

Australia Pacific LNG Project

Volume 3: Gas Pipeline

Chapter 15: Noise and Vibration

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15. Noise and vibration

15.1 Introduction

15.1.1 Purpose

The purpose of this noise and vibration assessment is to describe the potential effect of construction and operation of the Australia Pacific LNG proposed main gas transmission pipeline (the gas pipeline) on the environment, and identify suitable mitigation and management measures to reduce the risk of these impacts to an acceptable level. The assessment of the potential impact of noise and vibration from activities associated with development of the gas pipeline has been conducted in accordance with the terms of reference for the Australia Pacific LNG Project (the Project) environmental impact statement (EIS).

Development of the gas pipeline will result in emissions of noise and vibration to the surrounding environment, including the marine environment in the vicinity of the pipeline crossing at Port Curtis.

Australia Pacific LNG's sustainability principles will be applied to the planning, design, construction and operation of the gas pipeline to ensure noise and vibration emissions do not significantly impact the qualities of the acoustic environment or cause environmental harm.

Of Australia Pacific LNG's 12 sustainability principles, the following two are most relevant for noise and vibration over the gas pipeline:

- Minimising adverse environmental impacts and enhancing environmental benefits associated with Australia Pacific LNG's activities, products or services; conserving, protecting, and enhancing where the opportunity exists, the biodiversity values and water resources in its operational areas
- Identifying, assessing, managing, monitoring and reviewing risks to Australia Pacific LNG's workforce, its property, the environment and the communities affected by its activities.

The ambient noise levels over the gas pipeline is relatively quiet, given that most of the region is predominantly rural in nature. The sustainability principles as applied to noise and vibration mean that Australia Pacific LNG will seek to locate the pipeline away from sensitive receptors, where practicable and to control emissions from project activities to minimise environmental harm or loss of amenity.

Australia Pacific LNG will manage noise emissions and ground vibration associated with all construction activities through the design and location of the pipeline, and compliance with construction environmental management plans. This will entail application of industry best practice noise emission reduction to meet the acoustic quality objectives set down in the Queensland Environmental Protection (Noise) Policy 2008.

15.1.2 Scope of work

The potential noise and vibration impacts associated with pipeline construction were assessed by:

- Applying Queensland noise and vibration regulations, guidelines and policies for the non-marine environment to the expected noise and vibration levels during pipeline construction
- Conducting baseline underwater noise level surveys at representative locations in the Gladstone harbour area

- Measuring underwater noise emissions from dredges and vessels similarly proposed for the Project and assessment against published research data relative to the response of marine creatures.

The noise and vibration sources assessed included:

- Mechanical excavation and blasting associated with gas pipeline construction
- Transportation of equipment and employees associated with gas pipeline construction
- Temporary accommodation facilities associated with the gas pipeline construction
- Horizontal directional drilling (HDD) for pipeline crossing of The Narrows at Port Curtis
- Underwater dredging and associated vessel movements.

The assessment included the impacts of noise and vibration on humans, buildings and structures, and marine fauna.

15.1.3 Legislative framework

Environmental Protection Act

The Queensland *Environmental Protection Act 1994* authorises local government to gazette local laws for the management of environmental nuisance, including construction noise and blasting. In the absence of local laws, the Act specifies minimum requirements for building construction noise. Section 440R of the Act is discussed below in Construction criteria and Section 440ZB is discussed in Blasting.

Environment Protection (Noise) Policy

Environmental values to be enhanced or protected within Queensland are identified in the *Environmental Protection (Noise) Policy 2008*. The environmental values identified in the policy are the qualities of the acoustic environment conducive to:

- Protecting the health and biodiversity of ecosystems
- Ensuring a suitable acoustic environment for individuals to sleep, study or learn, or be involved in recreation including relaxation and conversation
- Protecting the amenity of the community.

Construction criteria

Construction noise is managed by local government under the *Environmental Protection Act 1994* (EP Act). The Act specifies building work may occur between 6.30am and 6.30pm on any day except Sundays and public holidays. There are no guidelines for noise limits within or outside of these hours for building or other works.

