16. Noise and Vibration

The Noise and Vibration Assessment examined the existing ambient noise environment and the potential impacts that the Project could have on sensitive receptors (in this case, mostly dwellings).

The assessment found that the construction of the Project has the potential to create adverse effects from noise and vibration at some sensitive receptors. Construction during the day is considered to be of negligible risk as management techniques including noise reduction technology on machinery would be implemented, and generally receptors are not as sensitive to noise during the day. Construction is considered to be of higher impact during the evenings, at night and at weekends, although evening, night time and weekend construction is only expected to occur in exceptional circumstances. Evening, night time and weekend construction noise impacts would be managed by consulting with potentially impacted residents and implementing a noise mitigation strategy.

Energy from construction activities can also be transformed into vibration. Based on the predicted peak vibration levels for the Project, it is expected that vibration would be barely perceivable at sensitive receptor locations within 50 metres (m) for most construction activities involving rolling and compacting. Accounting for likely property acquisition by VicRoads to accommodate the Project, within 50m of the alignments there are approximately eight houses near Option 2 and seven houses near Option 1 that may potentially be impacted. While vibration levels during construction would be noticeable at these dwellings, the vibration levels would not be sufficient to cause damage to buildings.

Traffic volumes on the highway would create noise during the operation of the Project. Some dwellings along the Project alignment may experience greater noise than they currently do from the existing alignment. This impact would usually occur where the Project alignment has been brought closer to their dwelling than the existing Western Highway alignment. Conversely, some dwellings would experience lower noise levels, usually where the alignment has been moved further away from their dwelling. Overall, it is predicted that during the operation of the Project more dwellings would experience a clearly noticeable reduction in traffic noise, than those that would experience a clear increase. Mitigation of traffic noise may be required for discrete sections of the alignment options that are considered to be 'new alignment' (where both carriageways are outside the existing road reserve) in accordance with the VicRoads Traffic Noise Reduction Policy. Potential mitigation measures include acoustic barriers or acoustic treatment of houses/buildings.

Based on a comparison between the existing highway and the proposed alignments under predicted 2025 traffic volumes; the Project is predicted to result in a 'clearly noticeable' increase in traffic noise levels at three dwellings in Option 2 and four dwellings in Option 1 and a 'clearly noticeable' reduction in traffic noise levels due to the alignment moving further away at nine dwellings Option 1 and 17 dwellings Option 2. Overall, more dwellings would experience a noticeable reduction, rather than a noticeable increase in traffic noise as a result of the Project.

Option 1 and Option 2 are similar in terms of impacts from noise and vibration; however noise modelling for Option 2 indicates that there would be one fewer sensitive receptor with a clearly noticeable noise impact during operation than in Option 1.

16.1 EES Objectives

The EES objectives relevant to the noise assessment are:

- To minimise air emissions, noise, visual, landscape and other adverse amenity effects, during the development and operation of the proposed duplicated highway to the extent practicable.

This chapter discusses the noise environment of the study area, the potential impacts from the Project on the characteristics of the noise environment, and management measures recommended for implementation to minimise these impacts. More specifically, this chapter:

- Characterises the ambient noise environment and identifies sensitive receptors in the study area.
- Identifies and assesses the potential for the Project to increase noise and vibration levels during construction and operation at sensitive receptors. The assessment includes an estimation of noise from all project-related sources and at different periods during the day to establish likely noise levels to be experienced at sensitive receptors.
- Identifies possible design and management measures to avoid, mitigate and manage any potential noise or vibration effects on sensitive receptors during construction and subsequently, to ensure the project will comply with applicable policy.

This chapter is based on a noise and vibration impact assessment report completed by GHD Pty Ltd (2012g), and is included in Technical Appendix M.

16.2 Study Area

The Noise and Vibration Assessment study area is the same as the project area, which encompasses a corridor extending approximately 1500 metres (m) to the north and south of the edge of the existing Western Highway. In some areas this corridor has been widened to incorporate alignment options (see Figure 16-1).

16.3 Methodology

An existing conditions assessment was undertaken and involved the deployment of six noise loggers at various points along the study area (Figure 16-1). These noise monitoring locations were chosen based on proximity to the highway, ease of access, absence of extraneous noise from other sources such as transformers, usefulness as a model calibration site or amenity value site, and property owner co-operation.

Four of the loggers were placed at residential dwelling locations, as close as possible to the existing Western Highway, in order to capture current traffic noise for model calibration purposes. Two additional locations were chosen based on their amenity value. Amenity value with regard to this noise assessment was defined as sites that were a significant distance from the existing highway, but were likely to be affected by one or more of the alignment options for the duplication running close to the property. Amenity site data describes more closely the true background noise of the study area, excluding or minimising traffic noise.

Attended and unattended measurements were taken from six sites along the alignment with consideration given to AS2702:1984 - Acoustics (Methods for the Measurement of Road Traffic Noise). Unattended loggers were deployed in the field on Monday 27 June 2011 and retrieved on Monday 4 July 2011 (a total of seven days), with a subset of three consecutive days selected for analysis based on meteorological conditions and policy requirements. The L_{A10} (18h), L_{A10} (12h), L_{Aeq} (15h), L_{Aeq} (16h), L_{Aeq} (8h), L_{Aeq} (9h) noise level descriptors (see glossary in Technical Appendix M) were processed for each hourly time interval over the logging period.

