18. Noise and Vibration

18.1 Overview

This section assesses potential environmental noise and vibration impact on noise sensitive land uses from the South Road Superway Project and provides mitigation measures to achieve the nominated criteria. Traffic noise has been modelled for two scenarios in this assessment:

- existing road network
- proposed South Road Superway Project in the year 2031.

The assessment is based upon traffic volume data and road alignment and elevation details provided by DTEI.

18.2 Legislative and policy requirements

Table 18.1 summarises relevant legislation relating to the acoustic and vibration elements of the project. The relevant policy is described in **Table 18.2**

Table 18.1. Relevant legislation

Legislation	Description	Relevance to Proposed Project
Environment Protection Act 1993 (SA)	This Act is the overarching environmental legislation that deals with the protection of the environment and environmental offences. The Act is administered and enforced by the SA Environment Protection Authority. In relation to noise and vibration Part 4 Section 25 of the Act states: *A person must not undertake an activity which pollutes, or might pollute the environment unless the person takes all reasonable and practicable measures to prevent or minimise any resulting environmental harm.*	Construction and operation of the proposed road network must comply with the Act. This includes the prevention of environmental harm as detailed in Part 4 Section 25 of the Act.

Table 18.2. Relevant policy

Policy	Description	Relevance to proposed project
DTEI Road Traffic Noise Guidelines (2007)	DTEI Road Traffic Noise Guidelines provide a framework for assessing and treating road traffic noise with regard to the construction of new roads or the upgrading of existing roads.	Noise mitigation to noise sensitive receivers will be undertaken where noise modelling indicates that the Guideline criteria will be exceeded.

18.3 Assessment methodology

The noise and vibration assessment follows the methodology below:

(a) *Noise logging*
Noise monitoring was conducted for a minimum period of 7 days at nine locations along the proposed South Road Superway Project alignment.

(b) *Noise modelling of the existing road alignment*
A noise model of the existing road alignment with its adjoining major roads was created (based on known traffic volumes and vehicle types).

(c) *Calibration of model of existing road alignment*

The noise model of the existing road alignment was calibrated with the noise logging results, to demonstrate accuracy of the model and to determine a calibration factor which will be applied to future noise model predictions and to determine the existing noise levels at the sensitive receivers throughout the study area.

(d) *Definition of assessment criteria*
Based on the existing noise levels obtained from the calibrated existing noise model, noise criteria were established for each noise sensitive receiver using the policies and guidelines applicable to the project. Construction noise and vibration criteria were also determined based on nominated policies and legislation.

(e) *Noise modelling of the proposed road alignment*
A noise model for the proposed road alignment was constructed to determine predicted future noise levels 15 years after the road opening (2031) based on projected traffic growth and vehicle type data.

(f) *Noise assessment*
Predicted noise levels at sensitive locations were assessed against the criteria in the DTEI Road Traffic Noise Guidelines (DTEI 2007). Potential construction noise and vibration effects were also determined and assessed against suitable criteria.

(g) *Mitigation measures*
Mitigation methods to control noise and vibration due to the potential effects of the North–South Corridor project were determined.

18.4 Existing environment

18.4.1 Noise logging

Methodology

Noise logging at nine locations along the South Road Superway Project area was conducted from 26 March to 16 April 2009 in order to determine the existing noise levels along this corridor.

The monitoring was conducted in accordance with Australian Standard *AS1055: Acoustics – Description and measurement of environmental noise*. Noise loggers were located 1 metre from the most affected façade of the building, where possible or completely in the free-field. The noise loggers were set to 'A' frequency weighting, 'F' time weighting and were set to record over 15-minute time intervals. All equipment was field calibrated before placement at each site and at the end of the data collection period. No significant drift in calibration was detected at any time. Approved windshields were installed on the microphones for the duration of the monitoring.

Meteorological conditions

Half-hourly observations of rainfall and wind speed were obtained from the Bureau of Meteorology Automatic Weather Station (BOM AWS) at Parafield Airport (Site Number: 023013) from 26 March 2009 to 16 April 2009. Rainfall data (un-cumulated) and wind speed data were synchronised with the 15 minute noise logging intervals. Noise logging data during periods of rainfall and wind speeds above 5 metres per second were then excluded from the noise logging results.

Noise logging results

Noise logging results are summarised in **Table 18.3**.