Acceptable levels of ground vibration and air-blast over-pressure for buildings are specified in the EP Act. Vibration criteria for human comfort are not applicable to pipeline construction because construction vibration is transient and a minimum separation distance of 100m is proposed between the pipeline alignment and the nearest sensitive locations. Maximum vibration levels for prevention of damage in structures are recommended in British Standard 7385.2 1993 'Evaluation and measurement for vibration in buildings Part 2. Guide to damage levels from ground-borne vibration'.

For further information about construction noise and vibration criteria for land construction and noise criteria for marine construction, refer to the technical report in Volume 5 Attachment 33.

There are no approved noise limits or guidelines¹ applicable to construction noise within the construction hours allowed by EP Act.

There is no approved guideline for control of construction noise outside standard day hours (6.30pm to 6.30am) in Queensland. In addition, pipeline construction activities do not neatly comply with the definition of 'building work' in the EP Act.

Appropriate noise objectives for inclusion in the pipeline construction management plan are based on the 'acoustic quality objectives' defined in the *Environmental Protection (Noise) Policy 2008*. The recommended noise goals for pipeline construction at dwellings (outdoors) are provided in Table 15.1.

Table 15.1 Recommended noise goals outdoors from a dwelling

Time of day ¹	Pipeline construction noise goals, dB(A) ²			
	L _{Aeq} adj. 1 hour	L _{A10} adj. 1 hour	L _{A01} adj. 1 hour	maxL _{pA}
Day and evening (6.30am to 10.00pm)	45	50	60	N/A
Night (10.00pm to 6.30am)	35	N/A	N/A	47

Notes:

1. The commencement of the day time (and the end of the night time) complies with the commencement time for 'building work' in the EP Act.

2. See glossary in noise and vibration technical report in Volume 5 Attachment 46 for explanation of acoustic terminology and abbreviations.

N/A not applicable.

The day and evening acoustic measurement requires an adjustment (designated by the 'adj' subscript) for tonality and/or impulsiveness to address the increased subjective impact of the noise. The adjustments for noise character in accordance with Australian Standard AS1055² are shown in Table 15.2.

Table 15.2 Adjustments for noise character

Audible noise characteristic	Assessment	Adjustment
Tonality	Subjectively just detectable	K1 = 2-3dB
	Subjectively prominent (clearly audible) ³	K1 = 5-6 dB
Impulsivity	Subjectively detectable ⁴	K2 = 2dB

¹ The former Department of Environment and Heritage E1 Guideline for construction noise was formally withdrawn and has not been replaced.

² AS1055,1997 Acoustics - Description and measurement of environmental noise Part 1: General procedures. This standard sets out general procedures for the description and measurement of environmental noise including repetitive impulsive noise, defines the basic quantities to be used for the description of noise in community environments and describes basic procedures for the determination of these quantities.

³ The objective test of tonality is as per AS1055.1 Clause 6.6.3

⁴ The objective test of impulsive characteristics is as per AS1055.1 Clause 6.6.4

Construction noise levels are typically adjusted by 5dB(A) due to the tonal and/or impulsive character of typical noise emitted from common construction activities.

Blasting

The EP Act defines acceptable levels of ground vibration and air-blast over-pressure for buildings in Section 440ZB, as follows:

- Airblast overpressure not to exceed 115dBZ for four out of five consecutive blasts with a maximum of 120dBZ Peak for any blast
- Ground vibration not to exceed 25mm a second, peak particle velocity respectively, for vibrations of more than 35Hz and 10mm a second for vibrations no more than 35Hz.

Detailed information about blast vibration and air-blast over-pressure estimation and control is provided in Appendix J of AS2187.2-2006 'Explosives - Storage and use part 2: Use of explosives'.

Vibration

Vibration criteria for human comfort are not applicable to pipeline construction given the transient nature of the activity and the proposed minimum separation distance of 100m between the pipeline alignment and the nearest sensitive locations.

Vibration criteria for structures are assessed against BS7385.2 1993 'Evaluation and measurement for vibration in buildings Part 2: Guide to damage levels from ground-borne vibration'. BS7385 recommends maximum vibration levels for prevention of damage to structures.

Maximum ground vibration guide values recommended by BS7385.2 to prevent cosmetic damage from 'transient' vibration sources are shown in Table 15.3. Transient vibration sources include impact piling, dropping of heavy objects, or irregular vibration from excavator buckets stalling/releasing during digging through uneven ground.

