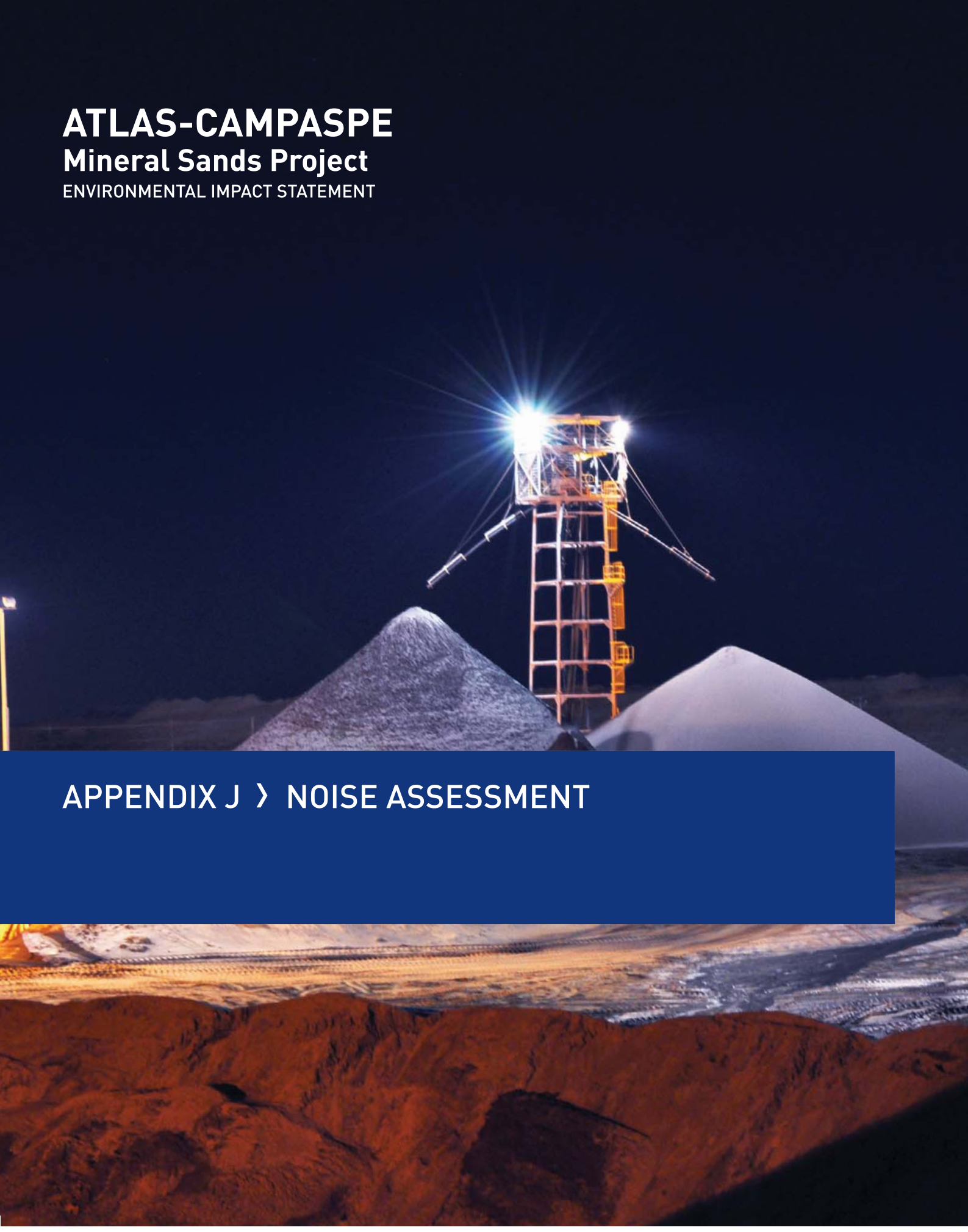
ATLAS-CAMPASPE
Mineral Sands Project
ENVIRONMENTAL IMPACT STATEMENT



APPENDIX J 〉 NOISE ASSESSMENT

CRISTAL Resource Strategies

ACOUSTICS AND AIR

ATLAS-CAMPASPE MINERAL SANDS PROJECT

NOISE ASSESSMENT

REPORT NO. 11241
VERSION B

NOVEMBER 2012

PREPARED FOR

CRISTAL MINING AUSTRALIA LIMITED

WILKINSON MURRAY

DOCUMENT CONTROL

Version	Status	Date	Prepared By	Reviewed By
A	Draft	6 August 2012	Jimi Ang	John Wassermann
B	Draft	4 September 2012	John Wassermann	-
B	Final	4 November 2012	John Wassermann	Brian Clarke

Note

All materials specified by Wilkinson Murray Pty Limited have been selected solely on the basis of acoustic performance. Any other properties of these materials, such as fire rating, chemical properties etc. should be checked with the suppliers or other specialised bodies for fitness for a given purpose. The information contained in this document produced by Wilkinson Murray is solely for the use of the client identified on the front page of this report. Our client becomes the owner of this document upon full payment of our **Tax Invoice** for its provision. This document must not be used for any purposes other than those of the document's owner. Wilkinson Murray undertakes no duty to or accepts any responsibility to any third party who may rely upon this document.

Quality Assurance

We are committed to and have implemented AS/NZS ISO 9001:2008 "Quality Management Systems – Requirements". This management system has been externally certified and Licence No. QEC 13457 has been issued.

AAAC

This firm is a member firm of the Association of Australian Acoustical Consultants and the work here reported has been carried out in accordance with the terms of that membership.

Celebrating 50 Years in 2012

Wilkinson Murray is an independent firm established 50 years ago originally as Carr & Wilkinson. In 1976 Barry Murray joined founding partner Roger Wilkinson and the firm adopted the name which remains today. From a successful operation in Australia, Wilkinson Murray expanded its reach into Asia by opening a Hong Kong office early in 2006. 2010 saw the introduction of our Queensland office and 2011 the introduction of our Orange office to service a growing client base in these regions. From these offices, Wilkinson Murray services the entire Asia-Pacific region.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ATTACHMENTS

GLOSSARY OF ACOUSTIC TERMS

Most environments are affected by environmental noise which continuously varies, largely as a result of road traffic. To describe the overall noise environment, a number of noise descriptors have been developed and these involve statistical and other analysis of the varying noise over sampling periods, typically taken as 15 minutes. These descriptors, which are demonstrated in the graph below, are here defined.

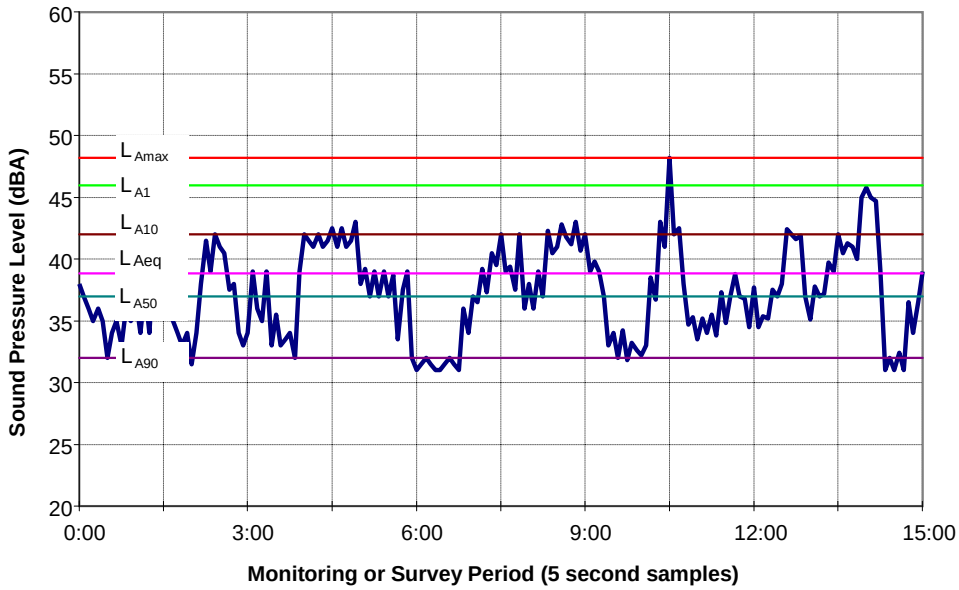
Maximum Noise Level (L_{Amax}) – The maximum noise level over a sample period is the maximum level, measured on fast response, during the sample period.

L_{A1} – The L_{A1} level is the noise level which is exceeded for 1 percent (%) of the sample period. During the sample period, the noise level is below the L_{A1} level for 99% of the time.

L_{Aeq} – The equivalent continuous sound level (L_{Aeq}) is the energy average of the varying noise over the sample period and is equivalent to the level of a constant noise which contains the same energy as the varying noise environment. This measure is also a common measure of environmental noise and road traffic noise.

RBL – The Rating Background Level for each period is the median value of the Assessment Background Level values for the period over all of the days measured. There is therefore an RBL value for each period **–** daytime, evening and night-time.

Typical Graph of Sound Pressure Level vs Time



1 INTRODUCTION

This assessment has been prepared for Cristal Mining Australia Limited (Cristal Mining) to address potential noise impacts associated with the proposed Atlas-Campaspe Mineral Sands Project (the Project). The Project includes the development of a mineral sands mining operation (herein referred to as the Atlas-Campaspe Mine), together with the construction and operation of a rail loadout facility located near the township of Ivanhoe (herein referred to as the Ivanhoe Rail Facility).

The proposed Atlas-Campaspe Mine is located approximately 80 kilometres (km) north of Balranald, New South Wales (NSW) and 270 km south-east of Broken Hill, NSW (**Figure 1-1**). The proposed Ivanhoe Rail Facility is located approximately 135 km north-east of the proposed Atlas-Campaspe Mine, and is approximately 4.5 km to the south-west of the township of Ivanhoe (**Figure 1-1**).

1.1 Objectives of this Study

The primary objective of this study is to assess the potential noise impacts associated with the Project by addressing the Director-General's Requirements (DGRs) issued by the NSW Department of Planning and Infrastructure (DP&I) on 19 March 2012, outlined as follows:

Noise & Vibration *– including a quantitative assessment of potential:*

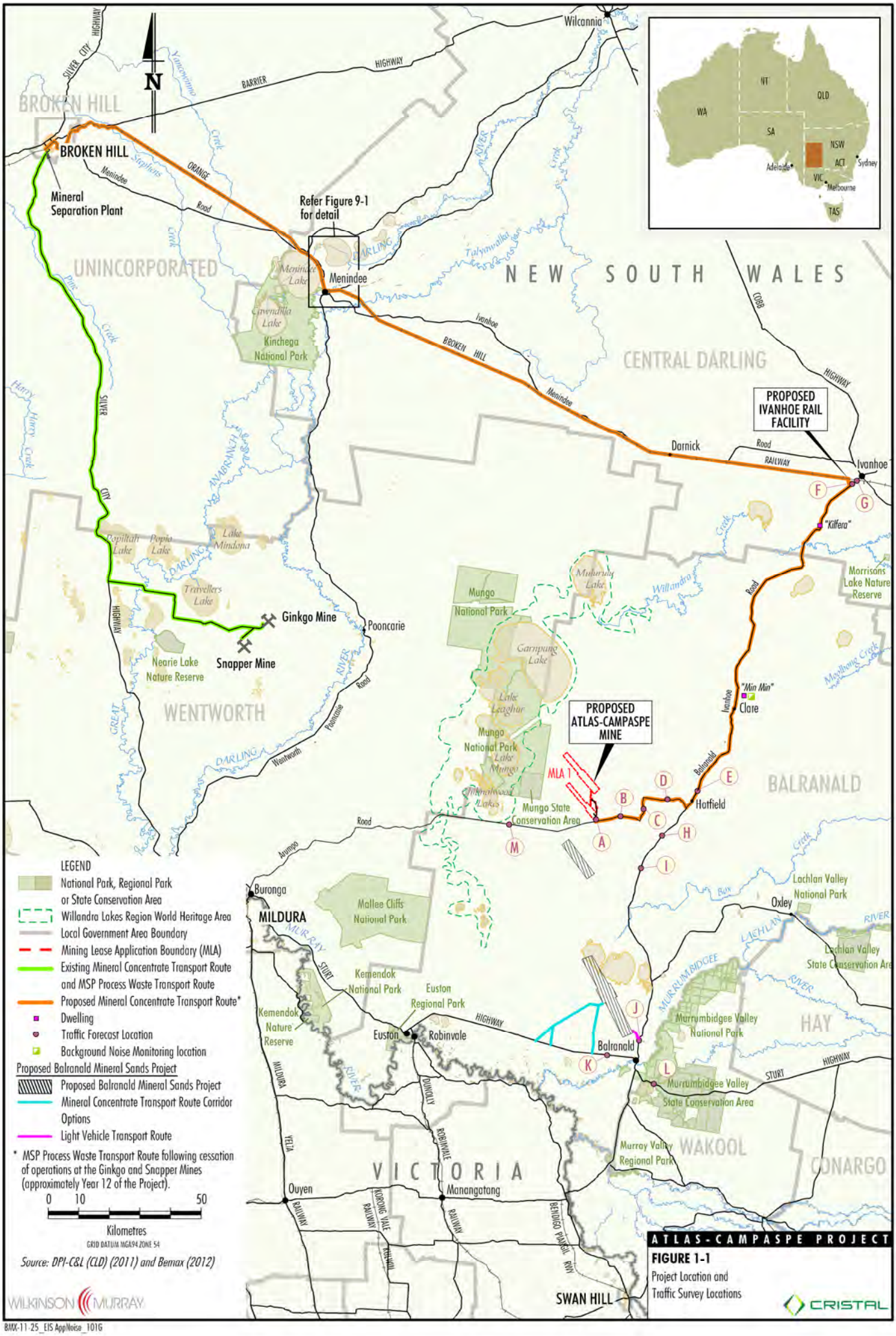
- *construction, operational and transport noise impacts;*
- *reasonable and feasible mitigation measures, including evidence that there are no such measures available other than those proposed; and*
- *monitoring and management measures, in particular real-time, attended noise monitoring and predictive meteorological forecasting;*

The NSW Environment Protection Authority (EPA) have also outlined their agency comments for the Noise Assessment. These comments, and the sections they are addressed in, are outlined in **Table 1-1**.

Table 1-1 – EPA Agency Comments

Comment	Section
The goals of the project should include design, construction, operation and maintenance of plant and equipment in accordance with relevant EPA policy, guidelines and criteria, and in order to minimise potential impacts from noise.	6.2
We expect that potential noise sources are assessed in accordance with the 'NSW Industrial Noise Policy' (EPA, 2000), and where required mitigation measures are proposed (e.g. appropriate equipment chosen to minimise noise levels).	6.1 and 6.2
All residential or noise sensitive premises likely to be impacts by the development must be identified and included in the assessment.	3
The proposed development will result in increased traffic movements. The potential noise impacts associated with any traffic increases need to be assessed in accordance with the 'NSW Road Noise Policy' (EPA, 2011).	8

The proposed Atlas-Campaspe Mine does not include any blasting as such vibration and overpressure from blasting has not been assessed. Vibration impacts, if any, could be attributed to truck and rail transportation which has been assessed in Section 10 of this report.


BROKEN HILL
Mineral Separation Plant
Refer Figure 9-1 for detail
Menindee
Wilcannia
UNINCORPORATED
NEW SOUTH WALES
CENTRAL DARLING
WENTWORTH
BALRANALD
MILDURA
VICTORIA
WAKOOL
HAY
CONARGO
Kinchega National Park
Ginkgo Mine
Snapper Mine
Pooncarie
Nearie Lake Nature Reserve
PROPOSED IVANHOE RAIL FACILITY
Darnick
Ivanhoe
"Killara"
Morrisons Lake Nature Reserve
"Min Min"
Clare
PROPOSED ATLAS-CAMPASPE MINE
MLA 1
Mungo National Park
Mungo State Conservation Area
Hattfield
Balranald
Buronga
Mallee Cliffs National Park
Kemendok National Park
Kemendok Nature Reserve
Euston Regional Park
Euston
Robinvale
Ouyen
Manangatang
Swan Hill
Lachlan Valley National Park
Lachlan Valley State Conservation Area
Murrumbidgee Valley National Park
Murrumbidgee Valley State Conservation Area
Murray Valley Regional Park
A
B
C
D
E
F
G
H
I
J
K
L
M
LEGEND
National Park, Regional Park or State Conservation Area
Willandra Lakes Region World Heritage Area
Local Government Area Boundary
Mining Lease Application Boundary (MLA)
Existing Mineral Concentrate Transport Route and MSP Process Waste Transport Route
Proposed Mineral Concentrate Transport Route*
Dwelling
Traffic Forecast Location
Background Noise Monitoring location
Proposed Balranald Mineral Sands Project
Proposed Balranald Mineral Sands Project
Mineral Concentrate Transport Route Corridor Options
Light Vehicle Transport Route
* MSP Process Waste Transport Route following cessation of operations at the Ginkgo and Snapper Mines (approximately Year 12 of the Project).
0 10 50
Kilometres
GRID DATUM MGA94 ZONE 54
Source: DPI-C&L (CLD) (2011) and Bemax (2012)
WILKINSON MURRAY
ATLAS-CAMPASPE PROJECT
FIGURE 1-1
Project Location and Traffic Survey Locations
CRISTAL
BMX-11-25_EIS AppNoise_101G

2 PROJECT OVERVIEW

2.1 General Description

The Project would involve two main development components (**Figure 1-1**):

1. Construction and development of infrastructure for mining operations at the Atlas and Campaspe deposits (the proposed Atlas-Campaspe Mine).
2. Construction and operation of the Ivanhoe Rail Facility (the proposed Ivanhoe Rail Facility).

The Project General Arrangements are shown on **Figures 2-1** and **2-2**.

A detailed description of the Project is provided in Section 2 in the Main Report of the Environmental Impact Statement (EIS).

The proposed life of the Project is approximately 20 years, commencing approximately 1 July 2013, or upon the grant of all required approvals.

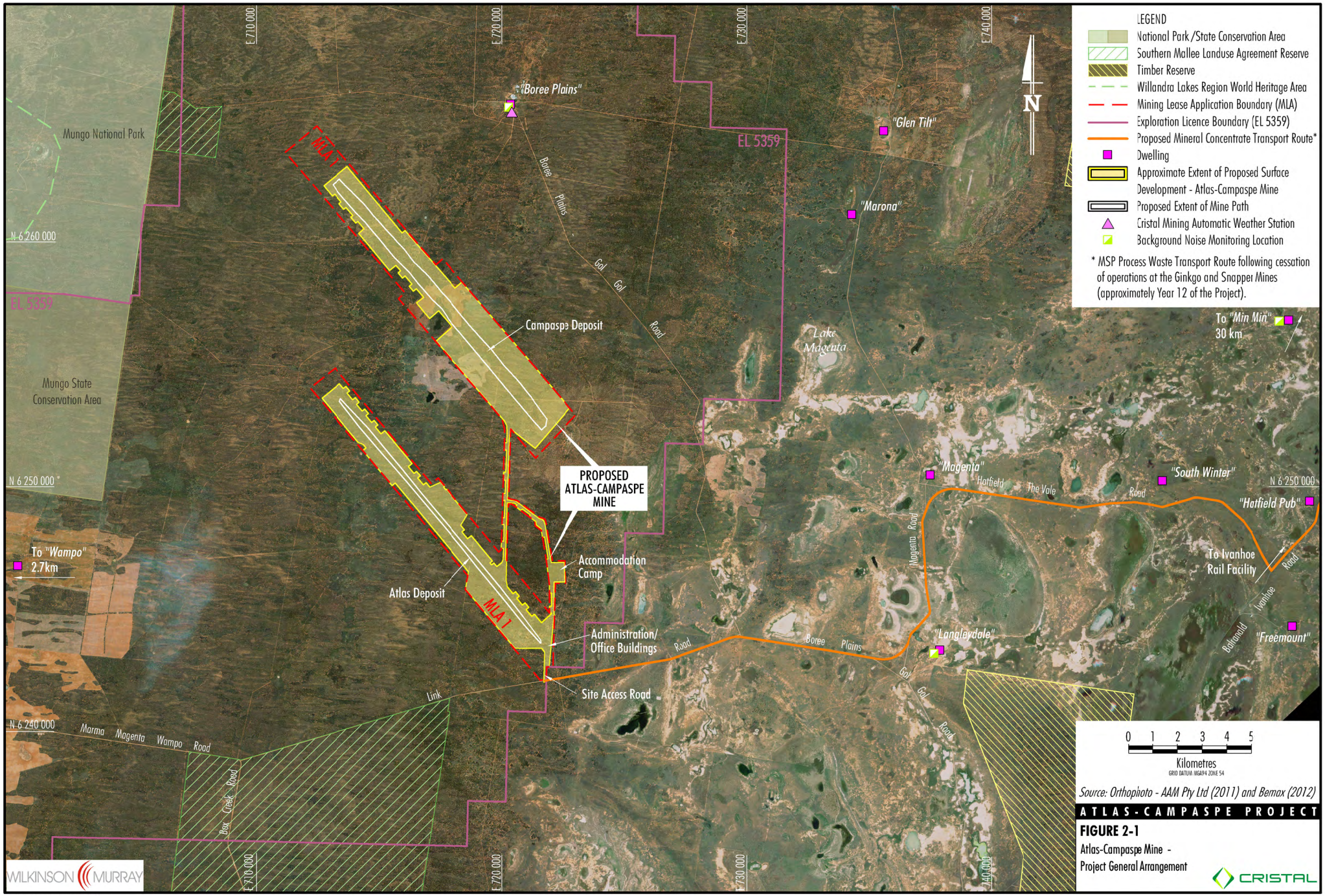
The activities associated with the two main development components of the Project are summarised below.

Atlas-Campaspe Mine

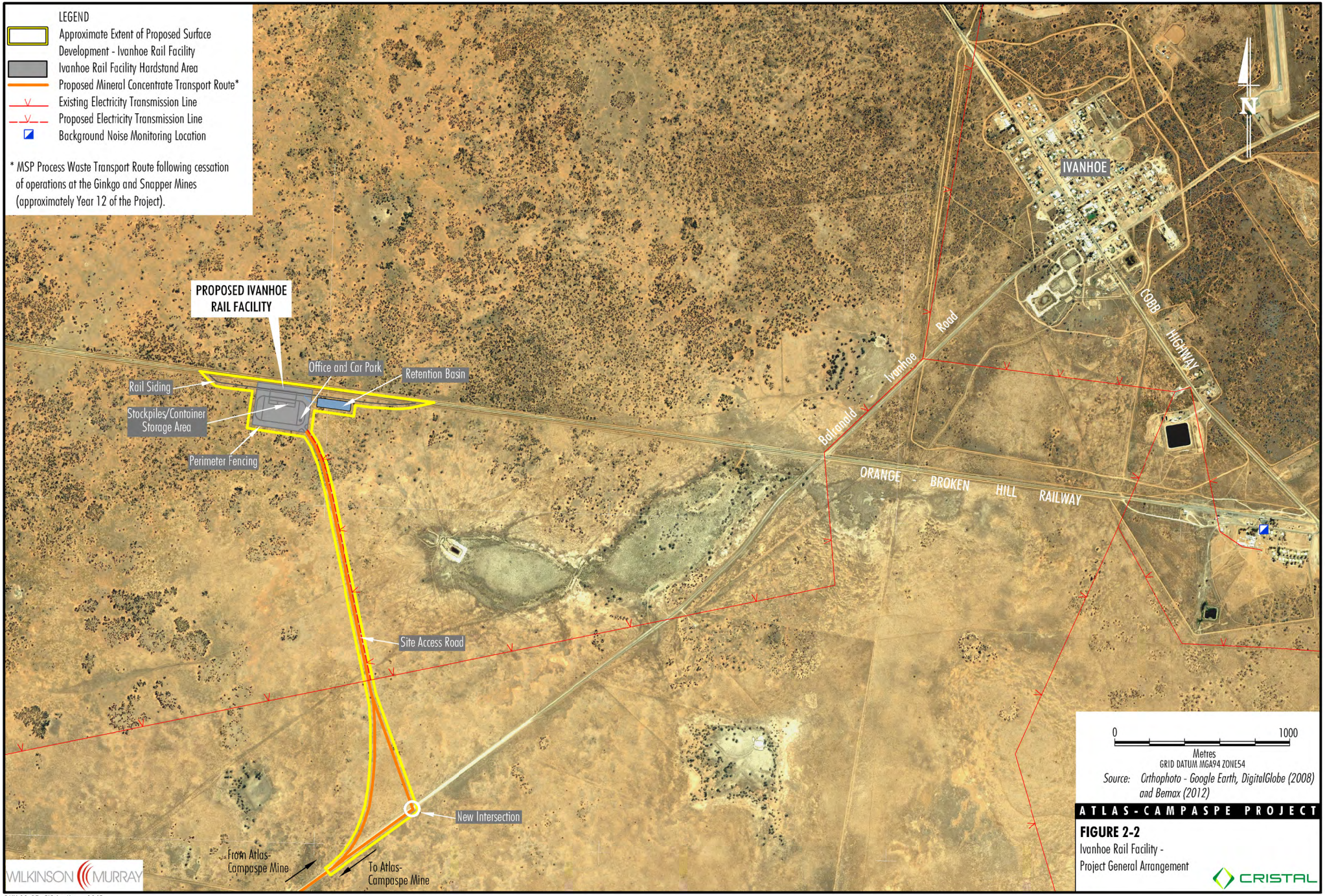
- ongoing exploration activities;
- sequential development and operation of two separate mineral sands ore extraction areas within the Mining Lease Application 1 area;
- use of conventional mobile equipment to mine and place mineral sands ore into dry mining unit(s)[1] (DMU) at a maximum ore production rate of up to 7.2 million tonnes per annum;
- mineral processing infrastructure including the primary gravity concentration unit, salt washing facility and a wet high intensity magnetic separation (WHIMS) circuit;
- mineral concentrate stockpiles and materials handling infrastructure (e.g. towers and stackers);
- progressive backfilling of mine voids with overburden behind the advancing ore extraction areas or in overburden emplacements adjacent to the mine path;
- placement of sand residues and coarse rejects (and Broken Hill Mineral Separation Plant [MSP] process wastes[2]) following mineral processing to either the active mining area (behind the advancing ore extraction area) or in sand residue dams;
- development of a groundwater borefield at the Atlas deposit and localised dewatering systems (bores, spearfields and trenches) at both the Atlas and Campaspe deposits, including associated pump and pipeline systems;
- reverse osmosis (RO) plant to supply the salt washing facility and potable water;

[1] Mining would use conventional open pit methods and would not involve dredge mining.

[2] Following cessation of operations at the Ginkgo and Snapper Mines (approximately Year 12 of the Project).



BMX-11-25_EIS AppNoise_103F



ATLAS-CAMPASPE PROJECT

FIGURE 2-2

Ivanhoe Rail Facility - Project General Arrangement

BMX-11-25_EIS AppNoise_104E

- progressive development of water storage dams, sediment basins, pumps, pipelines and other water management equipment and structures;
- administration/office buildings, car parking facilities, workshop and stores;
- on-site accommodation camp;
- sewage treatment plant;
- diesel powered generators, electricity distribution station and associated internal electricity transmission lines;
- site access road, internal access roads and haul roads;
- roadworks along the proposed mineral concentrate transport route to the Ivanhoe Rail Facility;
- transport of mineral concentrates along the mineral concentrate transport route to the Ivanhoe Rail Facility;
- road transport of MSP process waste[3] in sealed storage containers from the Ivanhoe Rail Facility to the Atlas-Campaspe Mine for subsequent unloading, stockpiling and placement behind the advancing ore extraction areas;
- development of soil stockpiles and laydown areas;
- monitoring and rehabilitation; and
- other associated minor infrastructure, plant, equipment and activities.

