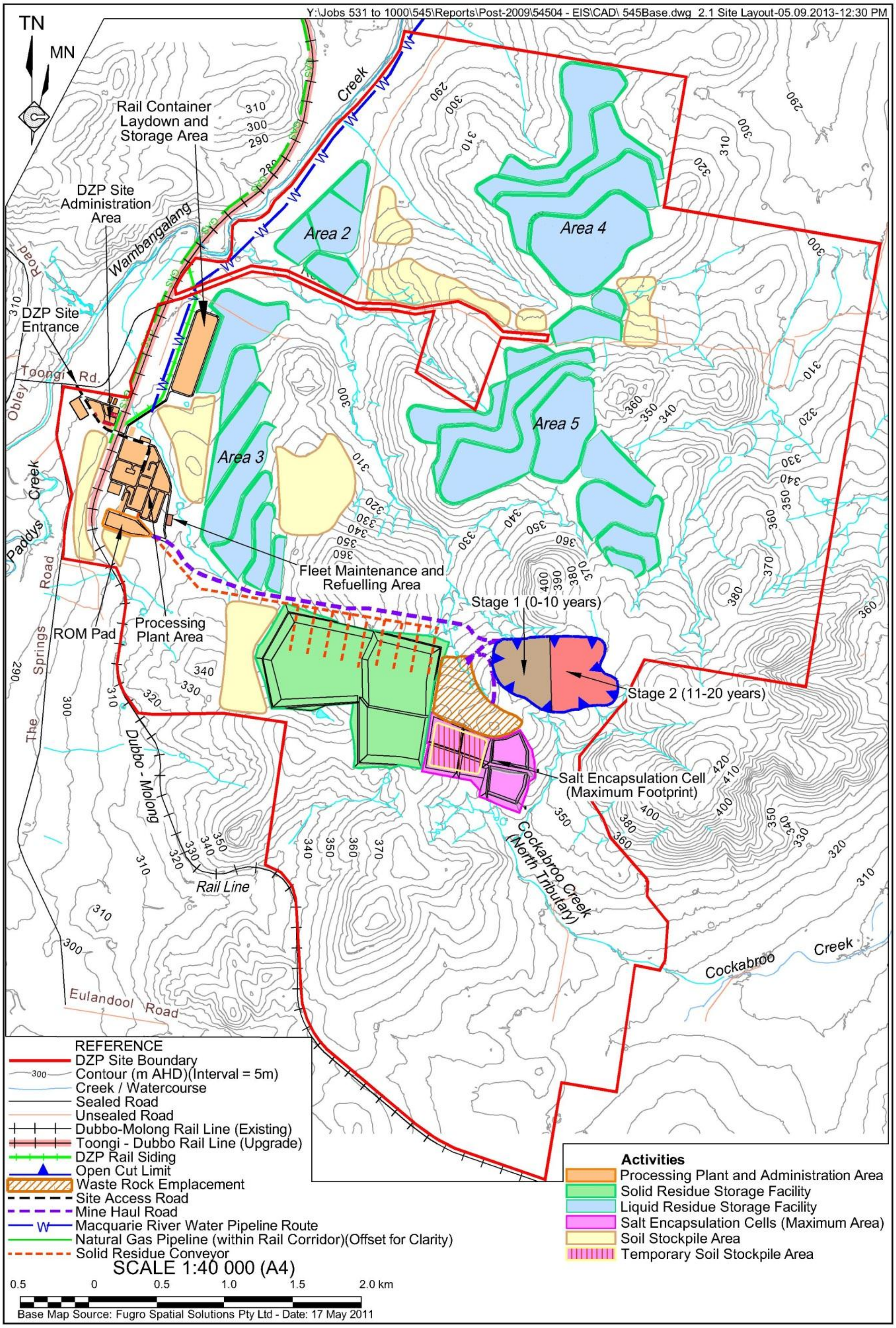


Figure 3 Principal Components and Activities

- Extraction and placement of approximately 3.5Mt of waste rock (weathered material or rock containing insufficient grades of rare metals or REEs for processing) within a small waste rock emplacement (WRE) to the southwest of the open cut.
- A conventional method of transportation is proposed using trucks to haul the ore to a Run-of-Mine (ROM) Pad for crushing and grinding.
- Processing of the crushed and ground ore by:
    - Sulphation roast of ore and leaching to dissolve sulphated metals.
    - Solvent extraction, precipitation, thickening, washing and drying of the various rare metal and REE products.

  The sulphuric acid required as part of the sulphation process would be manufactured within the DZP processing plant from imported raw sulphur.
- Construction and operation of a rail siding from the Toongi-Dubbo Rail Line and a Rail Container Laydown and Storage Area for the unloading and temporary storage of reagents and loading of products for despatch.

  Other reagents would be transported to the DZP Site via the public road network, with sections of Obley Road and Toongi Road to be upgraded to accommodate the proposed increase in heavy vehicle traffic.
- Mixing of solid residues produced by the processing of the ore with crushed and washed limestone and transportation via conveyor to a Solid Residue Storage Facility (SRSF).
- Pumping of water used in the processing operations, which cannot be recycled, to a Liquid Residue Storage Facility (LRSF), comprising a series of terraced and lined crystallisation cells.
- Recovery and disposal of an estimated 6.7Mt of salt which would accumulate within the LSRF within a series of Salt Encapsulation Cells adjoining the WRE and SRSF.
- Other ancillary activities including equipment maintenance, clearing and stripping of the areas to be disturbed and rehabilitation activities.

The maximum development footprint on the DZP Site would be approximately 807.7ha (within the DZP Site of 2 860ha; see **Figure 3**). Component disturbance areas or the DZP Site are as follows:

- Open Cut Mine – 40.3ha.
- Waste Rock Emplacement Area – 20.4ha.
- ROM Pad – 4.2ha.
- Processing Plant and DZP Site Administration Area (incorporating the processing plant and associated reagent storage areas, rail siding and container laydown areas and site offices and administration complex) – 43.3ha.
- Solid Residue Storage Facility – 102.8ha.
- Liquid Residue Storage Facility (Salt Crystallisation Cells) – 425.4ha.
- Salt Encapsulation Cells – up to 34.6ha.
- Roads and other Infrastructure – up to 5ha.
- Soil Stockpile Areas – up to 129ha.
- Internal Haul Roads – 7.3ha.

The ore body to be mined is a roughly elliptical stock in shape with outcrop dimension of 600m x 400m. Exploration completed by AZL has identified the ore body extends below a thin veneer of soil and recent sediments to be approximately 900m (east-west) x 500m (north-south) (surface area of 36ha) and appears to be a near vertical body of indeterminate depth.

While there is limited scope to modify the area of impact associated with the open cut, in order to minimise the impact of the mining operations, the Applicant has designed the mining sequence such that the initial 10 year mine plan develops the western half of the open cut with the eastern half developed and mined during the second 10 year mining period (see **Figure 3**).

The size and location of the other components of the DZP Site have been the subject of more detailed review, with impact minimisation a key consideration.

1.3.3 Toongi-Dubbo Rail Line and Natural Gas Pipeline Corridor

The processing operations require significant volumes of chemical reagents and other raw materials. While significant volumes of these reagents and materials would be delivered by road, the Applicant has identified the upgrade and use of the Toongi to Dubbo section of the currently disused Dubbo-Molong Rail Line as an opportunity to reduce the volume of traffic on the public road network. It is noted that the Applicant is still reviewing the viability of the rail line upgrade and has identified a preferred and two contingency transport options for consideration of environmental impacts (refer to Section 1.3.6).

Figure 4 provides the proposed alignment of the Toongi-Dubbo Rail Line, the key features of which are as follows.

- Upgrade of the Toongi to Dubbo section of the Dubbo-Molong Rail Line to a Class 1 track.
- Replacement or upgrade of steel bridges, culvert structures, and timber bridges.
- Reinstatement, civil works and installation back to the required standard at each of the 26 level crossings.

Figure 4 also identifies the proposed natural gas pipeline between the Central West Pipeline (of APA Group) at Purvis Lane, Dubbo, and the DZP Site which would deliver up to 970TJ/year of natural gas for the heating of various circuits within the processing plant.

1.3.4 Macquarie River Water Pipeline

Processing operations would require up to 4.05GL of water annually which would be sourced (partially or completely) from the Macquarie River (under licence) and transferred to the DZP Site by water pipeline.

Figure 5 provides the proposed alignment of the Macquarie River Water Pipeline, the key features of which are as follows.

- A pumping station which incorporates a dual water inlet, wet well and vertical mounted axial flow pump configuration.
- A 400mm to 450mm diameter HDPE pipeline within an embedded trench.

The easement to be created for the Macquarie River Water Pipeline Corridor would be approximately 15.2ha (20m x 7.6km), although the actual area of disturbance within this corridor would be much less. An area of less than 2 500m^2 would be disturbed on the river frontage of the "Mia Mia" property to allow for the construction of the pumping station for water from the Macquarie River.

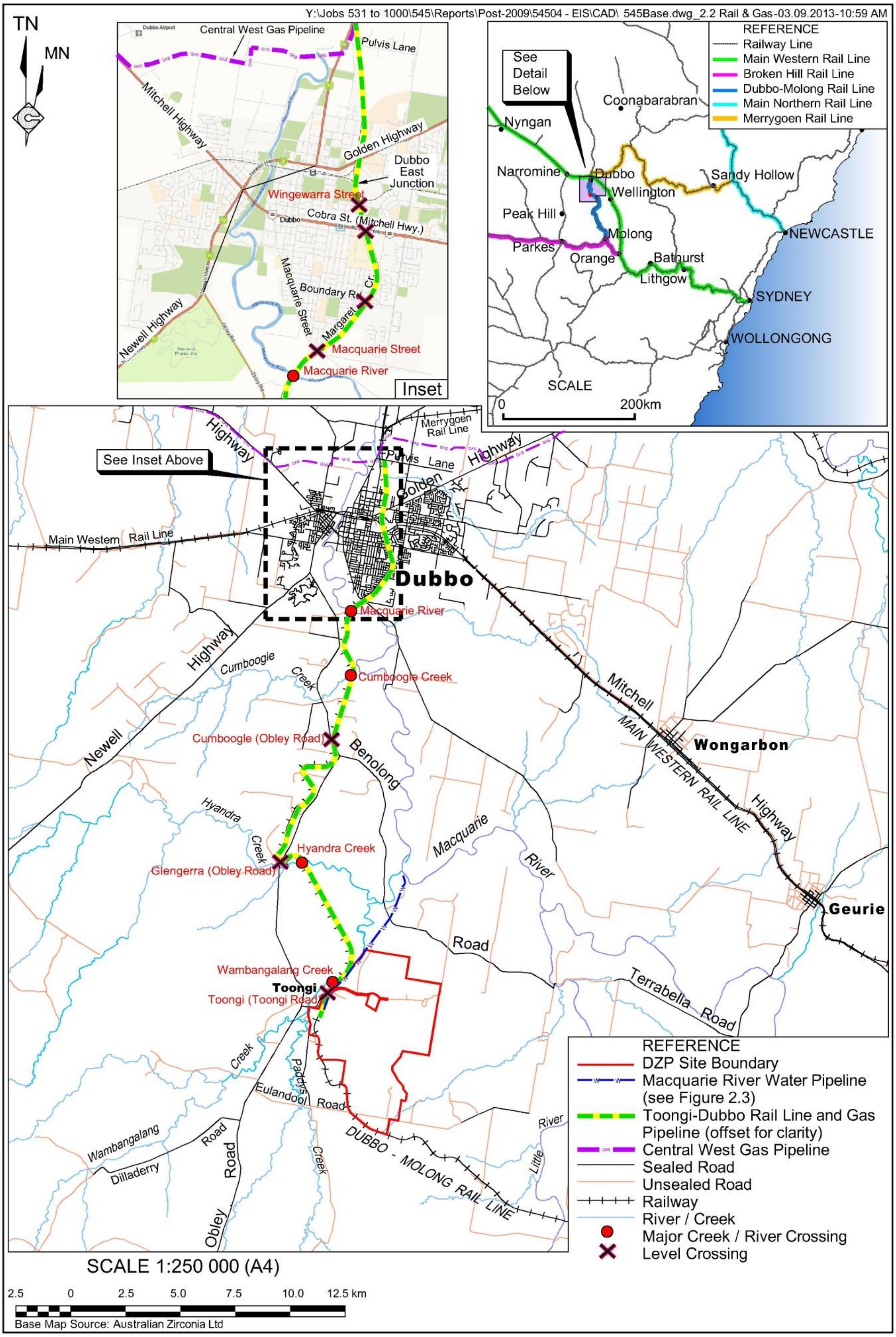


Figure 4 Proposed Natural Gas Pipeline

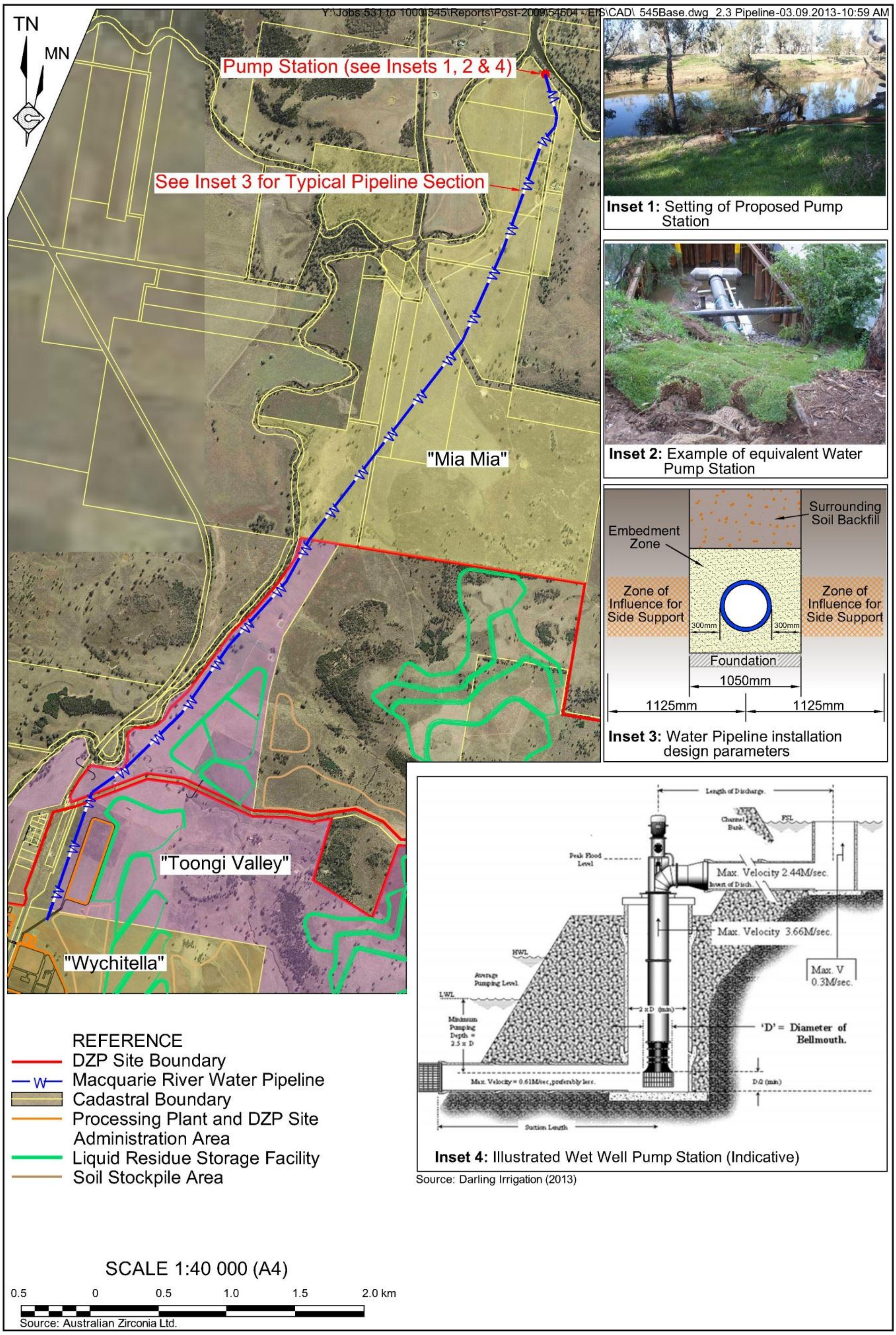


Figure 5 Macquarie River Pipeline

1.3.5 Public Road Network

Significant quantities of the processing reagents and other raw materials would be delivered by road, via the Newell Highway, Obley Road and Toongi Road. To accommodate the proposed heavy vehicle traffic associated with this transport, the alignment and pavement depth of the two roads would be improved in several locations, with a number of creek crossings, rail level crossings and intersections to be upgraded. **Figure 6** provides the locations of these works.

The main entrance to the DZP Site would be constructed off Toongi Road approximately 360m from Obley Road. It would be a sealed two lane road suitable for light and heavy vehicles. The site entrance would provide access to the DZP Site capitalise to the west of the rail line. Internal roads would connect the site entrance road to the Processing Plant and Administration Area and various areas of the DZP Site.

1.3.6 Reagent delivery and product dispatch

As noted in Section 1.3.2, processing operations would require several different reagents to be transported to the DZP. These include sulphur, limestone, quick lime, caustic soda, soda ash, salt, anhydrous ammonia, aluminium powder and several other reagents used in minor quantities. These would need to be transported to the DZP from several locations including Newcastle, Sydney, Charbon (NSW), and Cheetham (Victoria).

As noted in Section 1.3.3, the Applicant’s preferred method of transporting reagents is combined road and rail operations. However, due to the high capital cost of upgrading the required section of the Dubbo-Molong Rail Line from its current state of disrepair to a safe operating standard, and other logistical, operational and economic factors to be addressed prior to reopening, the Applicant considers it would be at least five years from the commencement of the Proposal (approximately 2020) before the incorporation of the rail option would be feasible. The Applicant has therefore identified two contingency transport options that may be implemented. Under all options certain reagents would need to be transported all the way from where they are sourced to the DZP using the public road network.

i Preferred Transport Option (A) – Rail to Toongi / Supplementary Road

For this option the bulk reagents of sulphur, caustic soda and hydrochloric acid would be transported by rail directly to the DZP Site along the reinstated Toongi-Dubbo Rail Line. Three trains per week would be operated between Newcastle (from where the bulk reagents would be sourced) and the DZP Site. The timing of these movements would be beyond the control of the Applicant, as they would have to be integrated with overall operations of the broader rail network.