To prevent minor damage to buildings from transient vibration sources, ground vibration levels should be less than twice the values shown in the table. Similarly, ground vibrations levels should be less than four times the values shown, to prevent major damage to buildings from transient vibration sources.

To prevent cosmetic damage from 'cyclic' vibration sources, ground vibration levels should be less than half the values shown in the table. Cyclic vibration sources include: vibratory rolling, vibratory pile driving, rock-hammering and rapid air-hammer impact piling.

Table 15.3 Guide values to avoid cosmetic building damage from transient vibration (BS 7385.2)

Building category	Type of building	Peak component particle velocity in frequency range of predominant pulse ¹	
		4 hertz (Hz) to 15Hz	1 Hz and above
Line 1	Reinforced or framed structures Industrial and heavy commercial buildings	50 millimetres per second (mm/s) at 4Hz and above	
Line 2 ²	Unreinforced or light framed structures Residential or light commercial type buildings	15mm/s at 4Hz increasing to 20mm/s at 15Hz	20mm/s at 15Hz increasing to 50mm/s at 40Hz and above

1. Values referred to are at the base of the building

2. For line 2, at frequencies below 4Hz, a maximum displacement of 0.6mm/s (zero to peak) should not be exceeded.

Sound for marine creatures

Underwater construction noise may impact marine creatures in a variety of ways relevant to the conservation and protection of some species. Behavioural disturbance is the mildest form of marine noise impact, such as re-location away from the noise source. Physiological impacts upon marine creatures are associated with higher levels of underwater noise which are normally described in terms of the effect on the auditory system, as for humans.

The effect of sudden or cumulative noise exposure may cause temporary loss of hearing sensitivity. This may cause adverse impacts for marine creatures, such as diminished response to danger, or diminished acuity of acoustic methods of food detection. More severe sudden or cumulative noise exposure may cause permanent loss of hearing sensitivity due to tissue damage within the auditory system.

The most severe acoustic impact on marine species is mortality which may occur close to underwater explosive noise sources. Underwater explosions may cause terminal vascular damage to critical organs, or terminal damage to air-filled cavities, such as swim-bladders in fish.

The behavioural response of marine mammals to human-made underwater noise is highly context-specific, depending on the significance of the noise to the subject mammal and the prior experience of the subject mammal to the given noise event. Vessel and dredge noise are not considered to cause significant behavioural response in mid-frequency cetaceans (for example, dolphins).

The recommended criteria for avoiding temporary or permanent loss of hearing impacts in mid-frequency cetaceans (such as dolphins, and assumed also for dugongs and turtles) are detailed in the technical report on the gas pipeline noise and vibration study in Volume 5 Attachment 33. The more stringent of the sound pressure level peak level or sound exposure level criteria should be applied to prevent such impacts.

Similarly, details of the noise criteria to avoid tissue damage in fish during marine piling have been adopted for assessment of both pulsed and non-pulsed sound in fish are presented in Volume 5 Attachment 33.

15.2 Methodology

15.2.1 Baseline surveys

The gas pipeline route is predominantly within a consistently quiet rural environment. Construction noise and vibration goals are based upon objective criteria and do not reference baseline levels.

Attended underwater noise sampling was conducted in the vicinity of the proposed gas pipeline crossing of The Narrows and existing operational wharfs in Gladstone Harbour. The baseline underwater noise levels in this study area provide context to the underwater noise assessment for construction activities in the marine environment.

Details of the underwater noise sampling are presented in Volume 5 Attachment 33.

15.2.2 Assessment

Preliminary modelling of airborne noise was conducted to explore the significance of HDD rig noise on the western side of The Narrows pipeline crossing. Noise predictions were based upon the ISO 9613-2⁵ noise propagation model implemented in SoundPLAN software. The topographical data, plant layout and noise source data were incorporated into the modelling.

A desktop assessment of ground vibration and blast over pressure was conducted based on published vibration levels from trenching equipment and construction practices expected to be employed during the gas pipeline construction phase.

