16 VIBRATION

16.1 INTRODUCTION

This chapter examines the potential for vibration impacts for the proposed western coal seam methane (CSM) water supply pipeline (the proposed pipeline). Vibration from construction equipment is considered in this chapter. The use of explosives is not being utilised for the proposed pipeline.

16.2 METHODOLOGY OF ASSESSMENT

There are no established vibration criteria in Queensland for the assessment of construction and operational vibration. However, other applicable criteria provided in other Australian states and International standards have been used for assessment purposes and are as follows:

- NSW Criteria Assessing Vibration: a technical guideline, 2006
- German Standard DIN 4150-3: 1999 Effects of vibration on structures, 1999
- British Standard BS 6472 'Evaluation of exposure to vibration in buildings', 1992.

Assessment is broken down into evaluation of human exposure to vibration and the effects of vibration on structures.

16.2.1 HUMAN EXPOSURE TO VIBRATION

Criteria for human exposure are defined in the NSW Department of Environment and Conservation document Assessing Vibration: a technical guideline, 2006, which is based on BS 6472 – 1992 Evaluation of human exposure to vibration in buildings. This guideline sets criteria (shown in Table 16-1) for evaluating the effects of human exposure to continuous and impulsive vibration. Guideline vibration levels below are measured in peak particle velocities (PPV) which are the sum of the vibration levels in each of the three directional axes. Vibration motion is split up into three perpendicular directional axes which are defined as follows for vibrations influencing humans:

- x-axis – back to chest
- y-axis – right side to left side
- z-axis – foot (or buttocks when sitting) to head

Vibration values up to the preferred guideline are unlikely to cause adverse comment or disturbance to the building occupants. Adverse comments or complaints may be expected as the vibration levels approach the maximum guideline. Where activities are predicted that will generate values exceeding the maximum guideline, community consultation should be carried out.

Table 16-1: Human exposure vibration guidelines

Place	Peak Particle Velocity (mm/s)		
	Time	Preferred	Maximum
Continuous vibration			
Residences	Daytime	0.28	0.56
	Night-time	0.20	0.40
Workshops	Day or night-time	1.1	2.2
Impulsive Vibration			
Residences	Daytime	8.6	17.0
	Night-time	2.8	5.6
Workshops	Day or night-time	18.0	36.0

16.2.2 EFFECTS OF VIBRATION ON STRUCTURES

The German standard DIN 4150-3: 1999 Effects of vibration on structures outlines guideline criteria for evaluating effects of short term vibration on structures (Table 16-2) as well as buried pipelines (Table 16-3). If the values outlined in the Tables below are not exceeded, damage that reduces serviceability of the affected structure will not occur. Usually vibration levels are measured in peak particle velocities (PPV) which is a sum of the vibration level in each of the three directional axes, whereas the guideline values below outline maximum vibration levels in one axis only. The vibration axes in relation to structures are defined as follows:

- x-axis and y-axis – directions perpendicular to each other encompassing the horizontal plane ie parallel to the floor
- z-axis – vertical direction i.e. perpendicular to the floor.

If the measured PPV values are lower than the values below, then they are considered to satisfy this standard.

Table 16-2: Guideline values for evaluating vibration on structures

Type of structure	Guideline values for velocity v_i (mm/s)			
	Vibration at foundation			Vibration at highest floor (v_{xy})
	1–10 Hz	10–50 Hz	> 50 Hz	
Commercial and industrial buildings	20	20 – 40	40 – 50	40
Dwellings	5	5 – 15	15 – 20	15
Sensitive buildings	3	3 – 8	8 - 10	8

Note: v_i refers to maximum vibration level in one axis only i.e. x, y or z direction. v_{xy} refers to the sum of the vibration in the horizontal plane ie x and y directions

Table 16-3: Guideline values for evaluating vibration on buried pipework

Pipe material	Guideline values for velocity v_i (mm/s) measured on pipe
Steel (including welded pipes)	100
Clay, concrete, reinforced concrete, prestressed concrete, metal (with or without flange)	80
Masonry, plastic	50

Note: v_i refers to maximum vibration level in one axis only ie x, y or z direction

16.2.3 SENSITIVE RECEPTORS

From an aerial photo review of the proposed pipeline route 10 potentially sensitive receptors have been identified as shown in Figure 16.1-V3.3. Note that figures/documents with numbering ending in V3.3, for example, refer to figures/documents contained in Volume 3, Book 3 of the EIS. Vibration sensitive receptors consist of any structures that can be affected by excessive vibration and can range from residential dwellings, commercial buildings, industrial structures as well as pipelines, phone towers and bridges. Human sensitive receptors generally include the occupants of structures. The closest identified dwelling from aerial photography was located approximately 600 m away from the pipeline (receptor W-8) with the remaining receptors being separated by at least a 1 km buffer zone. No receptors were identified within 2 km of the pump station.