During a typical week, it is probable there would be one inbound train movement to the DZP Site one day, with its outbound movement the following day (and one day per week with no train movements).

Some smaller quantity reagents would be transported by rail from Sydney via the Main Western Rail Line before being unloaded and transferred to trucks for delivery to the DZP Site. These rail movements would be combined with current freight rail movements between Sydney and Dubbo.

All other reagents, and other materials such as diesel fuel, would be transported to the DZP Site by road. Overall, however, this option would minimise the volume of heavy vehicle traffic on local roads generated by the DZP.

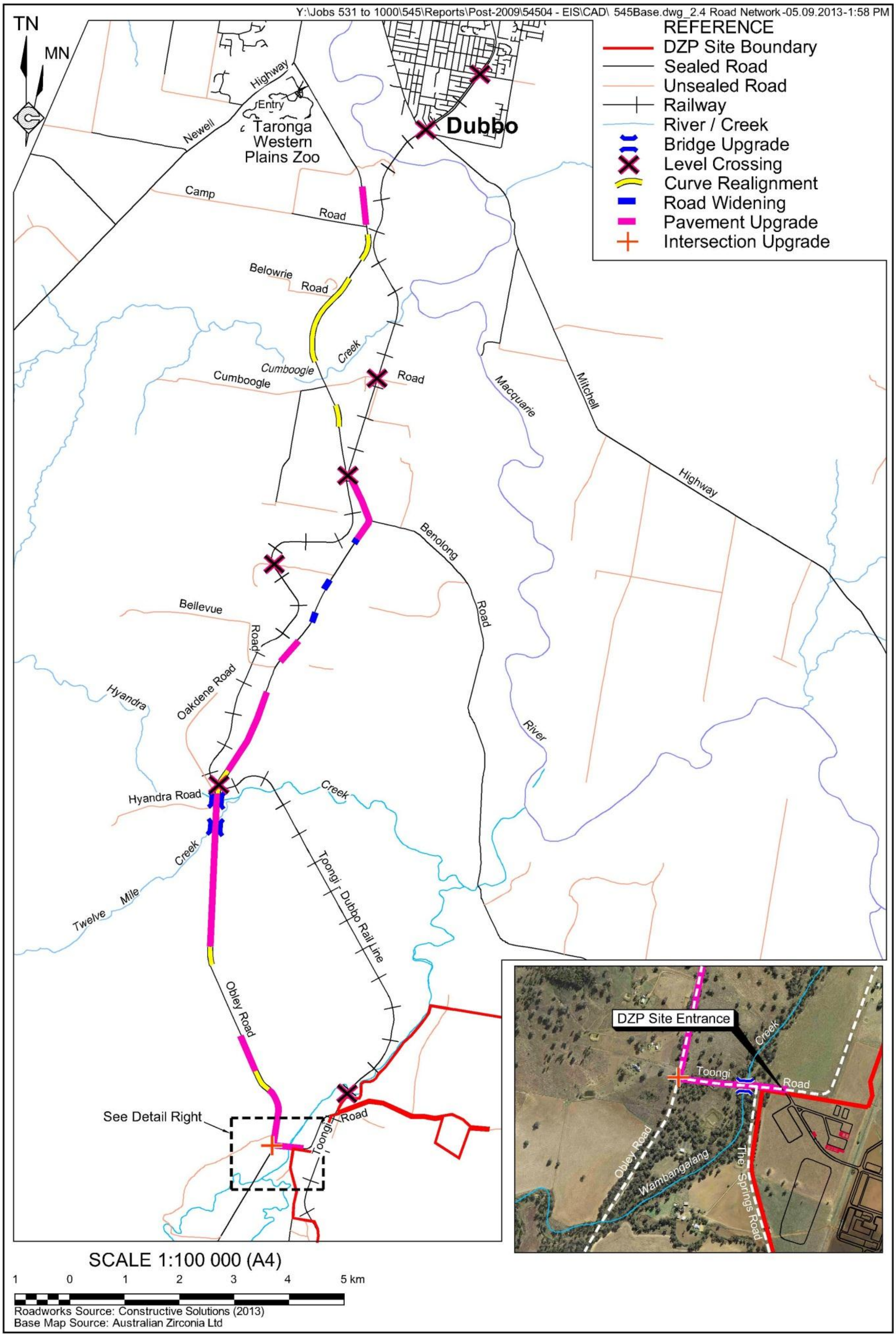


Figure 6 Road Network

ii Contingency Transport Option (B) – Rail to Dubbo / Road to Toongi

In the event that funding for the Toongi-Dubbo Rail Line upgrade cannot be sourced or appropriate rail paths obtained, resulting in a delay or prevention in Preferred Option A being implemented, the Applicant proposes that the bulk reagents of sulphur, caustic soda and hydrochloric acid would be transported from Newcastle to a rail terminal operated by Fletcher International Exports Pty Ltd on the Merrygoen Rail Line north of Dubbo. The reagents would be unloaded at this rail terminal and delivered to the DZP Site by road, utilising an approved heavy haulage route between the rail terminal and the Newell Highway. No B-doubles would be involved in the rail-road transfer, potentially increasing the overall number of heavy vehicles on Obley Road over Option A.

iii Contingency Option (C) – Road Only

In the event that the use of the rail terminal of Fletcher International Exports Pty Ltd becomes unavailable or impractical for unforeseen reasons, the Applicant would transport the majority of processing reagents and other materials (excluding those transported to Dubbo from Sydney by general freight rail) to the DZP Site by road. This contingency option would also be implemented in the event that access to the rail network is delayed for significant periods. Reagents required in bulk quantities such as sulphur, limestone and hydrochloric acid would be transported to the DZP Site primarily by B-double trucks. Reagents required in lower quantities or requiring specialised vehicles (such as quick lime) would be transported by various heavy vehicles appropriate for their particular safe transportation requirements. This option involves more B-double movements than either of the others, yet has a lower overall volume of heavy vehicles than Option (B).

Table 1.3 summarises the likely average daily heavy vehicle movements under each of the three options described above. These totals include movements of processed product by B-double trucks on public roads from the DZP Site. It is estimated there would be 4,230 of these movements (one-way outbound form the DZP Site) each year.

Table 1.3 Daily Truck Movements

Option	Truck Type	Loaded	Empty / Return	Total
Preferred Option (A) – Rail to Toongi / Supplementary Road	B Double	30	30	60
	Single	14	14	28
	Total	44	44	88
Contingency Option (B) – Rail to Dubbo / Road to Toongi	B Double	30	30	60
	Single	49	49	98
	Total	79	79	158
Contingency Option (C) – Road Only	B Double	42	42	84
	Single	27	27	54
	Total	69	69	138

Table 1.3 shows the 'worst case scenario' of 158 daily heavy vehicle movements associated with Contingency Option (B).

1.3.7 Workforce and operating hours

The proposed mine construction workforce would average between 150 and 300 people at any given time during the construction phase.

The proposed mine operation workforce is estimated to employ up to 245 persons at full production in operational and management roles.

Mine construction is expected to generally occur between 7 am and 10 pm Monday to Saturday. Selected activities would be undertaken between 8 am and 6 pm on Sundays, public holidays excluded. However, construction activities unlikely to generate noticeable noise may be undertaken outside these hours (e.g. electrical installation work within the Processing Plant and DZP Site Administration Area).

Mining operations would be undertaken over a single shift (day time only), of between 10 and 12 hours, 5 days per week, public holidays excluded. However, the processing operations would be 24 hours a day, 7 days per week, including public holidays. The processing plant would not be operating during scheduled shutdown events or in response to unforseen incidents.

2 Existing environment

2.1 Sensitive receptors

Receptors that are situated within the proposed DZP Site investigation area (DSIA) would be acquired and are not included in this assessment. Several receptors situated outside the DSIA have the potential to be impacted by the DZP and would be included in the NVIA. **Figure 6** provides a plan identifying receptors outside the MSIA. The sensitive receptors that are potentially affected by noise and vibration from the DZP and are provided in **Table 2.1**.

Table 2.1 Receptors and MGA Coordinates

Receptors	Description	Easting	Northing
R1	Mine owned[1]	648928	6408374
R2	Mine owned[1]	649518	6407265
R3	Mine owned[1]	652919	6405355
R4	Private	654256	6404770
R6	Private	649063	6403861
R7[3]	Private	648900	6404627
R8A	Private	647353	6405878
R8B	Private	646110	6403927
R11	Toongi Hall	648912	6408743
R13	Environmental Education Centre	646114	6404367
R18	Private	645287	6414152
R19	Private	646858	6407722
R20	Private	647417	6407975
R21	Private	645269	6409946
R22	Private	648629	6409049
R23	Private	648720	6409174
R24	Private	648654	6409412
R25	Private	648771	6409589
R26	Private	648196	6410327
R27	Private	646929	6412257
R28A	Private	646768	6412362
R28B	Private	646708	6412616
R30A	Private	648935	6413224
R30B	Private	649289	6413736
R31A	Private	647191	6413882
R31B	Private	647510	6414186
R32	Private	648447	6413958
R35A	Private	652513	6415246
R35B	Private	652904	6415188
R36	Private	653575	6414152
R38	Private	654940	6415361
R40	Private	654414	6413943
R42	Private	655986	6414235
R43	Private	657580	6412249
R46	Private	657040	6409630

Table 2.1 Receptors and MGA Coordinates

Receptors	Description	Easting	Northing
R48	Mine owned	654081	6409619
R49A	Mine owned	654318	6409008
R49B	Mine owned	654559	6409064
R51	Mine owned[1]	650362	6409786
R54	Mine owned	649753	6409460
R55	Mine owned[2]	649851	6409552
R56	Mine owned	649784	6409367
R58	Mine owned[1,2]	650031	6409679
R61	Private	656734	6404316

Note 1: Contractual 'call' agreement exists between the current landowner and AZL to sell on approval of the DZP.

Note 2: Contractual 'put' agreement exists between the current landowner and AZL for sale at agreed price on request by landowner.

Note 3: There are two residences on the "Cockleshell Corner" property, however, due to close proximity these are considered as one receptor.

2.2 Receptors adjacent to transport routes

Receptors potentially impacted by road transport noise include those located on Obley Road, while for rail transport several rural/residential receptors are situated in close proximity to the railway between the DZP and Dubbo.

Within Dubbo several 'hot-spot' areas have been identified that may be affected by rail noise and vibration which include those either side of the railway in the vicinity of Margaret Crescent and Chelmsford Street. **Table 2.2** provides a list of potentially the most affected receptors within close proximity to road and rail transport routes. All transportation options (refer to Section 1.2.6) are considered in this assessment.

Table 2.2 Receptors Adjacent to Transport Routes

Transportation	Route description	Distance to route – nearest receptor (m)
Preferred Option A	Obley Road	65
	Toongi-Dubbo Rail Line	25
Contingency Option B	Obley Road	65
Contingency Option C	Obley Road	65

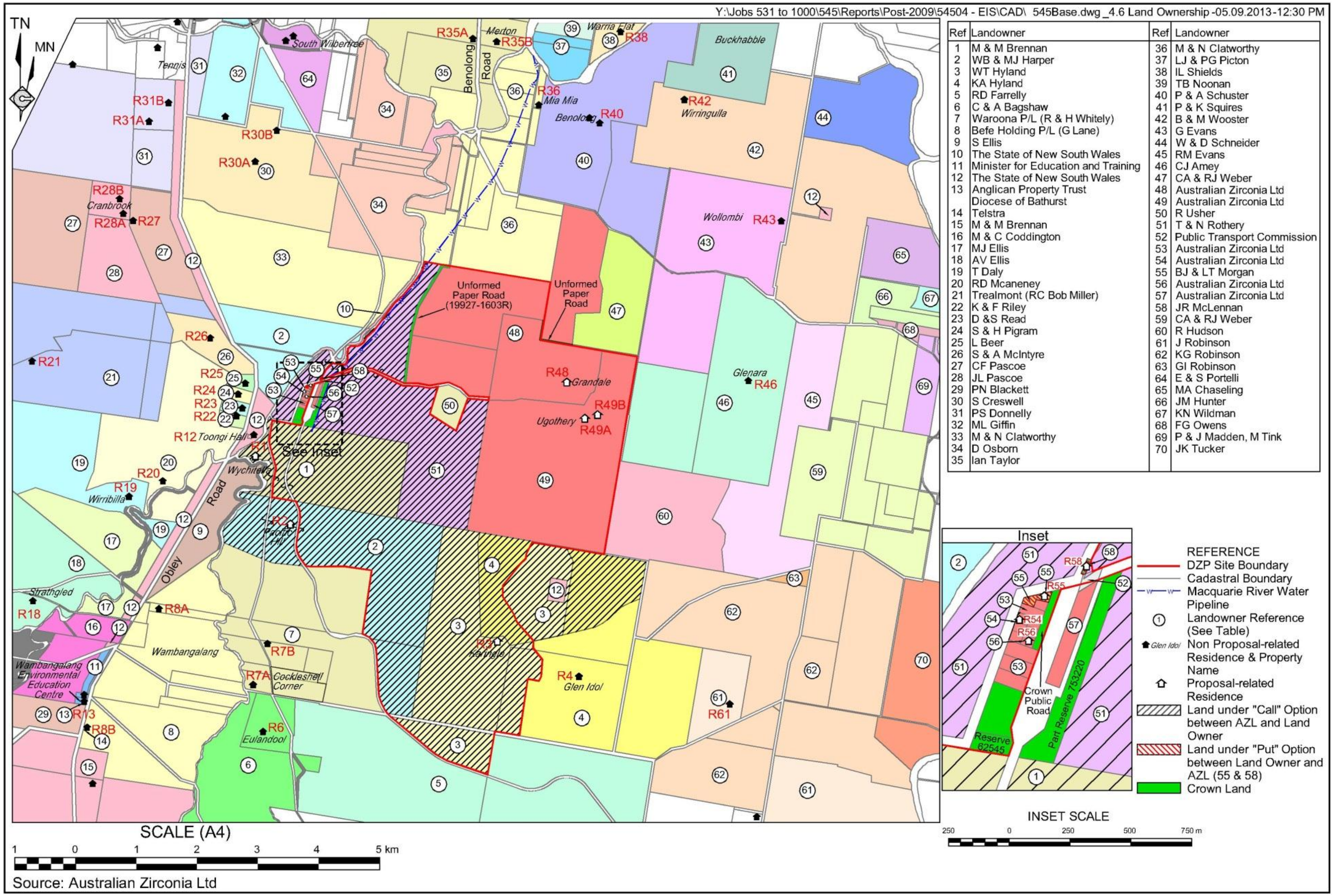


Figure 7 Receptor Plan

2.3 Noise environment

2.3.1 Unattended noise monitoring

Unattended noise logging was conducted in 2001 (RHA, 2001) to quantify the ambient noise environment at surrounding receptors to the DZP. **Table 2.3** reproduces the rating background levels (RBL's) from unattended noise logging undertaken over a 10 day period at five locations surrounding the DZP Site. As shown, the reported RBL values are generally at, or marginally below the INP's minimum recommended threshold of 30 dB(A).

Table 2.3 Historic Unattended Noise Results

Receptor	Rating background level (RBL), dB(A)		
	Day	Evening	Night
Bye (R54)	30	30	27
Grandale (R48)	28	29	28
Pacific Hill (R2)	28	30	30
Wambangalang (R8A)	33	31	28
Wirribilla (R19)	30	33	30

Source: RHA, 2001.

2.3.2 Attended noise surveys

EMM conducted 15-minute attended background noise surveys at three representative receptors within the vicinity of the DZP Site during an inspection conducted on 14 March 2012. The weather conditions at the time of monitoring included clear skies, no rain and mild winds.

Observations from measurements note that the existing ambient noise environment is dominated by rural noise sources with relatively low ambient noise levels.

A summary of the results of the attended noise monitoring are provided in **Table 2.4**.

Table 2.4 Summary of Operator Attended Monitoring Results

Receptor	Time (hrs)	Noise descriptor (dB(A) ref 20µPa)		Observations and typical maximum sound pressure levels (SPL)(dB(A))
		$L_{eq(15\text{-}min)}$	$L_{90(15\text{-}min)}$	
Bye (R54)	10:35	42	30	Rural background 30 to 32, wind 34 to 42.
Karingle (R3)	11:18	44	31	Birds 32 to 46, rural background 30 to 32, wind 35
Cnr Toongi and Obley Road	13:03	48	28	Rural background 28 to 30, traffic 40 to 67, insects/wind 42.

Attended monitoring conducted in March 2012 agrees well with historic long term unattended noise logging for receptors surrounding the DZP Site. Therefore, the historic noise logging data is considered representative of current conditions. For the purposes of the impact assessment, the INP's minimum recommended background level of 30 dB(A) has been adopted for the DZP for all assessment periods.

3 Noise criteria

3.1 Operational noise

3.1.1 Overview

Industrial sites in NSW, including open cut mines, are regulated by the Department of Planning and Infrastructure (DP&I) (if identified as State Significant Development under the EP&A Act) and/or the NSW Environment Protection Authority (EPA) (if production exceeds thresholds limits of the *Protection of the Environment Operations Act 1997*) and usually have a set of conditions for operations that include noise limits. These limits are normally derived from operational noise criteria that apply at sensitive receptors. They are based on guidelines stipulated in the INP (EPA, 2000) or noise levels that can be achieved at a specific site following the application of all reasonable and feasible noise mitigation.

The INP provides guidelines for assessing industrial facilities and has been adopted for this assessment. It states the following with respect to the criteria:

> 'They are not mandatory, and an application for a noise producing development is not determined purely on the basis of compliance or otherwise with the noise criteria. Numerous other factors need to be taken into account in the determination. These factors include economic consequences, other environmental effects and the social worth of the development.'

Assessment criteria depend on the existing amenity of areas potentially affected by a proposed development. Assessment criteria for sensitive receptors near industry are based on the following objectives:

- protection of the community from excessive intrusive noise; and
- preservation of amenity for specific land uses.

To ensure these objectives are met, the EPA provides two separate criteria: namely the intrusiveness criteria and the amenity criteria. A fundamental difference between the intrusiveness and the amenity criteria is the time period they relate to:

- intrusiveness criteria — apply over 15 minutes in any period; and
- amenity criteria — apply to the entire assessment period (day, evening and night).

3.1.2 Intrusiveness

The intrusiveness criteria require that $L_{eq(15\text{-}min)}$ noise levels from a newly introduced source during the day, evening and night do not exceed the existing rating background level (RBL) by more than 5 dB. This is expressed as:

$$L_{eq(15\text{-}min)} \leq RBL + 5 - K$$

where $L_{eq(15\text{-}min)}$ is the L_{eq} noise level from the source (i.e. site), measured over a 15 minute period and K is a series of adjustments for various noise characteristics.

