Chapter 19

Noise and Vibration

19.0 Noise and Vibration

A noise and vibration assessment was undertaken for the Project. The assessment is provided in Appendix H Noise and Vibration Technical Report, and a summary is presented below.

19.1 Existing Environment

19.1.1 Noise sensitive receptors

Sensitive receptors are shown on Figure 3-2 (Chapter 3 Project Description). There is one sensitive receptor within 500 m of the Draft Alignment, namely the old tin mine immediately on the northside of the Ergon 66kV line within 'Kilclooney' station (3198PH2177), which is used as a campsite. The Draft Alignment is located on the southern side of the 66kV line and is approximately 100m from the camp site.

19.1.2 Estimated background levels

In lieu of noise monitoring data, conservative estimates have been used to establish background noise levels for the nearby residential receptors. These estimates are based on Appendix A of Australian Standard 1055.2-1997 Acoustics – '*Description and measurement of environmental noise – Part 2: Application to specific situations*', which provides estimated background sound pressure level values for different areas in Australia.

As the receptors are all rural, they are concluded to lie within Noise Area Category R1: '*Areas with negligible transportation*'. The relevant background noise levels are presented below in Table 19-1, and have been compared to background noise levels measured by AECOM at other remote rural areas. The estimated noise levels are considered to be generally representative of typical rural environments.

Table 19-1 Background sound pressure levels

Noise Area Category	Description of Neighbourhood	Average background A-weighted sound pressure level, L_{A90}		
		Day 0700 - 1800	Evening 1800 - 2200	Night 2200 - 0700
Noise Area Category R1	Areas with negligible transportation	40	35	30

19.2 Potential Impacts

19.2.1 Methodology

19.2.1.1 Noise criteria

The noise criteria for the construction and operation of the Project have been derived by adopting the most stringent applicable criteria from:

- Queensland *Environmental Protection Act 1994* (EP Act)
- Queensland Environmental Protection Regulation 2008 (EP Regulation)
- Queensland *Environmental Protection (Noise) Policy 2008* (EPP (Noise))
- Powerlink Queensland *SM1 Primary Systems Infrastructure Design Manual*
- Powerlink Queensland *Standard Environmental Controls – Specification Appendix M – Noise and Vibration.*

This process is discussed further in Appendix H Noise and Vibration Technical Report. Applicable noise emission limits at nearby sensitive receptors for the construction and operation of the Project are outlined in Table 19-2 and Table 19-3 respectively.

Table 19-2 Construction noise criteria

Noise Source	Noise Criteria	External Noise Limit	Time of Day	Sensitive Receptor
Construction equipment	EP (Noise) Policy acoustic quality objectives	$L_{Aeq,adj,1hr}$ 50 dB(A)	Daytime and evening	Residential buildings
		$L_{Aeq,adj,1hr}$ 35[1] dB(A)	Night-time	Residential buildings
		$L_{A1,adj,1hr}$ 65 dB(A)	Daytime and evening	Residential buildings
		$L_{A1,adj,1hr}$ 45[1] dB(A)	Night-time	Residential buildings

Note:

1. Noise limit includes a 5 dB correction to allow for the assessment of noise levels as measured outdoors, assuming a façade with partially open windows
2. The EP (Noise) Policy defines the following:

   Daytime means the period after 7 am on a day to 6 pm on the day;

   Evening means the period after 6 pm on a day to 10 pm on the day;

   Night-time means the period after 10 pm on a day to 7 am on the next day.

Construction works involving the use of regulated devices (assumed to be the 'worst-case noise generating equipment' used in the assessment) are restricted to the hours of 7am to 7pm.

