PROJECT CHINA STONE

Noise Report

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MACMINES AUSTASIA PTY LTD

PROJECT CHINA STONE

ACOUSTIC IMPACT ASSESSMENT

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GLOSSARY

The following acoustical terms are used in this report:

- Sound Pressure — Small air pressure variations above and below normal atmospheric pressure that are perceived by human ears as sound;
- Frequency — The rate of sound pressure fluctuations per second, expressed as cycles per second or hertz (Hz). Human ears in good condition can typically detect sound in the frequency range 20 Hz to 20,000 Hz (20 kHz), depending on sound level;
- Decibels, dB — A noise level unit based on a logarithmic scale of pascals of sound pressure above and below atmospheric pressure. Expressing a sound pressure level in decibels implies root-mean-squared (RMS) sound pressure unless explicitly stated otherwise. Human ears in good condition can typically detect sound pressures from the threshold of perception at 0 dB (20 uPa) to the threshold of pain at 140 dB (200 Pa). An increase of 10 dB is perceived as an approximate doubling of sound level by an average human ear;
- dBL — Linear decibels, the same as dB but used to explicitly define a decibel scale in the absence of any frequency weighting;
- dBA — A-weighted decibels, where the A weighting means frequencies below 500Hz and above 10kHz are artificially reduced to approximate the frequency response of an average human ear. Most sound monitoring instruments include an A-weighting option, enabling direct measurement of noise levels in dBA;
- LA90 — The A-weighted noise level exceeded 90% of the time (which can be thought of as the quietest 10% of the time) over a defined measurement period, usually 15 minutes or one hour, and widely accepted as the background noise level;
- LAeq — The A-weighted equivalent continuous, or logarithmic average, noise level over a defined time period either measured or predicted at a specific location; and
- Sound Power — Sound energy emitted by a source, measured in watts (W) or expressed on a decibel scale with 0 dB representing 1 picowatt (1 pW) of sound power. While both sound pressure and sound power can be expressed on a decibel scale, the two are not interchangeable or directly comparable. Sound power levels are most commonly expressed as unweighted decibels (dBL) but can be expressed as A-weighted decibels (dBA).

1 INTRODUCTION

Bridges Acoustics was commissioned by Hansen Bailey on behalf of MacMines Austasia Pty Ltd (the proponent) to complete an acoustics impact assessment as part of the Environmental Impact Statement (EIS) for Project China Stone (the project).

The project involves the construction and operation of a large-scale coal mine on a greenfield site in Central Queensland. The project site (the area that will ultimately form the mining leases for the project) is remote, being located approximately 270 km south of Townsville and 300 km west of Mackay at the northern end of the Galilee Basin as shown in Figure 1. The closest townships are Charters Towers, approximately 285 km by road to the north, and Clermont, approximately 260 km by road to the south-east. The project site comprises approximately 20,000 ha of well vegetated land, with low-lying scrub in the south and east and a densely vegetated ridgeline, known as 'Darkies Range', running north to south through the western portion of the site.

The mine will produce up to approximately 55 million tonnes per annum (Mtpa) of Run of Mine (ROM) thermal coal. Coal will be mined using both open cut and underground mining methods. Open cut mining operations will involve multiple draglines and truck and shovel pre-stripping. Underground mining will involve up to three operating longwalls. Coal will be washed and processed on site and product coal will be transported from site by rail. It is anticipated that mine construction will commence in 2016 and the mine life will be in the order of 50 years.

The majority of the mine infrastructure will be located in the eastern portion of the project site (Figure 2). Infrastructure will include coal handling and preparation plants (CHPPs), stockpiles, conveyors, rail loop and train loading facilities, workshops, dams, tailings storage facility (TSF) and a power station. A workforce accommodation village and private airstrip will also be located in the eastern part of the project site.

The scope of this acoustics impact assessment is restricted to assessing activities that are proposed to be undertaken within the project site and no off-lease activities are considered in this assessment.

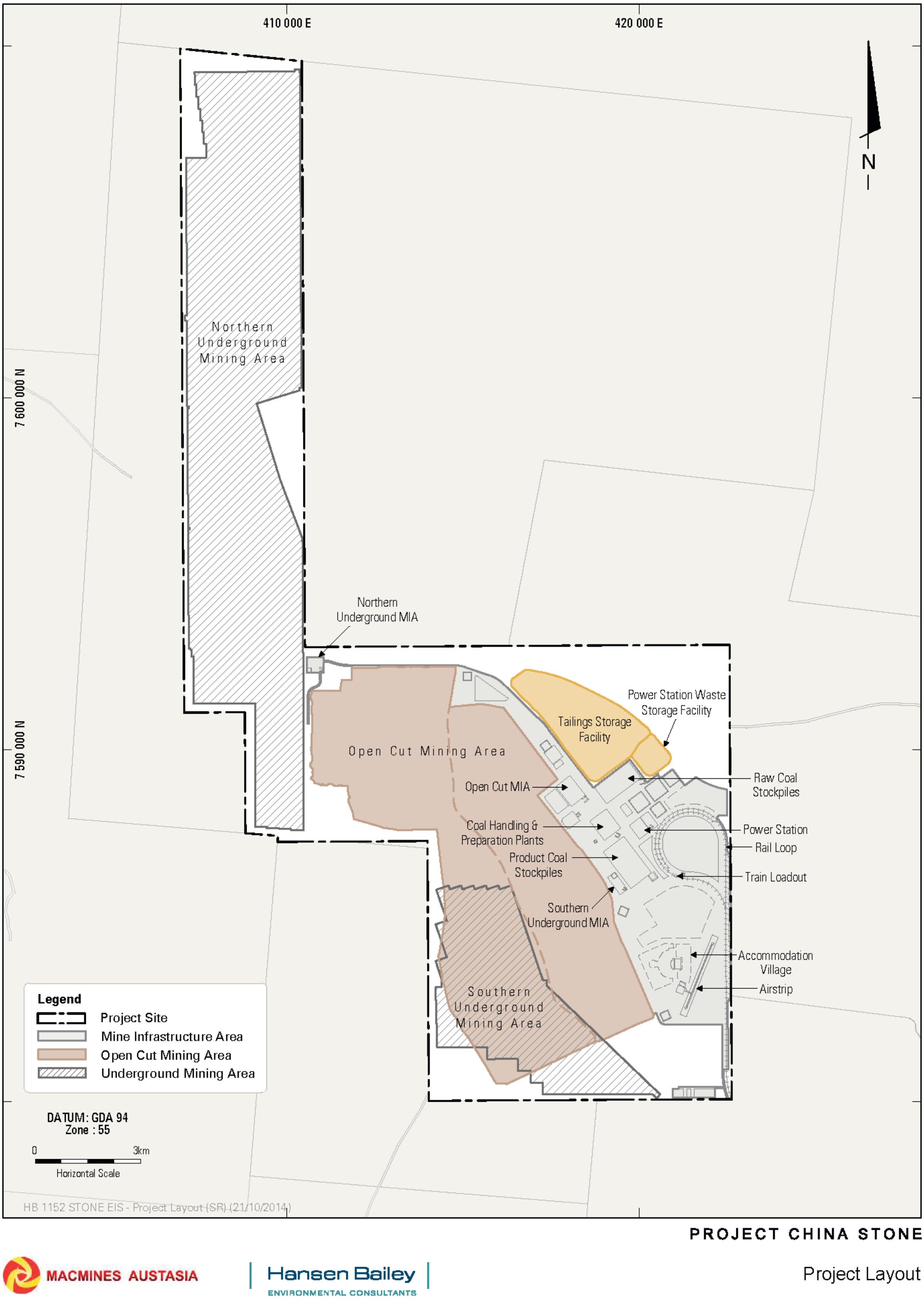
1.1 Assessment Scope

The assessment scope included the following components:

- Complete both long term and short term environmental noise surveys at representative receiver locations;
- Assess prevailing weather conditions that may affect noise propagation to receivers in the vicinity of the Project;
- Establish a software-based noise model of the Project to predict received noise levels during representative operating years and compare results with relevant noise criteria (including sleep disturbance and low frequency noise);
- Complete a cumulative assessment with any nearby existing or proposed mining and industrial projects;
- Assess environmental noise levels associated with proposed construction works, road traffic and aircraft noise associated with the Project; and
- Assess blasting noise and vibration levels at sensitive receiver locations.

Figure 1: Project Location

Figure 2: Project Layout



1.2 Environmental Noise Policies and References

The Department of Environment and Heritage Protection (EHP) has developed or adopted policies and recommended procedures to assess environmental noise levels from various noise source categories. The following policy and guidance documents are relevant to this assessment:

- The *Environmental Protection (Noise) Policy 1997* (Office of the Queensland Parliamentary Counsel, November 2007) (EPP 1997) (repealed);
- The *Environmental Protection (Noise) Policy 2008* (Office of the Queensland Parliamentary Counsel, January 2009) (EPP Noise);
- *Planning for Noise Control Guideline* (PNCG) (Environmental Protection Agency [EPA] now EHP, 2004);
- *Noise and Vibration from Blasting Guideline* (NVBG) (EPA now EHP, 2006);
- *Draft Ecoaccess Guideline for the Assessment of Low Frequency Noise* (EPA now EHP, 2004);
- *Noise Measurement Manual* (EHP, 2013);
- *Model Mining Conditions* (EHP, 2013);
- *Australian Standard 2187.2:2006 Explosives – Storage and use, Part 2 – Use of explosives* (SAI Global 2006); and
- *British Standard 7385*-2:1993 Evaluation and measurement for vibration in buildings, Part 2: Guide to damage levels from groundborne vibration (British Standards Institution, 1993).

1.3 Sensitive Receptors

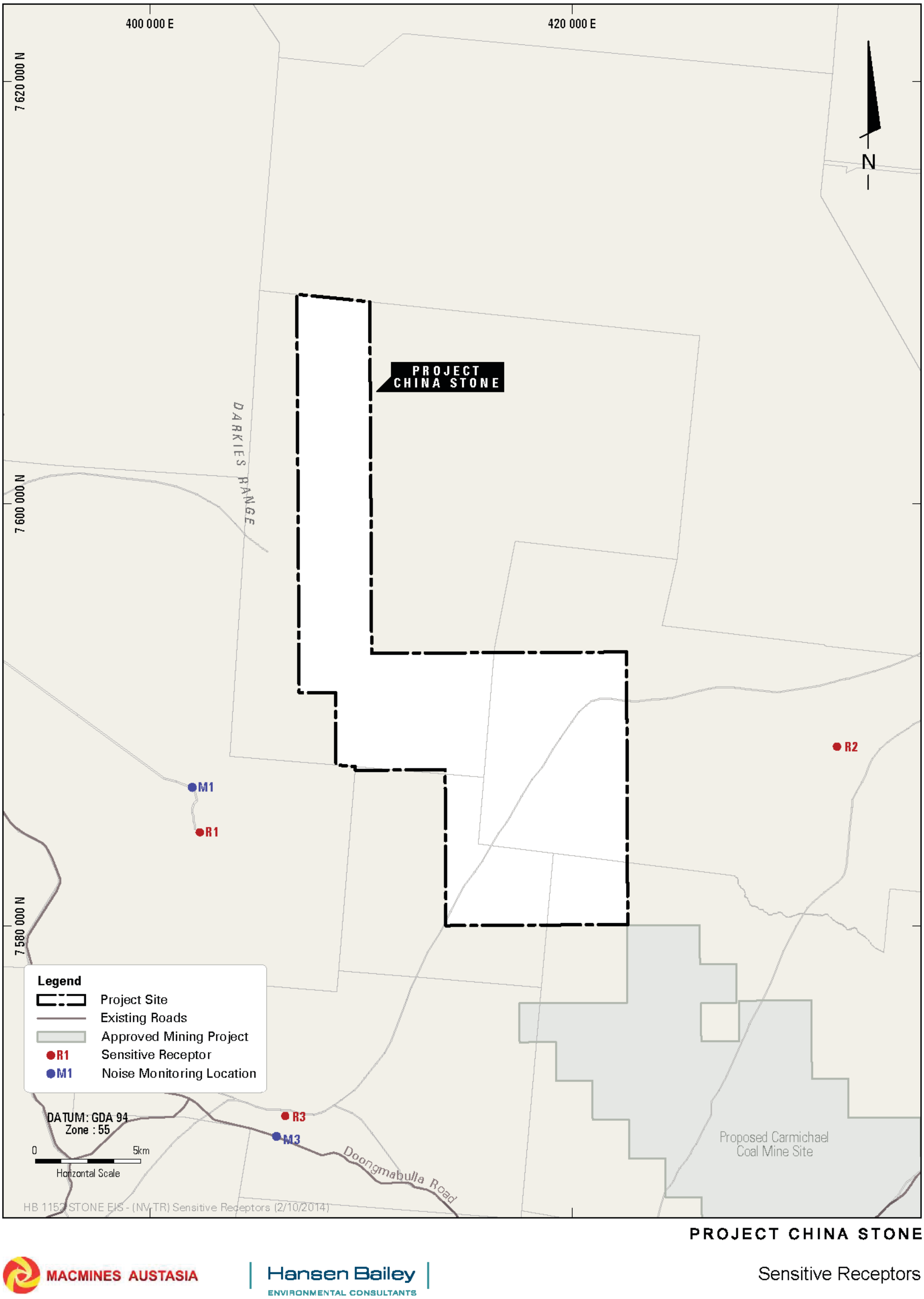
According to the EPP Noise, potential noise sensitive receptors include private dwellings, public buildings including childcare facilities, hospitals and educational institutions, commercial and industrial developments, open recreational areas and ecologically protected areas. The PNCG also classifies land use at and surrounding the noise receptor, therefore noise sensitive receptors for the project have been identified taking into account land use. Receptors adopted for the project have been selected based upon a number of factors including sensitivity to noise, potential exposure to project noise and distance from project noise sources. By assessing and managing project noise at the most exposed, sensitive and closest receptors, other potentially sensitive receptors at more remote or less exposed locations would be protected.

Table 1 shows all sensitive receptors in the vicinity of the project, with each receptor and baseline noise monitoring location shown in Figure 3.

Table 1: Sensitive Receptors

Number	Description	Distance from Project Site
R1	Moonoomoo Homestead	7.2 km west
R2	Dooyne Outstation (intermittent use only)	9.9 km east
R3	Carmichael Homestead	11.8 km south west

Figure 3: Sensitive Receptors and Noise Monitoring Locations



2 EXISTING ENVIRONMENT

2.1 Noise Monitoring Program

The baseline noise monitoring program included long-term measurements using unattended noise monitors combined with short term operator-attended noise measurements to assist in identifying and quantifying dominant sources of background and ambient noise, as recommended in the Noise Measurement Manual.

The long term survey occurred during the period 20 May to 4 June 2013 at two representative receptor locations as shown in Figure 3. The noise monitors were installed on the properties away from the residences to minimise disturbance to residents during the operator-attended noise survey, at the locations described below:

- M1 – Near Receptor R1, adjacent to the access road approximately 2.1 km north of the receptor; and
- M3 – Near Receptor R3, adjacent to the access road approximately 930 m south of the receptor.

Noise monitors used for the long term unattended survey consisted of Svan 955 Type 1 sound level meters housed in weatherproof cases with the microphones and windshields attached via extension cables and mounted approximately 1.2 m above the ground. The monitors were programmed to measure and store 1 second LAeq readings for the entire monitoring period, with recorded data converted to 15 minute percentile statistics for subsequent processing to determine background and ambient noise levels. Data from the monitors is presented in chart form in Appendix C.

Short term operator attended noise measurements were also taken at each location during the day, evening and night at the beginning and end of the long term noise survey, with measurements taken over periods of 15 minutes. Short term attended noise surveys were completed using a Svan 912AE Type 1 sound level analyser fitted with a 12.7 mm polarised condenser microphone and a windshield. This instrument was mounted on a tripod with the microphone approximately 1.2 m above the ground. All instrument calibration levels were checked at the beginning and end of the survey using an 01dB Cal-01 Type 1 calibrator producing 94 dB at 1 kHz.

2.2 Measured Noise Levels

Background noise levels at the two monitoring locations were determined according to recommended procedures described in Appendix B of the PNCG, with the exception that 15 minute measurement periods consistent with the Model Mining Conditions were used in lieu of hourly periods recommended in the PNCG. The noise survey occurred in the cooler months to avoid additional insect noise in summer. As measured noise levels during the survey were in all cases below the minimum 30 LA90,15min recommended in the MMC, additional noise surveys in other seasons would not change the adopted background noise levels and no further noise surveys were required.

The guideline requires ‘assessment background noise levels’ (ABLs) to be determined for each day, evening or night period by taking the lowest 10% of the individual measured background levels. Calculated ABLs for each time period are included on the results charts in Appendix C. Tables 2 and 3 show the ABLs and a single ‘rating background level’ (RBL) of 30 LA90,15min during each time period at each monitoring location.

Table 2: Measured Noise Levels at M1, May - June 2013, dBA

Day, Date	Background Levels, LA90 (ABL)			Ambient Levels, LAeq		
	Day	Evening	Night	Day	Evening	Night
Mon 20 – Tue 21 May	34.2 [1]	16.9	10.0	48.3 [1]	35.7	24.0
Tue 21 – Wed 22 May	21.0	15.0	17.4	45.0	28.5	47.7
Wed 22 – Thu 23 May	28.5	20.9	12.4	52.1	40.9	32.7
Thu 23 – Fri 24 May	20.8	14.9	10.3	47.4	37.5	35.3
Fri 24 – Sat 25 May	22.2	8.3	9.4	44.1	27.3	24.8
Sat 25 – Sun 26 May	16.0	6.7	9.5	38.7	38.0	30.6
Sun 26 – Mon 27 May	25.3	11.6	13.3	49.9	24.6	29.4
Mon 27 – Tue 28 May	17.5	19.5	12.9	45.4	35.0	36.9
Tue 28 – Wed 29 May	30.8	20.9	18.4	48.8	36.6	41.9
Wed 29 – Thu 30 May	27.1	15.0	27.8	43.5	40.0	44.9
Thu 30 – Fri 31 May	26.0	18.6	16.2	48.7	33.2	31.8
Fri 31 – Sat 1 June	25.8	13.3	15.4	45.9	36.2	32.8
Sat 1 – Sun 2 June	24.0	13.2	11.3	47.6	22.8	41.5
Sun 2 – Mon 3 June	19.7	10.4	11.8	47.1	46.6	30.3
Mon 3 – Tue 4 June	17.8	9.0	12.6 [1]	43.2	40.7	35.2 [1]
RBL [2]	30	30	30	-	-	-

1 Data at the beginning and end of the survey were collected for less than an entire day or night period.

2 A minimum background level of 30 LA90,15min has been adopted as recommended in the notes to Table D1 in the Model Mining Conditions.

Table 3: Measured Noise Levels at M3, May - June 2013, dBA

Day, Date	Background Levels, LA90 (ABL)			Ambient Levels, LAeq		
	Day	Evening	Night	Day	Evening	Night
Mon 20 – Tue 21 May	26.6 [1]	20.0	15.9	55.2 [1]	35.0	35.4
Tue 21 – Wed 22 May	22.4	23.0	21.5	60.4	34.2	39.0
Wed 22 – Thu 23 May	29.5	21.4	17.4	48.8	40.8	28.8
Thu 23 – Fri 24 May	22.8	17.7	14.1	43.8	40.7	34.7
Fri 24 – Sat 25 May	25.6	25.5	10.9	46.7	52.2	42.7
Sat 25 – Sun 26 May	19.0	7.9	8.5	48.0	43.3	28.2
Sun 26 – Mon 27 May	21.4	14.2	9.9	46.0	36.6	38.6
Mon 27 – Tue 28 May	19.0	24.2	9.1	43.5	39.4	31.7
Tue 28 – Wed 29 May	26.3	24.0	15.0	47.4	42.7	36.8
Wed 29 – Thu 30 May	23.2	25.3	23.0	47.4	48.6	42.5
Thu 30 – Fri 31 May	27.0	20.7	17.1	43.7	36.5	26.6
Fri 31 – Sat 1 June	20.3	26.0	15.8	46.2	38.4	35.4
Sat 1 – Sun 2 June	26.1	21.3	21.5	43.8	31.3	40.7
Sun 2 – Mon 3 June	18.8	22.2	15.3	44.6	41.6	38.1
Mon 3 – Tue 4 June	19.5	14.4	14.3 [1]	44.5	39.0	30.5 [1]
RBL [2]	30	30	30	-	-	-

1 Data at the beginning and end of the survey were collected for less than an entire day or night period.

2 A minimum background level of 30 LA90,15min has been adopted as recommended in the notes to Table D1 in the Model Mining Conditions.

Operator attended noise measurements and observations indicate the following dominant sources of background and ambient noise at the monitoring locations:

- Background LA90 noise levels at both locations are only influenced by natural sounds including insects, wind noise and birds. Noise from vehicle movements is very intermittent at both locations and does not affect the measured background levels. Particularly quiet nights, with no audible insect noise, occurred for a few nights during the survey however insect noise was audible for the majority of the time; and
- Ambient LAeq noise levels at both locations are influenced by a combination of intermittent road traffic and natural sounds such as wind, birds, insects and cattle. No mining or other industrial noise is currently audible at either location. Significant variations in ambient noise levels from one period to the next are primarily caused by varying average wind speeds and the presence of cattle grazing near the noise monitors.

3 CRITERIA

3.1 Mining Noise

Noise criteria for this assessment have been developed based on the Model Mining Conditions which are reproduced below.

Noise limits

D1 The holder of this environmental authority must ensure that noise generated by the mining activities does not cause the criteria in Table D1 – Noise limits to be exceeded at a sensitive place or commercial place.

Table D1 – Noise limits

Sensitive Place						
Noise level dBA measured as	*Monday to Saturday*			*Sundays and Public Holidays*		
	7am to 6pm	*6pm to 10pm*	*10pm to 7am*	*9am to 6pm*	*6pm to 10pm*	*10pm to 9am*
LAeq,adj,15min	*CV = 50 AV = 5*	*CV = 45 AV = 5*	*CV = 40 AV = 0*	*CV = 45 AV = 5*	*CV = 40 AV = 5*	*CV = 35 AV = 0*
LA1,adj,15min	*CV = 55 AV = 10*	*CV = 50 AV = 10*	*CV = 45 AV = 5*	*CV = 50 AV = 10*	*CV = 45 AV = 10*	*CV = 40 AV = 5*
Commercial Place						
Noise level dBA measured as	*Monday to Saturday*			*Sundays and Public Holidays*		
	7am to 6pm	*6pm to 10pm*	*10pm to 7am*	*9am to 6pm*	*6pm to 10pm*	*10pm to 9am*
LAeq,adj,15min	*CV = 55 AV = 10*	*CV = 50 AV = 10*	*CV = 45 AV = 5*	*CV = 50 AV = 10*	*CV = 45 AV = 10*	*CV = 40 AV = 5*

Table D1 – Noise limits notes:

1. *CV = Critical Value*
2. *AV = Adjustment Value*
3. *To calculate noise limits in Table D1:*

   If $bg \leq (CV - AV)$:

   Noise limit = $bg + AV$

   If $(CV - AV) < bg \leq CV$:

   Noise limit = CV

If bg > CV:

Noise limit = bg + 0

4. *In the event that measured bg (**LA90, adj, 15 mins**) is less than 30 dB(A), then 30 dB(A) can be substituted for the measured background level*
5. *bg = background noise level (**LA90, adj, 15 mins**) measured over 3-5 days at the nearest sensitive receptor*
6. *If the project is unable to meet the noise limits as calculated above alternative limits may be calculated using the processes outlined in the "Planning for Noise Control" guideline.*

The adopted background noise level of 30 LA90,15min at both monitoring locations and in all time periods is lower than the critical value less the adjustment value (CV – AV), therefore the noise limits are calculated by adding the adjustment value to the background level (bg + AV) as shown in Table 4.

Table 4: Model Mining Conditions Noise Limits

Sensitive Place						
Noise level dBA measured as	Monday to Saturday			Sundays and Public Holidays		
	7am to 6pm	6pm to 10pm	10pm to 7am	9am to 6pm	6pm to 10pm	10pm to 9am
LAeq,adj,15min	35	35	30	35	35	30
LA1,adj,15min	40	40	35	40	40	35
Commercial Place						
Noise level dBA measured as	Monday to Saturday			Sundays and Public Holidays		
	7am to 6pm	6pm to 10pm	10pm to 7am	9am to 6pm	6pm to 10pm	10pm to 9am
LAeq,adj,15min	40	40	35	40	40	35

The noise limits in Table 4 apply to noise from all mining and coal handling equipment. The noise limits have also been applied to noise from the proposed power station.

3.2 Sleep Disturbance

Sleep disturbance potentially occurs when short, sharp sounds that intrude above the ambient level can be heard within a bedroom during the night. Common sources of sleep disturbance include road, air and rail traffic, impact sounds from an industrial or mining site, bird calls and voices. Of these sources, only impact sounds potentially originating from the project are relevant to this assessment.

The PNCG recommends the maximum indoor sound level should not exceed 45 LAmax for more than 10-15 times per night, which according to Table 7 in the PNCG equates to an outdoor sound level of:

- 47 LAmax for windows wide open;
- 52 LAmax assuming windows partly closed; and
- 62 LAmax with windows fully closed.

The noise criteria assume a 10% probability of awakening and apply at a point 4 m from the façade of a potentially affected residence.

3.3 Low Frequency Noise

The *Draft Ecoaccess Guideline for the Assessment of Low Frequency Noise* (EPA, 2004) suggests a criterion of 50 dBL for the frequency range 10 Hz to 200 Hz to minimise the potential for impacts on noise sensitive receivers such as residences. It should be noted that dBL means unweighted decibels, without the usual A-weighting correction that is normally applied to approximate the frequency response of an average human ear. There is no dBA equivalent to the suggested criterion of 50 dBL.

The *Draft Ecoaccess Guideline for the Assessment of Low Frequency Noise* requires assessments of low frequency noise to assume windows and doors are closed to reduce background noise levels and to avoid contamination of the noise measurement with wind noise or other extraneous external noise sources. This approach is adopted because low frequency noise inside a dwelling is more audible when windows and doors are closed, thereby lowering background noise levels in the dwelling. Table 7 of the PNCG shows a difference of 20 dBA between outside and inside a dwelling where windows and doors are closed, however a lower attenuation of 10 dBA has been conservatively adopted for the low frequency assessment as the walls and roof of most dwellings provide less attenuation of low frequency noise compared to typical audible noise. The 50 dBL criterion inside a dwelling would be approximately equivalent to a criterion of 60 dBL outside a dwelling.

3.4 Cumulative Noise Levels

The Model Mining Conditions do not specifically address cumulative noise levels, however it is reasonable to adopt the Critical Values (CVs) recommended in the Model Mining Conditions, as appropriate cumulative noise criteria as shown below:

- 50 LAeq,15min during the day;
- 45 LAeq,15min during the evening; and
- 40 LAeq,15min during the night.

The cumulative noise criteria developed from the Model Mining Conditions are consistent with the Planning Noise Levels (PNLs) recommended in Table 3 of the PNCG as they fall between the two quietest Noise Area Categories Z1 and Z2 which represent rural residential receivers with only intermittent noise from vehicle movements.

3.5 Road and Rail Traffic Noise

Noise criteria applying to transportation sources are sourced from Schedule 1 of the EPP 1997, in the absence of equivalent guidance in the later EPP Noise. The EPP 1997 recommends a daytime traffic noise criterion of 63 LA10,18hr for the time period 6am to midnight from a public road, excluding state-controlled roads, to residences. This criterion is assumed to apply to project-related traffic travelling on all local roads in the vicinity of the project, while traffic noise from state-controlled roads such as the Gregory Developmental Road is assessed to a higher noise criterion of 68 LA10,18hr.

Rail noise criteria recommended by the EPP 1997 are an average level of 65 LAeq,24hr and a maximum level of 87 LAmax. All road and rail noise criteria are assessed 1 m in front of the most exposed part of a dwelling or other noise sensitive place.

3.6 Blasting

The blasting limits recommended by the Model Mining Conditions are consistent with criteria recommended in the NVBG.

The blasting limits are intended to minimise disturbance to residents and do not specifically consider the potential for building damage. British Standard 7385-2:1993 recommends ground vibration criteria in the range 15 mm/s to 50 mm/s for light residential and industrial buildings to protect them from minor cosmetic damage, with higher vibration levels required to cause significant structural damage, while overpressure levels significantly over 130 dB Lin Pk are regularly caused by winds and thunderstorms with no resultant damage to residences or other buildings. The recommended 'personal comfort' limits of 5 mm/s and 115 dBL therefore provide adequate protection for all rural, residential or industrial structures.

Blasting criteria recommended in Schedule D2 of the Model Mining Conditions are reproduced below:

Airblast overpressure nuisance

D2 The holder of this environmental authority must ensure that blasting does not cause the limits for peak particle velocity and air blast overpressure in Table D2 – Blasting noise limits to be exceeded at a sensitive place or commercial place.

Table D2 – Blasting noise limits

Blasting noise limits	*Sensitive or commercial place blasting noise limits*	
	7am to 6pm	*6pm to 7am*
Airblast overpressure	*115 dB (Linear) Peak for 9 out of 10 consecutive blasts initiated and not greater than 120 dB (Linear) Peak at any time*	*either no blasting or justified limits not less stringent than 7am to 6pm*
Ground vibration peak particle velocity	*5mm/second peak particle velocity for 9 out of 10 consecutive blasts and not greater than 10 mm/second peak particle velocity at any time*	*either no blasting or justified limits not less stringent than 7am to 6pm*

3.7 Aircraft Noise

Aircraft noise from large regional airports is typically assessed using the Australian Noise Exposure Forecast (ANEF) system, however calculation of ANEF contours requires detailed data regarding aircraft numbers, flightpaths and flight times. Appendix D of *Australian Standard 2021-2000 Acoustics – aircraft noise intrusion – Building siting and construction* (AS2021) (Standards Australia, 2000) recommends an alternative assessment method, based on maximum noise levels, to assess the acceptability of aircraft noise near smaller airports and airstrips without ANEF charts.

Table D1 in AS2021 recommends an acceptable maximum noise level of 80 dBA, with a conditionally acceptable maximum level of up to 90 dBA, for residences receiving less than 20 aircraft flights per day. Receptors subject to acceptable maximum noise levels of up to 80 dBA do not require noise mitigation to be applied to the residence according to AS2021, while receptors subject to conditionally acceptable noise levels up to 90 dBA should include noise mitigation measures to reduce internal noise levels.

3.8 World Health Organisation

The World Health Organisation (WHO) has developed two noise policy documents that may be considered relevant:

- Guidelines for Community Noise (WHO 1999) – Table 4.1 of this document recommends:
    - An average noise level of 35 LAeq,16hrs during the day and evening (6 am to 10 pm) inside a residence, which is approximately equivalent to a noise level of 45 LAeq,16hr outside a residence with all windows open. This criterion is 5 dBA and 10 dBA above the day and evening noise criteria recommended by the Model Mining Conditions as shown in Table 4;
    - An average noise level of 30 LAeq,8hrs during the night (10 pm to 6 am) inside a bedroom, which is approximately equivalent to a noise level of 40 LAeq,8hr outside a bedroom

window with the window open. This criterion is 10 dBA above the night noise criteria recommended by the Model Mining Conditions as shown in Table 4;

- A maximum noise level of 45 LAmax during the night (10 pm to 6 am) inside a bedroom, which is approximately equivalent to a noise level of 55 LAmax outside a bedroom window with the window open. This criterion is 20 dBA above the night maximum noise criteria recommended by the Model Mining Conditions as shown in Table 4;
- Average and maximum noise levels of 45 LAeq,8hrs and 60 LAmax during the night (10 pm to 6 am) outside a bedroom window with the window open, which are 15 LAeq,8hr and 25 LAmax higher than the night noise criteria recommended by the Model Mining Conditions as shown in Table 4.