Queensland regulations, guidelines and policies were applied to the expected vibration levels of the gas pipeline construction to determine potential impacts of ground vibration and blast overpressure.

Underwater marine noise was sampled in the Port of Brisbane and the Port of Bundaberg during dredging operations and a range of vessel pass-by events to determine marine source noise levels. The ports have protected water passages with similar depth, wave and bottom conditions to The Narrows gas pipeline study area.

15.3 Existing environment

15.3.1 Land

The ambient noise levels in the vicinity of the gas pipeline route are expected to be generally very quiet, with morning and evening bird-chorus, evening insect chorus and daytime vegetation rustling generated by breezes.

Human noise is generally expected to be limited to intermittent traffic noise near significant roadways, low levels of night-time air-conditioning and domestic noise emitted from dwellings in inhabited areas. Sounds of distant agricultural processes in cultivated areas are seasonally significant. Intermittent stock calling noise can also be significant at night in pastoral areas.

Daytime background noise levels in remote areas are typically less than 25dBA, and night-time background levels are typically less than 15dBA.

Ambient ground vibration levels are generally not expected to be significant along the gas pipeline route as there are few major roads or other human activity in the immediate area adjacent to the gas pipeline.

Friend Point, where the proposed gas pipeline is to cross The Narrows, is very sparsely settled rural land and shallow estuarine waterways. The nearest identified dwelling is located 5km to the west of Friend Point.

15.3.2 Marine

The marine environment supports a number of aquatic species such as dugongs, dolphins, turtles and a wide range of fish species. The area adjacent and south of the proposed gas pipeline crossing of The Narrows is designated as a dugong protection area by the Great Barrier Reef Marine Park Authority.

The ambient underwater noise level in the vicinity of the gas pipeline crossing was measured at approximately 155-165dB_(peak) and 103-130dB(M_{mf}). Snapping shrimp were identified as the dominant ambient marine noise source throughout the study area.

Vessel pass-bys were much quieter with underwater noise levels of less than 140dB_(peak) and 113-126dB(M_{mf}) for a pilot boat measured over 90 seconds at a distance of 150m.

15.4 Potential impacts

15.4.1 General

Details of the proposed pipeline construction techniques are described in Volume 3 Chapter 3.

Trenching will generally be conducted using a continuous trenching machine or an excavator. Trenching and pipe-laying will occur simultaneously at multiple locations along the proposed gas pipeline route. The rate of trenching and pipe-laying will vary from 200m to 3km per day, depending on ground conditions.

The total time of noise generating pipeline activities at any particular location along the land route is expected to be approximately one week, although this will typically be spread over a period of up to three to five months. These activities will include clearing, trenching, pipe-laying, backfilling and remediation.

There may be some areas along the proposed gas pipeline route where continuous sections of rock occur. An excavator rock-breaker and rock saw, or blasting may be required to establish a trench in these areas.

Boring may be used to enable the gas pipeline to traverse under major roads, railway lines or major watercourses without disruption. HDD is also the preferred method for the undersea pipeline crossing of The Narrows between Friend Point and Laird Point. In the event that HDD is determined not to be feasible, based on final engineering investigations or construction constraints, Australia Pacific LNG would instead use dredging equipment to excavate a trench across the seabed of the Narrows into which the pipeline would be installed.

Temporary accommodation facilities are proposed to be located at a minimum distance of 500m from the nearest noise sensitive dwellings. Typical accommodation facility noise sources include domestic reverse-cycle split-type air-conditioning units, kitchen exhaust fans and power generation plant. No adverse noise impact is expected from the accommodation facilities. The only noticeable noise

associated with the facilities may be vehicular traffic, particularly in the morning and evening. However, noise levels will generally be no greater than the noise levels normally experienced from traffic on local roads.

15.4.2 Airborne noise

Airborne noise will consist of diesel engine noise and intermittent noise from ground engagement of the trenching bar (scraping, rattling), or ground engagement with the trenching bucket (scraping, knocking).

Transportation noise will result from an average of 40 movements per day by semi-trailers delivering pipes to the gas pipeline right of way, as well as water trucks and work personnel vehicles on local roads.