During the initial selection of monitoring locations (using aerial maps), train noise was not considered an issue, based on each of the chosen sites' relative proximity to the railway line and also their proximity to the road.

Construction noise was modelled to predict construction noise at varying levels of distance from an indicative 2 kilometre (km) section of the Project around Ahrens Road. Two scenarios were run, one (Time Weighted) where a selection of different types of machinery were modelled using a time weighting to mimic a typical day construction with machinery stopping and starting throughout the day. A second scenario (Full Load) was run where a selection of different types of machinery was in use at all times throughout the construction day, which would describe a worst case scenario.

A further construction noise assessment was undertaken using construction equipment sound power levels found in the Australian Standard AS2436:2010 'Guide to Noise and Vibration Control on Construction Demolition and Maintenance Sites' and a distance to noise attenuation relationship. The predicted noise levels at various distances from the noise source are shown in Table 16-6.

Noise modelling was also undertaken to predict the operational impact of the Project on the surrounding area, by considering predicted traffic volumes at completion (estimated as 2015), and in 2025. The predicted volumes are explained in the Noise and Vibration Assessment Report (GHD, 2012g). The CoRTN algorithm was used as it is endorsed by both VicRoads and AustRoads as a suitable method for predicting road traffic noise levels, and accepted by the Victorian Environment Protection Authority (EPA).

The accuracy of the model outputs were validated by modelling the existing highway and comparing the results to the existing conditions data collected from the four loggers placed at sensitive receivers adjacent to the existing highway. The difference was less than +/- 2dB(A), which is considered acceptable.

16.4 Legislation and Policy

The relevant legislation and government policies for the noise assessment are shown in Table 16-1.

Table 16-1 Relevant noise legislation and government policies

Legislation/Policy	Description
State	
Transport Integration Act 2010	The *Transport Integration Act 2010* sets out a vision, objectives and principles for transport in Victoria. It makes clear that the transport system needs to be integrated and sustainable - in economic, environmental and social terms. Part 2, Division 2, Section 10 of the Act outlines the transport objectives with regard to environmental sustainability, these are: "The transport system should actively contribute to environmental sustainability by— *(a) protecting, conserving and improving the natural environment;* *(b) avoiding, minimising and offsetting harm to the local and global environment, including through transport-related emissions and pollutants and the loss of biodiversity;* *(c) promoting forms of transport and the use of forms of energy and transport technologies which have the least impact on the natural environment;* *(d) improving the environmental performance of all forms of transport and the forms of energy used in transport."*
Traffic Noise Reduction Policy (VicRoads, February 2005)	There is currently no State Environment Protection Policy (SEPP) for road traffic noise along state-controlled roads. Instead, traffic noise along these roads is controlled using the *VicRoads – Traffic Noise Reduction Policy 2005*. The policy seeks to regulate noise levels where a new alignment is built. New alignment refers to those areas where a new carriageway is constructed outside the current (i.e. pre-existing) road reserve boundary. **Existing Road Corridor Works (Retrofitting)** This Project would be exempt from the retrofitting program as the existing road was built prior to 1979. **New Alignment and Corridor Expansion Works** The Traffic Noise Reduction Policy seeks to limit noise at sites where arterial roads and freeways are built on new alignments or existing networks are widened as follows: ▪ Category A – For residential dwellings, aged person homes, hospitals, motels , caravan parks and other buildings of a residential nature, the noise level objective will be 63dB(A) $L_{10\ (18hr).}$ measured between 6 am and midnight; ▪ Category B – For schools, kindergartens, libraries and other noise sensitive community buildings, the noise level objective will be 63dB(A) $L_{10\ (12hr)}$ measured between 6 am and 6 pm; and ▪ Where the noise level adjacent to Category A or B buildings prior to road improvements is less than 50dB(A) $L_{10\ (18hr)}$, consideration will be given to limiting the noise level increase to 12dB(A).
Australian Standard (AS) 2702-1984: Acoustics-Methods for the Measurement of Road Traffic Noise	This Standard sets out methods for the measurements of the noise emitted by road traffic. The Standard describes minimum instrument requirements, preferred scales of measurements, and the location of measurement sites and non-acoustic data which are to be recorded in conjunction with the acoustic measurements.
Traffic Noise Measurement Requirements for Acoustic Consultants (VicRoads, November 2005)	The Traffic Noise Measurement Requirements are based on AS 2702 and have been developed to ensure that all measurements are of high quality and consistent over time.