Table 18.3. Noise logging summary

No	Type of location	Period of monitoring	Notes	Daytime noise level, Leq (15h), dBA	Night- time noise level, Leq (9h), dBA	Daytime RBL, dBA	Night-time RBL, dBA
1	Commercial	26 March–2 April 2009	Traffic noise from South Road dominates measurements	71	65	51	40
2	Residential	9–16 April 2009	Traffic noise from Days Road dominates measurements; traffic noise from South Road barely audible during day	63	58	41	37
3	Commercial	26 March–2 April 2009	Traffic noise from South Road dominates measurements during the day	74	69	54	43
4	Residential	9–16 April 2009	Traffic noise from Days Road dominates measurements; traffic noise from South Road barely audible during day	63	57	45	41
5	Residential	9–16 April 2009	Traffic noise from Days Road is audible; traffic noise from South Road inaudible during day	54	47	36	36
6	Industrial	2–9 April 2009	Traffic noise from South Road dominates measurements	73	67	57	45
7	Residential	2–9 April 2009	Traffic noise from South Road barely audible during day; measurements were influenced by industrial noise from RI industries during day	58	50	41	39
8	Commercial	26 March–2 April 2009	Traffic noise from South Road dominates measurements during day	68	62	48	40
9	Industrial	2–9 April 2009	Traffic noise from South Road dominates measurements; Measurements influenced by intermittent train horns, train crossing warning horns and train pass-by noise	66	60	53	42

RBL rating background level

18.4.2 Noise catchment areas

Noise catchment areas (NCAs) are defined as groups of sensitive properties similarly affected by existing and future traffic noise. They also define the limit of any potential effects of the South Road Superway Project (i.e. there is unlikely to be any noise effects beyond the extent of a NCA outer boundary). The NCAs in this project extend to 500 m from the proposed South Road Superway Project (**Figure 18.1**).