The potential impact on ambient noise levels of drilling and installing the gas pipeline using HDD equipment situated at Friend Point on the western shores of The Narrows was determined by noise modelling. Predicted levels from noise modelling are presented as noise contours overlaid on an aerial photograph of the surrounding area with nearby dwellings and other structures identified. Figure 15.1 shows noise contours from HDD operations presented as coloured contours.

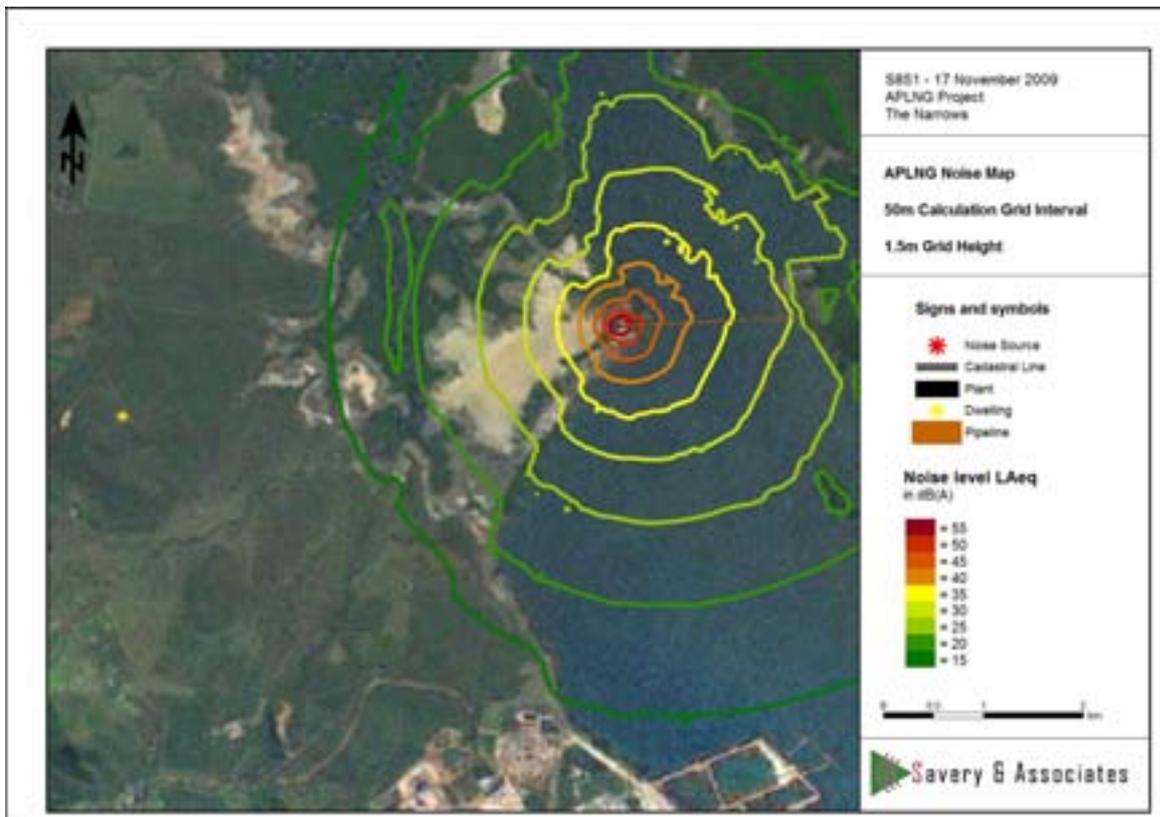


Figure 15.1 Modelled noise levels – horizontal directionally drilled pipeline crossing

The predicted noise level of the HDD plant at the temporary accommodation facility on Curtis Island is estimated to be below 25dB(A), with the noise level at the nearest residence, located approximately 5km to the west, estimated to be below 15dB(A).

The noise levels estimated at the nearest dwellings are less than the construction noise goals as set out in Table 15.1

Preliminary modelling indicates HDD from Friend Point across the Narrows on a 24-hour basis would not result in significant noise levels at the nearest dwelling or at temporary accommodation facilities on Curtis Island. Similarly, no significant noise levels are expected from HDD activities at Laird Point.

