20. NOISE AND VIBRATION

This chapter provides a summary of the acoustic environment values within the project development area and an assessment of the potential for these values to be affected by direct and indirect impacts associated with the construction, operation and decommissioning phases of the project. For the detailed findings of the project's noise and vibration impacts refer to Appendix N, Noise and Vibration Impact Assessment. Environmental protection objectives have been developed and the mitigation and management measures to achieve these objectives identified. The residual impact assessment assumes that the proposed mitigation and management measures have been applied.

Onsite occupational hazards associated with noise are outside of the scope of this assessment. Occupational health and safety hazards such as noise are addressed by Arrow's health, safety, and environmental management system.

20.1 Legislative Context and Standards

The following legislation, policy, guidelines and standards relate to the project and are relevant to identifying values and mitigating and managing impacts associated with noise and vibration during all phases of the project. These policies and guidelines and consideration of the existing acoustic environment inform proposed noise criteria for the project development area.

Environmental Protection Act 1994 **(Qld) (EP Act).** This act aims to protect the Queensland environment while facilitating ecologically sustainable development. With respect to noise, this is achieved through monitoring the impact of noise on sensitive receptors. This includes vibration and noise of any frequency, whether emitted through air or any other medium.

Environmental Protection (Noise) Policy 2008 (Qld) (EPP Noise). This policy aims to provide a method to control background noise creep as well as achieving acoustic quality objectives for sensitive receptors. This policy sets the minimum standards to be complied with in the installation and/or operation of vehicles, plant or equipment for the control of noise from these sources or places, and which are conductive to protecting the amenity of a community. It includes acoustic quality objectives based on the World Health Organization (WHO) guidelines with environmental noise criteria based on avoiding health and wellbeing impacts.

Guideline for Planning for Noise Control (DERM, 2004b). This guideline outlines the recommended methods and procedures for setting conditions related to noise emitted from industrial and commercial operations. The guideline is intended for planning purposes and is applicable to sounds from all sources that can contribute to the total noise emitted from a site to nearby sensitive receptors.

WHO Guidelines for Community Noise (WHO, 1999). The WHO has developed guidelines for community noise in specific environments. These guidelines provide noise level criteria for the sound pressure levels on balconies, terraces and indoor and outdoor living areas, which aim to protect the majority of people from being seriously or moderately annoyed.

Draft Guidelines for Assessing Low Frequency Noise (DERM, 2002). The draft guideline addresses noise based on the frequency of the noise and whether the noise is tonal or broad. It also provides acceptable indoor low frequency noise levels at noise-sensitive receptors.

Coal Seam Gas Industry Procedural Guide – Control of Noise from Gasfield Activities (DERM, 2011f). This protocol has been developed with the aim of assisting authorities with the regulation of noise emission from the gas industry in Queensland, specifically those relating to environmental noise from gas-field activities. The protocol recommends noise criteria for three different classes of activities: short-term, medium-term and long-term. For each type of noise emission, the criteria are determined based on measured background noise levels.

Noise Measurement Manual (DERM, 2000). This manual provides direction to 'authorised persons' as defined in the EP Act on the measurement of environmental noise to a standard suitable for determining compliance with the act, subordinate legislation and legal instruments issued under the authority of the legislation. It also provides information to people other than 'authorised persons' on the measurement of environmental noise.

AS 2670.2, Evaluation of Human Exposure to Whole-body Vibration - Part 2: Continuous and Shock Induced Vibration in Buildings (1 to 8080 HZ) (Standards Australia, 1990). The standard provides guidance in relation to assessing the potential human disturbance from ground-borne vibration inside buildings and structures.

DIN 4150.3, Structural Vibration – Part 3: Effect of Vibration on Structures (German Standard, 1999). The standard provides short-term and long-term vibration levels that are acceptable to maintain the structural integrity of various building types. Short-term vibration levels are relevant to the impact of vibration during the construction phase of a project. Long-term vibration levels are relevant to the impact of vibration throughout the operations phase.

Noise and Vibration from Blasting Guideline (DERM, 2006). Although blasting is not anticipated to form part of project activities, it has been considered to address the terms of reference. Appropriate noise and vibration criteria for blasting activity during construction were based on this guideline in addition to the EP Act. The guideline is used to set conditions of environmental authorities for activities such as mining. Specifically for human comfort, the recommended criteria are related to airblast overpressure level, ground vibration peak particle velocity and times of blasting.

20.2 Assessment Methods

The noise and vibration assessment involved identification of the baseline noise environment, modelling of potential noise sources and assessment of potential impacts associated with the project.

As the site location and facility design are yet to be finalised, the impact assessment was based on a typical site layout and indicative equipment, with the site assumed to be located in an acoustic environment typical of the project development area.

For the purposes of the assessment, a sensitive receptor is considered to be a location in the vicinity of the proposed development, where noise may affect the amenity of the land use. Sensitive receptors in the project development area are generally considered to be dwellings (but also include a library, childcare centre, kindergarten, school, college, university or other educational institution; a hospital, surgery or other medical institutions). The location of potential sensitive receptors is illustrated in Chapter 4, Environmental, Social and Economic Context (Figures 7.2a, b and c).

20.2.1 Desktop Study

To determine the existing acoustic environmental values that may be affected by noise and vibration from the project, reference was made to the EPP (Noise).

Twelve months of historical meteorological data was analysed to determine the prevalent meteorological conditions within the Surat Basin and to establish seasonally representative conditions for noise monitoring and modelling.

20.2.2 Field Survey

In order to determine the existing acoustic environment for different areas within the project development area, noise measurements were conducted at four locations in accordance with the DERM (2000) Noise Measurement Manual.

Monitoring locations were selected to provide a representative indication of the ambient and background noise levels likely to be experienced at sensitive receptors within the project development area. Monitoring locations also included some sites that are influenced by noise from existing gas industry infrastructure or other existing noise sources. The locations where noise measurements were taken are shown on Figure 20.1. The coordinates of the monitoring locations and the measurement period during which monitoring was undertaken are shown in Table 20.1. Noise levels were measured continuously during day and night throughout the measurement period.