Ivanhoe Rail Facility

- development of a rail siding for:
  - loading of train wagons with mineral concentrate for rail transport to the MSP via the Orange - Broken Hill Railway; and
  - unloading of MSP process waste in sealed storage containers (transported via the Orange - Broken Hill Railway) from train wagons[3];
- site access road and internal haul roads/pavements;
- hardstand areas for mineral concentrate and MSP process waste[3] unloading, stockpiling/sealed container storage and loading;
- a retention basin, drains, pumps, pipelines and other water management equipment and structures;
- site office and car parking facilities;
- extension to existing 11 kilovolt (kV) powerline;
- monitoring, landscaping and rehabilitation; and
- other associated minor infrastructure, plant, equipment and activities.

[3] Following cessation of operations at the Ginkgo and Snapper Mines (approximately Year 12 of the Project).

2.2 Project Construction/Development Activities

Construction activities at the Atlas-Campaspe Mine would be undertaken up to 24 hours per day, seven days per week. Construction activities associated with roadworks along the mineral concentrate transport route and Ivanhoe Rail Facility would be undertaken on a campaign basis during daytime hours only. The initial construction period (Year 1 of the Project) would be focussed on the development of the following Project infrastructure components:

- Atlas-Campaspe Mine:
  - site access roads and internal access roads;
  - on-site accommodation camp and sewage treatment plant;
  - water supply infrastructure (including groundwater borefield, RO plant and associated pump and pipeline systems);
  - power supply infrastructure (including diesel generators, electricity distribution station and transmission lines);
  - fixed infrastructure areas (including administration/office buildings and car parking facilities, workshop and stores, services corridor and laydown areas);
  - DMU assembly;
  - mineral processing infrastructure (including primary gravity concentration unit, salt washing facility and WHIMS);
  - materials handling infrastructure (including pumps and pipelines for mineral sands ore, heavy mineral concentrate (HMC) and process wastes, and towers and stackers for stockpiling mineral concentrates); and
  - off-path sand residue dams and process water storages.
- Roadworks along the mineral concentrate transport route including sections of:
  - Link Road;
  - Boree Plains - Gol Gol Road;
  - Magenta Road; and
  - Hatfield - The Vale Road.
- Ivanhoe Rail Facility:
  - a rail siding;
  - site access road and internal haul roads/pavements;
  - hardstand areas, including stockpiles/container storage areas;
  - a retention basin, drains, pumps, pipelines and other water management equipment and structures;
  - site office, ablutions and car parking facilities;
  - perimeter fencing;
  - night-lighting;
  - extension to existing 11 kV powerline; and
  - landscaping, including retention of existing vegetation along the site access road.

It should be noted that further construction activities would be undertaken during Year 5 of operations, however, these activities would not require any material additional mobile fleet or workforce.

2.3 Mining Operations

Project mining operations would be conducted 24 hours per day, seven days per week.

Mining at the Atlas-Campaspe Mine would commence with the development of an initial excavation at the south-eastern end of the Atlas deposit and then progress in a north-westerly direction during Years 2 to 5 of the Project.

Mining of the Campaspe deposit at the Atlas-Campaspe Mine would commence once mining within the Atlas footprint is complete. Initial development would commence at the south-eastern end of the Campaspe deposit in approximately Year 5 and mining would progress in a north-westerly direction during Years 6 to 20.

Progressive vegetation clearing and soil stripping would be undertaken ahead of the advancing mining operation, and would typically be conducted using a fleet of dozers, scrapers and water trucks.

Excavators, dozers and front end loaders would be used to remove overburden ahead of the advancing ore extraction areas. Haul trucks would be used to transport the overburden to either behind the advancing ore extraction areas or to overburden emplacements adjacent to the mine path[4].

Approximately 109 million tonnes of ore would be extracted throughout the life of the Project. The maximum mineral concentrate production rate from the Atlas deposit would be approximately 546,000 tonnes per annum (tpa), while the Campaspe deposit would be approximately 434,000 tpa.

A fleet of dozers and loaders would typically be used to place ore into a DMU, located within the ore extraction area. At the DMU, the mineral sands ore would be slurried, screened and pumped to the primary gravity concentration unit for on-site processing.

Primary separation of the valuable minerals from ore would occur in the primary gravity concentration unit. The HMC recovered by the primary gravity concentration unit would be processed further at the HMC treatment facility.

The HMC would be washed with desalinated water (from the RO plant) in the salt washing facility prior to processing in the WHIMS circuit. The WHIMS circuit is a preliminary treatment stage which separates the HMC into ilmenite-rich, leucoxene-rich and non-magnetic (containing rutile-rich and zircon-rich) mineral concentrates.

A full description of on-site mineral processing is provided in Section 2 in the Main Report of the EIS.

The mine path behind the advancing ore extraction area would be progressively rehabilitated.

[4] Mining would not involve blasting.

2.4 Mineral Concentrate and MSP Process Waste Road Transport

Mineral concentrate produced at the Atlas-Campaspe Mine would be transported via road approximately 175 km from the Atlas-Campaspe Mine to the Ivanhoe Rail Facility. The mineral concentrate would be transported in road trains[5].

Road transport of mineral concentrate would be undertaken 24 hours per day, seven days per week.

Up to a maximum 24 haulage vehicle trips (i.e. 48 haulage vehicle movements) per day would be required, with approximately 19 haulage vehicle trips (i.e. 38 haulage vehicle movements) per day on average over the life of the Project.

From approximately Year 12 of the Project, MSP process waste in sealed containers would be unloaded from trains at the Ivanhoe Rail Facility, and temporarily held in a designated area prior to loading onto haulage vehicles for the return trip to Atlas-Campaspe Mine. Therefore no additional haulage movements for the MSP process waste, in addition to the mineral concentrate haulage vehicle movements, would be required for the Project.

A maximum of approximately 50,000 tpa of MSP process waste would be disposed of at the Atlas-Campaspe Mine.

2.5 Rail Loading and Transport

A summary of the unloading, stockpiling and rail loading operations is provided below.

Unloading and Stockpiling

Haulage vehicles would enter the Ivanhoe Rail Facility via the access road off the Balranald-Ivanhoe Road. A turn-around loop at Ivanhoe Rail Facility would enable the haulage vehicles to turn-around, unload and exit using the same access road.

Mineral concentrate emptied from the haulage vehicles would be dumped directly onto mineral concentrate stockpiles within the hardstand area.

Loading of Train Wagon Containers

A front end loader would be used to reclaim mineral concentrate from the stockpiles at the Ivanhoe Rail Facility and load directly into containers on train wagons. A forklift would be used to remove and replace covers on the train wagons.

Based on train lengths of up to 600 m, a maximum of three trains per week would be required over the life of the Project. No more than one train load of mineral concentrate from the Atlas-Campaspe Mine would be railed to the MSP in any 24 hour period. Rail transport movements would be scheduled to occur at any time once loading is completed (i.e. 24 hours per day, seven days per week).

[5] Type 1 road train, as defined by the NSW Roads and Maritime Services (RMS), 2012.

From approximately Year 12 of the Project, MSP process waste in sealed containers would be unloaded from trains at the Ivanhoe Rail Facility prior to returning to the Atlas-Campaspe Mine. No additional rail movements for MSP process waste would be required (i.e. would be backloaded on the mineral concentrate train).

3 NOISE RECEIVER LOCATIONS

This section presents the identified receiver locations for both the Atlas-Campaspe Mine and Ivanhoe Rail Facility. Potential road and rail noise receivers are described in **Section 8.3** and **Section 9.2**, respectively.

3.1 Atlas-Campaspe Mine

A total of six residential receivers surrounding the Atlas-Campaspe Mine were identified within approximately 17.5 km (**Table 3-1**). The location of these receivers is shown on **Figure 2-1**.

Table 3-1 Spatial Information of Receiver Locations – Atlas-Campaspe Mine

Receiver No.	Property	Approximate distance from closest point of the mine site (m)	Easting	Nothing
1	Wampo	17,000	697143	6246702
2	Boree Plains	7,000	720369	6265623
3	Magenta	15,000	737487	6250484
4	Langleydale	18,000	737882	6243327
5	Glen Tilt	17,000	735584	6264556
6	Marona	14,000	734268	6261142

Note: Coordinates provided in MGA Zone 54

In addition to the receivers noted above, the following potentially sensitive land uses are located to the west of the Atlas-Campaspe Mine (**Figure 1-1**):

- Mungo National Park – located approximately 5 km west.
- Mungo State Conservation Area – located approximately 8 km west.
- Willandra Lakes Region World Heritage Area – located approximately 10 km west.

3.2 Ivanhoe Rail Facility

The closest residential receivers to the Ivanhoe Rail Facility are associated with the Ivanhoe Township, including two isolated dwellings located on the Cobb Highway to the south-east of the township and the dwellings associated with the Warakirri Correctional Centre (**Table 3-2**).

Figure 2-2 illustrates the identified receiver locations relative to the Ivanhoe Rail Facility.

Table 3-2 Spatial Information of Receiver Locations – Ivanhoe Rail Facility

Receiver No.	Description	Approximate distance from closest point of the Ivanhoe Rail Facility (m)	Easting	Northing
1	Ivanhoe Township	4,500	247277	6356492
2	Residences on the Cobb Highway	5,300	248151	6355799
3	Residences proximal to the Ivanhoe (Warakirri) Correctional Centre	5,500	248346	6354918

Note: Coordinates provided in MGA Zone 55

4 EXISTING ACOUSTIC ENVIRONMENT & NOISE CRITERIA

4.1 Background Noise Levels

Unattended ambient noise monitoring was conducted, using environmental noise loggers, in order to characterise the existing noise environment of the Project (in relation to both the construction and operational noise assessments). Environmental noise monitoring was completed at three representative locations surrounding the Atlas-Campaspe Mine (Boree Plains, Langleydale and Min Min) and one location at Ivanhoe (32 Mitchell Street, Ivanhoe).

The locations of unattended noise monitoring sites are presented on **Figure 1-1**, **Figure 2-1** and **Figure 2-2**. The results of the monitoring are presented in Attachment A.

These locations were selected based consideration of other noise sources which may adversely influence measurements, security issues for the equipment and ease of access.

The monitoring periods for the Atlas-Campaspe Mine and Ivanhoe Rail Facility are below:

- **Atlas-Campaspe Mine:** From Tuesday, 15 November to Wednesday, 30 November 2011.
- **Ivanhoe Rail Facility:** From Thursday, 14 April to Thursday, 19 April 2012.

All noise measurement instrumentation used in the surveys was designed to comply with the requirements of Australian Standard 1259.2-1990 "Acoustics – Sound Level Meters. Part 2: Integrating – Averaging" and carried appropriate and current National Association of Testing Authorities calibration certificates. The equipment used for the continuous unattended noise surveys comprised Acoustic Research Laboratories Type EL-215 and Type EL-316 Environmental Noise Loggers.

The calibration of the loggers was checked prior to, and following, each measurement survey and the variation in calibration was found not to exceed 0.5 decibels (dB) at any location.

All noise loggers were set to record statistical noise descriptors in continuous 15-minute sampling periods for the duration of the monitoring.

The noise logger deployed at Langleydale malfunctioned during the course of monitoring and the recorded data was found to be corrupted. The data recorded at this location was therefore discarded.

Table 4-1 presents the background noise levels derived from the ambient noise data for the purpose of establishing operational noise criteria.

These are expressed in terms of the Rating Background Level (RBL), which is a measure of background noise defined in the NSW *Industrial Noise Policy* (INP), (EPA, 2000).

Table 4-1 Measured Background Noise levels

Location	Site	Monitoring Period	RBL, dBA		
			Day	Evening	Night
Boree Plains	Atlas-Campaspe Mine	15/11/2011 to 30/11/2011	28	27	24
Min Min		15/11/2011 to 26/11/2011	25	25	25
32 Mitchell Street Ivanhoe	Ivanhoe	12/04/2012 to 19/04/2012	28	29	25

dBA = A-weighted decibel

4.2 Operational Noise Criteria

The INP recommends two criteria, "Intrusiveness" and "Amenity", both of which are relevant for the assessment of noise. In most situations, one of these is more stringent than the other and becomes the dominating noise criteria. The criteria are based on the equivalent continuous noise level (L_{Aeq}) noise descriptor, which is explained in the Glossary of Acoustic Terms. While the intrusiveness criterion is based on a typical worst case 15 minute period, the amenity criterion is expressed as an $L_{Aeq,period}$ noise level over the whole assessment period considered (day, evening or night).

Intrusiveness Criterion

The INP stipulates that *the background noise levels to be measured are those that are present at the time of the noise assessment and without the subject development operating.*

The intrusiveness criterion is then established by adding 5 dBA to the background noise levels. Monitoring of the ambient noise level surrounding the Atlas-Campaspe Mine and Ivanhoe Rail Facility was conducted to determine the background noise level (**Section 4.1**). In accordance with the INP, where the RBL is found to be less than 30 dBA (**Section 4.1**) the RBL is set to 30 dBA. Therefore, the resulting intrusiveness criteria for the Project would be 35 dBA for all residential receiver locations.

Amenity Criterion

The amenity criterion considers noise levels from all industrial sources (excluding traffic noise) including existing industrial noise sources and the Project. It is designed to protect amenity levels for different types of residential receiver areas (i.e. suburban, rural, etc.).

Where noise levels from existing industrial sources are close to or above the acceptable levels, the amenity criterion would incorporate a sliding scale to set limits which prevents overall noise levels exceeding the acceptable level due to the addition of a new noise source.

The potentially affected residences near the Atlas-Campaspe Mine are in an area which would be classified as "rural" and as such the relevant recommended "acceptable" amenity criteria are 50 dBA, 45 dBA and 40 dBA $L_{Aeq,period}$ for daytime, evening and night-time periods, respectively.

The potentially affected residences in the Ivanhoe township, residences on the Cobb Highway and residences at the Warakirri Correctional Centre, would be classified as "suburban" (based on the township zoning of these areas under the Central Darling Local Environmental Plan) and as such the relevant recommended "acceptable" amenity criteria are 55 dBA, 45 dBA and 40 dBA $L_{Aeq,period}$ for daytime, evening and night-time periods, respectively.

The INP also stipulates additional criterion for different types of receiver, including schools and churches. The Ivanhoe Central School is located within the township of Ivanhoe and would be subject to a recommended "acceptable" amenity criterion of 35 dBA for the noisiest 1-hour period whilst in use (internal). Internal noise levels are generally 10 dBA below external noise levels with windows open to a normal extent. The INP would therefore imply a recommended external noise level of L_{Aeq} 45 dBA at the school.

In addition, the INP recommends further criterion for recreational areas. As outlined in **Section 3.1**, the Atlas-Campaspe Mine is located approximately 5 km and 8 km east of the Mungo National Park and Mungo State Conservation Area, respectively. These potential receivers would be classified as an "area specifically reserved for passive recreation" and as such the relevant recommended "acceptable" amenity criterion is 50 dBA when in use.

Table 4-2 presents a summary of the relevant operational noise criteria.

Table 4-2 Project Criteria Summary

Receiver Area	Time Period	Intrusiveness Criterion $L_{Aeq,15min}$ (dBA)	Amenity Criterion* $L_{Aeq,period}$ (dBA)
Nearest residential receivers around the Atlas-Campaspe Mine	Daytime (7.00 am–6.00 pm)	35	50
	Evening (6.00 pm–10.00 pm)	35	45
	Night-time (10.00 pm–7.00 am)	35	40
Nearest residential receivers in Ivanhoe or residences on the Cobb Highway or Ivanhoe (Warakirri) Correctional Centre	Daytime (7.00 am–6.00 pm)	35	55
	Evening (6.00 pm–10.00 pm)	35	45
	Night-time (10.00 pm–7.00 am)	35	40
Ivanhoe Central School	Noisiest 1-hour period when in use	-	45#
Mungo National Park/Mungo State Conservation Area	When in Use	-	50

* Recommended acceptable.

\# External criterion, assuming a 10 dB loss for an open window.

The intrusiveness noise criteria are the most stringent criteria and as such are used as project-specific noise criteria. Therefore an $L_{Aeq,15min}$ noise criterion of 35 dBA is applicable for all identified receivers surrounding the Atlas-Campaspe Mine and the Ivanhoe Rail Facility.

4.3 Sleep Disturbance Criterion

To help protect residents from sleep disturbance, the EPA recommends that 1-minute L_{A1} noise levels (effectively, the maximum noise level [$L_{A,max}$]) should not exceed the background noise level (assessed by the RBL) by more than 15 dBA when measured or predicted at the location of a building façade. The "sleep disturbance" criterion is only applicable to night-time (10.00 pm to 7.00 am) operations.

On the basis that the RBL in the area around the Atlas-Campaspe Mine and the Ivanhoe Rail Facility can be assumed to be 30 dBA, the sleep disturbance criterion when assessed external to the residence is 45 dBA $L_{A1,1min}$.

5 METEOROLOGY

At relatively large distances from a source the resultant noise levels from a noise source will be influenced by meteorological conditions, specifically:

- wind; and
- temperature gradients.

Wind can increase noise at a receiver when it blows from the direction of the noise source at relatively low wind speeds (below 3 metres per second [m/s]). An increase in wind strength greater than 3 m/s generally results in a corresponding increase in wind noise at the receiver which masks noise from the source under investigation.

Temperature inversions (positive temperature gradients) can increase noise levels at surrounding receivers by the reflection of sound waves from warmer upper layers of air. Temperature inversions occur predominantly at night.

In assessing noise impacts, the criteria are expected to apply under weather conditions that would be expected to occur at a particular site for a significant period of time.

The INP describes two approaches for assessing these effects; the simple and the more detailed approach.

The simple approach forgoes a detailed analysis of meteorological data and simply applies given default meteorological parameters to predict noise levels. This approach assumes that meteorological effects are present for a significant amount of time, avoiding the need to quantify these effects in detail. It is conservative, in that it is likely to predict the upper range of increases in noise levels due to meteorological conditions.

The more detailed approach involves an analysis of meteorological data to determine whether inversions and/or wind effects are significant features warranting assessment. Where assessment is warranted, default parameters are available for use in predicting noise or where preferred, measured values maybe used instead.

Cristal Mining has installed an automatic weather station (AWS) at the Atlas-Campaspe Mine (**Figure 2-1**), however, the dataset available from the AWS is not yet sufficient for use as part of the assessment. The following sections provide a summary of the synthetic site-specific meteorological data for both the Atlas-Campaspe Mine and the Ivanhoe Rail Facility as presented in the Air Quality and Greenhouse Gas Assessment (Appendix K of the EIS) (Katestone Environmental Pty Ltd, 2013).

5.1 Wind

Figures 5-1 and **5-2** show seasonal windroses for the Atlas-Campaspe Mine and the Ivanhoe Rail Facility, respectively. For both sites the highest frequencies of winds generally occur from the south and southwest.

Figure 5-1 Seasonal Wind Roses for the Atlas-Campaspe Mine (Katestone Environmental, 2013)

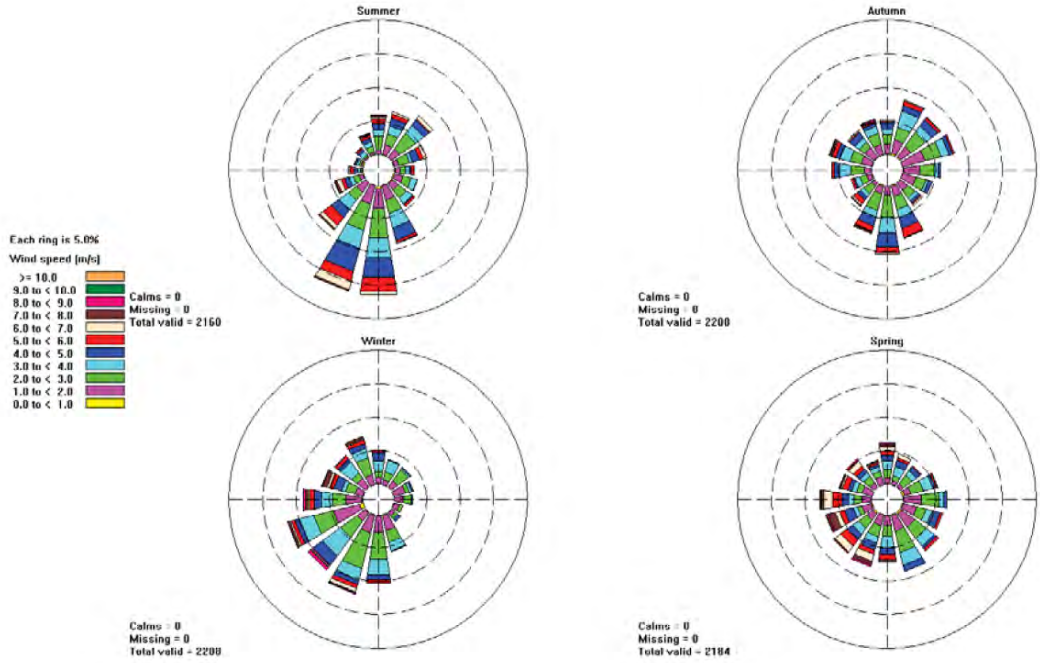
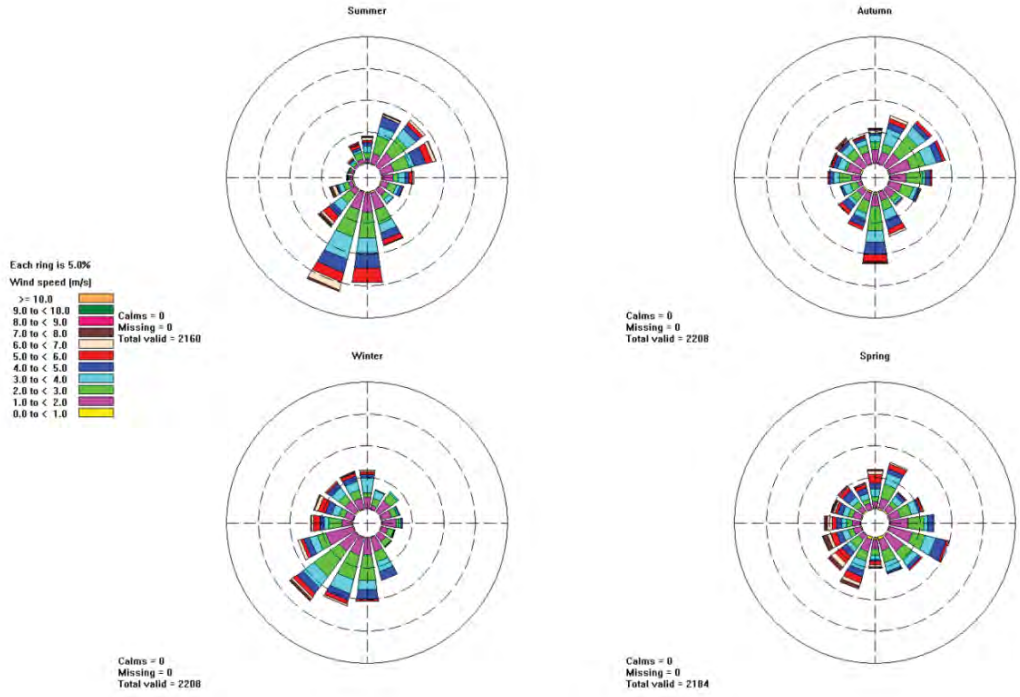


Figure 5-2 Seasonal Wind Roses for the Ivanhoe Rail Facility (Katestone Environmental, 2013)



Figures 5-1 and **5-2** indicate that the winds at the Atlas-Campaspe Mine and Ivanhoe Rail Facility are similar, and can be considered predominantly moderate. **Figures 5-1** and **5-2** also show that approximately 50 percent (%) of winds are between 2 and 4 m/s, with little seasonal variation.

5.2 Temperature Inversion

Pasquill-Gifford stability conditions indicate the potential for temperature inversions. There are seven stability classes referred to as A to G. The predicted frequencies of occurrence of stability class are shown in **Tables 5-1** and **5-2** for the Atlas-Campaspe Mine and for the Ivanhoe Rail Facility, respectively.

Pasquill-Gifford stability conditions A to D indicate lapse conditions (negative temperature gradient). Pasquill-Gifford stability conditions E to G indicate temperature inversion conditions, E indicating a temperature gradient of between -0.5 and 1.5 degrees Celsius (^{o}C)/100 m, F indicating a temperature gradient of between 1.5 and 4^{o}C/100 m and G indicating a temperature gradient greater than 4^{o}C/100 m.

Table 5-1 Distribution of Atmospheric Stability Categories for the Atlas-Campaspe Mine

Stability	Percentage Occurrence
A	1.3
B	7.9
C	18.2
D	28.9
E	11.3
F/G	32.4

Table 5-2 Distribution of Atmospheric Stability Categories for the Ivanhoe Rail Facility

Stability	Percentage Occurrence
A	1.5
B	8.6
C	19.1
D	26.8
E	9.4
F/G	34.6

Stability Classes F and G apply normally at night when winds are light and the sky is clear. Class E describe intermediate conditions between those described above.

There is a high percentage of D, E, F and G class conditions for both areas (**Tables 5-1** and **5-2**), reflecting a prevalence of stable meteorological conditions.

5.3 Meteorological Conditions Used for Noise Assessment Purposes

Noise levels experienced by a receiver at relatively large distances from a source can vary considerably under different meteorological conditions, particularly at night. Prevailing wind and air temperature gradients will change over the course of the night-time period; hence noise levels at receivers will change even when the source noise level is constant.

The Project area is located in an arid/semi arid area that has annual average rainfall of less than 500 millimetres. For such conditions, the INP recommends the following default meteorological conditions that enhance noise levels:

- Strong (G-class stability category) inversions:

  8^{o}C/100 m inversion strength and source-to-receiver drainage flow wind of 1 m/s.

- Gradient wind:

  Source-to-receiver gradient wind of 3 m/s.

Comparison of the synthesised wind and temperature inversion conditions with the INP default conditions indicates that the INP default meteorological conditions provide a worst case scenario in terms of enhancement of operational noise due to meteorological factors.

Therefore INP default meteorological parameters have been used to predict noise levels at each receiver. It is a conservative approach, in that it is likely to predict the upper range of increases in noise levels due to meteorological conditions.

6 NOISE ASSESSMENT

6.1 Noise Modelling Methodology

Operational noise levels at the identified receiver locations have been calculated using the Environmental Noise Model (ENM) predictive software. This modelling software has been previously accepted by the NSW Office of Environment and Heritage (OEH) for use in environmental noise assessments.

Factors that are addressed in the modeling are:

- equipment sound level emissions and location;
- screening effects from buildings (if relevant);
- receiver locations;
- ground topography;
- noise attenuation due to geometric spreading;
- ground absorption; and
- atmospheric absorption.