Overall, airborne noise associated with construction activities has the potential to cause short-term noise nuisance at the nearest sensitive receptors. Proposed mitigation and management measures to minimise such noise disturbance are discussed in Section 15.5.1.

Noise associated with operation of the gas pipeline is expected to be minimal and confined to rare occasions when pressure release may be necessary for safety or maintenance reasons. Any such depressurisation would occur at main line valves or scraper stations over a short period. Main line valves have been located away from dwellings.

15.4.3 Ground vibration

The route selection is proposed to achieve a minimum separation distance between the gas pipeline and sensitive locations (e.g. residences, commercial buildings, buried telecommunication cables and pipelines, and heritage listed structures) of at least 100m. Further information on heritage listed sites that might be susceptible to vibration impacts is presented in Volume 3 Chapter 19.

Potential impacts of ground vibration and blast overpressure are cosmetic or minor structural damage to property (e.g. dwellings and swimming pools), disturbance of work or relaxation, or temporary disturbance of livestock.

The majority of the gas pipeline will be trenched using either a dedicated continuous trencher or excavator and is unlikely to generate significant ground vibration at any receiver location.

The excavation may encounter sections along the gas pipeline alignment dominated by continuous rock where it may be necessary to use a rock-breaker and rock-saw, or blasting may also be required.

Levels of ground vibration associated with a range of mechanical construction vibration sources decrease with distance, and after 100m become insignificant for all trenching activities likely to occur, except for blasting.

If blasting is required, the blast will be designed to comply with the statutory criteria set down in Section 15.1.3 and with regard to any particular vibration or overpressure requirements or sensitivities of the nearby receptor locations. Blast vibration or overpressure may be perceived at levels much lower than levels that cause cosmetic or minor damage to property. Subjective perception of vibration or overpressure (evidenced by rattling of windows or contents) may lead to heightened awareness of construction.

The proposed minimum separation distance of 100m between the gas pipeline and sensitive dwellings or commercial premises will ensure no vibration impacts to buildings from all possible trench excavation techniques, excepting blasting. Blasting design will be conducted to ensure compliance with the noise and vibration criteria so blasting does not cause cosmetic cracking or structural damage to buildings.

Potential ground vibration associated with construction of the pipeline in the vicinity of buried infrastructure, such as telecommunications cables or other pipelines, will be assessed prior to commencement of construction to ensure that ground vibration levels do not present a risk of damage to this infrastructure.

15.4.4 Marine noise

The potential impacts of underwater noise on marine creatures relevant to conservation and protection of the species considered in the study were temporary and permanent loss of hearing, physiological injury and adverse behavioural responses.

A comparison of the ambient levels, source levels and peak sound pressure level criteria are presented in Volume 5 Attachment 33. The highest peak acoustic pressures associated with dredging occurs when a suction dredge is lifting rocky material, which generates significant impact noise in the hopper arm (176dB(peak) at 45m).

It is concluded that there is low risk of harm to any marine species associated with the peak sound pressure levels from dredging operations or miscellaneous vessel movements.

The potential cumulative sound exposure level a marine creature may experience in the vicinity of dredging operations is dependent on both the separation distance from the noise source and the duration of exposure. A comparison of measured ambient levels, source noise levels and criteria for cumulative sound exposure level sound pressures is also presented in Volume 5 Attachment 33. Sound exposure level criteria for dolphin are assumed to also apply to dugong and turtles.

The marine sound energy levels associated with the cutter-suction dredge and vessel pass-by noise levels are not significant in relation to the sound exposure level criteria. For the cumulative sound exposure to become significant, hundreds of vessel pass-bys each day within 45m of an individual marine creature would be necessary.

The behavioural response of marine creatures to introduced human noise is dependent on both instinctive responses (such as flight) and cognitive responses (curiosity, understanding of danger, irritation).

Dolphin species exhibit a high degree of cognition of marine sounds and are very mobile. Research literature indicates no significant adverse behavioural response (in the context of survival) to vessel noise and this is also expected to be the case for dredging noise.

Turtles do not appear to exhibit a significant behavioural avoidance response to marine vessel and dredging noise as indicated by the problem with boat strikes and the need for turtle-excluding dredge suction-heads.