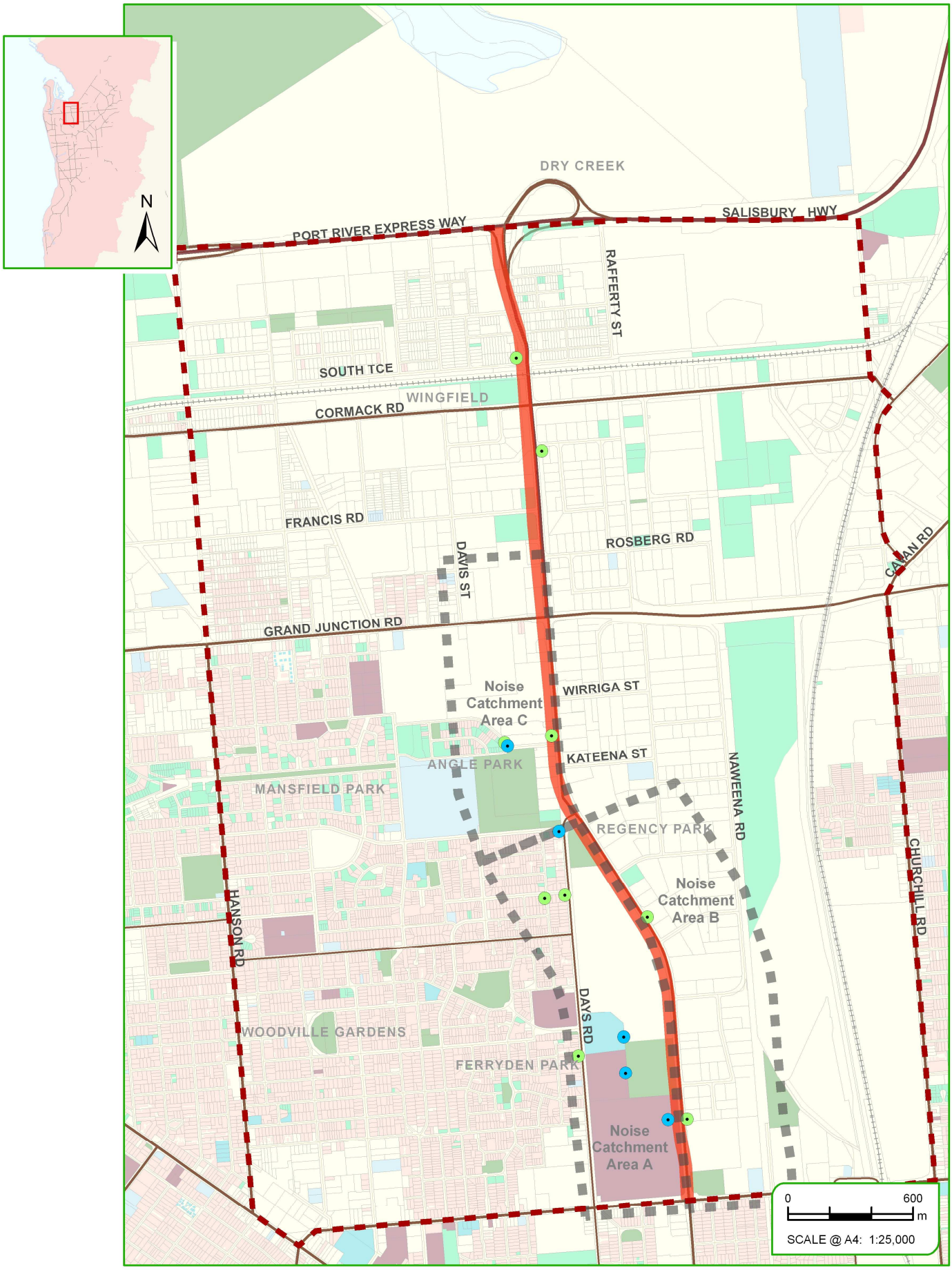
18.4.3 Sensitive locations

The above-mentioned criteria are applicable to noise sensitive land uses (defined by DTEI RTNG 2007) and are as follows:

- existing dwellings in a zone where dwellings are contemplated, as defined by the relevant development plan
- existing nursing homes
- caravan parks that accommodate existing long term residential usage
- areas used for passive recreation
- educational institutions, childcare centres and kindergartens

Sensitive locations within 500 m of the main alignment of are identified as:

- Days Road residences
- Angle Road residences
- Ferryden Park Primary School on Days Road (educational)
- Regency Green Multicultural Aged Care Facility on Days Road
- TAFESA Regency Campus on Regency Road (educational)



Study Area
Noise Monitoring Locations
Sensitive Receivers
South Road Superway
Education
Nonprivate Residential
Public Institution
Recreation
Residential
Vacant Residential

Noise Monitoring Locations, NCAs and Noise Sensitive Locations

Figure 18.1

18.5 Criteria

18.5.1 Road traffic noise

Criteria for road traffic noise are provided in the DTEI's Road Traffic Noise Guidelines (see extract in **Figure 18.2**).

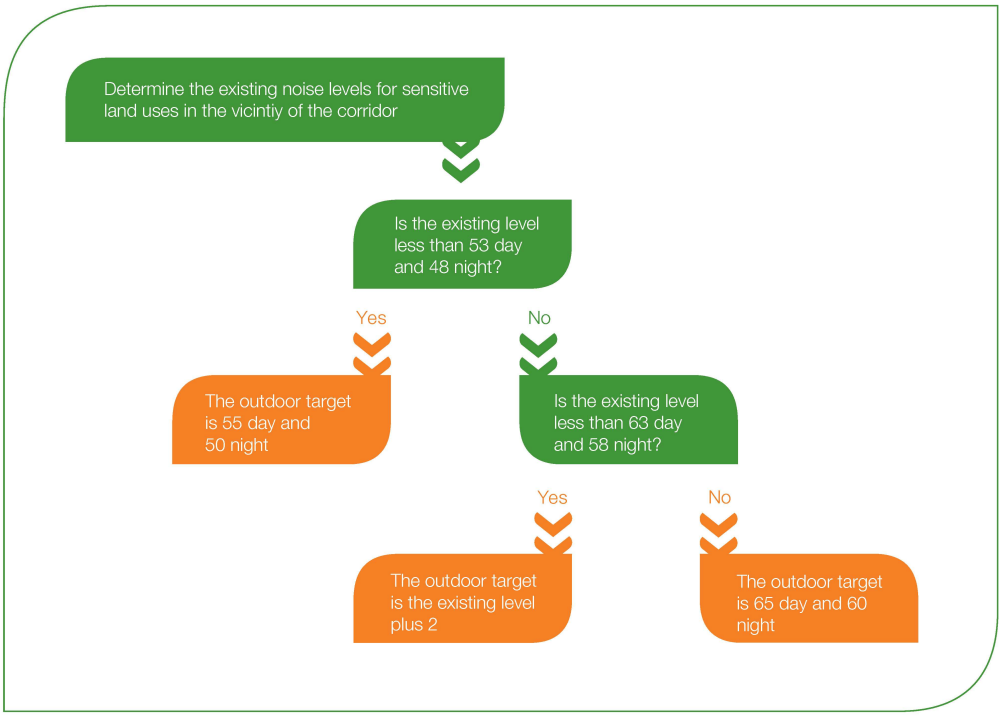


Figure 18.2. DTEI Road Traffic Noise Criteria

The criteria applicable to noise sensitive land uses are:

- existing dwellings in a zone where dwellings are contemplated, as defined by the relevant development plan
- existing nursing homes
- caravan parks that accommodate existing long term residential usage
- areas used for passive recreation
- educational institutions, childcare centres and kindergartens.

