7.3.5 Sleep disturbance

Sleep disturbance is a relevant consideration for OOHW that occurs at night time near residential receivers. In accordance with the ICNG, sleep disturbance should be assessed for any works which occur for two consecutive nights or more near a sensitive receiver (e.g. residence).

The most likely source of potential sleep disturbance from the night construction works will be from the use of saw cutting during services relocation and/or road pavement works or from truck movement on site, in particular the application of air brakes during other out of hours activities. Indicative maximum noise levels were predicted in the EIS to the nearest affected residential receivers to allow a review of the potential for sleep disturbance from OOHW. The results are summarised in Table 7-8.

Table 7-8 Preliminary sleep disturbance assessment for night works (EIS Table 12-21)

NCA	Sleep noise management level dB $L_{A1(1min)}$	Predicted L_{Amax} noise levels at worst affected receivers	
		Services / road pavement	Finishing / compounds
NCA1	59	51-58	48-55
NCA2	62	56	53
NCA3	62	48-66	45-63
NCA4	45	79	76
NCA5	45	44-60	41-57
NCA6	54	45-53	42-50
NCA7	54	38-43	35-40
NCA8	54	51-56	48-53
NCA9	54	56-63	53-60
NCA10	54	37-72	34-69
NCA11	61	45-70	42-67
NCA12	61	45-56	42-53
NCA13	61	49-75	46-72
NCA14	67	65	62
NCA15	67	< 60	< 60
NCA16	67	< 60	< 60

The predictions indicate that sleep disturbance is a potential concern for noisy works in some NCAs, mainly NCA3, NCA4, NCA5, NCA8, NCA9, NCA10, NCA11 and NCA13. Sleep disturbance will be assessed in accordance with the OOHW Approval Procedure in Appendix C. Specific noise mitigation measures to be implemented where sleep disturbance is a risk are outlined in Chapter 8.

7.3.6 Construction related road traffic noise

Construction-related traffic movements, including haulage routes and the expected number of truck movements, were discussed in Section 5.20.10 of the EIS. Light vehicle movements associated with construction were not considered to be substantial and have not been included in this traffic assessment.

Fulton Hogan expects that construction-related traffic will involve approximately 150 – 200 heavy vehicles per day on the following roads:

- East West Link
- Tongarra Road
- Illawarra Highway.

For the purpose of this assessment, it has been assumed that all movements occur during standard construction hours. Where construction activities are required outside recommended standard hours, this will be assessed as required as part of an OOHW assessment submitted in accordance with the procedure in Appendix C.

To determine the increase in traffic noise as a result of 200 additional heavy vehicle movements, traffic data from the concurrent traffic counts conducted in February 2015 (Appendix C of the EIS Noise and Vibration Assessment) were used in the relevant locations and then adjusted for the increase of construction traffic. Table 7-9 presents the predicted increase in road traffic noise from additional construction traffic. Note that the Princes Motorway and Princes Highway have also been included to provide information on these major access routes.

Table 7-9 Predicted impact of Fulton Hogan construction traffic on existing traffic noise levels

Road	Without construction traffic		With construction traffic		Change in $L_{Aeq(15\ hour)}$ traffic noise level dB
	Total	HV%	Total	HV %	
Princes Motorway	46773	7.4	46973	7.8	<1
Princes Highway	54623	6.1	54823	6.5	<1
Illawarra Highway	13669	4.4	13869	5.8	<1
Tongarra Road	11583	4.0	11783	5.6	<1
Princes Highway	42062	10.9	42262	11.4	<1
East-West Link	12741	3.2	12941	4.7	<1
Princes Motorway	31593	7.2	31793	7.8	<1

From Table 7-9, it is apparent that the noise impact of construction-related traffic is expected to be relatively minor in nature. To minimise the impact of construction-related traffic noise:

- Construction traffic will access the site compounds via defined routes on major arterial roads.
- Site access routes will be planned to avoid residential streets where reasonable and feasible.

It is expected that construction traffic will need to use local roads from time-to-time but this will be limited wherever possible and off road haulage will be prioritised. Where local roads are used, the number of movements would be significantly smaller than assumed above such that construction-related road traffic noise increases of greater than 2 dB above the existing road traffic noise level

are not expected when assessed across a daytime period. Noise impacts from any occasional movements on local roads will be managed in accordance with Chapter 8 of this NVMP.

7.3.7 Ancillary site operation (including access)

The Project will require a main site compound, and a number of ancillary facilities and stockpile sites. These compound and ancillary facilities will accommodate a range of activities, plant and equipment including, but not limited to:

- Office accommodation
- Staff amenities
- Light vehicle parking and access
- A plant and equipment maintenance workshop
- Material and chemical storage
- Equipment storage
- Material storage.

The ancillary facility sites shown in the EIS are shown on the noise contour maps in Appendix B of this NVMP. At this stage it is not confirmed which sites will be used and for what purpose and, therefore, an assessment has been undertaken on the basis of the activities listed in Table 7-1 occurring at each site.

The Ancillary Facilities Management Plan required under CoA A17 provides an assessment of all ancillary facilities on the Project.

Table 7-10 provides the predicted noise levels for ancillary sites within different NCAs, as well as the number of residences where the predicted noise levels exceed the NMLs for different periods of day. It can be seen that the majority of affected sensitive receivers by potential operations at ancillary facilities are located in NCA 5, partly due to the location of the sites and partly due to the lower background noise levels in this area. Small numbers of residential land uses are also predicted to be exposed to compound noise levels above the NMLs in other NCAs but typically no more than ten residences per NCA.