The behavioural response of dugong to marine dredging noise is unknown. However, the history of low mortality from boat-strike and scientific literature on the auditory response of dugong suggests cognition of dredging noise as a threat for this species may be low.

The marine sound energy levels associated with the cutter-suction dredge and vessel pass-by noise levels are not significant in relation to the peak sound pressure or cumulative exposure sound exposure level criteria. Hundreds of vessel pass-bys each day within 45m of an individual creature would be necessary for the cumulative sound exposure to become significant, which is very unlikely to occur.

Marine noise associated with dredging operations and vessel movements for a marine pipeline crossing are unlikely to affect the hearing sensitivity of marine animals due to their natural flight response and are not anticipated to cause significant adverse behavioural responses.

15.5 Mitigation and management

15.5.1 Airborne noise

Non-standard trenching operations, such as rock-sawing, rock-hammering or boring will be scheduled during standard daytime working hours. In addition, Australia Pacific LNG will notify residents of dwellings and/or businesses within 200m before any of these activities are conducted.

Out-of-hours standard trench excavation (trencher or excavator) and other pipeline construction operations within 1km of a residence, or within 2km of a residence for non-standard noisier trench excavation (rock-sawing, rock-hammering or directional drilling), will be conducted subject to noise measures outlined in the environmental management plan.

Noise associated with traffic during both the construction phase of the Project will be managed as part of a traffic management plan, which is included in the pipeline environmental management plan (see Volume 3 Chapter 25).

15.5.2 Ground vibration and blast overpressure

A minimum separation distance of 100m between the pipeline and sensitive dwellings or commercial premises will ensure no vibration impacts to buildings from all possible trench excavation techniques, excepting blasting.

If blasting is required, the blast will be designed to achieve vibration and air-blast levels that will comply with EP Act, Section 440ZB Blasting requirements.

Consultation with potentially affected residents will be undertaken prior to construction commencement where concern about cosmetic or minor damage may arise as a result of significant 'noticeable' vibration.

A pre-construction inspection of the building condition by both the owner and a construction representative will be conducted if there is a potential threat to the property building, with post-construction follow-up inspection, if necessary.

Vibration monitoring will be considered if predicted vibration levels are more than 20% of the statutory vibration limit values. Lower vibration goals will be considered in the case of heritage-listed structures, or where there is elevated sensitivity of people (e.g. infirmity) or building contents to vibration.

Volume 3 Chapter 19 discusses the cultural heritage significance of stone bridges along the Defence Road, located between the Eidsvold–Theodore Road and Camboon Station, which is in close proximity to the gas pipeline route and will be used for construction traffic. Australia Pacific LNG recognises the potential impacts to these structures from its proposed activities. Mitigation and management measures are also discussed in Chapter 19.

15.5.3 Marine noise

Significant adverse physiological or behavioural responses of marine animals to dredging noise or vessel noise are not expected. Neither mitigation nor management are therefore necessary.

15.6 Conclusion

15.6.1 Assessment outcomes

A summary of the environmental values, sustainability principles, potential impacts and mitigation measures in relation to noise and vibration associated with the gas pipeline is presented in Table 15.4.

A risk assessment has been undertaken to identify potential risks, causes and consequences from noise and vibration associated with the construction of the gas pipeline. The risk assessment process is described in Volume 1 Chapter 4. Mitigation measures to reduce the risk have been nominated and the residual risk has been calculated. The residual risk level for noise and vibration impacts are identified in Table 15.4.

Implementation of the proposed mitigation and management measures will minimise the potential impacts of noise and vibration associated with the construction phase of the gas pipeline, such that there is a very low risk of potential adverse health effects or impacts on terrestrial and marine fauna. Similarly, the overall risk of temporary disturbance of residents in the vicinity of construction activities will be low.

By locating the pipeline away from sensitive receptors where ever practicable and by applying industry best practice to managing construction activities to minimise noise and vibration emissions, Australia Pacific LNG is able to undertake its activities in accord with its sustainability principles.