18.5.2 Construction vibration

At present, there is no legislation or guideline governing vibration in South Australia. Thus, acceptable levels of vibration are obtained from nominated vibration standards applicable to this assessment.

Human comfort

The NSW Department of Environment and Climate Change's Guideline *Assessing Vibration* (February 2006) has the most appropriate criteria on which to assess the potential impact from vibration on human comfort and is based on the procedures contained in BS 6472–1992, Evaluation of human exposure to

vibration in buildings (1–80 Hz). The guideline gives recommendations for preferred and maximum allowable vibration levels in three axes for human comfort in building interiors.

Structural damage

The German Standard *DIN 4150 1999-02 Structural vibration – Effects of vibration on structures* provides guidelines for allowable levels of vibration for building structures. Long-term periods of vibration may lead to damage to building structures (either superficial or structural) and should therefore be kept within allowable limits.

18.6 Road traffic noise modelling

18.6.1 Modelling methodology

Noise modelling of the study area used the UK Department of Transport (1988), *Calculation of Road Traffic Noise* (CORTN) algorithms incorporated in the SoundPLAN noise modelling software. The modelling allows for traffic volume and mix, type of road surface, vehicle speed, road gradient, reflections off building surfaces, ground absorption and shielding from ground topography and physical noise barriers such as intervening buildings.

The algorithm output of CORTN (which outputs L_{10} noise levels) has been modified to calculate the relevant Leq road traffic noise emission descriptors, as required. All reported road traffic prediction noise levels are 'facade-corrected'. The predicted noise levels have been adjusted upwards to include a notional 2.5 dBA reflection in the noise model computation.

The predicted levels are for receiver points 1.5 m above the external ground level.

18.6.2 Traffic flow and composition

Existing scenario

The existing major roads carrying significant traffic volumes were identified. In the absence of traffic counts on the existing roads, traffic flow and composition data was obtained from DTEI.

Project, Year 2031

Traffic projections were processed to obtain inputs for the proposed road in Year 2031. Fifteen hour (7.00am to 10.00pm) traffic volumes and 9 hour (10.00pm to 7.00am) traffic volumes were obtained from analysis of hourly traffic data at selected road along the existing alignment to determine the trend of 15-hour and 9-hour traffic distribution.

The project road sections are assumed to be made of stone mastic asphalt (SMA) and a correction of -3 dB was applied to predictions concerning them. The service road sections were assumed to be made of dense graded asphaltic cement (DGAC) and no noise corrections were applied to them.