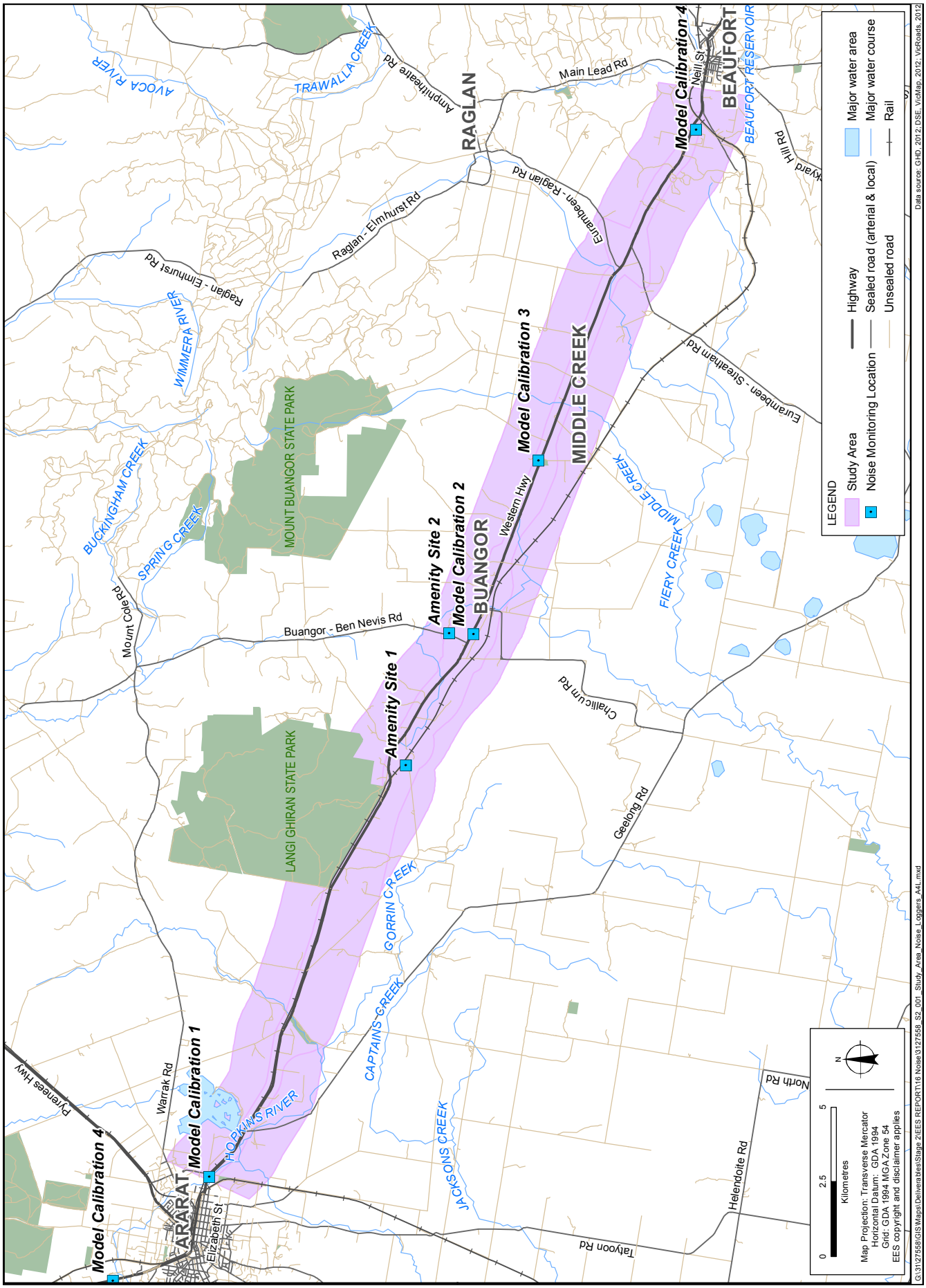

Figure 16-1 Noise Assessment study area and noise monitoring locations

16.5 Existing Conditions

16.5.1 Meteorology

The following meteorological conditions will have an effect on noise propagation and absorption:

- Inversions: Temperature inversions can cause noise to refract ground-ward. An inversion is a thin air layer which experiences increasing temperature with height, rather than the typical decreasing trend.
- Wind direction and speed: Sound refracts or bends across a wind pressure gradient, bending ground-ward downwind, and skyward upwind of the noise source.

Climate data downloaded from the Bureau of Meteorology website indicates that the entire study area from Beaufort to Ararat has a 'temperate' climate with 'no dry season (warm summer)'. Extreme values in temperature occur less frequently at the eastern end than the western end. The wettest months occur in late winter to early spring, with traditionally greater rainfall at the eastern end of the study area. Annual average winds for the project are predominately from the north, with a seasonal switch to the south during the warmer late spring and summer period.

Atmospheric stability in the study area is predominately 'neutral' for well over half the time with 'stable' conditions for a little less than a quarter of the time. These stable and low wind speed conditions are suitable for the formation of inversion layers.

Local meteorology is discussed in detail in the Air Quality Assessment Report (GHD, 2012g) prepared for the Project.

16.5.2 Noise Levels

A summary of unattended measured noise levels is presented in

Table 16-2, and their locations mapped in Figure 16-1. A summary for each site on a daily basis is presented in Table 17 through to Table 22 in Technical Appendix M

Table 16-2 Noise monitoring locations and summary of measured road traffic noise levels (dB)

Site ID	Location	GPS Coordinates	Duration	$L_{A10, 18hr}$	$L_{Aeq, 15hr}$	$L_{Aeq, 16hr}$	$L_{Aeq, 8hr}$	$L_{Aeq, 9hr}$
Model Calibration Site 1	444 Barkly Street, Ararat	E 0673406 N 5871483	28/6/11 - 1/7/11	66	62	62	61	61
Model Calibration Site 2	98 Buangor Road, Buangor	E 0691556 N 5862648	28/6/11 - 1/7/11	66	62	62	61	61
Model Calibration Site 3	6132 Western Highway, Middle Creek	E 0697362 N 5860465	28/6/11 - 1/7/11	65*	61*	61*	59*	59*
Model Calibration Site 4	4919 Western Highway, Beaufort	E 0708436 N 5855186	28/6/11 - 1/7/11	63	59	59	58	59
Amenity Site 1	844 Hillside Road, Buangor	E 0687165 N 5864903	28/6/11 - 1/7/11	53	51	52	52	52
Amenity Site 2	70 Buangor-Ben Nevis Road, Buangor	E 0691593 N 5863460	28/6/11 - 1/7/11	47	47	48	43	43

* The average values at Model Calibration Site 3 have been adjusted, and do not include noise levels measured on Tuesday 28 June 2011 due to their dissimilarity with other days at the same site.