Generally:

- During standard work hours, including the shoulder period, predicted noise levels from ancillary sites are generally less than 10 dB above the NML with the exception of residences in NCA 5.
- Any OOHW at ancillary sites in NCA 3, 4, 5, 9, 10, 11, 15 and 16 have the potential to produce noise levels in excess of the OOHW NMLs at residential land uses. Any such works will be assessed in accordance with the OOHW Procedure in Appendix C.

All reasonable and feasible mitigation measures will be implemented for the ancillary sites in accordance with the procedures detailed in Chapter 8. This will include the use of site access routes for the ancillary sites that use major roads and avoid residential streets.

Vibration impacts from the operation of compound and ancillary facilities are not anticipated given the distance of the sites to sensitive land uses and the typical activities that will occur at each site.

Table 7-10 Predicted construction noise levels from ancillary sites at residences during different time periods

NCA	Daytime during standard hours			Shoulder (D-E) during standard hours			OOHW Shoulder (N-D)			OOHW Day			OOHW Evening			OOHW Night		
	NML, dB(A)	Maximum PNL, dB(A)	No of receivers exceeding NML	NML, dB(A)	Maximum PNL, dB(A)	No of receivers exceeding NML	NML, dB(A)	Maximum PNL, dB(A)	No of receivers exceeding NML	NML, dB(A)	Maximum PNL, dB(A)	No of receivers exceeding NML	NML, dB(A)	Maximum PNL, dB(A)	No of receivers exceeding NML	NML, dB(A)	Maximum PNL, dB(A)	No of receivers exceeding NML
NCA1	58	<35	0	52	<35	0	53	<35	0	53	<35	0	51	<35	0	49	<35	0
NCA2	55	<35	0	50	<35	0	50	<35	0	50	<35	0	52	<35	0	52	<35	0
NCA3	55	53	0	50	53	10	50	53	10	50	53	10	52	53	2	52	53	2
NCA4	54	61	2	49	61	2	44	61	2	49	61	2	42	61	2	35	61	2
NCA5	45	57	281	40	57	380	39	57	393	40	57	380	38	57	404	35	57	412
NCA6	62	44	0	57	44	0	54	44	0	57	44	0	53	44	0	44	44	0
NCA7	62	<35	0	57	<35	0	54	<35	0	57	<35	0	53	<35	0	44	<35	0
NCA8	62	42	0	57	42	0	54	42	0	57	42	0	53	42	0	44	42	0
NCA9	62	69	1	57	69	1	54	69	1	57	69	1	53	69	1	44	69	6
NCA10	57	54	0	52	54	1	52	54	1	52	54	1	48	54	1	44	54	2
NCA11	58	62	2	53	62	3	53	62	3	53	62	3	51	62	3	51	62	3
NCA12	58	49	0	53	49	0	53	49	0	53	49	0	51	49	0	51	49	0

NCA	Daytime during standard hours			Shoulder (D-E) during standard hours			OOHW Shoulder (N-D)			OOHW Day			OOHW Evening			OOHW Night		
NCA13	58	52	0	53	52	0	53	52	0	53	52	0	51	52	1	51	52	1
NCA14	64	54	0	58	54	0	59	54	0	59	54	0	58	54	0	57	54	0
NCA15	64	63	0	58	63	18	59	63	13	59	63	13	58	63	18	57	63	21
NCA16	64	63	0	58	63	2	59	63	2	59	63	2	58	63	2	57	63	3

7.4 Early mitigation measures as per Condition E47

Condition E47 of the CoA for the Project identifies a requirement for operational noise mitigation measures to be implemented early for residences that may be impacted by construction noise. CoA E47 also requires the early implementation measures to be detailed in the NVMP and justification for the measures to be implemented early to be provided in a report to the Secretary of DPIE.

This NVMP fulfils the requirement for the report to the Secretary, with justification for the approach to CoA E47 provided below.

7.4.1 Summary of operational noise mitigation measures

The operational noise mitigation measures referred to in CoA E47 primarily refer to at-property architectural treatments, which are proposed for up to 183 properties, including 172 residences.

Additional operational noise mitigation measures proposed for the project include the noise mound to the north of East-West Link, a noise barrier to the west of the elevated road near Albion Park and a low noise road surface. As these measures will be affected by construction works and are restricted as to when they can be installed by the overall construction program, they are not considered relevant to CoA E47.

For example, the noise mound requires significant excavation works to occur prior to it being constructed, and the barrier on the elevated road requires the bridge structure to be in place. It is also noted that the low noise road surface and low height noise barrier on the elevated road would not be expected to provide any noticeable benefit to construction noise levels at residences. Therefore, the primary form of early treatment will be the provision of at-property treatments.

7.4.2 Early implementation of operational noise mitigation measures

The intention of CoA E47 is to ensure that the operational noise mitigation measures not affected by construction works also provide control of construction noise.

It is intended to provide all at-property treatments as early in the construction process as possible. However, it is noted that it may not be reasonable and feasible to implement at-property treatments to all 183 properties within six months of construction commencing, as the at-property treatments will require approval from each individual property owner, which may cause delays outside of Fulton Hogan control.