- Night Noise Guidelines for Europe (WHO 2009) – This document only applies to European communities, however it may be considered by some to apply to receptors near the project. Table 5.1 of the Guidelines recommends:
  - a maximum noise level of 32 LAmax,inside which is approximately equivalent to a level of 42 LAmax,outside assuming windows remain fully open. This recommended level is lower than the recommended sleep disturbance criterion in the PNCG but is higher than the adopted LAmax criterion derived from the Model Mining Conditions as shown in Table 4; and
  - a criterion of 40 Lnight,outside which refers to the annual average noise level outside a residence and can be conservatively approximated by the measured or predicted LAeq,15min noise level. The recommended 40 Lnight,outside is therefore substantially higher and less restrictive than the Model Mining Conditions recommendation of 30 LAeq,15min at night as shown in Table 4.

The WHO's recommendations are less restrictive than the recommended noise criteria in the Model Mining Conditions, therefore the Model Mining Conditions is the primary policy document referred to in this assessment.

4 ASSESSMENT

4.1 Atmospheric Conditions

4.1.1 General Discussion

A review of atmospheric conditions that occur in the region has been carried out to assist in determining the effect of such conditions on noise propagation from the project site. Parameters such as air temperature, relative humidity, wind speed profile and vertical temperature gradient can influence noise levels at some distance from a source, while such effects are rarely significant at much shorter distances.

The effect of atmospheric conditions on noise propagation is complex. The EHP recognises this complexity and has adopted a general assessment procedure for the purpose of noise modelling, as described in the PNCG, which is intended to represent most real situations for most of the time. Essentially, in cases where such weather effects occur for 30% of the time or more in any season or time period, the PNCG recommends the following default weather conditions should be modelled:

- A 3 °C/100m inversion during the night plus a 2 m/s drainage flow from source to receiver where the source is on higher ground than the receiver with no intervening hills; or
- A 3 m/s gradient wind from source to receiver where such a wind direction occurs for at least 30% of the time in any season or time period.

Weather conditions occurring in the vicinity of the project site have been assessed in detail as described in the EIS Air Quality Assessment. An output file from the California Meteorological

(CALMET) model of the region developed by Katestone Environmental was obtained to determine prevailing weather conditions for the noise model, as further described in the following sections.

4.1.2 Temperature Inversions

Direct measurement of temperature inversion strength requires at least two temperature sensors mounted at different heights above the ground, generally with one sensor at 10 m above the ground and a second sensor at a height in the range 50 m to 80 m above the ground. In the absence of direct inversion measurements, Pasquill stability classes were included in the CALMET model output file for the year 2007 provided by Katestone Environmental and have been used to estimate the occurrence of temperature inversions. The data were analysed using the following method:

- Separate the data into day (7 am to 6 pm) and evening/night (6 pm to 7 am) periods and discard data for the day;
- Separate the evening/night data by season; and
- Count the percentage occurrence of each stability class.

Table 5 shows the results of this analysis.

Table 5: Occurrence of Temperature Inversions, 2007 CALMET

Pasquill Stability Class	Occurrence of Temperature Inversions by Season, 6 pm to 7 am			
	Summer	Autumn	Winter	Spring
Class A – E	71%	34%	37%	57%
Class F and G	29%	66%	63%	43%

The CALMET atmospheric model does not distinguish between F and G classes. Table 5 indicates mild F and strong G class inversions occur for more than 30% of the time in autumn, winter and spring and for almost 30% of the time in summer and therefore should be considered by the noise model. Combined F and G class inversions have been modelled using an inversion strength of 3 °C/100 m which is at the upper end of the F class range.

Temperature inversions tend to be accompanied by cold air drainage flows which tend to run downhill towards river valleys then along the valleys. Rather than remain within a narrow channel, the cold air tends to spill over the entire valley width as it travels downhill. Drainage flows can enhance noise for receivers downwind and should therefore be considered in the assessment.

A detailed inspection of terrain within and around the project site indicates a general downward gradient towards the south east. Cold air drainage flows associated with temperature inversions would therefore tend to run from the north-west, particularly when gradient winds are low, and have been modelled in this direction.

4.1.3 Wind Analysis

Results from the CALMET atmospheric model have been analysed to determine the occurrence of gradient winds that may enhance noise levels at receptors. For the purposes of this assessment, a noise enhancing wind is defined as a wind from 0.5 m/s to 3 m/s blowing from the project site generally towards a noise sensitive receptor, or causing a significant wind vector component in the direction of a receptor. Higher wind speeds tend to cause turbulence and increased background noise levels so do not increase the relative audibility of a distant source, while lower wind speeds do not significantly affect received noise levels.

The analysis was completed using the following method:

- Separate all data by season and time period (day, evening and night);

- For each season and time period, count and discard all occurrences of wind speed below 0.5 m/s and above 3 m/s;
- Calculate the vector component of wind speed for each of the 16 compass directions, for each data point; and
- Count the occurrence of a vector component above 0.5 m/s from each of the 16 compass directions as a percentage of all data in that season and time period.

Wind analysis results are shown in Table 6 below, with bold font highlighting significant prevailing winds that have been included in the noise model.

Table 6: Prevailing Winds, CALMET 2007.

Wind Direction	Occurrence of Noise Enhancing Winds, % of Season and Time Period											
	Summer			Autumn			Winter			Spring		
	Day	Even.	Night	Day	Even.	Night	Day	Even.	Night	Day	Even.	Night
N	23	**36**	**35**	16	**36**	**39**	10	**16**	**14**	22	**38**	**35**
NNE	23	36	35	31	40	38	12	13	13	26	44	36
NE	**27**	27	27	**39**	13	7	**21**	2	2	**26**	24	23
ENE	26	33	30	34	17	5	25	2	1	31	23	18
E	23	29	24	29	21	10	32	5	4	28	22	20
ESE	19	30	25	29	38	33	42	28	32	20	24	20
SE	**13**	**24**	**21**	**31**	**31**	**34**	**46**	**47**	**51**	**14**	**19**	**20**
SSE	18	21	20	19	27	35	42	61	61	14	18	17
S	9	15	16	10	27	34	37	65	66	11	18	17
SSW	7	**12**	**13**	8	**27**	**32**	28	**67**	**67**	7	**18**	**17**
SW	6	6	5	6	14	16	17	60	52	6	15	13
WSW	6	5	5	5	10	7	12	38	28	6	11	7
W	7	10	11	3	10	16	8	25	22	6	10	11
WNW	6	22	24	7	34	39	4	28	21	8	29	34
NW	13	**31**	**32**	8	**33**	**40**	4	**19**	**16**	11	**32**	**34**
NNW	18	34	33	12	34	39	6	19	15	17	33	33

Table 6 indicates dominant winds occur from the north-east in autumn and from the south-east in winter during the day. Evening and night winds are similar, therefore the evening and night periods have been combined in this assessment. Dominant winds during the evening and night occur from a number of directions including the north, south-east, south-south-west and north-west.

4.1.4 Weather Conditions Summary

The analysis of weather conditions for the project resulted in the weather parameters shown in Table 7 being considered in this assessment. Representative parameters for air temperature and relative humidity have been selected although calculated noise levels are not significantly affected by these parameters.

Table 7: Modelled Weather Conditions.

Atmospheric Parameter	Day			Evening/Night				
	Neutral	NE Wind	SE Wind	Inversion	Inversion+ NW Wind	N Wind	SE Wind	SSW Wind
Temperature, °C	25			15				
Relative Humidity, %	60			80				
Wind Speed, m/s	0	3		0	2	3		
Wind Direction	-	NE	SE	-	NW	N	SE	SSW
Temp Gradient, °C/100 m	-2			3		0		
Effective Inversion, °C/100m	-2	5.5	5.5	3	8	7.5	7.5	7.5
Weather Conditions Included in Noise Contour Figures								
Day Neutral	X	-	-	-	-	-	-	-
Day Prevailing	X	X	X	-	-	-	-	-
Evening/Night Prevailing	-	-	-	X	X	X	X	X

The 'effective inversion' row of Table 7 indicates the total level of atmospheric noise enhancement, based on the following relationship between winds and temperature inversions adopted in the noise model software for the 'rural' terrain category:

Equivalent Inversion °/100m = Inversion °/100m + 2.5 x Wind speed m/s. *Equation 1.*

Table 7 indicates an equivalent inversion of 7.5 °C/100m to 8 °C/100m would be considered to receivers in almost all directions from the project during the evening and night, therefore a noise enhancing effect equivalent to strong G class inversions has been implicitly considered in the noise model.

Noise contours for neutral weather conditions consider only neutral or calm weather conditions, while noise contours for day prevailing conditions represent the worst of the calm, north-east and south-east wind scenarios. Noise contours for the evening and night period were prepared by taking the worst case from the five modelled sets of weather conditions.

4.2 Operational Noise Sources

Sound power levels produced by proposed equipment associated with the project operations have been adopted based on noise levels currently produced by similar equipment at other Queensland coal mines. Sound power levels and spectra for proposed equipment are shown in Table 8. The listed sound power levels represent reasonable worst case noise levels produced by each machine or noise source operating continuously. The assumed situation reflected in the noise model is therefore likely to overstate average noise levels produced by the project and to provide a measure of conservatism.

Table 8: Modelled Sound Power Levels, dB.

Noise Source Code, Description, Height (m)		Sound Power Level (dBLeq except where noted)									Total	
		31.5	63	125	250	500	1k	2k	4k	8k	dBL	dBA
MINING SOURCES												
B, Dragline	12	118	116	114	107	110	109	105	99	86	121.9	112.9
S, Shovel	8	118	116	114	107	110	109	105	99	86	121.9	112.9
E, Excavator	5	124	125	121	116	115	116	113	110	103	129.2	120.2
Z, Dozer (with track noise)	1.5	108	105	108	118	120	122	120	116	96	126.8	126.0
T, Truck (overburden)	3	119	122	122	120	120	115	114	106	102	128.1	121.1

Noise Source Code, Description, Height (m)		Sound Power Level (dBLeq except where noted)									Total	
		31.5	63	125	250	500	1k	2k	4k	8k	dBL	dBA
t, Truck (coal)	3	118	121	121	119	119	114	113	105	101	127.1	120.1
G, Grader	2	115	116	118	116	111	100	101	98	90	122.8	112.2
W, Water cart	2	115	118	118	116	116	111	110	102	98	124.1	117.1
M, Miner (coal)	2	113	114	116	114	111	108	109	98	90	121.4	114.5
D, Drill (overburden)	2.5	105	107	112	115	117	108	108	98	94	120.8	116.5
d, Drill (coal)	2.5	104	106	111	114	116	107	107	97	93	119.8	115.5
H, Load Haul Dump	1	99	101	107	111	107	105	103	98	89	114.8	110.4
P, Personnel carrier	1	92	109	105	105	104	103	101	98	95	113.4	108.3
Co, Compressors	2	101	104	107	114	108	106	104	97	89	116.7	111.6
F, Ventilation fans	3	120	115	113	106	101	106	98	92	81	122.1	108.3
R, Breaker	5	116	113	113	113	114	114	111	104	96	122.2	117.8
c, Conveyor 500m <2000tph	1	112	113	115	115	108	101	104	101	93	120.4	111.6
C, Conveyor 500m >2000tph	1	114	109	108	108	109	111	107	97	87	118.6	114.0
tr, Transfer	4	101	99	103	97	98	97	95	88	80	107.9	101.4
sk, Stacker	6	99	98	99	98	101	96	97	94	88	107.2	103.1
r, Reclaimer	4	109	111	107	101	100	97	94	87	80	114.6	102.3
PP, Preparation plant	15	131	123	117	115	115	113	110	106	99	131.8	117.6
TL, Train loadout	5	109	107	109	103	99	97	94	92	82	113.9	102.8
Loc, Locomotive (slow)	3	109	109	102	101	105	104	100	94	88	114.1	107.7
POWER STATION SOURCES												
PS, Power station	15	132	132	128	130	127	124	119	115	107	137.5	128.8
St, Stack outlet (unsilenced)	210	120	126	128	133	131	126	120	114	105	136.9	131.6
SLEEP DISTURBANCE (MAXIMUM NOISE LEVEL) SOURCES												
V, PS Relief valve	75	128	132	136	139	141	142	144	147	149	153.6	152.7
BB, Dragline bucket impact	2	114	111	124	122	121	128	120	106	100	131.2	129.3
SG, Shovel gate impact	2	124	122	121	126	120	116	110	106	102	130.4	122.2
TB, Train wagon bunching	2	112	115	116	119	122	121	117	110	98	127.1	124.7
MH, Material handling	2	107	104	107	117	119	121	119	115	95	125.8	125.0

Table 9 shows the number of each source type included in the model in each assessed year, the total sound power produced by all sources of each type and the total site sound power. Project years 5, 10 and 20 have been modelled as these years include open cut mining at the eastern and western limits and at maximum intensity. While the power station stack outlet is the loudest single LAeq noise source in dBA as shown in Table 8, the dozer and haul truck fleets produce a significantly higher total sound power due to the large number of individual machines in these fleets.

Noise from mobile machines has occasionally been distributed over a number of locations, typically along a haul route or over a working area. In some cases a single machine has been modelled in a number of locations for a percentage of the time at each location. An example, a dozer working in the open cut mining area has been modelled at two locations for 50% of the time at each location, as indicated by the ‘Z/2’ code shown on the source location figures in Appendix B.

Table 9: Modelled Fleet and Total Sound Power Level, LAeq,1hr

Noise Source Code, Description, Height (m)		Year 5		Year 15		Year 20	
		Fleet	Total dBA	Fleet	Total dBA	Fleet	Total dBA
MINING SOURCES							
B, Dragline	12	2	116	2	116	2	116
S, Shovel	8	3	118	3	118	6	121
E, Excavator	5	1	120	6	128	5	127
Z, Dozer (with track noise)	1.5	17	138	18	139	25	140

Noise Source Code, Description, Height (m)		Year 5		Year 15		Year 20	
		Fleet	Total dBA	Fleet	Total dBA	Fleet	Total dBA
T, Truck (overburden)	3	20	134	38	137	38	137
t, Truck (coal)	3	16	132	28	135	38	136
G, Grader	2	3	117	5	119	5	119
W, Water cart	2	4	123	6	125	7	126
M, Miner (coal)	2	6	122	12	125	14	126
D, Drill (overburden)	2.5	3	121	5	123	4	122
d, Drill (coal)	2.5	1	115	1	115	3	120
H, Load Haul Dump	1	5	117	5	117	5	117
P, Personnel carrier	1	9	118	9	118	9	118
Co, Compressors	2	2	115	2	115	2	115
F, Ventilation fans	3	2	111	2	111	2	111
R, Breaker	5	2	121	2	121	2	121
c, Conveyor 500m <2000tph	1	26	126	26	126	26	126
C, Conveyor 500m >2000tph	1	24	128	24	128	24	128
tr, Transfer	4	15	113	15	113	15	113
sk, Stacker	6	7	112	7	112	7	112
r, Reclaimer	4	6	110	6	110	6	110
PP, Preparation plant	15	3	122	3	122	3	122
TL, Train loadout	5	1	103	1	103	1	103
Loc, Locomotive (slow)	3	12	119	12	119	12	119
POWER STATION SOURCES							
PS, Power station	15	1	129	1	129	1	129
St, Stack outlet (unsilenced)	210	1	132	1	132	1	132
PROJECT TOTAL (Fleet, dBA)		192	142	240	143	263	144

4.3 Mining Noise Levels

4.3.1 Calculation Procedure

Environmental noise levels from the project have been predicted using RTA Technology's Environmental Noise Model (ENM) software. ENM is a general purpose noise modelling package that combines terrain and noise source information with other input parameters such as weather conditions to predict noise levels at specific receiver locations or as contours over a specified receiver area. It is recognised as one of the most appropriate choices for situations involving complex topography and a large number of individual noise sources, and where a detailed assessment of the effects of atmospheric conditions on noise propagation is required.

The standard ENM package includes data input modules to allow terrain and noise source information to be entered and amended, plus an initial setup page containing terrain and source lists and modelled weather conditions for each scenario. All terrain and source files were prepared for this assessment using a combination of AutoCad and Excel based data then automatically converted to ENM format terrain and source files using specially prepared software. All outputs were obtained using algorithms equivalent to ENM's standard sectioning and contouring functions and are presented on a base plan after minor tidying such as closing gaps in the contour lines. All noise contour figures are presented in Appendix A.

4.3.2 Calculated Noise Levels

Noise levels have been calculated including all noise sources within the project site operating normally including open cut and underground mining, coal processing, train loading and operation of the power station. Table 10 shows predicted received noise levels for each assessed year and time period, including maximum noise levels at night for comparison with the sleep disturbance criteria.

Predicted noise levels in Table 10 indicate compliance with the anticipated noise limits at all receptors. Noise levels at more remote receptors that are not listed in Table 10, including the Carmichael Coal Mine and Rail Project (CCM&RP) accommodation village proposed to be constructed approximately 35 km south-east of the project site, would be less than 25 LAeq,15min and below 30 LAmax in all time periods.

Table 10: Predicted Project Noise Levels and Noise Limits, dBA

Noise Contour Figure	Scenario Description	Assessed Year	Predicted noise level dBA			Noise Limits
			R1	R2	R3	
A1	Day Neutral LAeq,15min	5	<25	<25	<25	35
A2	Day Prevailing LAeq,15min	5	27	<25	<25	35
A3	Evening/Night Prevailing LAeq,15min	5	27	27	<25	30
A4	Day Neutral LAeq,15min	15	<25	<25	<25	35
A5	Day Prevailing LAeq,15min	15	28	<25	26	35
A6	Evening/Night Prevailing LAeq,15min	15	28	28	26	30
A7	Day Neutral LAeq,15min	20	<25	<25	<25	35
A8	Day Prevailing LAeq,15min	20	29	<25	26	35
A9	Evening/Night Prevailing LAeq,15min	20	29	29	27	30
A10	Day Neutral LAeq,15min	All	<25	<25	<25	35
A11	Day Prevailing LAeq,15min	All	29	<25	26	35
A12	Evening/Night Prevailing LAeq,15min	All	29	29	27	30
A13	Sleep Disturbance LAmax	All	32	37	30	47

4.4 Low Frequency Noise

Low frequency noise levels, in the range 10 Hz to 200 Hz, have been assessed using the project noise model in the following configuration:

- Include sound power levels shown in Table 8 in only the 31.5 Hz, 63 Hz and 125 Hz octave bands. The 31.5 Hz octave band includes all sound power from 10 Hz, while the frequency bands above 125 Hz were set to zero as they primarily fall outside the 10 Hz to 200 Hz low frequency range;
- Calculate noise levels to closest receptors in octave bands and sum received noise levels in the three relevant bands to determine total low frequency noise levels at each receptor.

Low frequency noise levels outside each receptor were calculated for all years and weather conditions, with the worst case levels and the conditions that give rise to these levels shown in Table 11. Predicted worst case low frequency noise levels would remain well below the external 60 dBL criterion at all receptors.

Table 11: Predicted Low Frequency Noise Levels, dBL Leq,15min

Receptor	Worst Case Year and Weather Conditions	Predicted Low Frequency Noise Level, dBL
R1	Year 20 Night south-east wind	47
R2	Year 20 Night Inversion + NW wind	53
R3	Year 20 Night north wind	47

4.5 Cumulative Noise Impacts

Receivers would be potentially exposed to cumulative noise impacts from the following significant industrial developments:

- The project; and
- The CCM&RP located adjacent to the project's south-eastern corner.

No other significant industrial developments with the potential to generate cumulative noise impacts exist or have been proposed in the vicinity of the project.

The Supplementary EIS for the CCM&RP (Carmichael SEIS), particularly the *Updated Mine Noise and Vibration Assessment* (GHD, October 2013) attached to the SEIS as Appendix N, reports predicted noise levels from the CCM&RP at closest receivers.

Cumulative noise levels from both projects, under worst case weather conditions during the night which is the most sensitive time period and based on the maximum received noise levels over the life of each project, are shown in Table 12. Reasonable worst case LAeq,1hr project noise levels are conservatively assumed to equal the predicted LAeq,15min noise levels from the project shown in Table 10. All other receptors would receive insignificant noise from the project, therefore no cumulative noise impacts will occur at those receptors.

Table 12: Predicted Cumulative Noise Levels, Night, LAeq,15min

Receptor	Predicted Noise Level, LAeq,15min			Cumulative Criterion, Night, LAeq,15min
	Project	CCM&RP	Cumulative Level	
R1	29	< 10	29	35
R2	29	20	30	
R3	27	13	27	

4.6 Construction Noise

Construction work associated with the project would require a number of diesel powered earthmoving and other machines to complete earthworks, install buried services, pour concrete for foundations, grade and seal hardstand areas and construct buildings and other infrastructure.

Simultaneous construction of a number of major components such as the CHPP, power station, accommodation village, airstrip and internal access roads would represent a reasonable worst case situation and is assumed to include a fleet of machines such as the following:

- 12 scrapers;
- 4 excavators;
- 16 off-highway trucks;
- 6 graders;
- 6 rollers;
- 4 backhoes;
- 1 mobile concrete batching plant;
- 6 concrete mixer trucks; and
- 4 water carts.

Additional minor noise sources such as compressors and hand tools would also be required, however noise from these sources would be insignificant compared to noise from the major machines listed above.

A total site sound power level of approximately 132 dBA would be generated by the assumed fleet of 59 major construction machines operating simultaneously at full power, which is at least 10 dBA lower than the total site sound power produced during operation of the project as shown in Table 9. Construction noise levels would therefore be at least 10 dBA lower than operational noise levels listed in Table 10 and would therefore meet the conservative operational noise criteria. A more detailed assessment of construction noise levels is therefore not required.

4.7 Road Traffic Noise

Construction and operation of the project would result in increased car and truck movements on local and regional roads, including the Flinders Highway and Gregory Developmental Road between Clermont and Charters Towers and Elgin Moray Road and Moray Carmichael Road which approach the project site from the east.

4.7.1 Traffic Flows

Baseline and project-related traffic flows on state-controlled and local roads are based on relevant data in the EIS Traffic Report for two vehicle categories (cars and trucks) and four scenarios:

- Baseline traffic;
- Traffic associated with the nearby CCM&RP;
- Project construction traffic; and
- Project operation traffic.

Separate data for baseline car and truck traffic were derived from the heavy vehicle data in Table 9-1 in the EIS Traffic Report, however equivalent heavy vehicle data are not available for the other three scenarios. Heavy vehicles are conservatively assumed to comprise 50% of all CCM&RP, project construction and project operation traffic, except for construction traffic on Moray-Carmichael Road which is assumed to include 85% heavy vehicles travelling to and from a gravel quarry. Adopted traffic flows are shown in Table 13.

Table 13: Predicted Traffic Flows, Vehicles per Day.

Road	Vehicle Type	Baseline 2016	CCM&RP	Project Construction	Project Operation
Flinders Highway	Total	3534	88	72	100
	Cars	3039	44	36	50
	Trucks	495	44	36	50
Gregory Developmental Road North	Total	826	122	72	100
	Cars	669	61	36	50
	Trucks	157	61	36	50
Gregory Developmental Road South	Total	473	136	8	6
	Cars	359	68	4	3
	Trucks	114	68	4	3
Elgin-Moray Road	Total	68	344	80	106
	Cars	34	172	40	53
	Trucks	34	172	40	53

Road	Vehicle Type	Baseline 2016	CCM&RP	Project Construction	Project Operation
Moray-Carmichael Road	Total	22	306	306	114
	Cars	11	153	46	57
	Trucks	11	153	260	57

4.7.2 Traffic Noise Levels

Traffic noise levels have been calculated for combinations of the four scenarios shown in Table 13 to a nominal receptor located 100 m from the road, as shown in Table 14. As all receptors are located more than 100 m from the road between the project site and major urban centres, compliance with the traffic noise criteria at 100 m would ensure compliance with the criteria at all receptors. Traffic associated with the CCM&RP has also been considered in the project construction and operational scenarios to present the worst case traffic noise levels.

Table 14: Predicted Traffic Noise Levels, LA10,18hr.

Road	Baseline	Baseline + CCM&RP	Baseline + CCM&RP + Construction	Baseline + CCM&RP + Operation
Flinders Highway	54.3	54.6	54.8	54.8
Gregory Developmental Road North	48.8	49.9	50.4	50.6
Gregory Developmental Road South	47.0	48.8	48.8	48.8
Elgin-Moray Road	40.9	48.8	49.5	49.8
Moray-Carmichael Road	36.0	47.8	51.7	49.1

Predicted traffic noise levels from assessed roads are predicted to remain at least 10 dBA below relevant traffic noise criteria of 68 LA10,18hr from the Flinders Highway and Gregory Developmental Road and 63 LA10,18hr from Elgin-Moray Road and Moray-Carmichael Road, to a nominal receptor located 100 m from the road. As all rural receptors are located more than 100 m from the road, traffic noise levels at each receptor would be lower than the levels shown in Table 14 and would be acceptable.

4.8 Blasting

Softer rock strata would generally be removed by dozer while blasting is proposed to break and loosen harder rock for subsequent removal by a dragline, shovel or excavator. A blast event generally includes a pattern of holes typically 30 m deep, with the bottom of the holes filled with an explosive mixture and the top of the holes filled with gravel or other stemming material to confine the explosive force and improve the blast efficiency.

Blast effects include ground vibration, typically expressed in mm/s peak particle velocity, and low frequency noise known as overpressure which is typically expressed as dBL Peak. Audible overpressure typically sounds like a few seconds of distant thunder to a remote observer. Overpressure levels measured in dBL Peak are quite different and cannot be readily compared to more common noise levels expressed in dBA.

Blast effects depend on the following factors:

- Ground conditions including rock types and layers;
- Groundwater conditions including extent and depth;

- Distance from the blast site to a receptor;
- How well the explosive charges are confined with stemming material;
- Maximum Instantaneous Charge (MIC) for the blast event, which is the weight of explosive mixture per hole multiplied by the number of holes detonated simultaneously in the blast pattern;
- Topography between the blast site and receptors; and
- Atmospheric conditions including wind speed, wind direction and vertical temperature gradient.

The MIC is typically in the range 1000 kg to 2000 kg for large open cut coal mines such as the project. Blast effects have been calculated using the equations in Appendix J of AS 2187.2:2006. Common values of K = 1140 and B = 1.6 have been adopted for the ground vibration coefficients required by the equations in the Standard, although some site-specific adjustment to these parameters may be appropriate in the future based on initial blast monitoring results. Predicted blast effects have been calculated to closest receptors and are shown in Table 15.

Table 15: Predicted Blast Impacts to Closest Receptors

Receptor	Closest Distance, km[1]	MIC, kg						Criteria, mm/s, dBL
		1000	1500	2000	1000	1500	2000	
		Ground Vibration mm/s			Overpressure dBL			
R1	9.5 km	0.12	0.17	0.22	84 [1]	85 [1]	86 [2]	5, 115
R2	15.3 km	0.06	0.08	0.10	83	84	85	5, 115
R3	13.5 km	0.07	0.10	0.12	84	86	87	5, 115

1 Distance measured from closest open cut mining area to receptor

2 Overpressure levels at R1 have been reduced by 5 dBL to account for topographical shielding.

Predicted blast effects in Table 15 are well below relevant criteria. Ground vibration is unlikely to be perceptible for the majority of blast events, or at worst may be barely perceptible on occasions. Overpressure levels would generally be imperceptible, particularly on a warm or windy day, but may occasionally be noticed as a low distant rumble for a few seconds on a calm and cloudy day. No blast mitigation measures are recommended considering the low predicted ground vibration and overpressure levels.

4.9 Aircraft Noise

Workforce transport to and from the project would primarily occur by air upon completion of the airstrip. A preliminary aircraft schedule indicates:

- Aircraft destinations are likely to include major population centres such as Cairns, Townsville, Bundaberg and Brisbane; and
- The number of people travelling to and from each destination is likely to require aircraft with a capacity of 150 to 200 seats for large population centres such as Brisbane and smaller aircraft with less than 100 seats for smaller population centres such as Cairns.

Aircraft would generally head north from the airstrip for destinations such as Cairns and Townsville or east from the airstrip for destinations such as Bundaberg and Brisbane. A theoretical worst case situation, assuming a large jet aircraft such as a Boeing 737 or Airbus A-320 travelling from the project airstrip directly over the closest Receptor R2, would result in a maximum noise level of 69 LAmax according to Table 3.12 in AS2021. Maximum noise levels from aircraft serving the project would therefore be acceptable at all receptors compared to the maximum noise level criterion of 80 LAmax recommended in Appendix D of AS2021.

Aircraft movements would be scheduled during the day and early evening where possible, while aircraft flightpaths would be selected to minimise noise impact to receptors including the CCM&RP accommodation village.

5 CONCLUSION

This assessment shows the project is expected to produce acceptable environmental noise levels compared to appropriate criteria at all noise sensitive receptors under all prevailing meteorological conditions. As the assessment included conservative operating and weather conditions, noise levels produced by the project would generally be lower than the predicted levels.

Maximum noise levels are predicted to remain at least 10 dBA below the PNCG sleep disturbance criteria at all receptors, which indicates the project is unlikely to result in disturbance to sleep. Predicted low frequency, cumulative and construction noise levels are also below relevant criteria.

Road and rail traffic noise levels from construction and operation of the project, and ground vibration and overpressure levels from production blasting, are predicted to be substantially lower than relevant criteria.

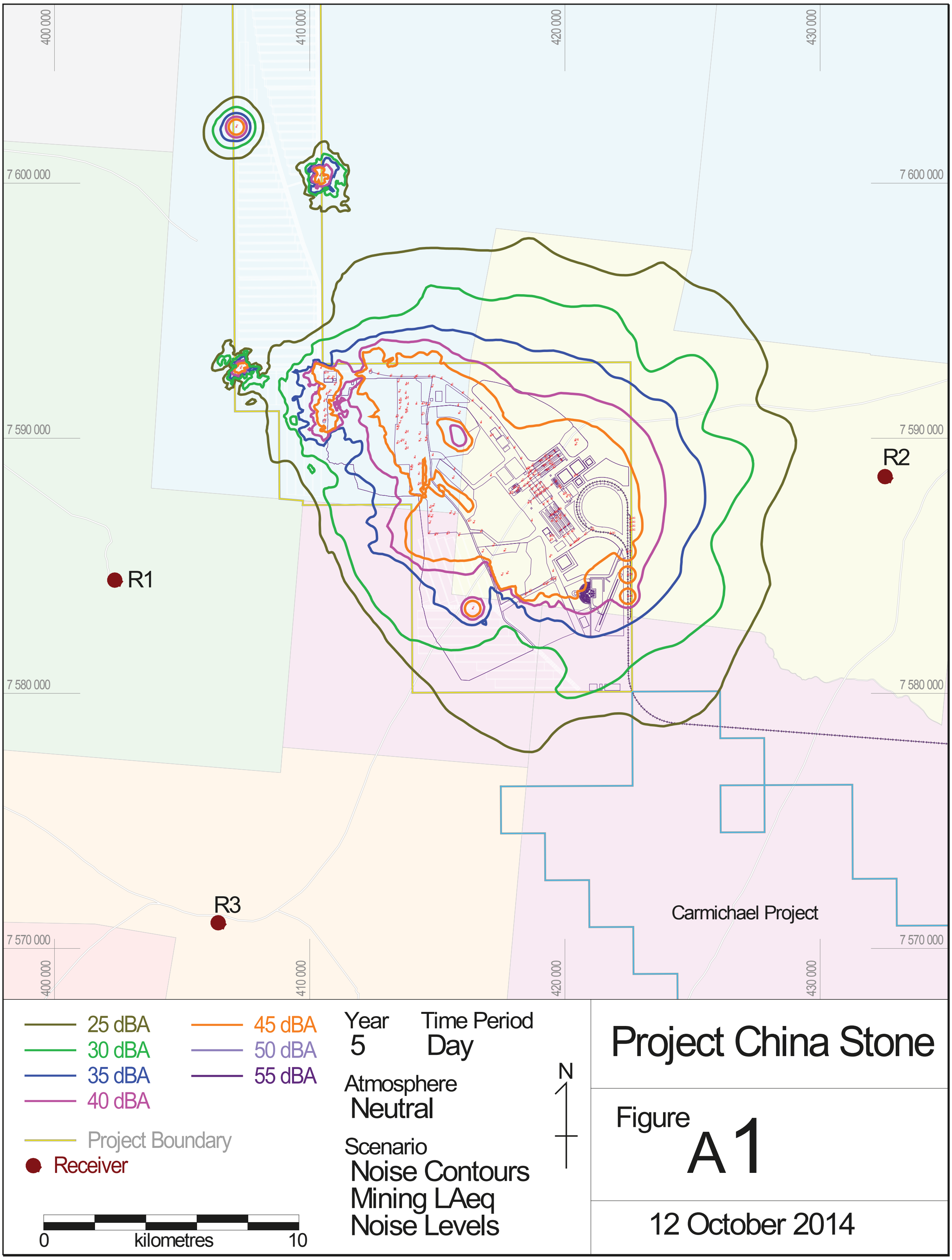
Maximum aircraft noise levels would be at least 10 dBA below relevant aircraft noise criteria at the closest receptor and lower at all other receptors, assuming a theoretical worst case situation with aircraft flightpaths passing directly over receptors. However, aircraft noise would be managed by avoiding flightpaths over closest receptors and scheduling aircraft movements during the day and evening where possible to avoid or minimise noise impacts on receptors.