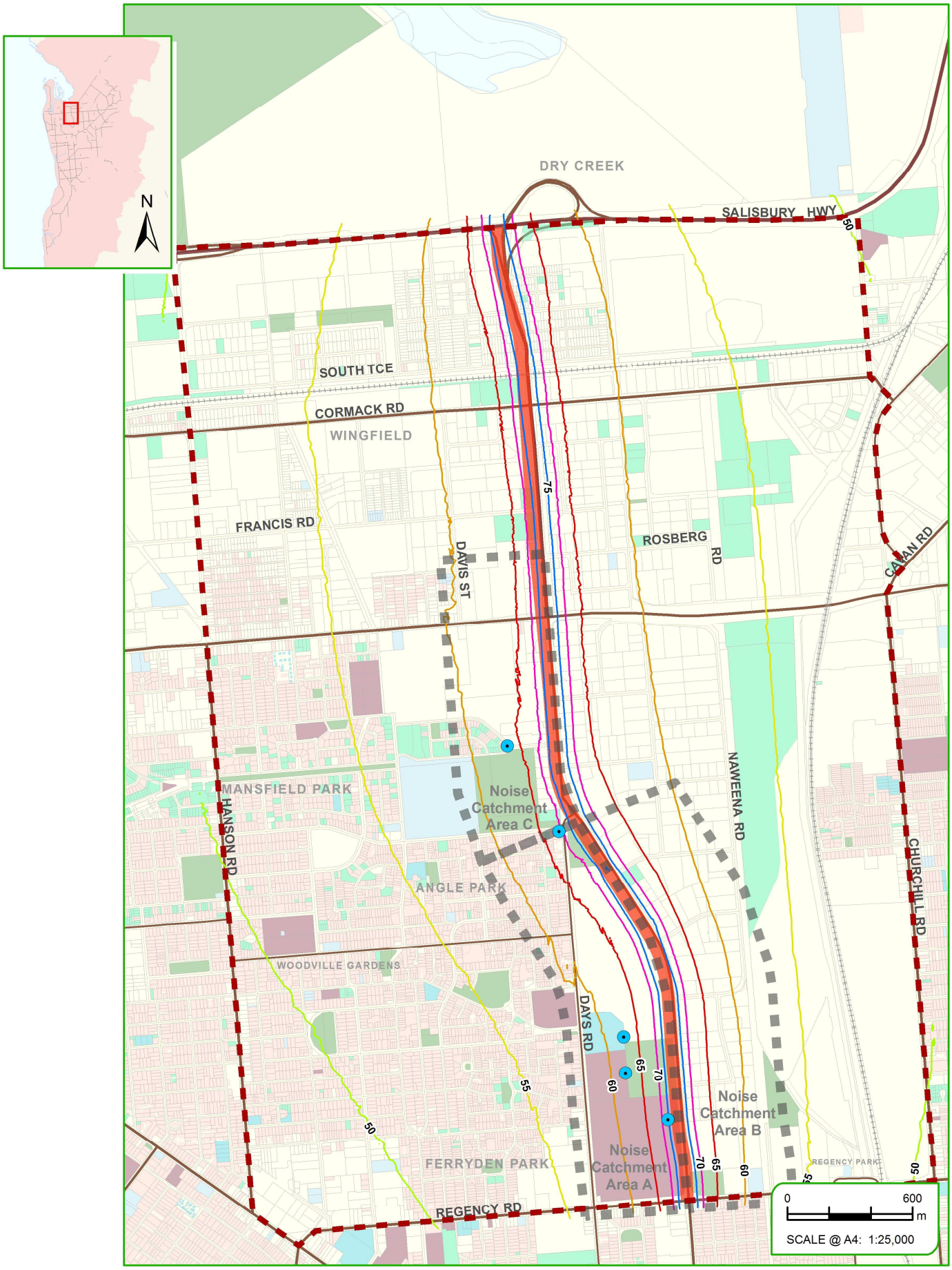
18.6.3 Calibration

The noise model of the existing road network was used to predict the current traffic noise levels at the nine noise logger locations. Noise logging locations influenced by industrial noise or rail noise were excluded for calibration. The noise logging locations dominated only by road traffic noise generated by heavy traffic volumes were used for calibration.

18.7 Effects of the project

18.7.1 Road traffic noise modelling results

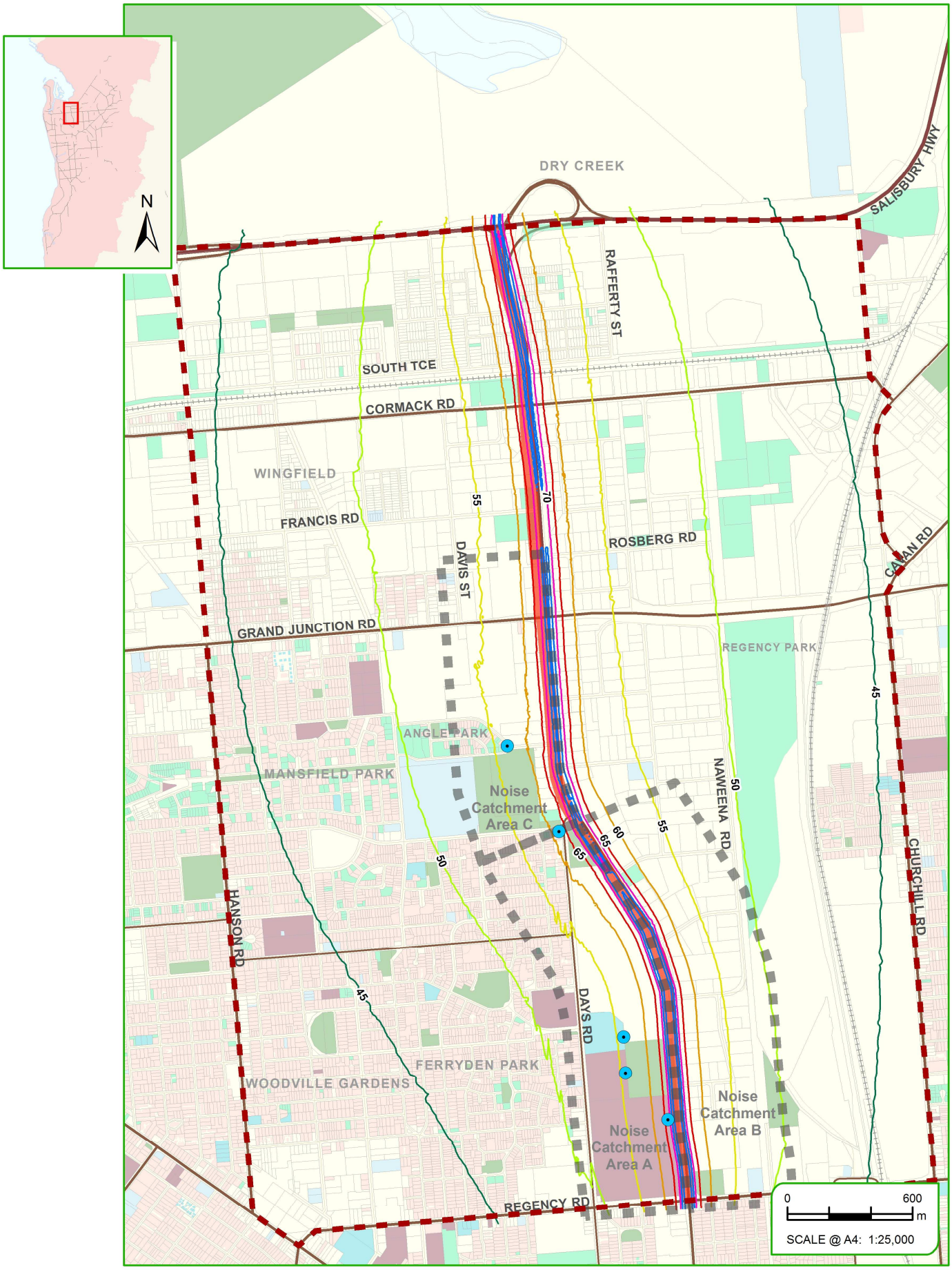
Noise contour charts in Year 2031 without any mitigation measures are shown in **Figures 18.3** and **18.4.** The residences north of Days Road and TAFESA Regency Campus were identified as areas likely to experience adverse road traffic noise effects during both the day and night periods.