Therefore, the following approach will be undertaken to address Condition E47 most effectively by prioritising treatments for those residences expected to be most impacted by construction noise as part of the Project works:

- To address those properties most potentially affected by construction noise, early treatment will be provided to any residence where at-property treatment is proposed for operational road traffic noise and where the predicted typical worst-case construction noise level exceeds the daytime NML by more than 10 dB for any construction phase. Therefore, CoA E47 will be addressed through the provision of early at-property treatments at the 26 residential properties listed in Table 7-11.
- These priority early treatments will be provided within six months of construction works commencing within 150 – 200 m of the nominated residence (or as per CoA E47 at other times during construction). At these distances, predicted construction noise levels remain below the standard hours NML and therefore the treatments would be installed no later than six months after the commencement of works with the potential to create noise levels above the NML for the residence.
- Other at-property treatments (at the remaining 157 properties) will be installed as early as is practical in the construction process, noting that consultation with the property owners needs to occur and property treatment agreements need to be in place. Where possible, this will also be carried out within six months of commencing construction near the residence.
- The East-West Link noise mound will be installed as early as practical in the construction process.

- Works will proceed with the application of all reasonable and feasible temporary mitigation and management measures as per Chapter 8 of this NVMP to minimise impacts as much as is feasible both prior to and following the at-property treatments.

Table 7-11 identifies those residences where the highest NML exceedances are predicted and where early at-property treatment will be provided where reasonable and feasible and an indication of the timing for the treatment. The locations of the properties are also shown on the Project Map in Appendix E of this NVMP.

Table 7-11 Residences where early at-property treatment required

NCA	Properties nominated for at-property treatment where construction noise PNL exceeds daytime NML by more than 10 dB	Timing
NCA1	None	n/a
NCA2	None	n/a
NCA3	3_0204, 3_0205, 3_0224, 3_0235	Within 6 months of works commencing within 150 m of the residence.
NCA4	4_0001, 4_0002	
NCA5	5_0011, 5_0014, 5_0017, 5_0018, 5_0019, 5_0020, 5_0021, 5_0022, 5_0030, 5_0031, 5_0032, 5_0033, 5_0034, 5_0035, 5_0038, 5_0039	Within 6 months of works commencing within 200 m of the residence.
	5_0223	Within 6 months of activities at an ancillary site within 200 m of residence.
NCA6	None	n/a
NCA7	None	n/a
NCA8	None	n/a
NCA9	9_0014	Within 6 months of works commencing within 100 m of the residence.
NCA10	10_0001	
NCA11	None	n/a
NCA12	12_0246	Within 6 months of works commencing within 100 m of the residence.
NCA13	None	n/a
NCA14	None	n/a

7.5 Construction vibration impacts

7.5.1 CNVG vibration management approach

The Roads and Maritime CNVG provides additional context to the management of construction vibration as shown in Table 7-12, with additional mitigation measures to be applied where the predicted or measured vibration level exceeds the "Maximum" level for human comfort.

Table 7-12 CNVG vibration management approach

Predicted vibration level at sensitive land use	Additional mitigation measures to be applied to affected sensitive receivers (refer Chapter 8 for detail)
STANDARD WORKING HOURS: Mon – Fri 7 am – 7 pm, Sat 8 am – 5 pm	
Exceeds "Maximum" human comfort criteria from Assessing Vibration: A Technical Guideline	• Validation of predicted vibration levels • Notification drops • Respite period
OOHW PERIOD 1: Mon – Fri 7 pm – 10 pm, Sat 7 am – 8 am & 5 pm – 10 pm, Sun/Pub Hol, 7 am – 6 pm	
Exceeds "Maximum" human comfort criteria from Assessing Vibration: A Technical Guideline	• Validation of predicted vibration levels • Individual briefings • Notification drops • Project-specific respite offer • Phone calls • Respite period • Specific notifications
OOHW PERIOD 2: Mon – Sat 10 pm – 7 am, Sun/Pub Hol, 6 pm – 7 am	
Exceeds "Maximum" human comfort criteria from Assessing Vibration: A Technical Guideline	• Consideration of alternative accommodation options • Validation of predicted vibration levels • Individual briefings • Notification drops • Phone calls • Respite period • Specific notifications

Further details on the project-specific application of construction vibration mitigation measures are provided in Chapter 8 of this NVMP.

7.5.2 Vibration assessment

The propagation of vibration emitted from a source is site-specific with the level of vibration potentially experienced at a receiver dependent on the vibration energy generated by the source, the main frequencies of vibration, the localised geotechnical conditions and the interaction of structures and features which can dampen vibration. The recommended safe working distances for

construction plant provided in Table 7-13 are referenced from the CNVG and from in-house measurement data from Resonate.