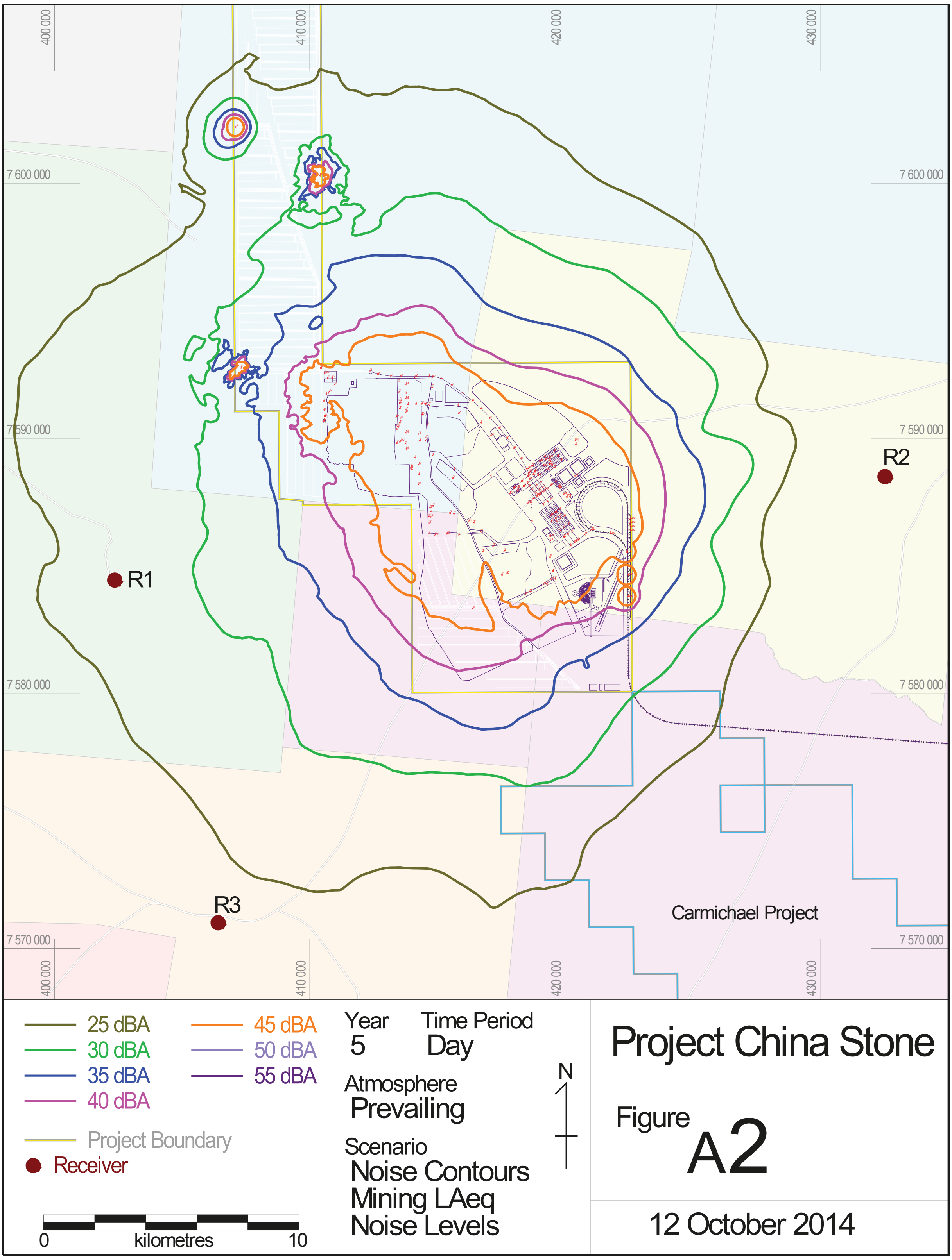
Notwithstanding predicted compliance with all relevant criteria, the proponent will develop and maintain an effective complaints handling procedure including a prompt and effective response to any complaints and appropriate communication with complainants and the community.

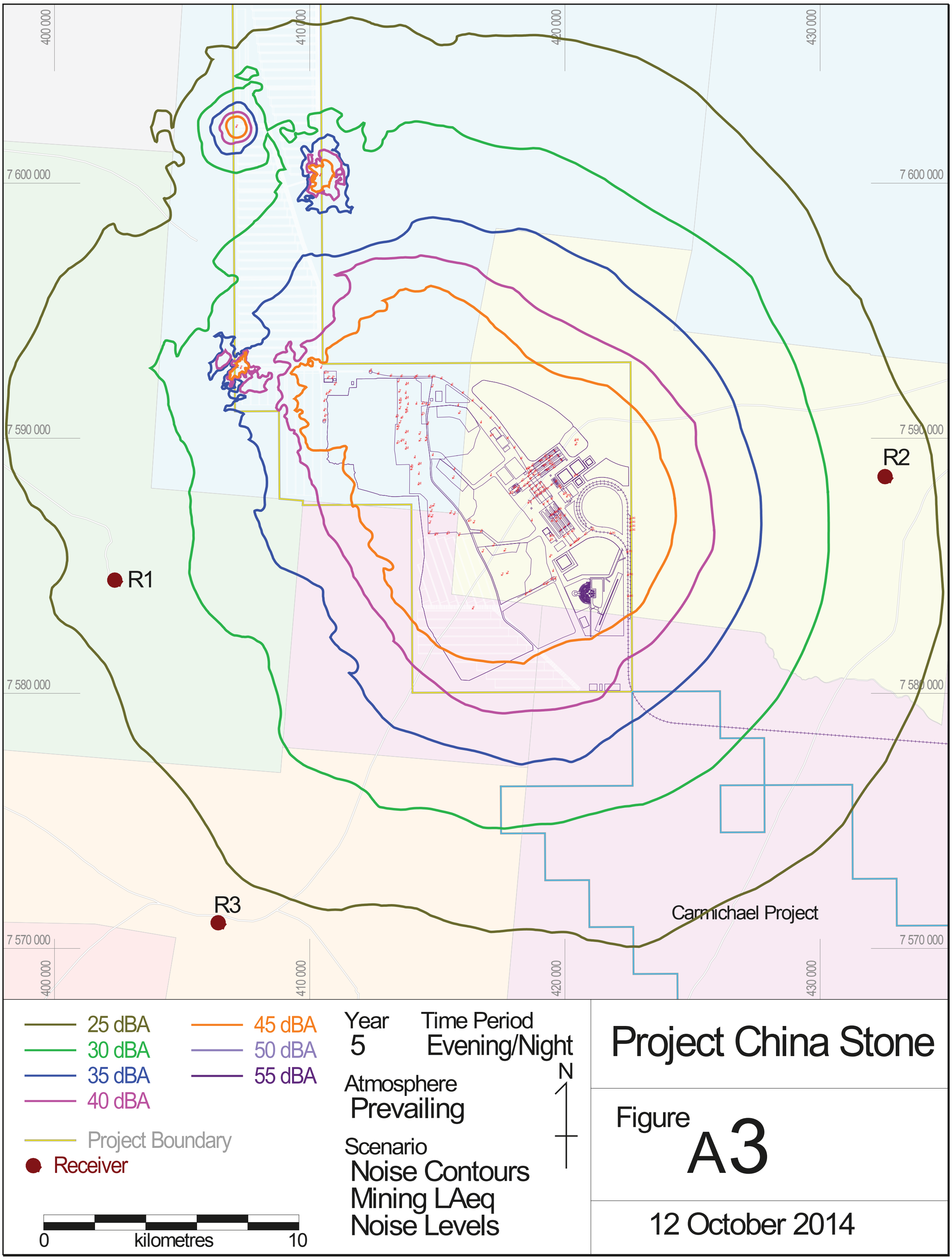
APPENDIX A – NOISE CONTOUR FIGURES

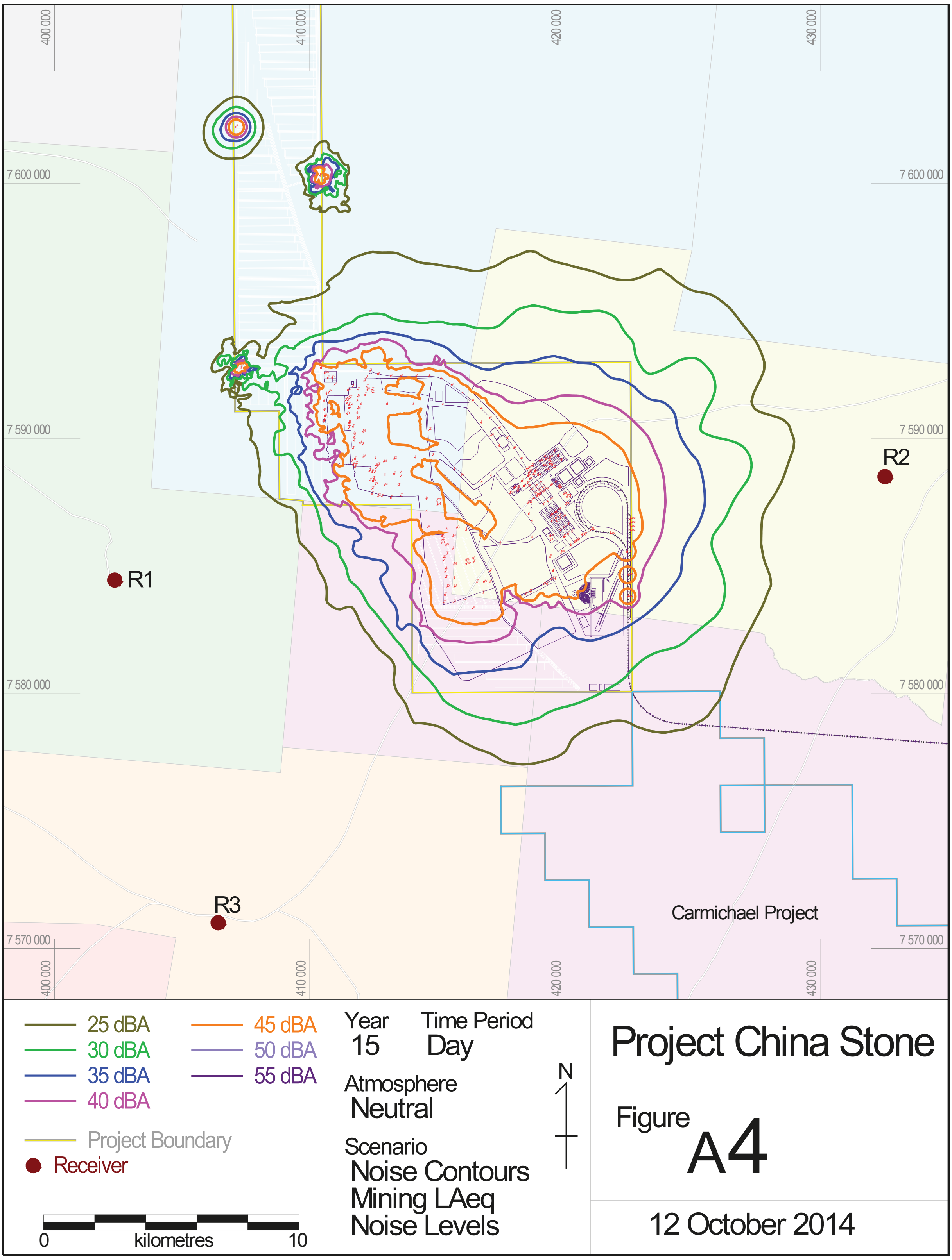
FIGURE	DESCRIPTION
A1	Year 5 Day, Neutral Weather, LAeq,15min
A2	Year 5 Day, Prevailing Weather, LAeq,15min
A3	Year 5 Evening/Night, Prevailing Weather, LAeq,15min
A4	Year 15 Day, Neutral Weather, LAeq,15min
A5	Year 15 Day, Prevailing Weather, LAeq,15min
A6	Year 15 Evening/Night, Prevailing Weather, LAeq,15min
A7	Year 20 Day, Neutral Weather, LAeq,15min
A8	Year 20 Day, Prevailing Weather, LAeq,15min
A9	Year 20 Evening/Night, Prevailing Weather, LAeq,15min
A10	All Years Day, Neutral Weather, LAeq,15min
A11	All Years Day, Prevailing Weather, LAeq,15min
A12	All Years Evening/Night, Prevailing Weather, LAeq,15min
A13	All Years Evening/Night, Prevailing Weather, LAmax

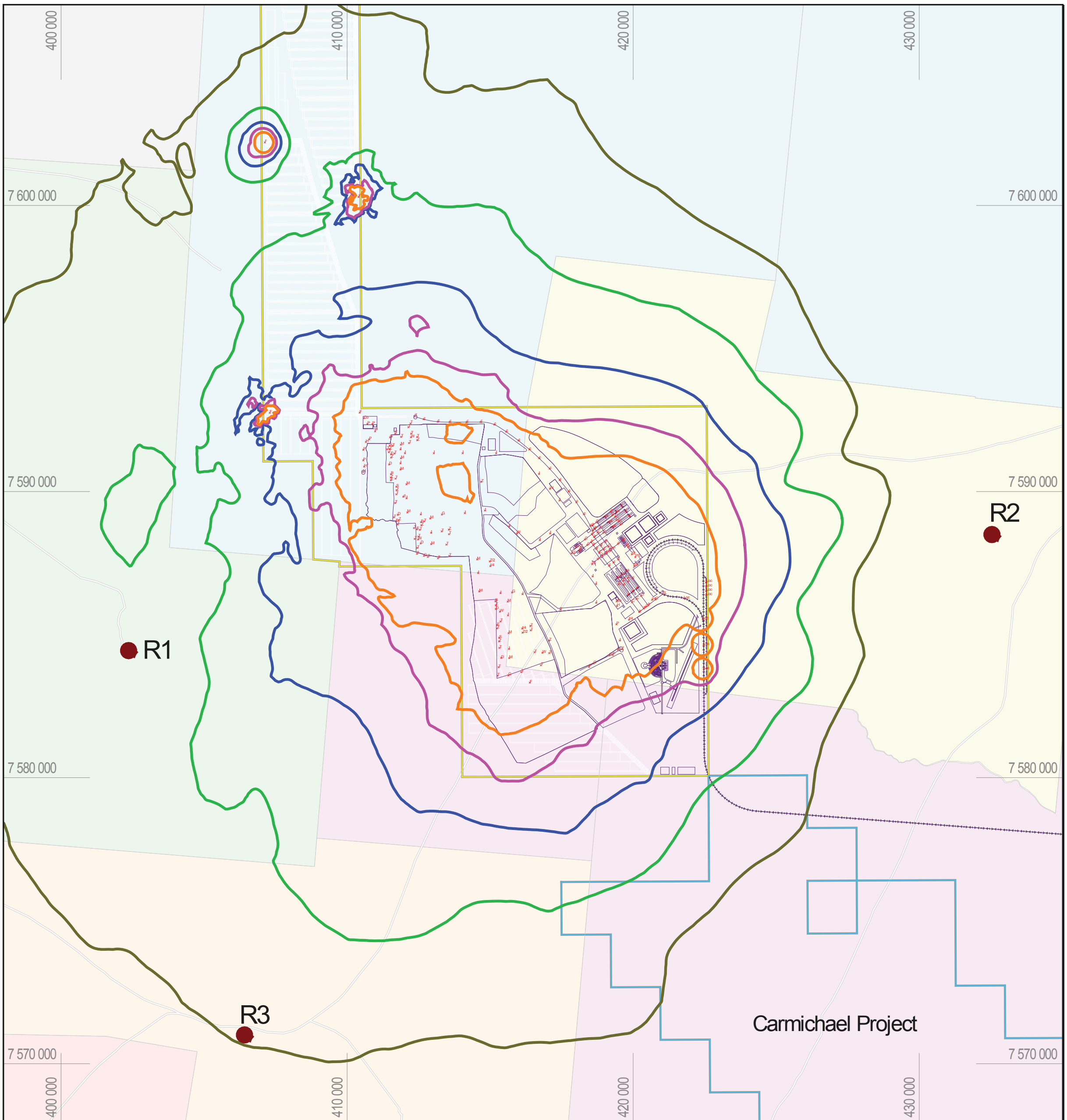
Predicted noise levels at each receptor are shown in Table 10.


400 000
410 000
420 000
430 000
7 600 000
7 590 000
7 580 000
7 570 000
R1
R2
R3
Carmichael Project
25 dBA
30 dBA
35 dBA
40 dBA
45 dBA
50 dBA
55 dBA
Project Boundary
Receiver
0
kilometres
10
Year
5
Time Period
Day
Atmosphere
Neutral
Scenario
Noise Contours
Mining LAeq
Noise Levels
N
Project China Stone
Figure
A1
12 October 2014


400 000
410 000
420 000
430 000
7 600 000
7 590 000
7 580 000
7 570 000
R1
R2
R3
Carmichael Project
25 dBA
30 dBA
35 dBA
40 dBA
45 dBA
50 dBA
55 dBA
Project Boundary
Receiver
0
kilometres
10
Year
5
Time Period
Day
Atmosphere
Prevailing
Scenario
Noise Contours
Mining LAeq
Noise Levels
N
Project China Stone
Figure
A2
12 October 2014


400 000
410 000
420 000
430 000
7 600 000
7 590 000
7 580 000
7 570 000
R1
R2
R3
Carmichael Project
25 dBA
30 dBA
35 dBA
40 dBA
45 dBA
50 dBA
55 dBA
Project Boundary
Receiver
0
kilometres
10
Year
5
Time Period
Evening/Night
Atmosphere
Prevailing
Scenario
Noise Contours
Mining LAeq
Noise Levels
N
Project China Stone
Figure
A3
12 October 2014


400 000
410 000
420 000
430 000
7 600 000
7 590 000
7 580 000
7 570 000
R1
R2
R3
Carmichael Project
25 dBA
30 dBA
35 dBA
40 dBA
45 dBA
50 dBA
55 dBA
Project Boundary
Receiver
0 kilometres 10
Year 15
Time Period Day
Atmosphere Neutral
Scenario Noise Contours Mining LAeq Noise Levels
N
Project China Stone
Figure A4
12 October 2014



25 dBA
30 dBA
35 dBA
40 dBA
45 dBA
50 dBA
55 dBA

Project Boundary
Receiver

0 kilometres 10

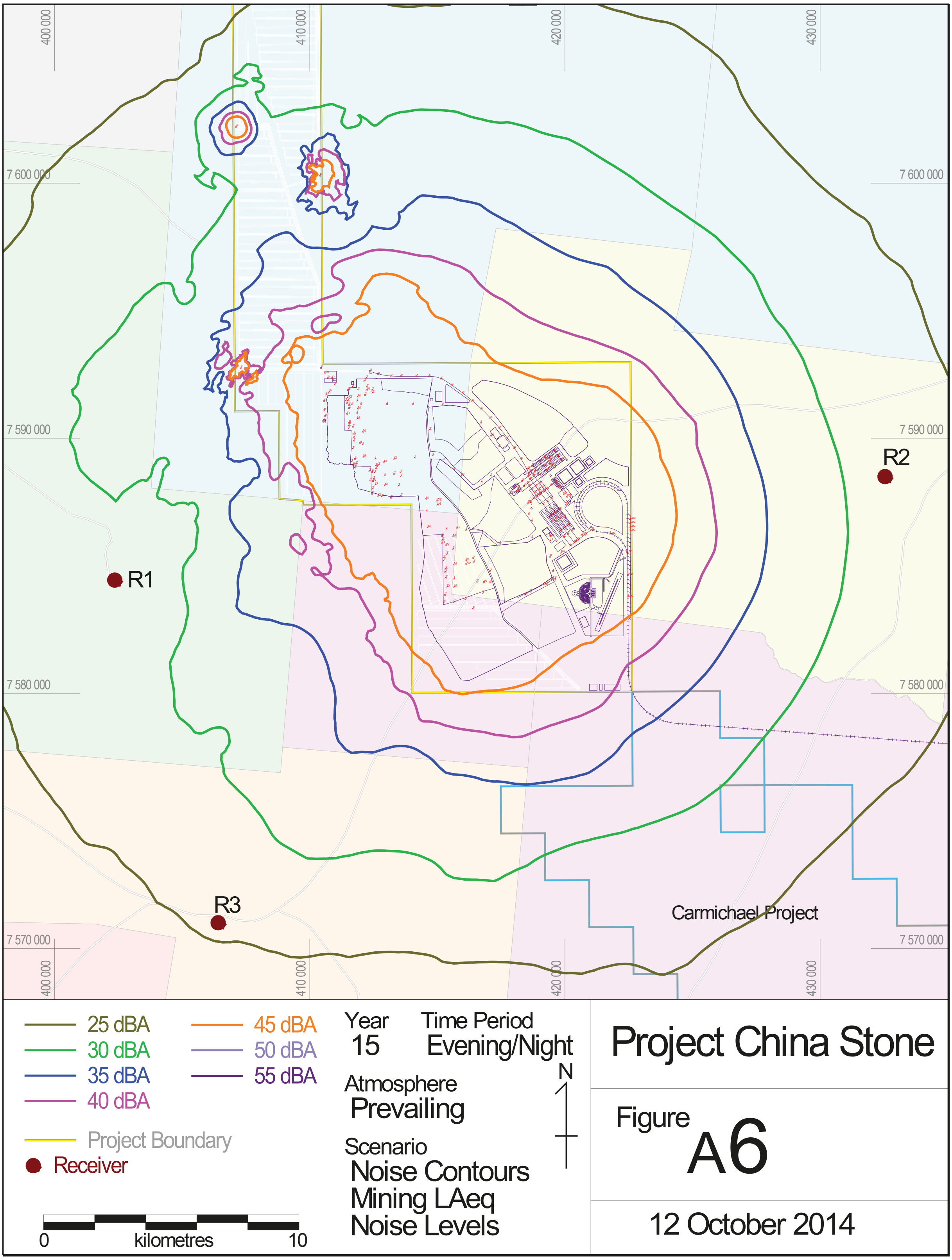
Year 15
Time Period Day
Atmosphere Prevailing
Scenario Noise Contours Mining LAeq Noise Levels

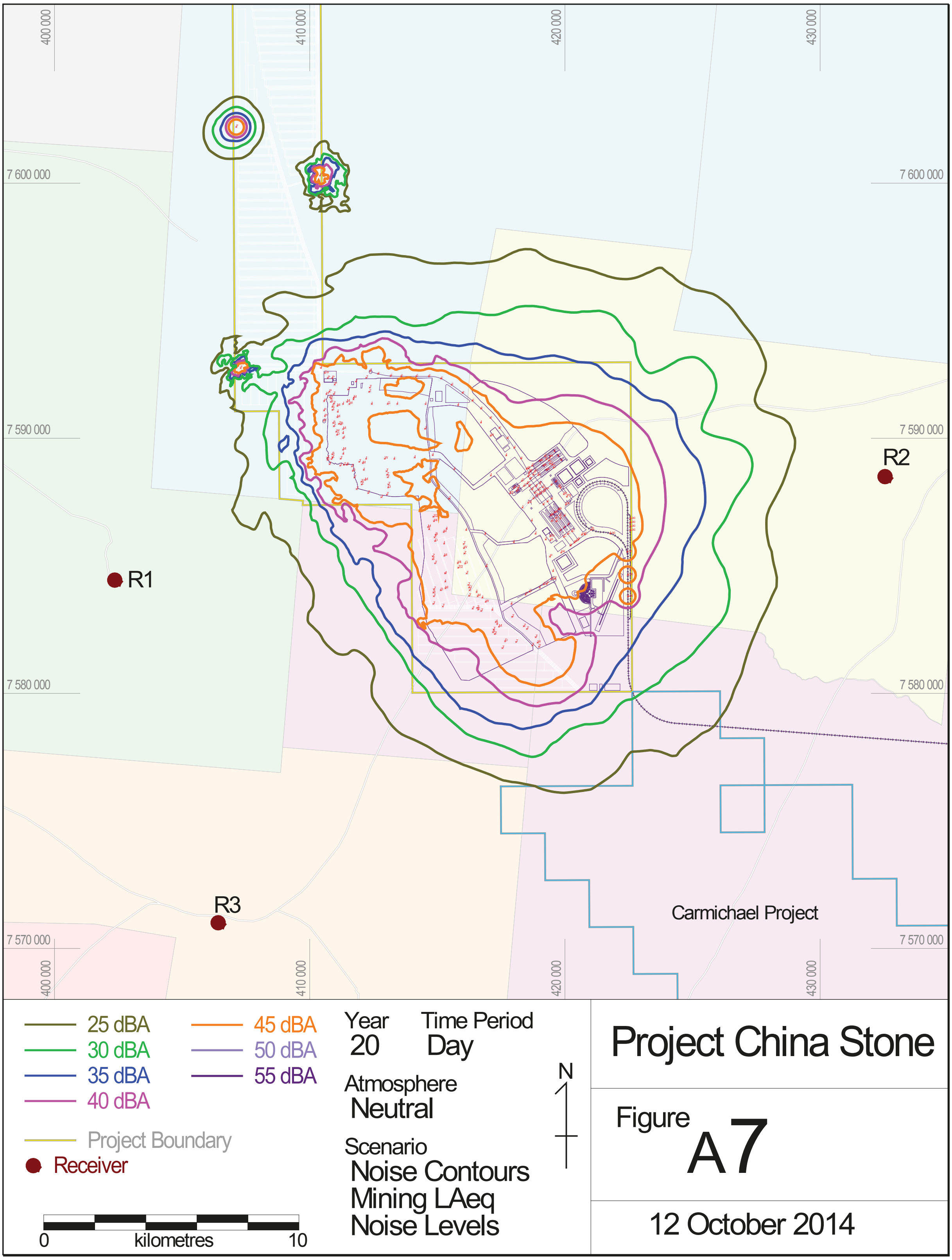
N

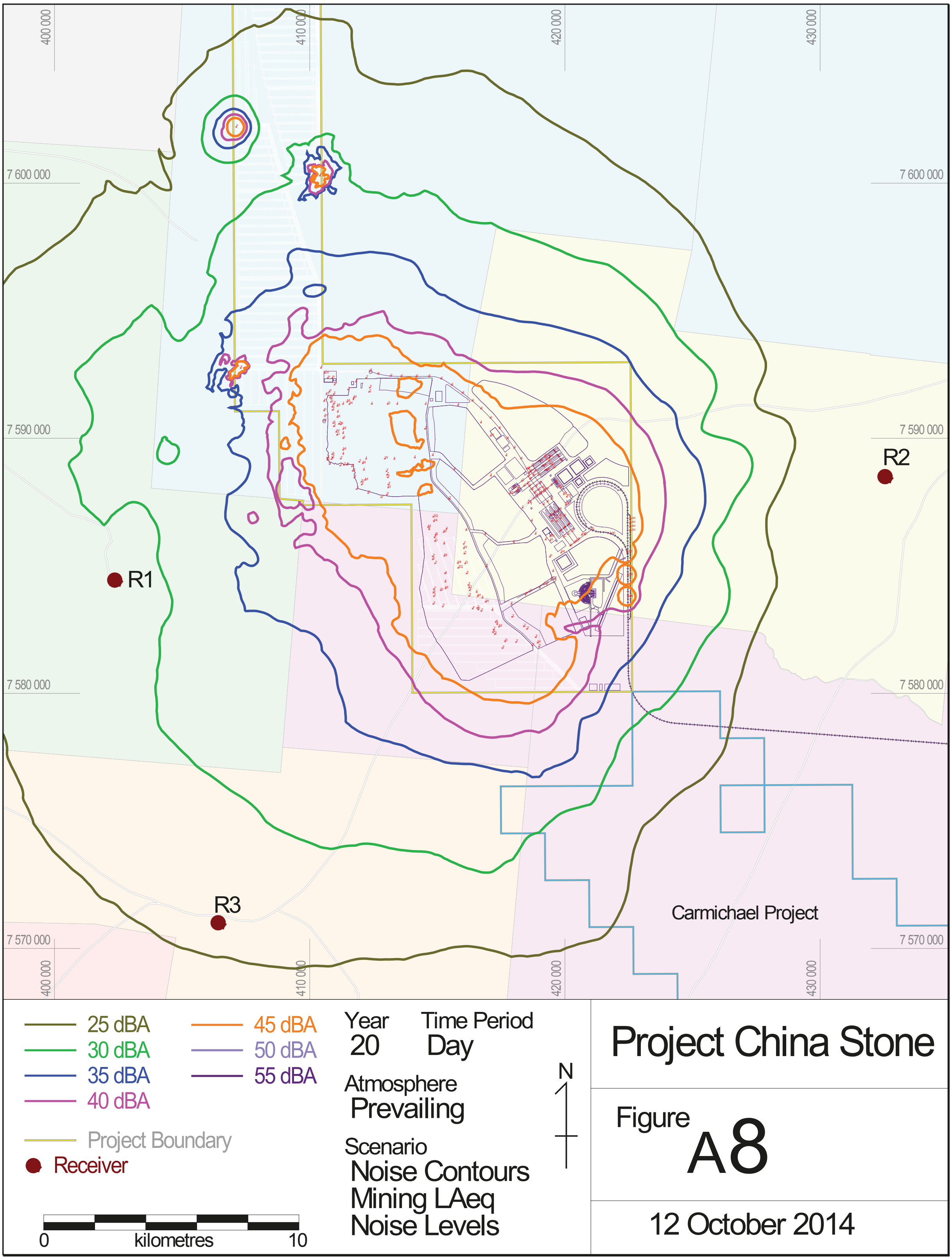
Project China Stone

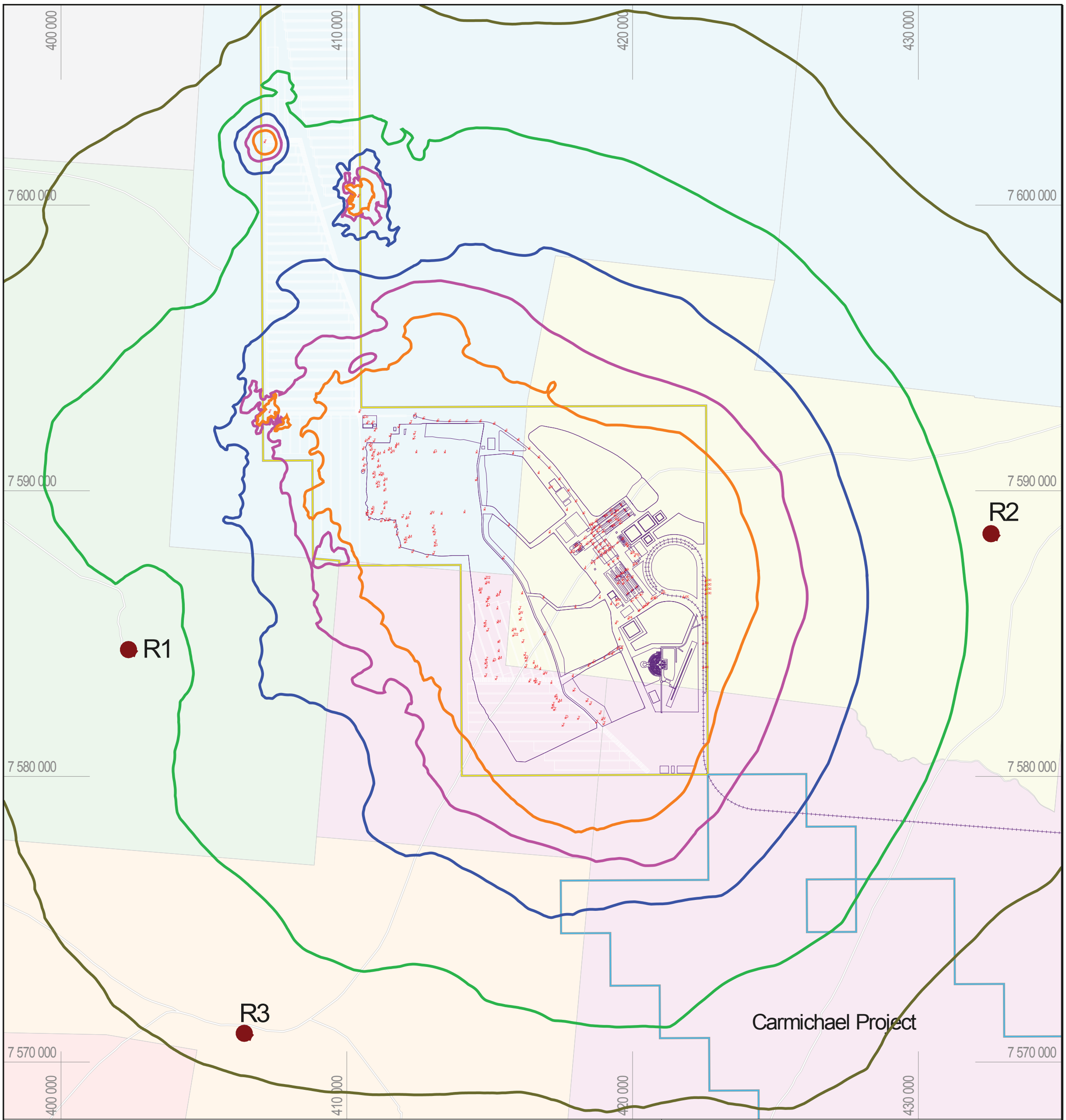
Figure A5

12 October 2014


400 000
410 000
420 000
430 000
7 600 000
7 590 000
7 580 000
7 570 000
R1
R2
R3
Carmichael Project
25 dBA
30 dBA
35 dBA
40 dBA
45 dBA
50 dBA
55 dBA
Project Boundary
Receiver
0
kilometres
10
Year
15
Time Period
Evening/Night
N
Atmosphere
Prevailing
Scenario
Noise Contours
Mining LAeq
Noise Levels
Project China Stone
Figure
A6
12 October 2014