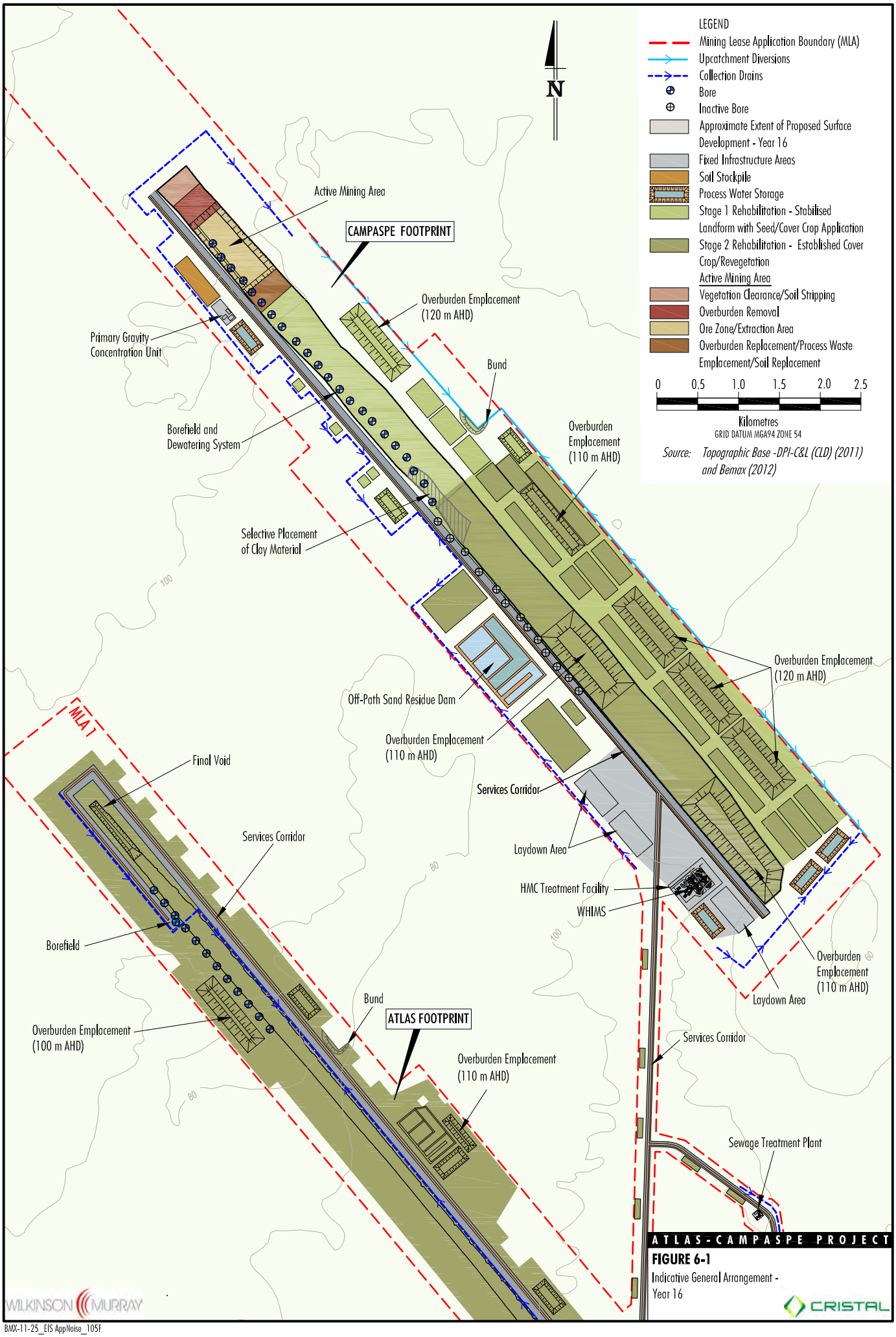
Information for the purpose of the noise modelling was provided by Cristal Mining. This includes description of infrastructure and mobile plant, location of equipment, hours of operation and topographical information.

6.1.1 Noise Assessment Scenarios

Operations at the Atlas-Campaspe Mine have been modelled for two scenarios, namely:

- An initial construction scenario (Year 1) where infrastructure would be built, DMU assembled, etc. The construction activities would be largely concentrated at the south-eastern end of the Atlas footprint. The mobile fleet would include construction specific items.
- A typical worst case operational scenario when all plant is working concurrently during Year 16. The major items of mobile fleet would be consistent throughout the life of the Project. As such, Year 16 of operations was chosen for modelling due to its proximity to the nearest residential receiver (Boree Plains). An indicative general arrangement for Year 16 of operations at the Atlas-Campaspe Mine is presented on **Figure 6-1**. The Atlas-Campaspe Mine would operate 24 hours a day with similar operations during daytime, evening and night-time.

Operations at the Ivanhoe Rail Facility have been modelled for a single worst case operational scenario which assumes all fleet is located on the loading pad (i.e. including a road train) which is closest to potential receivers and operating concurrently with two locomotives on the rail siding.



ATLAS-CAMPASPE PROJECT

FIGURE 6-1

Indicative General Arrangement - Year 16

WILKINSON MURRAY

CRISTAL

BMX-11-25_EIS AppNoise_105F

At times during the operation of the Ivanhoe Rail Facility, there would be occasions when more than one road train would be present on the site (e.g. one unloading and one parked, or one departing and one arriving on the site access road). Consideration was therefore given to modelling alternative scenarios including the movement of a road train on the site access road. However, as the site access road is generally located further away from potential receivers and the impact of an additional road train on the total site sound power level (SWL) would be modest, this does not require additional analysis given the setback distances to the nearest private receivers and the predicted impacts of all fleet items operating concurrently.

As outlined in **Section 2.2**, construction at the Ivanhoe Rail Facility is to take place on a campaign basis during daytime hours only (i.e. when strong inversion conditions are less likely to be present). It is anticipated that construction would require a fleet with a total SWL similar to that which has been modelled for 24 hour operations of the Ivanhoe Rail Facility (**Section 6.3.3**). Review of the results of the operations modelling indicates that there is no requirement for detailed modelling of construction noise given the distances from the nearest potential receivers and the restriction of construction activities to daytime only.

6.2 Investigation of Feasible and Reasonable Noise Mitigation Measures

This section details the investigation of noise mitigation measures undertaken for the Atlas-Campaspe Mine and the Ivanhoe Rail Facility.

6.2.1 Atlas-Campaspe Mine

Initial modelling of Year 1 and Year 16 predicted noise emissions at the Atlas-Campaspe Mine was undertaken assuming an unattenuated operational fleet which undergoes regular maintenance and is in good working order.

The initial modelling did not indicate any potential exceedances of the intrusiveness noise criterion at any of the surrounding receivers for Year 1 or Year 16, due to the significant distances between potential receivers and the Atlas-Campaspe Mine.

As the modelling for the Atlas-Campaspe Mine did not indicate a likely exceedance at any of the surrounding receivers, there is no justification for further investigation of noise mitigation measures (e.g. factory or retrofitted noise attenuation of operational fleet are not considered reasonable and feasible, as no exceedances are predicted at the significant setback distance to the nearest private receiver).

6.2.2 Ivanhoe Rail Facility

The Ivanhoe Rail Facility was originally proposed to be sited north of the Orange-Broken Hill Railway and east of Balranald-Ivanhoe Road, proximal to the Ivanhoe (Warakirri) Correctional Centre. This location was selected to take advantage of existing rail infrastructure.

Initial modelling of the operations at the proposed site of the Ivanhoe Rail Facility was undertaken using an unattenuated operational fleet. The results of this modelling indicated potential exceedances of intrusiveness noise criterion at the dwellings proximal to the Ivanhoe (Warakirri) Correctional Centre, sections of the Ivanhoe Township as well as a number of dwellings located on the Cobb Highway (**Figure 2-2**).

Several modelling iterations were undertaken to evaluate options to minimise potential noise levels at the receivers indicated above. These iterations included the following:

1. Implementation of restrictive operational scenarios, including the use of a single locomotive whilst operating at the Ivanhoe Rail Facility and minimisation of locomotive use at the eastern end of the rail siding.

2. Installation of noise bunding (approximately 4.5 m and up to 6 m high) on the southern side of the Orange-Broken Hill Railway to minimise noise impacts on sensitive receptors south of the proposed Ivanhoe Rail Facility.

3. Installation of noise bunding (approximately 6 m high) on the northern extent of the proposed Ivanhoe Rail Facility to minimise noise impacts on sensitive receptors to the north and north-east.

4. Installation of additional locomotive turning points which would allow locomotive to remain behind the noise bunding outlined in points 2 and 3, above.

5. Restriction of Ivanhoe Rail Facility operations to daytime only.

The construction of a shed which enclosed the Ivanhoe Rail Facility was also considered as a potential means of minimising operational noise from the Ivanhoe Rail Facility.

Analysis of the scenarios outlined above indicated that a combination of the above mitigation measures may have been able to reduce the operational noise levels to acceptable levels.

Notwithstanding, Cristal Mining's evaluation of these potential noise mitigation options indicated that these potential measures were not reasonable or feasible. The results of this preliminary noise modelling as well as results of other environmental studies (see Section 6 in the Main Report of the EIS) resulted in the relocation of the Ivanhoe Rail Facility to a location that is some 4.5 km from Ivanhoe, and hence minimises potential operational noise emissions at the nearest private receivers.

It is noted that the relocation of the Ivanhoe Rail Facility also minimises potential road traffic noise in the vicinity of Ivanhoe by removing the need for road trains to cross the Orange-Broken Hill Railway and enter the area proximal to private receivers.

6.3 Plant, Fleet List and Sound Power Levels

6.3.1 Atlas-Campaspe Mine Construction Plant and Fleet – Year 1

Table 6-1 shows the indicative major operational and construction mobile and fixed equipment for the Atlas-Campaspe Mine relevant to Year 1 (i.e. the plant with potential to contribute to noise levels at the receiver locations) and the modelled SWL associated with each item.

Table 6-1 Sound Power Levels and Proposed Equipment – Year 1

Equipment	Construction No. of Units	L_{Aeq} SWL (dBA)	Source
Backhoe (CAT 330B)	1	102	WM Measurements
Bobcat	1	97	WM Measurements
Bus (Toyota Coaster)	2	109	WM Measurements
Road Roller/Compactor (CAT 825G)	2	109	WM Measurements
Scraper (Water Cart) (CAT 740)	1	115	WM Measurements
Grader (CAT 16G)	2	108	WM Measurements
Front End Loader (IT62G)	1	113	WM Measurements
Crane (GROVE RT650E/ LIEBHERR LTM 1100)	4	105	WM Measurements
Mobile Fuel Tank (MACK)	1	109	WM Measurements
1,000 kVA Generators	4	98	WM Measurements
Scraper / Laser Bucket (Case STX 535/ New Holland t9060)	9	115	WM Measurements
Dozer (CAT D11)	3	116	WM Measurements
Excavator (EX 1900/PC1800)	3	114	WM Measurements
Haul Truck (CAT 777D)	12	115	WM Measurements
Water Truck (CAT 773)	2	115	WM Measurements
Service Truck (MACK)	1	109	WM Measurements
Maintenance Truck (Isuzu)	1	109	WM Measurements
Lighting Tower (ALL Light)	8	103	WM Measurements
Garbage Truck	1	109	WM Measurements
Electric Pump	4	103	WM Measurements
Sewage Treatment Plant	1	97	WM Measurements
Accommodation Block	1	102	WM Measurements

WM Measurements = Wilkinson Murray Measurements

kVA = kilovolt-ampere

6.3.2 Atlas-Campaspe Mine Operational Plant and Fleet

Table 6-2 shows the indicative major operational mobile and fixed equipment for the Atlas-Campaspe Mine relevant to mining operations (i.e. the plant with potential to contribute to noise levels at the receiver locations) and the modelled SWL associated with each item.

Table 6-2 Sound Power Levels and Proposed Equipment – Years 2-20

Equipment	No. of Units	L_{Aeq} SWL (dBA)	Source
Dozer (CAT D11)	4	116	WM Measurements
Excavator (EX1900/PC1700)	4	114	WM Measurements
Scraper (Water Cart) (CAT740)	1	115	WM Measurements
Front End Loader (CAT990)	3	113	WM Measurements
Front End Loader (CAT IT62G)	1	113	WM Measurements
Grader (CAT 16G)	2	108	WM Measurements
Road Roller/Compactor (CAT 825G)	1	109	WM Measurements
Front End Loader (CAT980H)	2	111	WM Measurements
Water Truck (CAT 773)	2	115	WM Measurements
1,000 kVA generators	4	98	WM Measurements
Haul Truck (CAT 777D)	12	115	WM Measurements
Scraper (Laser Bucket) (Case STX535/New Holland t9060)	9	115	WM Measurements
DMUs	2	112	Holmes Air Sciences (2007)
Primary Gravity Concentration Unit	1	103	Holmes Air Sciences (2007)
Electric Pumps	16	103	Holmes Air Sciences (2007)
Truck (Kenworth T650)	2	109	WM Measurements
Bobcat	1	97	WM Measurements
Bus (Toyota Coaster)	2	109	WM Measurements
Crane (GROVE RT650E/ LIEBHERR LTM 1100)	1	105	WM Measurements
Mobile Fuel Tank (MACK)	1	109	WM Measurements
Service Truck (MACK)	1	109	WM Measurements
Maintenance Truck (Isuzu)	1	109	WM Measurements
Lighting Tower (ALL Light)	8	103	WM Measurements
Garbage Truck (International 8 m^3)	1	109	WM Measurements
Sewerage Treatment plant	1	97	WM Measurements
Accommodation Block	1	102	WM Measurements

6.3.3 Ivanhoe Rail Facility Operational Fleet

Table 6-3 outlines the indicative Ivanhoe Rail Facility equipment relevant to this noise assessment (i.e. the plant with potential to contribute to noise levels at the receiver locations) and the modelled SWL.

Table 6-3 Sound Power Levels and Proposed Equipment – Ivanhoe Rail Facility

Equipment	No. of Units	L_{Aeq} SWL (dBA)	Source
Front End Loader (Cat 988)	1	114	WM Measurements
Truck (Kenworth T650)	1	109	WM Measurements
Forklift (Hyster 12 to 16 tonne)	1	106	WM Measurements
Locomotive (81 class Locomotive)	2	109	WM Measurements

7 PREDICTED NOISE LEVELS FROM THE PROJECT

This section presents the predicted noise levels at the identified receivers for the Atlas-Campaspe Mine, the Ivanhoe Rail Facility and potential cumulative noise impacts.

7.1 Atlas-Campaspe Mine

7.1.1 Predicted Noise Levels for Year 1 (Construction)

Table 7-1 presents the predicted Year 1 noise levels at the identified receiver locations surrounding the Atlas-Campaspe Mine.

Table 7-1 Predicted L_{Aeq} Noise Levels – Atlas-Campaspe Mine – Year 1

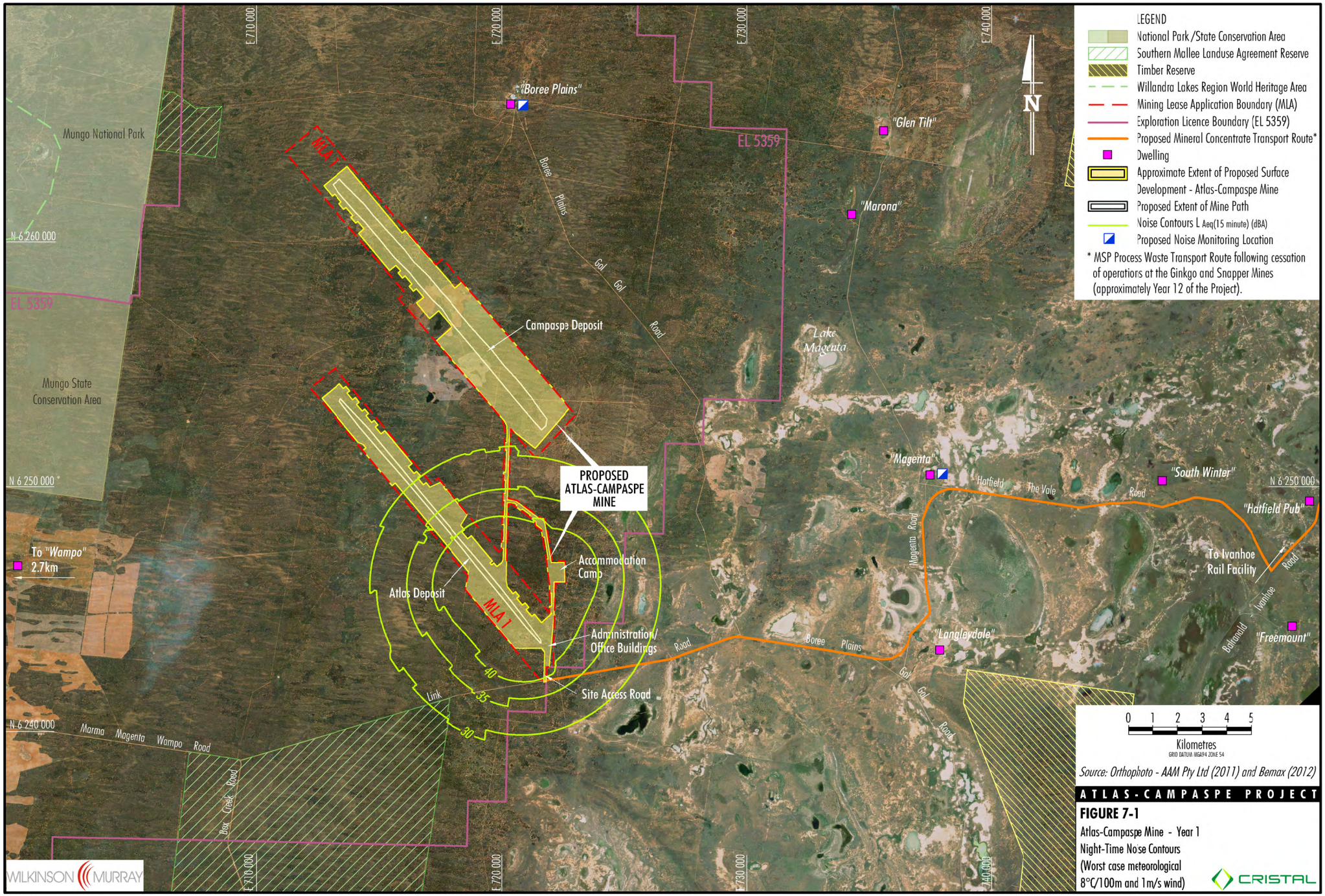
Receiver No.	Property	Calm Meteorological Conditions	Worst Case Meteorological Gradient Wind of 3 m/s Predicted L_{Aeq} Noise Level (dBA)	Worst Case Meteorological 8°C/100 m Inversion Strength and 1 m/s Wind Source to Receiver Predicted L_{Aeq} Noise Level (dBA)
1	Wampo	<10	<10	<10
2	Boree Plains	<10	<10	<10
3	Magenta	<10	<10	<10
4	Langleydale	<10	<10	<10
5	Glen Tilt	<10	<10	<10
6	Marona	<10	<10	<10

The Year 1 noise levels for the Atlas-Campaspe Mine comply with Project-specific noise criteria of 35 dBA for all modelled receivers.

Worst case Year 1 night-time noise contours for 8°C/100 m inversion strength and 1 m/s wind are presented in **Figure 7-1**.

7.1.2 Predicted Noise Levels for Year 16

Table 7-2 presents the predicted Year 16 noise levels at the receiver locations surrounding the Atlas-Campaspe Mine.



BMX-11-25_EIS AppNoise_106E

Table 7-2 Predicted L_{Aeq} Noise Levels – Atlas-Campaspe Mine – Year 16

Receiver No.	Property	Calm Meteorological Conditions	Worst Case Meteorological Gradient Wind of 3 m/s Predicted L_{Aeq} Noise Level (dBA)	Worst Case Meteorological 8°C/100 m Inversion Strength and 1 m/s Wind Source to Receiver Predicted L_{Aeq} Noise Level (dBA)
1	Wampo	<10	<10	<10
2	Boree Plains	16	27	28
3	Magenta	<10	<10	<10
4	Langleydale	<10	<10	<10
5	Glen Tilt	<10	<10	<10
6	Marona	<10	<10	<10

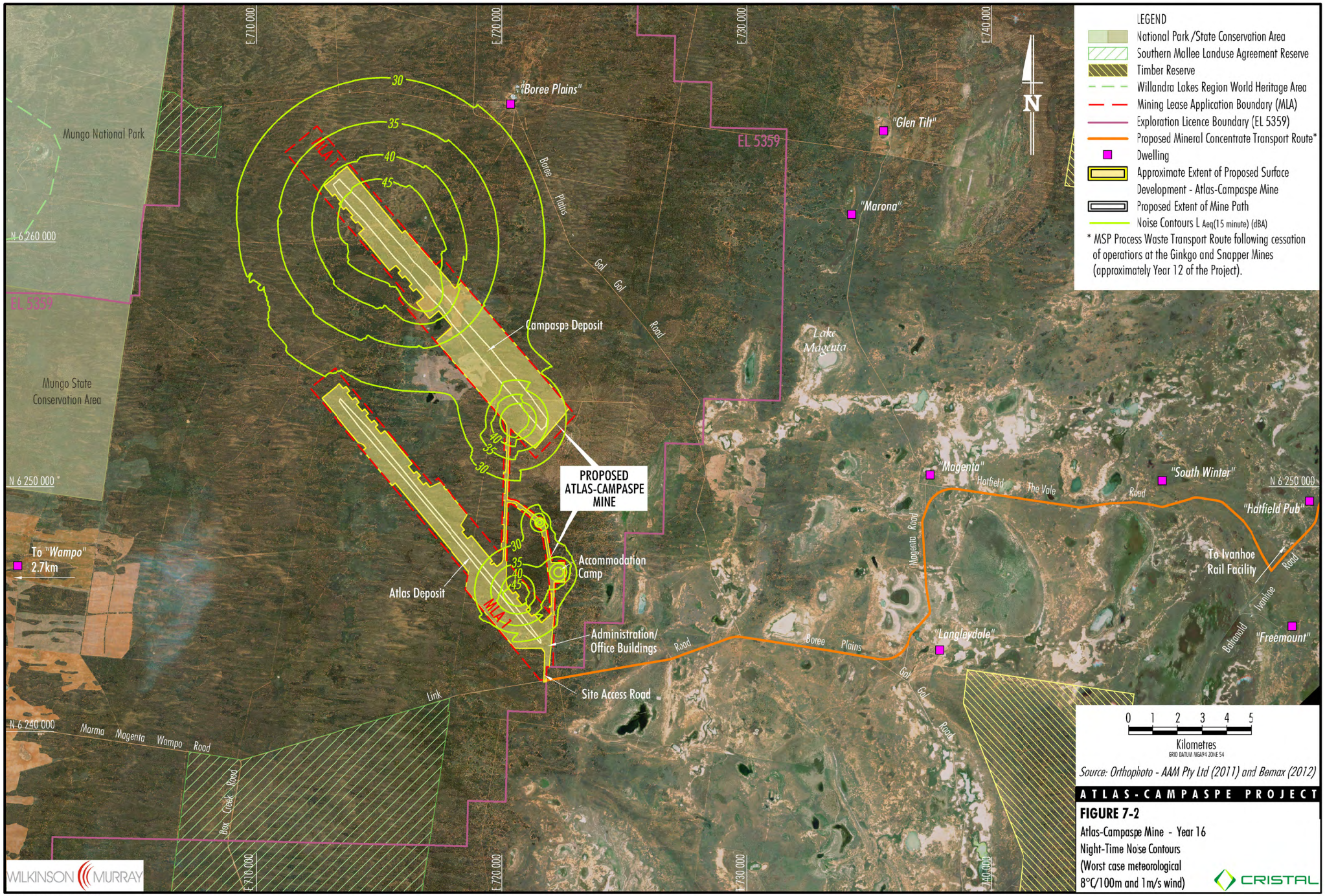
Based on the Year 16 modelling, noise levels associated with the Atlas-Campaspe Mine would readily comply with Project-specific noise criteria of 35 dBA for all modelled receivers for the life of the Atlas-Campaspe Mine.

Worst case Year 16 night-time noise contours for 8°C/100 m inversion strength and 1 m/s wind are presented in **Figure 7-2**.

As outlined in **Section 3.1**, the Mungo National Park and Mungo State Conservation Area lie approximately 5 km and 8 km west of the Atlas-Campaspe Mine, respectively. Figure 7-2 indicates that the 45 dBA noise contour associated with operations at the Atlas-Campaspe Mine would propagate approximately 2 km from the active mining area to the west and north-west under worst-case meteorological conditions.

Given the potential noise levels attributable to the Atlas-Campaspe Mine, it is anticipated that the resulting noise levels at the boundary of the Mungo National Park and Mungo State Conservation Area would readily comply with the relevant amenity criteria of 50 dBA for an "area specifically reserved for passive recreation". Worst case operational noise emissions at Mungo National Park and Mungo State Conservation Area (i.e. in Year 20 when mining operations would be located in closest proximity) would be less than 20 dBA and would likely be inaudible in most instances.

The Willandra Lakes Region World Heritage Area is located approximately 10 km west of the Atlas-Campaspe Mine. The potential noise levels at the Willandra Lakes Region World Heritage Area are also expected to readily comply with the relevant amenity criteria of 50 dBA given the significant setback distance from the Atlas-Campaspe Mine. Worst case operational noise emissions at Willandra Lakes Region World Heritage Area (i.e. in Year 20 when mining operations would be located in closest proximity) would be less than 15 dBA and would likely be inaudible in most instances.



BMX-11-25_EIS AppNoise_102F

7.2 Ivanhoe Rail Facility

Table 7-3 presents the predicted operational noise levels at the receiver locations surrounding the Ivanhoe Rail Facility.

Table 7-3 Predicted L_{Aeq} Noise Levels – Ivanhoe Rail Facility

Receiver No.	Description	Calm Meteorological Conditions	Worst Case Meteorological Gradient Wind of 3m/s Predicted LAeq Noise Level (dBA)	Worst Case Meteorological 8°C/100 m Inversion Strength and 1 m/s Wind Source to Receiver Predicted LAeq Noise Level (dBA)
1	Ivanhoe Township	14	20	21
2	Residences on the Cobb Highway	11	17	18
3	Residences proximal to the Warakirri Correctional Centre	11	17	18

Review of the predicted noise levels presented in **Table 7-3** indicates compliance with the Project-specific noise criteria of 35 dBA for all modelled receivers.