Table 7-13 Vibration safe working distances

Plant item	Rating / Description	Safe working distance, m					
		Cosmetic damage			Human response		
		Heritage structure	Residential structure	Commercial / industrial	Residence – night	Residence – day	Educational
Vibratory roller	<50 kN (typically 1-2t)	7	5	2	25	15	10
	<50 kN (typically 2-4t)	9	6	2	35	20	13
	<50 kN (typically 4-6t)	18	12	5	65	40	25
	<50 kN (typically 7-13t)	22	15	6	140	100	65
	<50 kN (typically 13-18t)	28	20	8	150	100	70
	<50 kN (typically >18t)	35	25	10	150	100	75
Handheld compactor	Up to 300 kg	7	5	2	30	20	12
Small hydraulic hammer	300 kg – 18-34t excavator	3	2	–	10	7	5
Medium hydraulic hammer	1600 kg – 5-12t excavator	12	7	3	35	23	15
Large hydraulic hammer	1600 kg – 12-18t excavator	30	22	9	100	73	45
Bored piling	< 800 mm	3	2	–	7	4	2
Excavation works	12-18t excavator	3	2	–	15	10	7
Jackhammer	Handheld	2	1	–	5	–*	–*

Notes:

** Avoid contact with structure*

The safe working distances are generally conservative, developed with reference to the more stringent objectives for continuous vibration for typical residential building constructions and the lowest applicable criterion for potential cosmetic building damage. It follows that work within the safe working distance does not necessarily mean that an impact will occur, but rather that further consideration may be required.

Based on the vibration data presented above, vibration generated by construction plant was estimated and potential vibration impacts are summarised in Table 7-14. The assessment is relevant to residential and commercial use buildings, and other similar type structures in the project area. The risk of human disturbance is described with respect to the potential for an adverse comment from an affected receiver.

Table 7-14 Potential vibration impacts (based on EIS Table 12-24)

Noise catchment area	Approx. distance of nearest buildings from the works	Type of building	Assessment of risk of vibration impact		
			Structural damage risk	Risk of human disturbance	Vibration monitoring
NCA1	100-130 m	Residential	Negligible	Very low	Not required
NCA2	120 m	Residential	Negligible	Very low	Not required
NCA3	40-130	Residential	Negligible	Low risk	Not required
	60 m (Park Rail Cemetery)	Heritage	Negligible	Very low	Not required
NCA4	20 m	Residential	Very low	Medium	May be required
	10-20 m (Swansea Farmhouse / Dairy)	Heritage	Medium	Medium	Required
NCA5	120-200 m	Residential	Negligible	Very low	Not required
NCA6	100 m	Residential	Negligible	Very low	Not required
NCA7	600 m	Residential	Negligible	Negligible	Not required
NCA8	130 m	Residential	Negligible	Very low	Not required
	175 m (Ravensthorpe grounds)	Heritage	Negligible	Negligible	Not required
NCA9	6-10 m	Commercial	Medium	High risk	Required
	80-100 m	Residential	Negligible	Low risk	Not required
NCA10	10-12 m	Residential	Low risk	High risk	May be required
NCA11	40-60 m	Residential	Negligible	Low risk	Not required
	70-400 m (Illawarra Regional Airport)	Heritage	Very low	Low risk	Not required
NCA12	10 m	Industrial	Negligible	Low risk	Not required
	200 m	Residential	Very low	High risk	May be required
NCA13	30-40 m	Residential	Very low	Medium	May be required
NCA14	25-60 m	Residential	Very low	Medium	May be required

Noise catchment area	Approx. distance of nearest buildings from the works	Type of building	Assessment of risk of vibration impact		
			Structural damage risk	Risk of human disturbance	Vibration monitoring
	80 m (House, Princes Hwy, Yallah)	Heritage	Very low	Low risk	Not required
NCA15	20-50 m	Residential	Low risk	High risk	May be required
NCA16	25-40 m	Residential	Low risk	High risk	May be required

Generally, there is low risk of damage to building structures from construction vibration, although care will be required where works are occurring in close proximity to the heritage-listed Swansea Farmhouse and Dairy in NCA4 and if heavy compaction works are required in very close proximity to commercial structures in NCA9.

There is the potential for human disturbance from vibration where works are occurring within 50 m of residential and other sensitive land uses but, for those NCAs where residences are located further than this from the works, the risk of vibration disturbance to building occupants is considered low to negligible.

Vibration management procedures are discussed further in Chapter 8, with monitoring procedures discussed further in Chapter 8.

7.5.3 Blasting assessment

Blasting is not required to excavate the lower benches of the cut at the eastern extent of East-West Link and is no longer proposed. As a result, all other references to blasting and associated impacts have been removed from this plan.

7.5.4 Potential impact on equestrian activities

The noise associated with the construction works, including that associated with ancillary sites, construction traffic and construction activities, has potential to impact on users of the Croom Regional Sporting Complex. In particular, construction noise has the potential to adversely impact horses and their riders. The extent to which any individual horse will be impacted by noise during construction is dependent on the degree to which it is habituated to noise, and is not possible to predict.

The main way in which this impact would be managed is via consultation with the equestrian groups using the Croom Regional Sporting Complex, to advise them of upcoming construction activities in proximity to the Complex. These groups would be included in the consultation with affected residents during the construction period.

ID	Mitigation Measure	Responsibility
NVMM45	If vibration intensive plant is to be used within the safe working distance for cosmetic damage (as per Table 7-13), works would not proceed until attended vibration measurements are undertaken.	Foreman, Environment Officer
NVMM46	Where vibration intensive works are occurring for a continuous period of time within the safe working distance for cosmetic damage (as per Table 7-13), install a permanent vibration monitoring system to warn operators (via flashing light, audible alarm, SMS etc.) when vibration levels are approaching the cosmetic damage objective.	Environment Officer Operators
NVMM47	Undertake pre-construction dilapidation surveys of buildings and structures where construction works will occur within safe working distances for cosmetic damage, at such a time that the report can be provided to the landowner at least one month prior to that work being undertaken.	Environment Officer
NVMM48	Undertake post-construction dilapidation surveys of buildings and structures where construction works has occurred within safe working distances for cosmetic damage.	Environment Officer, Environment Manager
NVMM49	Undertake surveys of buildings and structures immediately following a monitored exceedance of the relevant vibration criteria.	Environment Officer, Environment Manager

8 Environmental mitigation measures

Specific mitigation measures to address impacts from construction noise and vibration are outlined in Table 8-1 for Standard Hours work and in Table 8-2 for any OOHW. The application of these mitigation measures will ensure that construction noise and vibration impacts from the Project are managed in accordance with the outcomes specified in the EIS and SPIR.