A minimum RBL of 30 dB(A) has been used for this assessment and is considered representative of the ambient acoustic environment.

Table 3.1 presents the base intrusive criteria for the DZP.

Table 3.1 Base Intrusive Criteria

Location	Time period	RBL, dB(A)	Intrusive criteria dB(A), $L_{eq(15\text{-min})}$
Residential properties	Day	30	35
	Evening	30	35
	Night	30	35

Source: INP (EPA, 2000)

3.1.3 Amenity

The amenity assessment is based on noise criteria specific to the land use. The criteria relate only to industrial noise and exclude road or rail noise. Where measured existing industrial noise approaches the base amenity criteria, it needs to be demonstrated that noise levels from new industries would not cause the amenity criteria to be exceeded.

Residential receptors potentially affected by the DZP are covered by the EPA's suburban or rural amenity categories. For sensitive receptors located in and around the DZP, the rural residential category is suitable. For the Toongi Hall and tennis courts, the amenity criterion for passive and active recreation areas has been adopted respectively, for the Wambangalang Environmental Education Centre (WEEC) the school classroom criteria has been adopted. The base amenity criteria for the DZP are given in **Table 3.2**.

Table 3.2 Base Amenity Criteria

Receptor	Indicative area	Time period	Recommended noise level dB(A), Leq,period	
			Acceptable	Maximum
Residential	Rural	Day	50	55
		Evening	45	50
		Night	40	45
Active recreation area	All	When in use	55	60
Passive recreation area	All	When in use	50	55
School classroom	All	Noisiest 1-hour period	35 (internal)	40 (internal)

Source: INP (EPA, 2000)

3.1.4 Project specific noise level

The project-specific noise level (PSNL) is the lower of the calculated intrusive or amenity criteria. The intrusive criteria in **Table 3.3** are therefore adopted as the PSNL for the DZP.

Table 3.3 Project Specific Noise Levels (PSNL)

Receptor	Time period	RBL dB(A)	Intrusive criteria dB(A), Leq(15-min)
All receptors	Day	30	35
	Evening	30	35
	Night	30	35
Receptor	**Time period**	**RBL dB(A)**	**Amenity criteria dB(A), Leq(period)**
Tennis courts (R11)	When in use	N/A	55
Toongi Hall (R11)	When in use	N/A	50
WEEC (R13)	Noisiest 1-hour period	N/A	35

3.2 Zones of impact

Section 1.4.8 of the INP describes zones of impact. The commonly applied approach to zones of impact accepted by DP&I and EPA is provided below.

3.2.1 Noise management zone

The noise management zone is where modelled noise levels are above the PSNL but below the acquisition criteria (see Section 3.2.2). Within the management zone, receptors may experience noise levels up to 5 dB(A) above the PSNL. Depending on the degree of exceedance of the PSNL (1–5 dB), noise impacts in the noise management zone could range from minor (1–2 dB) to moderate (3–5 dB). DP&I recommended management procedures to implement in this zone, including:

- prompt response where issues of concern are raised by community;
- noise monitoring on-site and within the adjacent community;
- that mine operations planning considers on-site noise mitigation measures and plant maintenance procedures and where appropriate includes sound suppression components and preventative maintenance;
- investigation of, and where practical and cost-effective, acoustical treatment/mitigation at receptors where levels are 3–5 dB above PSNL; and
- consideration of negotiated agreements with property owners who are situated above the PSNLs where this process is initiated when the:
  - regulatory authority is satisfied that no further reduction in noise levels can be made through a Viable Mitigation Strategy; and
  - Applicant demonstrates that even when using its best economically viable, reasonable and feasible strategies it cannot achieve the PSNLs.

This negotiation is designed to be available to those whose acoustic amenity is potentially affected by not achieving the PSNLs. While negotiations of an agreed PSNL can occur at this time, further negotiations would be triggered when site noise exceeds the recommended PSNLs. See Section 8 of the INP for a more detailed explanation and examples of negotiated agreements.

3.2.2 Noise affectation zone

The noise affectation zone is where modelled noise levels are more than 5 dB over the PSNL. Implementation of the following measures may be required:

- discussions with relevant property owners to assess concerns and provide solutions;
- implementation of acoustical mitigation at receptors; and
- negotiated agreements with property owners, or acquisition of the property by the Applicant.

While the INP does not specifically deal with acquisition, an acquisition criteria of greater than 40 dB(A)$L_{eq(15\text{-}min)}$ for daytime, evening and night-time periods has been adopted in this assessment for privately owned dwellings. This is consistent with approval conditions issued recently by the DP&I.

This assessment used an acquisition zone and management zone as it has been widely applied in NSW.

AZL is committed to managing noise emissions where noise levels are modelled above the applicable criteria.

3.3 Vacant lands

The acquisition zone for vacant lands has been considered in this assessment for land parcels where more than 25% of the property is affected by an $L_{eq(15\text{-}min)}$ of greater than 40 dB(A) for daytime, evening and night-time periods.

The majority of vacant lands surrounding the DZP are zoned as Zone RU1 – Primary Production. Dubbo City Council enforces a minimum lot size within this zone preventing residential sub-division and/or the building of residences on these lots. Notwithstanding, a noise assessment of vacant lands has been assessed for three properties that are within close proximity to the ZDP.

3.4 Low frequency noise

Section 4 of the INP provides guidelines for applying 'modifying factor' adjustments to account for low frequency noise emissions. The INP states that where there is a difference of 15 decibels or more between 'C' weighted and 'A' weighted levels, then a correction factor of 5 dB is applicable. Section 5.3 of this report provides an assessment of low frequency noise for the DZP.

3.5 Cumulative noise criteria

Cumulative noise emissions from multiple industrial sources may have a significant impact on the acoustic amenity of communities. Following a site visit and review of spatial mapping of the area, no existing significant industrial sources near the DZP Site were identified, therefore cumulative operational noise is not expected to be relevant, and has not been considered in this assessment.

3.6 Sleep disturbance

The most important potential impact of intermittent noise that needs to be considered is disturbing the sleep of nearby residents. The EPA provides guidance on assessing sleep disturbance for industrial sites. The EPA nominates that a screening criteria of background noise level (L_{90}) plus 15 dB shall apply to maximum noise level events from the DZP site which are to be calculated at one metre from the bedroom facade at the nearest residential properties. Where noise levels have been calculated above the screening criteria, additional analysis should be undertaken, referencing guidance on maximum noise levels and sleep disturbance listed in the RNP (EPA, 2011). This guidance states:

- maximum internal noise levels below 50 to 55 dB(A) are unlikely to wake sleeping occupants; and
- one or two noise events per night, with maximum internal noise levels of 65-70 dB(A), are not likely to affect the health and well being of occupant's significantly.

It is commonly accepted by acoustic practitioners and regulatory bodies that a partially open window would reduce external noise levels by 10 dB(A). Therefore, external noise levels in the order of 60-65 dB(A) calculated at the facade of a residence are unlikely to cause sleep disturbance affects at worst case (i.e. with windows open). Similarly, the World Health Organisation (WHO, 1999) suggest that levels below 45 dB(A) inside homes are unlikely to wake sleeping occupants.

The descriptors L_{max} and L_1 may be considered interchangeable which is accepted by EPA.

If noise levels over the screening criteria were identified, then additional analysis would consider factors such as:

- How often the events would occur;
- The time the events would occur (between 10 pm and 7 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).

3.7 Construction

3.7.1 Construction noise unrelated to mining areas

Noise associated with construction activities for extractive industries are often assessed as operational noise, as emissions from plant and associated equipment are similar. However, construction works away from the mining area include the off-site construction of the gas pipeline corridor, water pipeline, rail line and Obley Road upgrades. These activities have several differences when compared to mining activities, including a short duration compared with the proposed operational life of the DZP. They are separate from the mining and processing areas and involve using some machinery unique to construction that would not be used during mining.

Construction noise would be assessed in accordance with the Department of Environment and Climate Change's (DECC, 2009) *Interim Construction Noise Guideline* (ICNG). The ICNG provides two methodologies to assess construction noise emissions:

- quantitative, which is suited to major construction projects with typical durations of more than three weeks; and
- qualitative, which is suited to short-term infrastructure maintenance of less than three weeks.

A quantitative assessment requires noise emission predictions from construction activities at the nearest receptors, while the qualitative assessment is a simplified approach that relies more on noise management strategies.

This study has adopted a quantitative assessment approach. The qualitative aspects of the assessment include identification of receptors, description of works involved and proposed management measures that include a complaints handling procedure.

Table 3.4 provides noise management levels for residential receptors reproduced from the ICNG (DECC, 2009).

Table 3.4 Construction Noise Criteria for Residences

Time of day	Management level $L_{eq(15\text{-}min)}$	Application
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	The noise-affected level represents the point above which there may be some community reaction to noise. • Where the predicted or measured $L_{eq(15\text{-}min)}$ is greater than the noise-affected level, the Applicant should apply all feasible and reasonable work practices to meet the noise affected level. • The Applicant 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: i) 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); ii) 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 strong justification would typically be required for works outside the recommended standard hours. • The Applicant 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 Applicant should negotiate with the community. • For guidance on negotiating agreements see Section 7.2.2 of the ICNG.

Source: ICNG (DECC, 2009)

Section 2.2 of the ICNG recommends the following standard hours for construction where noise from these activities is audible at residential premises:

- Monday to Friday 7 am to 6 pm;
- Saturday 8 am to 1 pm; and
- no construction work is to take place on Sundays or public holidays.

The ICNG recommends that noise levels at receptors as a result of construction activities during standard working hours are limited to an $L_{eq\ (15\text{-}min)}$ of RBL+10 dB(A) with a highly noise-affected maximum of 75 dB(A). The DZP specific construction noise criteria for recommended standard hours based on an RBL of 30 dB(A), is 40 dB(A) $L_{eq(15\text{-}min)}$. Furthermore, it is recommended that outside of these standard hours, noise at receptors is to be limited to an $L_{eq\ (15\text{-}min)}$ of RBL+5 dB(A), and only where out-of-hours works can be strongly justified.

3.7.2 Construction noise characteristic of mining activities

Noise associated with construction activities close to the mining and processing operations includes the construction of the processing plant, rail laydown and container storage and administration areas residue storage facilities, haul road, open cut, WRE and salt encapsulation cells (SECs). Noise associated with these activities is assessed against the operational criteria (PSNL).

3.7.3 Construction vibration

In the absence of an Australian Standard for structural effects from construction vibration, the construction vibration assessment would reference German Standard DIN 4150-3 1999 "*Structural Vibration Part 3: Effects of Vibration on Structures*" (see Section 3.12).

3.8 Road traffic

3.8.1 Assessment criteria

The road traffic noise assessment would be conducted in accordance with the RNP.

The freeway/arterial/sub-arterial road type has been adopted for the Newell Highway and Obley Road. **Table 3.5** presents the road noise assessment criteria reproduced from Table 3 of the RNP.

Table 3.5 Road Traffic Noise Assessment Criteria for Residential Land Uses

Road category	Type of project/development	Assessment criteria, dB(A)	
		Day (07.00 am to 10.00 pm)	**Night (10.00 pm to 07.00 am)**
Freeway/arterial/sub-arterial roads	Existing residences affected by additional traffic on existing freeway/arterial/sub-arterial roads generated by land use developments.	$L_{eq(15\text{-}hr)}$ 60 (external)	$L_{eq(9\text{-}hr)}$ 55 (external)

Additionally, the RNP states where existing road traffic noise criteria are already exceeded, any additional increase in total traffic noise level should be limited to 2 dB, which is generally accepted as the threshold of perceptibility to a change in noise level.

3.8.2 Relative increase criteria

In addition to meeting the assessment criteria, any significant increase in total traffic noise at receptors must be considered. Receptors experiencing increases in total traffic noise levels above those presented in **Table 3.6** should be considered for mitigation.

Table 3.6 Relative Increase Criteria for Residential Land Uses

Road Category	Type of project/development	Total traffic noise level increase - dB(A)	
		Day (07.00 am to 10.00 pm)	**Night (10.00 pm to 07.00 am)**
Freeway/arterial/sub-arterial roads and transit ways	New road corridor/redevelopment of existing road/land use development with the potential to generate additional traffic on existing road.	Existing traffic $L_{eq(15\text{-}hr)}$+12 dB (external)	Existing traffic $L_{eq(9\text{-}hr)}$+ 12 dB (external)

3.9 Offsite rail noise criteria

3.9.1 Overview

The *Rail Infrastructure Noise Guideline* (RING) has been issued by the EPA (2013), the RING supersedes both the Interim Guideline for Assessment of Noise from Rail Infrastructure Projects (IGANRIP) and the existing EPA policy on rail traffic generating developments.

Furthermore, the Australian Rail Track Corporation (ARTC) Environmental Protection Licence (EPL) 3142 provides rail noise emission criteria that are relevant to the DZP. Condition L6.1 is reproduced below and will be considered for the NVIA.

> *'L6.1.1 General Noise Limits:*
>
> *It is an objective of this Licence to progressively reduce noise levels to the goals of 65 dB(A)Leq, (day time from 7am – 10pm), 60 dB(A)Leq, (night time from 10pm – 7am) and 85dB(A) (24 hr) max pass-by noise, at one metre from the façade of affected residential properties through the implementation of the Pollution Reduction Programs.'*

3.9.2 Airborne noise trigger levels for heavy rail

The airborne noise trigger levels address an increase in rail noise due to rail infrastructure projects and absolute levels of rail noise. The RING requires that rail noise and the absolute level of rail noise meet the trigger values, where exceeded, an assessment of rail noise impacts should be undertaken.

RING noise trigger levels relevant to the DZP are provided in **Table 3.7**.

Table 3.7 Airborne Rail Traffic Noise Trigger Levels for Residential Land Uses

Type of development	Noise trigger levels dB(A) (External)	
	Day (7 am to 10 pm)	**Night (10 pm to 7 am)**
Redevelopment of existing rail line	Development increases existing $L_{eq(period)}$ rail noise levels by 2dB or more, or existing L_{max} rail noise levels by 3dB or more	
	65 $L_{eq(15\text{-}hr)}$ 85 L_{max}	60 $L_{eq(9\text{-}hr)}$ 85 L_{max}

Note: 1.The trigger levels presented in this table should be read with the technical notes of Tables 1 and 3 of the RING.

For land uses other than residential, the RING trigger values are shown in **Table 3.8**.

Table 3.8 Airborne Rail Noise Trigger Levels Applicable to Heavy and Light Rail Developments for Sensitive Land Uses Other than Residential

Other Sensitive land use	Noise trigger levels dB(A) (when in use)
	Redevelopment of existing railway
	Development increases existing rail noise levels by 2 dB(A) or more in L_{eq} for that period *and* resulting rail noise levels exceed:
Schools, educational institutions - internal	45 $L_{eq(1\text{-}hr)}$ internal
Places of worship - internal	45 $L_{eq(1\text{-}hr)}$ internal
Hospital wards	40 $L_{eq(1\text{-}hr)}$ internal
Hospitals – other uses	65 $L_{eq(1\text{-}hr)}$ external
Open space	65 $L_{eq(24\text{-}hr)}$ external

Note: The trigger levels presented in this table should be read with the technical notes that follow Table 3 of the RING.

3.9.3 Ground-borne noise trigger levels

Ground-borne noise is noise generated inside a building by ground-borne vibration from trains passing by. Section 2.5 of the RING (EPA, 2013) states:

> '*Groundborne noise level values are relevant only where they are higher than the airborne noise from railways (such as in the case of an underground railway) and where the groundborne noise levels are expected to be, or are, audible within habitable rooms.*'

The DZP would use an above-ground rail network and does not include an underground section of rail. As the proposed rail movements are not expected to generate ground-borne noise in a receiving building that is higher than airborne noise, the issue does not require further consideration.

3.10 Transport related vibration

Vibration impacts associated with transport would be assessed in accordance with the Department of Environment and Conservation (DEC) *Assessing vibration: A technical guideline* (DEC, 2006).

3.11 Blasting criteria

The limits adopted by EPA for blasting are provided in the Australian and New Zealand Environment Conservation Council (ANZECC, 1990) guidelines, *Technical basis for guidelines to minimise annoyance due to blasting overpressure and ground vibration*.

The blasting limits address two main effects of blasting:

- airblast noise overpressure; and
- ground vibration.

3.11.1 Airblast

The recommended maximum vibration level for airblast is 115 dB linear peak. The vibration level of 115 dB may be exceeded on up to 5% of the total number of blasts over 12 months. However, the level should not exceed 120 dB linear peak at any time.

3.11.2 Ground vibration

Peak particle velocity (PPV) from ground vibration should not exceed 5 mm/s for more than 5% of the total number of blasts over 12 months. However, the maximum level should not exceed 10 mm/s at any time.

A summary of blast limits are provided in **Table 3.9**.

Table 3.9 Airblast Overpressure and Ground Vibration Limits

Airblast overpressure level dB(L_{peak})	**Allowable exceedance**
115	5% of the total number of blasts over 12 months
120	0%
Ground vibration	
Peak particle velocity (mm/s)	**Allowable exceedance**
5	5% of the total number of blasts over 12 months
10	0%

3.12 Structural vibration from rail

Another consideration with respect to vibration can be related structural vibration with the potential to cause damage to buildings. For structural damage, vibration should be assessed at the foundation of the structure in question.

In the absence of an Australian standard for structural vibration damage threshold, we have considered the *German Standard DIN 4150: Part 3-1999 "Structural vibration Part 3: Effects of vibration on structures"*. This provides guideline levels of vibration velocity for evaluating the effects of vibration in structures. The limits presented in this standard are generally recognised to be conservative.

The DIN 4150 values (maximum levels measured in any direction at the foundation, OR maximum levels measured in (x) or (y) horizontal directions, in the plane of the uppermost floor), are summarised in **Table 3.10**. For residential type structures, the standard recommends safe limits as low as 5mm/s, with limits increasing with frequency values above 10Hz. This assessment has adopted Line 2 as the limiting criteria, being that for residential type structures.