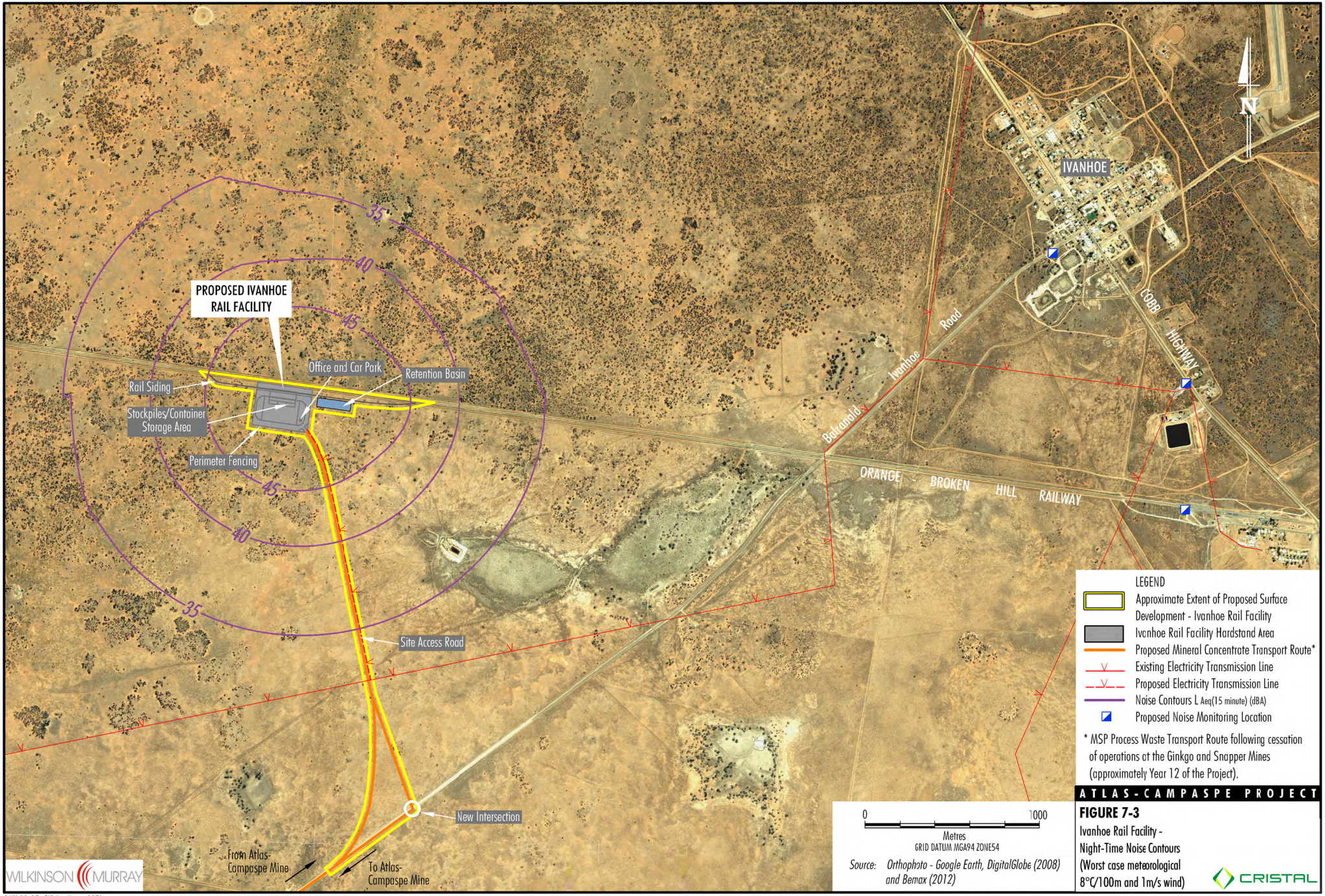
Worst case night-time noise contours for 8°C/100 m inversion strength are presented in **Figure 7-3**.

Figure 7-3 indicates that the 35 dBA operational noise contour would not propagate as far as the Ivanhoe township. As such, it is anticipated that the Ivanhoe Central School would easily comply with the external amenity criterion of 45 dBA for the noisiest 1-hour period whilst in use.

7.3 Potential for Sleep Disturbance

The noise models were also used to analyse potential L_{Amax} noise levels likely to arise from night-time operations at the Atlas-Campaspe Mine and the Ivanhoe Rail Facility. The instantaneous noise sources and their typical L_{Amax} SWLs that may have the potential to disturb sleep can be summarised as follows:

- Plant reversing alarms 115 dBA L_{Amax}
- Dozer track noise 120 dBA L_{Amax}
- Engine noise as trucks pass at-grade 118 dBA L_{Amax}
- Engine noise as trucks ascend inclines 121 dBA L_{Amax}



ATLAS-CAMPASPE PROJECT

FIGURE 7-3

Ivanhoe Rail Facility - Night-Time Noise Contours (Worst case meteorological 8°C/100m and 1m/s wind)

CRISTAL

BMX-11-25_EIS AppNoise_107J

In addition to the above, occasional or intermittent noise from the Ivanhoe Rail Facility associated with the operation of the freight trains is likely to consist of noise from rail shunting. Indicative SWLs from previous Wilkinson Murray measurements for shunting activities are 118 dBA L_{Amax}.

Whilst these L_{Amax} noise levels would not significantly affect overall L_{Aeq} noise emissions, they are used to assess the potential for sleep disturbance.

These L_{Amax} noise level predictions were modelled for both Atlas-Campaspe Mine and Ivanhoe Rail Facility sites using the same plant locations used for the modelling of operational noise impacts. The predictions are based on a typical adverse weather condition 8^{o}C/100 m inversion strength and source-to-receiver drainage flow wind of 1 m/s.

Modelling of L_{Amax} noise levels at nearby receivers for both Atlas-Campaspe Mine and Ivanhoe Rail Facility sites was undertaken for typical instantaneous noise sources, such as reversing alarms. This analysis indicates that predicted noise levels would comply comfortably with the 45 dBA $L_{A1,1\ min}$ criterion at all privately owned receivers.

7.4 Cumulative Impacts

It is noted that Iluka Resources Limited lodged a Project Application and Project Scoping Report for the Balranald Mineral Sands Project (SSD-5285) (EMGA Mitchell McLennan, 2012) with the DP&I.

While the Balranald Mineral Sands Project is not approved and no detailed noise modelling results are available for the proposal, consideration to the cumulative impacts is provided below. The Project Scoping Report for the Balranald Mineral Sands Project indicates that mining of the West Balranald and Nepean deposits would be undertaken in series. Whilst mining is being undertaken at the Atlas deposit, operations at the Balranald Mineral Sands Project would be focussed on the West Balranald deposit (approximately 45 km south of the Atlas deposit). By the time operations at the Balranald Mineral Sands Project progress to the Nepean deposit (northern-most deposit) Project mining operations would be focussed at the Campaspe deposit.

The Balranald Mineral Sands Project would be operating at its northern-most extent during Year 11 of operations at the Atlas-Campaspe Mine. This would result in a distance between the operational ore extraction areas of the Atlas-Campaspe Mine and the Balranald Mineral Sands Project (Nepean deposit) of approximately 21 km.

Figure 7-1 indicates that the worst case operational noise contour of 35 dBA resulting from the Atlas-Campaspe Mine would extend no further than approximately 4.5 km south from the Atlas-Campaspe Mine active mining area.

Given the above, it is anticipated that no cumulative noise impact would occur from the coincident construction or operation of the Project and the Balranald Mineral Sands Project.

7.5 Noise Monitoring

It is noted that the DGRs suggest the implementation of real-time, attended noise monitoring and predictive meteorological forecasting. Given the predicted absence of noise impacts at receivers, it is not considered reasonable to implement real-time monitoring for the Project. Instead it is proposed to implement a half yearly attended noise monitoring regime at receiver locations along the mineral concentrate transport route and at the Ivanhoe Rail Facility. Proposed monitoring locations are shown on **Figure 7-1** and **Figure 7-3**. The need for half yearly attended monitoring would be reviewed following 2 years of monitoring along the mineral concentrate transport route and at the Ivanhoe Rail Facility.

In addition to the monitoring outlined above, it is also proposed to conduct half yearly attended noise monitoring at the nearest residential receiver (Boree Plains) during Years 14 – 18 (i.e. when mining operations are nearest the receiver). The need for half yearly attended monitoring would be reviewed following 5 years of monitoring at the nearest residential receiver.

As outlined in **Section 5.3**, modelling has been undertaken assuming worst-case meteorological conditions. Given that the results of modelling do not suggest any likely exceedance of the relevant criteria for all Project operations, and noting that it is unlikely for worst-case meteorological conditions to occur for extended periods, the implementation of predictive meteorological forecasting is considered unwarranted for the Project given its remote location from potential receivers.

8 ROAD TRAFFIC NOISE

8.1 Introduction

Construction and operation of the Project would result in an increase in the traffic volumes on public roads in the Project area. It is for this reason that a traffic noise assessment has been undertaken to determine potential noise impacts resulting from increased traffic flows on public roads in the area. The results of this traffic noise assessment are presented in the sub-sections below.

As outlined in **Section 2.4**, mineral concentrate would be hauled via road approximately 175 km from the Atlas-Campaspe Mine to the Ivanhoe Rail Facility. The mineral concentrate would be transported in road trains[6].

Road transport of mineral concentrate would be undertaken 24 hours per day, seven days per week.

In addition to the transport of mineral concentrates, the construction and operation of the Project would result in an increased rate of vehicular activity on the roads surrounding the Project which is attributable to both deliveries and employee travel.

8.2 Road Traffic Noise Criteria

Criteria for assessment of noise from traffic on public roads are set out in the NSW *Road Noise Policy* (RNP). The relevant criteria are set out in **Table 8-1**.

Table 8-1 Criteria for Traffic Noise – Residences

Type of Development	Noise Level Criterion	
	Day (7.00 am-10.00 pm)	**Night (10.00 pm-7.00 am)**
Existing residences affected by **additional traffic** on existing freeways/arterial/sub-arterial roads generated by land use developments.	$L_{Aeq,15\ hour}$ 60 dBA	$L_{Aeq,9\ hour}$ 55 dBA
Existing residences affected by **additional traffic** on existing local roads generated by land use developments.	$L_{Aeq,1\ hour}$ 55 dBA	$L_{Aeq,1\ hour}$ 50 dBA

The RNP states:

> *In assessing feasible and reasonable mitigation measures, an increase of up to 2 dB represents a minor impact that is considered barely perceptible to the average person.*

The RNP defines daytime as 7.00 am to 10.00 pm and night-time as 10.00 pm to 7.00 am.

[6] Type 1 road train, as defined by RMS, 2012.

8.3 Road Traffic Impacts

The Road Transport Assessment (Appendix D of the EIS) concluded that no significant impacts on the performance, capacity, efficiency and safety of the road network are expected to arise as a result of the Project.

The Road Transport Assessment (Appendix D of the EIS) also projected the future traffic volumes on roads in the Project region for Year 1 and Year 20[7] of operations. These projections were based on traffic counts in the Project area (**Figure 1-1**).

Based on the projected traffic numbers in the Project region (**Table 8-2**), the closest residential receivers to the mineral concentrate transport route in the Project area have been selected to determine whether compliance with the criteria presented in **Table 8-1** can be achieved. These residences included:

- South Winter – approximately 1 km from Hatfield - The Vale Road (**Figure 2-1**);
- Magenta – approximately 0.8 km from Magenta Road (**Figure 2-1**);
- Langleydale – approximately 1.3 km from Magenta Road (**Figure 2-1**);
- Kilfera – approximately 1.5 km from Balranald-Ivanhoe Road (**Figure 1-1**); and
- Hatfield Pub – approximately 49 m from Balranald-Ivanhoe Road (**Figure 2-1**).

The classification of all public roads in the Project region relevant to this assessment is presented in **Table 8-2**.

In addition to the receivers presented above that are located on the mineral concentrate transport route, analysis of Traffic Forecast Location J (**Figure 1-1**) has also been undertaken. Traffic Forecast Location J represents the greatest potential cumulative impact of traffic from the Project and the Balranald Mineral Sands Project (particularly light vehicle movements).

[7] Year 20 projections include a conservative estimate of traffic generated by the Balranald Mineral Sands Project.

Table 8-2 Average Weekday Traffic Volumes

	Road	Road Type	Peak Hour						Daytime (7.00 am-10.00 pm)						Night-time (10.00 pm-7.00 am)					
			Non-Project		Project		Total		Non-Project		Project		Total		Non-Project		Project		Total	
			LV	HV	LV	HV	LV	HV	LV	HV	LV	HV	LV	HV	LV	HV	LV	HV	LV	HV
Existing																				
B	Link Road	Local	3	2	-	-	3	2	-	-	-	-	-	-	-	-	-	-	-	-
C	Magenta Road	Local	3	2	-	-	3	2	-	-	-	-	-	-	-	-	-	-	-	-
D	Hatfield-The Vale Road	Local	3	2	-	-	3	2	-	-	-	-	-	-	-	-	-	-	-	-
E	Balranald-Ivanhoe Road – North of Hatfield-The Vale Road	Sub-arterial	-	-	-	-	-	-	24	13	-	-	24	13	5	2	-	-	5	2
J	Balranald-Ivanhoe Road – South of BMSP	Sub-arterial	-	-	-	-	-	-	166	84	-	-	166	84	17	8	-	-	17	8
Year 1																				
B	Link Road	Local	3	2	114	5	117	7	-	-	-	-	-	-	-	-	-	-	-	-
C	Magenta Road	Local	3	2	114	5	117	7	-	-	-	-	-	-	-	-	-	-	-	-
D	Hatfield-The Vale Road	Local	3	2	114	5	117	7	-	-	-	-	-	-	-	-	-	-	-	-
E	Balranald-Ivanhoe Road – North of Hatfield-The Vale Road	Sub-arterial	-	-	-	-	-	-	55	14	34	1	89	15	5	3	34	1	39	4
J	Balranald-Ivanhoe Road – South of BMSP	Sub-arterial	-	-	-	-	-	-	341	90	80	4	421	94	211	10	80	4	291	14
Year 20																				
B	Link Road	Local	3	2	96	9	99	11	-	-	-	-	-	-	-	-	-	-	-	-
C	Magenta Road	Local	3	2	96	9	99	11	-	-	-	-	-	-	-	-	-	-	-	-
D	Hatfield-The Vale Road	Local	3	2	96	9	99	11	-	-	-	-	-	-	-	-	-	-	-	-
E	Balranald-Ivanhoe Road – North of Hatfield-The Vale Road	Sub-arterial	-	-	-	-	-	-	35	17	13	33	48	50	11	3	28	17	39	20
J	Balranald-Ivanhoe Road – South of BMSP	Sub-arterial	-	-	-	-	-	-	299	106	45	4	344	110	95	12	68	4	163	16

LV – Light vehicles; HV – Heavy vehicles; BMSP = Balranald Mineral Sands Project

8.3.1 Magenta Road

The closest residential receivers on Magenta Road are shown **Figure 2-1**. Based on the estimated traffic scenarios presented in **Table 8-2** calculated traffic noise levels at the closest residential receiver (Magenta residence which is approximately 0.8 km from Magenta Road) have been predicted and are presented in **Table 8-3**. If the predicted traffic noise levels at the Magenta residence meet the proposed criteria then the criteria would be met at all other receivers along the road.

Table 8-3 Calculated Traffic Noise Levels at the Magenta Residence on Magenta Road

	Existing	Year 1	Year 20
	$L_{Aeq,1\ hour}$ (Peak 1 hour) (dBA)	$L_{Aeq,1\ hour}$ (Peak 1 hour) (dBA)	$L_{Aeq,1\ hour}$ (Peak 1 hour) (dBA)
Non–Project Traffic Noise	25	25	25
Project Traffic Noise	-	38	37
Total	25	38	37
Criteria (Day/Night)		55/50	
Complies	Yes	Yes	Yes

The predicted traffic noise levels at the Magenta residence are well within both day and night-time road traffic noise criteria.

8.3.2 Hatfield - The Vale Road

The closest residential receivers on Hatfield-The Vale Road are shown **Figure 2-1**. Based on the estimated traffic scenarios presented in **Table 8-2** calculated traffic noise levels at the closest residential receiver (South Winter residence which is approximately 1 km from Hatfield-The Vale Road) have been predicted and are presented in **Table 8-4**. If the predicted traffic noise levels at the South Winter residence meet the proposed criteria then the criteria would be met at all other receivers along the road.

Table 8-4 Calculated Traffic Noise Levels at the South Winter Residence on Hatfield-The Vale Road

	Existing	Year 1	Year 20
	$L_{Aeq,1\ hour}$ (Peak 1 hour) (dBA)	$L_{Aeq,1\ hour}$ (Peak 1 hour) (dBA)	$L_{Aeq,1\ hour}$ (Peak 1 hour) (dBA)
Non–Project Traffic Noise	25	25	25
Project Traffic Noise	-	38	37
Total	25	38	37
Criteria (Day/Night)		55/50	
Complies	Yes	Yes	Yes

The predicted traffic noise levels at the South Winter residence are well within both day and night-time road traffic noise criteria.

8.3.3 Balranald-Ivanhoe Road

Kilfera

There are a number of residential receivers along Balranald-Ivanhoe Road, north of the intersection with Hatfield – The Vale Road, the closest occupied dwelling has been determined as the Kilfera residence which is located approximately 1.5 km from Balranald-Ivanhoe Road (**Figure 1-1**). Based on the estimated traffic scenarios presented in **Table 8-2** calculated traffic noise levels at the Kilfera residence have been predicted and are presented in **Table 8-5**. If the predicted traffic noise levels at the Kilfera residence meet the proposed criteria then the criteria would be met at all other receivers along the road.

Table 8-5 Calculated Traffic Noise Levels at the Kilfera Residence on Balranald-Ivanhoe Road

	Existing	Year 1	Year 20
	$L_{Aeq,15\ hour}/L_{Aeq,9\ hour}$ (Day/Night) (dBA)	$L_{Aeq,15\ hour}/L_{Aeq,9\ hour}$ (Day/Night) (dBA)	$L_{Aeq,15\ hour}/L_{Aeq,9\ hour}$ (Day/Night) (dBA)
Non–Project Traffic Noise	<25/<25	<25/<25	<25/<25
Project Traffic Noise	-	<25/<25	<25/<25
Total	<25/<25	<25/<25	<25/<25
Criteria (Day/Night)		60/55	
Complies	Yes	Yes	Yes

The predicted traffic noise levels at the Kilfera residence are well within the road traffic noise criteria.

Hatfield Pub

Hatfield Pub is approximately 49 m from Balranald-Ivanhoe Road (**Figure 2-1**). Hatfield Pub is currently unoccupied. However, conservatively assuming it is a residential receiver and based on the estimated traffic scenarios presented in **Table 8-2** calculated traffic noise levels are presented in **Table 8-6**.

Table 8-6 Calculated Traffic Noise Levels at the Hatfield Pub on Balranald-Ivanhoe Road

	Existing	Year 1	Year 20
	$L_{Aeq,15\ hour}/L_{Aeq,9\ hour}$ (Day/Night) (dBA)	$L_{Aeq,15\ hour}/L_{Aeq,9\ hour}$ (Day/Night) (dBA)	$L_{Aeq,15\ hour}/L_{Aeq,9\ hour}$ (Day/Night) (dBA)
Non–Project Traffic Noise	39/39	40/34	42/42
Project Traffic Noise	-	34/40	39/42
Total	39/39	41/41	44/42
Criteria (Day/Night)		60/55	
Complies	Yes	Yes	Yes

The predicted traffic noise levels at the Hatfield Pub are also well within the road traffic noise criteria for residential receivers.

Balranald-Ivanhoe Road – South of the proposed Balranald Mineral Sands Project

As outlined in **Section 8.3**, Traffic Count Location J represents the greatest potential cumulative impact of light vehicle traffic from the Project and the Balranald Mineral Sands Project. As such, an assessment of road traffic related noise has been undertaken to determine the anticipated noise levels as a result of potential cumulative increased traffic volumes (particularly light vehicle movements) presented in **Table 8-2**. These noise levels have been evaluated against the compliance with the criteria outlined in **Table 8-1**.

The results of this analysis are presented in **Table 8-7**.

Table 8-7 Calculated Traffic Noise Levels at Traffic Count Location J on Balranald-Ivanhoe Road

	Existing	Year 1	Year 20
	$L_{Aeq,15\ hour}/L_{Aeq,9\ hour}$ (Day/Night) (dBA)	$L_{Aeq,15\ hour}/L_{Aeq,9\ hour}$ (Day/Night) (dBA)	$L_{Aeq,15\ hour}/L_{Aeq,9\ hour}$ (Day/Night) (dBA)
Cumulative Non–Project Traffic	55/46	56/42	56/50
Project Traffic Noise	-	44/49	48/47
Cumulative Non–Project Traffic Plus Project Traffic	55/46	56/54	56/52
Criteria (Day/Night)		60/55	
Complies	Yes	Yes	Yes

The results presented in **Table 8-7** indicate that the relative increase in traffic noise level resulting from the Project related traffic movements at Traffic Count Location J is likely to be less than 2 dB. The RNP states that *an increase of up to 2 dB represents a minor impact that is considered barely perceptible to the average person.*

Assuming that all estimated Project traffic at Traffic Count Location J travels south along Balranald-Ivanhoe Road and disperses along the Sturt Highway (**Figure 1-1**), Project related traffic would result in an imperceptible increase (i.e. less than 2dB) in road noise levels at all potential receivers along Balranald-Ivanhoe Road. The Project contributions to traffic noise on the Sturt Highway would be less than on Balranald-Ivanhoe Road due to higher baseline traffic volumes on the Sturt Highway. It is therefore expected that Project related traffic movements would also result in an imperceptible impact on potential road noise receivers along the Sturt Highway.

9 RAIL NOISE

Mineral concentrates and MSP process waste[8] would be railed between the Ivanhoe Rail Facility and the MSP via the Orange-Broken Hill Railway (**Figure 1-1**).

9.1 Rail Noise Criteria

The relevant section of the Orange-Broken Hill Railway is operated by Australian Rail Track Corporation (ARTC).

Noise emissions from railways operated by ARTC are regulated via ARTC's Environment Protection Licence (EPL) 3142. EPL Section L6 does not nominate specific environmental noise limits but notes that:

> *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.*

In addition, the EPA's rail noise requirements *"Environmental Assessment Requirements for Rail Traffic – Generating Developments"* (OEH, 2012a) provides rail noise assessment criteria which are presented in **Table 9-1**.

Table 9-1 EPA Rail Noise Assessment Trigger Levels

Descriptor	Rail Traffic Noise Goal
$L_{Aeq,24\ hour}$	60 dBA
Maximum Pass-by L_{Amax} (95^{th} percentile)	85 dBA

Note: 95^{th} percentile equates to the 5% exceedance value.

The EPA's rail noise assessment trigger levels are similar to the ARTC's EPL noise goals, however, the EPA trigger levels have an averaging period of 24 hours, rather than daytime (15 hours) and night-time (9 hours) for the ARTC's goals. The EPA rail noise assessment requirements also provide:

> *Where the cumulative noise level exceeds the noise assessment trigger levels, and project-related noise increases are predicted, all feasible and reasonable noise mitigation measures should be implemented. As a general principle, where the reduction of existing noise levels can be achieved through feasible and reasonable measures, a reduction in noise levels to meet the noise assessment trigger levels is the primary objective. In all cases where the LAeq noise level increases are more than 2dB(A), strong justification should be provided as to why it is not feasible or reasonable to reduce the increase.*

[8] Following cessation of operations at the Ginkgo and Snapper Mines (approximately Year 12 of the Project).

In addition, the EPA's rail noise assessment requirements also provides guidance in relation to the geographical extent of rail noise assessment which should be undertaken for a rail traffic generating development (such as the Project):

> *Ideally, the geographical extent of the rail noise assessment should be to where project/related rail noise increases are less than 0.5dB. This roughly equates to where project/related rail traffic represents less than 10% of total line/corridor rail traffic.*

At the time of writing, the OEH had released the *Draft Rail Infrastructure Noise Guideline* (OEH, 2012b) as a draft for consultation. The *Draft Rail Infrastructure Noise Guideline* provides the following criteria for rail traffic generating developments:

Rail traffic generating developments

- $L_{Aeq,9\ hour}$ = 55 dBA;
- $L_{Aeq,15\ hour}$ = 60 dBA; and
- L_{Amax} (95^{th} percentile) = 80 dBA.

Consideration of the *Draft Rail Infrastructure Noise Guideline* has been incorporated in the assessment of potential rail noise impacts for completeness and is presented in Attachment B.

9.2 Rail Noise Impacts

9.2.1 Existing Rail Noise Impacts

The ARTC master train plan indicates that there is a total of 40 rail passbys per week along the Orange-Broken Hill Railway through the Ivanhoe Railway Station. It is proposed to have a maximum two train passbys in any one 24 hour period as a result of the Project. The following scenarios could occur:

- Scenario 1 - two train passbys occurring during the daytime (between 7.00 am and 10.00 pm); or
- Scenario 2 - one passby occurring during the day (between 7.00 am and 10.00 pm) and one at night (between 10.00 pm and 7.00 am); or
- Scenario 3 - two passbys occurring at night (between 10.00 pm and 7.00 am).

Please note that we have defined a 'passby' as the passing of a single train in one direction only.

The breakdown of daily rail passbys for Orange-Broken Hill Railway is presented in **Table 9-2**.

Table 9-2 Breakdown of Existing Daily Rail Passbys for Orange-Broken Hill Railway

Status	Type	Peak Train Movements			Train Length (m)
		Daytime/Evening	Night	24 Hours	
Approved	Passenger Trains	1	1	2	600
Approved	Freight Trains	4	4	6	1500 – 1800

Source: ARTC, 2012

9.2.2 Rail Noise Impacts associated with Project

As the maximum number of Project rail passbys represents more than 10% of the total traffic on the line, a quantitative rail noise impact assessment is required.

In order to provide some insight into the rail noise impacts, the existing and proposed noise levels at different setback distances from the Orange-Broken Hill Railway are presented in **Table 9-3**. The existing and proposed offset distances from the Orange-Broken Hill Railway in order to meet the relevant criteria have been calculated and are presented in **Table 9-4**.

Table 9-3 indicates that for the Orange-Broken Hill Railway west of the proposed Ivanhoe Rail Facility the peak Project related noise increase is approximately 0.7 dBA. Given that the peak Project related noise increase is anticipated to be less than 2 dBA, an assessment of 'reasonable and feasible' noise mitigation measures is not considered necessary.

Table 9-4 indicates that for the Orange-Broken Hill Railway west of the proposed Ivanhoe Rail Facility:

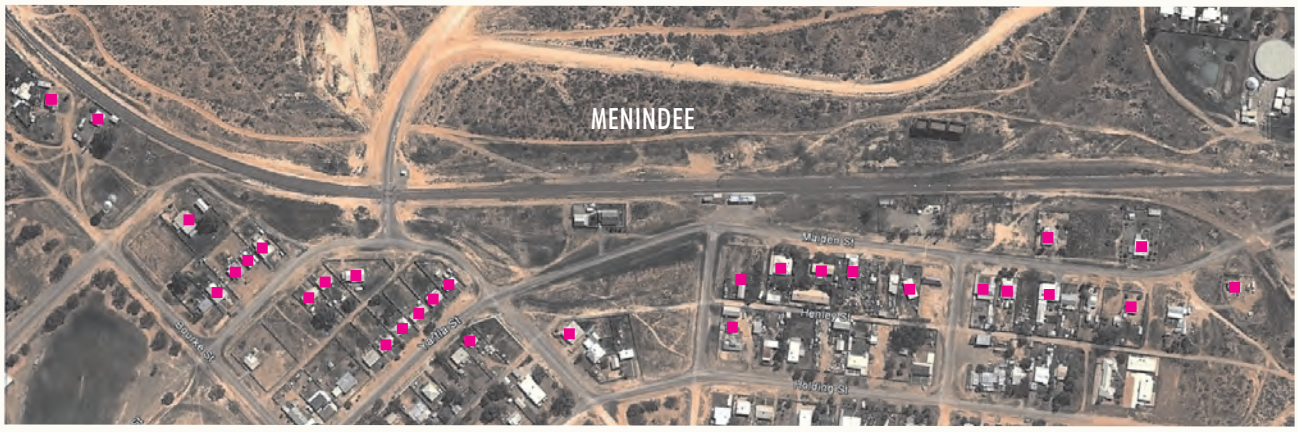
- The maximum increase in distance from the railway line at which the ARTC EPL criteria are met including the Project rail movements, compared with the existing/approved rail movements, would be 3 m for daytime operations and 5 m for night-time operations. It is anticipated that this increase in distance would not result in any additional exceedances of the daytime criterion, however would result in an additional exceedance of night-time criterion at two additional residential receivers along the Orange-Broken Hill Railway. The locations of these residential receivers are shown on **Figure 9-1**.
- The maximum increase in distance from the railway line at which the EPA criteria are met including the Project rail movements, compared with the existing/approved rail movements, would be 2 m for 24 hour operations. It is anticipated that this increase in distance would not result in any additional exceedances of criterion at residential receivers along the Orange-Broken Hill Railway.
- There would be no change to the maximum passby noise as a result of the Project rail movements.