400 000
410 000
420 000
430 000
7 600 000
7 590 000
7 580 000
7 570 000
R1
R2
R3
Carmichael Project
25 dBA
30 dBA
35 dBA
40 dBA
45 dBA
50 dBA
55 dBA
Project Boundary
Receiver
0
kilometres
10
Year
20
Time Period
Day
Atmosphere
Neutral
Scenario
Noise Contours
Mining LAeq
Noise Levels
N
Project China Stone
Figure
A7
12 October 2014


400 000
410 000
420 000
430 000
7 600 000
7 590 000
7 580 000
7 570 000
R1
R2
R3
Carmichael Project
25 dBA
30 dBA
35 dBA
40 dBA
45 dBA
50 dBA
55 dBA
Project Boundary
Receiver
0
kilometres
10
Year
20
Time Period
Day
Atmosphere
Prevailing
Scenario
Noise Contours
Mining LAeq
Noise Levels
N
Project China Stone
Figure
A8
12 October 2014



25 dBA
30 dBA
35 dBA
40 dBA
45 dBA
50 dBA
55 dBA

Project Boundary
Receiver

0 kilometres 10

Year
20

Time Period
Evening/Night

Atmosphere
Prevailing

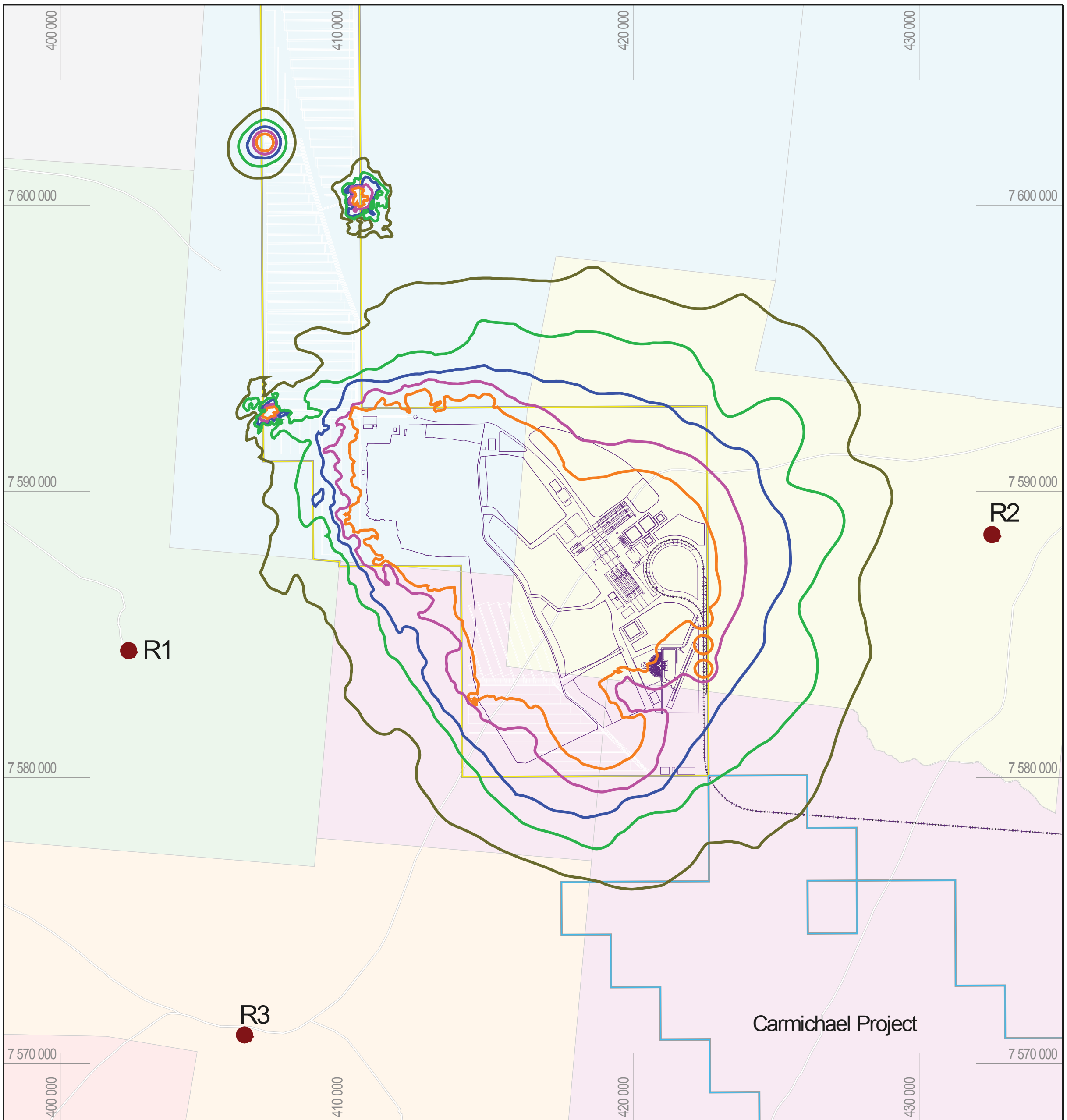
Scenario
Noise Contours
Mining LAeq
Noise Levels

N

Project China Stone

Figure **A9**

12 October 2014



25 dBA	45 dBA
30 dBA	50 dBA
35 dBA	55 dBA
40 dBA	

Project Boundary
Receiver

0 kilometres 10

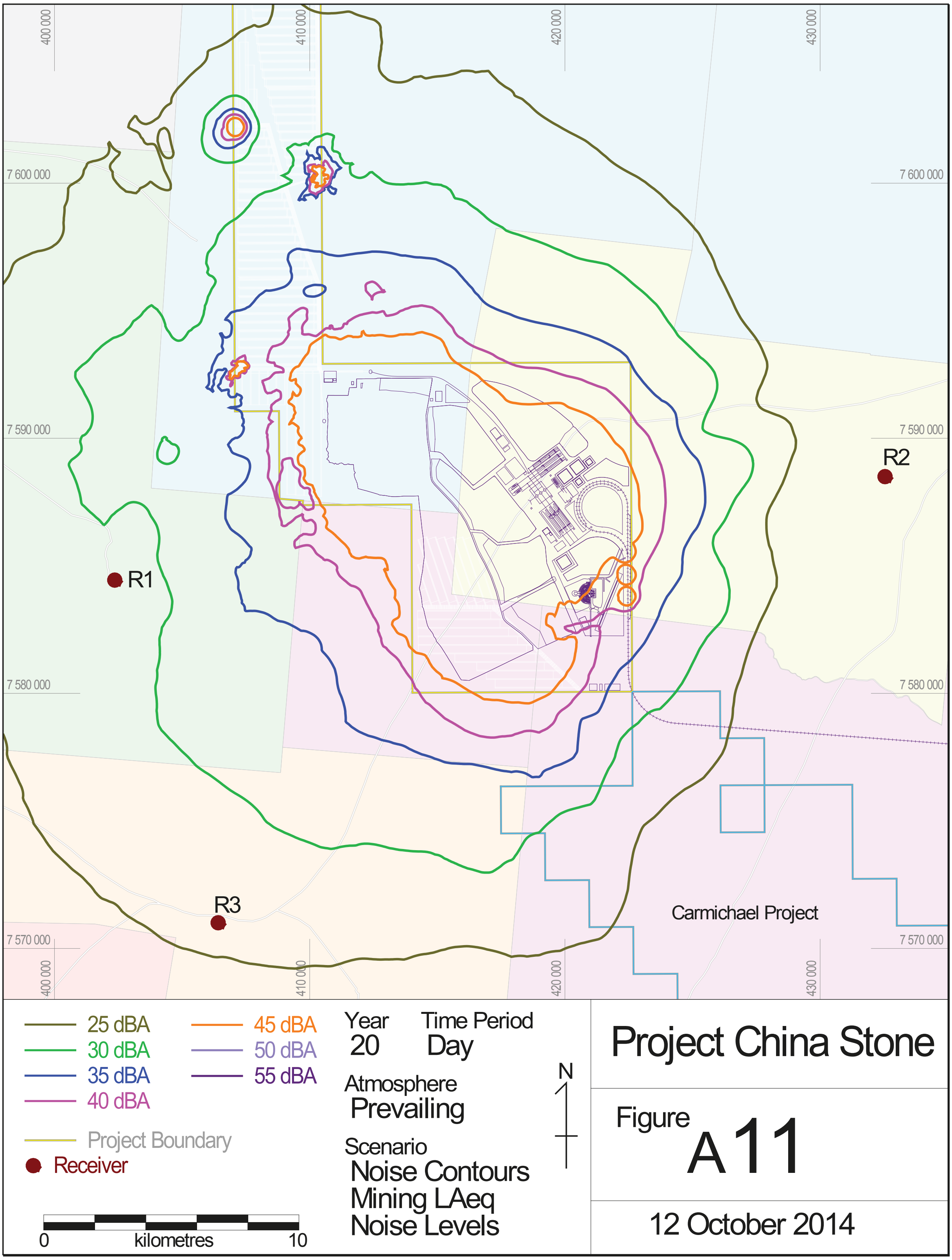
Year: All
Time Period: Day
Atmosphere: Neutral
Scenario: Noise Contours Mining LAeq Noise Levels

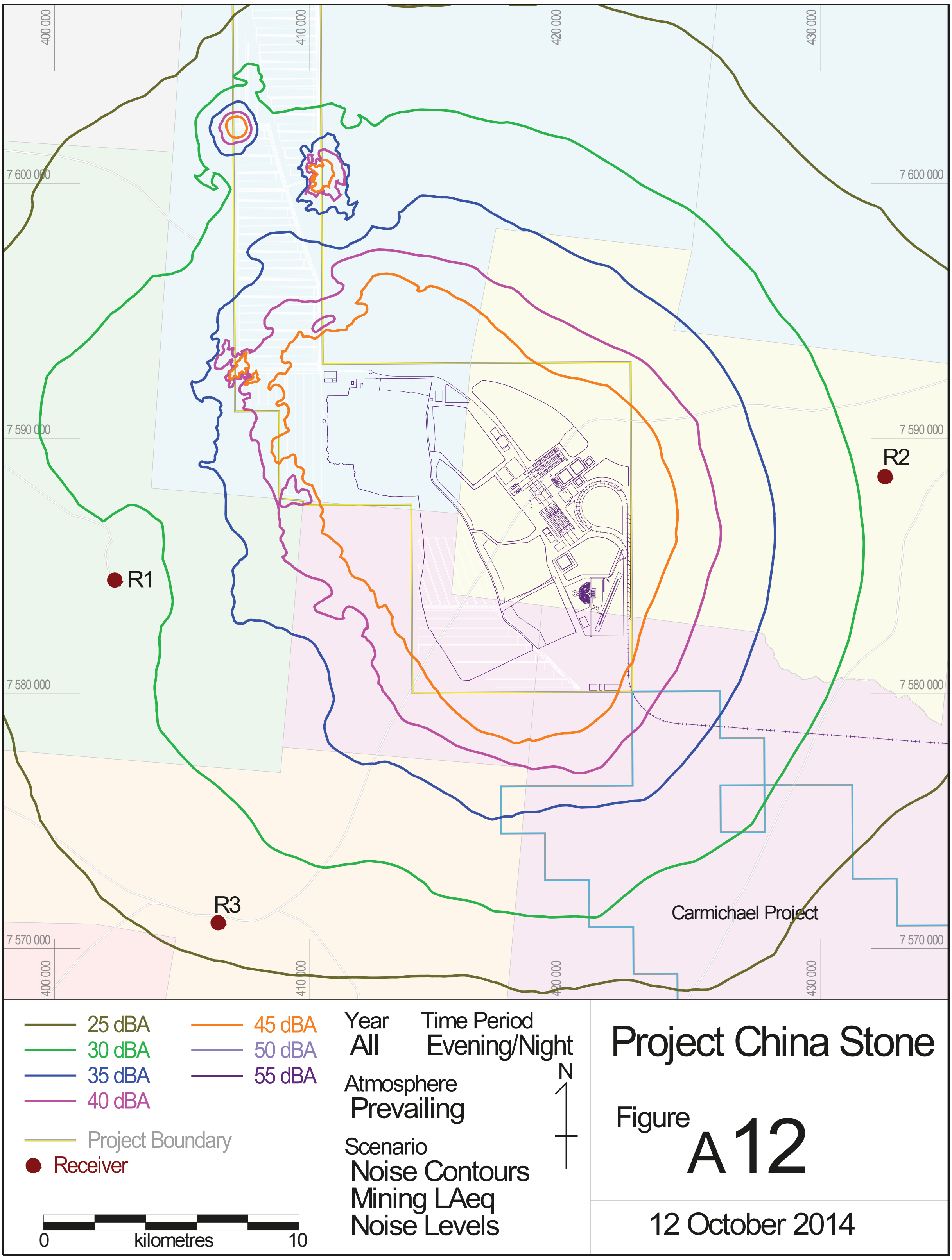
N

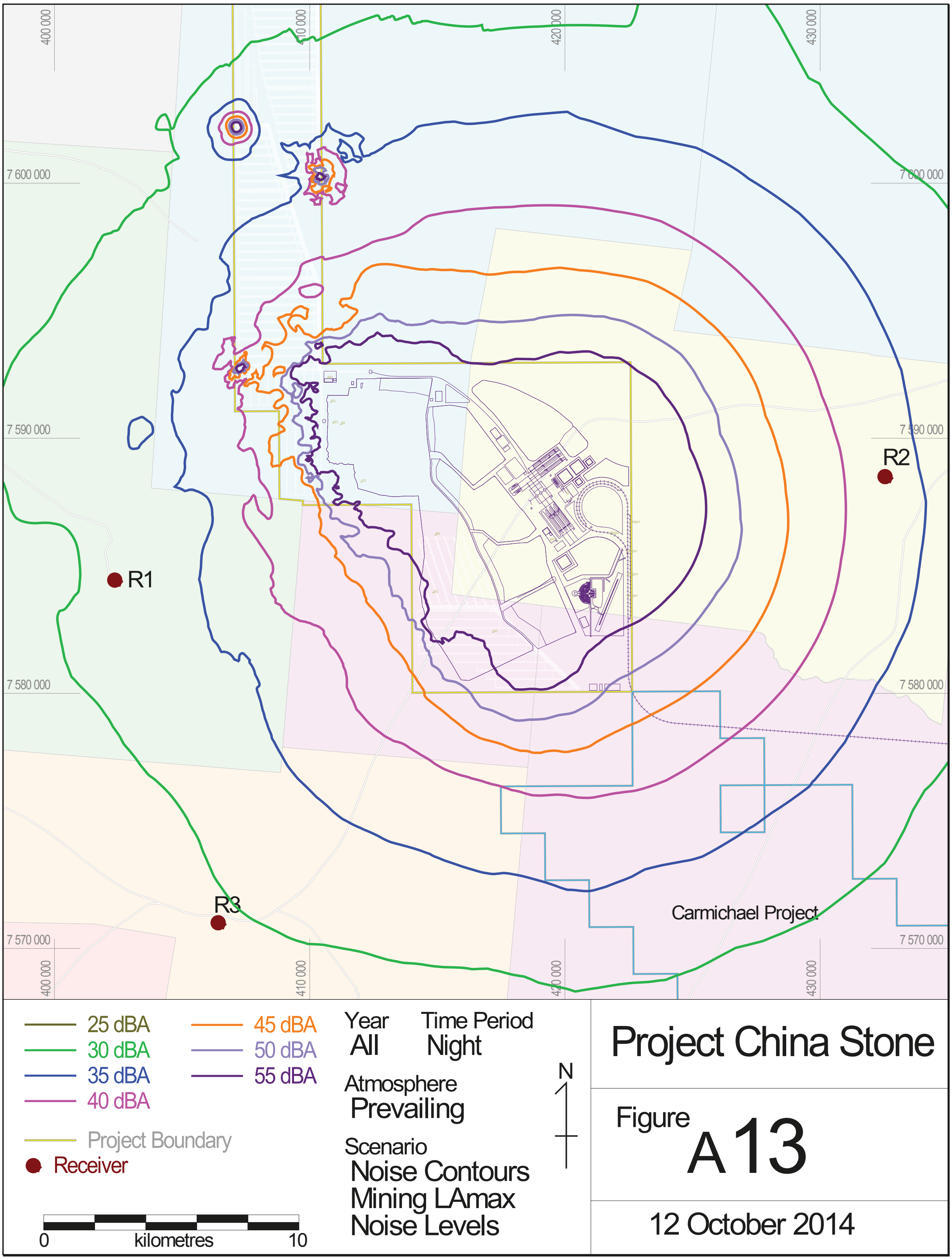
Project China Stone

Figure A10

12 October 2014

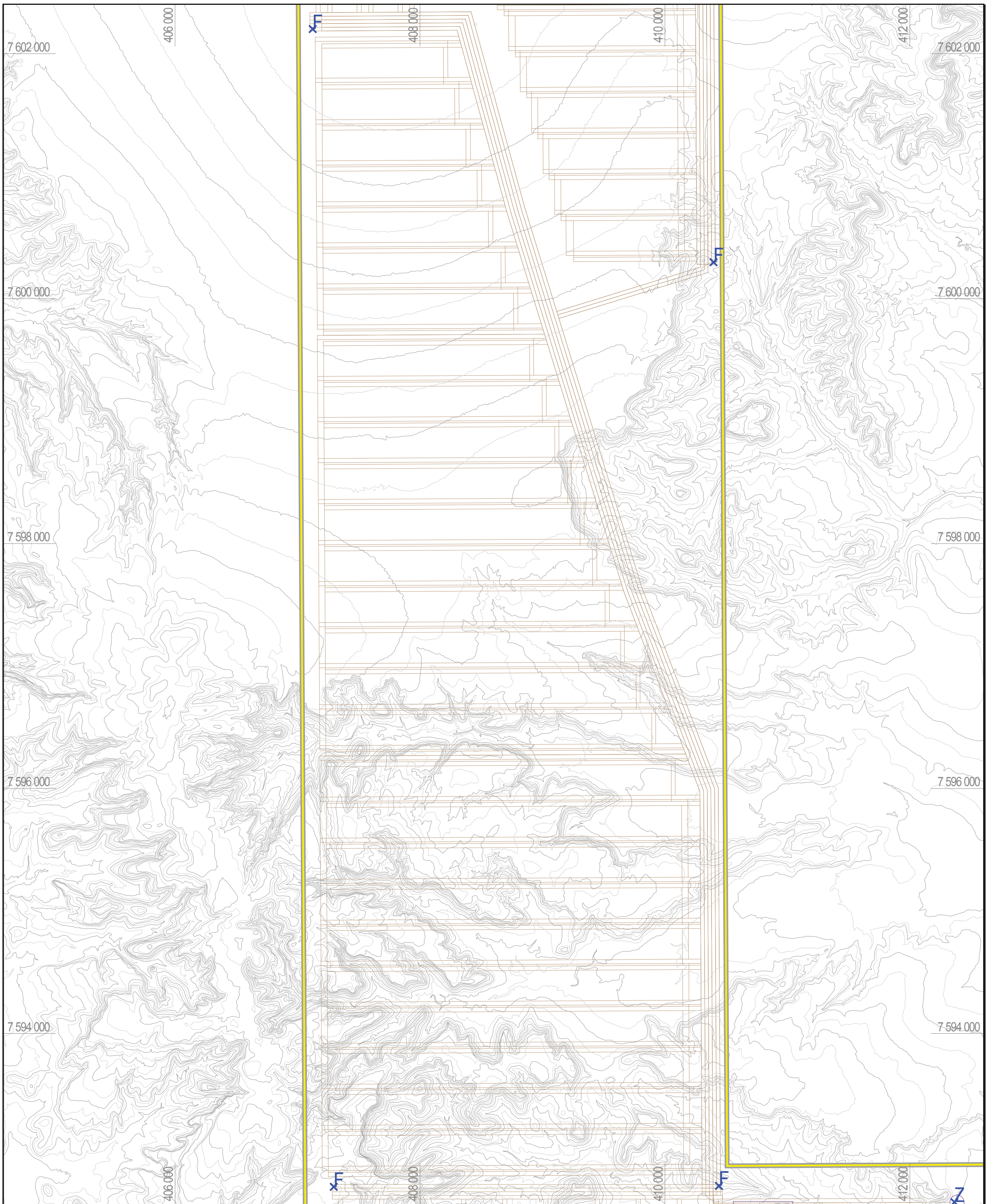

400 000
410 000
420 000
430 000
7 600 000
7 590 000
7 580 000
7 570 000
R1
R2
R3
Carmichael Project
25 dBA
30 dBA
35 dBA
40 dBA
45 dBA
50 dBA
55 dBA
Project Boundary
Receiver
0
kilometres
10
Year
20
Time Period
Day
Atmosphere
Prevailing
Scenario
Noise Contours
Mining LAeq
Noise Levels
N
Project China Stone
Figure
A11
12 October 2014


400 000
410 000
420 000
430 000
7 600 000
7 590 000
7 580 000
7 570 000
R1
R2
R3
Carmichael Project
25 dBA
30 dBA
35 dBA
40 dBA
45 dBA
50 dBA
55 dBA
Project Boundary
Receiver
0
kilometres
10
Year
All
Time Period
Evening/Night
Atmosphere
Prevailing
Scenario
Noise Contours
Mining LAeq
Noise Levels
N
Project China Stone
Figure
A12
12 October 2014


400 000
410 000
420 000
430 000
7 600 000
7 590 000
7 580 000
7 570 000
R1
R2
R3
Carmichael Project
25 dBA
30 dBA
35 dBA
40 dBA
45 dBA
50 dBA
55 dBA
Project Boundary
Receiver
0
kilometres
10
Year
All
Time Period
Night
Atmosphere
Prevailing
Scenario
Noise Contours
Mining LAmax
Noise Levels
N
Project China Stone
Figure
A13
12 October 2014

APPENDIX B – NOISE SOURCE LOCATION FIGURES

A description of noise sources represented by each code shown in the noise source location figures, and each source's sound power level, are included in Table 8.



B Dragline
S Shovel
E Excavator
L Loader
T Waste truck
t Coal truck
D Waste Drill
d Coal Drill
Z Dozer
G Grader
W Water cart
M Surface Miner
PS Power Station
St Stack Outlet

R ROM Breaker
Tr Transfer Station
Sk Stacker
r Reclaimer
PP Prep Plant
TL Train loadout
Loc Locomotive
C Conveyor 500m Hi-Cap
c Conveyor 500m Lo-Cap

BB Dragline bucket impact
SG Shovel gate impact
MH MIA material handling impact
TB Train wagon bunching

P Personnel Carrier
H Load Haul Dump
Co Compressors
F Vent Fans

N

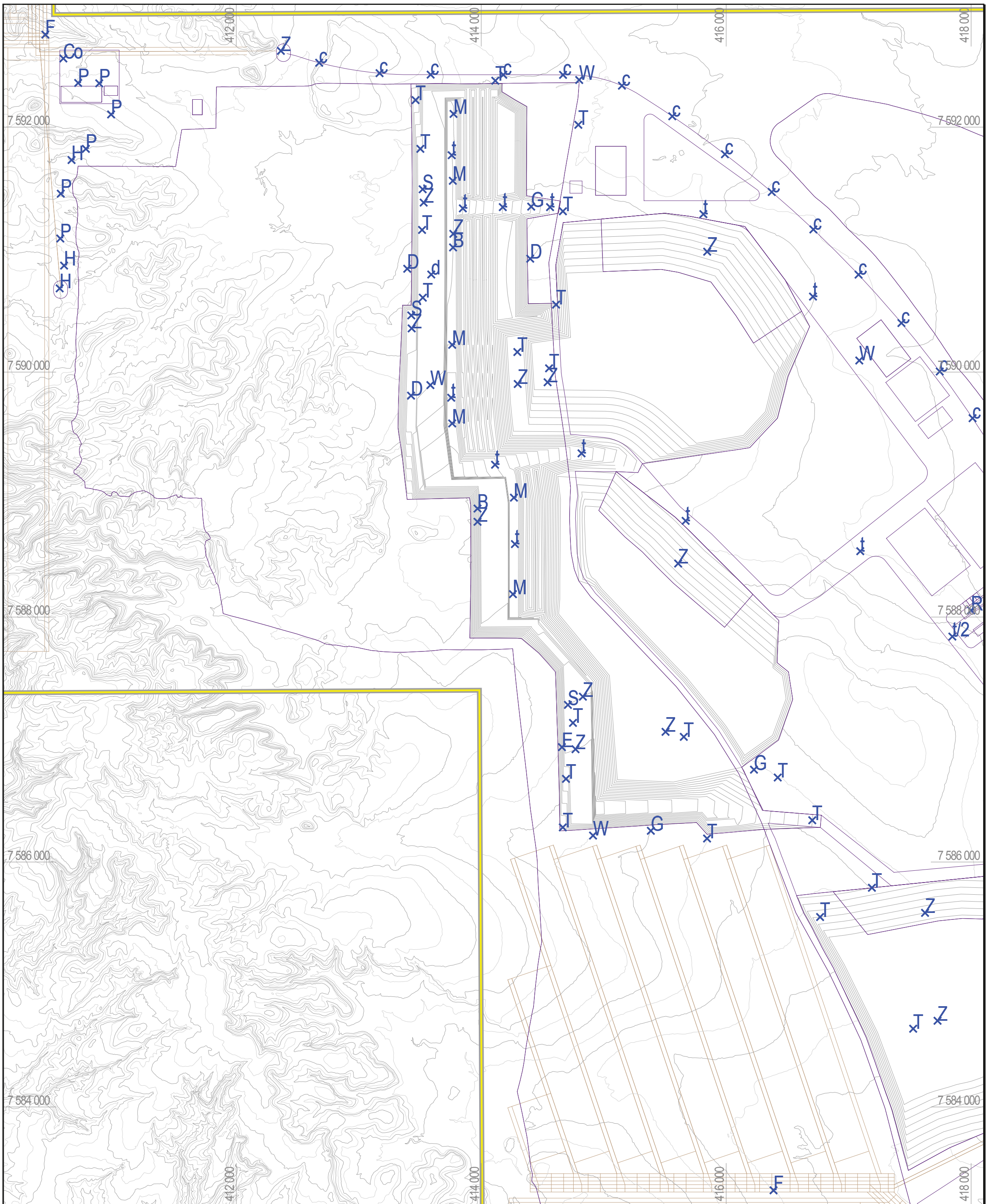
Project China Stone

Scenario
Noise Sources
All Years
Northern Section

Figure B1

0 kilometres 2

12 October 2014



B	Dragline	R	ROM Breaker	P	Personnel Carrier		
S	Shovel	Tr	Transfer Station	H	Load Haul Dump		
E	Excavator	Sk	Stacker	Co	Compressors		
L	Loader	r	Reclaimer	F	Vent Fans		
T	Waste truck	PP	Prep Plant				
t	Coal truck	TL	Train loadout				
D	Waste Drill	Loc	Locomotive				
d	Coal Drill	C	Conveyor 500m Hi-Cap				
Z	Dozer	c	Conveyor 500m Lo-Cap				
G	Grader						
W	Water cart						
M	Surface Miner	BB	Dragline bucket impact				
		SG	Shovel gate impact				
PS	Power Station	MH	MIA material handling impact				
St	Stack Outlet	TB	Train wagon bunching				