Table 3.10 Structural Vibration Velocity Guideline Values

Line*	Type of Structure	Vibration Velocity in mm/s			
		At Foundation at a Frequency of			Plane of Floor of Uppermost Storey
		Less than 10Hz	10Hz to 50 Hz	50Hz to 100Hz	All Frequencies
1	Buildings used for commercial purposes, industrial buildings and buildings of similar design	20	20 to 40	40 to 50	40
2	Dwellings and buildings of similar design and/or use	5	5 to 15	5 to 20	15
3	Structures that because of their particular sensitivity to vibration do not correspond to those listed in Lines 1 or 2 and have intrinsic value (e.g. buildings that are under a preservation order)	3	3 to 8	8 to 10	8

Notes: *1. *line refers to curves in Figure 1 of DIN4150.*
2. for frequencies above 100Hz the higher values in the 50Hz to 100Hz column should be used.
3. bold identifies the criteria adopted for the assessment of potential heritage receptors in this assessment.

These levels are "safe limits", for which damage due to vibration effects is unlikely to occur. "Damage" is defined in DIN 4150 to include even minor non-structural effects such as superficial cracking in cement render, the enlargement of cracks already present, and the separation of partitions or intermediate walls from load bearing walls.

Should such damage be observed without vibration levels exceeding the "safe limits" then it is likely to be attributable to other causes. DIN 4150 also states that when vibration levels higher than the "safe limits" are present, it does not necessarily follow that damage will occur.

As indicated by the criteria from DIN 4150, high frequency vibration has less potential to cause damage than lower frequencies.

4 Noise modelling methodology and parameters

4.1 Introduction

This section presents the methods and base parameters used to model noise emissions from the DZP, including the effect of prevailing meteorological conditions. The assessment was conducted in accordance with the following policies and guidelines:

- *The NSW Industrial Noise Policy* (EPA, 2000);
- *The NSW Road Noise Policy* (DECCW, 2011);
- *Rail Infrastructure Noise Guideline* (RING) (EPA, 2013);
- German Standard DIN4150 - Part 3: 1999;
- *Technical basis for guidelines to minimise annoyance due to blasting overpressure and ground vibration* (ANZECC, 1990); and
- *The Interim Construction Noise Guideline* (DECC, 2009).

Noise modelling was based on three-dimensional digitised ground contours of the surrounding land, mine pits and overburden emplacement areas for three stages of the DZP. The DZP plans represent snapshots, with equipment placed at various locations and heights, representing realistic operating scenarios for each stage of the DZP (see **Appendix A**).

Noise predictions were carried out using Brüel and Kjær Predictor Version 8.11 noise prediction software. 'Predictor' calculates total noise levels at receptors from the concurrent operation of multiple noise sources. The model considers factors such as:

- the lateral and vertical location of plant;
- source-to-receptor distances;
- ground effects;
- atmospheric absorption;
- topography of the mine and surrounding area; and
- applicable meteorological conditions.

4.2 Meteorology

4.2.1 Prevailing Conditions

The INP provides procedures for identifying and combining prevailing meteorological conditions at a site (referred to as a 'feature' of the area) and assessing the noise levels against the relevant criteria.

4.2.2 Wind

Wind has the potential to increase noise impacts at a receptor when it is relatively light and stable and blows from the direction of the noise source. As the strength of the wind increases the noise produced by the wind usually obscures noise from most industrial and transport sources.

The prevailing wind directions in the area have been determined in accordance with Section 5 of the INP. The NSW INP requires that winds at or below 3m/s with an occurrence greater than 30 per cent of the time be assessed.

4.2.3 Temperature inversions

During wind and temperature gradient conditions (e.g. temperature inversions), noise levels at receptors may increase or decrease compared with noise during calm conditions. This change is due to refraction caused by the varying speed of sound with increasing height above ground. The noise level received increases when the wind blows from source to receptors or under temperature inversion conditions. Conversely, the noise level decreases when the wind blows from receptors to source or under temperature lapse conditions.

The default inversion parameter for 'F' class stability has been adopted in the NVIA. Additionally, the INP suggests that for areas classed as arid/semi-arid (i.e. areas with <500mm average rainfall), 'G' class stability should also be assessed. However, a screening analysis using on-site sigma theta data, in accordance with section E4 of the INP, indicates that the prevalence of 'G' Class stability is <30% occurrence.

4.2.4 Drainage flow

Drainage flow winds have the potential to occur during night time hours. It is noted that only processing operations are proposed for during the night with mining and all other DZP Site activities to be undertaken during day hours. The processing area has a lower relative height to surrounding receptors, therefore, drainage flows are not considered to be applicable for this assessment.

4.2.5 Meteorological analysis

Detailed analysis of winds was undertaken using historical weather data obtained from the DZP Site (*P.Zib & Associates Pty Limited, 2012*). The prevailing winds analysis has taken into account continuous weather data over a two year period (2007 and 2008).

Analysis determined prevailing winds are dominant in the area during the evening and night periods, and at most times there is a direct prevailing wind from site to the nearest residential receptors. The detailed analysis of wind speed and direction is provided in **Appendix B**.

Prevailing winds (±45^{o}) and associated speed for each season and period are summarised in **Table 4.1**.

Table 4.1 Calculated Prevailing Wind Conditions

Season	Period	Wind speed (m/s) (10th percentile)	Direction (degrees)	Percentage occurrence (%)
	Day	n/a	n/a	<30
Summer	Evening	n/a	n/a	<30
	Night	2.6	45, 67.5	33, 35
	Day	n/a	n/a	<30
Autumn	Evening	2.5	202.5	34
	Night	2.4	202.5	64
	Day	1.8	270	31
Winter	Evening	2.6	202.5	47
	Night	2.4	202.5	68
	Day	n/a	n/a	<30
Spring	Evening	2.6	180	31
	Night	2.4	202.5	59

Temperature inversion data was not available and the INP default inversion parameters have been adopted.

The analysis identified the meteorological conditions that were considered applicable in the noise modelling as shown in **Table 4.2**.

Table 4.2 Modelled Meteorological Conditions

Period	Scenario	Wind speed (m/s)	Direction (degrees)	Inversion class
Day				
	Calm	0	N/A	N/A
	Prevailing	1.8	270	N/A
Evening				
	Calm	0	N/A	N/A
	Prevailing	2.6	All	N/A
Night				
	Calm	0	N/A	N/A
	Prevailing	2.6	All	N/A
	Inversion	0	N/A	F

4.3 Operational noise modelling

4.3.1 Modelled Scenarios

The results presented assume the maximum number of plant and equipment are operating simultaneously and at full power. In practice, such operating scenarios would rarely occur. The noise predictions are therefore conservative.

The plans used for modelling (Year 1, Year 5 and Year 15) were supplied by AZL and modified by EMM in consultation with RWC. These years are considered representative of the various stages of mining, processing, delivery and dispatch operations over the life of the DZP.

The noise model was configured to predict the total L_{eq} noise levels from all operations. The operation stages were modelled to determine the potential acoustic impact from the DZP on surrounding receptors for all meteorological conditions identified in Section 4.1. Noise from all sources that contribute to the total noise level from the DZP were assessed. The DZP operations plans and plant item locations for each modelled stage are presented in **Appendix B**. It should be noted that Year 1 also includes plant items and their location for the construction phase.

Two activities have the potential to contribute to the total noise emissions from DZP Site, processing and extraction. Extraction would occur during day time only and processing is proposed to occur 24 hours every day.

Table 4.3 summarises the acoustically significant noise sources and associated sound power levels for the DZP. Items of plant deemed acoustically insignificant (such as small pumps and compressors) were not included in this assessment. **Appendix C** provides indicative plant and equipment model and total sound power levels.

Table 4.3 Processing and Extraction Plant Sound Power Levels

Description	Lw, $L_{eq(15\text{-}min)}$, dB(A)
Processing	
Rock breaker	121
Crushing and ore handling (primary jaw)- unmitigated[1]	124
Crushing and ore handling (medium and fine cone crusher) - unmitigated	117
Limestone mill- unmitigated	117
Conveyor (2x 300mm idler roll length)	68/m
Extraction	
Dozer	116
Drill rig	114
Excavator	107
Forklift	87
Front-end loader (FEL)	116
Grader	104
Haul truck (medium size)	108
Light/Support vehicle	76
Lighting plant	98
Road truck	102
Road truck idling	90
Train idle	92

Note 1: includes a 5dB(A) modifying factor for low frequency.

4.3.2 Reasonable and Feasible Noise Mitigation

Preliminary noise modelling was completed and identified several receptors where residual noise impacts were applicable. Notwithstanding, acoustically significant plant contributing to elevated noise levels at these receptors were comprehensively reviewed with the intension of reducing noise levels, substituting them as a source or removing them from operations. **Table 4.4** provides a summary of reviewed reasonable and feasible noise management and controls, along with a justification for adopting each option.

i Crushing and ore handling

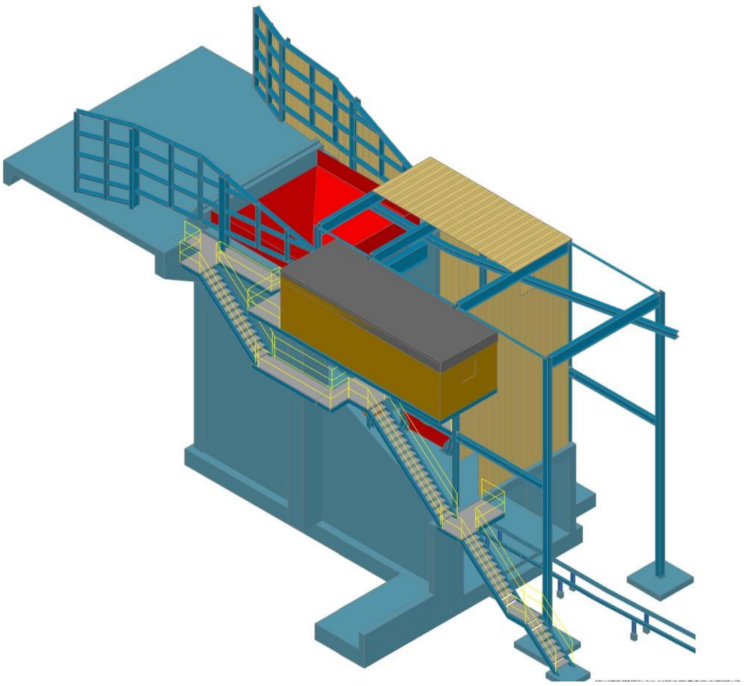
The main acoustic contributor to elevated noise levels to receptors surrounding the DZP Site was identified to be the crushing and ore handling circuit. Therefore, noise mitigation for this area was comprehensively reviewed with the aim of achieving compliance at neighbouring receptors. Based on discussion with the Applicant, the initial noise model has been modified to incorporate a partial enclosure/screen of the crushing and ore handling circuit. The preliminary model adopted a full enclosure that housed the crusher (found to be the main acoustic noise source) was not a practical or safe mitigation option.

Subsequently, the model was modified to incorporate semi enclosed barrier/screen adjacent to the western side of the primary crusher and ore handling circuit. The height of the barrier was modelled at 1m higher than the acoustic centre of the crusher and 3m higher than the ore handling circuit acoustic centre.

Figures 8 and **9** present the detailed concepts for the proposed semi enclosed barriers/screens to be constructed. Section 6.1.2 provides a more detailed assessment of the proposed application of reasonable and feasible mitigation for the DZP.

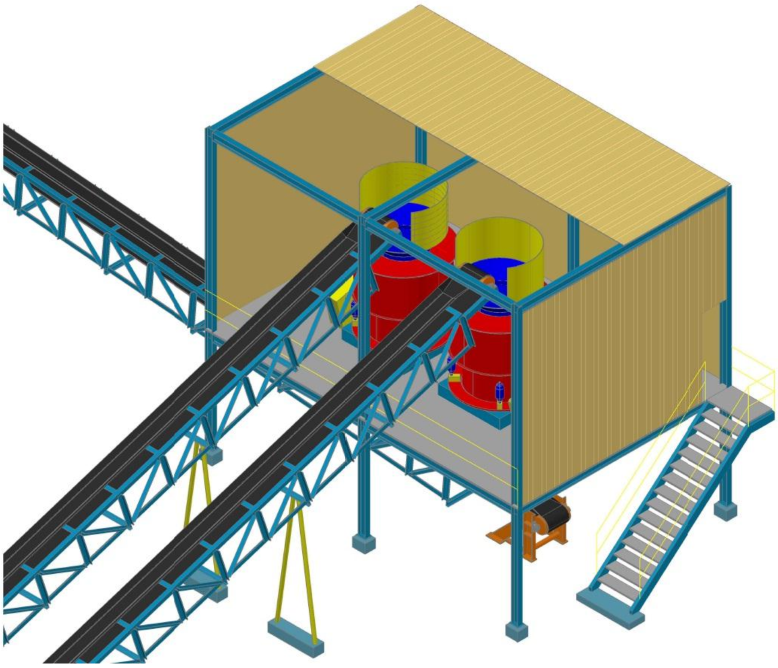
Table 4.4 Reasonable and feasible noise mitigation and management considered for Project

Reasonable and feasible measures	Adopted?	Justification
	Operational noise	
500m long barrier western boundary, adjacent to crushing and processing	No	Topography of western receivers would negate any barrier attenuation. Elevated sources, including crusher would remain in clear line of site.
Enclosing crushing and ore handling	No	Enclosed space not feasible due to OH&S requirements
Substitution of plant	No	Crushing of material unavoidable
Scheduling	Yes	Extraction has been limited to day period only
Elimination	Yes	The rock hammer, previously proposed to be used adjacent to the processing area has been relocated to the extraction pit.
Barrier/cladding	Yes	Barriers have been optimised adjacent to the crushing and ore handling facility to maximise attenuation and to meet PSNLs at nearby western receptors.
	Sleep disturbance	
300m long barrier western boundary, adjacent to rail load out	No	Topography of western receivers would reduce effectiveness of attenuation. Approximate costing ~$210,000 for 2 dB(A) attenuation.
Installation of duratray (lining) on rail wagons	No	Uncertainty as to what wagons would consistently be returning to site and that treatments would remain in place.
Scheduling	Yes	AZL commit to not loading trains during night, with the exception of times where rail pathway availability result in night time loading being unavoidable.
Elimination	Yes	Loading of rail wagons would avoid metallic impacts. Staff will be trained and instructed to avoid generating impact noise when loading material on rail wagons. This commitment will be strictly enforced and incorporated into noise management plans and procedures for site.



Source: Engineering and Project-Management Services

Figure 8 Proposed crushing barrier/screen



Source: Engineering and Project-Management Services

Figure 9 Proposed ore handling barrier/screen

4.4 Construction noise modelling

4.4.1 Introduction

Construction would take up to two years and would take place across a number of areas. Activities assessed against the recommended ICNG criteria (i.e. background + 10 dB(A) criteria) include water and gas pipelines, the rail upgrade, bridges, and road upgrade. It should be noted that several of these activities including water and gas pipeline, the rail upgrade and the Wambangalang Creek Bridge upgrade would also take place within the DZP Site boundary. All on-site construction activities have been assessed as construction, however adopt the operational site noise criteria (i.e. background + 5 dB(A) criteria).

Noise associated with the remaining activities taking place within the DZP Site have also been assessed as construction site noise and include the site access road, processing plant and administration area, residue storage facility areas (LRSF and SRSF), haul road, open cut, WRE and SECs. Construction of the LRSF, SRSF, WRE and SECs may overlap extraction operations, therefore these activities have been assessed adopting the operational site noise criteria (i.e. background + 5 dB(A) criteria).

4.4.2 Toongi-Dubbo Rail Line upgrade and gas pipeline

The natural gas pipeline would be constructed within the Toongi-Dubbo Rail Line easement. The construction assessment of the off-site gas pipeline corridor and the Toongi-Dubbo Rail Line upgrade assumes sequential rather than a simultaneous construction scenario. The nearest receptors to the gas pipeline and rail line corridor are located in the vicinity of Margaret Crescent and Chelmsford Street. The noise levels associated with these two construction activities are calculated at the nearest receptor situated 25 m from the rail line and gas pipeline corridor.

4.4.3 Obley Road upgrade and water pipeline

The off-site construction of the water pipeline and the upgrade of Obley Road is also modelled separately. Generally, most off-site construction tasks are transient in nature and result in a greater number of receptors being exposed to elevated noise levels for a short period of time.

4.4.4 Obley Road bridges

The upgrade of Hyandra Creek bridge and Twelve mile Creek bridge along Obley Road are modelled sequentially. The total duration of several static activities such as bridge construction/upgrades would occur for several weeks. The predicted noise levels for these construction activities would be calculated at their respective nearest receptors.

4.4.5 LRSF, SRSF, WRE and SECs construction

Several LRSF, SRSF, WRE and SECs are to be constructed within the DZP Site boundary. While the LRSF is expected to be completed prior to extraction operations, some overlap may eventuate with mining and processing operations. Also it is expected that parts of the SRSF, WRE and SECs would also be constructed later in the DZP's life after mining and processing operations have started.

4.4.6 Construction plant sound power levels and associated activities

Table 4.5 summarises noise sources and associated sound power levels for typical plant used in the construction phase of the DZP. **Appendix C** provides indicative plant and equipment model details and total single octave sound power levels.

Table 4.5 Construction Plant Sound Power Levels

Description	Lw, $L_{eq(15\text{-}min)}$, dB(A)
Backhoe/small excavator	103
Compactor	116
Crane	106
Dozer	116
Excavator	107
Front-end loader (FEL)	116
Generator	98
Grader	104
Haul truck	108
Jackhammer	107
Light/Support vehicle	76
Pneumatic wrench	97
Road truck	102
Road truck idling	90
Scraper	110
Trencher	108
Tamping machine	116
Vibrating roller	116
Water truck	103
Welding truck	96

5 Noise impact assessment results

5.1 Operations noise modelling results

The predicted noise levels for each meteorological condition are provided in **Table 5.1** for privately owned residential and recreational receptors, and receptors with a contractual agreement in place with AZL. **Figure 7** provides the locations of residential and recreational receptors on and surrounding the DZP.

The bold text indicates receptors where noise predictions fall into the management zone (i.e. 1–5 dB above the PSNL), while receptors identified to be within the affectation zone (i.e. >5 dB above the PSNL) are shaded

The predicted noise levels with mitigated plant for calm, prevailing wind and inversion meteorology are below acquisition levels at all privately owned receptors (see **Table 5.1**).

Noise contours (**Appendix D**) have been prepared for the following operational stages and meteorological conditions:

- Year 1: calm, prevailing wind and temperature inversion meteorological conditions, $L_{eq(15\text{-}min)}$ dB(A);
- Year 5: calm, prevailing wind and temperature inversion meteorological conditions, $L_{eq(15\text{-}min)}$ dB(A); and
- Year 15: calm, prevailing wind and temperature inversion meteorological conditions, $L_{eq(15\text{-}min)}$ dB(A).