Study Area
Sensitive Receivers
South Road Superway
Education
Nonprivate Residential
Public Institution
Recreation
Residential
Vacant Residential
Noise Contours
50
55
60
65
70
75

Average Daytime Noise Levels in 2031 Without Mitigation Measure (7am-10pm)

Figure 18.3



Study Area
Sensitive Receivers
South Road Superway
Education
Nonprivate Residential
Public Institution
Recreation
Residential
Vacant Residential
Noise Contours
45
50
55
60
65
70
75

Average Night Time Noise Levels in 2031 Without Mitigation Measure (7am-10pm)

Figure 18.4

18.7.2 Days Road residences

Approximately 25 residences at the north of Days Road exceed the stipulated criteria by 4 dBA during the day and 2 dBA during the night. This is mainly due to the proximity of these residences to the new road alignment. The day assessment is the limiting assessment, as more properties were affected by the road traffic noise emissions.

Mitigation options for these residences are discussed in Section 18.8.

18.7.3 Angle Road residences

There is a marginal exceedance of 1 dBA during the day period. This exceedance is not significant and does not warrant noise control treatment.

18.7.4 TAFESA Regency Campus

The current traffic noise level adjacent to TAFE SA Regency Campus is 68.7 dBA and this is predicted to increase by 2031 as traffic volumes increase. Until the ultimate design solution for the South Road–Regency Road junction is designed it is not possible to determine the noise effects and whether treatment is required at TAFE SA Regency Campus.

18.7.5 Construction noise

Typical construction activities during construction of the South Road Superway will include the noise generating activities of:

- clearing – removal of vegetation by chainsaw and chipping by tub grinder; tree and stump removal; topsoil stripping; and loading.
- earthworks and drainage – casting; concrete pours; placement of pre-cast elements; bored piling; and demolition.
- elevated roadway and ramp construction – casting; concrete pours; placement of pre-cast elements; driven piling; and demolition.
- pavement – excavation of soil and rock; hammering/rock breaking; drilling; loading; and haulage.

Table 18.4 shows typical construction noise levels of construction machinery and equipment.