N

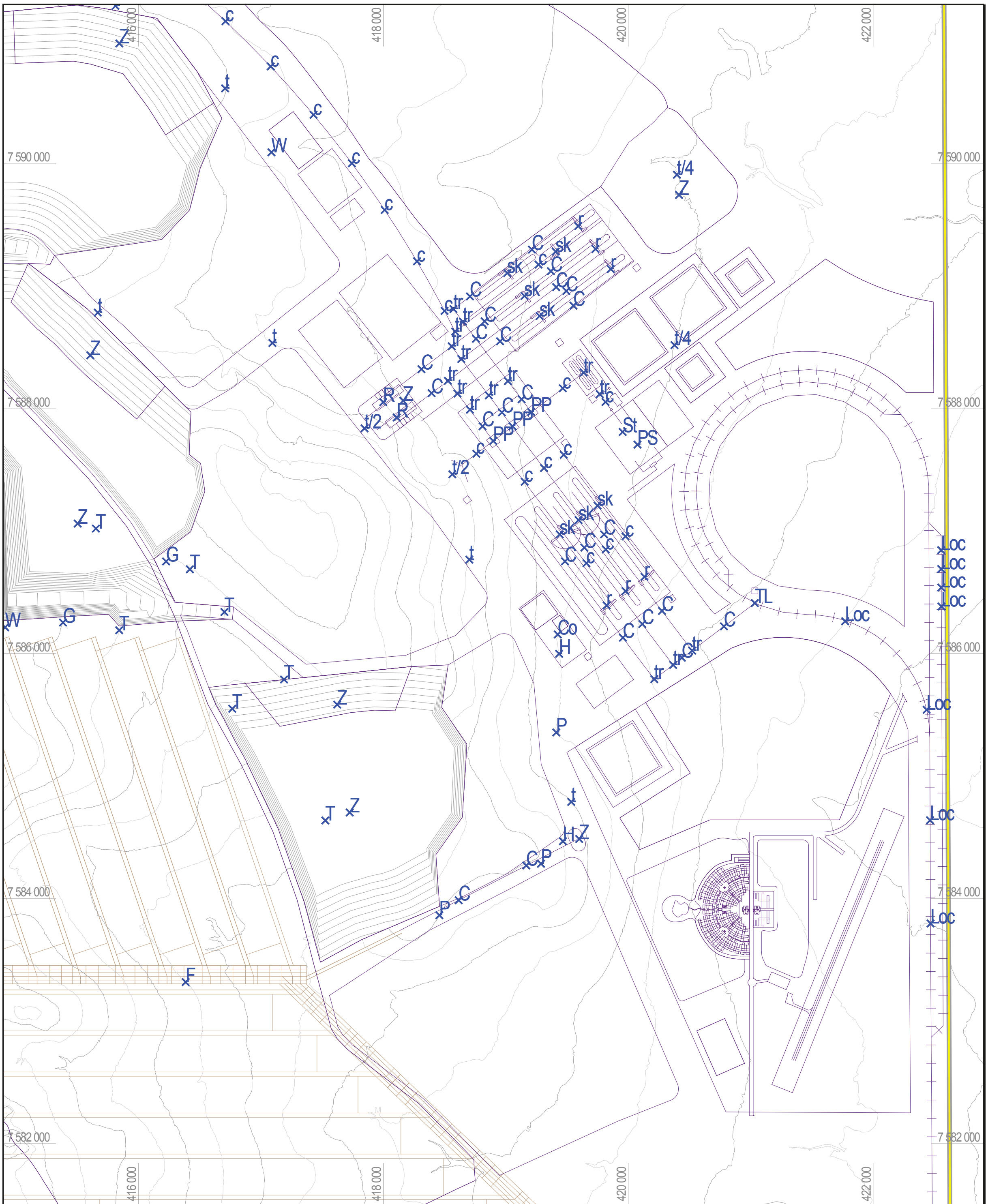
Project China Stone

Scenario
Noise Sources
Year 5
Central Section

Figure **B2**

0 kilometres 2

12 October 2014



B	Dragline	R	ROM Breaker	P	Personnel Carrier
S	Shovel	Tr	Transfer Station	H	Load Haul Dump
E	Excavator	Sk	Stacker	Co	Compressors
L	Loader	r	Reclaimer	F	Vent Fans
T	Waste truck	PP	Prep Plant		
t	Coal truck	TL	Train loadout		
D	Waste Drill	Loc	Locomotive		
d	Coal Drill	C	Conveyor 500m Hi-Cap		
Z	Dozer	c	Conveyor 500m Lo-Cap		
G	Grader				
W	Water cart				
M	Surface Miner	BB	Dragline bucket impact		
		SG	Shovel gate impact		
PS	Power Station	MH	MIA material handling impact		
St	Stack Outlet	TB	Train wagon bunching		

N

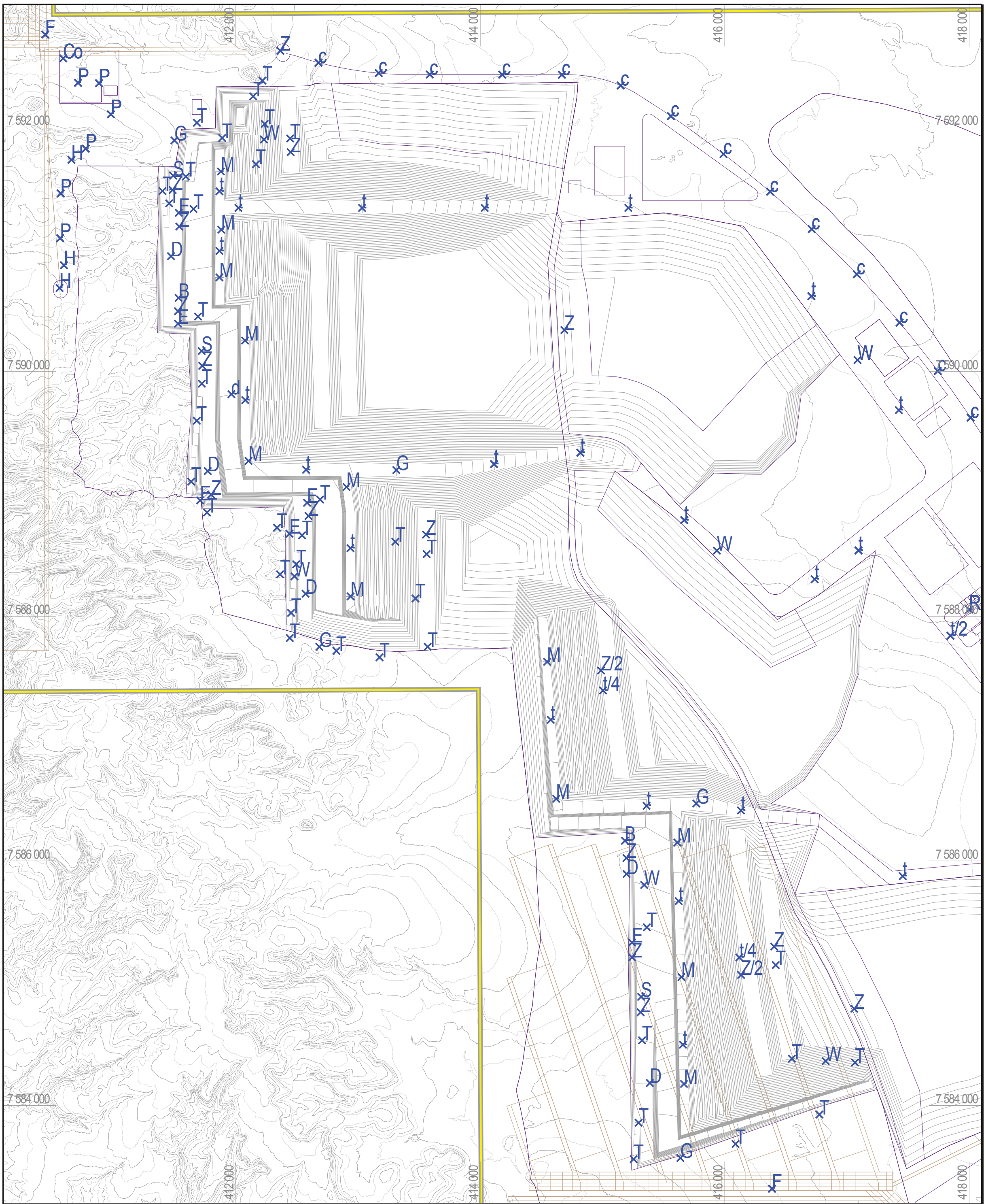
Project China Stone

Scenario
Noise Sources
Year 5
Southern Section

Figure B3

0 kilometres 2

12 October 2014



B	Dragline	R	ROM Breaker	P	Personnel Carrier
S	Shovel	Tr	Transfer Station	H	Load Haul Dump
E	Excavator	Sk	Stacker	Co	Compressors
L	Loader	r	Reclaimer	F	Vent Fans
T	Waste truck	PP	Prep Plant		
t	Coal truck	TL	Train loadout		
D	Waste Drill	Loc	Locomotive		
d	Coal Drill	C	Conveyor 500m Hi-Cap		
Z	Dozer	c	Conveyor 500m Lo-Cap		
G	Grader				
W	Water cart				
M	Surface Miner	BB	Dragline bucket impact		
		SG	Shovel gate impact		
PS	Power Station	MH	MIA material handling impact		
St	Stack Outlet	TB	Train wagon bunching		

N

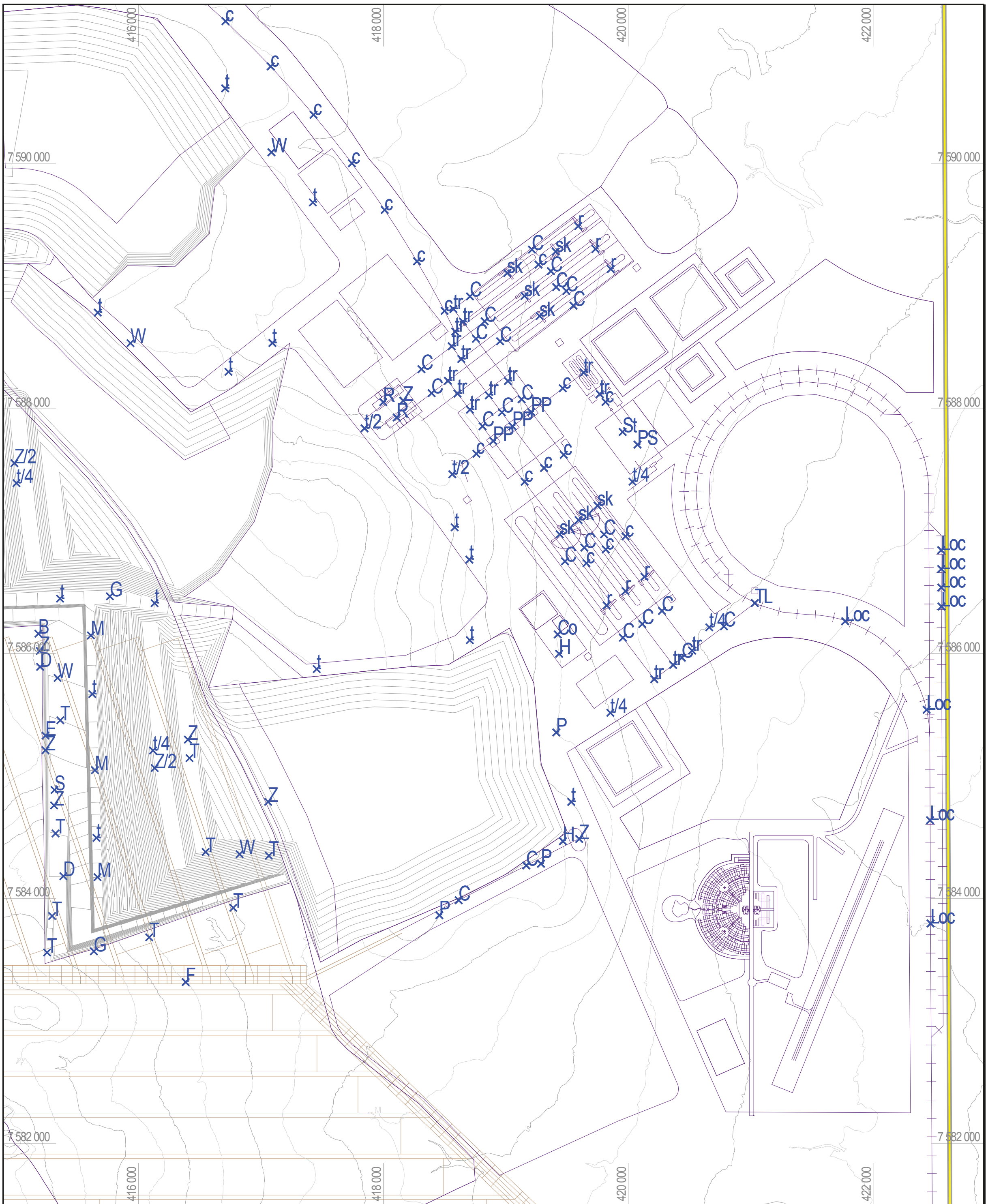
Project China Stone

Scenario
Noise Sources
Year 15
Central Section

Figure B4

0 kilometres 2

12 October 2014



B	Dragline	R	ROM Breaker	P	Personnel Carrier
S	Shovel	Tr	Transfer Station	H	Load Haul Dump
E	Excavator	Sk	Stacker	Co	Compressors
L	Loader	r	Reclaimer	F	Vent Fans
T	Waste truck	PP	Prep Plant		
t	Coal truck	TL	Train loadout		
D	Waste Drill	Loc	Locomotive		
d	Coal Drill	C	Conveyor 500m Hi-Cap		
Z	Dozer	c	Conveyor 500m Lo-Cap		
G	Grader				
W	Water cart				
M	Surface Miner	BB	Dragline bucket impact		
		SG	Shovel gate impact		
PS	Power Station	MH	MIA material handling impact		
St	Stack Outlet	TB	Train wagon bunching		

N

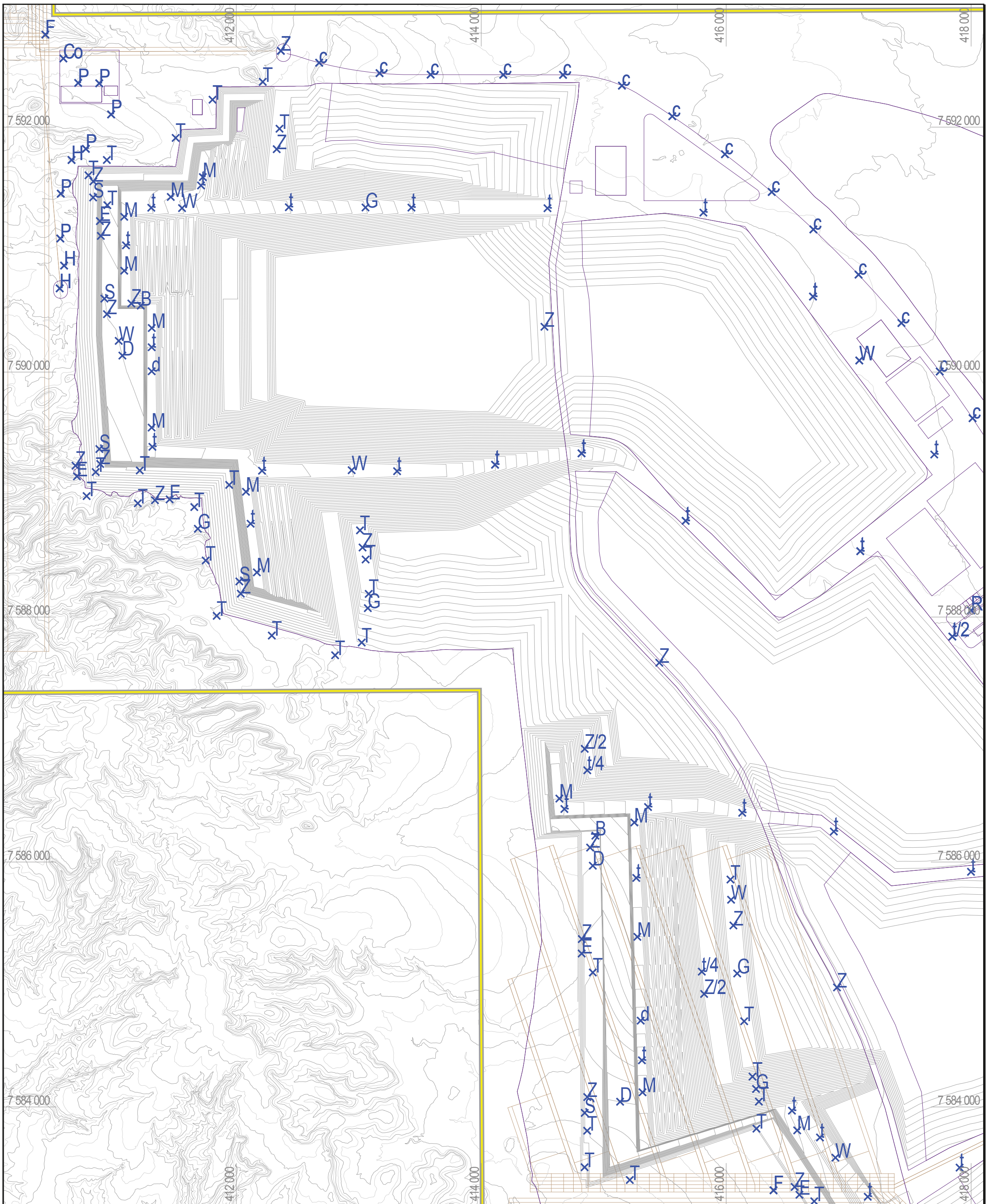
Project China Stone

Scenario
Noise Sources
Year 15
Southern Section

Figure
B5

0 kilometres 2

12 October 2014



B	Dragline	R	ROM Breaker	P	Personnel Carrier
S	Shovel	Tr	Transfer Station	H	Load Haul Dump
E	Excavator	Sk	Stacker	Co	Compressors
L	Loader	r	Reclaimer	F	Vent Fans
T	Waste truck	PP	Prep Plant		
t	Coal truck	TL	Train loadout		
D	Waste Drill	Loc	Locomotive		
d	Coal Drill	C	Conveyor 500m Hi-Cap		
Z	Dozer	c	Conveyor 500m Lo-Cap		
G	Grader				
W	Water cart				
M	Surface Miner	BB	Dragline bucket impact		
		SG	Shovel gate impact		
PS	Power Station	MH	MIA material handling impact		
St	Stack Outlet	TB	Train wagon bunching		

N

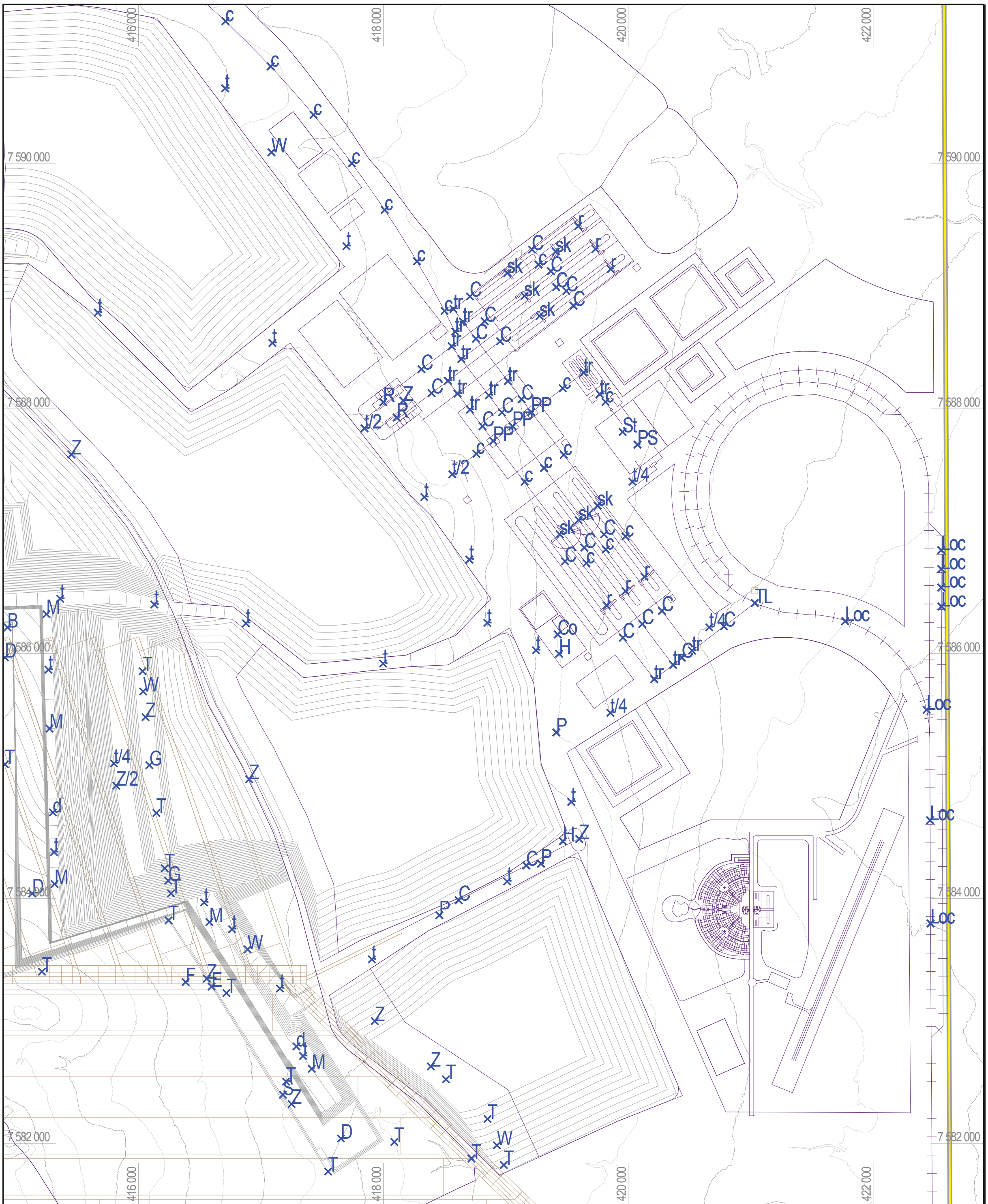
Project China Stone

Scenario
Noise Sources
Year 20
Central Section

Figure
B6

0 kilometres 2

12 October 2014



B	Dragline	R	ROM Breaker	P	Personnel Carrier
S	Shovel	Tr	Transfer Station	H	Load Haul Dump
E	Excavator	Sk	Stacker	Co	Compressors
L	Loader	r	Reclaimer	F	Vent Fans
T	Waste truck	PP	Prep Plant		
t	Coal truck	TL	Train loadout		
D	Waste Drill	Loc	Locomotive		
d	Coal Drill	C	Conveyor 500m Hi-Cap		
Z	Dozer	c	Conveyor 500m Lo-Cap		
G	Grader				
W	Water cart				
M	Surface Miner	BB	Dragline bucket impact		
		SG	Shovel gate impact		
PS	Power Station	MH	MIA material handling impact		
St	Stack Outlet	TB	Train wagon bunching		

N

Project China Stone

Scenario
Noise Sources
Year 20
Southern Section

Figure B7

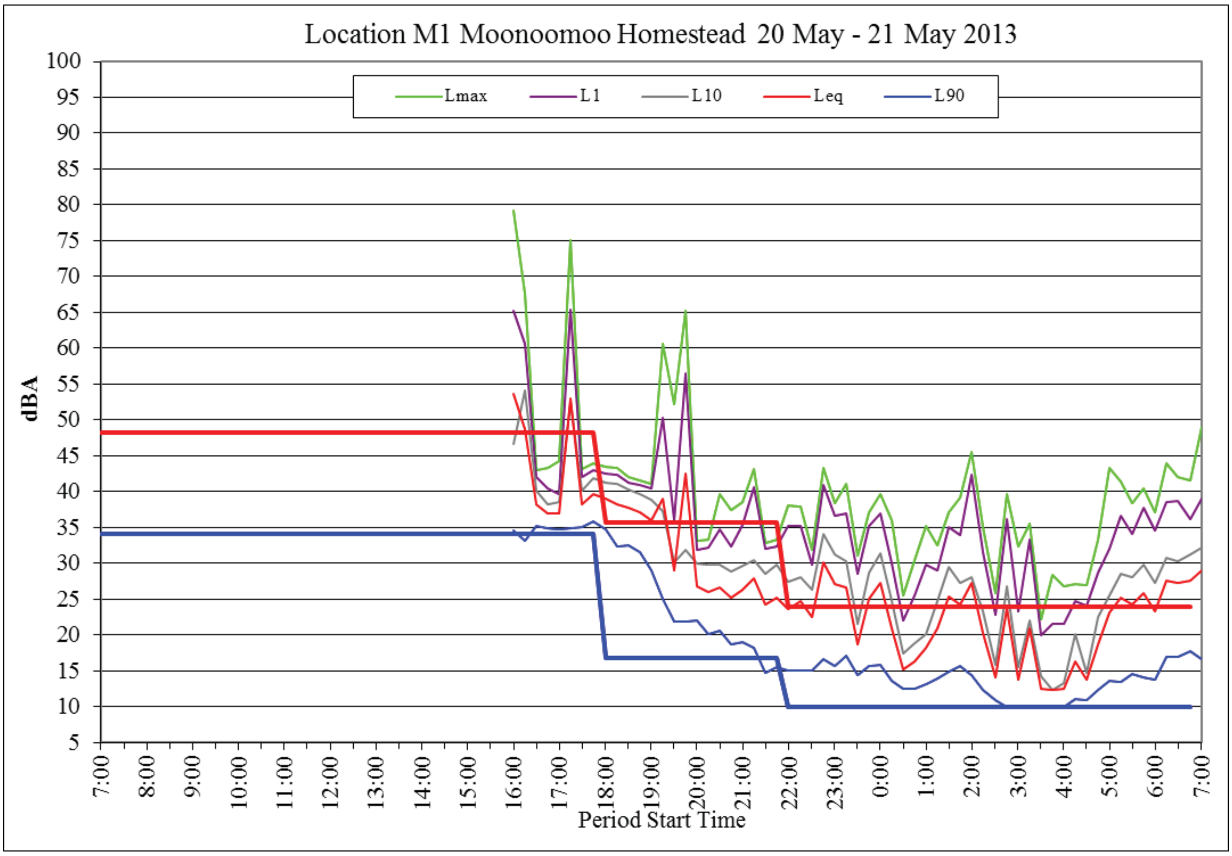
0 kilometres 2

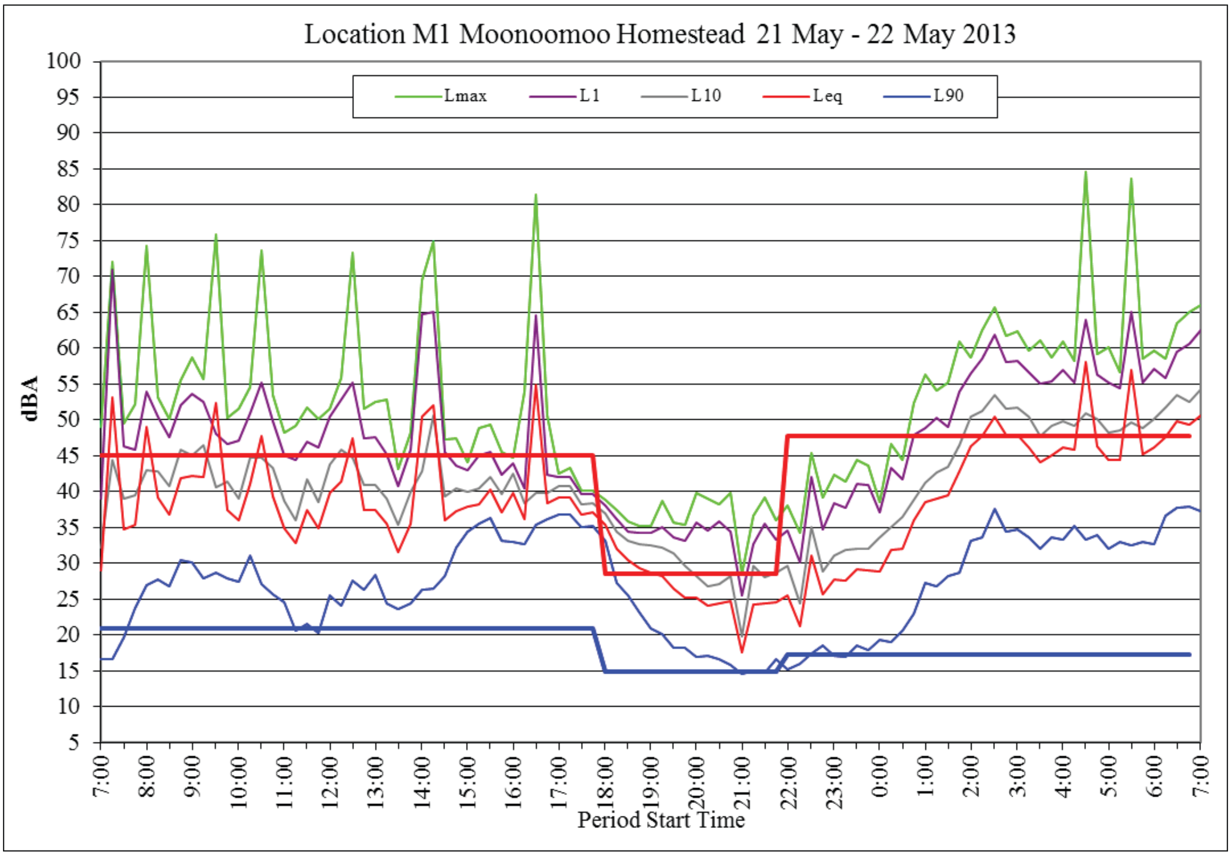
12 October 2014

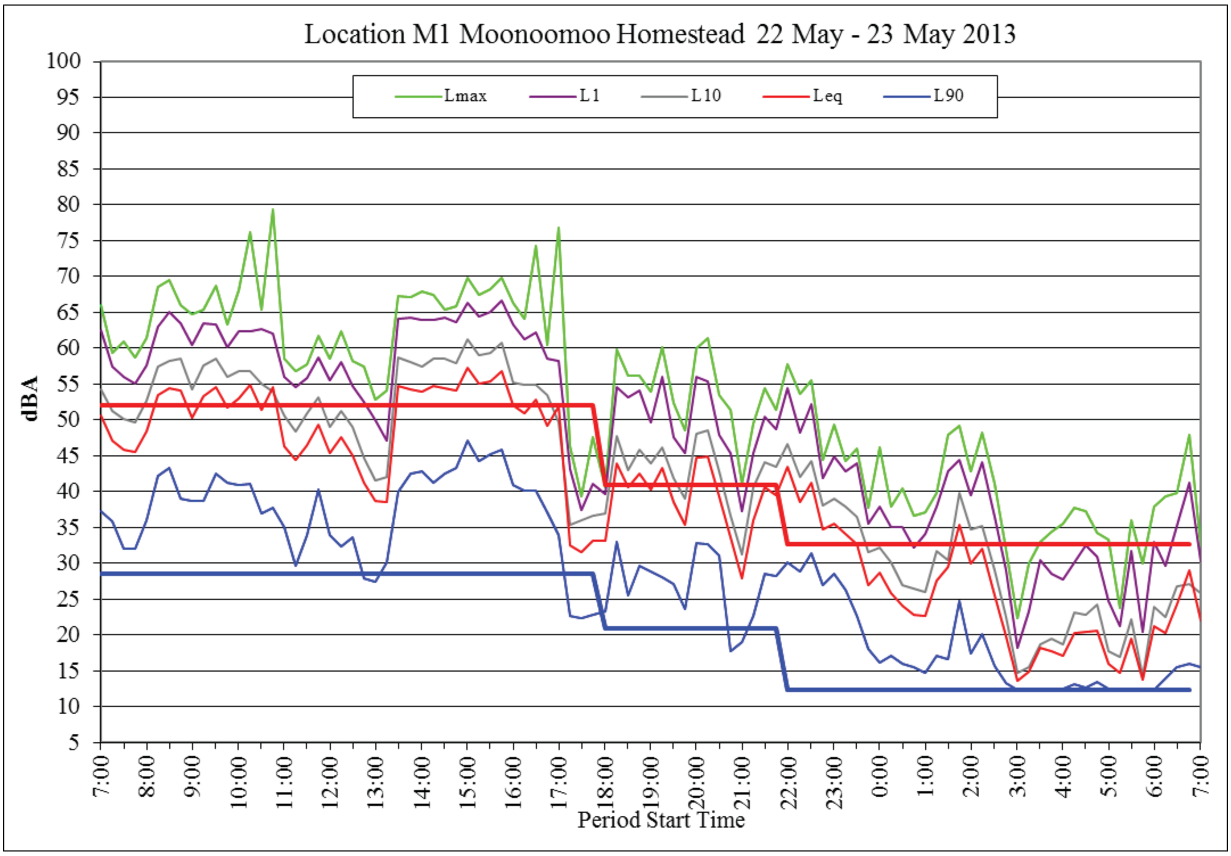
APPENDIX C – LONG TERM NOISE MONITORING RESULTS