The mitigation measures are provided in various stages, depending on the predicted noise levels relative to the NMLs or vibration management levels, in general accordance with the CNVG. The standard feasible and reasonable mitigation measures will be implemented at all times on site, with additional mitigation measures applied depending on the predicted exceedance of the relevant NMLs and the times of the works.

Noise mitigation measures for OOHW are also provided, which are applied in accordance with the OOHW Approval Procedure in Appendix C.

The vibration mitigation measures are to be implemented where works are occurring within the safe working distances from residences for human response identified in Section 7.5.2 and in accordance with the CNVG.

8.1 Feasibility and reasonableness

Mitigation measures are applied where feasible and reasonable. This requires judgment in accordance with the definitions in the CNVG.

It also requires consideration of any requirements of the CoA. For example, OOHW may require compliance with noise criteria established in the CoA and EPL regardless of feasibility and reasonableness.

Feasibility relates to engineering considerations (what can be practically built). These engineering considerations may include:

- The inherent limitations of different techniques to reduce noise emissions from construction works;
- Safety issues such as restrictions on road vision;
- Worksite constraints such as space limitations;
- Floodway and stormwater flow obstruction;
- Access requirements; and/or
- Maintenance requirements.

The CNVG advises that selecting reasonable measures from those that are feasible involves judging whether the overall noise benefits provide significant social, economic or environmental benefits. The factors to be considered are:

- The noise reduction provided and the overall number of people that benefit from the mitigation;
- The duration of the construction noise impact on the sensitive land uses;
- Existing noise levels at the residence in the absence of construction works;
- The cost of mitigation, including the cost of noise mitigation measures as a percentage of the total project cost and the ongoing maintenance and operational costs;
- The impact a mitigation measure may have on the duration of the construction works, noting that a higher noise level for a shorter duration may be preferable;
- The impact a mitigation measure may have on the wider community, e.g. by extending traffic management controls on a major road; and
- Community views and preferences regarding the above (typically gathered during community consultation processes).

8.2 Mitigation measures for Standard Working Hours

Specific mitigation measures to address construction noise and vibration impacts during Standard Working Hours are outlined in Table 8-1.

Table 8-1 Standard hours noise and vibration mitigation measures

ID	Mitigation Measure	Responsibility
NOISE: Standard Working Hours and Extended Working Hours measures applied at all times		
NVMM1	Undertake works during Standard Hours or Approved Extended Working Hours. Where works must occur outside of these hours, assess Out of Hours works in accordance with the Out of Hours Work Approval Procedure provided in Appendix C, and ensuring compliance with Condition E38.	Construction Manager
NVMM2	Maintain communication with third parties providing utility works to ensure that cumulative noise and vibration impacts on sensitive land uses are assessed and considered in accordance with this NVMP prior to works commencing.	Construction Manager
NVMM3	Prioritise noisier works to occur during Standard Hours rather than Out of Hours Work, including deliveries.	Construction Manager
NVMM4	Operate the hotline and complaints management system as detailed in the CCS.	Community Relations Manager
NVMM5	Include noise and vibration management practice information in site induction training for staff and contractors. A one-page summary will be provided regarding noise and vibration management practices during all inductions	Construction Manager, Foreman
NVMM6	Ensure all mobile construction equipment on site for longer than two months have non-tonal reversing alarms.	Foreman, Operators
NVMM7	Plan and conduct works in a manner to minimise the reversing of vehicles with audible reversing alarms.	Construction Manager, Foreman
NVMM8	Trucks will travel via internal haul roads and major roads where practicable to minimise use of local roads.	Foreman
NVMM9	Site compounds, access points and roads will be positioned as far as practicable away from residential receivers. Equipment within site compounds will be oriented as positioned as far as possible from sensitive receivers, to take advantage of natural shielding and shielding provided by buildings. Enclose stationary noisy sources at compounds where practicable.	Foreman
NVMM10	Ensure that truck tailgates are cleared and locked at the point of unloading.	Foreman, Operators
NVMM11	Use two way radios at the minimum effective volume. Avoid slamming of doors, shouting and whistling. Reinforce behavioural practices such as no swearing and no unnecessary shouting.	Foreman, Operators