Attended noise measurements were undertaken in order to monitor noise sources at different times of the day at the different sites. A summary of the results of attended noise monitoring is provided in Table 16-3.

Table 16-3 Summary of attended noise measurements (dB)

Site ID	Time	Duration	L_{Aeq}	L_{A90}	L_{A10}	L_{max}	L_{min}
Model Calibration Site 1	13:15	15 min	58	36	62	74	29
Model Calibration Site 2	14:15	15 min	61	40	64	78	26
Model Calibration Site 3	15:45	15 min	62	42	67	75	35
Model Calibration Site 4	16:45	15 min	60	49	65	77	43
Amenity Site 1	13:45	15 min	45	38	46	76	31
Amenity Site 2	15:00	15 min	44	34	45	73	30

The sensitivity of the human ear to noise depends on any number of contextual factors which typically include distance from source, wind, humidity, traffic density, etc. Perception of sound will vary from person to person but generally, the human ear can pick up sounds from 0dB(A) through to the pain threshold of 130dB(A). Daytime noise levels of around 55dB(A) are generally classed as acceptable in residential areas for planning purposes, while industrial zones have higher values. During sleep, it is generally accepted that an internal noise level below 50 to 55dB(A) is unlikely to cause a person to wake up, whereas a level of 65dB(A) or above is likely to cause some sleep disturbance.

Future traffic noise levels can be predicted from the existing and future traffic volumes, as well as the changes in the road alignment due to the Project. A 100% increase (or doubling) in traffic volume translates to an increase of 3dB(A) in traffic noise levels. Note, noise levels in dB(A) are measured on a logarithmic scale. Therefore, a small change in traffic volume, say 20%, would result in a traffic noise increase of less than 1dB(A).

It is important to note that the residential dwellings along the highway already experience noise from the existing road and that a 3dB(A) increase in traffic noise levels would not be easily noticeable.

Results from attended and unattended measurements show:

- As expected, the amenity site which was furthest from the existing Western Highway had a lower overall L_{A10} (18hr) than the model calibration sites. Amenity Site 2 is currently below the noise level of 50dB(A) L_{A10} (18hr) described in the VicRoads - Traffic Noise Reduction Policy, February 2005 for both Category A & B buildings as the level in which 'consideration will be given to limiting the noise level increase to 12dB(A)' L_{A10} (18hr).
- Model calibration Sites 1, 2 and 3 had similar traffic noise levels at 66, 66, and 65dB(A) L_{A10} (18hr) respectively. Model calibration Site 4, which was just outside Beaufort, experienced lower noise levels than Sites 1-3 (63dB(A) L_{A10} (18hr)). Calibration Sites 1-3 are all currently above the noise level objective of 63dB(A) L_{A10} (18hr) described in the VicRoads - Traffic Noise Reduction Policy, February 2005 for Category A - Residential dwellings and Model Calibration Site 4 is at the objective level.
- None of the six logger locations were found to be at or above the trigger level of 68dB(A) L_{A10} (18hr) described in the VicRoads - Traffic Noise Reduction Policy, February 2005 for initiating the noise abatement program.
- Traffic counts were taken at 15 minute intervals from 13:15 hours to 17:00 hours during the attended readings. Counts ranged from 85 to 122 vehicles per 15 minutes. The ratio of heavy to light vehicles was randomly spread throughout the day ranging from 16% heavy vehicles to 29%. Heavy vehicles included buses and all trucks over 3,500 kilograms Tare weight (visual inspection only).

16.6 Impact Assessment

16.6.1 Key Issues

The Project would result in an overall improvement in road operation noise levels in Buangor and around Box's Cutting, as the alignment options are further away from sensitive receptors than the existing highway. However, there are some dwellings that may potentially be impacted more, such as several of those dwellings located west of Buangor township. This is discussed further in Section 16.6.3.

16.6.2 Impact Pathways

16.6.2.1 Construction Noise

Plant and equipment needed for the Project would be determined during the construction planning phase, however an estimation has been made to predict the likely construction noise levels.

The magnitude of off-site noise impact associated with construction would be dependent upon a number of factors:

- The intensity and location of construction activities.
- The type of equipment used.
- Existing background noise levels.
- Intervening terrain and structures.
- The prevailing weather conditions.

Construction machinery would move about the study area, altering noise impacts with respect to individual receptors. During any given period, the machinery items to be used in the study area would operate at maximum sound power levels for only brief stages. At other times, the machinery may produce lower sound levels while carrying out activities not requiring full power. It is highly unlikely that all construction equipment would be operating at their maximum sound power levels at any one time and certain types of construction machinery would be present in the study area for only brief periods during construction.