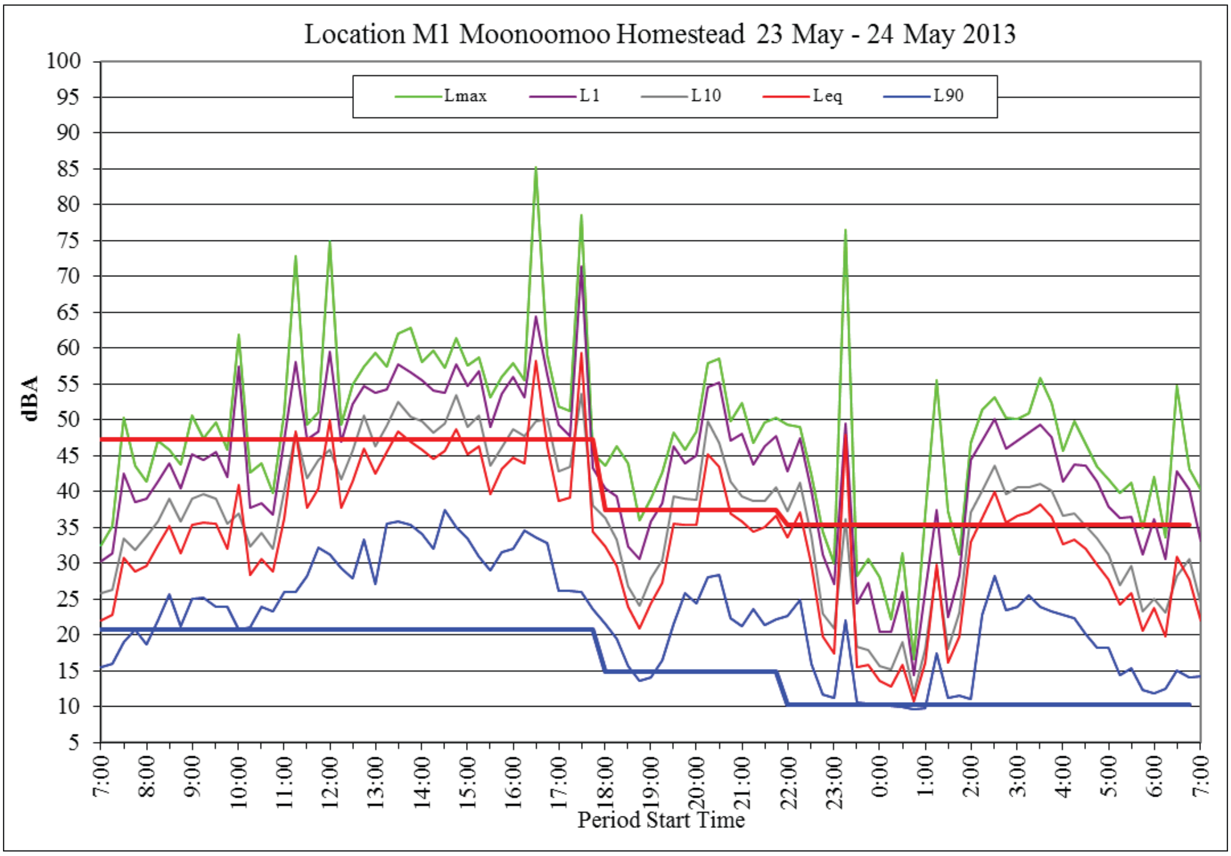
Environmental noise level charts on the following pages show 15 minute percentile statistics from noise loggers installed at two representative receiver locations in the area in May and June 2013, with each chart showing a 24 hour period beginning at 7:00am. Each chart includes:

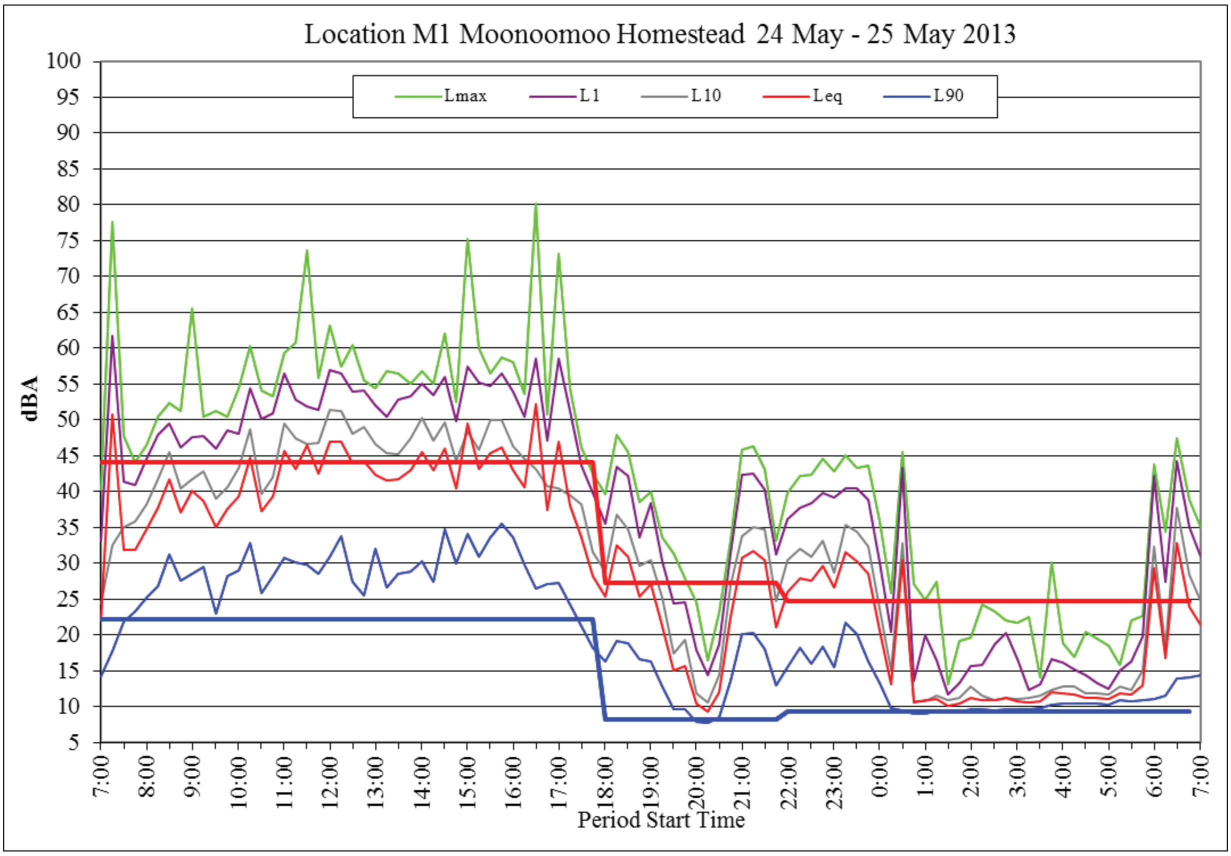
Lmax -	The highest line on the chart, shown with a light green line. The Lmax is the maximum dBA noise level measured in each 15 minute period.
L1 -	The second highest line on the chart, shown with a violet line and representing the loudest 1 percent of the time (9 seconds) in each 15 minute period.
L10 -	The third highest line on each chart without data markers, shown as a grey line and representing the loudest 10% of the time (90 seconds) during each 15 minute period.
Leq -	the equivalent continuous (acoustic average) noise level in each 15 minute period, shown as a red line. The Leq can be above or below the L10 line and can, in extreme cases, extend above the L1 line.
Period Leq -	the equivalent continuous (acoustic average) noise level in each day, evening or night period, calculated from the average of all 15 minute Leq values in that time period excluding those affected by wind over 5m/s or rain. The Period Leq line is shown as a heavy red line.
L90 -	the lowest line on the chart, shown by a blue line, representing the quietest 10 percent of the time in each 15 minute period and accepted as the background noise level. Sections of line shown dotted indicate periods affected by wind over 5m/s or rain.
Period L90 -	The 'L90 of the 15 minute L90s' for each day, evening and night period, representing the Assessment Background Levels (ABLs) for each period according to the EPA's INP. The Period L90 represents the lowest 10% of all 15 minute L90 values in that time period, excluding those affected by wind or rain, and is shown as a heavy blue line.

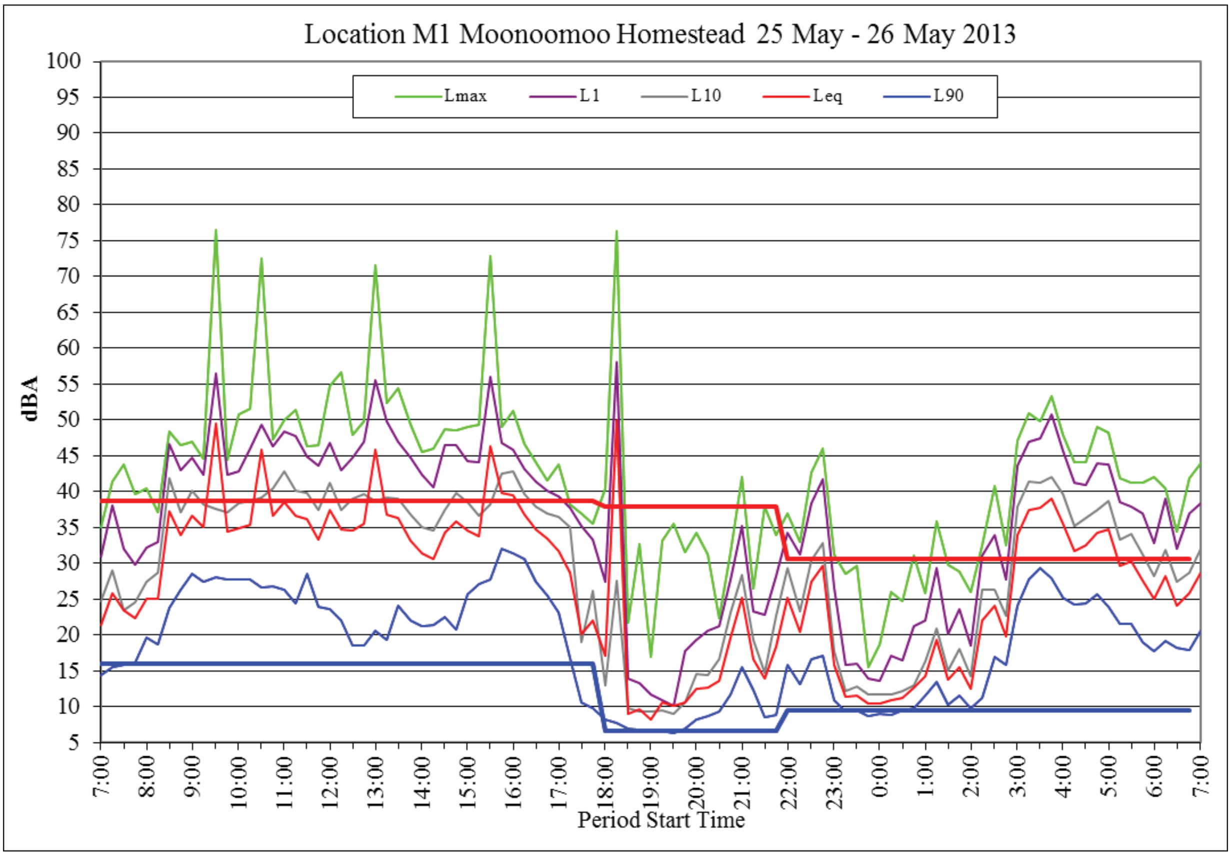

Location M1 Moonoomoo Homestead 20 May - 21 May 2013
Lmax
L1
L10
Leq
L90
dBA
100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
25
20
15
10
5
7:00
8:00
9:00
10:00
11:00
12:00
13:00
14:00
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
0:00
1:00
2:00
3:00
4:00
5:00
6:00
7:00
Period Start Time

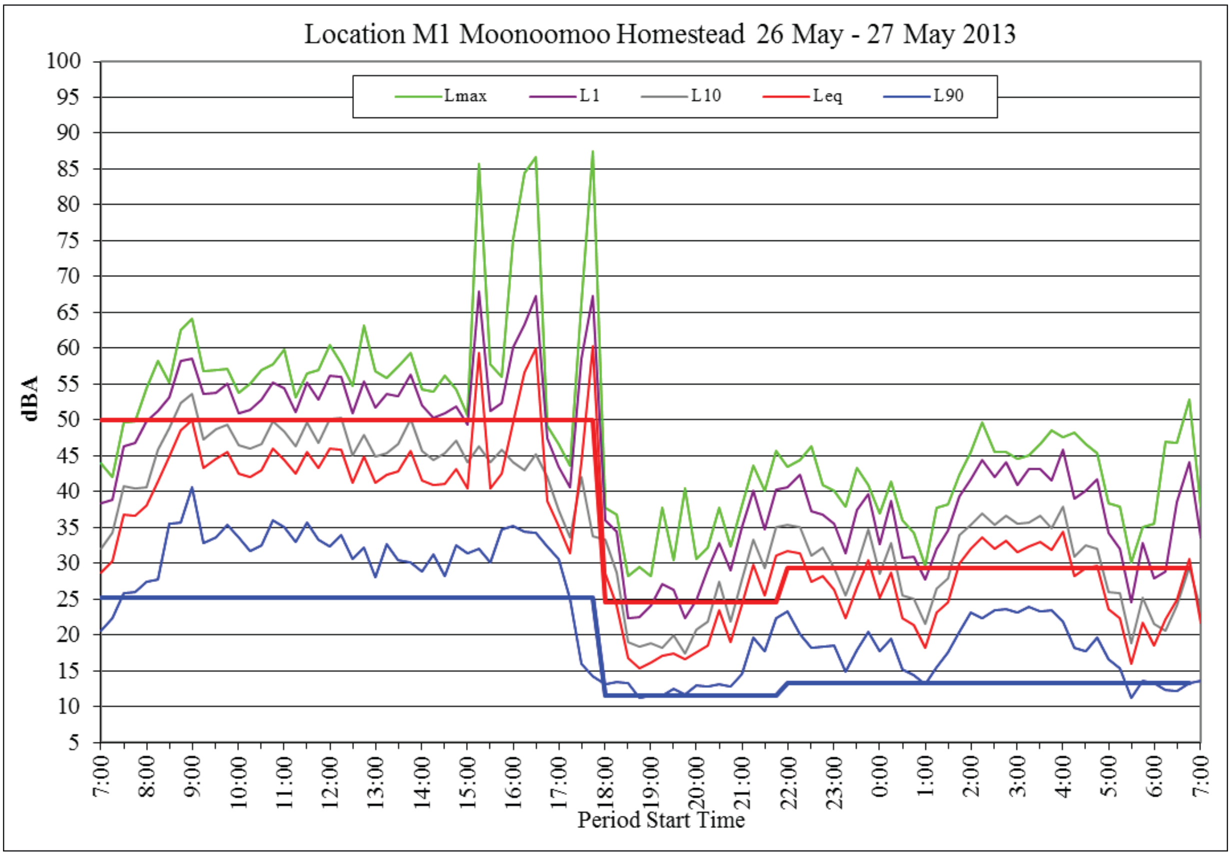

Location M1 Moonoomoo Homestead 21 May - 22 May 2013
Lmax
L1
L10
Leq
L90
dBA
100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
25
20
15
10
5
7:00
8:00
9:00
10:00
11:00
12:00
13:00
14:00
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
0:00
1:00
2:00
3:00
4:00
5:00
6:00
7:00
Period Start Time

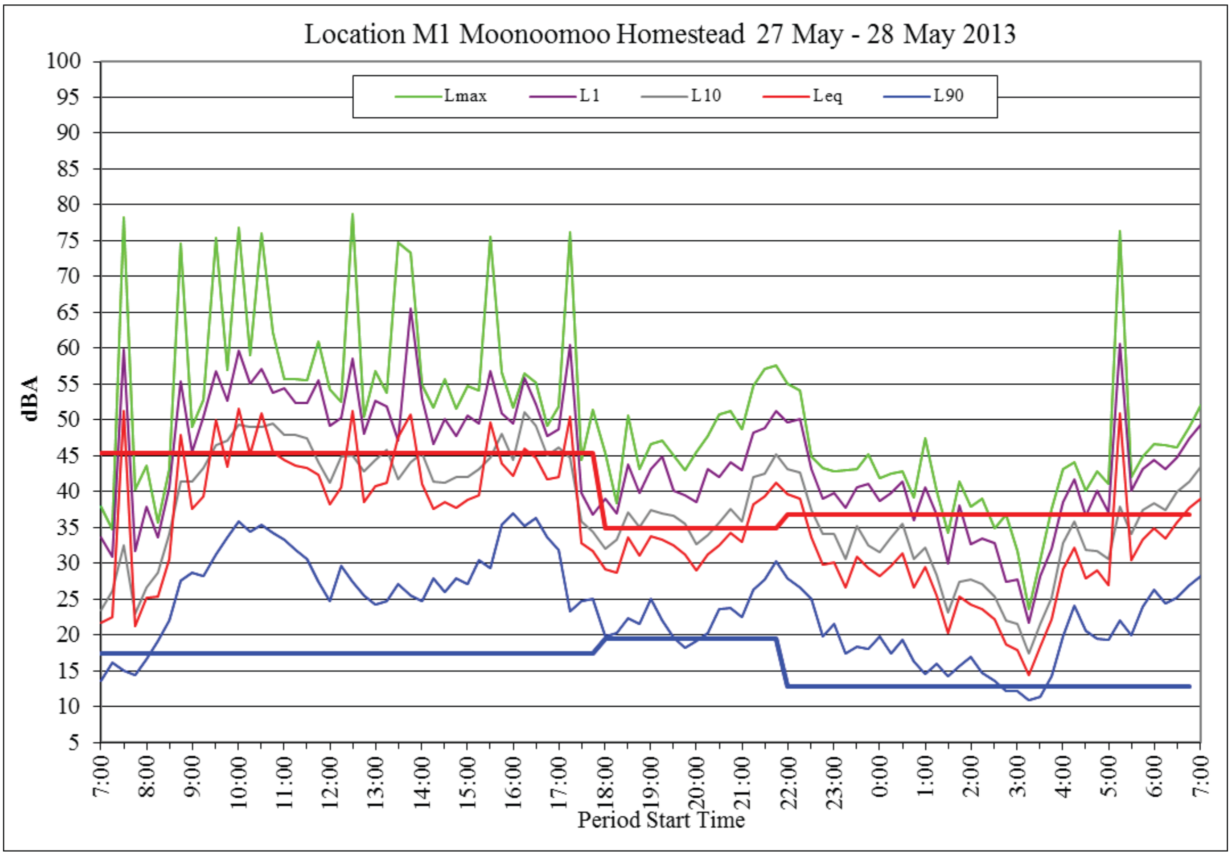

Location M1 Moonoomoo Homestead 22 May - 23 May 2013
Lmax
L1
L10
Leq
L90
dBA
Period Start Time


Location M1 Moonoomoo Homestead 23 May - 24 May 2013
Lmax
L1
L10
Leq
L90
dBA
Period Start Time


Location M1 Moonoomoo Homestead 24 May - 25 May 2013
Lmax
L1
L10
Leq
L90
dBA
Period Start Time


Location M1 Moonoomoo Homestead 25 May - 26 May 2013
Lmax
L1
L10
Leq
L90
dBA
Period Start Time


Location M1 Moonoomoo Homestead 26 May - 27 May 2013
Lmax
L1
L10
Leq
L90
dBA
100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
25
20
15
10
5
7:00
8:00
9:00
10:00
11:00
12:00
13:00
14:00
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
0:00
1:00
2:00
3:00
4:00
5:00
6:00
7:00
Period Start Time


Location M1 Moonoomoo Homestead 27 May - 28 May 2013
Lmax
L1
L10
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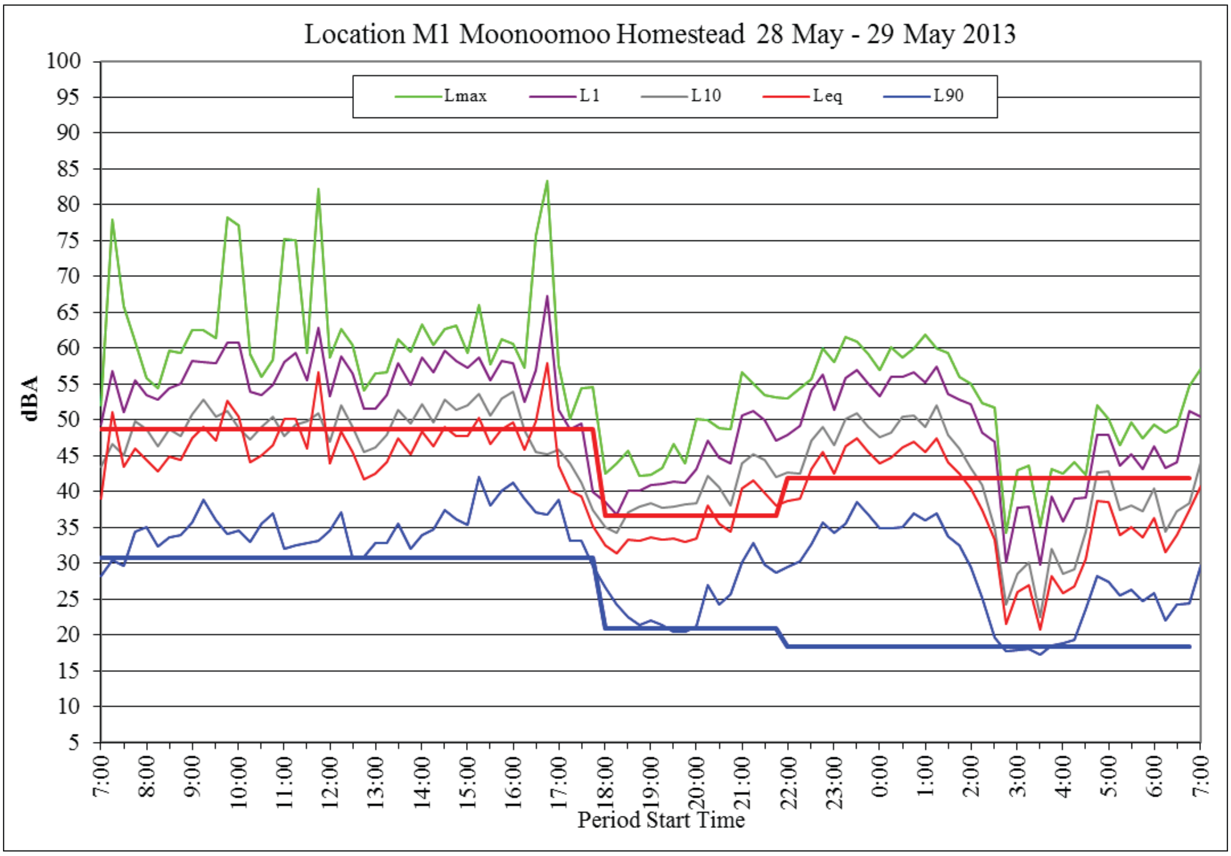
Period Start Time


Location M1 Moonoomoo Homestead 28 May - 29 May 2013
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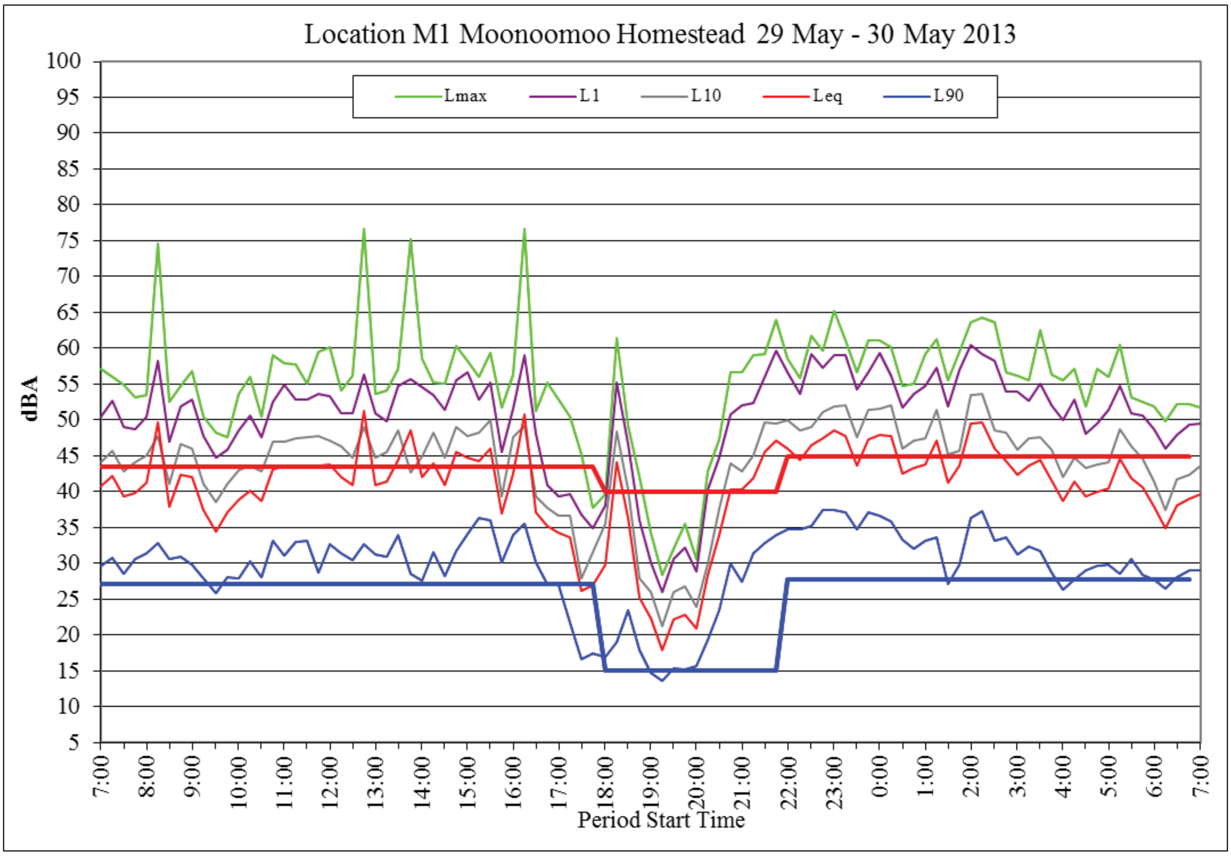
Location M1 Moonoomoo Homestead 29 May - 30 May 2013
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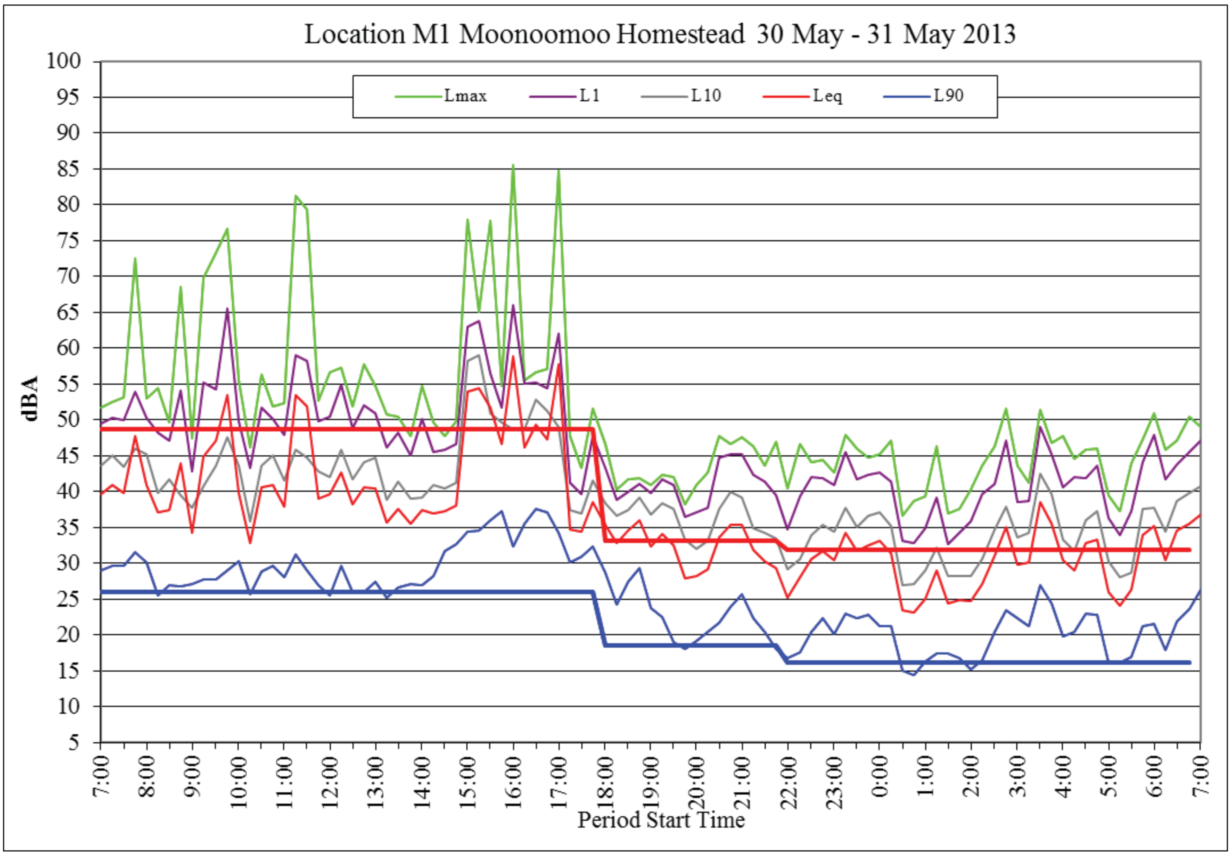
Period Start Time