Table 20.1 Coordinates of background noise monitoring locations

Monitoring Location	Coordinates (GDA 94 MGA 56)		Measurement Period
	Easting	Northing	
ML 1	317259	6972259	21 to 29 October 2009
ML 2	319207	6947778	21 to 29 October 2009
ML 3	309392	6986083	21 to 29 October 2009
ML 4	310426	6969874	7 to 13 January 2010

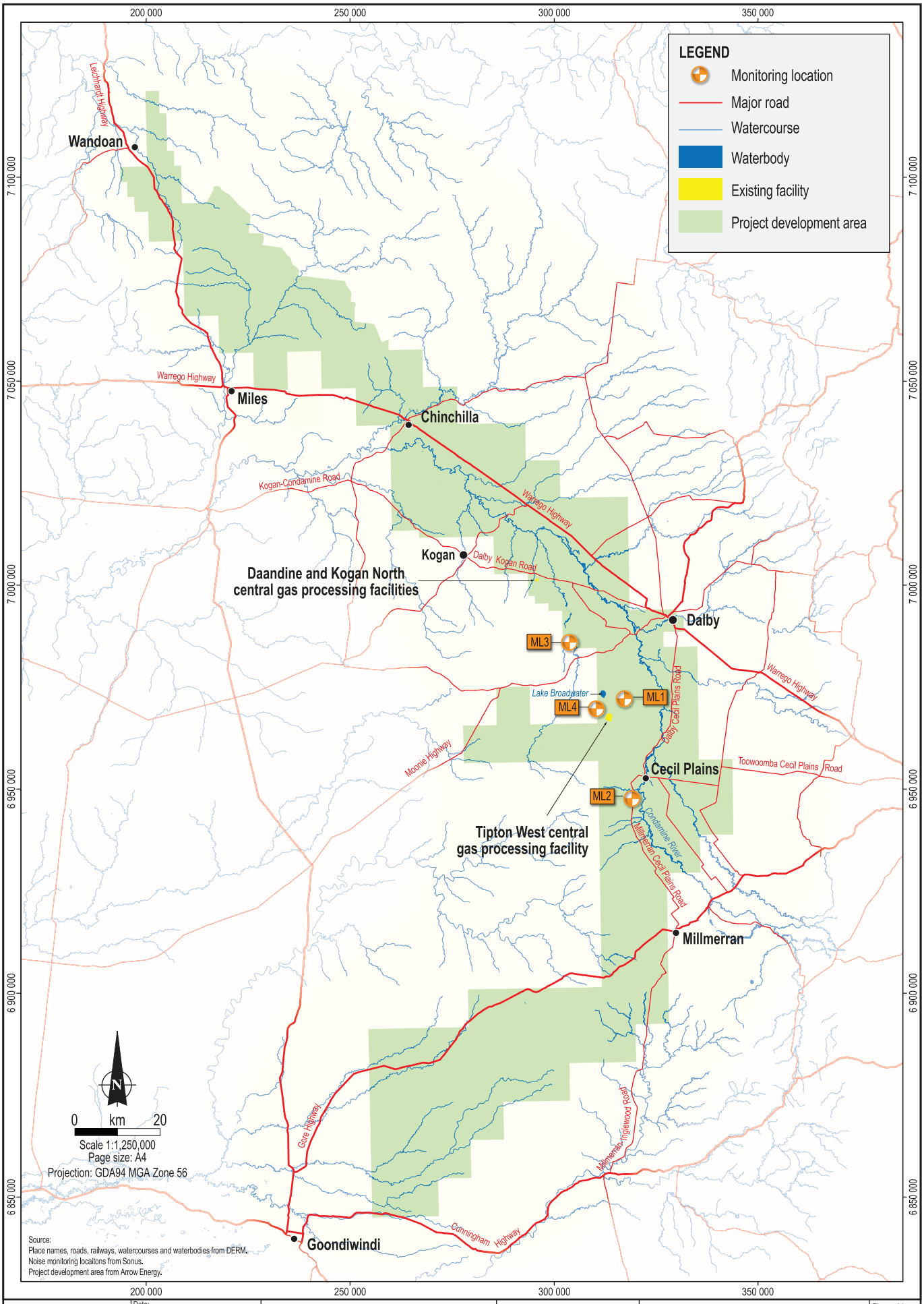
20.2.3 Modelling Assumptions

Noise modelling was undertaken for expected noise sources at a typical production facility and a production well. Receptor sites for the modelling of noise were selected to represent a range of distances and directions from any nominal location.

Given that construction equipment and techniques have not been finalised, noise levels were modelled based upon known sound levels of typical construction equipment. The construction equipment, and the stage during which they were predicted to be used, are summarised below.

- Site preparation (truck, front-end loader, excavator, scraper, dozer and grader).
- Surface equipment installation (crane, hand-held grinder, rock saw, generator, welding generator and air compressor).
- Drilling (drill rig, generator, truck and front-end loader).
- Site rehabilitation (grader and bobcat).

Operational noise levels were modelled on indicative equipment. Main operational noise sources for the different components of the proposed production facilities, production wells and pipelines are summarised below.



coffey environments	Date: 06.12.2011 MXD: 7040AC_04_GIS110_v1_3 File Name: 7040_04_F20.01_GIS_GL	Arrow Energy Surat Gas Project	arrow energy go further	Approximate noise monitoring locations	Figure No: 20.1

Production facilities:

- Gas compression units (screw compressors, reciprocating compressors, electric motors and coolers).
- Power generation plant (power generators and gas engines).
- Water treatment facility (centrifugal pumps and electric motors).
- Water transfer pump (centrifugal pumps).
- Flare.

Production wells and pipelines:

- 60-kW wellhead electric motor.
- 5.7-L gas engine generator.

20.2.4 Meteorological Conditions for Modelling

Noise was modelled for each of the monitoring locations using the CONCAWE noise propagation model (Manning, 1981), which is widely accepted as an appropriate sound propagation model for predicting noise over significant distances.

The CONCAWE system categorises meteorological conditions into six categories, from Category 1, which is considered the 'best-case' meteorological conditions (i.e., low noise levels are experienced due to meteorological conditions that hinder noise propagation), to Category 6, which is considered the 'worst-case' (i.e., a high noise level will result due to meteorological conditions that are conducive to noise propagation), when considering wind speed, wind direction, time of day and level of cloud cover.

Through assessment of existing meteorological conditions in the project development area it was determined that sensitive receptors located to the south and east of a facility represent Category 4 meteorological conditions, and sensitive receptors located to the west and north of a facility represent Category 6 meteorological conditions.