ID	Mitigation Measure	Responsibility
NVMM12	Utilise quieter work methods and equipment, including the use of mufflers and silencers, or hydraulic and electric-controlled units where practicable.	Construction Manager
NVMM13	Noise levels generated by plant and equipment will be considered in rental decisions, with noise levels to be compliant with Appendix B and Table 2 of the CNVG.	Construction Manager
NVMM14	Vehicle warning devices, such as horns, are not to be used as signaling devices.	Foreman, Operators
NVMM15	Undertake regular maintenance of plant and equipment, including silencers, to ensure that noise emissions do not increase over time. Servicing, refueling and warm-up to be undertaken during standard construction hours.	Foreman, Operators
NVMM16	Throttle down equipment where practicable and turn vehicles and machinery off when not in use.	Foreman, Operators
NVMM17	Only necessary equipment, of an appropriate size and power, will be on site.	Construction Manager
NVMM18	The use of engine compression brakes near residential areas will be limited.	Foreman, Operators
NVMM19	Orient plant and equipment known to emit noise strongly in one direction so that noise is directed away from noise sensitive areas.	Foreman, Operators
NVMM20	Maximise the offset distance between noisy items of plant and sensitive receivers for each task and activity.	Foreman, Operators
NVMM21	Where possible, the occurrence of consecutive works within the same locality, and coincidence of noisy plant/equipment working close together (and adjacent to sensitive receivers) will be avoided or otherwise minimised.	Construction Manager, Foreman
NVMM22	Locate plant and equipment to take advantage of barriers provided by existing site features and structures.	Foreman, Operators
NVMM23	Use traffic controllers to minimise occurrences of vehicles queuing, idling or reversing near noise sensitive receivers as much as is practical.	Construction Manager, Foreman
NVMM24	Avoid metal-to-metal contact on equipment where feasible.	Foreman, Operators
NVMM25	Avoid dropping material from a height into unlined metal trays (line trays with soil or similar to reduce noise).	Foreman, Operators
NVMM26	Undertake high noise impact activities (including activities with impulsive or tonal noise emissions) only: • Between hours of 8 am to 6 pm Mondays to Fridays; • Between hours of 8 am to 1 pm Saturdays; and • In continuous blocks not exceeding three hours each with a minimum respite from those activities and works of not less than one hour between each block.	Construction Manager, Foreman

ID	Mitigation Measure	Responsibility
NVMM27	Early Treatment: Subject to agreement from landowners, provide early at-property treatments to residences nominated to receive at-property treatments for operational noise. Refer to Section 7.4 of this NVMP for process for early treatments.	Construction Manager
NOISE: Standard Working Hours and Extended Working Hours where Predicted Noise Level exceeds NML by more than 10 dB		
	Implement all feasible and reasonable measures NVMM1 to NVMM27 inclusive	As noted above.
NVMM28	Verification: Measure noise levels from noise intensive plant prior to use and check against manufacturer's specifications and/or the sound power levels listed in Appendix A.	Construction Manager
NVMM29	Notification: Sensitive receivers will be notified of construction activities to be undertaken through letterbox drops five to fourteen working days prior to commencement.	Community Relations Manager, Construction Manager
NVMM30	Stockpiles of excavated material will be positioned to provide shielding to noise-sensitive land uses where possible.	Construction Manager, Foreman, Operators
NVMM31	Use noise screens/shields where possible.	Construction Manager, Foreman
NVMM32	Plant and machinery will not be permitted to warm up before the nominated construction hours.	Construction Manager, Foreman
NVMM33	Loading and unloading will be carried out as far as practical away from sensitive receivers.	Construction Manager, Foreman
NOISE: Standard Working Hours and Extended Working Hours where Predicted Noise Level are greater than 75 dB(A) at residences (Highly Noise Affected)		
	Implement all feasible and reasonable measures NVMM1 to NVMM33 inclusive	As noted above.
NVMM34	Phone calls: Phone calls detailing relevant information will be made to identified residences within seven calendar days of proposed work. Phone calls will provide affected residences with specific contact details and advice regarding noise management measures to be implemented. If the resident is not able to be reached via phone, door knocking and/or personalised letterbox drops will be used.	Community Relations Manager

ID	Mitigation Measure	Responsibility
NVMM35	Respite offers: Consultation with highly noise affected residences will involve discussion of specific respite periods. If specific respite periods are not agreed, then NVMM36 will be followed.	Community Relations Manager, Construction Manager, Foreman
VIBRATION: Standard Hours Work and Extended Hours Work occurring within safe working distances for human comfort		
NVMM36	Undertake works during Standard Working Hours. Where works must occur outside of these hours, assess Out of Hours works in accordance with the Out of Hours Work Approval Procedure provided in Appendix C	Construction Manager
NVMM37	Prioritise vibration-intensive works to occur during Standard Hours.	Construction Manager
NVMM38	Implement a hot line and complaints handling procedure for vibration and other construction related complaints.	Community Relations Manager
NVMM39	Avoid vibration intensive works within the safe working distances unless necessary and consider feasible alternatives if works must occur within the distance. Ensure Hold Point is released prior to commencement of any piling, hammering, ripping, demolition operations or any other activities which may cause damage through vibration.	Foreman Construction Manager
NVMM40	Restrict construction traffic speed to 20 km/h across the site, or 40 km/h for haul roads. Signpost the speed limit.	Foreman
NVMM41	Restrict construction traffic to designated roadways.	Foreman
NVMM42	Run plant that has high and low vibration operating settings on the lowest effective vibration setting, including static rolling where feasible.	Foreman
NVMM43	Notification: Sensitive receivers will be notified of construction activities to be undertaken through letterbox drops five to fourteen working days prior to the works.	Community Relations Manager, Construction Manager
NVMM44	Respite offers: Consultation with highly affected residences will involve discussion of specific respite periods. If specific respite periods are not agreed, then works will not be carried out for continuous blocks of more than three hours without a minimum respite period of one hour.	Community Relations Manager, Construction Manager, Foreman
VIBRATION: Standard Hours Work and Extended Hours Work occurring within safe working distances for cosmetic damage to buildings		
	Implement all feasible and reasonable measures NVMM36 to NVMM44 inclusive	As noted above.