The EPA Noise Control Guidelines 2008 provide noise criteria for evening (6pm to 10pm) and night (10pm-7am) works. There are no construction noise limits for daytime activities. The evening criteria allows up to a 10dB(A) increase in ambient noise levels for up to 18 months after the Project has commenced. The existing evening background noise levels (LA90) range from 39dB(A) to 46dB(A), therefore a range of 49dB(A) to 56dB(A) would be allowable in the first 18 months. After 18 months, the permissible increase is limited to no more than 5dB(A) above background. The night-time criterion

stipulates that the noise should be inaudible within a habitable room of any residential premises.

As described in Section 16.3 construction noise was modelled to predict construction noise levels at varying distances from an indicative 2km section of the Project around Ahrens Road using a combination of different types of construction equipment. Results of the construction modelling for two scenarios (Time Weighted and Full Load) are presented in Table 16-4 and Table 16-5. Sensitive receivers at a distance of approximately 100m from the centre of the construction activities were predicted to experience construction noise levels between 73 and 79dB(A) L_{Aeq} north and south of the construction activities respectively for scenario one and between 76 and 80dB(A) L_{Aeq} north and south of the construction activities respectively for the second scenario. Sensitive receivers at a distance of approximately 200m from the centre of construction activities are likely to experience construction noise levels between 66 and 65dB(A) L_{Aeq} north and south of the construction activities respectively for scenario one and between 69 and 67dB(A) L_{Aeq} north and south of the construction activities respectively for the second scenario.

Table 16-4 Predicted Construction Noise Emissions North of the Centreline of an Indicative Section

Location	Distance away from centreline (m)	Construction Noise from Time Weighted Equipment Usage L_{Aeq} dB(A)	Construction Noise from Using Equipment All Day (100%) L_{Aeq} dB(A)
South of Alignment	100	73	76
	200	66	69
	300	62	65
	400	59	62
	500	57	60
	600	56	59
	700	55	58
	800	54	57
	900	53	56
	1000	51	54

Table 16-5 Predicted Construction Noise Emissions South of the Centreline of an Indicative Section

Location	Distance away from centreline (m)	Construction Noise from Time Weighted Equipment Usage L_{Aeq} dB(A)	Construction Noise from Using Equipment All Day (100%) L_{Aeq} dB(A)
North of Alignment	100	79	80
	200	65	67
	300	64	67
	400	61	63
	500	56	59
	600	55	58
	700	53	57
	800	52	56
	900	51	54
	1000	48	52

Further construction noise assessment, as described in Section 16.3, was undertaken using a distance to noise attenuation relationship and construction equipment sound power levels.

Anticipated plant and equipment are shown in Table 16-6, with the corresponding maximum noise emission sound power levels and predicted noise levels at various receptor distances. Noise level data has been obtained from Australian Standard AS2436 and the VicRoads Technical Noise Guidelines – Construction and Maintenance Works (VicRoads 2007). Other equipment may be used, however it is anticipated that it would produce similar noise emissions.

Table 16-6 Typical construction plant and equipment noise level at various distances from noise source dB(A)

Source	Sound Power Level dB(A)	Sound Pressure Levels dB(A)									
		Distance (metres)									
		15 metres	80 metres	100 metres	200 metres	500 metres	1000 metres	2000 metres	4000 metres	8000 metres	10000 metres
Asphalt paver	108	76	62	60	54	46	40	34	28	22	20
Asphalt rotomill	111	79	65	63	57	49	43	37	31	25	23
Backhoe with auger	106	74	60	58	52	44	38	32	26	20	18
Bulldozer	108	76	62	60	54	46	40	34	28	22	20
Compactor	113	81	67	65	59	51	45	39	33	27	25
Concrete pump truck	108	76	62	60	54	46	40	34	28	22	20
Concrete saw	117	85	71	69	63	55	49	43	37	31	29
Crane (mobile)	104	72	58	56	50	42	36	30	24	18	16
Excavator	107	75	61	59	53	45	39	33	27	21	19
Front end loader	113	81	67	65	59	51	45	39	33	27	25
Generator (diesel)	99	67	53	51	45	37	31	25	19	13	11
Grader	110	78	64	62	56	48	42	36	30	24	22
Hand tools (pneumatic)	116	84	70	68	62	54	48	42	36	30	28
Jack hammers	121	89	75	73	67	59	53	47	41	35	33
Piling (bored)	111	79	65	63	57	49	43	37	31	25	23
Piling (impact sheet) (Lmax)	137	105	91	89	83	75	69	63	57	51	49
Roller (vibratory)	108	76	62	60	54	46	40	34	28	22	20
Truck (>20 tonne)	107	75	61	59	53	45	39	33	27	21	19
Truck (dump)	117	85	71	69	63	55	49	43	37	31	29
Truck (water cart)	107	75	61	59	53	45	39	33	27	21	19
Vehicle (light commercial e.g. 4WD)	106	74	60	58	52	44	38	32	26	20	18

Results of the construction noise modelling and further construction noise assessment indicate that most construction activities occurring within 200 m of a residential dwelling receptor would exceed the evening and night time criteria. The further construction noise assessment indicates that some activities such as piling and jackhammers may exceed the evening criteria up to a distance of over 1 kilometre away. However, construction outside of the standard hours is likely to be minimal and would be subject to approval by VicRoads and notification of affected members of the community.