An existing low noise environment with no noise contribution from existing industrial facilities was assumed for noise modelling at all locations.

20.2.5 Noise Modelling for Production Facilities

The assessment considered noise from the construction and operation of each of the production facility types (field compression facility, central gas processing facility and integrated processing facility), of which integrated processing facilities are considered to have the most noise sources and emit the highest noise levels. For this reason, noise modelling was based on the operation of an integrated processing facility at maximum production capacity (150 TJ/d).

Sound propagation was modelled to several reference locations that were considered to be representative of possible locations of the closest sensitive receptors. These reference locations are summarised in Table 20.2.

Table 20.2 Reference locations of the potential closest sensitive receptor

Reference Location	Relative Direction from Facility	Distance from Facility (km)
RF1	West	1
RF2	West	2
RF3	West	3
RF4	West	5
RF5	South	1
RF6	South	2
RF7	South	3
RF8	South	5

20.2.6 Noise Modelling for Production Wells

For the modelling of construction noise, separation distances of 50 m, 100 m, 150 m, 200 m, 250 m, 500 m, 750 m and 1,000 m between sensitive receptors and production wells were considered. The production wells layout was based on the conceptual 800-m wide grid spacing, with the associated gas and water gathering systems linking the production wells to production facilities.

For the modelling of operational noise, separation distances of 50 m, 100 m, 150 m, 200 m, 250 m and 300 m, measured from the location of the generator and motor, were considered.

20.2.7 Vibration

The assessment of vibration impacts of the project on sensitive receptors has been based on previous measurements of vibration levels at similar facilities with similar equipment and settings. The measured vibration levels were used to determine where there is potential for vibration impacts on sensitive receptors.

20.2.8 Establishment of Assessment Criteria

The noise impact assessment was based on what is considered to be a typical environment within the project development area for the sensitive receptors, whereby sensitive receptors are subject to a low baseline noise environment with no noise contribution from existing gas infrastructure.

Based on this assumption, the potential impacts resulting from noise generated by project activities have been assessed and compared to the gas industry procedural guide (DERM, 2011f), which proposes the following noise criteria for short-term, medium-term and long-term activities, as shown in Table 20.3. The descriptors include:

- $L_{Aeq,adj,15mins}$: The noise level, adjusted to represent the response of the human ear and measured in decibels over a period of 15 minutes and adjusted for tonality.
- $_{max}L_{p,A,15mins:}$ The maximum noise level, adjusted to represent the response of the human ear and measured in decibels over a period of 15 minutes.

Table 20.3 Noise criteria at sensitive receptors

Time Period	Descriptor	Short-term Noise Event	Medium-term Noise Event	Long-term Noise Event
7:00 a.m. to 6:00 p.m.	$L_{Aeq,adj,15mins}$	45 dB(A)	43 dB(A)	40 dB(A)
6:00 p.m. to 10:00 p.m.	$L_{Aeq,adj,15mins}$	40 dB(A)	38 dB(A)	35 dB(A)
10:00 p.m. to 6:00 a.m.	$L_{Aeq,adj,15mins}$ $\max L_{p,A,15mins}$	28 dB(A) 55 dB(A)	28 dB(A) 55 dB(A)	28 dB(A) 55 dB(A)
6:00 a.m. to 7:00 a.m.	$L_{Aeq,adj,15mins}$	40 dB(A)	38 dB(A)	35 dB(A)

Blasting is not anticipated to occur at any stage of the project. If blasting does occur, it will be conducted in accordance with the criteria set out in the guidelines for blasting noise and vibration (DERM, 2006) and the EP Act.

There are two aspects to vibration impacts associated with the project – human comfort and structural damage.

To ensure human comfort, the measured vibration at a sensitive receptor should range from 3.6×10^{-3} to 5×10^{-2} (rms) m/s^2 (the root mean square (rms) acceleration is a method of quantifying severity of human vibration exposures) across an octave band range of 1 to 80 Hz, as stated in AS 2670.2 (Standards Australia, 1990).

To ensure structural integrity and protect dwellings from damage, the measured vibration at a sensitive receptor should not exceed 15 mm/s during construction or 5 mm/s during operation, as stated in DIN 4150.3 (German Standard, 1999).

20.3 Existing Environment and Environmental Values

The existing environment is described below in terms of setting and baseline monitoring.

20.3.1 Setting

The proposed project is located in a rural area of the Surat Basin that is dominated by natural sounds. These sounds, such as birds and wind in the trees, result in a low noise environment typical of rural settings. There are, however, some areas where existing facilities associated with the coal seam gas, power generation or mining industries may have an influence on the existing acoustic environment. The location of sensitive receptors throughout the project development area reflects the typically low population density of agricultural areas.

20.3.2 Baseline Monitoring

Results from baseline noise monitoring at four representative monitoring locations within the project development area determined that two of the four locations (ML 2 and ML 3) had low background noise levels and were not influenced by any existing gas industry activities.

Baseline monitoring at site ML 1 (situated approximately 1,700 m to 2,200 m from existing productions wells) and site ML 4 (situated approximately 3.8 km from Tipton West central gas processing facility and approximately 800 m to 1,500 m from existing production wells) identified elevated background noise levels. The baseline monitoring at these locations thus provides an indication of the existing background noise levels at sensitive receptors in proximity to existing production facilities and, accordingly, those locations that are affected by unnatural noise.

The ambient and background noise levels recorded at each of the four monitoring locations are presented in Figure 20.2. Using this data, each monitoring location's rating background level was calculated in accordance with the guidelines for planning for noise control (DERM, 2004b).

The rating background level is the overall background noise level representing an assessment period (day, evening or night) over a monitoring period of (normally) three to seven days.

A generally low noise environment persists through the project development area, even where there is influence from existing industrial activity. This is indicated by the rating background levels summarised in Table 20.4. These background levels are considered to be representative of all seasons.

Table 20.4 Calculated rating background levels

Measurement Location	Industrial Noise Influence	Rating Background Level (dB(A))		
		Day	Evening	Night
ML 1	Yes	26	29	26
ML 2	No	29	22	19
ML 3	No	25	22	19
ML 4	Yes	32	34	34

Elevated background noise levels at sites ML 1 and ML 4 are influenced by the existing production facilities and other existing noise sources in the vicinity. It is noted that the noise levels at site ML 4 are comparatively higher due to noise influences predominantly from existing production wells with hydraulic wellheads. These wellheads produce more noise than modern wellheads, and it is not anticipated that Arrow will use hydraulic wellheads as part of the Surat Gas Project.