The noise model predictions have been assessed by comparing the calm, winds and temperature inversion results to the INP criteria for all modelled scenarios. Receptors predicted to be within the noise management zone or within the noise affectation zone, during adverse weather conditions are presented in **Table 5.2**.

Table 5.1 Receptors Above Management Zone and Affectation Zone Criteria During Adverse Weather Conditions

Noise management zone (>35 dB(A) to ≤40 dB(A))	Noise affectation zone (>40 dB(A))
Privately owned receptors	
None	None
Receptors with a contractual agreement in place with AZL	
R3	R1
R51	R2
R58	R55

Note: Excludes duplicated receptors from each stage. Receptors owned by the DZP have been excluded from this summary.

During night time and max prevailing wind conditions for all years of the DZP, it is predicted that all private receptors would experience noise levels below the operational criteria for all assessment periods and all stages of the DZP life.

Further, it is predicted that three of the receptors with a contractual agreement in place with AZL would experience noise levels above the operational criteria (i.e. >35 dB(A)). Three of the receptors are predicted to experience noise levels above the likely acquisition criteria (i.e. >40 dB(A)). These receptors have agreements with AZL to be acquired if development consent is granted.

Table 5.2 Predicted Operational Noise Levels - dB(A), $L_{eq(15\text{-}min)}$

ID	PSNL	Year 1 – Day		Year 1 – Night			Year 5 – Day		Year 5 – Night			Year 15 – Day		Year 15 – Night		
		Calm	**Winds**	**Calm**	**Winds**	**Inversion**	**Calm**	**Winds**	**Calm**	**Winds**	**Inversion**	**Calm**	**Winds**	**Calm**	**Winds**	**Inversion**
Privately owned receptors																
R11 (Hall)	50	35	38	≤35	39	37	≤35	≤35	≤35	39	40	≤35	≤35	≤35	39	37
R11 (Tennis court)	55	35	38	≤35	39	37	≤35	≤35	≤35	39	40	≤35	≤35	≤35	39	37
R13 (WEEC)[7]	35[1]	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35
All remaining private receptors	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35
Receptors with a contractual agreement in place with AZL																
R1	35	**36**	**38**	**36**	**40**	**38**	**36**	≤35	≤35	**41**	**42**	**36**	≤35	**36**	**40**	**38**
R2	35	**41**	**39**	**41**	**46**	**43**	**41**	**40**	≤35	**46**	**46**	**41**	**41**	**41**	**45**	**43**
R3	35	≤35	≤35	≤35	**39**	**39**	≤35	**37**	≤35	**39**	≤35	**37**	**39**	≤35	**37**	≤35
R51	35	≤35	≤35	≤35	35	≤35	≤35	≤35	≤35	**36**	**40**	≤35	≤35	≤35	**36**	≤35
R55	35	≤35	**37**	≤35	**38**	**36**	≤35	≤35	≤35	**39**	**41**	**36**	35	≤35	**39**	**36**
R58	35	≤35	**36**	≤35	**36**	≤35	≤35	≤35	≤35	**36**	**40**	≤35	≤35	≤35	**36**	≤35

Notes: *1. internal criteria apply when WEEC is in use;*

2. calm: no wind or temperature gradient;

3. winds: max prevailing wind;

4. inversion: F class;

5. bold - receptors that fall into the management zone; shaded – receptors that fall into affectation zone.

6. all results include modification factor correction(+5dB(A)) applied to crushing plant due to low frequency noise.

7. levels presented are external

5.2 Vacant land noise assessment

Noise predictions consider three vacant land parcels adjoining the DZP Site. Receptor 13 (Crown land) has been identified as likely to experience operational noise levels greater than the acquisition zone of 40 dB(A), $L_{eq(15\text{-}min)}$ over 25% the land area. AZL has commenced negotiations with the Department of Primary Industries - Catchments and Lands (DP1-C&L).

Receptors 50 and 53 are in close proximity to the DZP, however, modelling identifies that these properties would not experience operational noise levels greater than 40 dB(A), $L_{eq(15\text{-}min)}$ over more than 25% of their land area, and therefore, are not within the acquisition zone.

5.3 Low frequency operational noise modelling results

Another consideration in assessing operational noise is the potential of 'low' frequency content. The INP recommends a 5dB penalty if sources are perceived to exhibit low frequency noise at receptors, defined by received dB(C) noise being 15dB or more than received dB(A) noise levels.

Results in **Table 5.1** include a 5dB modifying factor to the crushing plant for low frequency.

5.4 Sleep disturbance assessment

People asleep in their homes may be disturbed by intermittent noises. The likely source on the DZP Site that has the potential to generate significant L_{max} events is associated with unloading/loading trains.

The maximum (at source) sound power level of train being loaded/unloaded (onsite) by a forklift has previously been measured to be typically 120 dB(A) L_{max}. Maximum noise levels at privately owned receptors and receptors with a contractual agreement in place with AZL were calculated for prevailing meteorological conditions and are presented in **Table 5.3**. It should be noted that the results presented are based on a single source of 120 dB(A) L_{max} and do not include the application of mitigation measures to the forklift.

Predicted L_{max} noise levels from a train being loaded or unloaded by a forklift at receptors were based on the typical position used when loading or unloading a train along the rail siding. Predictions were based on a single event, rather than the simultaneous operation of a number of plant items, because of the low probability of more than one maximum noise event occurring concurrently. The criterion used to assess sleep disturbance is based on the EPA's 'background noise level plus 15 dB' criteria for maximum (L_{max}) noise sources.

Noise modelling identified that L_{max} noise levels associated with the train loading or unloading operations are above the strict EPA sleep disturbance criteria at several receptors. There are up to three planned train movements during the week (10 pm to 7 am), therefore, in a worst case scenario there is the potential for exceedances to occur three night-time periods in a week. Despite this, L_{max} noise levels from the rail loading/unloading operations remain below levels that are likely to wake sleeping occupants indoors, based on international research as published in the EPA's RNP.

AZL is committed to managing noisy impacts from loading activities, especially during night time periods by limiting rail loading at night, with the exception of times rail pathway availability make night loading unavoidable. Loading of rail wagons would avoid metallic impacts. Additionally, AZL staff will be trained and instructed to avoid generating impact noise when loading material on rail wagons. This commitment will be strictly enforced and incorporated into noise management plans and procedures for site. Recommendations to reduce sleep disturbance impact are provided in the noise management and mitigation section of this report.

5.5 Construction noise

The details around construction for the DZP are preliminary at this stage, therefore this assessment has provided indicative areas where construction activities are anticipated to have the highest potential noise impacts. Construction noise criteria have been adopted when assessing activities associated with off-site construction including water and gas pipelines, the rail upgrade, bridges, and road upgrade. These tasks have several differences to mining. A short duration compared with the proposed operational life of the DZP, geographic separation from mining and processing areas and use of machinery unique to construction. Several on-site construction tasks such as the site access road, processing plant and administration area, residue storage facility areas (LRSF and SRSF), haul road, open cut, WRE and SECs are assessed as construction, however adopt the more conservative operational criteria in this assessment (i.e. RBL+5dB(A)).

Table 5.4 summarises the anticipated generic fleet and the construction activities for the DZP. It is noted that the exact details and configurations of each fleet are yet to be confirmed, however the overall sound power of the modelled fleet is considered to be representative for assessment purposes.

The noise model was configured to predict the total L_{eq} noise levels from all construction activities at surrounding receptors for applicable meteorological conditions identified in Section 4.1.

Construction activities and the distance to nearest receptors are provided in **Table 5.5**.

Table 5.3 Predicted Maximum On-site Noise from Intermittent Sources at Privately Owned Residences and receptors with a contractual agreement in place with AZL

Receptor ID	L_{max} criterion, dB(A)	Modelled L_{max} noise level, dB(A)
Privately owned receptors		
R11	n/a	n/a
R13	n/a	n/a
R18	45	≤35
R19	45	37
R20	45	42
R21	45	≤35
R22	45	**54**
R23	45	**55**
R24	45	**53**
R25	45	**53**
R26	45	44
R27	45	≤35
R28A	45	≤35
R28B	45	≤35
R30A	45	≤35
R30B	45	≤35
R31A	45	≤35
R31B	45	≤35
R32	45	≤35
R35A	45	≤35
R35B	45	≤35
R36	45	≤35
R38	45	≤35
R4	45	≤35

Table 5.3 Predicted Maximum On-site Noise from Intermittent Sources at Privately Owned Residences and receptors with a contractual agreement in place with AZL

Receptor ID	L_{max} criterion, dB(A)	Modelled L_{max} noise level, dB(A)
R40	45	≤35
R42	45	≤35
R43	45	≤35
R46	45	≤35
R6	45	≤35
R61	45	≤35
R7	45	≤35
R8A	45	≤35
R8B	45	≤35
Receptors with a contractual agreement in place with AZL		
R1	45	37
R2	45	45
R3	45	≤35
R51	45	39
R55	45	45
R58	45	40

Table 5.4 Constructions Activities, Type/Duration and Associated Plant Items

Activity	Type/duration	Plant items used
Gas Pipeline Corridor	Transient - 50 weeks	Backhoe/small excavator, dozer, grader, trencher, road truck and light vehicle
Rail Line upgrade	Transient - 50 weeks	Excavator, crane, FEL, tamping machine, welding truck, road truck and light vehicle
Water Pipeline	Transient - 40 weeks	Backhoe/small excavator, dozer, grader, trencher, road truck and light vehicle
Obley Road upgrade	Transient - 40 weeks	Excavator, dozer, grader, vibrating roller, road truck and light vehicle
Wambangalang Creek Bridge	Static - 25 weeks	Excavator, crane, FEL, haul truck and light vehicle
Hyandra Creek Bridge	Static - 25 weeks	Excavator, crane, FEL, road truck and light vehicle
Twelve Mile Creek Bridge	Static - 25 weeks	Excavator, crane, FEL, road truck and light vehicle
Processing area (a), haul road (b) and LRSF 1 (c)	Static - 20 weeks	(a) - Compactor, trencher, jackhammer, pneumatic wrench, rock breaker, scrapers, dozer, grader, generators, road trucks (b) - Compactor, grader, water truck, FEL, haul truck, scraper and light vehicle (c) - scrapers, dozers, water truck, excavator, grader and light vehicle
LRSF 2	Static - 20 weeks	scrapers, dozers, water truck, excavator, grader and light vehicle
LRSF 3	Static - 20 weeks	scrapers, dozers, water truck, excavator, grader and light vehicle
LRSF 4	Static - 20 weeks	scrapers, dozers, water truck, excavator, grader and light vehicle
Open cut (a), WRE (b) and SRSF (c)	Static - 20 weeks	(a)- Drilling rig, dozer, FEL and haul trucks (b)- Dozer and haul trucks (c)- Grader, scrapers, compactor, water truck, haul trucks and light vehicle

Table 5.5 Nearest Receptors to Construction Activities

Construction activity	Nearest distance to nearest receptor (m)
Gas Pipeline Corridor	25
Rail Line upgrade	25
Water Pipeline	70 (R36)
Obley Road upgrade	65
Wambangalang Creek Bridge	780
Hyandra Creek Bridge	200
Twelve Mile Creek Bridge	235
Processing area (a), haul road (b) and LRSF 1 (c)	2000
LRSF 2	2200
LRSF 3	3800
LRSF 4	3100
Open cut (a), WRE (b) and SRSF (c)	1900

The anticipated range of noise levels from construction works are presented in **Table 5.6**, the maximum noise level is expected with all plant operating simultaneously at 100 percent capacity for the entire fifteen minute period. The minimum level represents the noise levels during reduced construction activities over a fifteen minute period.

Table 5.6 Noise Levels from Construction Activities at Closest Receptor

Task	Noise affected $L_{eq(15\text{-}min)}$ criteria, dB(A)	Highly noise affected $L_{eq(15\text{-}min)}$ criteria, dB(A)	Modelled $L_{eq(15\text{-}min)}$ noise level range, dB(A)[1]
Gas Pipeline Corridor	40	75	30-**78**
Rail Line upgrade	40	75	35-**79**
Water Pipeline	40	75	34-72
Obley Road upgrade	40	75	35-**77**
Wambangalang Creek Bridge	40	75	35-45
Hyandra Creek Bridge	40	75	35-52
Twelve Mile Creek Bridge	40	75	35-53
Processing area (a), haul road (b) and LRSF 1 (c)	35	75	<30-52
LRSF 2	35	75	<30-41
LRSF 3	35	75	<30-49
LRSF 4	35	75	<30-39
Open cut (a), WRE (b) and SRSF (c)	35	75	<30-43

Note 1: modelled level is to the nearest receptor from construction activities

Results of the construction noise assessment identifies that the noise affected criteria and in some instances, the highly noise affected noise criteria (in **bold**) may be exceeded when activities pass at the near point of certain receptors. Noise management and mitigation measures are critical in reducing noise emissions when these three activities occur adjacent to receptors.

Transient tasks (i.e. water and gas pipelines, the rail upgrade and the Obley road upgrade) result in a greater number of receptors being exposed to elevated noise levels for a relatively short period of time as the construction fleet passes the receptor. The anticipated exposure from transient sources to privately owned receptors is expected to occur for less than three consecutive days. The total duration of several static activities (i.e. bridges upgrade, mine access road and remaining on-site activities) would occur for several weeks.

A summary of receptors where reasonable and feasible management and mitigation is recommended is provided in **Table 5.7**. Reasonable and feasible management and mitigation measures are summarised in Section 6.2.3.

Table 5.7 Summary of Privately Owned Receptors Where Reasonable and Feasible Management and Mitigation Is Recommended

Activity	Receptor
Gas Pipeline corridor	Margaret Crescent and Chelmsford Street (when passing in the vicinity of receptors)
Rail Line upgrade	Margaret Crescent and Chelmsford Street (when passing in the vicinity of receptors)
Water pipeline	R36[1], R35B, R38 and R40
Obley Road upgrade	Obley Road receptors within 100m from construction
Wambangalang Creek Bridge	Receptors within 500m from construction
Hyandra Creek bridge	Receptors within 500m from construction
Twelve Mile Creek bridge	Receptors within 500m from construction
Processing area (a), haul road (b) and LRSF 1 (c)	R10, R19, R20, R22, R23, R24, R25, R8A,
LRSF 2	R24, R25
LRSF 3	Compliance at all receptors
LRSF 4	Compliance at all receptors
Open cut (a), WRE (b) and SRSF (c)	R61

Note:1 Receptor locations are listed where reasonable and feasible management and mitigation is to be considered.

5.6 Road traffic noise

5.6.1 Introduction

The road network that would be used (in both directions) includes the Newell Highway, Obley Road and Toongi Road. Obley Road and Toongi Road are currently lightly trafficked and would require upgrading to accommodate DZP related traffic. The nearest privately owned receptor to these roads is 65 m away.

The Calculation of Road Traffic Noise (CORTN) (UK Department of Transport) method was used to predict the L_{eq} noise levels at the closest receptor for additional traffic travelling along Obley Road. CORTN, which was developed by the UK Department of Transport, considers traffic flow volume, average speed, percentage of heavy vehicles and road gradient to establish noise source strength, and includes attenuation due to distance, ground, atmospheric absorption and screening from buildings or barriers. Current traffic volumes (2012) were used to calculate existing Obley Road noise levels.

5.6.2 Operations road traffic noise

Three transportation options (refer to Section 1.3.6) have been considered in this assessment and each option would produce different numbers of daily truck movements. **Table 5.8** presents the daily truck movements for each option.

It is expected that the majority of the workforce would travel between Dubbo and the DZP Site via Obley Road and Toongi Road, although some employees would be sourced from local farms, towns and villages. The estimated daily movements on the road transportation network along with the summarised heavy vehicle daily traffic movements are presented in **Table 5.9**.

Table 5.8 DZP Related Daily Truck Movements

Option	Truck Type	Loaded	Empty / Return	Total
Preferred Option (A) – Rail to Toongi / Supplementary Road	B Double	30	30	60
	Single	14	14	28
	Total	44	44	88
Contingency Option (B) – Rail to Dubbo / Road to Toongi	B Double	30	30	60
	Single	49	49	98
	Total	79	79	158
Contingency Option (C) – Road Only	B Double	42	42	84
	Single	27	27	54
	Total	69	69	138

(Source: Alkane Resources Ltd)

Table 5.9 DZP Related Daily Total Traffic Movements

Option	Light vehicle	Heavy vehicles
Preferred Option (A) – Road / Rail (Toongi)	220	88
Contingency Option (B) – Rail (Dubbo) / Road	220	158
Contingency Option (C) – Road only	220	138

(Source: Alkane Resources Ltd)

The overall traffic volumes have been used in CORTN calculations to predict noise emissions for the day and night assessment periods. To account for differences in traffic volumes along different sections of Obley road, the latter was divided into three sections including:

1. Obley Road between the Newell Highway and the zoo entrance;
2. Obley Road south of the zoo entrance to Dundullimal Homestead (includes zoo breading pens); and
3. Obley Road between Dundullimal Homestead and Toongi Road.

The results of the traffic noise calculations for each section of Obley Road for Year 1 are presented in **Table 5.10** for the closest privately owned receptors and Taronga Western Plains Zoo rhinoceros breeding pens.

The predicted future (combined) road traffic noise levels satisfy the RNP criteria at all receptors for each section of Obley Road for all transportation options. The predicted increase in road traffic noise levels are ≤3.0 dB(A) at all receptors for all transportation options with the exception of night-time levels between Dundullimal Homestead and Toongi Road for Preferred Option A, Contingency Option B and Contingency Option C where increases of 3.1 dB(A), 4.5 dB(A) and 3.9 dB(A) are predicted respectively. However, these are below the relative increase criteria of 12 dB(A), additionally, the 2dB(A) increase criteria is not applicable as existing road traffic noise is below the relevant criteria.