VicRoads would require that the construction contractor(s) Construction Environmental Management Plan (CEMP) adopt the EPA and VicRoads construction noise guidelines. These suggest the following measures for minimising construction noise that would be relevant on this Project:

- Fit and maintain appropriate mufflers on earthmoving and other vehicles on the site.
- Enclose noisy equipment.
- Carry out-on-site noise monitoring.
- Provide noise attenuation screens, where appropriate.
- All mechanical plant must have their noise levels reduced by best practical means using current technology.
- Where possible, no vehicle associated with the work should be left standing with its engine operating in a road adjacent to a residential area.

Site buildings, access roads and plant should be positioned such that the minimum disturbance occurs to sensitive receptors.

16.6.2.2 Construction Vibration

Energy from construction equipment is transmitted into the ground and transformed into vibration, which weakens with distance. The magnitude and attenuation of ground vibration is dependent on the following:

- The efficiency of the energy transfer mechanism of the equipment (i.e. impulsive, reciprocating, rolling or rotating equipment);
- The frequency content;
- The impact medium stiffness;
- The type of wave (surface or body); and
- The ground type and topography.

Due to these factors, there is inherent variability in ground vibration predictions without site-specific measurement data. The NSW RTA Environmental Noise Management Manual (ENMM) 2001 provides typical construction equipment ground vibration levels at 10m (Roads and Traffic Authority of New South Wales, 2001). These levels are suitable in the absence of Victorian specific guidelines.

The predicted ground vibrations at various distances are shown in Table 16-7 for typical equipment that may be used based on data from the ENMM. The typical vibration from heavy trucks is generally low, and usually imperceptible in nearby buildings.

Some blasting may be required on sections of the Project around Box's Cutting and Langi Ghiran Picnic Ground, however if required these would be is expected to be short term, minor events at distances far enough away from sensitive receivers as to cause no more than minor transitory impacts.

Table 16-7 Typical vibration levels at distances (Peak mm/s)

Plant Item	Peak Vibration (mm/s), Distance from Source			
	10m	20m	50m	100m
15t roller	7.0 to 8.0	3.8	1.5	0.8
7t compactor	5.0 to 7.0	3.0	1.2	0.6
Dozer	2.5 to 4.0	1.6	0.7	0.3
Backhoe	1.0	0.5	0.2	0.1
Pavement breaker	4.5 to 6.0	2.6	1.1	0.5

Based on the predicted peak vibration levels described in Table 16-7 it is expected that vibration would be barely perceptible at sensitive receiver locations within 50m for most construction activities involving rolling and compacting. Accounting for likely property acquisition by VicRoads to accommodate the Project, within 50m of the alignments there are approximately eight houses near Option 2, compared to seven houses near Option 1 that may potentially be affected. While vibration levels would be noticeable at the seven or eight dwellings, they would not be sufficient to cause damage to buildings.

The vibration from rolling and compacting activities would be considered intermittent and short-term, and likely to be tolerated if prior warning is given to potentially affected residents. Residents would therefore be pre-warned of high vibration events (e.g. piling operations), and any operations being undertaken outside recommended hours. Public notification would be given a minimum of 72 hours prior to planned works. Residents would be made aware of the construction times and the duration they would likely be affected, through letterbox drops, personal meetings/phone calls as necessary. These notification measures would be outlined in a Community Engagement Plan.

16.6.3 Operational Noise

The noise assessment for operational impacts is based on noise modelling of future traffic volumes along the alignment options, as described in Section 16.3.

The model predicts noise levels would increase when compared to the present, predominately due to increases in traffic which are anticipated regardless of whether or not the project proceeds. In some areas, on alignment option would be closer to dwellings than the existing and therefore the potential for impact is greater, and in other cases it would be further away, reducing noise levels.

An increase in the sound level by up to 3dB(A) would only just be perceptible to the normal human ear (Bies, 2003). A change in sound level of approximately 5dB(A) would be clearly noticeable, and a change of 10dB(A) would seem twice as loud.

A comparison of predicted noise levels from the existing Western Highway in 2025 and the predicted noise levels from Option 1 and 2 for the same year (2025) was undertaken. This showed that there would be an increase in noise levels at some sensitive receptors that may be "just perceptible" i.e. 3-4dB(A) or "clearly noticeable" i.e. greater than

or equal to 5dB(A) by 2024. Sensitive receptors that would experience a "clearly noticeable" change are listed in Technical Appendix M. Predicted noise levels at all sensitive receptors are highlighted in Technical Appendix M.

It is estimated that Option 1 and 2 would result in four and three dwellings respectively, experiencing a "clearly noticeable" increase in noise levels, based on a comparison between the existing highway and the proposed alignments under 2025 traffic volumes. However it is also predicted that compared to the existing highway, Option 1 would result in a "clearly noticeable" lowering of noise levels of 5dB(A) or more for 9 dwellings, while Option 2 would result in a clearly noticeable reduction for 17 dwellings. Overall, more dwellings would experience a clearly noticeable reduction, than a clearly noticeable increase. There are therefore potential beneficial effects from reduced noise at some locations.