Table 19-3 Operational noise criteria

Noise Source	Noise Criteria	External Noise Limit	Time of Day	Sensitive Receptor
Corona discharge and operation/ maintenance of substation and transmission line	EP (Noise) Policy acoustic quality objectives	$L_{A1,1hr}$ 65 dB(A)	Daytime and evening	Residential buildings
		$L_{A1,1hr}$ 45[1] dB(A)	Night-time	Residential buildings
	EP (Noise) Policy background creep	$L_{Aeq,T}$ 45 dB(A)	Daytime	Residential buildings
		$L_{Aeq,T}$ 40 dB(A)	Evening	Residential buildings
		$L_{Aeq,T}$ 35 dB(A)	Night-time	Residential buildings

Note:

1. Noise limit includes a 5 dB correction to allow for the assessment of noise levels as measured outdoors, assuming a façade with partially open windows
2. The EP (Noise) Policy defines the following:

   Daytime means the period after 7 am on a day to 6 pm on the day;

   Evening means the period after 6 pm on a day to 10 pm on the day;

   Night-time means the period after 10 pm on a day to 7 am on the next day.

Maintenance works involving the use of regulated devices (assumed to be the 'worst-case noise generating equipment' used in the assessment) are restricted to the hours of 7am to 7pm.

19.2.1.2 Vibration criteria

The relevant standards and guidelines for the assessment of construction vibration are summarised in Table 19-4.

Table 19-4 Standards/guidelines used for assessing construction vibration

Item	Standard/guideline
Structural damage	German Standard DIN 4150 – Part 3 – *Structural Vibration in Buildings – Effects on Structures* (DIN 4150)
Human comfort (tactile vibration)	Transport Noise Management Code of Practice: Volume 2 – *Construction Noise and Vibration, Department of Transport and Main Roads*[1]

Note:

1. This document is based upon the guidelines contained in British Standard 5228-2:2009 *"Code of practice for noise and vibration control on construction and open sites – Part 2: Vibration* (BS 5228)

Applicable vibration limits at nearby sensitive receptors for structural damage and human comfort are outlined in Table 19-5 and Table 19-6 respectively. The lower limits for human comfort are generally considered to be just perceptible whereas the upper limits are considered to cause significant annoyance if exceeded.

Table 19-5 Structural damage safe limits (DIN 4150) for building vibration

Group	Type of structure	At foundation – Less than 10 Hz	At foundation - 10 Hz to 50 Hz	At foundation - 50 Hz to 100 Hz[1]	Vibration at the horizontal plane of the highest floor for all frequencies
1	Buildings used for commercial purposes, industrial buildings and buildings of similar design	20 mm/s	20 to 40 mm/s	40 to 50 mm/s	40 mm/s
2	Dwellings and buildings of similar design and/or use	5 mm/s	5 to 15 mm/s	15 to 20 mm/s	15 mm/s
3	Structures that because of their particular sensitivity to vibration, do not correspond to those listed in Lines 1 or 2 and have intrinsic value (e.g. buildings that are under a preservation order/heritage listed)	3 mm/s	3 to 8 mm/s	8 to 10 mm/s	8 mm/s

Note:

1. At frequencies above 100 Hz, the values given in this column may be used as minimum values

Table 19-6 Peak particle velocity human comfort limits to minimise annoyance

Building	Work Period	Resultant PPV, mm/s	
		Lower limit	Upper limit
Dwellings (including hotels, motels and mine camps)	Standard hours[1]	1.0	2.0
	Non-Standard hours – evening[1]	0.3	1.0
	Non-Standard hours – night-time[1]		

Note:

1. QLD Department of Transport and Main Roads *Transport Noise Management Code of Practice: Volume 2 – Construction Noise and Vibration* defines the following:

Standard hours refers to Monday – Friday 7am to 6pm, Saturday 8am to 1pm;

Non-standard hours – day/evening refers to Monday – Friday 6pm to 10pm, Saturday 1pm to 10pm;

Non-standard hours – night-time refers to Monday – Sunday 10pm to 7am.