Table 5.10 Operational Road Traffic Noise Levels at the Nearest Receptor for Each Section of Obley Road (Year 1)

Option	Road section	Distance to nearest receptor (m)	Assessment criteria	Existing traffic noise	Calculated DZP site traffic noise	Future combined traffic noise	Difference between existing and future
			Day $L_{eq(15\text{-hour})}$, dB(A)				
A	1	355	60	42.9	34.5	43.5	0.6
	2	225	60	43.4	37.0	44.3	0.9
	2	65 (zoo)	60	50.0	43.6	50.9	0.9
	3	65	60	46.9	43.6	48.6	1.7
			Night $L_{eq(9\text{-hour})}$, dB(A)				
A	1	355	55	39.8	34.5	40.9	1.1
	2	225	55	40.4	37.0	42.0	1.6
	2	65 (zoo)	55	47.0	43.6	48.6	1.6
	3	65	55	43.5	43.6	46.6	3.1
			Day $L_{eq(15\text{-hour})}$, dB(A)				
B	1	355	60	42.9	37.1	43.9	1.0
	2	225	60	43.4	39.5	44.9	1.5
	2	65 (zoo)	60	50.0	46.1	51.5	1.5
	3	65	60	46.9	46.1	49.5	2.6
			Night $L_{eq(9\text{-hour})}$, dB(A)				
B	1	355	55	39.8	37.1	41.7	1.9
	2	225	55	40.4	39.5	43.0	2.6
	2	65 (zoo)	55	47.0	46.1	49.6	2.6
	3	65	55	43.5	46.1	48.0	4.5
			Day $L_{eq(15\text{-hour})}$, dB(A)				
C	1	355	60	42.9	36.0	43.7	0.8
	2	225	60	43.4	38.5	44.6	1.2
	2	65 (zoo)	60	50.0	45.1	51.2	1.2
	3	65	60	46.9	45.1	49.1	2.2
			Night $L_{eq(9\text{-hour})}$, dB(A)				
C	1	355	55	39.8	36.0	41.3	1.5
	2	225	55	40.4	38.5	42.6	2.2
	2	65 (zoo)	55	47.0	45.1	49.2	2.2
	4	65	55	43.5	45.1	47.4	3.9

To account for traffic volume growth in the area (excluding DZP Site related traffic), road traffic noise was calculated to predict noise levels in 2032, 20 years from the current traffic volumes and towards the end of the DZP life. The results of the traffic noise calculations for each section of Obley Road for 2032 are presented in **Table 5.11** for the nearest privately owned receptors.

Table 5.11 Operational Road Traffic Noise Levels at the Nearest Receptor for Each Section of Obley Road (2032)

Option	Road section	Distance to nearest receptor (m)	Assessment criteria	2032 traffic noise (exc.DZP)	Calculated DZP site traffic noise	Future combined traffic noise	Difference between existing and future
Day $L_{eq(15\text{-}hour)}$, dB(A)							
A	1	355	60	45.8	34.5	46.1	0.3
	2	225	60	45.7	37.0	46.2	0.5
	2	65 (zoo)	60	53.0	43.6	53.5	0.5
	3	65	60	50.0	43.6	50.9	0.9
Night $L_{eq(9\text{-}hour)}$, dB(A)							
A	1	355	55	42.7	34.5	43.3	0.6
	2	225	55	42.7	37.0	43.7	1.0
	2	65 (zoo)	55	49.9	43.6	50.8	0.9
	3	65	55	46.8	43.6	48.5	1.7
Day $L_{eq(15\text{-}hour)}$, dB(A)							
B	1	355	60	45.8	37.1	46.3	0.5
	2	225	60	45.7	39.5	46.6	0.9
	2	65 (zoo)	60	53.0	46.1	53.8	0.8
	3	65	60	50.0	46.1	51.5	1.5
Night $L_{eq(9\text{-}hour)}$, dB(A)							
B	1	355	55	42.7	37.1	43.8	1.1
	2	225	55	42.7	39.5	44.4	1.7
	2	65 (zoo)	55	49.9	46.1	51.4	1.5
	3	65	55	46.8	46.1	49.5	2.7
Day $L_{eq(15\text{-}hour)}$, dB(A)							
C	1	355	60	45.8	36.0	46.2	0.4
	2	225	60	45.7	38.5	46.5	0.8
	2	65 (zoo)	60	53.0	45.1	53.7	0.7
	3	65	60	50.0	45.1	51.2	1.2
Night $L_{eq(9\text{-}hour)}$, dB(A)							
C	1	355	55	42.7	36.0	43.5	0.8
	2	225	55	42.7	38.5	44.1	1.4
	2	65 (zoo)	55	49.9	45.1	51.1	1.2
	3	65	55	46.8	45.1	49.0	2.2

The predicted combined road traffic noise contributions are below the RNP criteria for both day and night periods at the nearest privately owned receptors for each section of Obley Road for all transportation options. The predicted increase in road traffic noise levels are <3.0 dB(A) at all receptors along Obley Road for all transportation options. Further, these are below the relative increase criteria of 12 dB(A) and therefore satisfy all RNP criteria.

5.6.3 Construction road traffic noise

During construction, the DZP would generate vehicle traffic movements from both the workforce and site visitors. A breakdown of total traffic movement numbers during the construction phase are presented in **Table 5.12**.

Table 5.12 DZP Related Daily Total Traffic Movements During Construction

	Light vehicle	Heavy vehicles	Oversize
Construction	400	20	2

(Source: Alkane Resources Ltd)

The same approach as per Section 5.5.1 was used for the calculation of road traffic noise during construction. However, there is only one transportation option considered during construction. Also it should be noted that no construction activities would occur during night-time and subsequently no night time construction traffic will be generated. The results of the construction road traffic noise assessment for each section of Obley Road for 2012 are presented in **Table 5.13** for the nearest privately owned receptors and Taronga Western Plains Zoo breeding pens.

Table 5.13 Construction Road Traffic Noise Levels at Obley Road Receptors

Road section	Distance to nearest privately owned receptor (m)	Assessment criteria	Existing traffic noise	Calculated DZP site traffic noise	Future combined traffic noise	Difference between existing and future
			Day $L_{eq(15\text{-hour})}$, dB(A)			
1	355	60	42.9	33.4	43.4	0.5
2	225	60	43.4	35.8	44.1	0.7
2	65 (zoo)	60	50.0	42.4	50.7	0.7
3	65	60	46.9	42.4	48.2	1.3

Existing ambient traffic noise levels were calculated to be below the day criteria for all sections of Obley Road at the nearest privately own receptors. The predicted combined road traffic noise levels associated with construction satisfy the RNP criteria at all receptors along Obley Road.

5.7 Off-site rail noise emissions

5.7.1 Introduction

Transport options are yet to be finalised, however, there are two possibilities for rail usage (Option A and Option B as per Section 1.3.6). Both options have the potential to generate off-site rail noise and have been assessed in accordance with the RING. It is noted that there would be a maximum of one train per 24 hr period travelling along either the Toongi-Dubbo Rail Line or from Dubbo to other regional centres.

The emission levels used for the off-site calculations were taken from an EMM measurement database and are considered representative of typical trains. The calculations adopted a typical sound exposure level (SEL) of 90 dB(A) at 30 m for mixed freight train pass-bys, while the L_{max} calculation is based on a typical train noise emission of 82 dB(A) at 30 m from the rail line.

5.7.2 Option A

This option assumes that the Toongi-Dubbo Rail Line would be dedicated to the DZP, therefore reagent deliveries and product dispatch would be managed based on operations at the DZP Site. Some of the reagents would be delivered at the DZP Site at Toongi using three trains per week on the Toongi-Dubbo Rail Line.

It is anticipated that approximately one train would either enter or exit the DZP Site rail siding each day.

Table 5.14 provides the calculated $L_{eq(15\text{-hour})}$, $L_{eq(9\text{-hour})}$ and L_{max} noise levels from proposed DZP rail movements to Dubbo. It is noted that currently the L_{max} noise level is above the RING for receptors within 20m of the railway.

Table 5.14 Potential Noise Levels Relating to Additional DZP Train Movements – Option C

Distance[1]	**DZP train noise, dB(A)[3]**		
(m)	**Day, $L_{eq(15\text{-hour})}$**	**Night, $L_{eq(9\text{-hour})}$**	**L_{max}**
15	49	51	88
25	48	50	84
40	46	48	80
50	43	45	78
80	42	44	74
100	41	43	72
140	40	42	69
RING	**65**	**60**	**85**

Note 1: assumed distance to nearest privately owned receptor.

Note 3: based on two DZP movements during any period.

The review of the maximum train movement scenario shows that:

- Day and night criteria would be met for all noise receptors at distances 15 m (and greater) from the track;
- L_{max} criteria would be met for noise receptors situated 25 m (and greater) from the railway; and
- rail noise as a results of DZP would not increase existing levels by more than 2dB(A).

5.7.3 Option B

This option assumes that reagents would be delivered by rail from the supplier to the Dubbo terminal on the Merrygoen (Newcastle) Rail Line. Trucks would be used to transport the reagents to DZP Site. Therefore, there is the potential for one train per day (two movements) to occur as a result of the DZP along the Merrygoen line.

Rail numbers for the Dubbo region have been requested from ARTC and have yet to be received. Therefore, the existing off-site trains have been conservatively assumed at three per day (i.e. six movements).

Table 5.15 provides the calculated $L_{eq(15\text{-hour})}$, $L_{eq(9\text{-hour})}$ and L_{max} noise levels from proposed DZP rail movements. It is noted that currently the L_{max} noise level is above the RING for receptors within 20 m of the railway.

Table 5.15 Existing and Potential Noise Levels Relating to Additional DZP Train Movements – Option B

Distance[1]	Existing train noise, dB(A)[2]			DZP train noise, dB(A)[3]			Total train noise, dB(A)[4]		
(m)	Day, $L_{eq(15\text{-}hour)}$	Night, $L_{eq(9\text{-}hour)}$	L_{max}	Day, $L_{eq(15\text{-}hour)}$	Night, $L_{eq(9\text{-}hour)}$	L_{max}	Day, $L_{eq(15\text{-}hour)}$	Night, $L_{eq(9\text{-}hour)}$	L_{max}
15	53	56	88	49	51	88	54	57	88
25	52	55	84	48	50	84	53	56	84
30	50	53	80	46	48	80	51	54	80
60	47	50	78	43	45	78	48	51	78
80	46	49	74	42	44	74	47	50	74
100	45	48	72	41	43	72	46	49	72
140	45	47	69	40	42	69	46	48	69
RING	**65**	**60**	**85**	**65**	**60**	**85**	**65**	**60**	**85**

Note 1: assumed distance to nearest privately owned receptor.
Note 2: based on six existing non-DZP train movements assumed for all periods.
Note 3: based on two DZP movements during any period.
Note 4: based on eight total movements during a 24hr period (i.e. existing trains +DZP trains).

The review of the maximum train movement scenario shows that:

- day and night L_{eq} criteria would be met for all noise receptors at distances 15 m (and greater) from the track;
- L_{max} criteria would be met for noise receptors situated 25 m (and greater) from the railway; and
- rail noise as a result of DZP would not increase existing L_{eq} levels by more than 2dB(A), and no change to L_{max} levels is expected, satisfying the RING recommended increase goals.

5.8 Blasting

Blast overpressure and vibration results have been calculated using the method given in the AS2187-2: Explosives – Storage and use Part 2: Use of explosives, 2006 and ICI Explosives Blasting Guide, as applicable to blasting in hard rock. This formula has been shown to be conservative in calculating overpressure and vibration.

The relevant formulae are as follows:

PVS = $500 (R/Q\,^{\wedge 0.5})^{\wedge -1.6}$

dB = $164.2 - 24(\log_{10} R - 0.33 \log_{10} Q)$

Where,

PVS = peak vector sum ground vibration level (mm/s)

dB = peak airblast level (dB Linear)

R = distance between charge and receptor (m)

Q = charge mass per delay (kg) or maximum instantaneous charge (MIC)

The proposed blast parameters for the DZP identify a maximum instantaneous charge (MIC) of up 68 kg (generally 30 kg). **Table 5.16** provides the derived overpressure and vibration levels based on 68 kg MIC for the closest privately-owned receptors.

Table 5.16 Predicted Blast Overpressure and Vibration Levels - Privately Owned Receptors

Approximate minimum distance from blast to privately owned receptors (m)	Derived overpressure (dB(L)peak)	Derived vibration PPV (mm/s)	Max MIC (kg)
2,200	98.5	0.1	68
Criteria	115	5	

Notes: 1. airblast overpressure criteria 115 dB(L_{inpeak}).
2. ground vibration criteria 5 (mm/s) PPV.

The predicted blast overpressure and vibration levels identify that a maximum MIC of 68kg would comply with ANZECC criteria at distances greater than 450m. It is noted that the closest privately owned receptor is located 2,200m from potential blast locations. Therefore, it is predicted that based on a maximum MIC of 68kg, blast overpressure and vibration levels would comply at all privately owned receptors.

5.9 Rail vibration

A review of potential structural vibration has been completed for the Dundullimal Homestead, off Obley Road. The homestead is situated approximately 65m from the Toongi-Dubbo Rail Line.

Historical EMM measured data from train pass-bys identifies that levels at this distance would generate vibration levels less than 0.5mm/s and would satisfy the sensitive structural criteria of 3mm/s.

6 Noise management

6.1 Operational noise

6.1.1 Feasible and reasonable measures

The INP (EPA 2000:06) states the following with respect to feasible and reasonable noise management measures:

> *"Feasibility relates to engineering considerations and what is practical to build; reasonableness relates to the application of judgment in arriving at a decision, taking into account the following factors:*
>
> - *noise mitigation benefits (amount of noise reduction provided, number of people protected);*
> - *cost of mitigation (cost of mitigation versus benefit provided);*
> - *community views (aesthetic impacts and community wishes); and*
> - *noise levels for affected land uses (existing and future levels, and changes in noise levels)."*

The assessment of the DZP under the INP would enable noise monitoring and management at the DZP Site in accordance with contemporary standards.

6.1.2 Feasibility review

To reduce potential noise impacts on the surrounding community, ranked outputs of preliminary noise modelling were reviewed. Several acoustically dominant plant were identified to control noise emissions from the DZP Site and as such are recommended for reasonable and feasible noise mitigation.

Acoustically significant plant items were associated with the processing plant and include:

- the crushing and ore handling equipment; and
- the rock breaker.

Reasonable and feasible mitigation was considered for these items, with a partial enclosure identified to be the most effective solution for reducing noise. The model incorporated a barrier/cladding proposed to be installed as per **Figure 8** and **Figure 9**.

The proposed rock hammer would be placed within the open cut as opposed to the ROM Pad.

Furthermore, AZL has committed to actively managing and monitoring noise levels at potentially affected receptors.

6.1.3 Noise Management Plan

A *Noise Management Plan* (NMP) should detail activities to manage noise emissions from operations. The NMP should:

- identify noise affected properties consistent with the environmental assessment and any subsequent assessments;
- outline mitigation measures to use to achieve the noise limits established;

- outline measures to reduce the impact of intermittent, low frequency and tonal noise (including truck reversing alarms);
- outline the procedure to notify property owners and occupiers that could be affected by noise from the DZP;
- establish a protocol to handle noise complaints that includes recording, reporting and acting on complaints;
- specify procedures for undertaking independent noise investigations; and
- describe proactive and predictive modelling and real-time reactive monitoring/management protocols for managing noise during adverse meteorological conditions.

6.1.4 Sleep disturbance (on-site sources)

On-site noise from loading and unloading trains could, if unmitigated or managed, generate L_{max} noise events above the sleep disturbance criteria at several privately owned receptors.

To reduce the potential occurrence of such sleep disturbing noise events, the Applicant commits to restricting train loading and unloading to after 6:00am and before 10:00pm unless rail pathing requires an overnight turn-around of trains. To mitigate against these potentially sleep disturbing noise events during night-time loading and unloading, AZL commits to implementing and enforcing a *Noise Management Plan* which requires operators to avoid high impact events, e.g. between container and wagon. Forklifts equipped with modern hydraulics are capable of all but eliminating impact noise of such activities. Operators unable to adhere to noise management requirements would be excluded from operating that equipment.

6.2 Construction noise

6.2.1 Overall Approach

The primary objective of the noise management strategy is to minimise noise impacts on the surrounding community, the following hierarchical strategy to achieve this objective should be adopted:

1. ensure that construction activities meet construction noise goals within the allowable hours of operation as far as practicable;
2. where noise levels are above relevant goals, implement reasonable and feasible best practice noise controls to minimise noise emissions and/or exposure duration at affected receptors; and
3. where the use of best practice noise controls do not adequately address exceedance of noise goals, adopt alternative measures to minimise impacts on the community.

6.2.2 Construction hours

Construction activities, with the exception of those listed in Section 5.2.2, shall only be undertaken during the following hours:

- 7 am to 6 pm, Mondays to Fridays, inclusive;
- 8 am to 1 pm on Saturdays; and
- at no time on Sundays or public holidays.

6.2.3 Construction noise management and mitigation

Australian Standard AS 2436-2010 "*Guide to Noise Control on Construction, Maintenance and Demolition Sites*" sets out numerous practical recommendations to assist in mitigating construction noise emissions. Recommendations provided in this standard include operational strategies, source noise control strategies, noise barrier controls, and community consultation.

It is estimated that adopting strategies contained in this standard may result in the following noise attenuation:

- Up to 10 dB(A) where space limitations allow for the attenuation options available; and
- Up to 20 dB(A) in situations where at source noise mitigation measures (silencers, mufflers, etc.) can be combined with noise barriers and other management techniques;

Should compliance noise monitoring indicate exceedances of the noise criteria, a combination of comprehensive noise mitigation treatments (i.e. noise barriers, equipment enclosures, silencers, regular equipment maintenance, etc.) and consultation with the local communities should be considered to manage exceedances. Further generic descriptions of management measures and mitigation options are provided in the following sections. It is recommended that specific detailed noise management and mitigation measures be reviewed once the construction activities for each task are clearly defined and contractors for the work have been engaged.

6.2.4 Noise management

During construction operations, the following mitigation strategies to manage noise include:

- radios should not be used and no yelling;
- no slamming of doors;
- prohibit the use of air brakes is not permitted;
- park plant in accessible and where possible shielded locations prior to being used for out of hours works;
- drive all plant in a conservative manner (no over-revving);
- obtain site access via entry points most remote to receptors;
- do not permit monitoring to 'warm-up' before the nominated working hours;
- where possible, machinery to direct noise away from the closest sensitive receptors;
- adopt mobile barriers/screens or utilise the location of earth/rock stockpiles adjacent to static rock breaking sources to shield neighbouring receptors;
- undertake regular maintenance of machinery to minimise noise emissions. Maintenance would be confined to standard daytime construction hours and where possible, away from noise sensitive receptors;
- select the quietest suitable machinery reasonably available would be selected for each work activity;
- all machinery would have efficient low noise muffler design and be well-maintained;

- maximise the offset distance between noisy items of plant/machinery and nearby sensitive receptors;
- do not queue vehicles adjacent to any residential receptor/catchment;
- where queuing is required, for example due to safety reasons, a site entry position would be selected that is well removed from receptors/catchments. Where this is not feasible, engines are to be switched off to reduce their overall noise impacts on receptors;
- where practicable, ensure the coincidence of noisy plant/machinery working simultaneously in close proximity to sensitive receptors is avoided; and
- monitoring of out of hours work would be undertaken to verify modelled noise levels of out of hours activities and to highlight potential mitigation options where relevant for any audible activities.