Table 9-3 Existing and Proposed Noise Levels: Train Movements on the Orange Broken Hill Railway

Period	Criterion (dBA)	Noise Level (dBA)											
		Existing/Approved Movements			Existing/Approved Movements plus Scenario 1			Existing/Approved Movements plus Scenario 2			Existing/Approved Movements plus Scenario 3		
		0-20m	20-40m	40-60m	0-20m	20-40m	40-60m	0-20m	20-40m	40-60m	0-20m	20-40m	40-60m
ARTC Licence													
$L_{Aeq,Day}$ (7.00 am-10.00 pm)	65	62.1	57.7	55.0	62.8	58.4	55.7	62.5	58.1	55.4	62.1	57.7	55.0
$L_{Aeq,Night}$ (10.00 pm-7.00 am)	60	64.3	59.9	57.2	64.3	59.9	57.2	64.7	60.3	57.6	65.0	60.6	57.9
$L_{amax,passby}$ Noise (24 hours)	85	87.4	82.2	79.1	87.4	82.2	79.1	87.4	82.2	79.1	87.4	82.2	79.1
Environmental Assessment Requirements for Rail Traffic – Generating Developments													
$L_{Aeq,24\ hour}$ (24 hour)	60	63.1	58.7	56.0	63.4	59.0	56.3	63.5	59.1	56.4	63.4	59.0	56.3
$L_{Amax,Passby}$ Noise (95^{th} percentile)	85	87.4	82.2	79.1	87.4	82.2	79.1	87.4	82.2	79.1	87.4	82.2	79.1

Table 9-4 Criteria Offset Distances: Train Movements on the Orange-Broken Hill Railway

Period	Criterion (dBA)	Compliance Distance from Track (m)			
		Existing/Approved Movements	Existing/Approved Movements plus Scenario 1	Existing/Approved Movements plus Scenario 2	Existing/Approved Movements plus Scenario 3
ARTC Licence					
$L_{Aeq,Day}$ (7.00 am-10.00 pm)	65	7	10	8	7
$L_{Aeq,Night}$ (10.00 pm-7.00 am)	60	39	39	41	44
$L_{amax,passby}$ Noise (24 hours)	85	29	29	29	29
Environmental Assessment Requirements for Rail Traffic – Generating Developments					
$L_{Aeq,24\ hour}$ (24 hour)	60	27	29	29	29
$L_{Amax,Passby}$ Noise (95^{th} percentile)	85	29	29	29	29



LEGEND

- Potential Receiver Location
- Predicted Additional Exceedance of Night Time ARTC EPL Criteria

Source: Google Earth (2012)

ATLAS - CAMPASPE PROJECT

FIGURE 9-1

Receptors Proximal to the Orange-Broken Hill Railway within Menindee

WILKINSON MURRAY

CRISTAL

10 TRANSPORT VIBRATION

Transport of mineral concentrate and MSP process waste via road and rail has the potential to produce ground borne vibration. A summary of the potential effects of vibration resulting from the transportation is provided in the sub-sections below.

10.1 Vibration Criteria

Impacts from vibration can be considered both in terms of effects on building occupants (human comfort) and the effects on the building structure (building damage). Of these considerations, the human comfort limits are the most stringent. Hence, for occupied buildings, if compliance with human comfort limits is achieved, it will follow that compliance will be achieved with the building damage objectives.

10.2 Human Comfort

The EPA's *Assessing Vibration: A Technical Guideline* (NSW Department of Environment and Conservation [DEC], 2006) provides acceptable values for continuous vibration in the range 1-80 Hertz. Both preferred and maximum vibration limits are defined for various locations and are shown in **Table 10-1**.

Table 10-1 Preferred and Maximum Peak Particle Velocity Values for Continuous Vibration

Location	Assessment Period	Preferred Value (mm/s)	Maximum value (mm/s)
Continuous vibration			
Critical Areas	Day or night-time	0.14	0.28
Residences	Day	0.28	0.56
Residences	Night	0.20	0.40
Offices, School, etc	Day or night-time	0.56	1.1
Workshops	Day or night-time	1.1	2.2

mm/s = millimetres per second

Where vibration is intermittent, a vibration dose is recommended and is shown in **Table 10-2**.

Table 10-2 Acceptable Vibration Dose Values for Intermittent Vibration ($m/s^{1.75}$)

Location	Daytime		Night-time	
	Preferred Value	Maximum Value	Preferred Value	Maximum Value
Critical Areas	0.10	0.20	0.10	0.20
Residences	0.20	0.40	0.13	0.26
Offices, School, etc	0.40	0.80	0.40	0.80
Workshops	0.80	1.60	0.80	1.60

10.3 Building Damage

In regard to potential building damage, Table 1 of German Standard DIN 4150-3:1999 *Structural Vibration* shows guideline values for short-term vibration for commercial buildings, houses and heritage buildings which are dependent on the frequency of vibration. The recommended vibration level ranges from 5 to 20 mm/s for dwellings.

10.4 Road Transport Vibration

Balranald-Ivanhoe Road is an RMS-approved road train route (Appendix D of the EIS) that is currently in use.

From previous vibration measurements conducted by Wilkinson Murray (Wilkinson Murray, 2007) vehicles operating within approximately 15 m on a roadway are unlikely to cause a perceptible level of vibration unless there are significant road irregularities such as potholes.

Based on the above and given the identified setback distances of sensitive receivers from the mineral concentrate transport route (**Section 8.3**), it is anticipated that a perceptible level of vibration effects would not be experienced at any potential receiver along the mineral concentrate transport route.

10.5 Rail Transport Vibration

At the time of writing the Orange-Broken Hill Railway in the vicinity of Ivanhoe was subject to 40 rail passbys per week. It is anticipated that any vibration effects on receivers proximal to the Orange-Broken Hill Railway attributable to Project rail movements would not exceed effects that are currently experienced as a result of other existing/approved rail movements.

11 CONCLUSION

This study has assessed the potential noise impacts associated with the proposed Project. A quantitative assessment was used to assess the potential for noise impact at sensitive receiver locations.

11.1 Operational Noise

11.1.1 Atlas-Campaspe Mine

The area around the Atlas-Campaspe Mine is remote and sparsely populated with the closest residence, Boree Plains, located approximately 7 km from the closest point to the proposed Atlas-Campaspe Mine. Based on the predicted results (operation and construction), it is concluded that the proposed Atlas-Campaspe Mine will comply with the project-specific noise criteria at all modelled private residences during construction and operation.

It is anticipated that operations at the Atlas-Campaspe Mine would likely be inaudible at the Mungo National Park, Mungo State Conservation Area and the Willandra Lakes Region World Heritage Area with compliance with the relevant amenity criteria expected.

No cumulative impacts between the Project and the proposed Balranald Mineral Sands Project are expected to occur.

11.1.2 Ivanhoe Rail Facility

The Ivanhoe Rail Facility is located 4.5 km south-west of the township of Ivanhoe. Based on the predicted results, it is concluded that the proposed Ivanhoe Rail Facility will comply with the Project-specific noise criteria at all modelled private receivers during operation and construction.

11.2 Sleep Disturbance

Compliance with relevant sleep disturbance criteria is predicted at all modeled private residences surrounding the Atlas-Campaspe Mine and the Ivanhoe Rail Facility.

11.3 Road Traffic Noise

Based on the road traffic noise assessment presented, the proposed additional Project related traffic movements on the mineral concentrate transport route are expected to result in measurable increases in traffic noise levels along Magenta Road, Hatfield-The Vale Road and Balranald-Ivanhoe Road (north of the intersection with Hatfield-The Vale Road), however, compliance at the nearest private receivers is predicted.

Project related traffic movements along Balranald-Ivanhoe Road south of the proposed Balranald Mineral Sands Project are not expected to result in a perceptible increase in road traffic noise.

11.4 Rail Noise

Based on the rail noise assessment presented, the proposed Project rail movements are expected to result in two additional exceedances of the ARTC EPL night-time rail noise criteria along the Orange-Broken Hill Railway.

11.5 Transport Vibration

11.5.1 Road Transport

The transport of mineral concentrates and MSP process waste via road between the Atlas-Campaspe Mine and the Ivanhoe Rail Facility, is not expected to result in any perceptible increase in vibration effects along the mineral concentrate transport route.

11.5.2 Rail Transport

The transport of mineral concentrates and MSP process waste via rail, between the MSP and the Ivanhoe Rail Facility, is not expected to result in vibration effects in excess of those currently experienced by potential receivers along the Orange-Broken Hill Railway.

12 REFERENCES

Australian Rail Track Corporation (2012) *ARTC Master Train Plan, Effective 8 July 2012*.

Department of Environment and Conservation (2006) *Assessing Vibration: a technical guideline.*

EMGA Mitchell McLennan (2012) *Balranald Mineral Sands Project - Project Scoping Report*.

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

Environment Protection Authority (2011) *NSW Road Noise Policy*.

Holmes Air Sciences (2007) *The Murray Basin Stage 2 Project Ouyen Mineral Sands Deposits Noise Assessment for Revised Mine Plan*.

Katestone Environmental Pty Ltd (2013) *Air Quality and Greenhouse Gas Assessment – Atlas-Campaspe Mineral Sands Project, NSW*. Report prepared for Cristal Mining Australia Limited.

NSW Roads and Maritime Services (2012) *Road Transport (General) Act 2005 Road Train Notice 2012*.

Office of Environment and Heritage (2012a) *Environmental Assessment Requirements for Rail Traffic-Generating Developments.* Website: www.environment.nsw.gov.au/noise.railnoise.htm

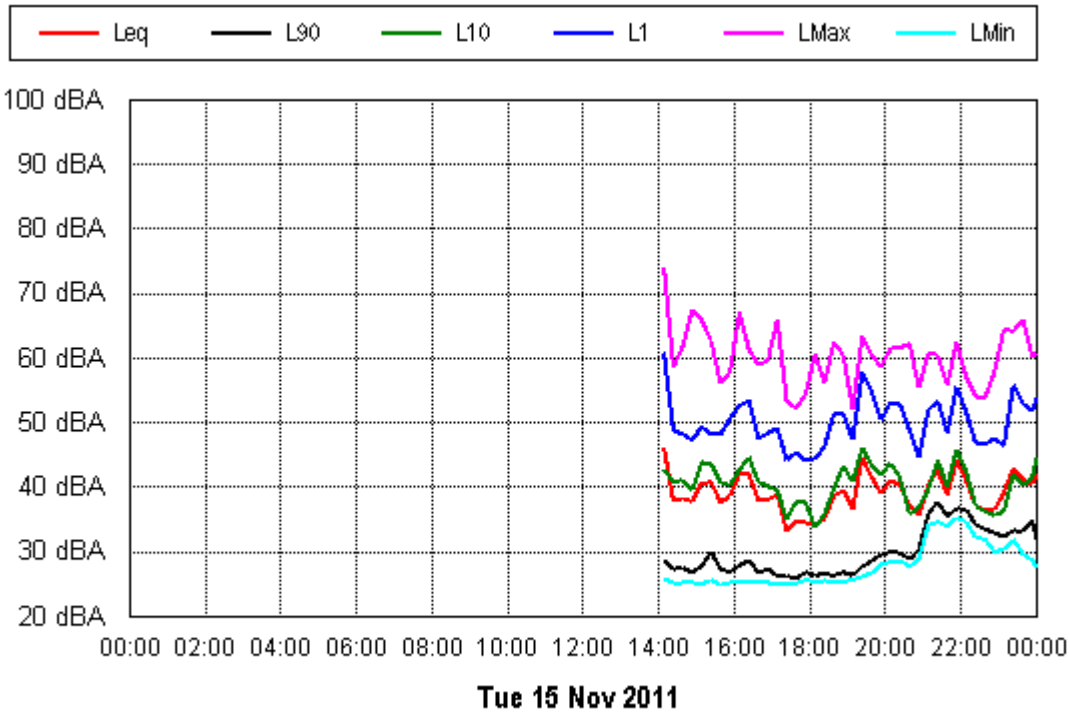
Office of Environment and Heritage (2012b) *Draft Rail Infrastructure Noise Guideline.*

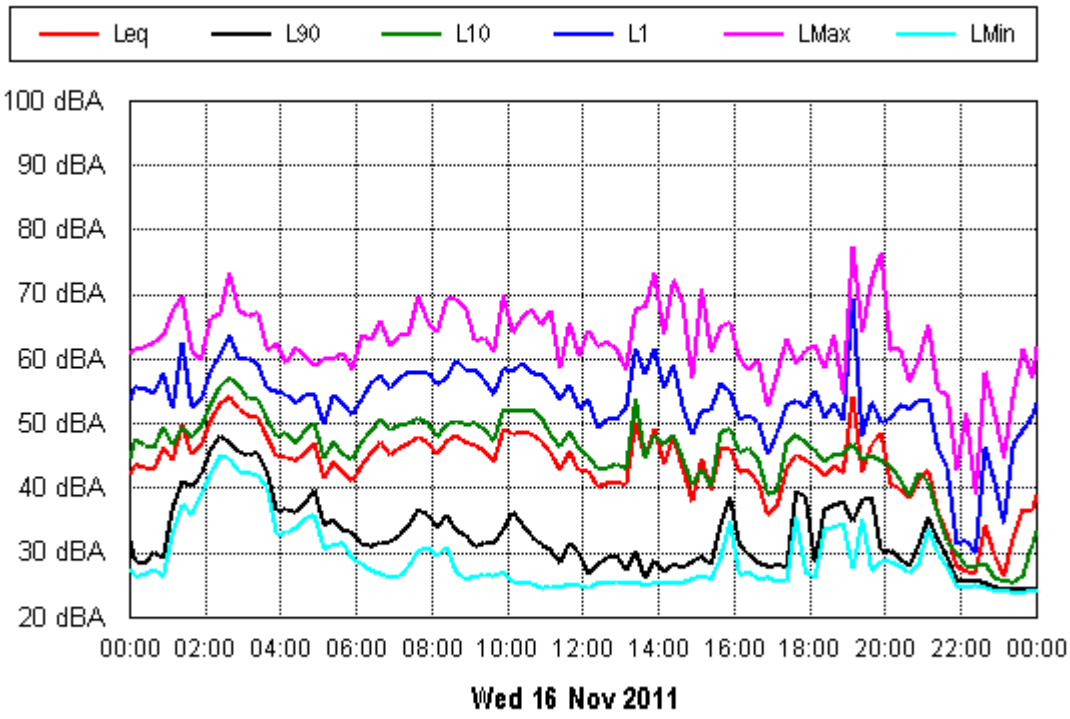
Wilkinson Murray (2007) *Victoria Road Upgrade Project – Noise and Vibration Assessment*.

ATTACHMENT A

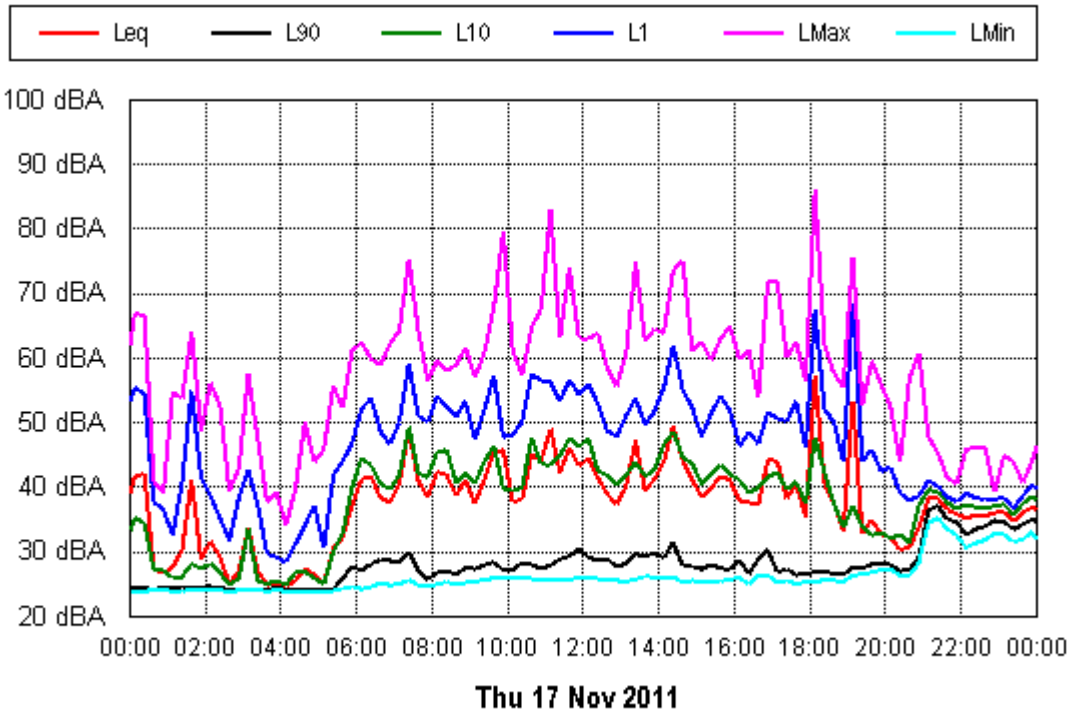
NOISE MEASUREMENT RESULTS

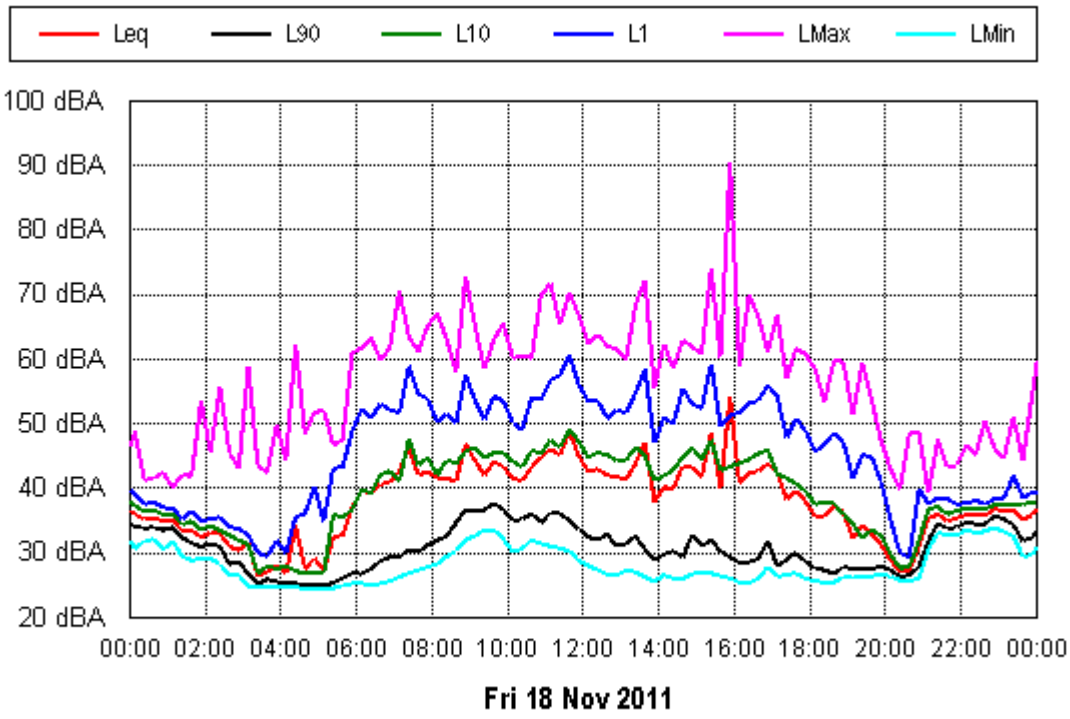
Project: Atlas-Campaspe
Location: Boree Plains



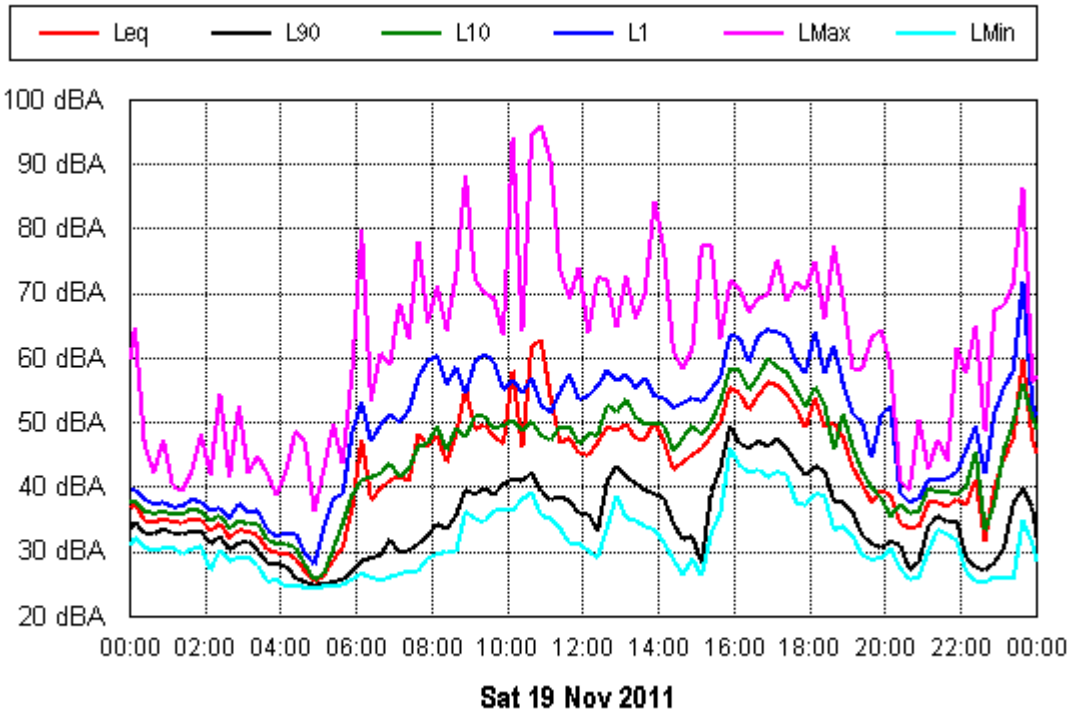


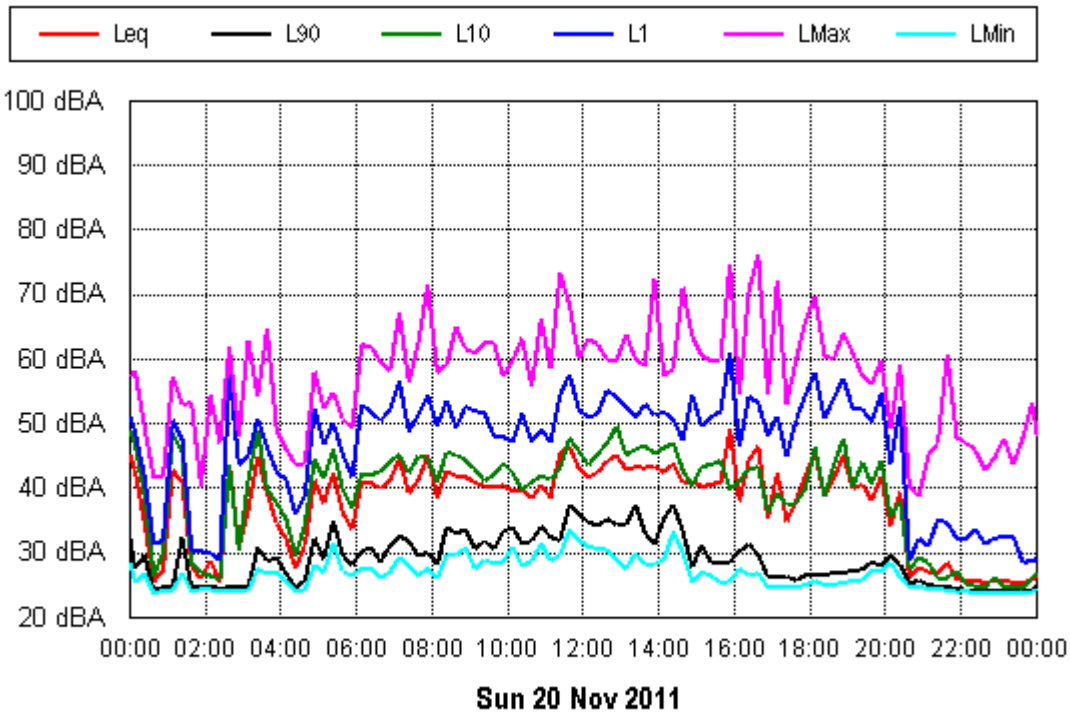
Project: Atlas-Campaspe
Location: Boree Plains



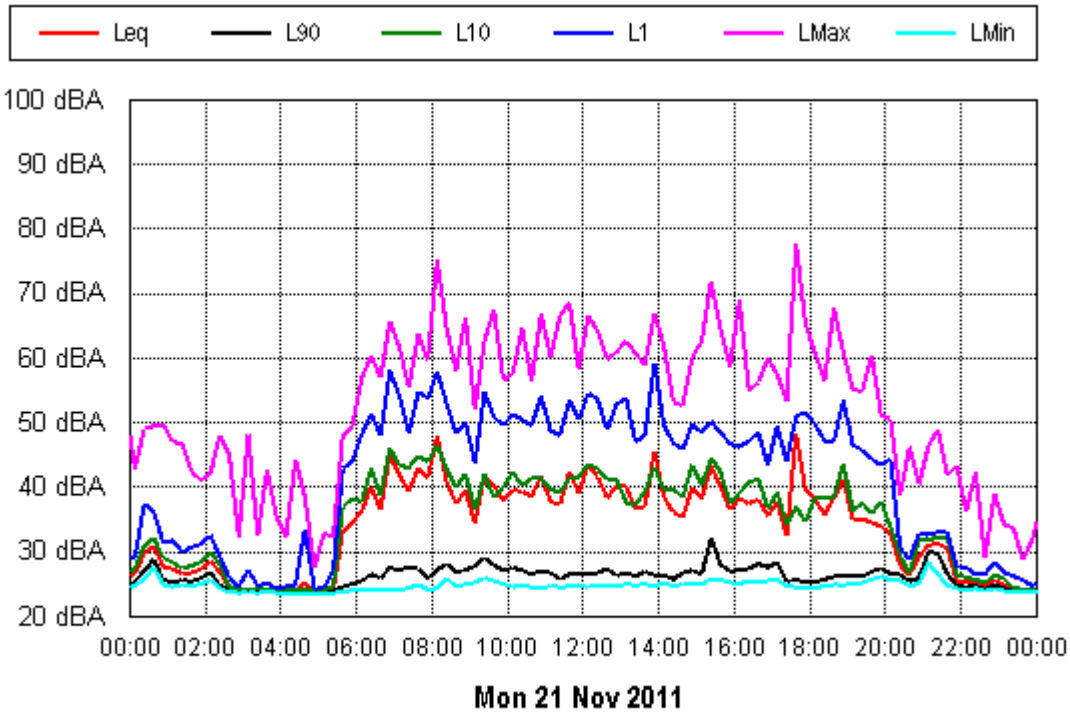


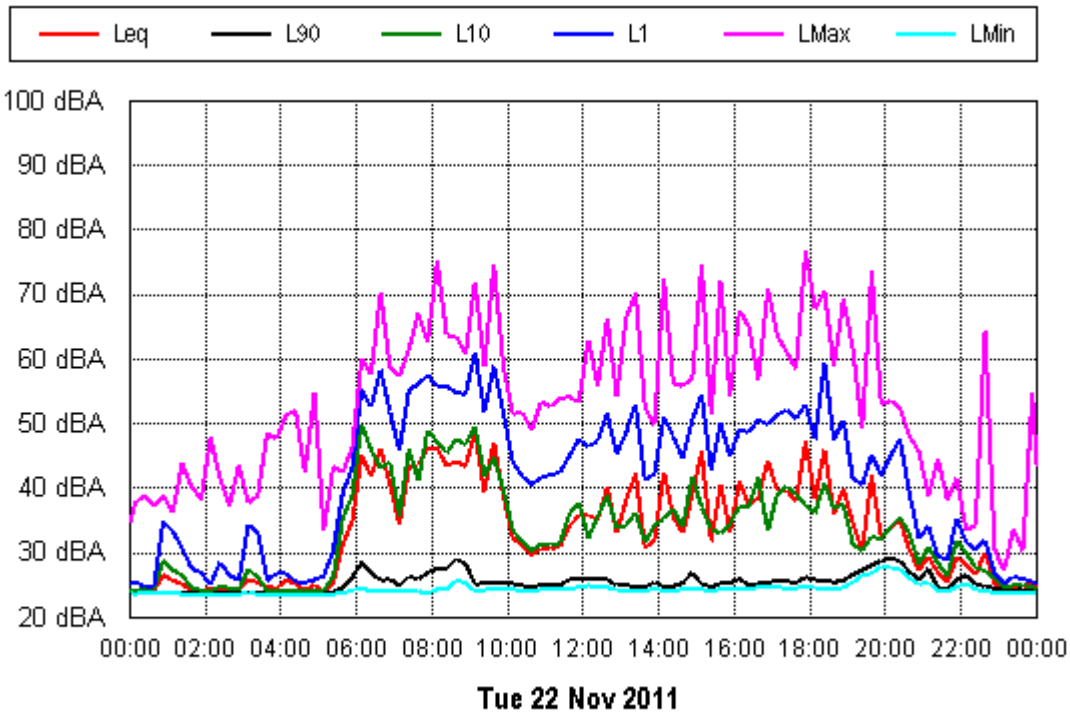
Project: Atlas-Campaspe
Location: Boree Plains