19.2.1.3 Noise setback distance prediction

The CONCAWE method was used to predict the propagation of noise from the Project. This method is especially suited to predicting noise propagation over large distances because it accounts for a range of atmospheric conditions which can significantly influence the propagation of noise over large distances. The calculations assumed worst-case noise propagating meteorological conditions (3 m/s source to receptor wind with Pasquill stability category D). The predicted noise propagation was used to identify setback distances from the Draft Alignment at which noise associated with the Project is expected to comply with the relevant limits. The construction noise setback distances were calculated from the site boundary which is a 30 m buffer from the transmission line alignment, with the exception of the heli-stringing scenario which has been calculated from the alignment. All operational noise setback distances have been calculated from the alignment.

It can be expected that there may be differences between predicted and measured noise levels due to variations in instantaneous operating conditions, plant in operation during the measurement and also the location of the plant equipment.

19.2.2 Construction noise

Noise-generating equipment was identified across fifteen construction stages to determine the potential associated noise levels. The worst case construction scenarios were then assessed in greater detail, and setback distances at which construction noise is expected to achieve the relevant criteria were calculated for these scenarios.

Predicted setback distances at which construction noise associated with the Project is expected to comply with the relevant limits are presented in Table 19-7, as well as the number of residential receptor locations at which exceedance of the noise limit is predicted to occur. Construction noise setback distance maps are provided in Appendix H Noise and Vibration Technical Report.

Table 19-7 Predicted construction noise setback distances

Scenario	Representative Worst-case Equipment	Noise limit, $L_{Aeq,adj,1hr}$ dB(A)	Setback Distance, (metres)	Number of Exceedances	Number of Exceedances
				Alignment A	Alignment B
Installation of gates, grids, wash downs and access tracks	Vibratory roller	50	250	1	1
Access track construction Benching of substation pads Excavation for foundations Rehabilitation of disturbed areas (tower pads, batters including substation batters)	Excavator	50	110	1	1
Benching of tower pad sites, cut/fill	Tipper truck	50	210	1	1
Vegetation clearing	Mulcher	50	500	1	1
Foundations, substation electrical equipment and transmission line	Bored piling rig	50	220	1	1
Steel assembly and erection Electrical plant erection Lines assembly	Crane	50	120	1	1
Heli-stringing	Helicopter	50	2,400	20	13

The construction activities are predicted to generally exceed the noise limits at a single sensitive receptor (the tin mine camp) across all scenarios for both alignment A and B. It is noted that this one receptor is only occasionally used as accommodation.

The heli-stringing construction scenario has 20 receptors for Draft Alignment A which are located within the setback distance of 2.4 km, and 13 receptors for Draft Alignment B. This difference is attributed to the close proximity of Draft Alignment A towards the receptors in Kidston. Whilst there are a significant number of exceedances associated with heli-stringing, this is over the entire extent of the Project. The duration of the predicted exceedance at any one receptor would be limited. Furthermore, it is expected that heli-stringing is a much more accelerated process when compared with conventional stringing methods which would be quieter but may have a longer term impact.

19.2.3 Construction vibration

The only significant vibration-intensive works expected to take place during the proposed works would be pile boring and the use of vibratory rollers. Safe working distances to minimise disturbance to occupants of nearby buildings have been recommended and are based on the British Standards *BS 6472 'Evaluation of human exposure to vibration in buildings'* and *BS 7385 'Evaluation and measurement for vibration in buildings'*. These distances are up to 2 m for pile boring (structural damage) and up to 100 m for the vibratory roller (human comfort).

There are no vibration-sensitive receptors within these structural damage safe working distances for pile boring rigs and vibratory rollers. However there is a single receptor (the tin mine camp) which is located within the maximum human response safe working distance for vibratory rollers with a rating of greater than 100 kN.

19.2.4 Operational noise

Noise associated with the power lines themselves is primarily due to corona discharge. The intensity of the corona discharge and the resulting noise is dependent on meteorological conditions (such as humidity, rain, fog and wind), the concentration of airborne particles (dust, ash) and the state of the conductor surface. As the power lines are primarily to be located in sparsely-populated rural areas and the 275 kV line is to be designed as a twin conductor set, the acoustic effect of corona discharge is expected to be minimal on nearby sensitive receptors. In addition line fittings (such as hardware corona rings) and insulator arrangements are to be designed to minimise corona discharge.