8.3 Mitigation measures for Out of Hours Work

Specific mitigation measures to address construction noise and vibration impacts during Out of Hours Work are outlined in Table 8-2.

Table 8-2 Out of Hours Work noise and vibration mitigation measures

ID	Mitigation Measure	Responsibility
OOHW STAGE 1 NOISE ANY TIME: • NML EXCEEDANCE ≤ 5 dB & NO EXCEEDANCE OF SLEEP DISTURBANCE CRITERIA		
OOOHM1	Assess Out of Hours works in accordance with the Out of Hours Work Approval Procedure in Appendix C, including: • Justification for Out of Hours work. • Noise assessment. • Notification to and consultation with the EPA, Roads and Maritime, and with the affected community. • Implementation of reasonable and feasible mitigation measures for receivers where night time NMLs are predicted to be exceeded.	Environment Manager, Community Relations Manager
OOHMM2	Implement a hot line and complaints handling procedure for noise and other construction related complaints.	Community Relations Manager
OOHMM3	Ensure all mobile construction equipment have non-tonal reversing alarms.	Foreman, Operators
OOHMM4	Plan and conduct works in a manner to minimise the reversing of vehicles with audible reversing alarms.	Construction Manager, Foreman
OOHMM5	Trucks will travel via internal haul roads and major roads where practicable to minimise use of local roads.	Foreman
OOHMM6	Site access points and roads will be positioned as far as practicable away from residential receivers.	Foreman
OOHMM7	Ensure that truck tailgates are cleared and locked at the point of unloading.	Foreman, Operators
OOHMM8	Use two way radios at the minimum effective volume.	Foreman, Operators
OOHMM9	Utilise quieter work methods and equipment, including the use of mufflers and silencers where practicable.	Construction Manager
OOHMM10	Noise levels generated by plant and equipment will be considered in rental decisions, with noise levels to be compliant with Appendix A and Table 2 of the CNVG.	Construction Manager
OOHMM11	Vehicle warning devices, such as horns, are not to be used as signalling devices.	Foreman, Operators

ID	Mitigation Measure	Responsibility
OOHMM12	Undertake regular maintenance of plant and equipment, including silencers, to ensure that noise emissions do not increase over time. Servicing, refueling and warm-up to be undertaken during standard construction hours.	Foreman, Operators
OOHMM13	Turn vehicles and machinery off when not in use.	Foreman, Operators
OOHMM14	Only necessary equipment, of an appropriate size and power, will be on site.	Construction Manager
OOHMM15	The use of engine compression brakes near residential areas will be limited.	Foreman, Operators
OOHW STAGE 2 NOISE OOHW TIME PERIOD 1 Mon–Fri 7 pm–10 pm, Sat 7 am–8 am & 5 pm–10 pm, Sun / Pub Hol 7 am–6 pm • NML EXCEEDANCE > 5 dB & ≤ 25 dB OOHW TIME PERIOD 2 Mon–Fri 10 pm–7 am, Sat 10 pm–7 am, Sun / Pub Hol 6 pm–7 am • NML EXCEEDANCE > 5 dB & ≤ 15 dB, & NO EXCEEDANCE OF SLEEP DISTURBANCE CRITERIA		
	Implement all feasible and reasonable measures OOHMM1 to OHMM15 inclusive	As noted above.
OOHMM16	Verification: Measure noise levels from noise intensive plant prior to use and check against manufacturer's specifications and/or the sound power levels listed in Appendix D.	Construction Manager
OOHMM17	Notification: Sensitive receivers will be notified of construction activities to be undertaken through letterbox drops at least two weeks prior to works commencing.	Community Relations Manager, Construction Manager
OOHMM18	Respite Period 1 (OOHW Period 1 only): Out of hours construction noise will be limited to no more than three consecutive periods per week impacting particular sensitive receivers except where there is a Duration Respite (OOHMM21). For the purposes of this measure, a separation distance of 300 m is considered sufficient to provide respite.	Community Relations Manager, Construction Manager
OOHMM19	Respite Period 2 (OOHW Period 2 only): Out of hours construction noise will be limited to no more than two consecutive periods per week impacting particular sensitive receivers except where there is a Duration Respite (OOHMM21). For the purposes of this measure, a separation distance of 500 m is considered sufficient to provide respite.	Community Relations Manager, Construction Manager