The VicRoads Traffic Noise Reduction Policy would only to apply to three sections within each of the alignment options alignments. This is because these areas are considered as 'new' carriageway under the policy. The sections relevant to each option are described below:

- Both Options
  - Ch. 1500 to 3400: 580m West of McKinnon Lane through to 340m West of Centre Road;
  - Ch. 4400 to 5600: Around Eurambeen-Streatham Road/Eurambeen-Raglan Road Intersection (Eurambeen).
- Option 1
  - Ch. 16200 to 20200: 160m East of Yarrabbin Road/Andersons Road through to 860m West of Buangor-Ben Nevis Road; and
  - Ch. 23000 to 28400: 510m to the West of Pope Road through to 980m East of Langi Ghiran Picnic Ground Road.
- Option 2
  - Ch. 16200 to 20200: 160m East of Yarrabbin Road/Andersons Road through to 860m West of Buangor-Ben Nevis Road; and

In accordance with Section 2.4 of the VicRoads' Interpretation and Application of VicRoads Traffic Noise Reduction Policy 2005 (RDN06-01), *"if the additional noise level from the new alignment section of the road at a residence is above 63 dB(A) or the level that would have prevailed if the 'new alignment' had not been built, then the VicRoads Policy applies and the noise attenuation should be considered for this property."*

16.7 Risk Assessment

An environmental risk assessment was undertaken to identify key environmental issues associated with the construction and operation of the Project. The methodology for this risk assessment has been described in Section 4.2. A Risk Assessment report that explains the process in detail and contains the complete project risk register has also been included in Technical Appendix Q.

The risk assessment was conducted on the proposed alignment options only.

Table 16-8 shows a summary for noise and vibration of:

- The impact pathways identified.
- A description of the consequence.

Table 16-8 Noise Risks

Risk No.	Impact Pathway	Consequence Descriptor
N1	Daytime construction of Western Highway at an individual sensitive receptor. Normal working hours under EPA Publication 1254 - Guidelines for Noise Control (2008) are: ▪ 7 am -6 pm Monday to Friday ▪ 7 am -1 pm Saturdays	▪ Noise disturbance at a dwelling or other sensitive receptor. ▪ There are no limiting noise criteria for the daytime period, however there is still a duty to minimise noise impacts on the surrounding environment.
N2	Daytime construction of Western Highway near sensitive receptors (i.e. more than one receptor) in a local area (community) such as: ▪ McKinnon Lane, Beaufort (Ch. 800 - 1000) ▪ Woodnaggerak/Middle Creek Road Community, Middle Creek (Ch. 10400 - 12800) ▪ Buangor Township, Between Andersons/Gravel Route Roads, Buangor (Ch. 16400 - 20000)	▪ Noise disturbance within the local community, dwellings or other sensitive receptors. ▪ There are no limiting noise criteria for the daytime period, however there is still a duty to minimise noise impacts on the surrounding environment.

Risk No.	Impact Pathway	Consequence Descriptor
	▪ Geelong Road Community, Ararat (Ch. 35200 - 40400)	
N3	Evening construction of Western Highway Evening hours as laid out in the EPA Publication 1254 are as follows: ▪ 6 pm -10 pm Monday to Friday ▪ 1 pm -10 pm Saturdays ▪ 7 am - 10 pm Sundays and public holidays	▪ Noise disturbance within the local community, dwellings or other sensitive receptors, including individual receptors. ▪ If evening works are required EPA Publication 1254 - Guidelines for Noise Control (2008) would apply.
N4	Night time construction of Western Highway The night period as laid out in the EPA Publication 1254 is as follows: ▪ 10 pm -7 am Monday to Sunday	▪ Noise disturbance within the local community, dwellings or other sensitive receptors, including individual receptors. ▪ If night time works are required EPA Publication 1254 - Guidelines for Noise Control (2008) would apply.
N5	Site compounds and laydown areas during construction	▪ Noise disturbance within the local community, dwellings or other sensitive receptors, including individual receptors. ▪ There are no limiting noise criteria for the daytime period, however there is still a duty to minimise noise impacts on the surrounding environment. If evening weekend or night time works are required EPA Publication 1254 - Guidelines for Noise Control (2008) would apply.
N6	Vibration caused by construction of Western Highway	▪ Vibration disturbance within the local community, dwellings or other sensitive receptors, including individual receptors. ▪ The magnitude of ground vibrations is not expected to be sufficient to cause structural damage, as defined by the DIN 4150-3 criteria. ▪ No significant vibration impacts are expected, however vibration may be just perceptible at residences within 50m (as described in Table 27 in the Noise and Vibration Impact Assessment Report) for construction activities involving rolling and compacting. The vibration from rolling and compacting activities would be considered intermittent and short-term.
N7	Operation of the Western Highway generates noise emissions from vehicular traffic Areas where the VicRoad Traffic Noise Reduction Policy 2005 **Applies**	▪ Noise disturbance within the local community, dwellings or other sensitive receptors, including individual receptors. ▪ Locations Where Policy Applies: ▪ Sections where both alignments are located outside the existing road reserve, described in Section 3.2.2 in the Noise and Vibration Impact Assessment Report (GHD, 2012g).
N8	Operation of the Western Highway generates noise emissions from vehicular traffic. Areas where the VicRoads Traffic Noise Reduction Policy 2005 **Does Not Apply**	▪ Noise disturbance within the local community, dwellings or other sensitive receptors, including individual receptors. ▪ Locations Where Policy Does Not Apply: ○ Sections where either one or both alignments are located inside the existing road reserve, described in Section 3.2.2 in the Noise and Vibration Impact Assessment Report (GHD, 2012g).