16.3 EXISTING ENVIRONMENT

No ambient vibration monitoring has been carried out as no significant sources of ground vibration are present in the vicinity of proposed pipeline development. Potential sensitive receptors are not located in the vicinity of the pipeline corridor.

16.4 DESCRIPTION OF PROPOSED DEVELOPMENTS

The proposed pipeline involves the construction and operation of a water pipeline from a reverse osmosis plant at Spring Gully to the Wandoan Coal Project (the Project) mine infrastructure area (MIA). Typical machinery used for pipeline construction and installation will involve a wheel trencher and excavator, hydraulic rock breaking equipment (if hard rock is encountered), pipe delivery trucks, multiple tractors fitted with side cranes would be used to lift and move the pipe string over the trench and lower the pipe into position and, bedding sand deliveries. The construction period is estimated at approximately nine months with construction activities in the vicinity of sensitive receptors not expected to exceed seven working days.

The reverse osmosis plant will be the responsibility of the water supply proponent to construct and operate, while the operation of the inlet water pump station and pipeline and will be the responsibility of the Wandoan Joint Venture (WJV).

Pumping is expected to occur around 20 hr/day. The pumps will be powered by gas powered motors of between 375 kW and 600 kW.

Further details on the construction methodology are provided in Chapter 5 Project Construction.

16.5 POTENTIAL IMPACTS

16.5.1 CONSTRUCTION

As detailed construction methods and earthworks schedules are not available at this stage, vibration levels have been predicted from typical construction activities associated with pipeline construction. The majority of the generated vibration will be from excavation and compacting activities.

Vibration levels from construction activities should not exceed the allowable levels shown in Tables 16-1 and 16-2. Typical vibration levels (peak particle velocities) from construction equipment are shown in Table 16-4 including a predicted vibration transmission.

In instances where the proposed pipeline is to traverse or intersect existing pipelines or other infrastructure easements, exact specifications of the infrastructure being affected should be acquired from the respective operator to identify if any potential vibration issue would arise. It is not expected that significant changes in the construction methodology will be required in those areas however lower vibration construction techniques can be implemented if required.

Table 16-4: Typical vibration levels from construction activities

Equipment	PPV (mm/s) at 10 m*	Predicted PPV (mm/s) at 200 m
Loader (breaking kerbs)	6 – 8	0.07 – 0.09
15t roller	7 – 8	0.08 – 0.09
7t compactor	5 – 7	0.06 – 0.08
Roller	5 – 6	0.06 – 0.07
Pavement breaker	4.5 – 6	0.05 – 0.07
Dozer	2.5 – 4	0.03 – 0.04
Backhoe	1	0.01
Jackhammer	0.5	0.01

*SOURCE: RTA Environmental Noise Management Manual 2001

16.5.2 OPERATIONS

Any potential vibration levels expected to be associated with the operational phase of the pipeline will occur due to the operation of the pump station and will be limited to its immediate vicinity.

16.6 MITIGATION MEASURES

Mitigation measures related to the operation phase of the development will only be potentially installed at the pump station. Vibration isolation mounts can be incorporated into the pumps and other associated reciprocating machines with detailed specification being outlined during the design phase.

Vibration generated by the construction will be sufficiently attenuated due to the high buffer distances between the construction site and any sensitive receptor. Any vibration issues associated with traversing existing pipelines or other easements can be controlled through the use of low vibration construction techniques and equipment e.g. smaller excavators, different compaction techniques, or use of vibration isolating trenches.

16.7 RESIDUAL IMPACTS

No remaining vibration impacts are anticipated during the operational phase of the development.

16.8 REFERENCES

Assessing Vibration: a technical guideline, Department of Environment and Conservation February NSW, 2006.

BS 6472 "Evaluation of exposure to vibration in buildings", 1992.

DIN 4150-3 "Structural vibration – Effects of vibration on structures", 1999.

RTA Environmental Noise Management Manual, Roads and Traffic Authority NSW December, 2001.