Table 18.4. Construction noise levels

Activity	Plant	Sound pressure level (dBA)									
		7 m		20 m		50 m		100 m		200 m	
		$L_{eq\ (15min)}$	L_{max}	$L_{eq\ (15min)}$	L_{max}	$L_{eq\ (15min)}$	L_{max}	$L_{eq\ (15min)}$	L_{max}	$L_{eq\ (15min)}$	L_{max}
Clearing	Small bulldozer	90	93	81	84	73	76	67	70	61	64
	45 t tracked excavator	83	90	74	81	66	73	60	67	54	61
	4–5 hp chainsaw	89	92	80	83	72	75	66	69	60	63
	40–50 hp tub grinder & mulcher	91	95	82	86	74	78	68	72	62	66
	Front-end loader	88	90	79	81	71	73	65	67	59	61
	50 t dump truck – loaded	76	90	67	81	59	73	53	67	47	61
	50t dump truck – unloaded	83	90	74	81	66	73	60	67	54	61
Elevated roadway and ramp construction(boring, not piling)	Bored piling rig	89	92	80	83	72	75	66	69	60	63
	Power pack	78	80	69	71	61	63	55	57	49	51
	Mobile crane	88	91	79	82	71	74	65	68	59	62
	Concrete pump	80	84	71	75	63	67	57	61	51	55
	Concrete vibrator	78	80	69	71	61	63	55	57	49	51

Activity	Plant	Sound pressure level (dBA)									
		7 m		20 m		50 m		100 m		200 m	
		$L_{eq\ (15min)}$	L_{max}	$L_{eq\ (15min)}$	L_{max}	$L_{eq\ (15min)}$	L_{max}	$L_{eq\ (15min)}$	L_{max}	$L_{eq\ (15min)}$	L_{max}
	Welding equipment	80	85	71	76	63	68	57	62	51	56
	45 t tracked excavator	83	90	74	81	66	73	60	67	54	61
	Pneumatic jackhammer	88	90	79	81	71	73	65	67	59	61
	Concrete truck	84	85	75	76	67	68	61	62	55	56
	Delivery truck	83	88	74	79	66	71	60	65	54	59
Elevated roadway and ramp construction (piling)	Piling rig	91	113	82	104	74	96	68	90	62	84
	Power pack	78	81	69	72	61	64	55	58	49	52
	Crane	88	90	79	81	71	73	65	67	59	61
	Concrete pump	80	84	71	75	63	67	57	61	51	55
	Concrete vibrator	78	80	69	71	61	63	55	57	49	51
	Welding equipment	80	85	71	76	63	68	57	62	51	56
	45 t tracked excavator	93	96	84	87	76	79	70	73	64	67
	Pneumatic jackhammer	88	90	79	81	71	73	65	67	59	61
	Delivery truck	83	88	74	79	66	71	60	65	54	59
	Concrete truck	84	85	75	76	67	68	61	62	55	56
Earthworks & drainage	Small bulldozer	90	93	81	84	73	76	67	70	61	64
	Large bulldozer	92	95	83	86	75	78	69	72	63	66
	Scraper	85	98	76	89	68	81	62	75	56	69
	45 t tracked excavator	83	90	74	81	66	73	60	67	54	61
	Line driller	89	99	80	90	72	82	66	76	60	70
	Grader	85	90	76	81	68	73	62	67	56	61
	Vibratory roller	84	85	75	76	67	68	61	62	55	56
	Spreader	70	70	61	61	53	53	47	47	41	41
	Vibratory rammer	83	83	74	74	66	66	60	60	54	54
	Vibrating plates	76	90	67	81	59	73	53	67	47	61
	Dump truck	83	90	74	81	66	73	60	67	54	61
	Road truck	83	88	74	79	66	71	60	65	54	59
	Compactor	88	90	79	81	71	73	65	67	59	61
	Water cart	82	83	73	74	65	66	59	60	53	54
Pavement	Batch plant	91	90	82	81	74	73	68	67	62	61
	Paver	89	91	80	82	72	74	66	68	60	62
	Road truck	83	88	74	79	66	71	60	65	54	59
	Concrete vibrator	78	80	69	71	61	63	55	57	49	51
	Asphalt truck/sprayer	81	81	72	72	64	64	58	58	52	52
	Roller	82	88	73	79	65	71	59	65	53	59
	Concrete saw	93	93	84	84	76	76	70	70	64	64
	Generator	78	81	69	72	61	64	55	58	49	52
	Backhoe	79	83	70	74	62	66	56	60	50	54
	Pneumatic tyred roller	86	86	77	77	69	69	63	63	57	57

Source: Infrastructure Works at Night Operational Instruction 21.7. Department for Transport, Energy and Infrastructure, Government of South Australia.

Elevated roadway and ramp construction through piling is deemed to be noisiest construction activity. The noise sensitive receivers highlighted in **Figure 18.2** are assessed during this event under a worst-case scenario where all the equipment is fully operational during this activity.

Criteria exceedances are prevalent at all the properties due to the high number of concurrent noise sources and the proximity of the alignment to construction activities. Mitigation measures to control construction noise are discussed in Section 18.8.