6.3 Blasting

Mitigation measures to minimise vibration emissions during blasting will include the following:

- blast design should be actively managed by AZL, and hence corresponding airblast overpressure and ground vibration will be controlled;
- minimise the impact of blast overpressure and vibration on livestock, and relocation of livestock where required prior to commencement of a blast;
- all blasts should be monitored at representative locations to nearby sensitive infrastructure and private residences to assess the response of the ground to blasting. This will allow the calibration of blast vibration calculations that will allow subsequent blasts to be sized and designed to minimise offsite impacts;
- a schedule of blasts should be distributed to privately owned residences as required. The schedule should notify landowners and residents as to the time and location of blasts and road closures. Telephone contact with those residents within 3 km of the blasting area will be made prior to blasting; and
- the *Noise and Vibration Management Plan* should detail blast monitoring requirements for the DZP Site.

7 Conclusion

The noise assessment demonstrates that during noise enhancing (prevailing) weather conditions (determined in accordance with the INP) for all assessment periods and all stages of the DZP, no privately owned receptors that do not hold an agreement with AZL for property purchase are predicted to experience noise levels above the operational criterion of 35 dB(A).

Sleep disturbance impacts from maximum noise level events have been assessed and are expected to satisfy the relevant criteria for the majority of private receptors. Noise modelling identified L_{max} noise levels associated with rail loading above the sleep disturbance criteria at several adjacent receptors, although these impacts are expected to be actively managed by AZL. This notwithstanding, L_{max} noise levels from the rail loading remain below levels that are likely to wake sleeping occupants based on more recent international research (WHO, 1999).

Receptors with the potential for the greatest construction noise impact include those situated on Margaret Crescent and Chelmsford Street, Dubbo, as construction fleets pass-by. It should be noted that noise levels at all remaining receptors during construction are shown to remain below the ICNG's highly affected criterion of 75 dB (A). Noise management measures will be applied to minimise construction noise impacts on the surrounding community and will be reviewed on a case by case basis once the resolution of construction activities is available and a contractor has been engaged.

The road traffic noise associated with the DZP's operation and construction is expected to comply with relevant goals for all receptors.

Review of proposed train movements for Preferred Option A and Contingency Option B, identify that the RING criteria for all assessment periods will be satisfied.

The predicted blast overpressure and vibration levels identify that the proposed MIC of 68 kg would result in compliance with ANZECC criteria at all receptors. Notwithstanding, the proposed MIC blast patterns should be designed specifically to meet the relevant ANZECC guidelines at nearby receptors.

8 References

Australian and New Zealand Environment Council (ANZECC) 1990, *Technical basis for guidelines to minimise annoyance due to blasting overpressure and ground vibration.*

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German Standard 1999*, DIN4150*: Part 3: Effects of vibration on structures.

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NSW Department of Environment and Climate Change (DECC), 2009, *Interim Construction Noise Guideline.*

NSW Environment Protection Authority (EPA) 2000, *NSW Industrial Noise Policy*.

New South Wales Roads and Traffic Authority (NSW RTA) 2001, *Noise Management Manual*.

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NSW Environment Protection Authority (EPA) 2013, *Rail Infrastructure Noise Guideline (RING)*.

NSW Department of Environment and Conservation (DEC) 2006, *Assessing Vibration: A Technical Guideline.*

NSW Environment Protection Authority (EPA) 1999, *Environmental Criteria for Road Traffic Noise*.

NSW Environment Protection Authority (EPA) 2009, *Environment Protection License (EPL) Number 3142, Licensee: the Australian Rail Track Corporation Limited (ARTC).*

World Health Organisation (WHO), 1999, *Guidelines for Community Noise.*

Appendix A Operational Scenarios - Plant locations and pit stages

Note: A colour version of this Appendix is available on the Project CD

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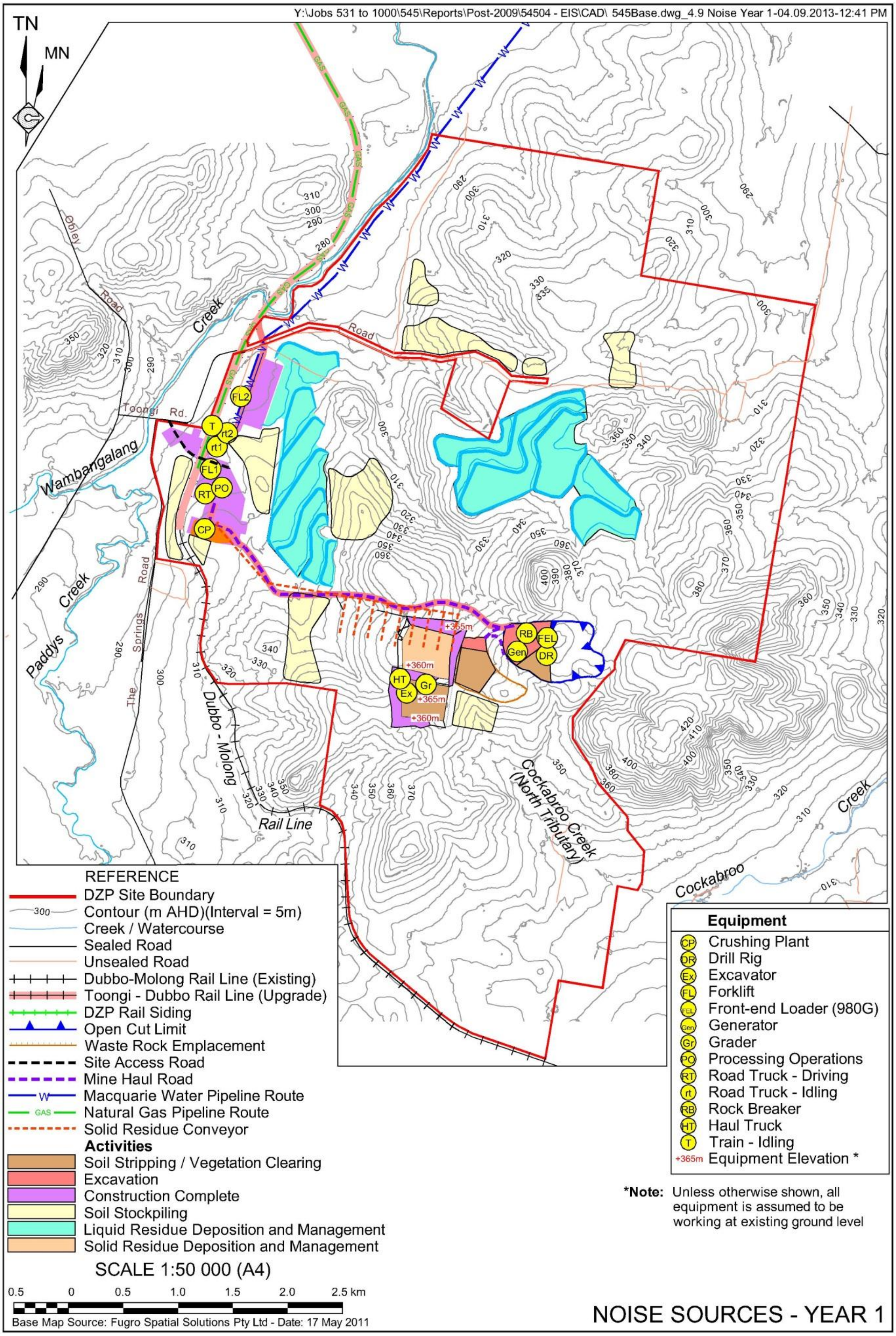
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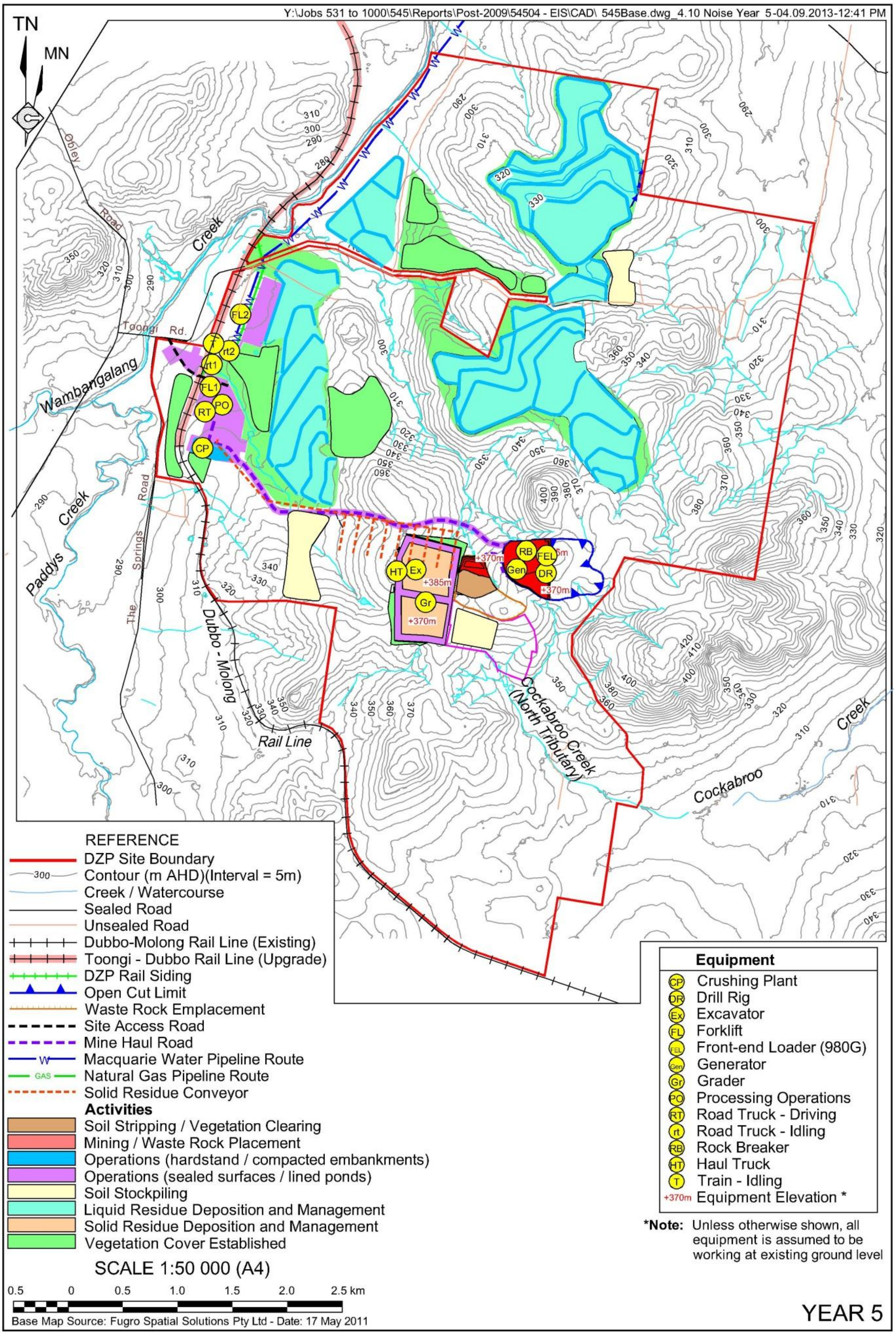
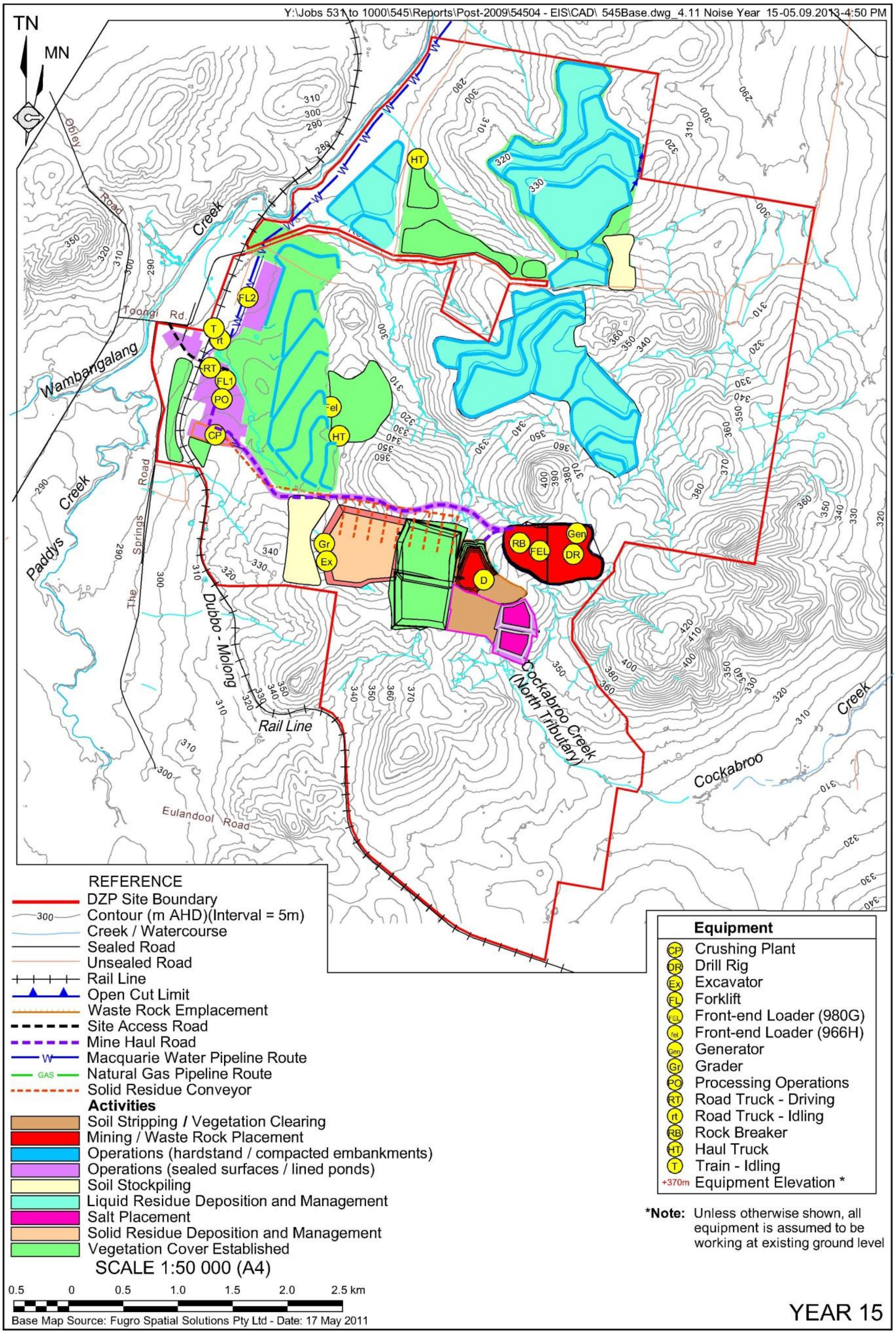
DZP Site Boundary
Contour (m AHD)(Interval = 5m)
Creek / Watercourse
Sealed Road
Unsealed Road
Dubbo-Molong Rail Line (Existing)
Toongi - Dubbo Rail Line (Upgrade)
DZP Rail Siding
Open Cut Limit
Waste Rock Emplacement
Site Access Road
Mine Haul Road
Macquarie Water Pipeline Route
Natural Gas Pipeline Route
Solid Residue Conveyor
Activities
Soil Stripping / Vegetation Clearing
Excavation
Construction Complete
Soil Stockpiling
Liquid Residue Deposition and Management
Solid Residue Deposition and Management
SCALE 1:50 000 (A4)
0.5 0 0.5 1.0 1.5 2.0 2.5 km
Base Map Source: Fugro Spatial Solutions Pty Ltd - Date: 17 May 2011
Equipment
Crushing Plant
Drill Rig
Excavator
Forklift
Front-end Loader (980G)
Generator
Grader
Processing Operations
Road Truck - Driving
Road Truck - Idling
Rock Breaker
Haul Truck
Train - Idling
+365m Equipment Elevation *
*Note: Unless otherwise shown, all equipment is assumed to be working at existing ground level
NOISE SOURCES - YEAR 1
Obley Road
Creek
Toongi Rd.
Wambangalang
Paddys Creek
The Springs Road
Dubbo - Molong
Rail Line
Cockabroo Creek (North Tributary)
Cockabroo
Creek
Road


Y:\Jobs 531 to 1000\545\Reports\Post-2009\54504 - EIS\CAD\ 545Base.dwg_4.10 Noise Year 5-04.09.2013-12:41 PM
TN
MN
Obley Road
Creek
Toongi Rd.
Wambangalang
Paddys Creek
The Springs Road
Dubbo - Molong
Rail Line
Cockabroo Creek (North Tributary)
Cockabroo Creek
+385m
+370m
REFERENCE
DZP Site Boundary
Contour (m AHD)(Interval = 5m)
Creek / Watercourse
Sealed Road
Unsealed Road
Dubbo-Molong Rail Line (Existing)
Toongi - Dubbo Rail Line (Upgrade)
DZP Rail Siding
Open Cut Limit
Waste Rock Emplacement
Site Access Road
Mine Haul Road
Macquarie Water Pipeline Route
Natural Gas Pipeline Route
Solid Residue Conveyor
Activities
Soil Stripping / Vegetation Clearing
Mining / Waste Rock Placement
Operations (hardstand / compacted embankments)
Operations (sealed surfaces / lined ponds)
Soil Stockpiling
Liquid Residue Deposition and Management
Solid Residue Deposition and Management
Vegetation Cover Established
SCALE 1:50 000 (A4)
0.5 0 0.5 1.0 1.5 2.0 2.5 km
Base Map Source: Fugro Spatial Solutions Pty Ltd - Date: 17 May 2011
Equipment
CP Crushing Plant
DR Drill Rig
Ex Excavator
FL Forklift
FEL Front-end Loader (980G)
Gen Generator
Gr Grader
PO Processing Operations
RT Road Truck - Driving
rt Road Truck - Idling
RB Rock Breaker
HT Haul Truck
T Train - Idling
+370m Equipment Elevation *
*Note: Unless otherwise shown, all equipment is assumed to be working at existing ground level
YEAR 5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TN
MN
Obley Road
Creek
Toongi Rd.
Wambangalang
Paddys Creek
The Springs Road
Dubbo - Molong Rail Line
Cockabroo Creek (North Tributary)
Cockabroo Creek
Eulandool Road
REFERENCE
DZP Site Boundary
Contour (m AHD)(Interval = 5m)
Creek / Watercourse
Sealed Road
Unsealed Road
Rail Line
Open Cut Limit
Waste Rock Emplacement
Site Access Road
Mine Haul Road
Macquarie Water Pipeline Route
Natural Gas Pipeline Route
Solid Residue Conveyor
Activities
Soil Stripping / Vegetation Clearing
Mining / Waste Rock Placement
Operations (hardstand / compacted embankments)
Operations (sealed surfaces / lined ponds)
Soil Stockpiling
Liquid Residue Deposition and Management
Salt Placement
Solid Residue Deposition and Management
Vegetation Cover Established
SCALE 1:50 000 (A4)
0.5 0 0.5 1.0 1.5 2.0 2.5 km
Base Map Source: Fugro Spatial Solutions Pty Ltd - Date: 17 May 2011
Equipment
CP Crushing Plant
DR Drill Rig
Ex Excavator
FL Forklift
FEL Front-end Loader (980G)
fel Front-end Loader (966H)
Gen Generator
Gr Grader
PO Processing Operations
RT Road Truck - Driving
rt Road Truck - Idling
RB Rock Breaker
HT Haul Truck
T Train - Idling
+370m Equipment Elevation *
*Note: Unless otherwise shown, all equipment is assumed to be working at existing ground level
YEAR 15