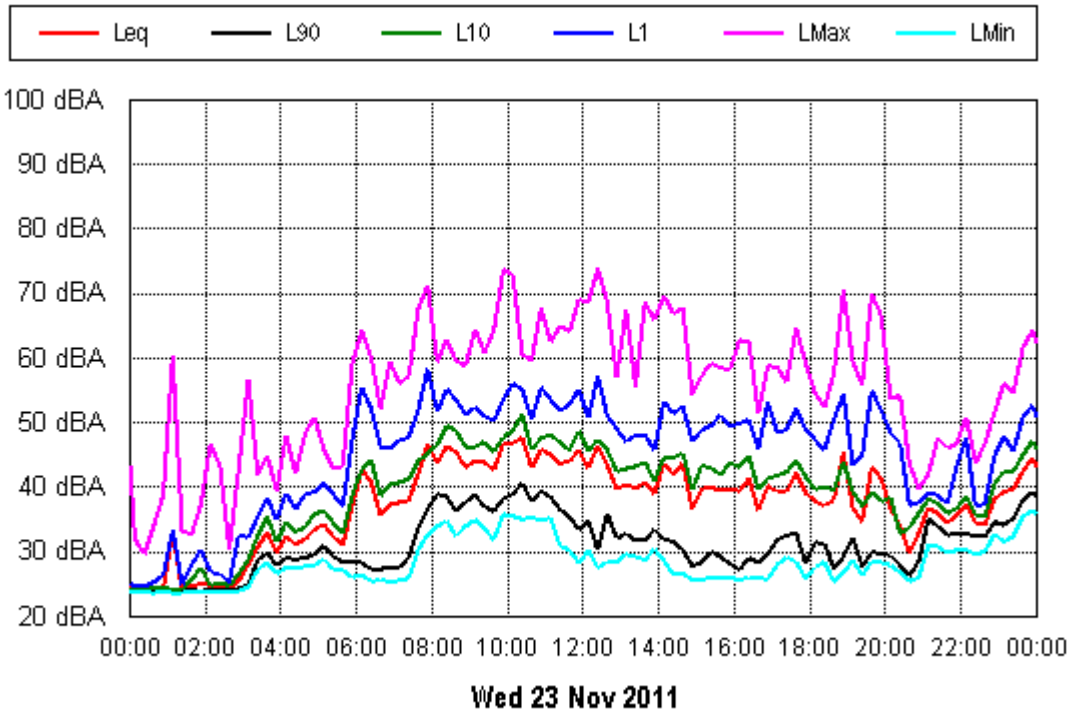


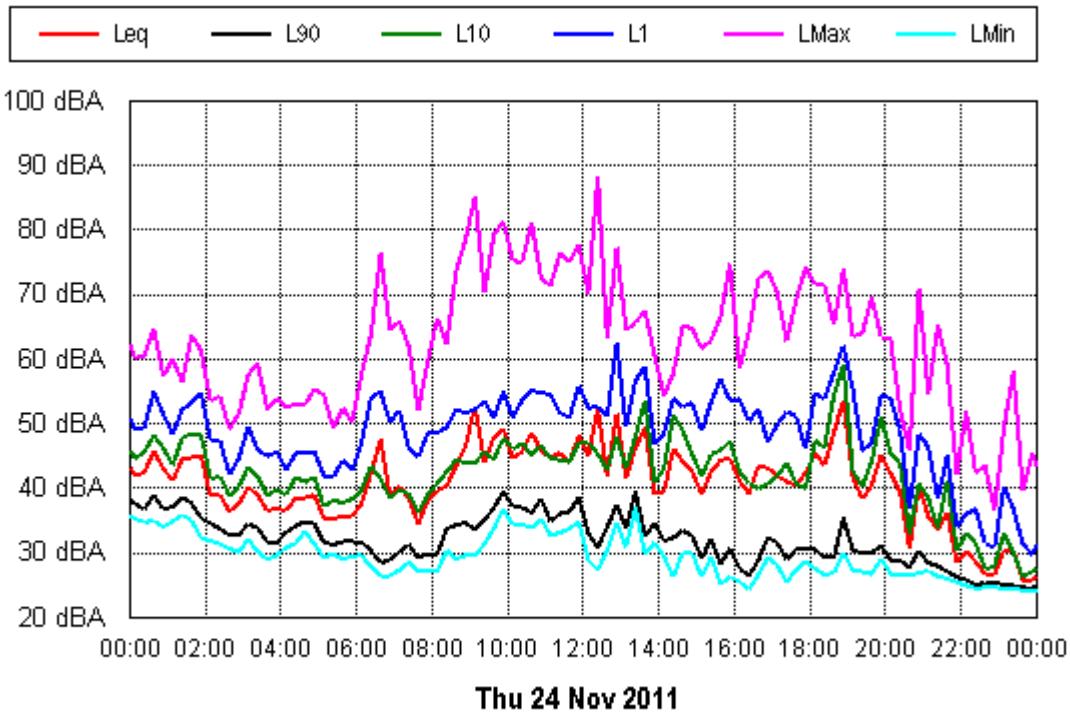
Project: Atlas-Campaspe
Location: Boree Plains



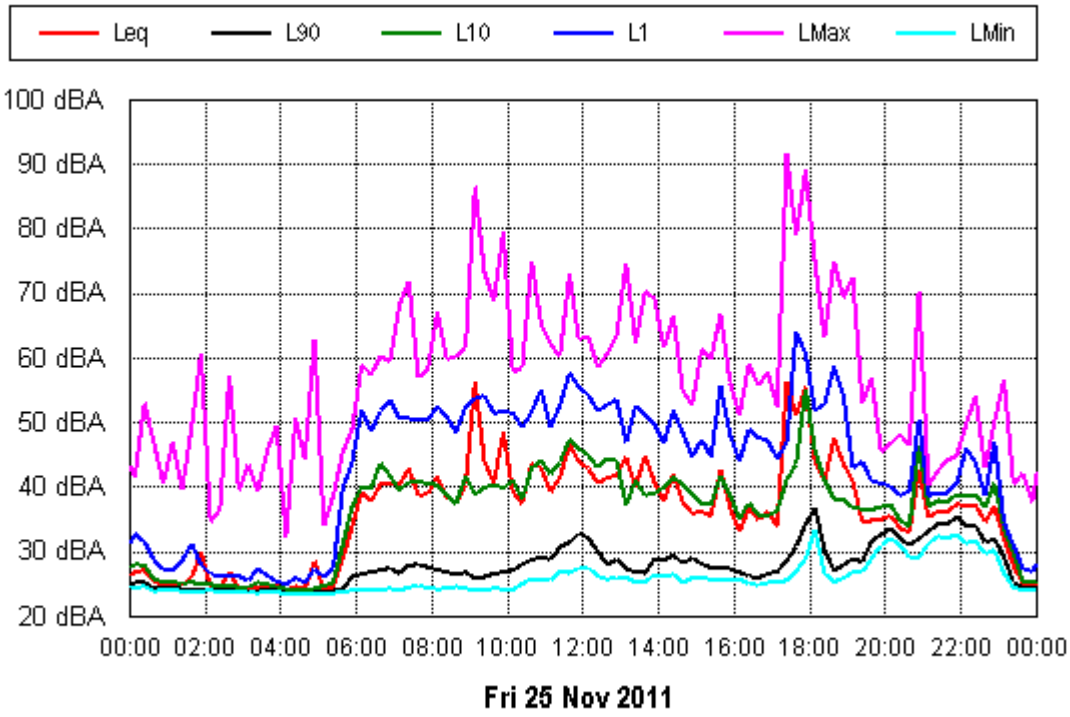


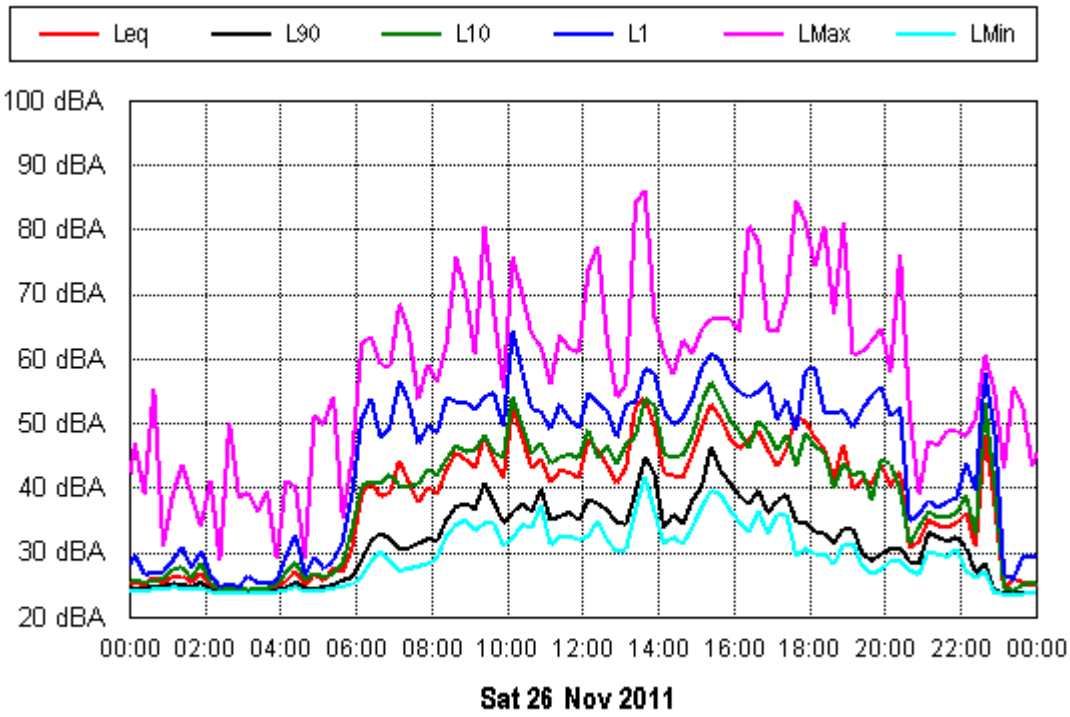
Project: Atlas-Campaspe
Location: Boree Plains



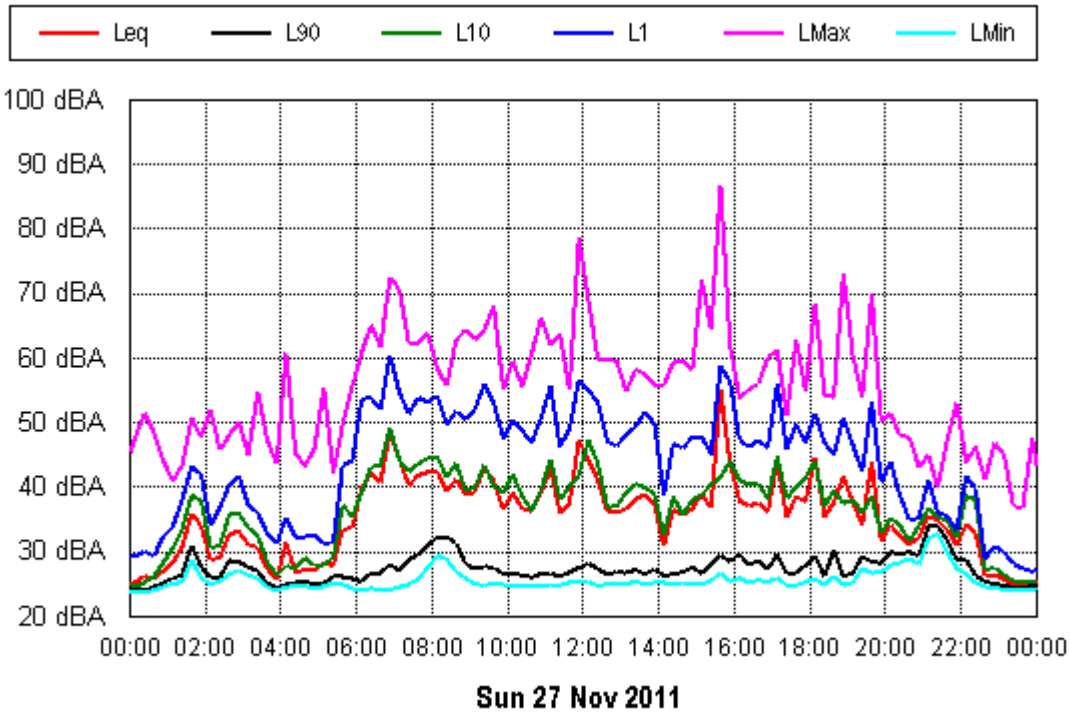


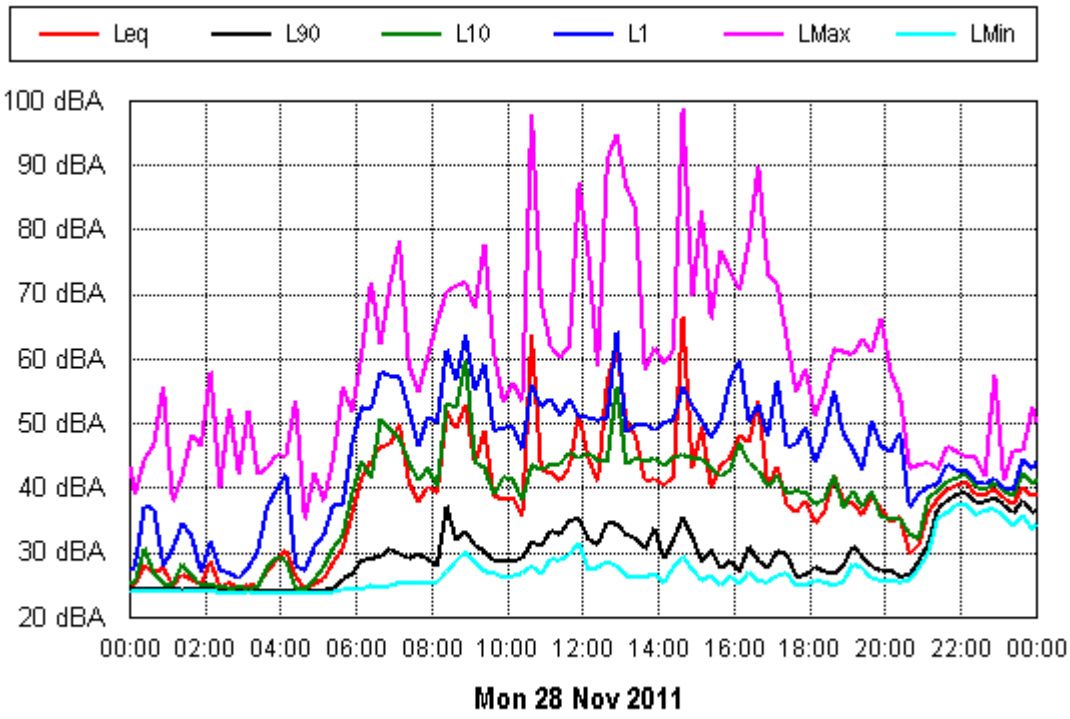
Project: Atlas-Campaspe
Location: Boree Plains



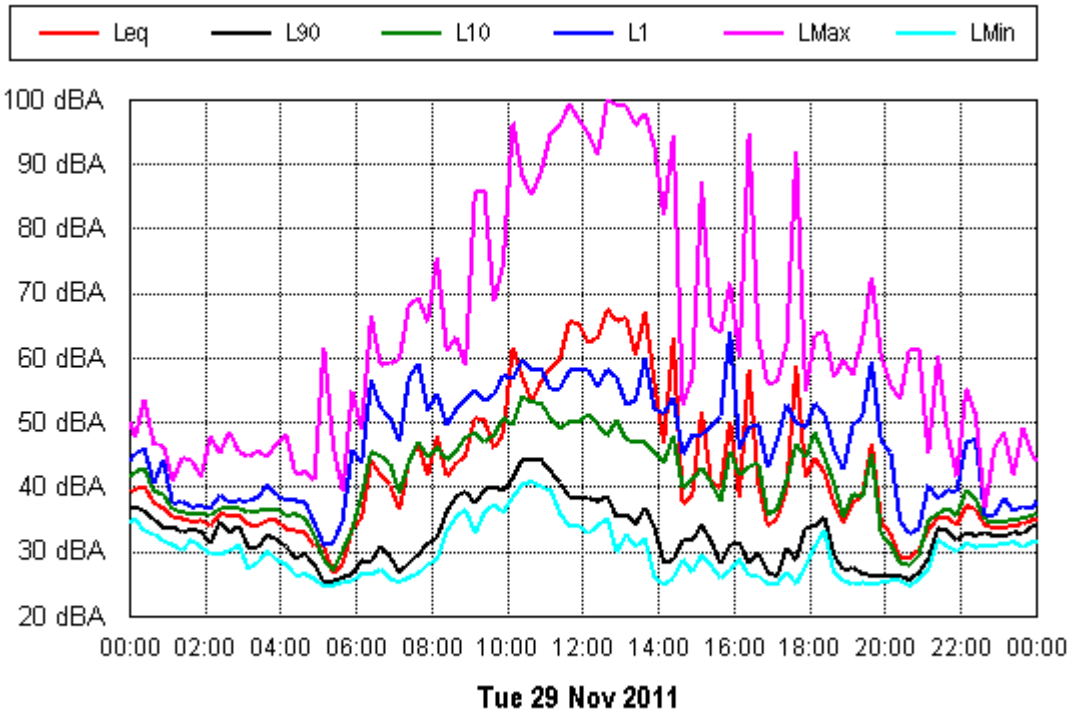


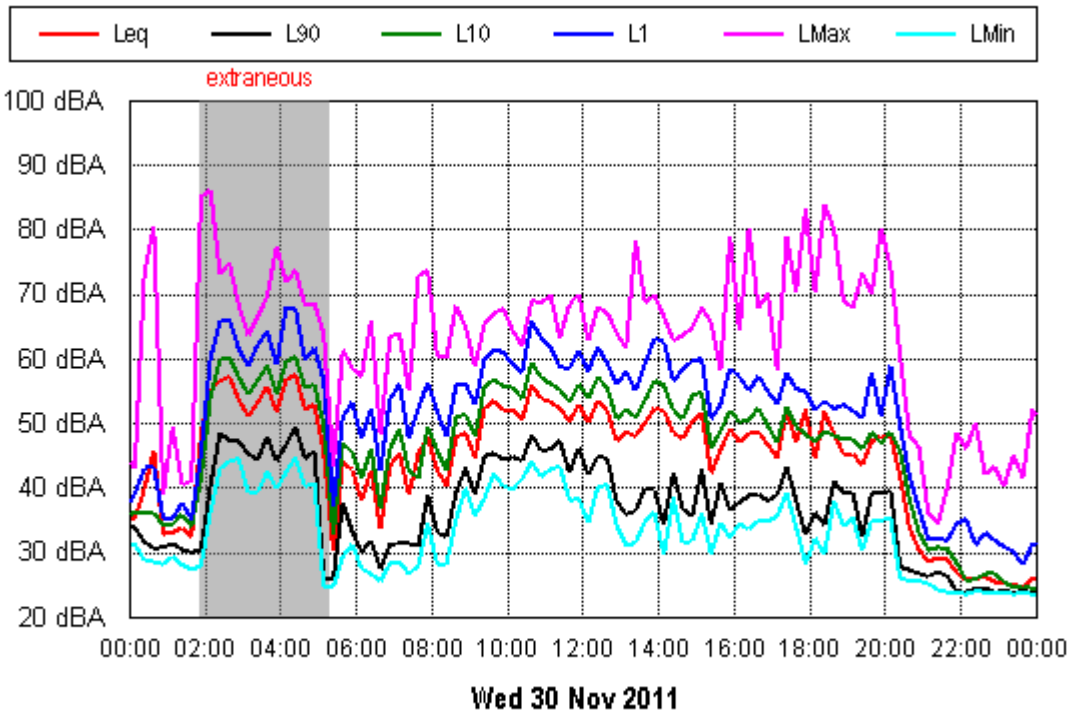
Project: Atlas-Campaspe
Location: Boree Plains