18.7.6 Construction vibration

Human comfort

Vibration levels are dependent on both the source level and the transmission path attenuation. Increased distance and higher levels of ground attenuation will reduce the effect on sensitive receivers. A detailed geological survey has not been completed to determine ground attenuation for the prediction of vibration levels. Estimations of the vibration levels of various items of equipment are given in **Table 18.5.**

Table 18.5. Example equipment and activity generated vibration levels

Item	Vibration levels peak particle velocity at 10 m (mm/s)
Loader breaking kerbs	6–8
Vibratory pile driver	10
15 tonne roller	7–8
7 tonne compactor	5–7
Roller	5–6
Pavement breaker	4.5–6
Dozer	2.5–4
Backhoe	1
Jackhammer	0.5

Where rock breaking or similar high-vibration activities are being undertaken, it is common or building condition surveys to be conducted where works are within 50 m residences (or other vibration sensitive structures). Such a requirement would be identified during the preparation of a project environmental management plan.

Continuous or impulsive vibration is unlikely to create an adverse vibration effect at Days Road or Angle Road residences due to them being more than 50 m from the proposed road alignment. However, the occupants at TAFE SA Regency Campus may experience some level of discomfort during construction activities which generate high levels of vibration that occur in proximity (<30 m).

Restricting the hours of work for equipment/processes that generate high levels of vibration should be considered to reduce the impact of human discomfort. Consideration should be given to using construction techniques that produce low levels of vibration to minimise possible effects to residents and properties.

Structural damage

Considering the category of ‘dwellings’ under the DIN4150 Standard, the maximum allowable vibration velocity is 5 mm per second. This value is to be measured in the horizontal plane of the highest floor of the building. It is not expected that vibration levels will create any significant adverse effect such as structural damage due to the attenuation from the propagation distance (generally no less than 20 metres) with additional mitigation provided from the connection between the building structure and the ground.

Pile driving will result in vibration levels of 1–3 mm per second at distances of 25–50 m depending on soil conditions and the energy of the pile driving hammer. These levels are well below the threshold of any possibility of damage to structures in the vicinity of these works.

18.7.7 Traffic vibration

Traffic vibration is a low frequency disturbance producing physical movement in buildings and their occupants. Vibration can be air borne or ground borne.

Air borne vibration from traffic can be produced by the engines or exhausts of road vehicles with dominant frequencies in the 50–100 Hz range. There is no evidence that exposure to airborne vibration causes even minor damage to building so it is unlikely that there will be adverse traffic vibration effects due to passing vehicles on the South Road Superway.

Ground borne vibration is more often in the 8–20 Hz range and is produced by the interaction between rolling wheels and the road surface. They may be perceptible in buildings near roads if heavy vehicles pass over irregularities in the road. A new road such as the South Road Superway is unlikely to create ground borne vibration as the surface is expected to be smooth and be without poor surfaces, potholes or exposed sub grade surfaces.

18.8 Mitigation measures

18.8.1 Road traffic noise

Days Road residences

Noise barriers are proposed to mitigate the potential traffic noise effects at the affected residences north of Days Road.

18.8.2 Construction noise

Work practices to minimise noise effects from approved works outside the recommended construction noise may be managed through a proper construction noise management plan. DTEI will develop a project-specific framework for the management of construction noise to ensure the minimisation of adverse construction noise effects where possible. A detailed noise and vibration management plan will be developed before construction begins.

Management practices will notify the community of the works and:

- provide a 24-hour phone number to contact a construction officer who has the authority to alter works being undertaken where the complaint was justified
- use ‘smart’ (less intrusive) movement alarms on mobile cranes
- locate compressors, power generators and other fixed plant at ground level and behind site structures to provide the greatest shielding
- select the quietest equipment available – equipment fitted with high-performance mufflers on engine exhausts and sealed enclosures on engines
- locate the site entry, site offices and parking areas as far as possible from sensitive receivers.

18.9 Conclusion

The sensitive locations surrounding the project were assessed to determine potential noise and vibration effects.

The existing noise environment was determined through noise logging and noise modelling of the existing road network. Noise level predictions of the traffic noise emissions of the proposed road in the Year 2031 were calibrated using the noise logging locations.

Noise modelling evaluated the potential impact on sensitive receivers and identified locations with criteria exceedances. Noise treatment measures at these sensitive receivers will depend on the amount of noise reduction required to achieve the stipulated noise criteria.

Construction noise and vibration generated by the project will be managed through the development of a noise and vibration management plan.