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Appendix B Meteorological analysis

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Table B1 Calculated prevailing winds

Season	Period	Wind speed (m/s) (10th percentile)	Direction (degrees)	Percentage occurrence (%)
Summer	Night	2.4	22.5	31
Summer	Night	2.6	45	33
Summer	Night	2.6	67.5	35
Summer	Night	2.4	90	40
Summer	Night	1.9	112.5	51
Summer	Night	1.8	135	50
Summer	Night	2.1	157.5	41
Summer	Night	2.3	180	34
Summer	Night	2.3	202.5	31
Summer	Night	2.0	225	30
Autumn	Evening	2.0	112.5	37
Autumn	Evening	1.9	135	37
Autumn	Evening	2.2	157.5	37
Autumn	Evening	2.4	180	36
Autumn	Evening	2.5	202.5	34
Autumn	Evening	2.3	225	34
Autumn	Evening	1.8	247.5	33
Autumn	Evening	1.5	270	30
Autumn	Night	1.7	112.5	60
Autumn	Night	1.7	135	71
Autumn	Night	2.0	157.5	69
Autumn	Night	2.3	180	66
Autumn	Night	2.4	202.5	64
Autumn	Night	2.2	225	62
Autumn	Night	1.7	247.5	59
Autumn	Night	1.1	270	52
Winter	Day	1.8	270	31
Winter	Evening	1.5	112.5	38
Winter	Evening	1.7	135	45
Winter	Evening	2.0	157.5	48
Winter	Evening	2.4	180	47
Winter	Evening	2.6	202.5	47
Winter	Evening	2.6	202.5	47
Winter	Evening	2.5	225	47
Winter	Evening	2.2	247.5	47
Winter	Evening	1.9	270	44
Winter	Night	1.2	112.5	52
Winter	Night	1.6	135	66
Winter	Night	2.0	157.5	67
Winter	Night	2.3	180	68
Winter	Night	2.4	202.5	68
Winter	Night	2.2	225	67
Winter	Night	1.8	247.5	66
Winter	Night	1.3	270	58
Spring	Evening	1.9	112.5	36
Spring	Evening	2.0	135	35

Table B1 Calculated prevailing winds

Season	Period	Wind speed (m/s) (10th percentile)	Direction (degrees)	Percentage occurrence (%)
Spring	Evening	2.3	157.5	33
Spring	Evening	2.6	180	31
Spring	Evening	2.5	202.5	31
Spring	Evening	2.3	225	30
Spring	Night	1.8	112.5	58
Spring	Night	1.6	135	67
Spring	Night	2.0	157.5	64
Spring	Night	2.3	180	61
Spring	Night	2.4	202.5	59
Spring	Night	2.2	225	58
Spring	Night	1.7	247.5	55
Spring	Night	1.1	270	50

Appendix C Sound power levels

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Table C1 Plant items $L_{eq(15\text{-}min)}$ dB(A) sound power level spectrum

Noise Source	'A' Weighted frequency (Hz)									Total
	31.5	63	125	250	500	1000	2000	4000	8000	dB(A)
Dozer	108	113	108	106	106	103	100	94	85	116
Drill Rig	67	81	103	104	106	109	108	100	92	114
Excavator	63	81	92	98	101	101	101	95	85	107
Forklift	68	65	74	75	81	82	80	78	70	87
Front-end loader (pit)	99	104	107	110	108	107	107	101	91	116
Generator	57	73	81	90	87	94	90	87	81	98
Grader	68	75	89	97	97	99	97	90	80	104
Haul truck	73	94	99	97	101	103	102	95	87	108
Light vehicle	50	64	70	73	67	64	62	58	44	76
Lighting plant	57	73	81	90	87	94	90	87	81	98
Road truck	71	89	95	90	89	93	97	92	85	102
Road truck idling	43	61	67	77	82	85	86	81	74	90
Rock breaker	68	79	93	102	114	116	115	111	101	121
Water truck	71	89	89	91	96	100	95	90	81	103
Train idle	57	70	77	77	87	86	84	85	78	92
Crushing and ore handling (primary jaw)	78	100	107	114	119	120	117	111	101	124
Crushing and ore handling (cone crusher)	71	93	100	107	112	113	110	108	95	117
Limestone mill	74	86	96	101	111	112	112	108	95	117
Conveyor	40	51	55	57	64	61	57	52	42	68/m

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Appendix D Noise contours

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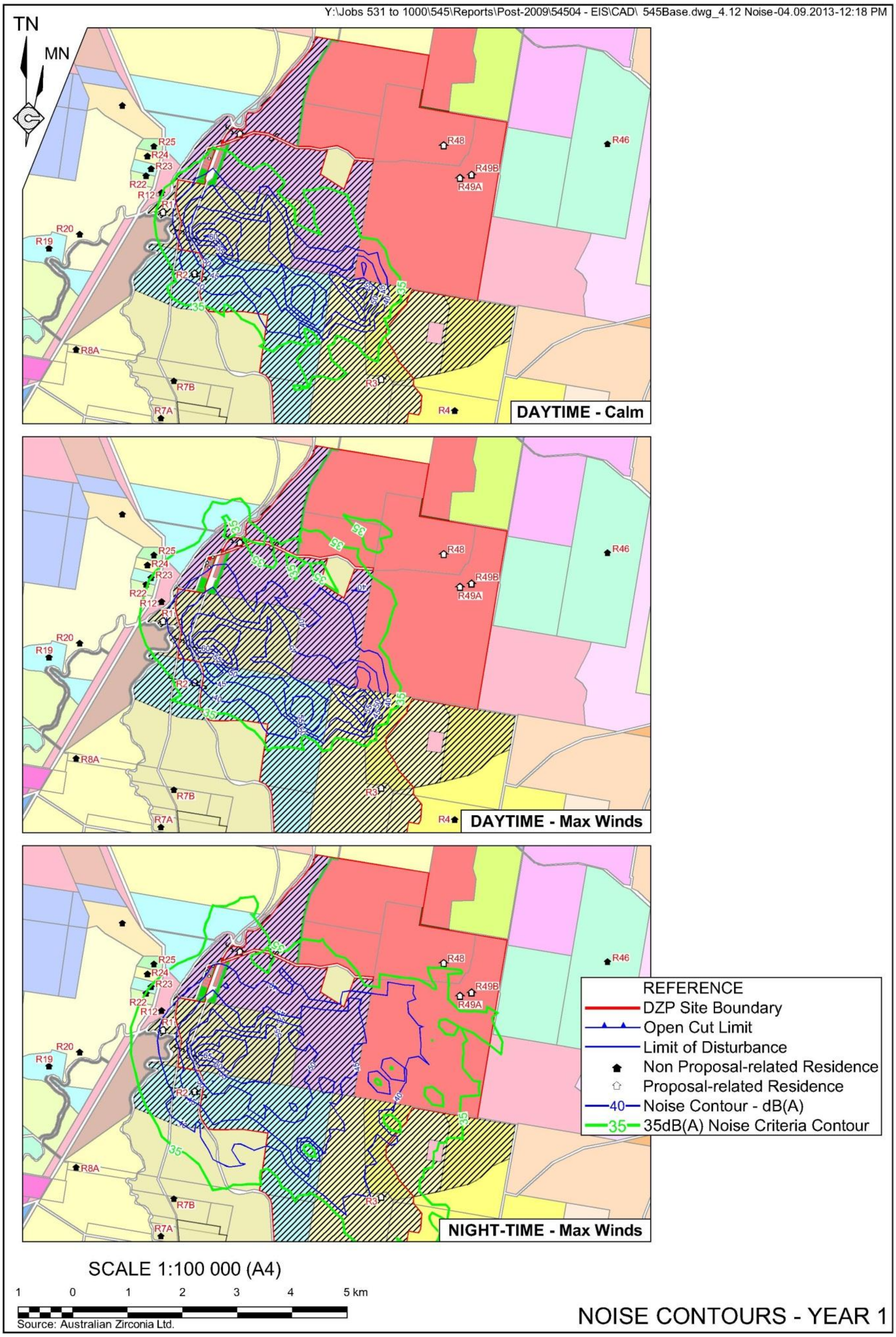
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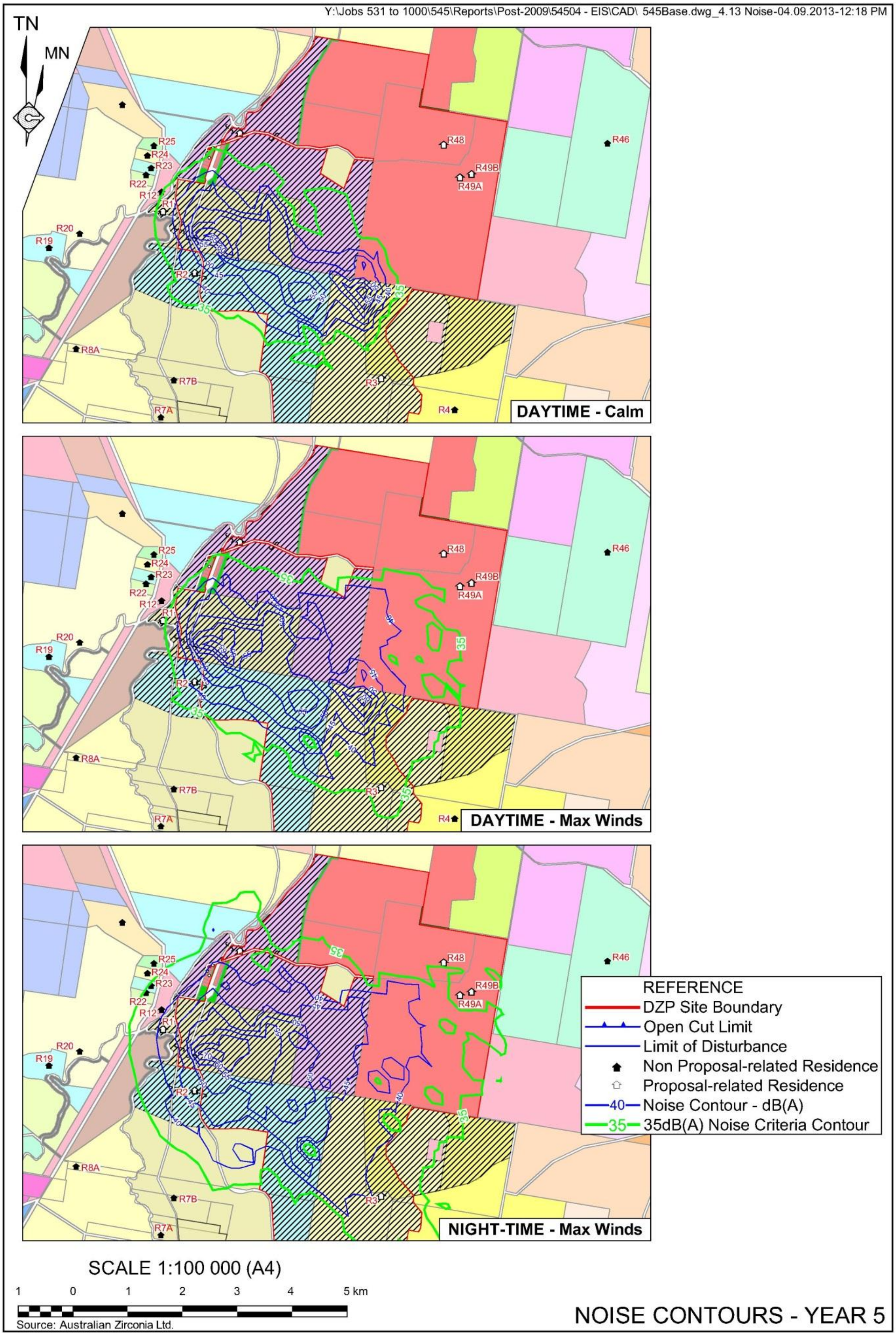
TN
MN
DAYTIME - Calm
DAYTIME - Max Winds
NIGHT-TIME - Max Winds
REFERENCE
DZP Site Boundary
Open Cut Limit
Limit of Disturbance
Non Proposal-related Residence
Proposal-related Residence
40 Noise Contour - dB(A)
35 35dB(A) Noise Criteria Contour
SCALE 1:100 000 (A4)
1 0 1 2 3 4 5 km
Source: Australian Zirconia Ltd.
NOISE CONTOURS - YEAR 1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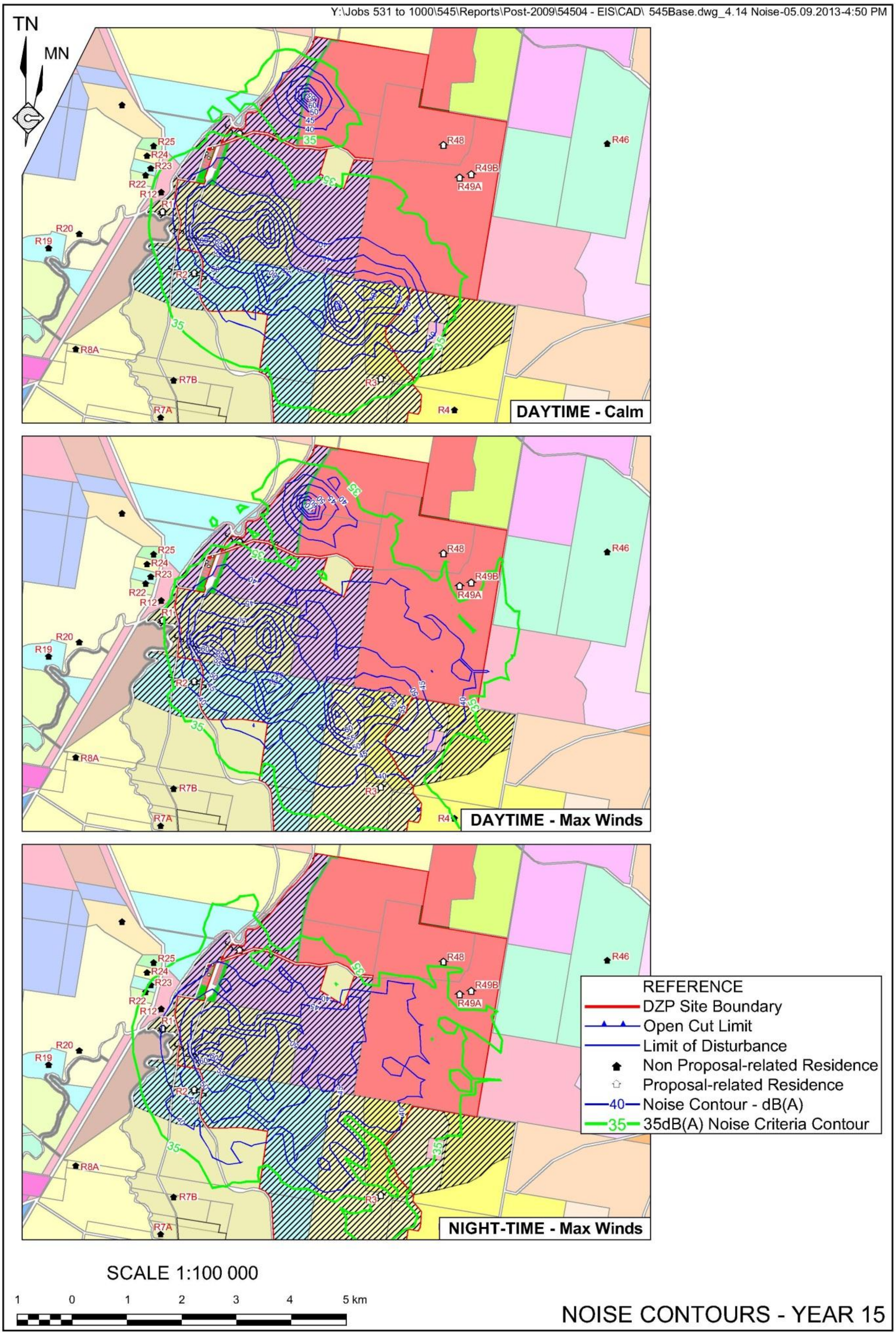
TN
MN
DAYTIME - Calm
DAYTIME - Max Winds
NIGHT-TIME - Max Winds
REFERENCE
DZP Site Boundary
Open Cut Limit
Limit of Disturbance
Non Proposal-related Residence
Proposal-related Residence
40 Noise Contour - dB(A)
35 35dB(A) Noise Criteria Contour
SCALE 1:100 000 (A4)
1 0 1 2 3 4 5 km
Source: Australian Zirconia Ltd.
NOISE CONTOURS - YEAR 5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TN
MN
R25
R24
R23
R22
R12
R1
R20
R19
R2
R8A
R7B
R7A
R3
R4
R48
R49B
R49A
R46
DAYTIME - Calm
DAYTIME - Max Winds
NIGHT-TIME - Max Winds
REFERENCE
DZP Site Boundary
Open Cut Limit
Limit of Disturbance
Non Proposal-related Residence
Proposal-related Residence
40 Noise Contour - dB(A)
35 35dB(A) Noise Criteria Contour
SCALE 1:100 000
1 0 1 2 3 4 5 km
NOISE CONTOURS - YEAR 15

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