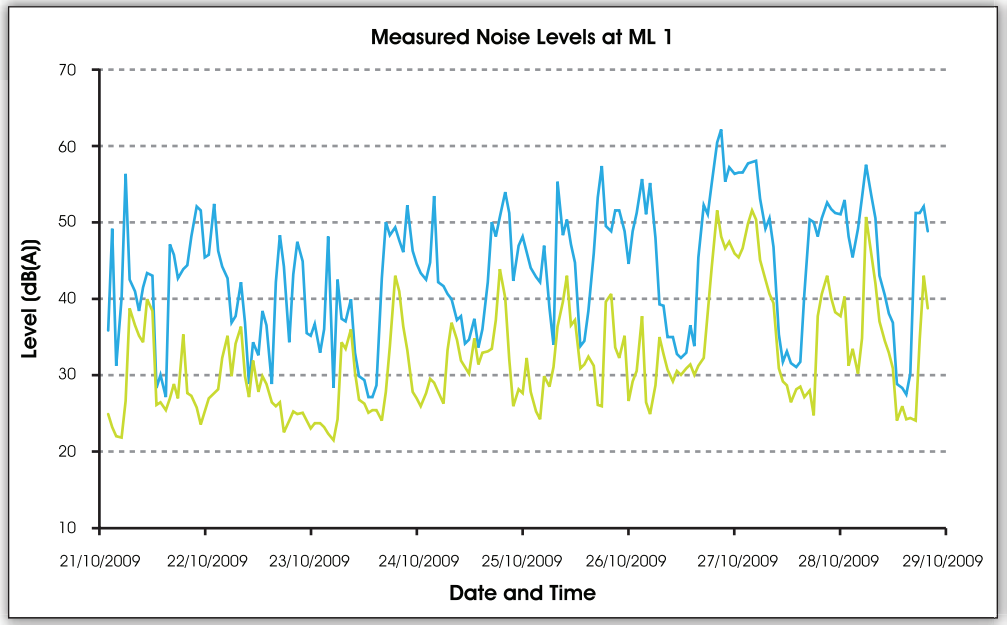
By analysing the ambient and background noise level measurements at ML 4, it was possible to estimate that the contribution of noise from the existing production wells (located 800 m to 1,500 m away) and other facilities (located 3.8 km away) is approximately 40 dB(A), under worst-case meteorological conditions.

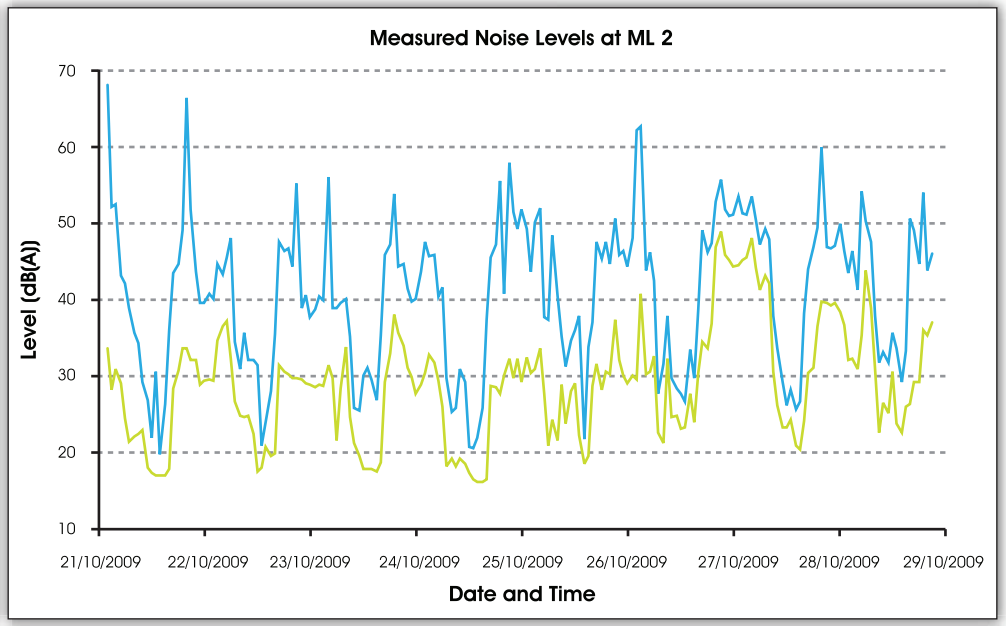
No appreciable vibration sources could be detected during inspection of the four representative measurement locations.