Location M1 Moonoomoo Homestead 30 May - 31 May 2013
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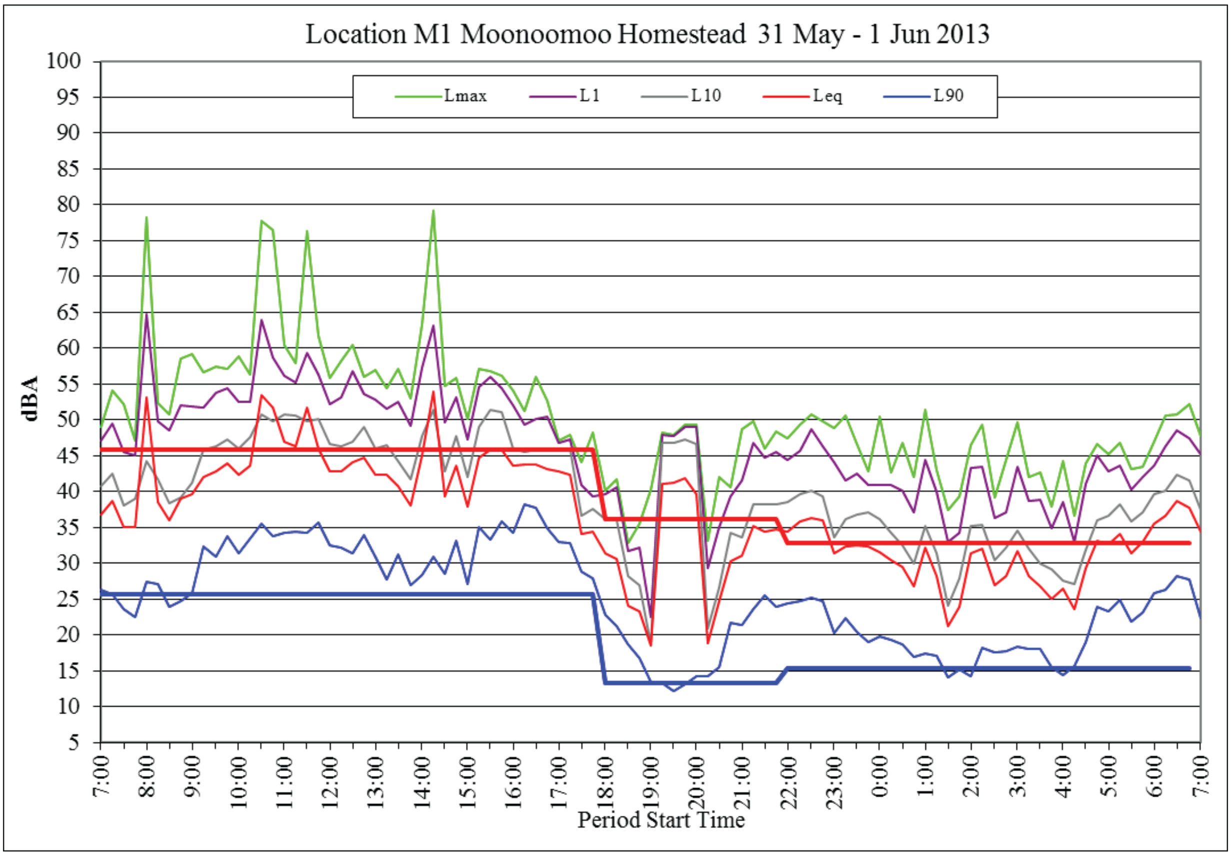
Location M1 Moonoomoo Homestead 31 May - 1 Jun 2013
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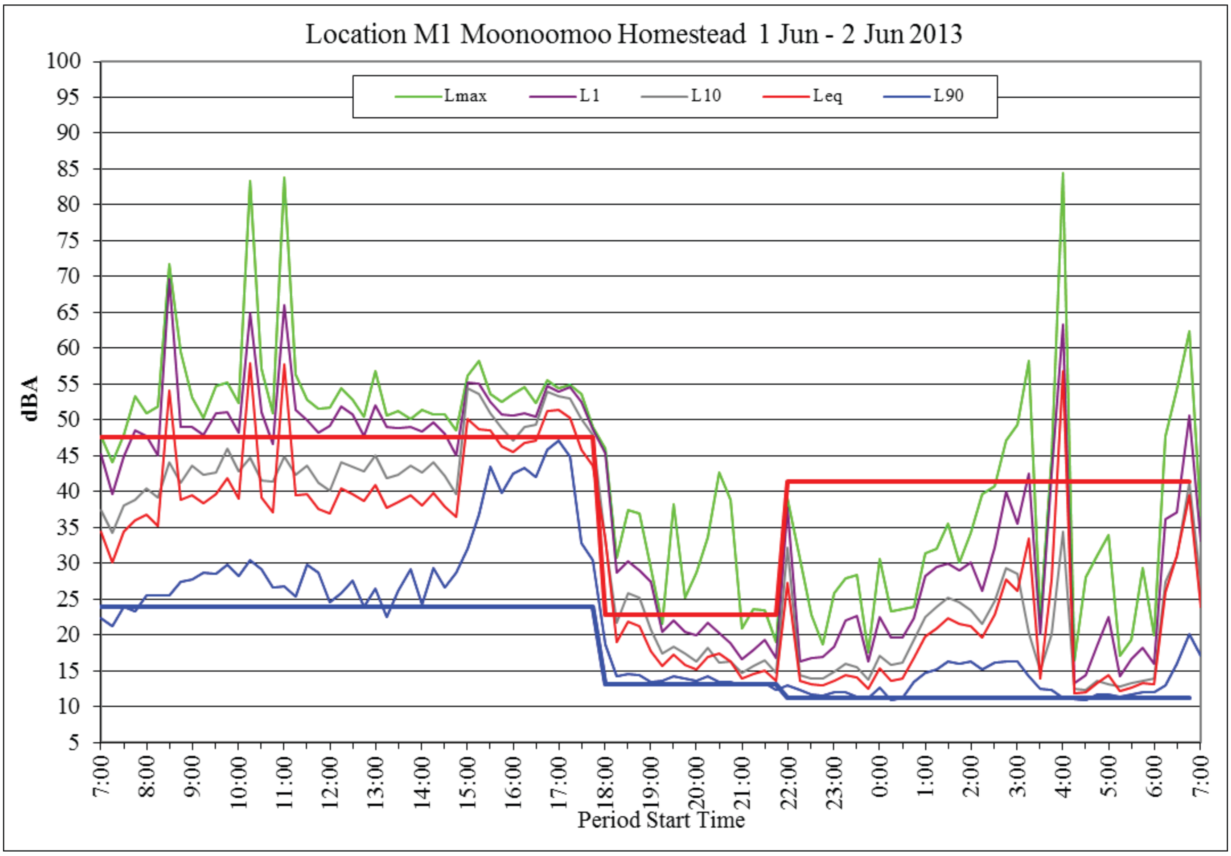
Location M1 Moonoomoo Homestead 1 Jun - 2 Jun 2013
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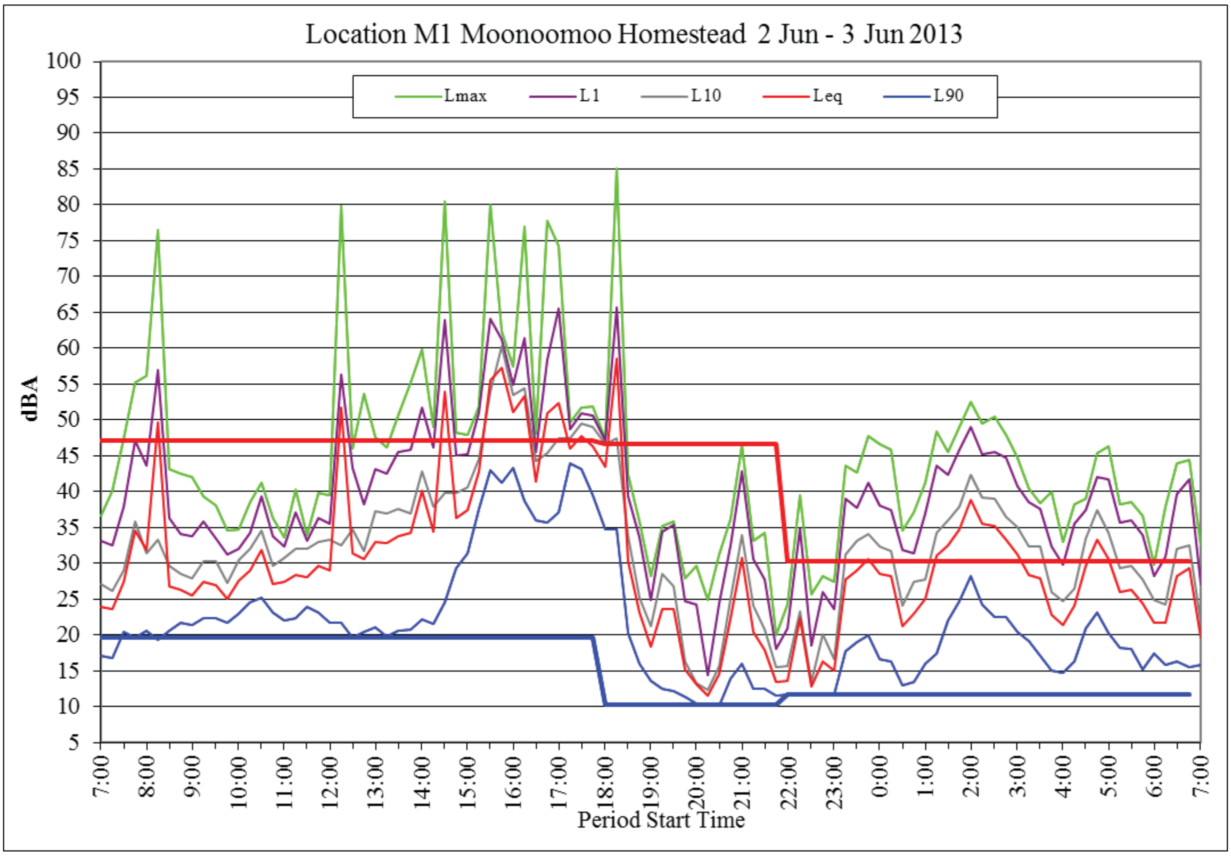
Period Start Time


Location M1 Moonoomoo Homestead 2 Jun - 3 Jun 2013
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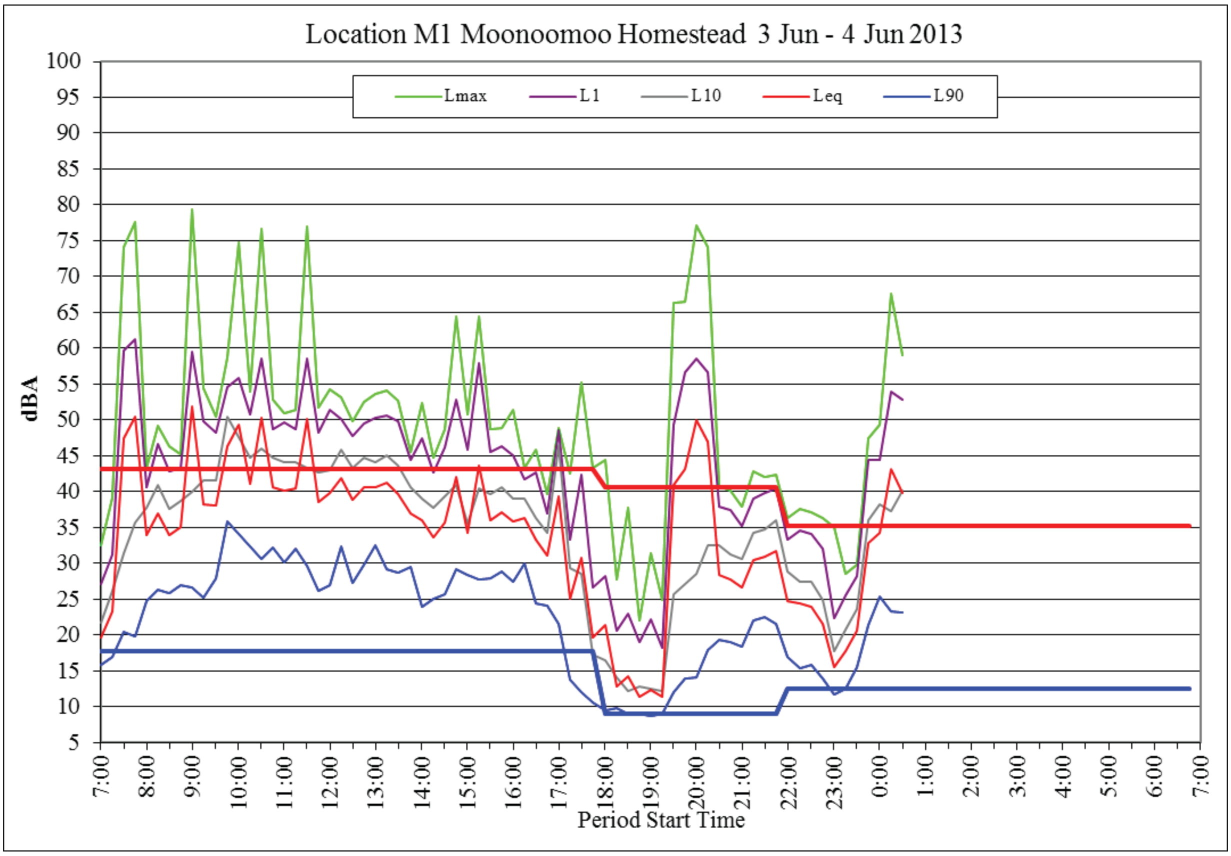
Period Start Time


Location M1 Moonoomoo Homestead 3 Jun - 4 Jun 2013
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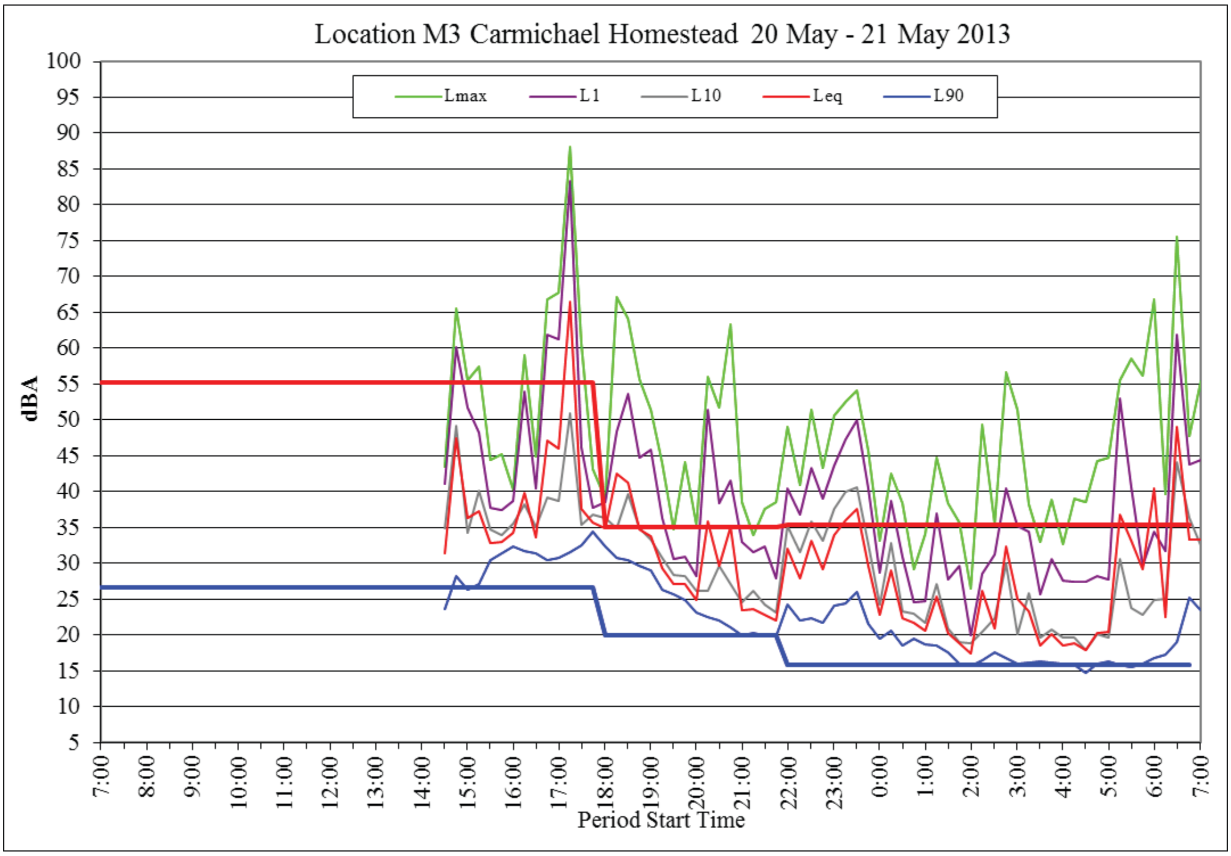
Location M3 Carmichael Homestead 20 May - 21 May 2013
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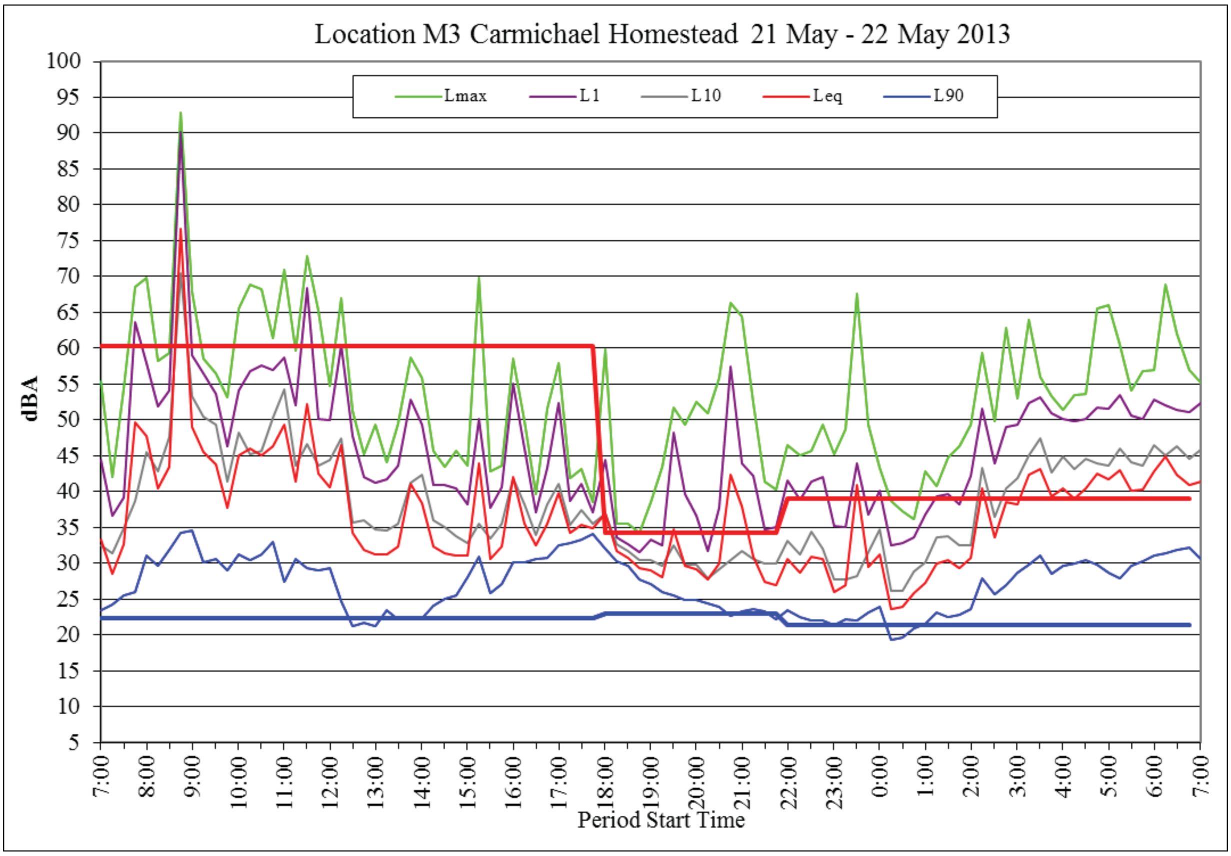
Location M3 Carmichael Homestead 21 May - 22 May 2013
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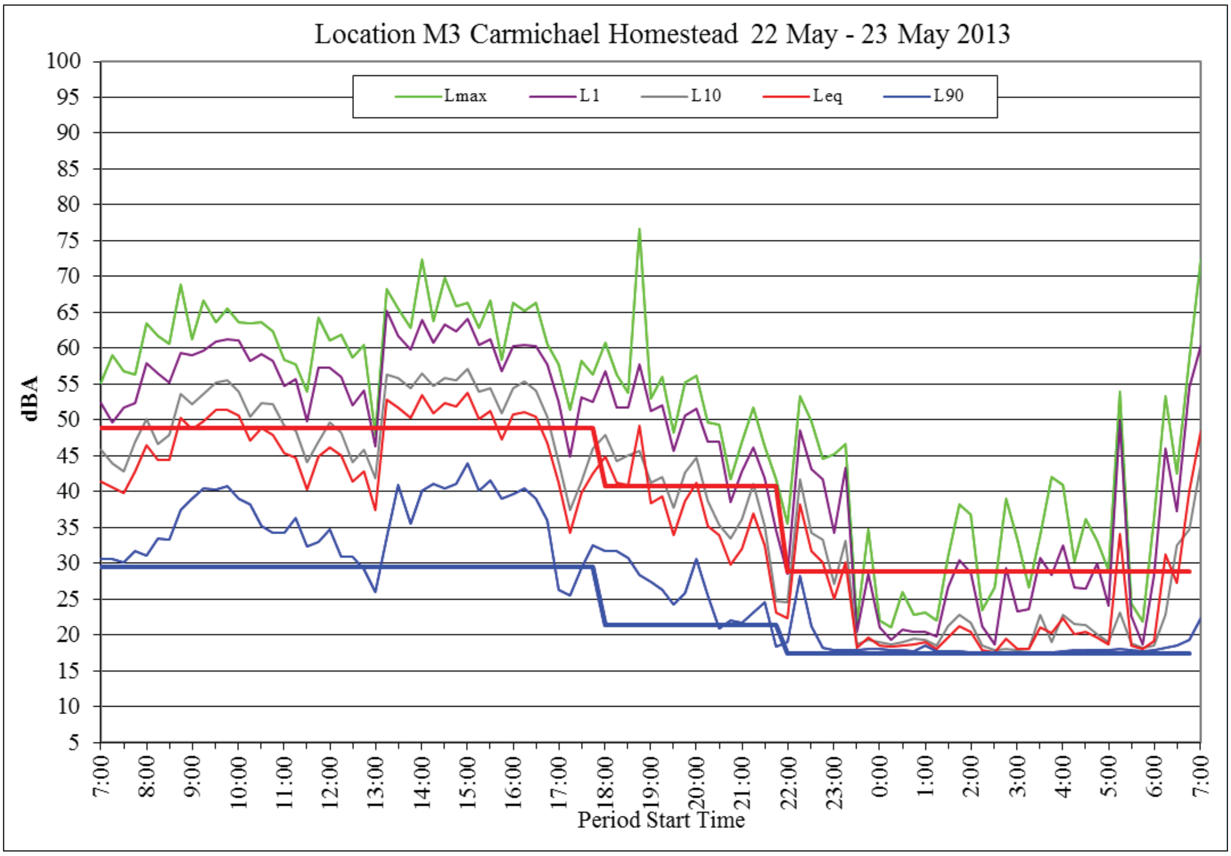
Location M3 Carmichael Homestead 22 May - 23 May 2013
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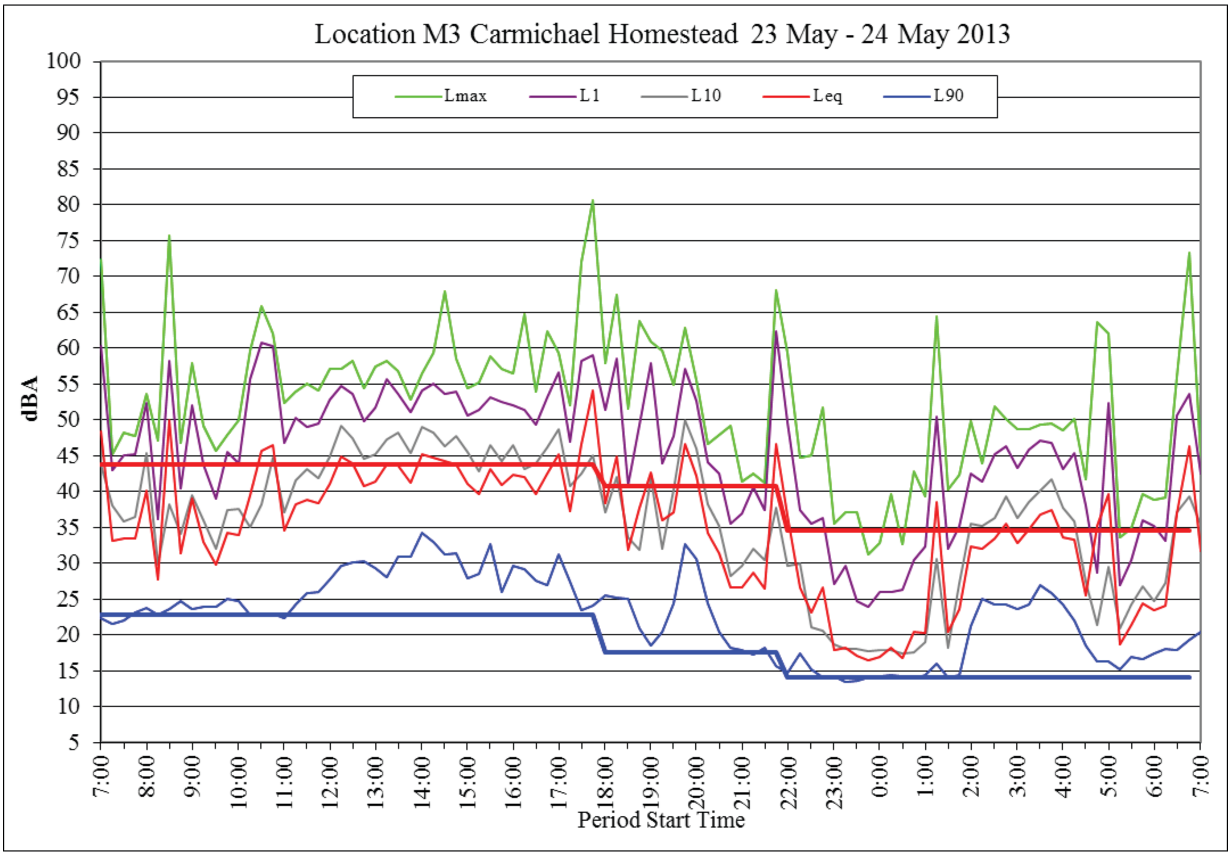
Location M3 Carmichael Homestead 23 May - 24 May 2013
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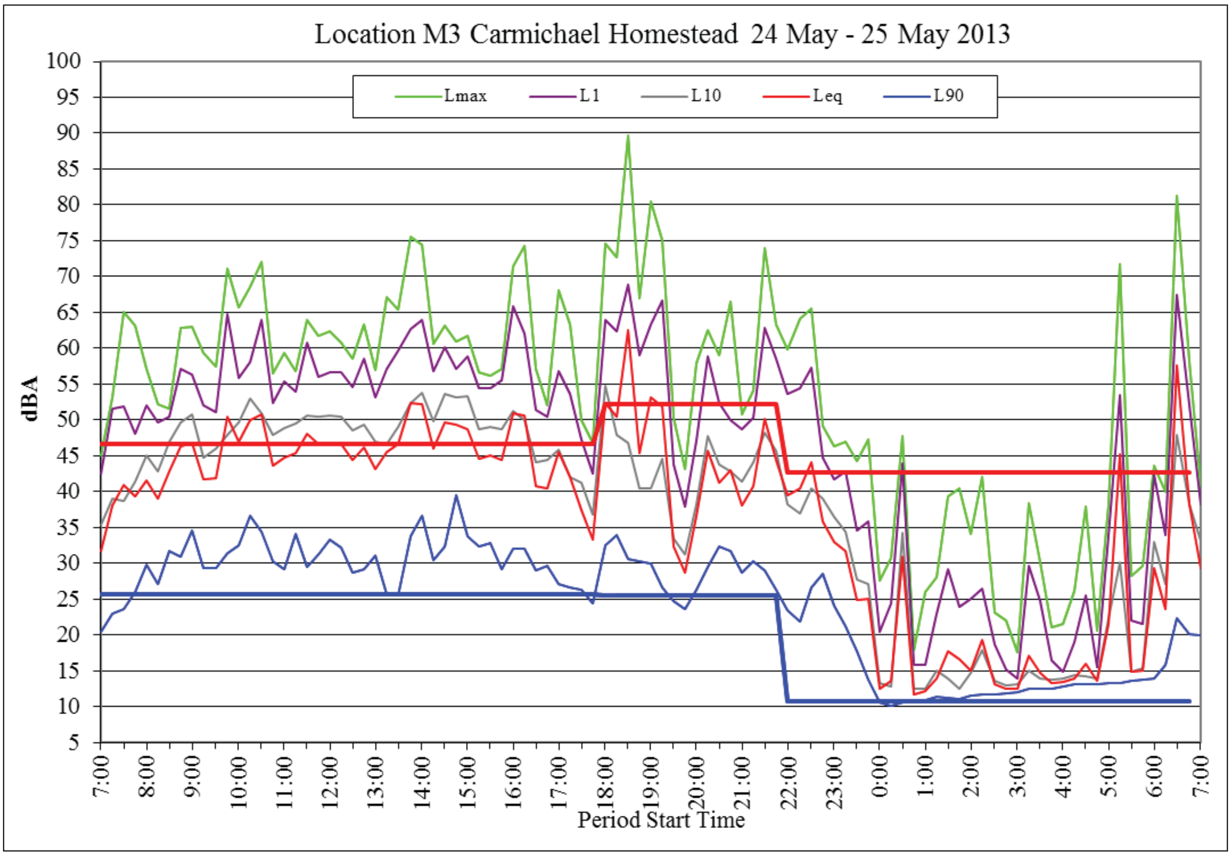
Location M3 Carmichael Homestead 24 May - 25 May 2013
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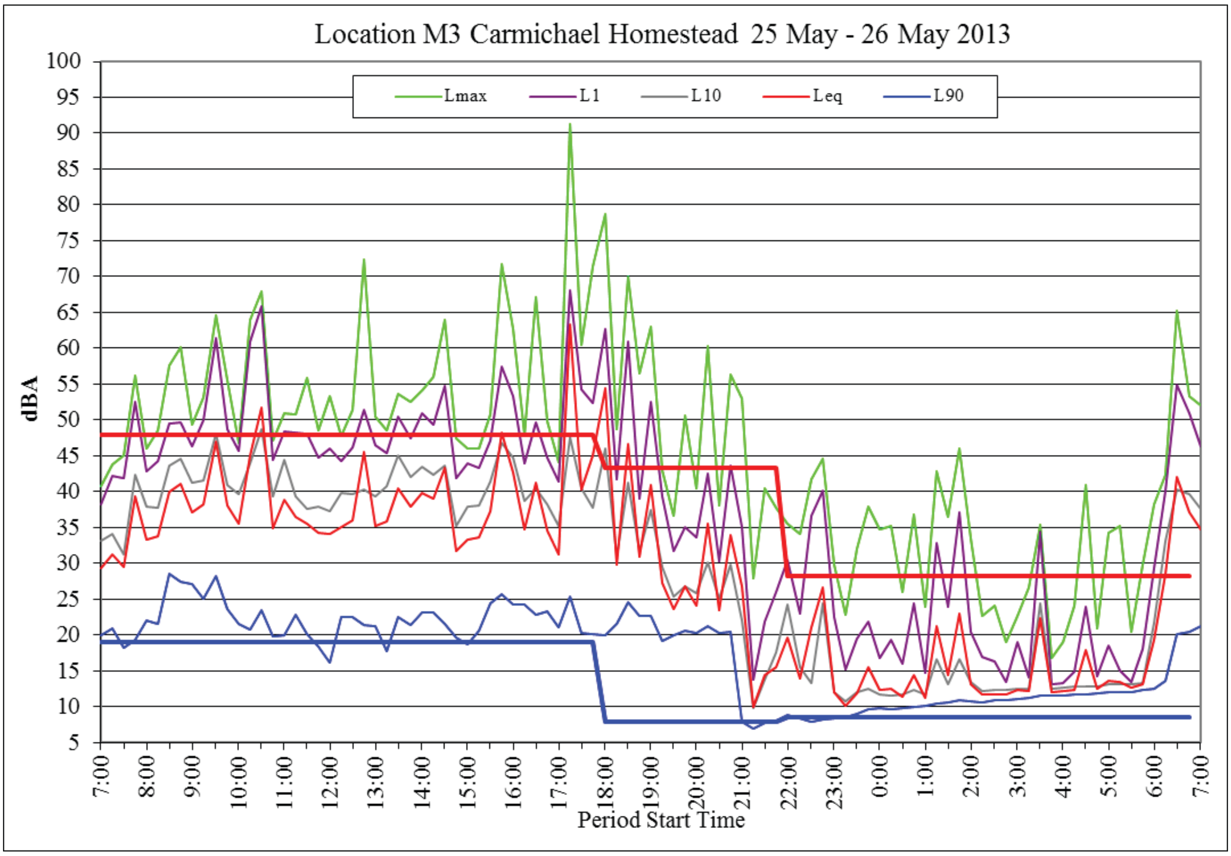
Location M3 Carmichael Homestead 25 May - 26 May 2013
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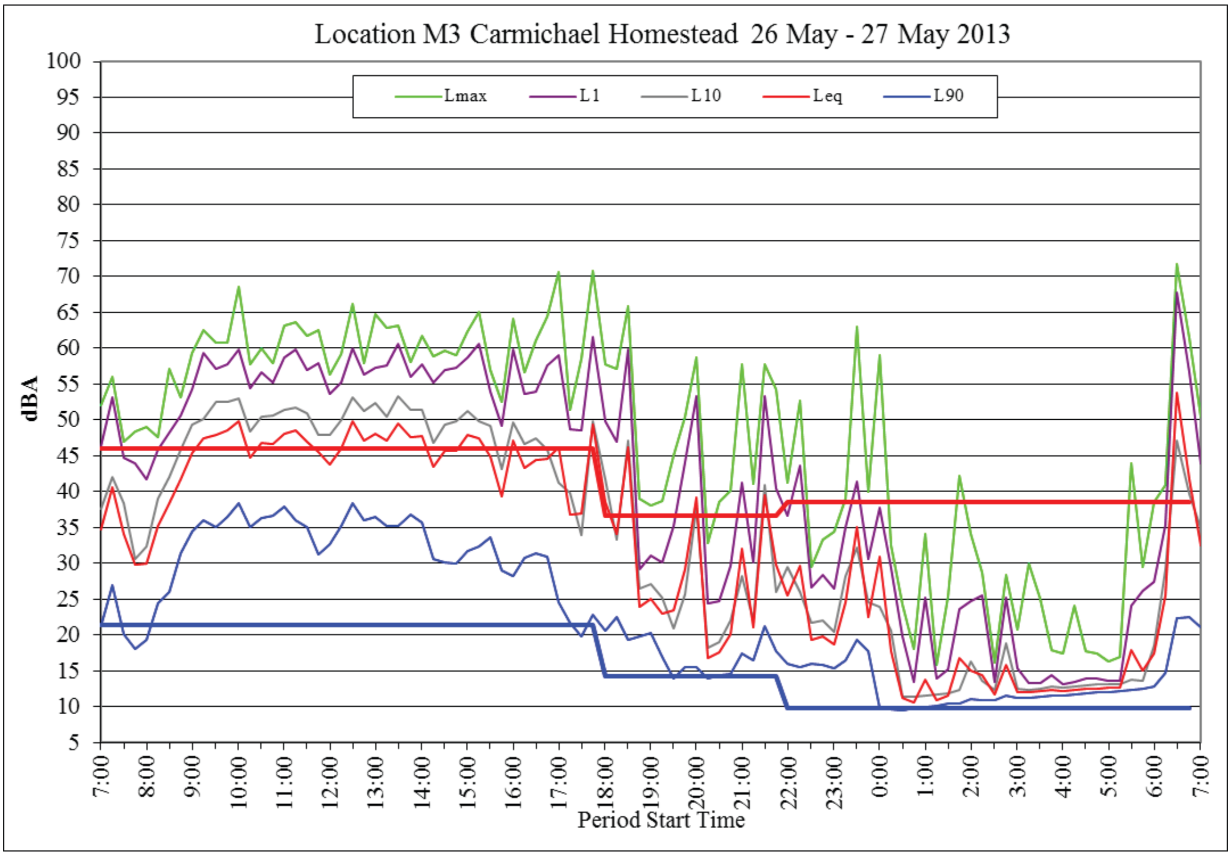
Location M3 Carmichael Homestead 26 May - 27 May 2013
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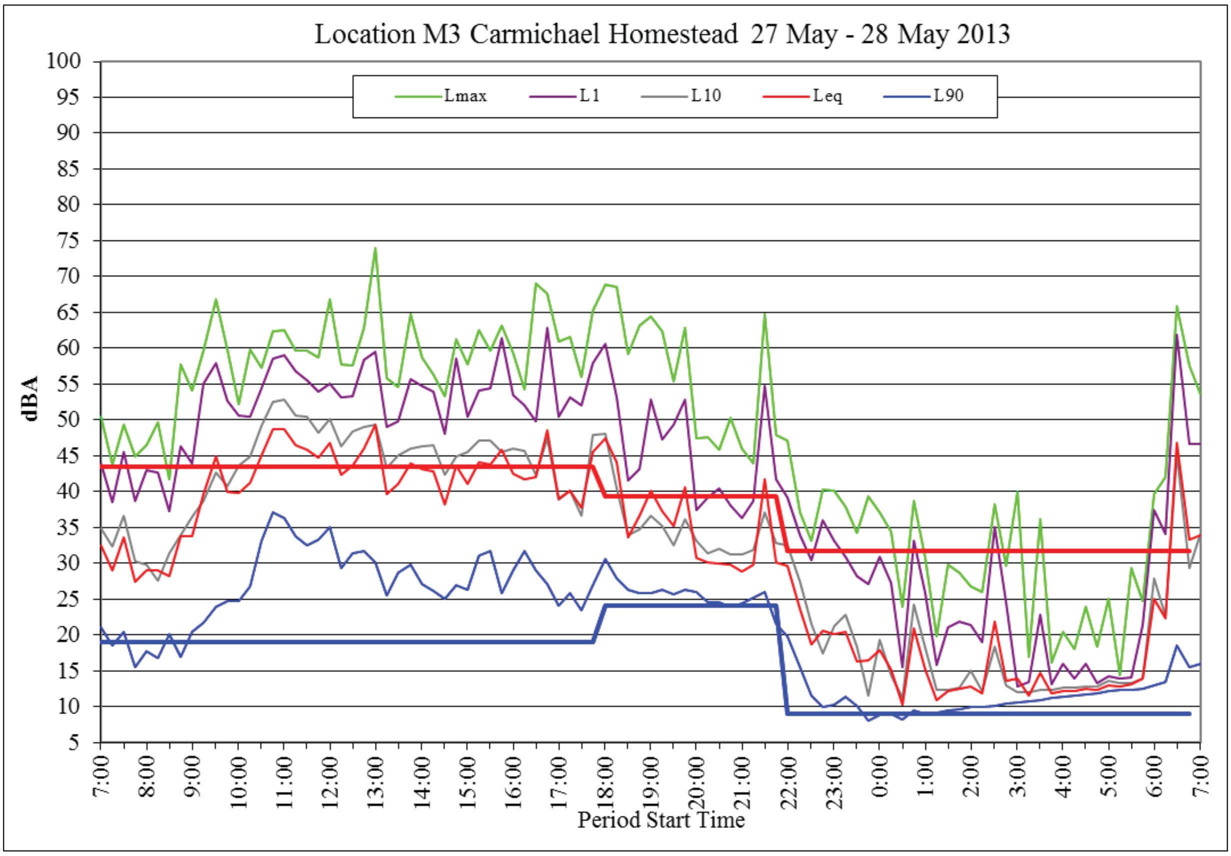
Period Start Time