Table 15.4 Summary of environmental values, sustainability principles, potential impacts and mitigation measures

Environmental values	Sustainability principles	Potential impacts	Possible causes	Mitigation and management measures	Residual risk level
<p>Qualities of the acoustic environment conducive to:</p> <ul style="list-style-type: none"> • Health and diversity of ecosystems • Human health and wellbeing to enable people to sleep, study and learn, engage in recreation and relaxation • Protect the amenity of the community 	<p>Minimising adverse environmental impacts and enhancing environmental benefits associated with Australia Pacific LNG's activities, products or services; conserving, protecting, and enhancing where the opportunity exists, the biodiversity values and water resources in its operational areas</p> <p>Identifying, assessing, managing, monitoring and reviewing risks to Australia Pacific LNG's workforce, its property, the environment and the communities affected by its activities.</p>	<p>Annoyance of persons within hearing of noise sources</p> <p>Sleep disturbance</p>	<p>Noise from construction activities (for example clearing, trenching, rock breaking, rock-sawing, drilling)</p> <p>Traffic noise, especially heavy vehicle transport of pipe, water and other construction materials.</p> <p>Noise from temporary accommodation facilities (for example generators, air conditioners, loud music)</p>	<p>Notify residents or businesses within 200m of non-standard trenching operations, such as rock-sawing, rock-hammering or boring, before any of these activities are scheduled during standard daytime working hours.</p> <p>Restrict out-of-hours (6.30pm to 6.30am) construction activities within 2km of sensitive receptors, unless alternative arrangements have been agreed with the potentially affected residents.</p> <p>Undertake unavoidable out-of-hours activities (for example drilling) in accordance with a noise management plan that addresses the Environmental Protection (Noise) Policy's acoustic quality objectives.</p> <p>Identify suitable routes and times of travel prior to well development and plant construction to reduce disturbances to residents and traffic conditions</p> <p>Undertake truck deliveries to construction sites during normal operating hours, when ever possible</p> <p>Locate temporary accommodation facilities at appropriate distances from sensitive</p>	Low



Environmental values	Sustainability principles	Potential impacts	Possible causes	Mitigation and management measures	Residual risk level
Life, health and wellbeing of people	Identifying, assessing, managing, monitoring and reviewing risks to Australia Pacific LNG's workforce, its property, the environment and the communities affected by its activities.	Concern about perceived harm to property or sensitive equipment Damage to structures (cosmetic cracking, structural damage)	Ground vibration from non-standard construction activities (for example rock breaking and blasting)	<p>receptors.</p> <p>Locate the gas pipeline at least 100m from buildings and other vibration sensitive structures.</p> <p>Design blasting to meet vibration and air blast criteria set down in the EP Act (Section 440ZB – Blasting).</p> <p>Conduct pre- and post-construction inspections of sensitive structures and monitor during construction if predicted levels of ground vibration exceed 20% of statutory limits.</p>	Low
Health and diversity of ecosystems	Minimising adverse environmental impacts and enhancing environmental benefits associated with Australia Pacific LNG's activities, products or services; conserving, protecting, and enhancing where the opportunity exists, the biodiversity values and water resources in its operational areas	Disturbance of marine fauna (adverse behaviour response) Marine fauna hearing impairment	Marine dredging activities associated with pipeline crossing The Narrows	<p>Use HDD across The Narrows (Australia Pacific LNG's preferred methodology).</p> <p>In the event HDD is not used, the alternative dredging methodology is not expected to result in significant adverse hearing impacts or behavioural responses of marine animals.</p>	Negligible

15.6.2 Commitments

To manage potential impacts of airborne noise and ground vibration associated with construction of the gas pipeline, Australia Pacific LNG will:

- Locate the gas pipeline at least 100m from sensitive dwellings, commercial premises or cultural heritage listed structures to minimise the risk of cosmetic or structural damage
- Schedule non-standard trenching operations such as rock-sawing, rock-hammering or directional-drilling during standard daytime working hours and notify residents or businesses within 200m before any of these activities are conducted
- Limit construction activities near dwellings to between 6.30am and 6.30pm, as far as practicable
- Undertake out-of-hours construction activities (for example, drilling) in accordance with a noise management plan that addresses the Environmental Protection (Noise) Policy 2008 acoustic quality objectives
- Locate temporary accommodation facilities at least 500m from sensitive receptors
- Prepare a traffic management plan prior to construction to identify suitable routes and times of travel to minimise disturbances to residents and traffic conditions.