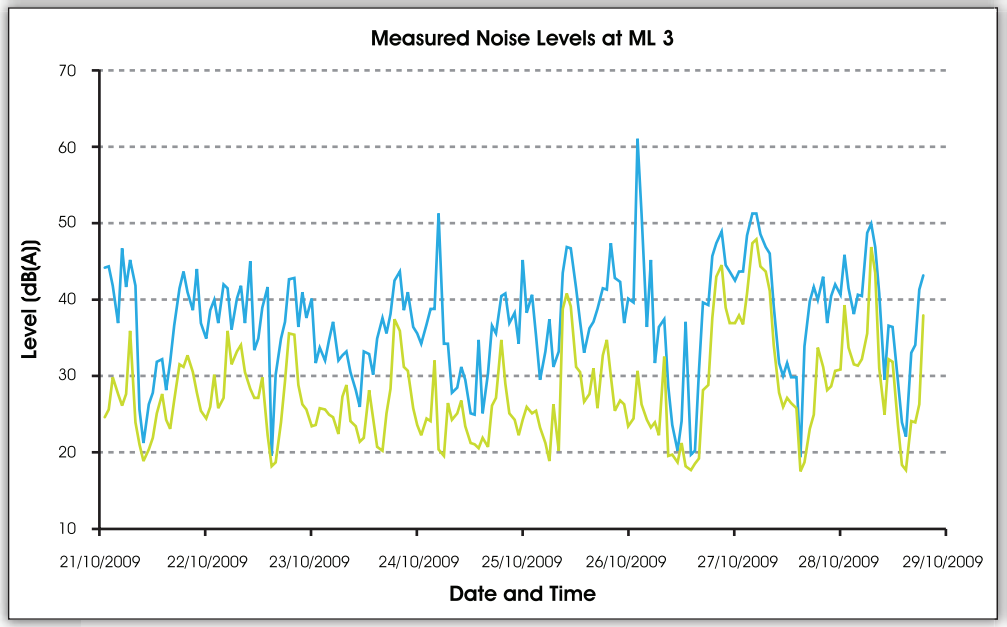
20.3.3 Environmental Values

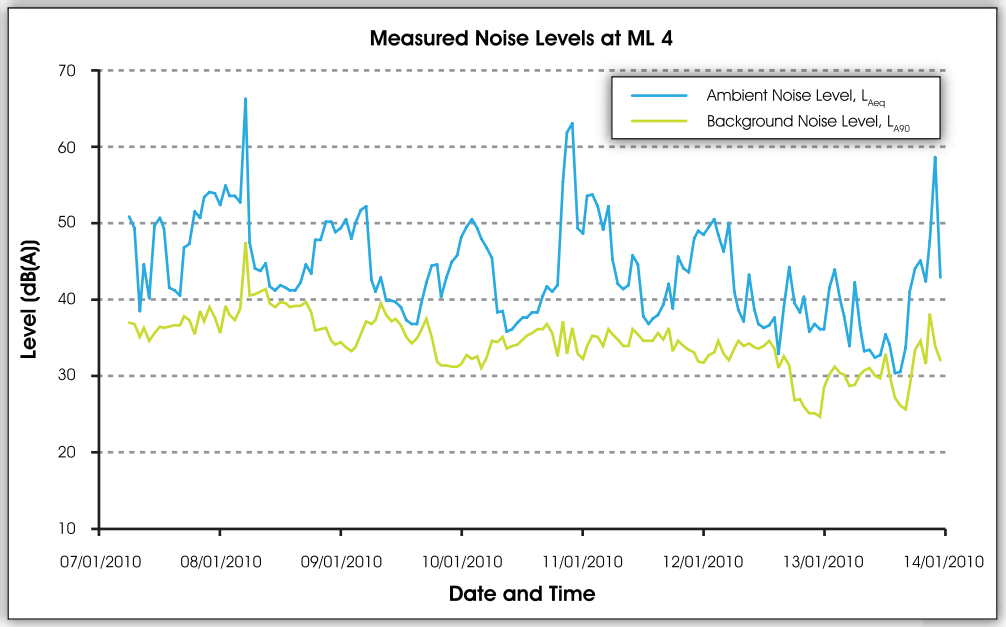
The EPP (Noise) (Part 3, Clause 7) states that the environmental values to be protected from noise and vibration are:

- the qualities of the acoustic environment that are conducive to protecting the health and biodiversity of ecosystems; and
- the qualities of the acoustic environment that are conducive to human health and wellbeing, including by ensuring a suitable acoustic environment for individuals to do any of the following:
  - (i) sleep;
  - (ii) study or learn;
  - (iii) be involved in recreation, including relaxation and conversation; and
- the qualities of the acoustic environment that are conducive to protecting the amenity of the community.









Source: Data from Sonus Pty Ltd
Note: All x-axis intervals taken at 12:00 pm

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Measured background noise levels

Figure No: 20.2

20.4 Issues and Potential Impacts

The significance of potential impacts from project activities on the values of the acoustic environment has been assessed with consideration for using the sensitivity of the values and the magnitude of the potential impacts (as described in Chapter 7, Impact Assessment Method).

Potential impacts on the acoustic environment from project activities include:

- Environmental noise disturbance. This includes nuisance noise and background noise creep, which is when noise levels progressively become higher over time.
- Vibration-induced human discomfort and structural damage.

Activities with the potential to cause these adverse impacts on the values of the acoustic environment during the construction, operation and decommissioning phases of the project are described below.

20.4.1 Construction

The following construction activities represent potential impacts on acoustic environmental values:

- Construction of the production wells, which includes site preparation, drilling and well construction.
- Construction of the associated gas and water gathering systems.
- Construction of the medium-pressure gas pipelines that connect production facilities and the high-pressure gas pipelines that connect production facilities with the sales gas pipeline.
- Construction of powerlines in the event that mains power is used to eliminate the need for wellhead generators.
- Construction of the production facilities comprising the field compression facilities, central gas processing facilities and integrated processing facilities.
- Blasting during construction. Blasting is not anticipated during construction of the project but was considered in the assessment, should the need arise.

20.4.2 Operation

The following operational activities represent potential impacts on acoustic environmental values:

- Operation of the production wells and the production facilities.
- Blasting activities (not anticipated to occur).
- Operation of the power generators.

20.4.3 Decommissioning

Impacts from decommissioning activities are expected to be low but similar to those associated with construction. The following decommissioning activities represent potential impacts on acoustic environmental values:

- Decommissioning of the production wells.
- Decommissioning of powerlines in the event that mains power is used to eliminate the need for a wellhead generator.

- Decommissioning of the production facilities.

20.4.4 Predicted Construction Noise Levels

For construction of production facilities, modelling predictions indicate that, under worst-case meteorological conditions where noise propagation is pronounced, the daytime long-term noise criterion of 40 dB(A) will be met at sites located 3 km or more from the facility site (i.e., RF 3, RF 4, RF 7 and RF 8).

If activities were to be undertaken at a distance of less than 3 km from the noise source, acoustic treatment would need to be applied in order to meet the criteria.

Similarly, for construction of production wells and pipelines, modelling predictions indicate that if activities were to be undertaken at a distance of less than 1 km from the noise source, acoustic treatment would need to be applied in order to meet the criteria.

20.4.5 Predicted Operational Noise Levels

Production facility operational noise was modelled at each of the reference locations under the assumption of a worst-case noise scenario where all equipment is operating simultaneously and continuously, using a 150-TJ/d integrated processing facility, which is considered to be the facility that would generate the most noise.

The noise levels, modelled without any acoustic treatment, are shown as noise contours around the integrated processing facility in Figure 20.3. The modelling of sound propagation from a typical facility operating at full output indicates that, without acoustic treatment, the long-term night-time noise criterion of 28 dB(A) will be met at the reference locations at a distance of 5 km or more from the production facility. The application of different levels of acoustic treatment will ensure that the long-term night-time noise criterion of 28 dB(A) can be met at all reference locations, as seen in Figure 20.4.