Noise compliant setback distances have been calculated for operational (substation shunt reactor; corona discharge) and maintenance (helicopter; mulcher) equipment.

Predicted compliant operational noise setback distances associated with the Project are presented in Table 19-8. Operational noise setback distance maps are provided in Appendix H Noise and Vibration Technical Report.

The operational activities are predicted to comply with the established noise limits at nearby sensitive receptors across all operational scenarios with the exception of maintenance activities involving the inspection of the transmission line and infrastructure associated with the Project using a helicopter. The inspection activities are expected to be completed only during the daytime and on average twice per year with the possibility of additional inspections due to emergency repairs. Whilst there are a significant number of exceedances associated with inspection activities with a helicopter, this is over the entire extent of the Project, which means the duration of the predicted exceedance at any one receptor would be limited. Therefore; the overall impact of inspection activities is limited.

There is also a single exceedance of the night-time noise limit for Alignment A and B associated with corona discharge. This single exceedance is associated with the tin mine camp which lies 10 m within the calculated night-time setback distance. At the distance considered, this approximately equates to a <1 dB(A) exceedance. A difference of up to 2 dB(A) is generally considered to be imperceptible. Also the conservative approach used in the calculation of corona discharge noise will mean that actual noise levels will typically be lower than what has been calculated. Refer to Appendix H Noise and Vibration Technical Report for more information on the assumptions used in the calculation of noise associated with corona discharge.

The operation of a mulcher during vegetation clearing maintenance activities is predicted to result in an exceedance at one receptor for both options. This exceedance means that this maintenance activity only exceeds the relevant criterion at a single particular location along the transmission line alignment (and for a limited duration), hence the overall impact is limited.

Table 19-8 Predicted operational noise setback distances

Scenario	Representative Worst-Case Equipment	External Noise Limit, $L_{Aeq,adj,1hr}$, dB(A)	Setback Distance, (metres)	Number of Exceedances	Number of Exceedances
				Alignment A	Alignment B
Operation	Substation shunt reactors	Day: 45	Mount Fox: 80[1]	0	0
			Kidston: 150		
		Night: 35	Mt Fox: 250	0	0
			Kidston: 380		
		Substation property boundary:	Mt Fox: 25[1]	0	0
			Kidston: 45[1]		

Scenario	Representative Worst-Case Equipment	External Noise Limit, $L_{Aeq,adj,1hr}$, dB(A)	Setback Distance, (metres)	Number of Exceedances	Number of Exceedances
				Alignment A	Alignment B
		55			
	Corona discharge	Day: 45	35[1]	0	0
		Night: 35	110	1	1
Maintenance activities – Transmission line and infrastructure inspection	Helicopter	Day: 45[2]	3,400	82	82
Maintenance activities – Vegetation clearing	Mulcher	45[1]	710	2	2

Note:

1. The CONCAWE method has not been validated at ranges below 100m, hence this distance has been determined via geometric spreading calculations.
2. It is assumed that inspection and routine maintenance activities will be restricted to daytime hours only due to safety and practical considerations; hence it has been assessed against the daytime criteria.

19.2.5 Operational vibration

No significant vibration-generating equipment is expected to be used during the operation of the Project hence an assessment was not considered to be required.

19.3 Mitigation and Management Measures

Exceedances of noise and vibration (human comfort) criteria have been assessed as occurring at a limited number of sensitive receptors, with these exceedances being short in duration. Management measures for potential noise and vibration impacts are in line with Powerlink Queensland's Standard Environmental Controls. Several additional measures have been proposed to further minimise potential impacts:

- appropriate plant and equipment to be selected for each task to minimise the noise contributions
- plant to be turned off when not in use
- plant is to be regularly maintained, and repaired or replaced if it becomes noisier
- emphasis should be placed during driver training and site induction sessions on the potential adverse impact of reversing alarms and the need to minimise their use
- non-tonal reversing alarms to be used where practicable.