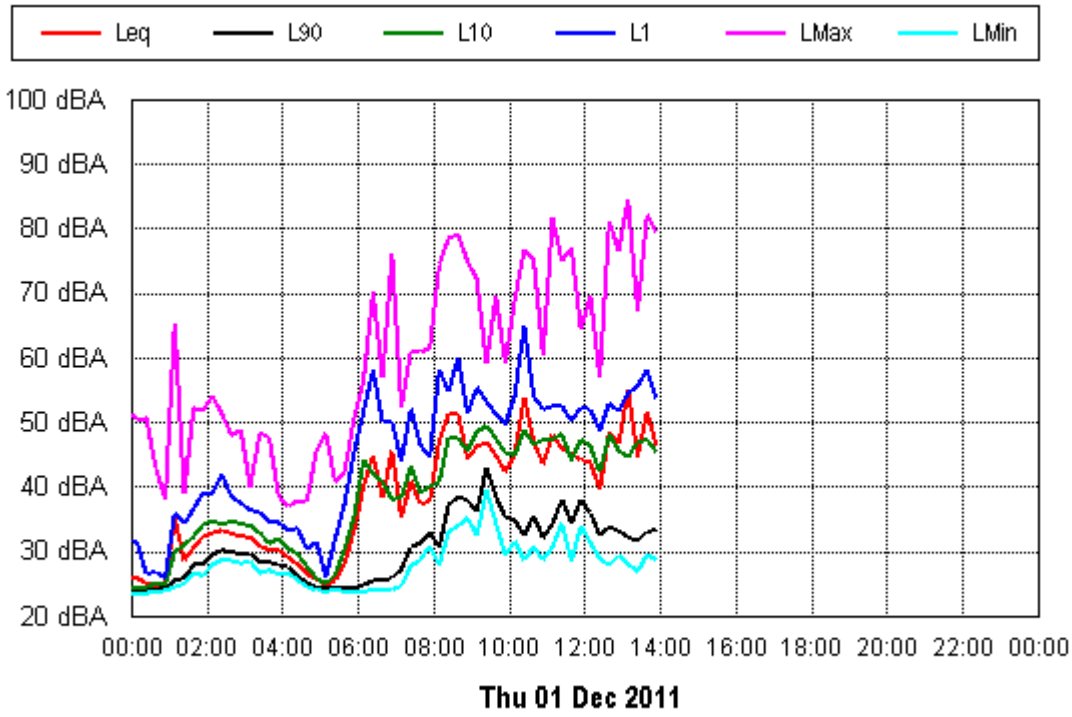


Project: Atlas-Campaspe
Location: Boree Plains

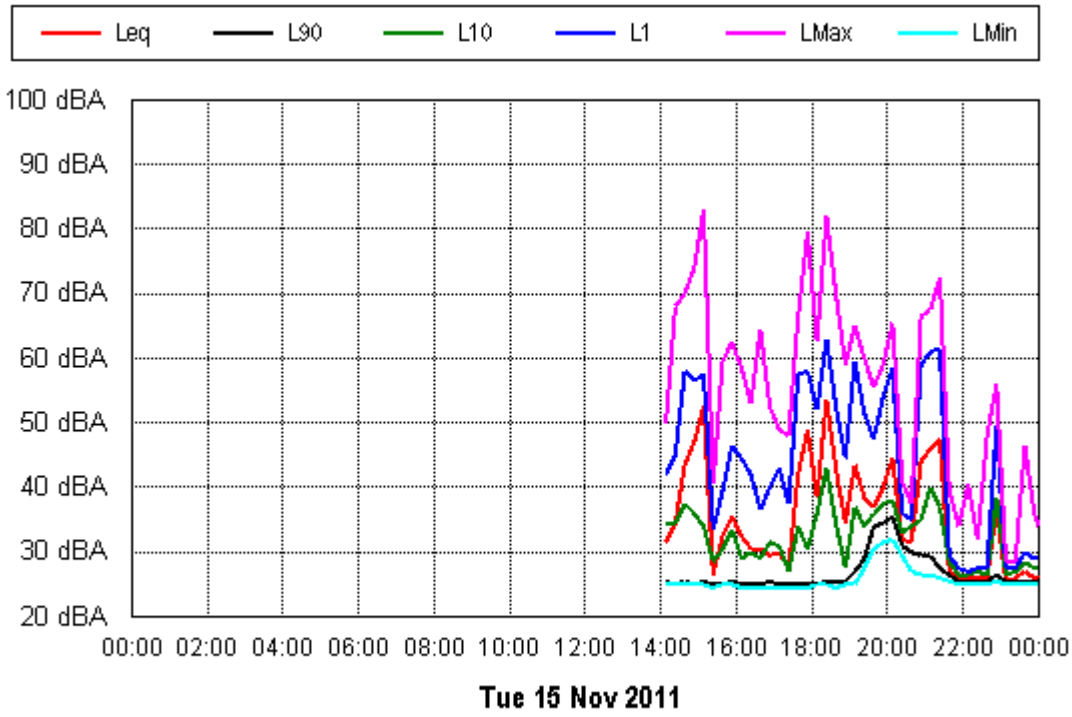


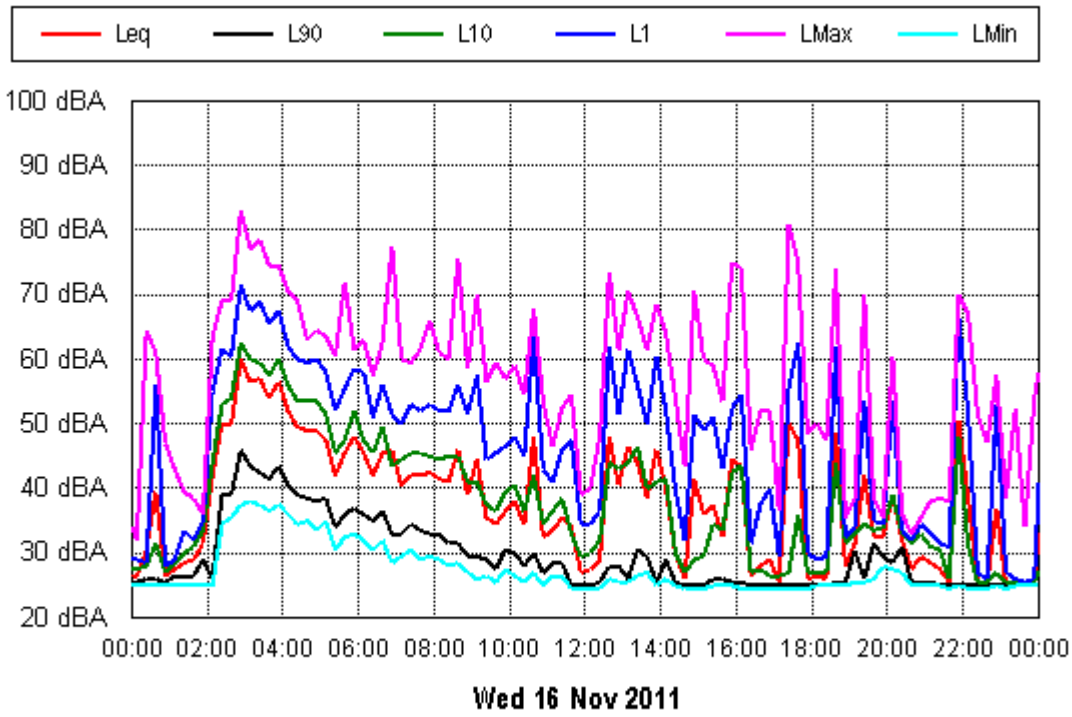


Project: Atlas-Campaspe
Location: Boree Plains

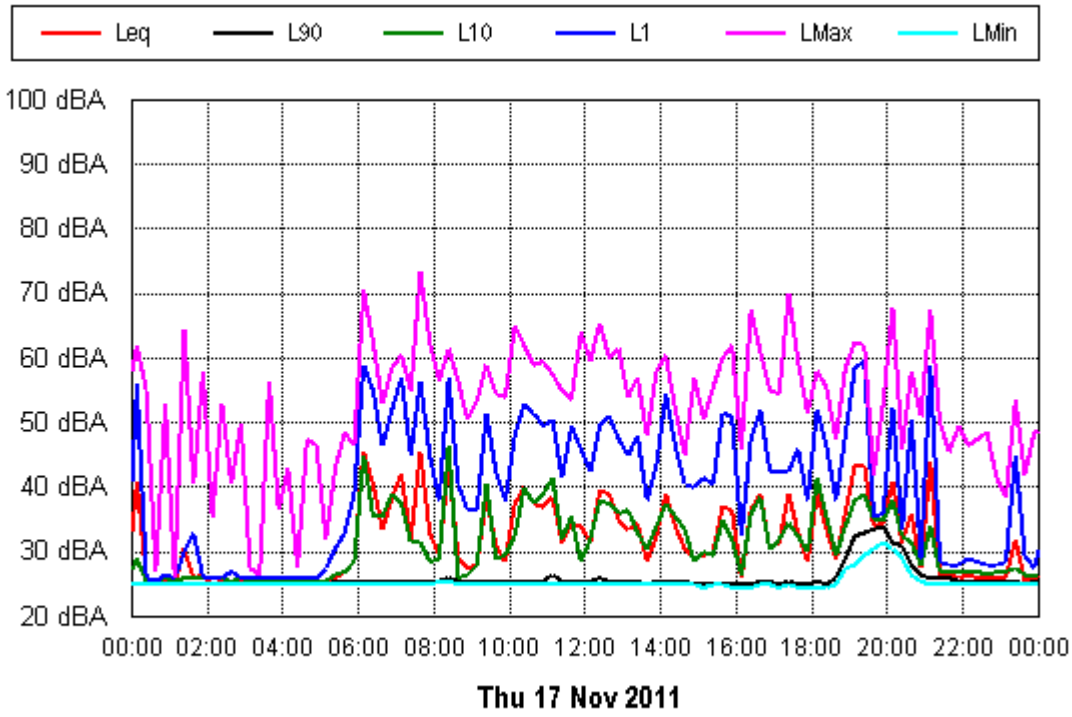


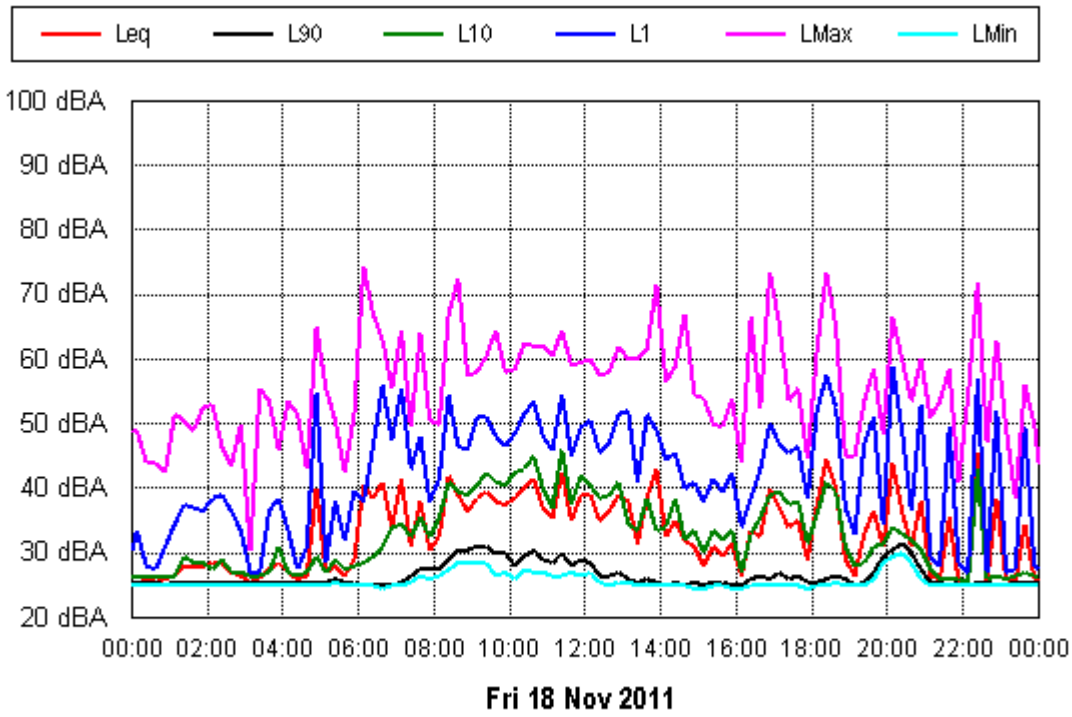
Project: Atlas-Campaspe
Location: Min Min



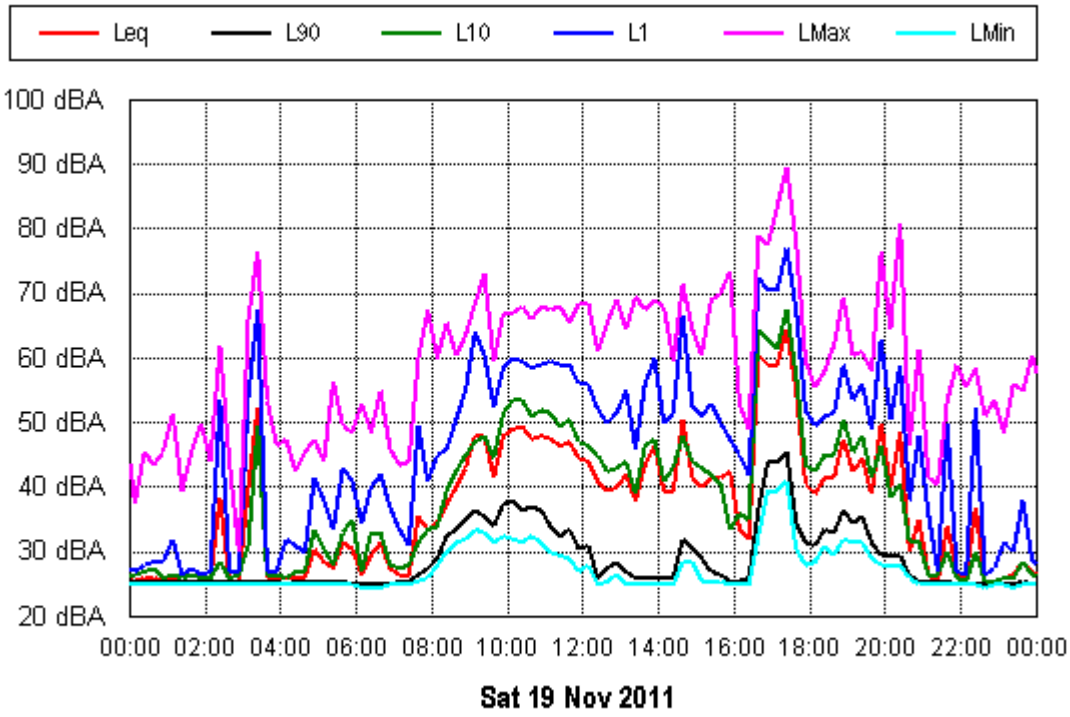


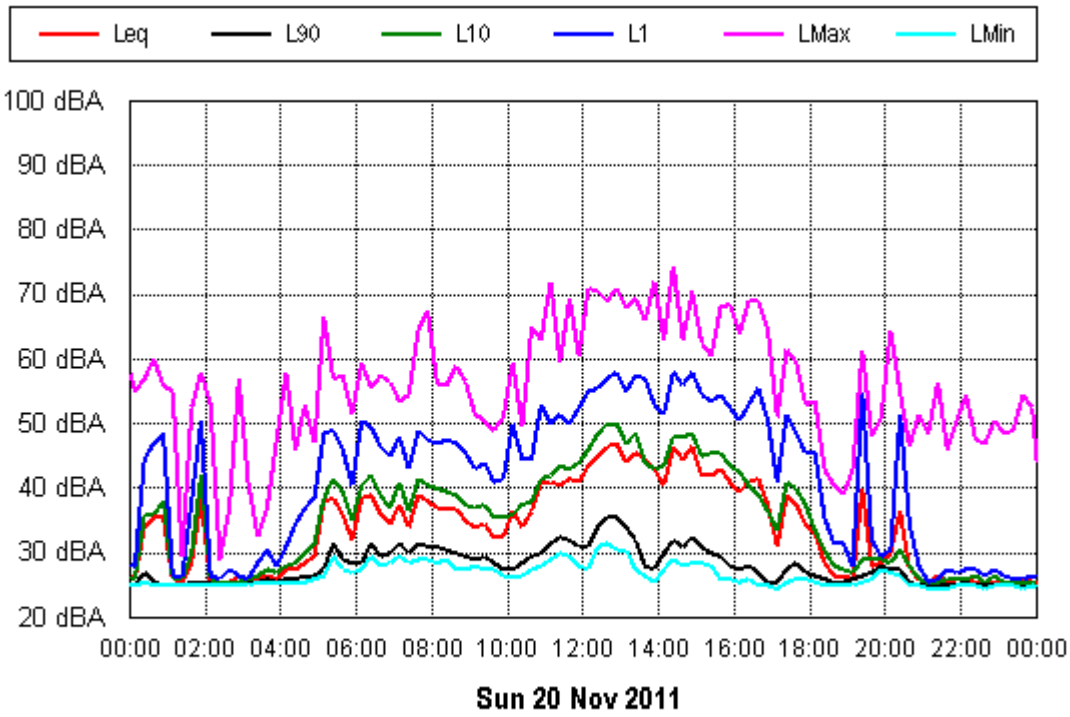
Project: Atlas-Campaspe
Location: Min Min



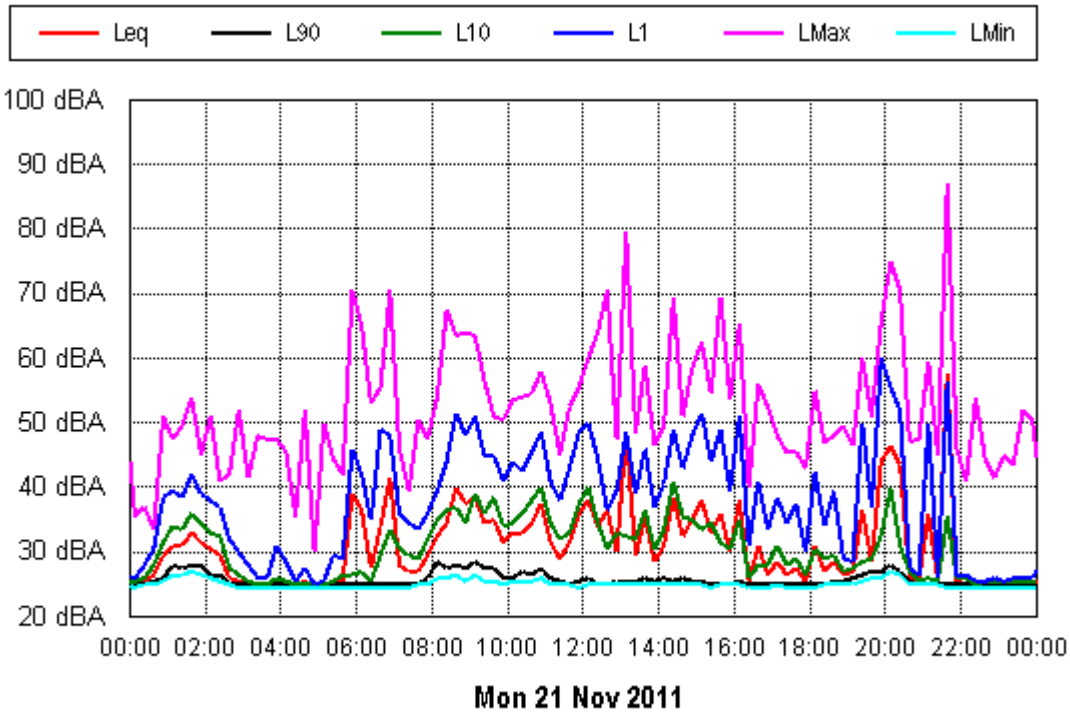


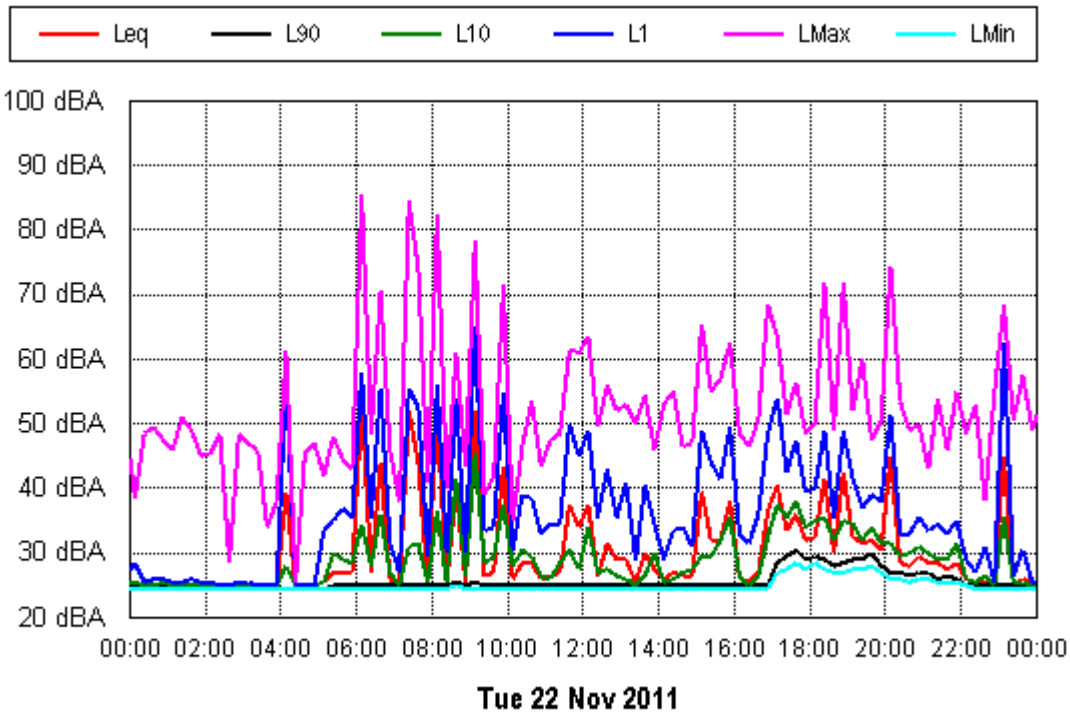
Project: Atlas-Campaspe
Location: Min Min



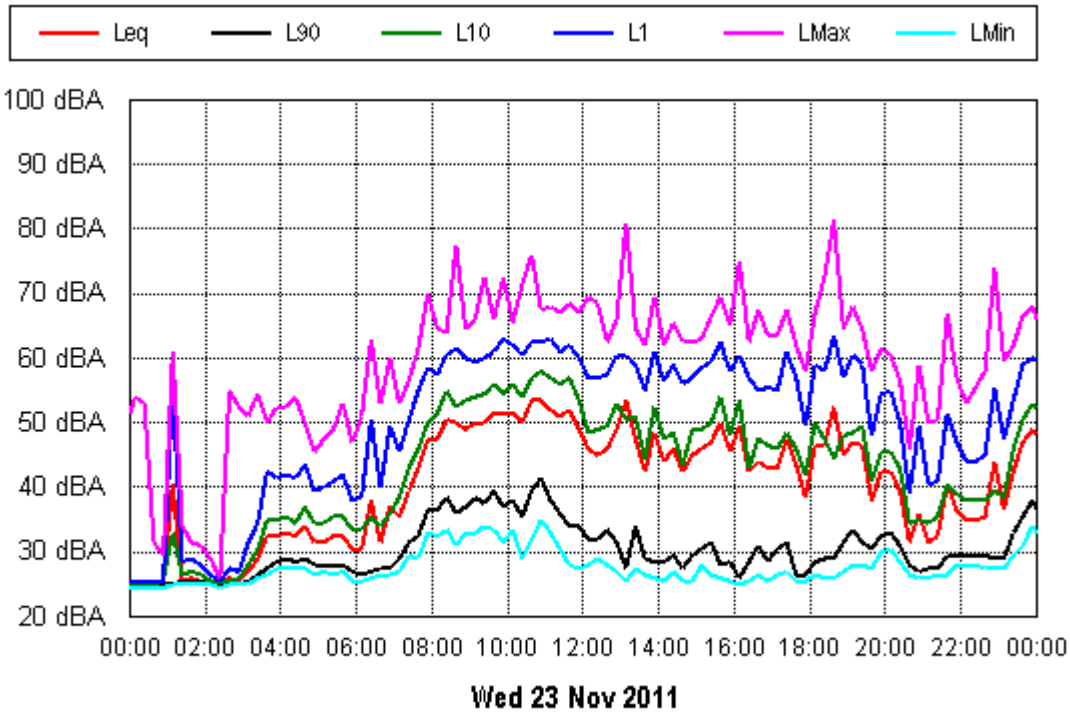


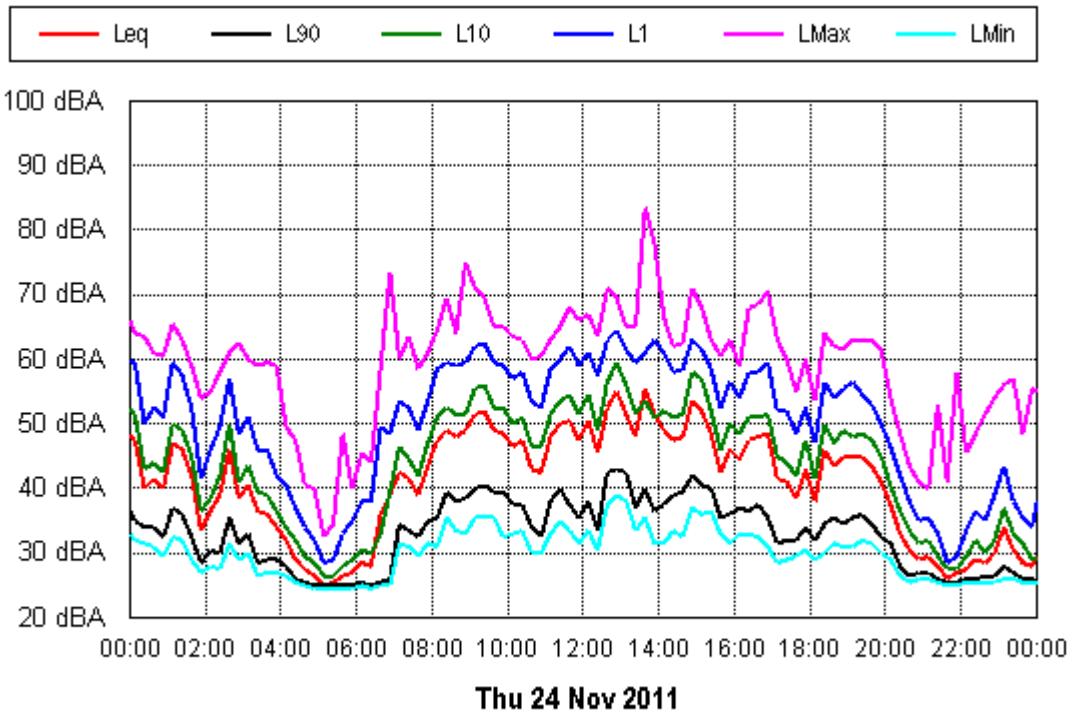
Project: Atlas-Campaspe
Location: Min Min



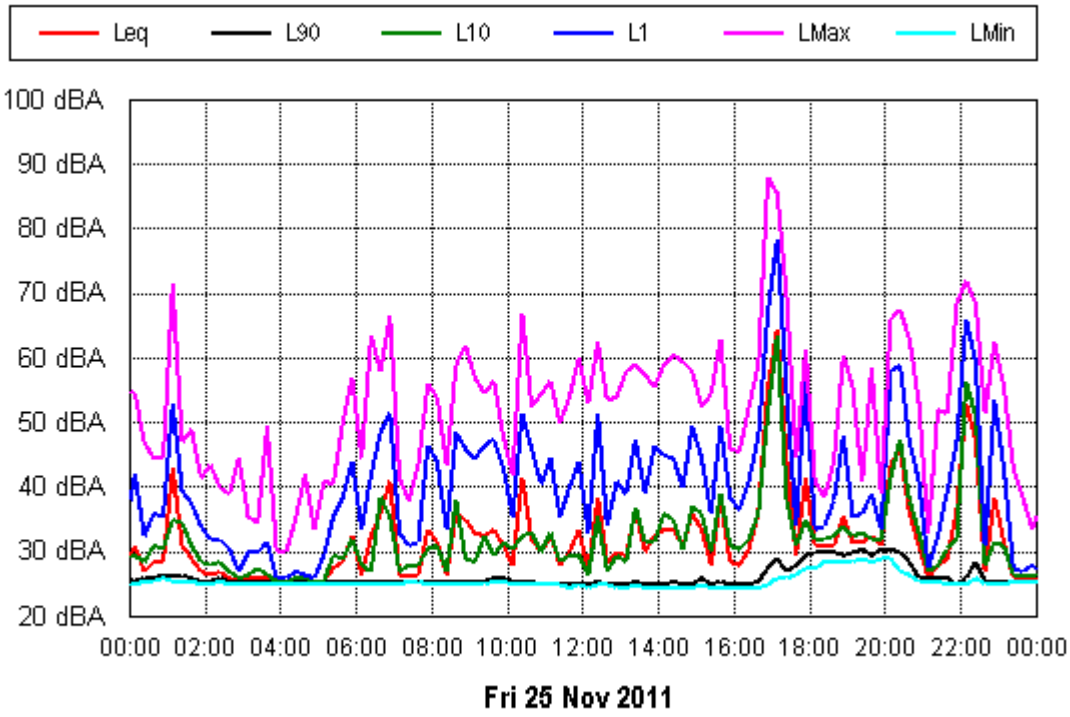


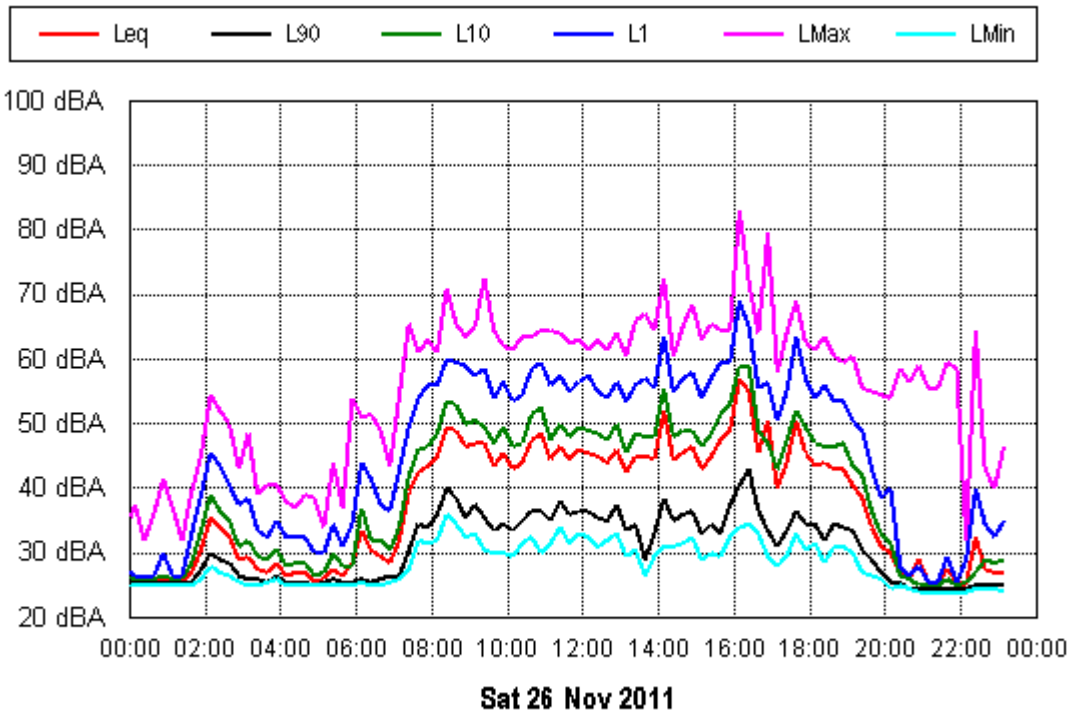
Project: Atlas-Campaspe
Location: Min Min