Production well operational noise modelling predicted that, without any acoustic treatment, the long-term night-time noise criterion of 28 dB(A) can be met at a distance of 300 m from a production well. This distance decreases to 200 m for the alternative scenario where the 5.7-L gas generator is replaced by the use of electricity from the power grid, and to 80 m with the incorporation of acoustic treatments (e.g., barriers and equipment housing) into facility design.

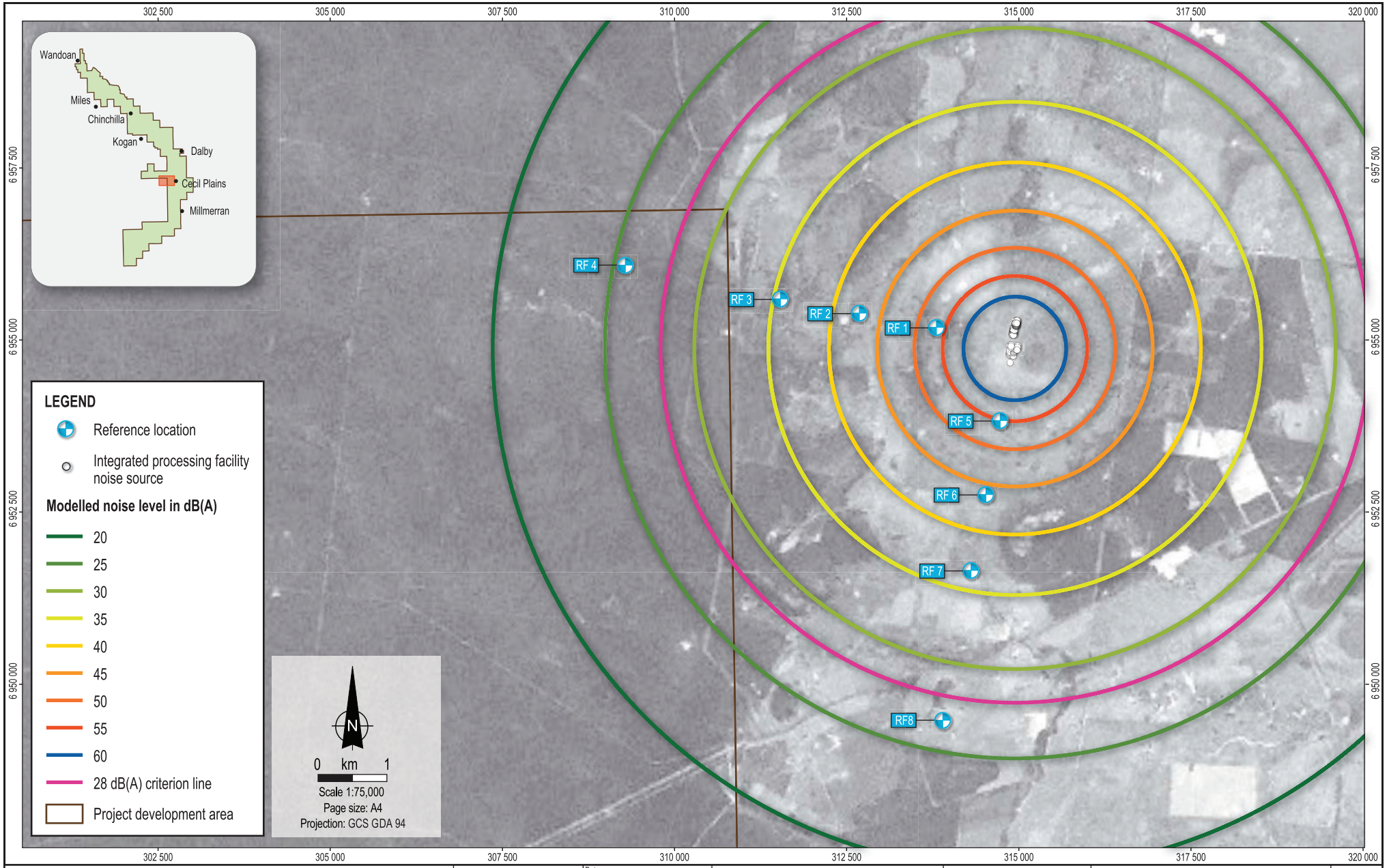
There will be no significant noise sources associated with the operation of water and gas pipelines as they will be located underground.

20.4.6 Flaring

Modelling of short-term noise sources, such as gas flaring, indicates that the short-term night-time criterion of 28 dB(A) will be exceeded at reference locations located within 1 km of a typical integrated processing facility, but will be met at other reference locations. The noise criteria for other periods of the day will be met at all reference locations. Facilities will be sited to provide adequate separation from sensitive receptors, although short-term exceedences might occur under emergency conditions.

20.4.7 Low Frequency Noise

Modelling of low-frequency noise levels indicates that, with the application of acoustic treatment at the source, the criterion of 20 dB(A) during the evening or night and 25 dB(A) during the day (DERM, 2002) will be met at all reference locations.



Source:
Place names from DERM.
Noise contours, receivers and IPF noise sources from Sonus.
Project development area from Arrow Energy.
Imagery from ArcOnline (currency unknown).

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File Name: 7040_04_F20.03_GIS_GL