Location M3 Carmichael Homestead 27 May - 28 May 2013
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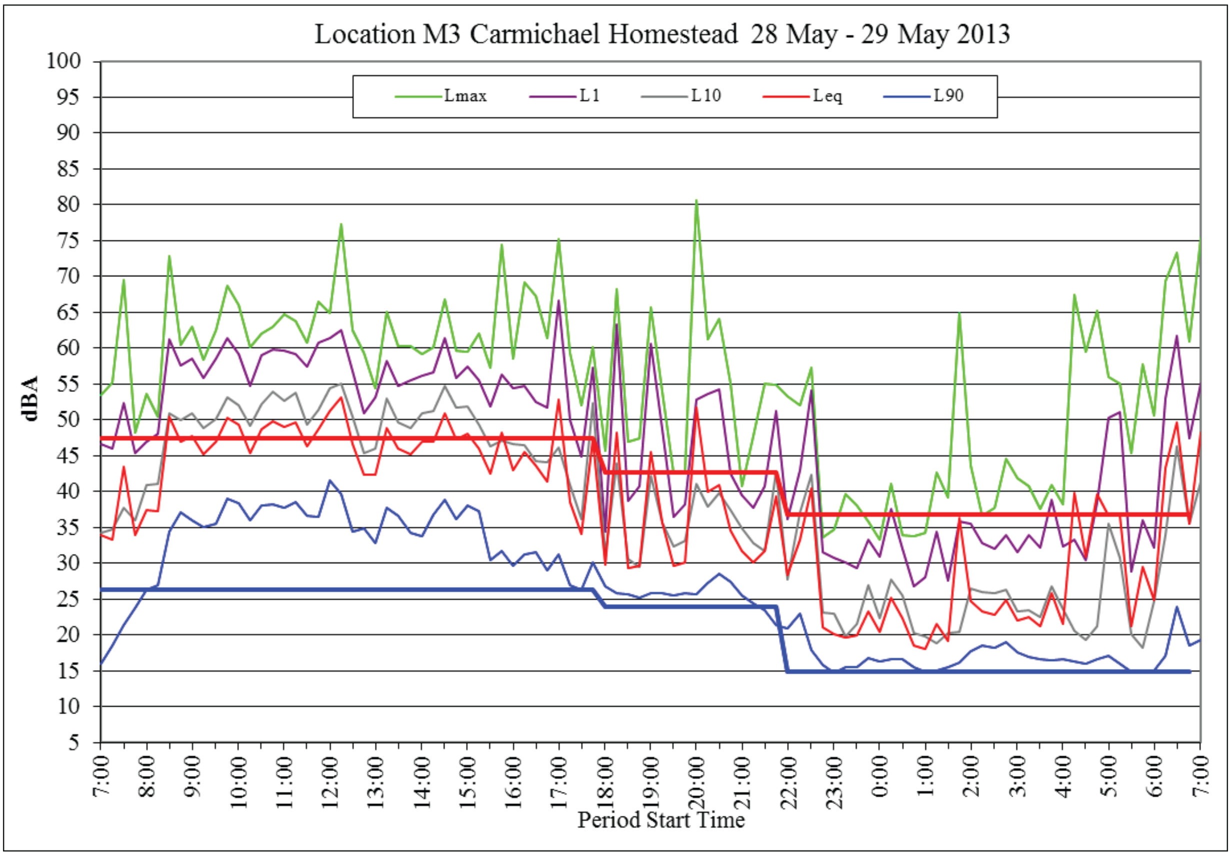
Location M3 Carmichael Homestead 28 May - 29 May 2013
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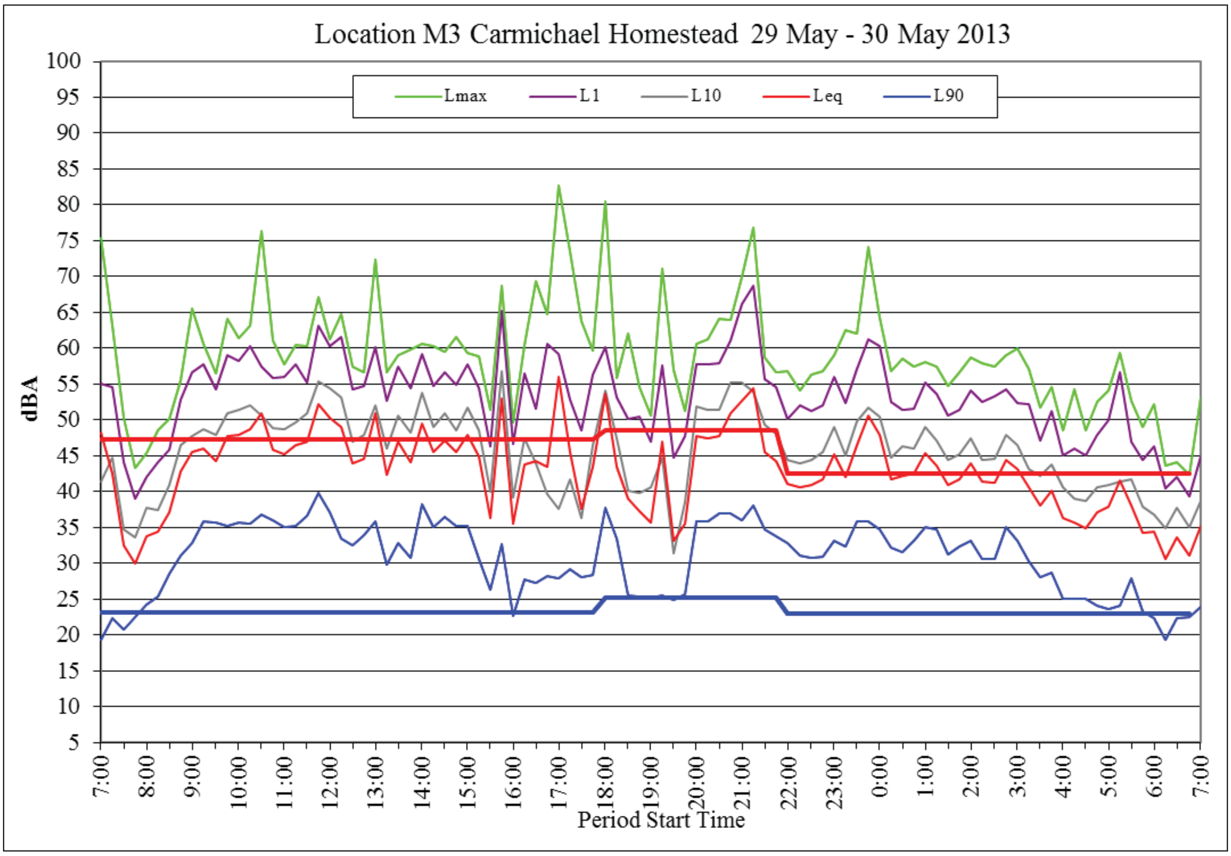
Location M3 Carmichael Homestead 29 May - 30 May 2013
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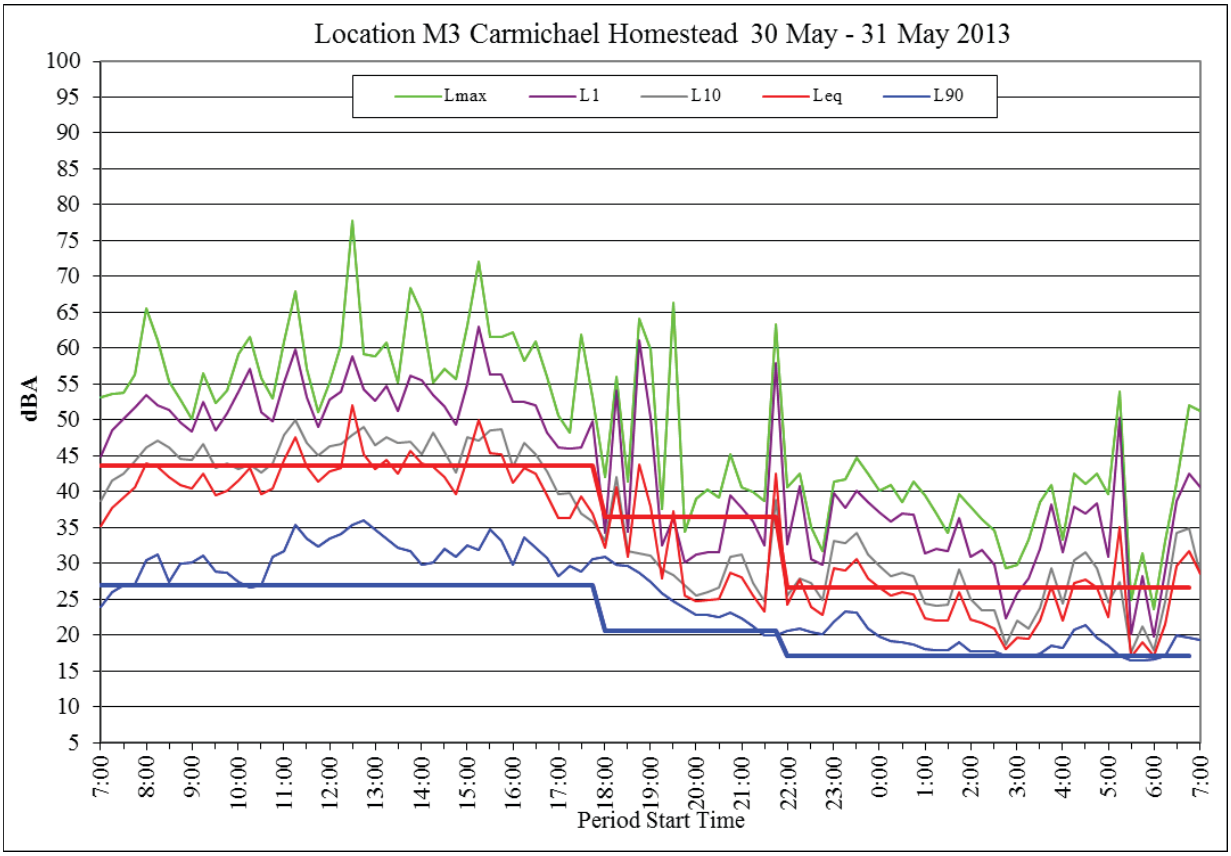
Location M3 Carmichael Homestead 30 May - 31 May 2013
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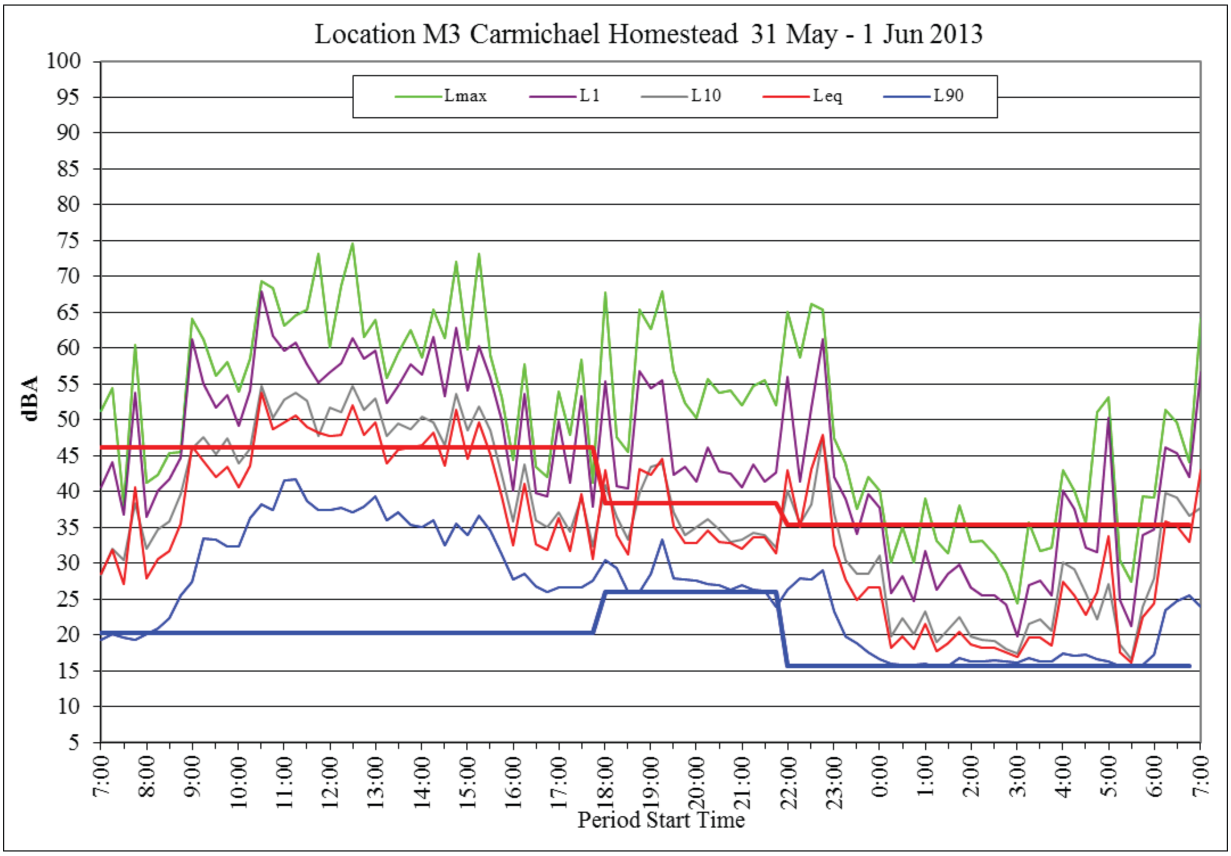
Location M3 Carmichael Homestead 31 May - 1 Jun 2013
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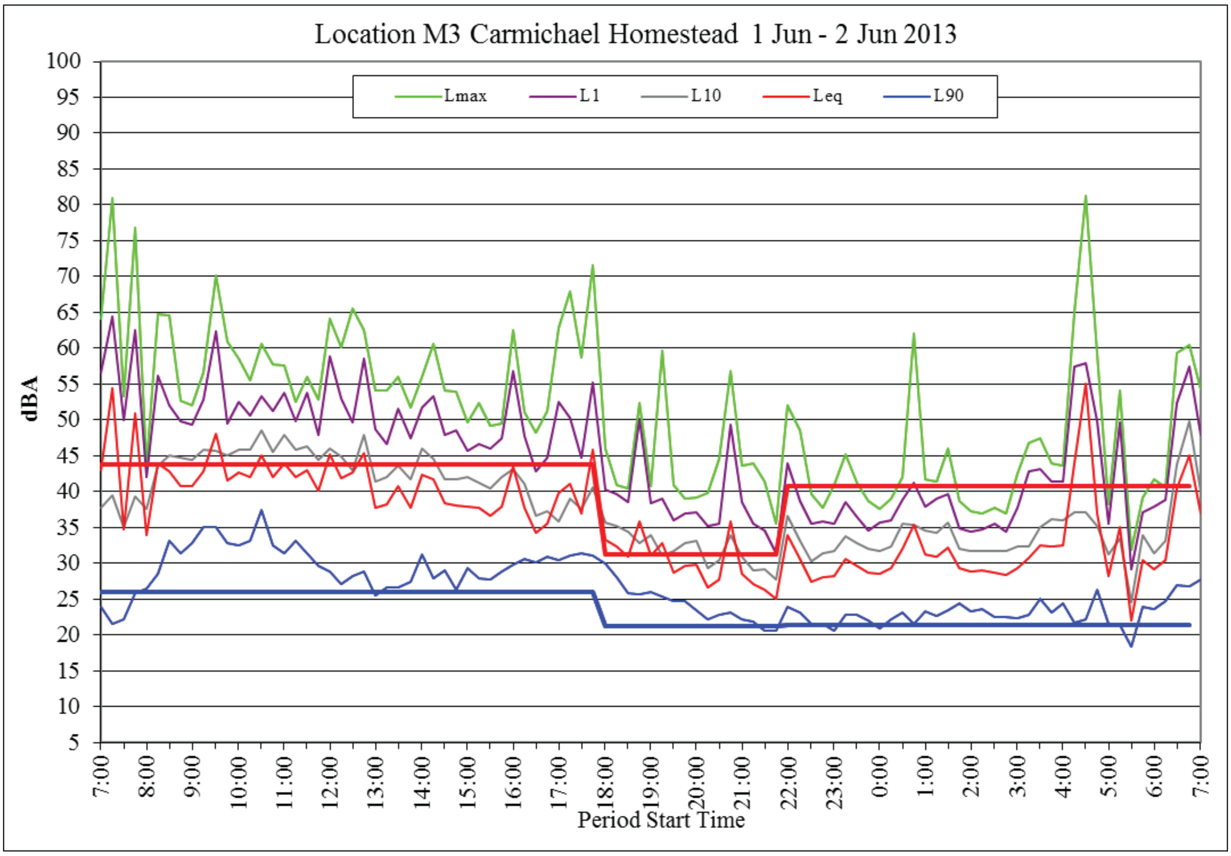
Location M3 Carmichael Homestead 1 Jun - 2 Jun 2013
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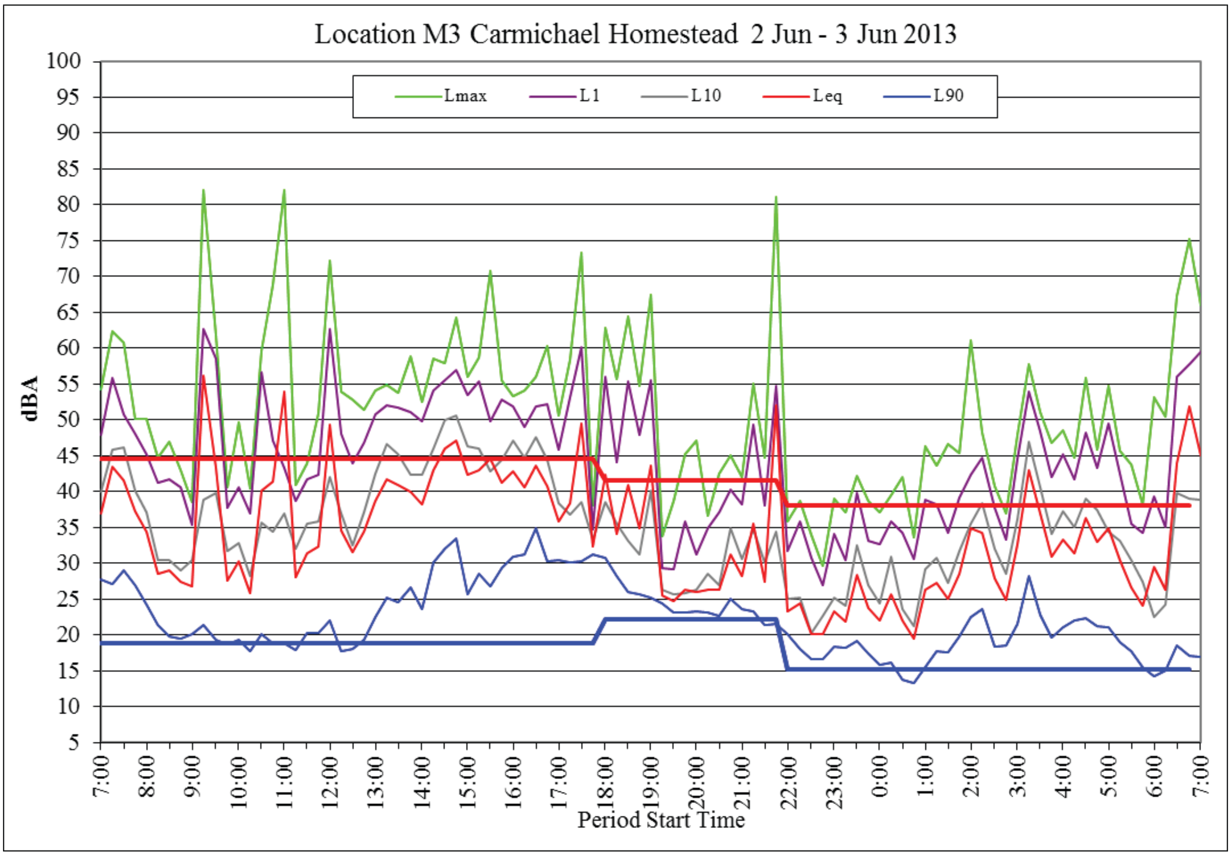
Location M3 Carmichael Homestead 2 Jun - 3 Jun 2013
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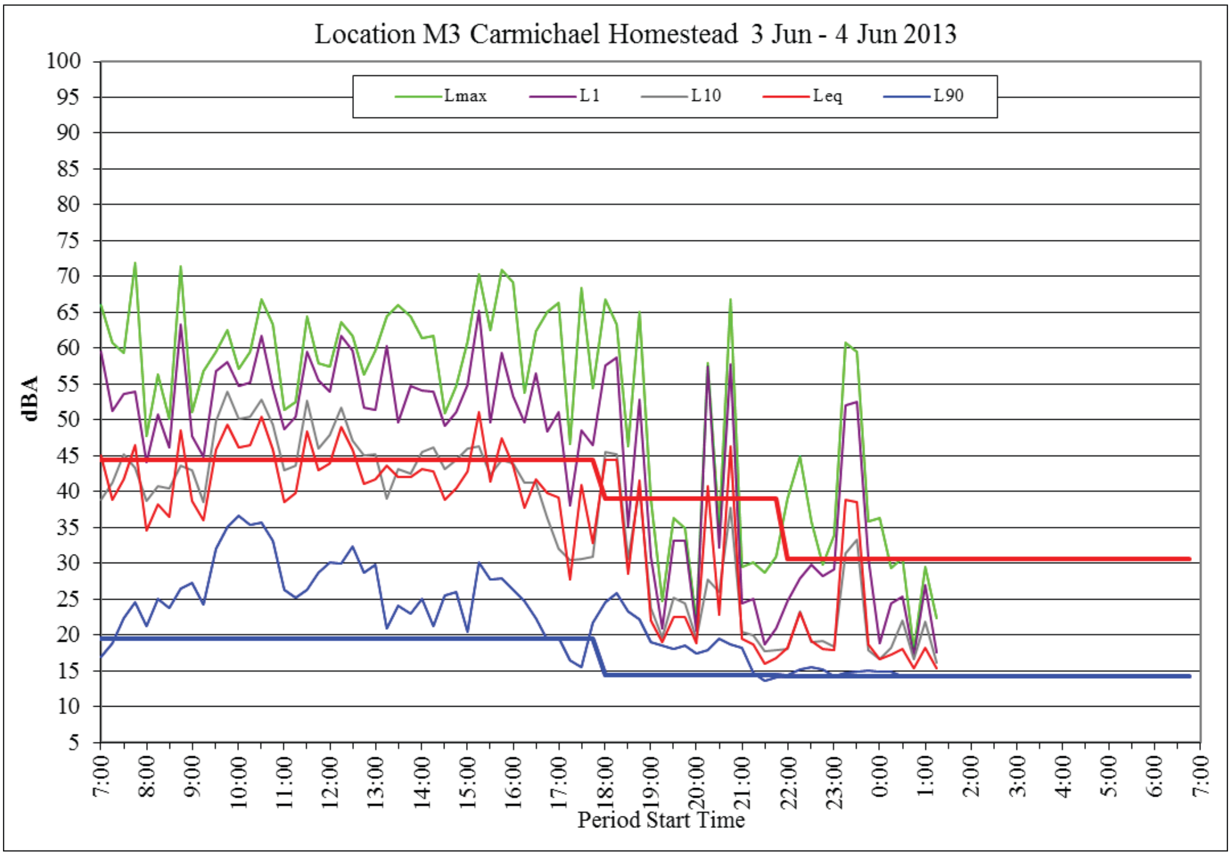
Location M3 Carmichael Homestead 3 Jun - 4 Jun 2013
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