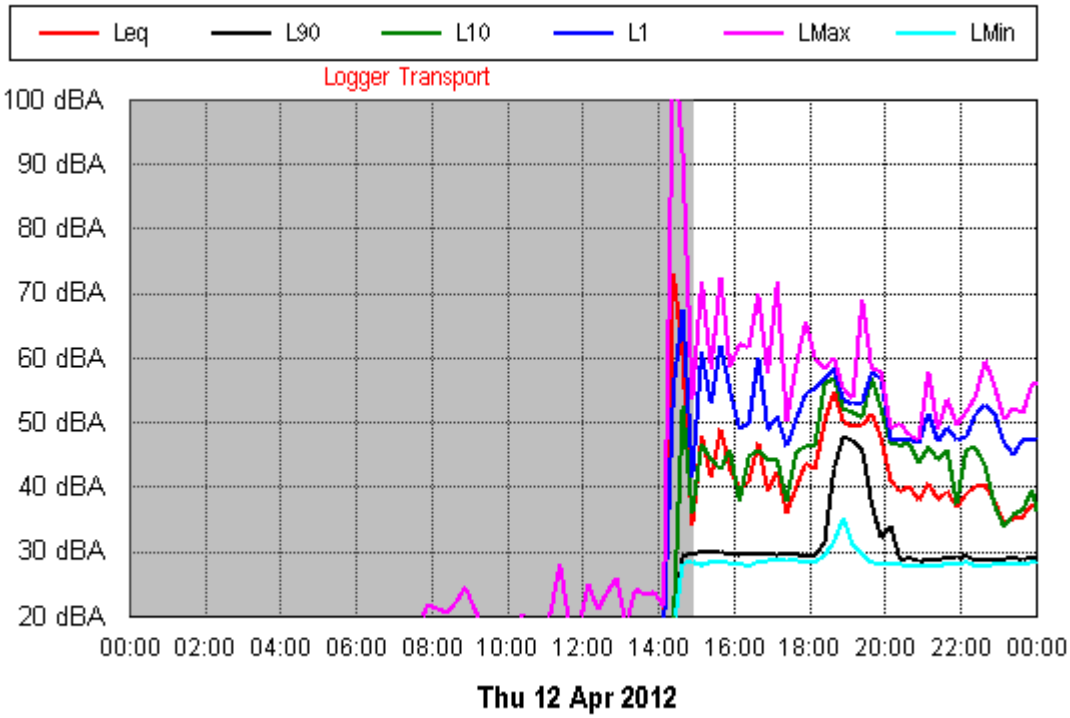


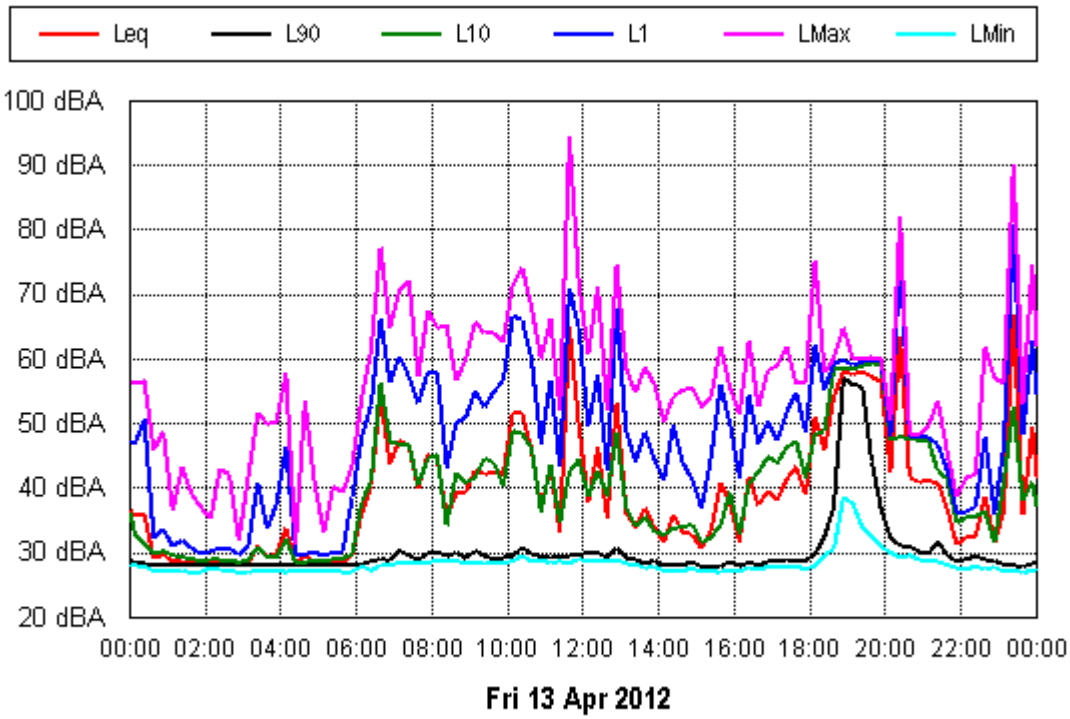
Project: Atlas-Campaspe
Location: Min Min



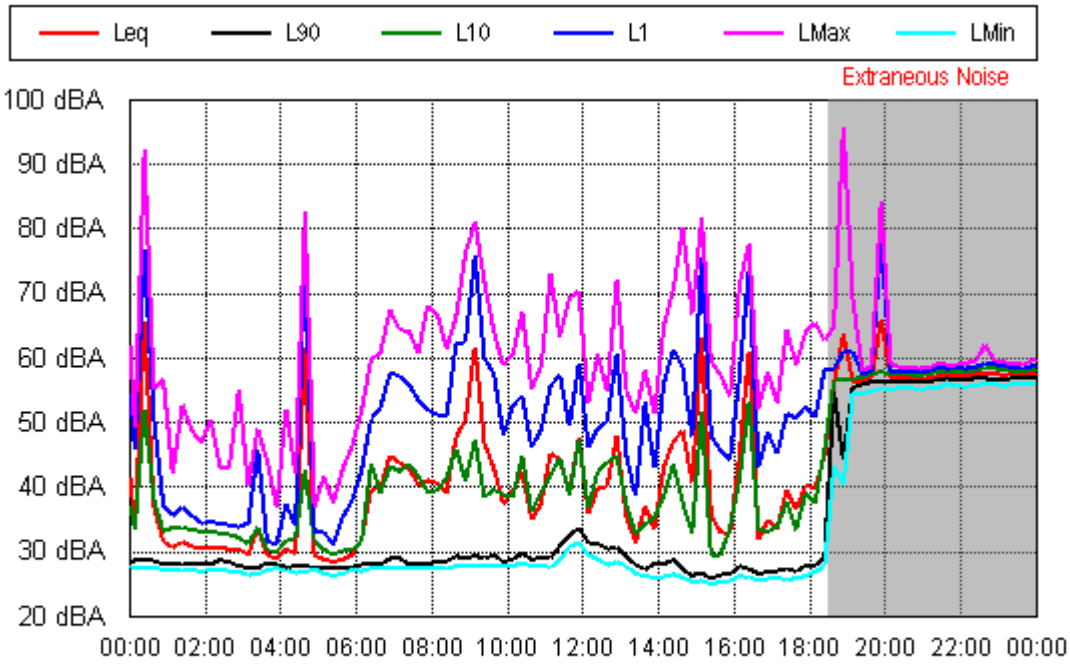


Project: Atlas
Location: Ivanhoe

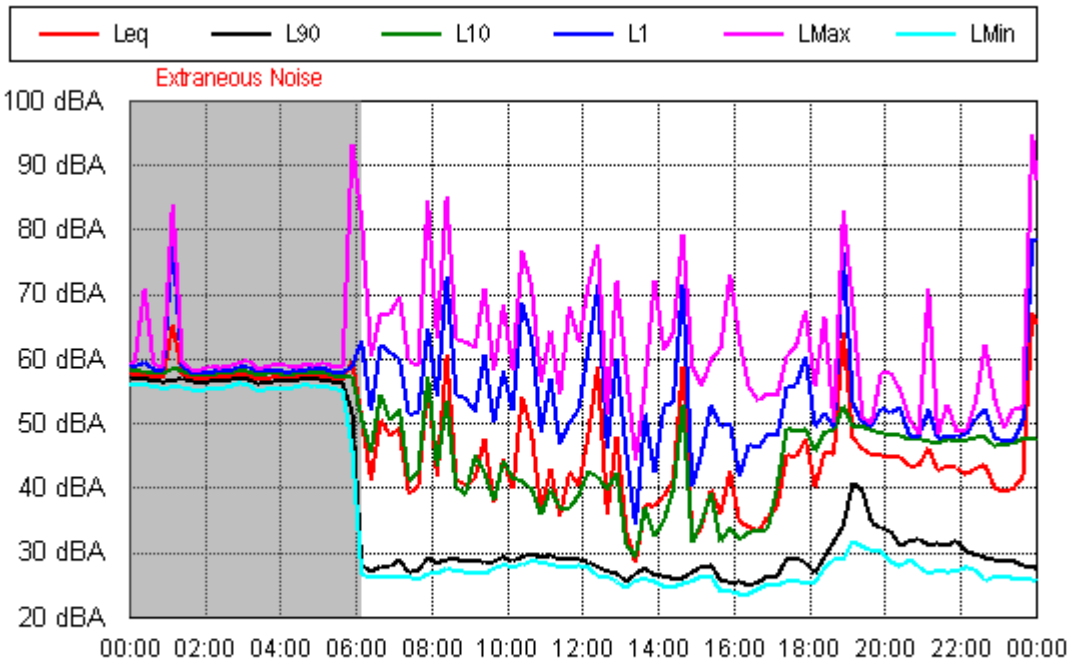




Project: Atlas
Location: Ivanhoe

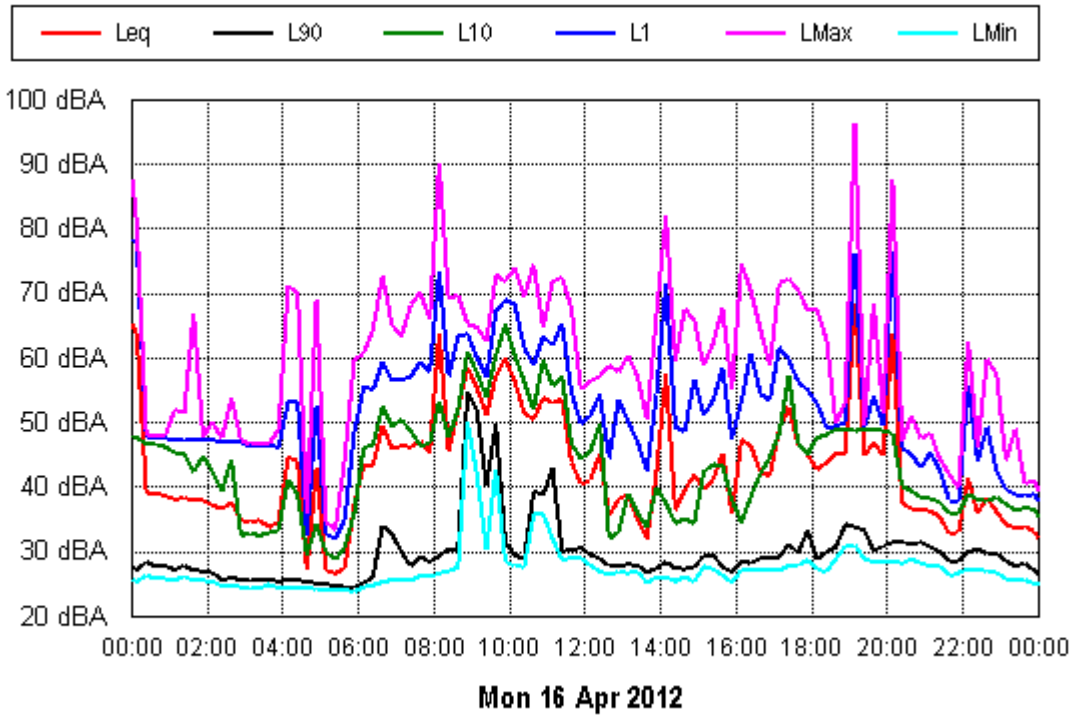


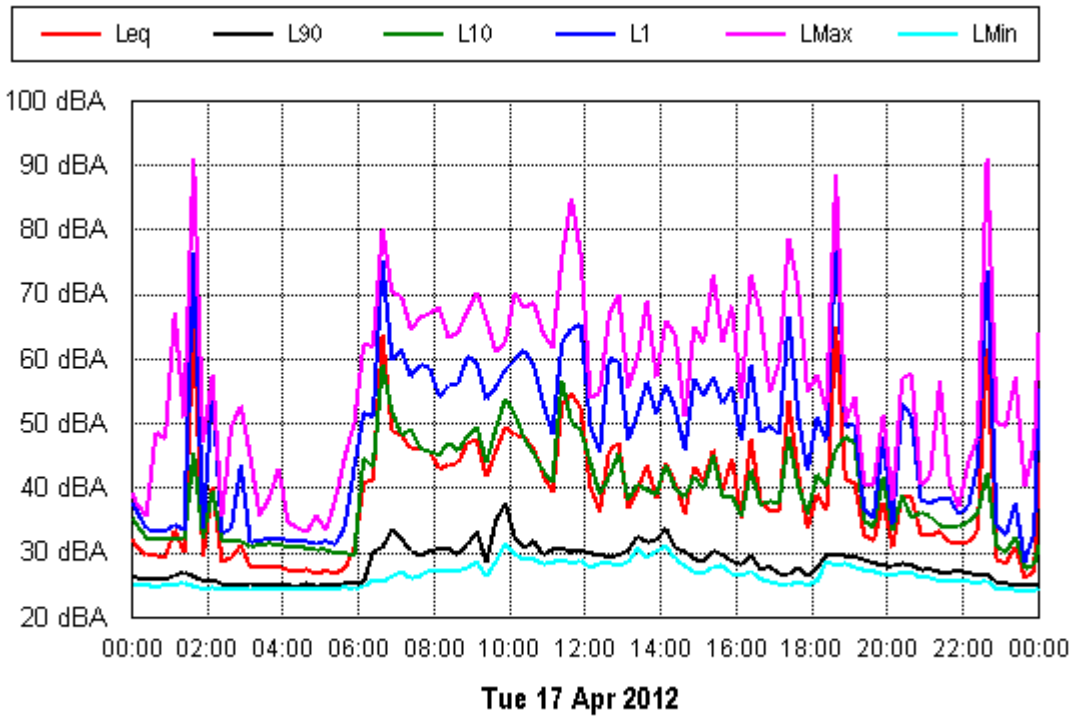
Sat 14 Apr 2012



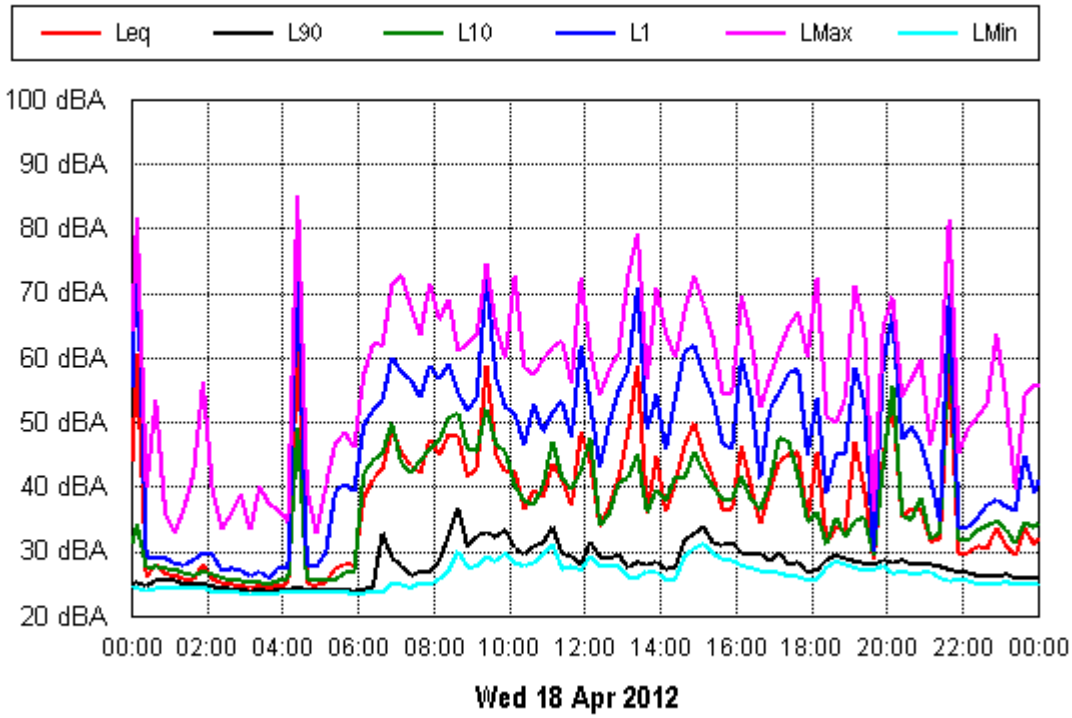
Sun 15 Apr 2012

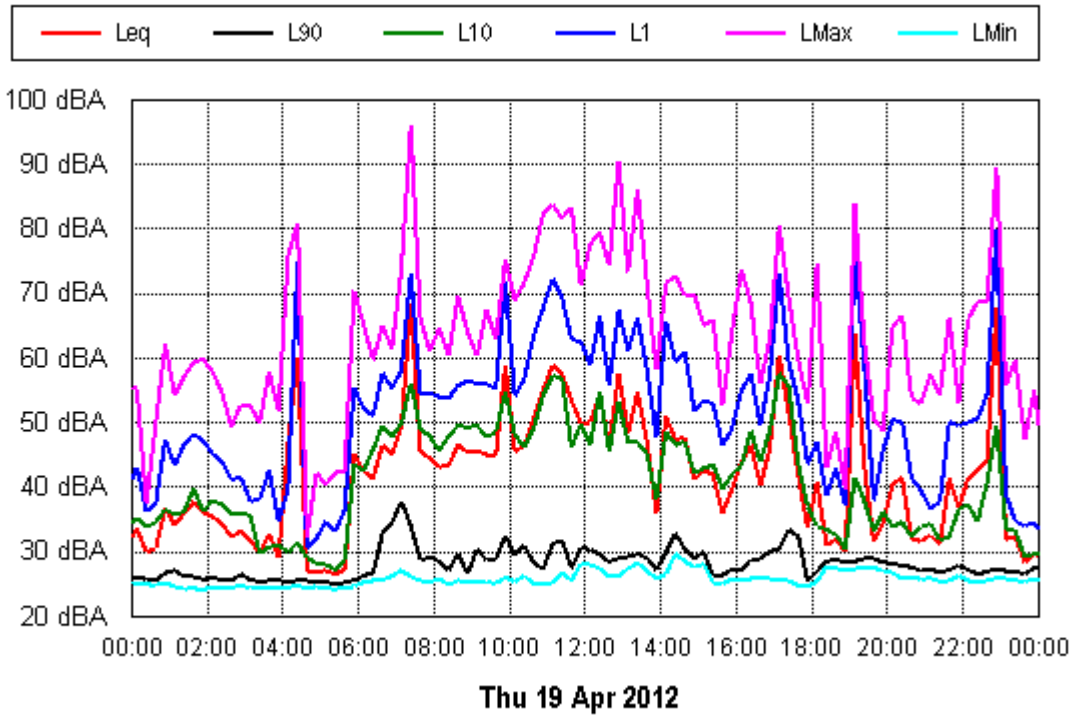
Project: Atlas
Location: Ivanhoe



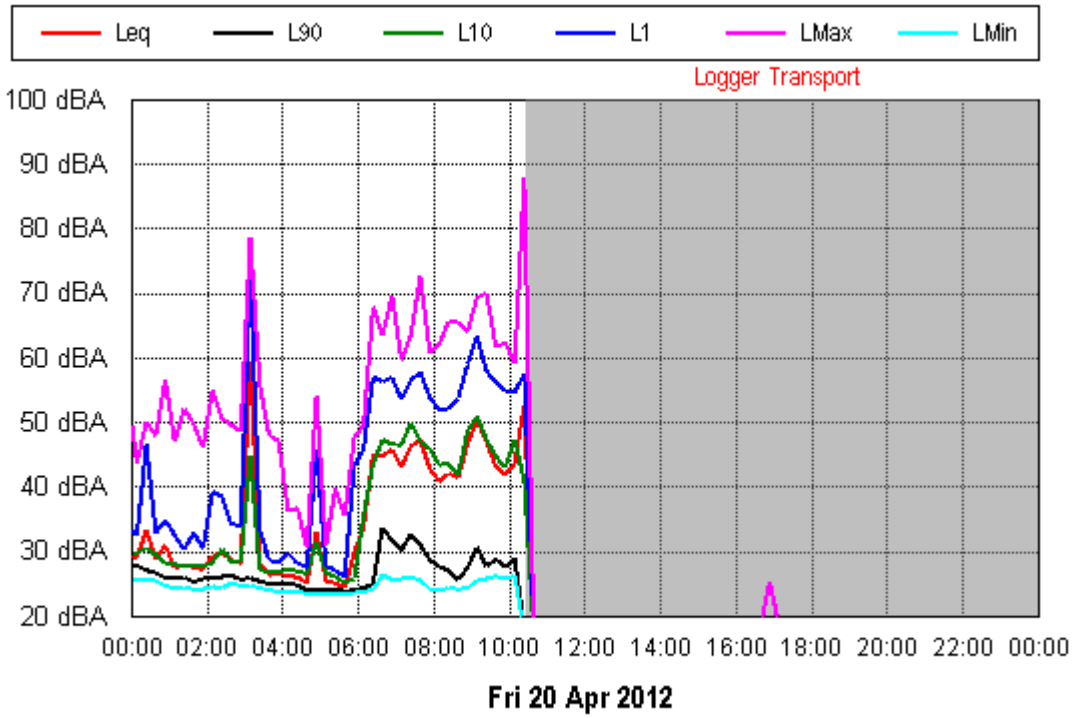


Project: Atlas
Location: Ivanhoe





Project: Atlas
Location: Ivanhoe



ATTACHMENT B

EPA Draft Rail Infrastructure Noise Guideline

1 DRAFT RAIL INFRASTRUCTURE NOISE GUIDELINE

At the time of writing, the Office of Environment and Heritage (OEH) had released the *Draft Rail Infrastructure Noise Guideline* (OEH, 2012) as a draft for consultation. The information provided in the *Draft Rail Infrastructure Noise Guideline* has been incorporated in the assessment of potential rail noise impacts for completeness and is presented in the sub-sections below.

1.1 Existing Rail Noise Impacts

The Australian Rail Track Corporation (ARTC) Master Train Plan 2012 indicates that there is a total of 40 rail passbys per week along the Orange-Broken Hill Railway through the Ivanhoe Railway Station. It is proposed to have a maximum two train movements in any one 24 hour period as a result of the Project. The following scenarios could occur:

- Scenario 1 - two train passbys occurring during the daytime (between 7.00 am and 10.00 pm); or
- Scenario 2 - one passby occurring during the day (between 7.00 am and 10.00 pm) and one at night (between 10.00 pm and 7.00 am); or
- Scenario 3 - two passbys occurring at night (between 10.00 pm and 7.00 am).

Please note that we have defined a 'passby' as the passing of a single train in one direction only.

The breakdown of daily rail passbys for Orange-Broken Hill Railway are presented in **Table B-1**.

Table B-1 Breakdown of Existing Daily Rail Passbys for Orange-Broken Hill Railway

Status	Type	Peak Train Movements			Train Length (m)
		Daytime/Evening	Night	24 Hours	
Approved	Passenger Trains	1	1	2	600
Approved	Freight Trains	4	4	6	1500 – 1800

Source: ARTC, 2012
m = metres

1.2 Rail Noise Impacts associated with Project

As the maximum number of Project rail passbys represents more than 10 percent of the total traffic on the line, a quantitative rail noise impact assessment is required.

In order to provide some insight into the rail noise impact assessment, the existing and proposed offset distances from the Orange-Broken Hill Railway in order to meet the relevant criteria have been calculated and are presented in **Table B-2**.

Table B-2 Criteria Offset Distances: Train Movements on the Orange-Broken Hill Railway

Period	Criterion (dBA)	Distance from Track (m)			
		Existing/Approved Movements	Existing/Approved Movements plus Scenario 1	Existing/Approved Movements plus Scenario 2	Existing/Approved Movements plus Scenario 3
EPA Draft Rail Infrastructure Noise Guideline trigger levels (rail traffic generating developments)					
$L_{Aeq,Day}$ (7.00 am-10.00 pm)	60	28	31	30	28
$L_{Aeq,Night}$ (10.00 pm-7.00 am)	55	85	85	90	94
$L_{Amax,Passby}$ Noise (95th percentile)	80	50	50	50	50

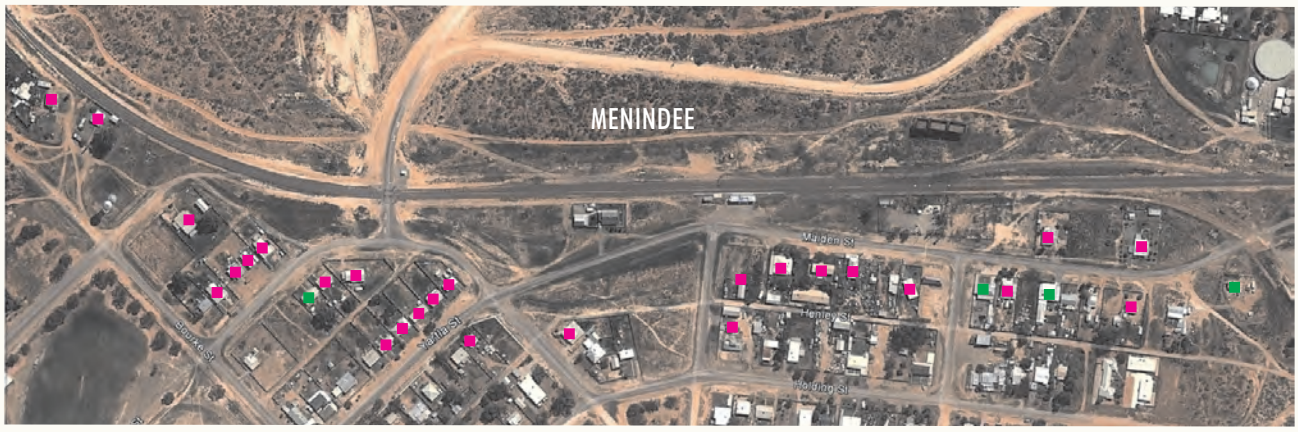
dBA = A-weighted decibel
L_{Aeq} = equivalent continuous noise level
L_{Amax} = maximum noise level

Table B-2 indicates that for the Orange-Broken Hill Railway west of the proposed Ivanhoe Rail Facility:

- The maximum increase in distance from the railway line at which the *Draft Rail Infrastructure Noise Guideline* criteria are met including the Project rail movements, compared with the existing/approved rail movements, would be 3 m for daytime operations and 9 m for night-time operations. It is anticipated that the increase in distances outlined above would result in one and seven additional exceedances of the relevant criteria for daytime and night-time operations along the Orange-Broken Hill Railway, respectively. The location of these additional exceedances are shown on **Figure B-1 and Figure B-2**.
- There would be no change to the maximum passby noise as a result of the Project rail movements.

REFERENCES

Australian Rail Track Corporation (2012) *ARTC Master Train Plan*, Effective 8 July 2012.
Office of Environment and Heritage (2012) *Draft Rail Infrastructure Noise Guideline*.



LEGEND

- Potential Receiver Location
- Predicted Additional Exceedance of Night Time Draft RING Criteria

Source: Google Earth (2012)

ATLAS - CAMPASPE PROJECT

FIGURE B-1

Receptors Proximal to the Orange-Broken Hill Railway within Menindee

WILKINSON MURRAY

CRISTAL

LEGEND

- Potential Receiver Location
- Predicted Additional Exceedance of Night Time Draft RING Criteria

Source: Google Earth (2012)

ATLAS - CAMPASPE PROJECT

FIGURE B-2

Receptors Proximal to the Orange-Broken Hill Railway

WILKINSON MURRAY

CRISTAL