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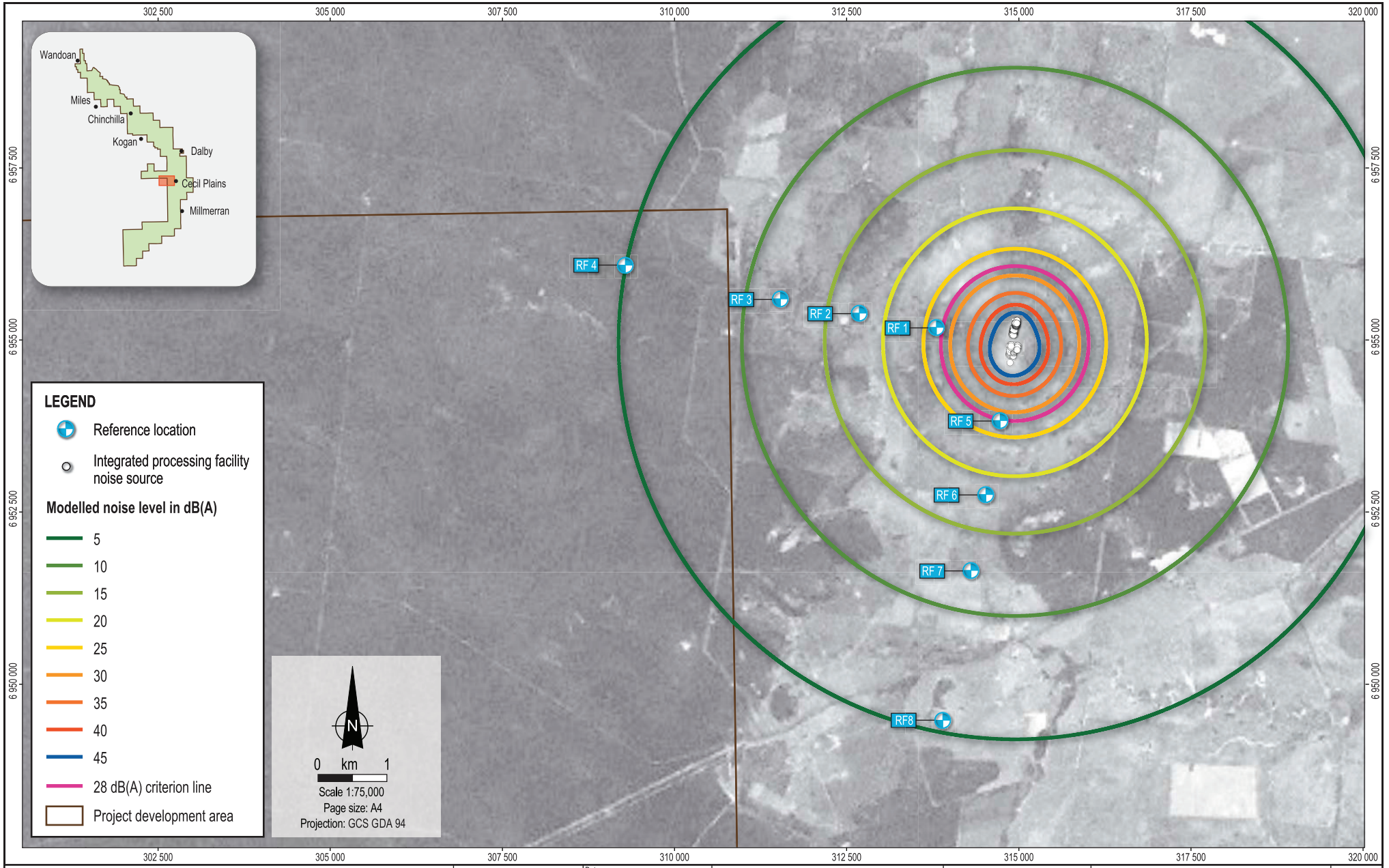
Noise contours – without acoustic treatment

Figure No: 20.3



Source:
Place names from DERM.
Noise contours, receivers and IPF noise sources from Sonus.
Project development area from Arrow Energy.
Imagery from ArcOnline (currency unknown).

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MXD: 7040AC_04_GIS141_v1_1
File Name: 7040_04_F20.04_GIS_GL

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Noise contours – with the acoustic treatment required to achieve 28 dB(A) at 1 km

Figure No: 20.4

20.4.8 Vibration

Vibration levels are expected to be below the threshold of human detection and to not cause structural damage at sensitive receptors that are located at distances greater than 100 m from the activity.

20.4.9 Traffic Noise and Vibration

The potential noise and vibration impact from off-site traffic generated by the project was considered based on the estimated peak project-generated travel determined in Appendix M, Road Impact Assessment.

Based on the anticipated vehicle (heavy and light) travel increase of less than 2% on the road network, the noise levels at sensitive receptors from road traffic will increase by no greater than 0.1 dB(A) above the current level. From a noise perspective, a 0.1 dB(A) increment is considered negligible and will not be evident at sensitive receptors.

Similarly for vibration, the impact from additional vehicles on the road will not be dissimilar to the impact from existing vehicles using the road network. Therefore, the vibration impact from traffic generated by the project is not expected to change the existing levels at sensitive receptors.

Given that direct use of rail transportation is not anticipated for the project, the potential impact from rail was not considered in the assessment.

20.4.10 Impact on Livestock

It is predicted that livestock will experience noise and vibration levels that will be similar to those experienced when grazing near road or rail infrastructure.

20.5 Environmental Protection Objectives

Environmental protection objectives for noise and vibration are to:

- Ensure that noise emissions from Arrow's Surat Gas Project activities comply with current legislation.
- Protect the amenity of nearby sensitive receptors by reducing noise and vibration impacts from production facilities and associated workforce and infrastructure.

20.6 Avoidance, Mitigation and Management Measures

Avoidance, mitigation and management measures have been proposed for each project phase, to achieve the identified environmental protection objectives.

20.6.1 Planning and Design

The principal mechanism for avoiding impacts on the acoustic environment of sensitive receptors is through site selection and incorporation of acoustic treatments into facility design. Avoidance through site selection that provides effective separation distances between facilities and infrastructure and the nearest sensitive receptor forms part of Arrow's environmental framework (See Chapter 8, Environmental Framework). Acoustic design involves detailed noise engineering at the design stage that is considerate of the specific locations of sensitive receptors in the vicinity of selected sites, the nature of equipment to be installed and the level of acoustic treatment that would be necessary to ensure that the noise criteria are met at the sensitive receptor locations. Design and planning measures include, but are not necessarily limited to, the following:

- Preferential selection of sites in sparsely populated areas. [C309]
- Site-specific, detailed noise modelling of production facilities and the application of acoustic treatments where the modelled noise from facilities exceeds the established noise criteria at one or more sensitive receptors. Consideration of intrinsically quieter equipment or design of acoustic treatments such as hospital-grade exhaust systems and mufflers, or barriers and equipment housing will be given. [C310]
- Manage noise in accordance with the relevant environmental authority conditions. Where night-time activities are planned (10 p.m. to 6 a.m.) and are likely to exceed the prescribed noise criteria, conduct prior consultation with affected parties. [C304]
- Locate equipment associated with production wells and associated wellhead infrastructure at a distance of 200 m or more from a sensitive receptor. [C311]

20.6.2 Construction and Decommissioning

To limit the impact of noise caused by construction and decommissioning activities on nearby sensitive receptors, Arrow shall:

- Consult with those who may be affected by increased noise levels due to construction activities with particular reference to the type and timing of works. [C305]
- Implement a grievance management system that responds to noise complaints. If necessary, undertake noise monitoring of construction activities to facilitate a response to the grievance. [C307]
- Where noise reduction devices are deemed necessary, ensure devices (such as mufflers, low-noise fans and possibly enclosures) are fitted and work correctly. [C301]
- Conduct a risk-based assessment or potential vibration monitoring during any construction activity that occurs within 100 m of a sensitive receptor that might be subject to vibration. [C306]
- Operate equipment and handle materials in a manner that does not cause unnecessary noise (e.g., excessive revving or dropping materials). [C302]
- Consider the following factors prior to any blasting operations being conducted:
  - The type of rock and stratigraphy being blasted and any associated faulting.
  - The distance of the blast site from sensitive receptors.
  - The type, size and number of charges used.
  - The depth and manner in which the charge is installed.
  - The meteorological conditions.
  - Methods of controlling blast noise and vibration, such as mats or smaller blasts. [C312]

20.6.3 Operation

Mitigation measures to limit the impact of noise and vibration caused by operating activities on nearby sensitive receptors include:

- Ensure all engines, machinery equipment and pollution control mechanisms are operated and maintained in accordance with manufacturers' recommendations. [C011]
- Where practicable, schedule planned flaring events (e.g., those preceding shut-down maintenance) for the period between 6 a.m. and 10 p.m. [C313]

20.7 Residual Impacts

The avoidance, mitigation and management measures outlined above will reduce the severity of noise and vibration impacts on the surrounding environment. The residual impacts associated with construction, operation and decommissioning of the project in relation to noise are summarised in Table 20.5 and further described below.

Residual impacts are expected to be negligible as the impact assessment determined that relevant criteria can be achieved at sensitive receptors through the use of appropriate mitigation measures, where necessary.

The primary mitigation measure will be the avoidance of project development near sensitive receptors. The relatively sparse pattern of population throughout the project development area provides opportunities to site the infrastructure with adequate separation, thus minimising the need for acoustic treatment.

Once locations are finalised, infrastructure will be designed to meet noise and vibration objectives at sensitive receptors.

20.8 Inspection and Monitoring

Implement monitoring and inspection of avoidance, mitigation and management measures to ensure the residual impacts continue to be negligible throughout the lifetime of the project. [C317]

If directed by the administering authority in response to a valid noise complaint, undertake noise monitoring in accordance with the DERM (2000) Noise Measurement Manual. [C318]

Table 20.5 Summary of noise impact assessment

Cause of Potential Impacts	Existing Environment	Premitigated Impact	Summary of Mitigation Measures	Residual Impact
Environmental Noise Associated with Production Facilities, Production Wells and Pipelines				
Construction and decommissioning • Vehicles and earthmoving equipment involved in construction. • Gas field decommissioning and rehabilitation.	The existing acoustic environment is dominated by natural sounds. An existing low noise environment was assumed at the locations of potential closest sensitive receptors to the sites.	**Construction and decommissioning (production facilities):** Noise criteria met at sensitive receptors 3 km from source. **Construction and decommissioning (production wells and** pipelines): Noise criteria met at sensitive receptors 1 km from source.	**Design and planning** • Preferential selection of sites in sparsely populated areas. • Conduct noise modelling of production facilities where the modelled noise exceeds the established noise criteria at sensitive receptors. Consider quieter equipment or design acoustic treatments such as mufflers, barriers or equipment housing. • Manage noise in accordance with the relevant environmental authority conditions. Where night-time activities are planned (10 p.m. to 6 a.m.) and are likely to exceed the prescribed noise criteria, conduct prior consultation with affected parties. **Construction and decommissioning** • Consult with those who may be affected by increased noise levels due to construction activities with particular reference to the type and timing of works. • Implement a grievance management system that responds to noise complaints. If necessary, undertake noise monitoring to facilitate a response to the grievance. • Ensure all engines, machinery equipment and pollution control mechanisms are operated and maintained in accordance with manufacturers' recommendations. Where noise reduction devices are deemed necessary, ensure devices are fitted and work correctly. • Consider the following factors prior to any blasting operations being conducted: – The type of rock and stratigraphy being blasted and any associated faulting. – The distance of the blast site from sensitive receptors. – The type, size and number of charges used. – The depth and manner in which the charge is installed. – The meteorological conditions. – Methods of controlling blast noise and vibration, such as mats or smaller blasts. **Operation** • Ensure all engines, machinery equipment and pollution control mechanisms are operated and maintained in accordance with manufacturers' recommendations. • Where practicable, schedule planned flaring events (e.g., those preceding shut-down maintenance) for the period between 6 a.m. and 10 p.m.	None anticipated – criteria expected to be met at the nearest sensitive receptor.
Operation • Operating equipment. • Compressor operation. • Flaring. • Wellhead operation.		**Operation (production facilities):** Noise criteria met at sensitive receptors 5 km from source. **Operation (production wells and pipelines):** Noise criteria met at sensitive receptors 300 m from source. **Flaring:** Noise criteria met at sensitive receptors 1 km from source. **Low frequency noise:** Noise criteria met at sensitive receptors.		

Table 20.5 Summary of noise impact assessment (cont'd)

Cause of Potential Impacts	Existing Environment	Premitigated Impact	Summary of Mitigation Measures	Residual Impact
Structural Damage and Vibration Disturbance				
Construction and decommissioning • Vibration from construction activities. • Gas field decommissioning and rehabilitation. **Operation** • Operating equipment and potential blasting activities.	Vibration levels well below the threshold of human detection.	Vibration criteria potentially not met at sensitive receptors up to 100 m from source.	**Design and planning** Locate equipment associated with production wells and associated wellhead infrastructure at a distance of 200 m or more from a sensitive receptor. **Construction and decommissioning** Conduct a risk-based assessment or potential vibration monitoring during any construction activity that occurs within 100 m of a sensitive receptor that might be subject to vibration. **Operation** Consider the following factors prior to any blasting operations being conducted: – The type of rock and stratigraphy being blasted and any associated faulting. – The distance of the blast site from sensitive receptors. – The type, size and number of charges used. – The depth and manner in which the charge is installed. – The meteorological conditions. – Methods of controlling blast noise and vibration, such as mats or smaller blasts.	None anticipated – criteria expected to be met at the nearest sensitive receptor.