16.8 Environmental Management Measures

VicRoads has a standard set of environmental management measures which are typically incorporated into its construction contracts for road works and bridge works. These measures have been used as the starting point for the assessment of construction related risks, and are described in detail in Chapter 21 (Environmental Management Framework). In some instances, additional Project specific environmental management measures have been recommended to reduce risks.

Management measures specific to each identified noise and vibration risk and the residual risk rating are outlined in Table 16-9.

Table 16-9 Noise environmental management measures and residual risk

Risk No.	Environmental Management Measures	Residual Risk Rating
N1	Comply with section 1200.12 Noise and section 1150.01 Working Hours of the VicRoads Contract Specifications Contractor to implement a communication strategy with the key stakeholders and the community to manage the impacts of construction noise and limit disturbance to local amenity. Contractor to implement a noise mitigation strategy for construction activities with consideration to the EPA Publication 480 - Environmental Guidelines for Major Construction Sites (1996) and EPA Publication 1254 - Guidelines for Noise Control (2008), as well as, referring to 'Typical Construction Plant and Equipment Noise Attenuation Over Distance' table, contained in the EES Noise Impact Assessment report (GHD, 2012g).	Negligible
N2	As per Risk N1	Negligible
N3	As per Risk N1; and Evening and weekend works may occur at certain stages during the Project. If the contractor is required to undertake work during evening or weekend times, this would need to be approved by the VicRoads Superintendent. A condition of VicRoads approval would be that all relevant stakeholders are consulted including nearby residents. In the event that it becomes apparent that the working hours are to be exceeded by more than 30 minutes, or work is required out of hours in an emergency, the Contractor would have a process in place that would immediately: ▪ notify and obtain approval from the Superintendent; ▪ where required by the Superintendent, notify the Environment Protection Authority; and ▪ advise surrounding property owners/occupiers that would be disturbed by any activity. Should 'unavoidable works' be required for evening or night time work, then where possible section 5.2.2 (b) and (c) of the VicRoads Noise Guidelines – Construction and Maintenance Works 2007 would be adhered to.	Low
N4	As per Risk N1 and N3	Low
N5	As per Risk N1 and N3	Low
N6	Comply with section 1150.04 Ground Vibration of the VicRoads Contract Specifications. If construction works causing vibration are required within 50 m of a sensitive receptor (building) a construction vibration assessment would be undertaken prior to works being carried out and appropriate methods of construction employed to minimise impacts. Timing of the works to be conducted during the recommended operational hours, to reduce vibration levels to residential properties. Residents to be made aware of the construction times and the duration they would likely be affected, through letterbox drops, personal meetings and community meetings. Residents to be pre-warned of high vibration events (e.g. piling operations), and any operations being undertaken outside recommended hours. Public notification would be given a minimum of 72 hours prior to planned works. As a precaution the contractor would undertake a dilapidation survey for any buildings, structures or utilities located within 50 m of construction works. Equipment operators to be made aware of potential vibration issues problems and of techniques to minimise vibration effects during construction works.	Low
N7	Limit potential noise production during design stage through the use of alignment shifts, pavement materials, speed limits and other such items as required. Adhere to VicRoads Traffic Noise Reduction Policy 2005: Noise attenuation would be considered for sensitive receptors that exceed 63 dB(A) (and the Policy is found to apply) Consideration for retrofitting (e.g. double glazed windows, barriers) would be given where noise levels at sensitive receptors exceed 68 dB(A) (and the Policy is found to apply). Where a "new alignment" as described in the VicRoads Traffic Noise Reduction Policy (2005) is constructed (and the Policy is found to apply), noise monitoring to check compliance with the policies noise	Negligible

Risk No.	Environmental Management Measures	Residual Risk Rating
	level objectives for Category A and B sensitive receptors would be carried out. Where the noise criteria outlined in the Traffic Noise Reduction Policy (2005) are exceeded, mitigation works as outlined in the policy would be carried out as required.	
N8	Limit potential noise production during design stage through the use of alignment shifts, pavement materials, speed limits and other such items as required.	Negligible

VicRoads would require the construction contract(s) to develop and implement a CEMP to implement the management measures described in this Chapter and Chapter 21 (Environmental Management Framework).

16.8.1 Residual Risks

Following implementation of the recommended mitigation measures there are not expected to be any significant impacts. The overall risk from noise and vibration impacts is low to negligible.

16.9 Conclusion

Construction noise impacts would be negligible as work would be undertaken during normal daytime hours. Suitable mitigation measures would be in place for any work undertaken outside these hours, in accordance with the EPA Noise Control Guidelines 2008.

Vibration effects on human comfort or structures would be minimal, and precautionary mitigation measures are proposed such as providing prior notice to occupiers, and undertaking an inspection of any structures near a works area.

Changes in operating noise from traffic flow vary for each option. In comparison to the existing highway, there are more dwellings that would experience a clearly noticeable reduction in traffic noise of 5dB(A) or greater following construction of the Project, than those that would experience the same level of increase.

Option 2 is the marginally preferred alignment. Modelling predicts Option 2 would result in a clearly noticeable traffic noise impact from operation of the new road of one fewer dwelling than Option 1, being a total of three dwellings compared with a total of four for Option 1. In addition, Option 2 would result in a clearly noticeable decrease in noise for 17 dwellings as opposed to nine for Option 1. Overall, the impact from noise and vibration impacts is low for both options following implementation of the recommended mitigation measures.