ID	Mitigation Measure	Responsibility
OOHMM20	Duration Respite: Engagement will be undertaken with the affected community to offer limiting respite periods to ensure works are completed more quickly.	Community Relations Manager, Construction Manager
OOHMM21	Maximise the offset distance between noisy items of plant and sensitive receivers for each task and activity.	Foreman, Operators
OOHMM22	Locate plant and equipment to take advantage of barriers provided by existing site features and structures.	Foreman, Operators
OOHMM23	Orient plant and equipment known to emit noise strongly in one direction so that noise is directed away from noise sensitive areas.	Foreman, Operators
OOHMM24	Use traffic controllers to minimise occurrences of vehicles queuing, idling or reversing near noise sensitive receivers as much as is practical.	Construction Manager, Foreman
OOHMM25	Position site access points and roads as far as practicable away from residential receivers.	Foreman, Operators
OOHMM26	Avoid metal-to-metal contact on equipment where feasible.	Foreman, Operators
OOHMM27	Avoid dropping material from a height into unlined metal trays (line trays with soil or similar to reduce noise).	Foreman, Operators
OOHW STAGE 3 NOISE **OOHW TIME PERIOD 1 Mon–Fri 7 pm–10 pm, Sat 7 am–8 am & 5 pm–10 pm, Sun / Pub Hol 7 am–6 pm** • NML EXCEEDANCE > 25 dB **OOHW TIME PERIOD 2 Mon–Fri 10 pm–7 am, Sat 10 pm–7 am, Sun / Pub Hol 6 pm–7 am** • NML EXCEEDANCE > 15 dB & ≤ 25 dB, AND/OR EXCEEDANCE OF SLEEP DISTURBANCE CRITERIA		
	Implement all feasible and reasonable measures OOHMM1 to OHMM27 inclusive	As noted above.
OOHMM28	Individual briefings: Where possible with agreement, individual visits made with identified stakeholders at least 48 hours ahead of potentially disturbing construction activities.	Community Relations Manager
OOHMM29	Phone calls: Phone calls detailing relevant information will be made to identified residences within seven calendar days of proposed work. Phone calls will provide affected residences with specific contact details and advice regarding noise management measures to be implemented. If the resident is not able to be reached via phone, door knocking and/or personalised letterbox drops will be used.	Community Relations Manager

ID	Mitigation Measure	Responsibility
OOHMM30	Specific notification: Personalised letterbox drops made to identified residences seven to fourteen calendar days ahead of works with specific details on works and management measurements in place.	Community Relations Manager
OOHW STAGE 4 NOISE **OOHW TIME PERIOD 2 Mon–Fri 10 pm–7 am, Sat 10 pm–7 am, Sun / Pub Hol 6 pm–7 am** **NML EXCEEDANCE > 25 dB**		
	Implement all feasible and reasonable mitigation measures OOHMM1 to OOHMM30 inclusive.	As noted above
OOHMM31	Install temporary hoarding where feasible to shield noise to affected sensitive receivers.	Construction Manager
OOHMM32	Alternative Accommodation Consider temporary relocation of receivers where the construction noise level exceeds the night time NML by more than 25 dB(A) for an extended period of time. As per the CNVG, the specifics of any offer will be considered on a case-by-case basis.	Community Relations Manager
OOHW VIBRATION **Work occurring within safe working distances for human comfort**		
OOHMM33	Assess OOHW in accordance with the OOHW Approval Procedure in Appendix C, including: • Justification for Out of Hours work. • Vibration assessment. • Notification to and consultation with Roads and Maritime and with the affected community. • Implementation of reasonable and feasible mitigation measures for receivers where night time human comfort 'Maximum' criteria are predicted to be exceeded.	Construction Manager
OOHMM34	Implement a hot line and complaints handling procedure for vibration and other construction related complaints.	Community Relations Manager
OOHMM35	Avoid vibration intensive works within the safe working distances unless necessary. Ensure a Hold Point is released prior to commencement of any impact piling, hammering or ripping, demolition operations or any other activities which may cause damage through vibration.	Foreman Construction Manager
OOHMM36	Restrict construction traffic speed to 20 km/h across the site, or 40 km/h for haul roads. Signpost the speed limit.	Foreman
OOHMM37	Restrict construction traffic to designated roadways.	Foreman

ID	Mitigation Measure	Responsibility
OOHMM38	Run plant that has high and low vibration operating settings on the lowest effective vibration setting, including static rolling where feasible.	Foreman
OOHMM39	Notification: Sensitive receivers will be notified of construction activities to be undertaken through letterbox drops five to fourteen working days prior to the works.	Community Relations Manager, Construction Manager
OOHMM40	Respite offers: Consultation with highly affected residences will involve discussion of specific respite periods. If specific respite periods are not agreed, then: • works will not be carried out for continuous blocks of more than three hours without a minimum respite period of one hour • works will not affect an individual residence for more than two consecutive nights and not more than six nights in each calendar month.	Community Relations Manager, Construction Manager, Foreman
OOHMM41	Individual briefings: Where possible with agreement, individual visits made with identified stakeholders at least 48 hours ahead of potentially disturbing construction activities.	Community Relations Manager
OOHMM42	Phone calls: Phone calls detailing relevant information will be made to identified residences within seven calendar days of proposed work. Phone calls will provide affected residences with specific contact details and advice regarding noise management measures to be implemented. If the resident is not able to be reached via phone, door knocking and/or personalised letterbox drops will be used.	Community Relations Manager
OOHMM43	Specific notification: Personalised letterbox drops made to identified residences seven to fourteen calendar days ahead of works with specific details on works and management measurements in place.	Community Relations Manager
OOHMM44	Alternative Accommodation (Night Work Only) Consider temporary relocation of receivers where the vibration levels will considerably exceed the night time human comfort criteria for extended periods of time and where respite periods may not be feasible. As per the CNVG, the specifics of any offer will be considered on a case-by-case basis.	Community Relations Manager
OOHW VIBRATION **Work occurring within safe working distances for cosmetic damage to buildings**		

ID	Mitigation Measure	Responsibility
	Implement all feasible and reasonable mitigation measures OOHMM33 to OOHMM44 inclusive.	As noted above
OOHMM45	If vibration intensive plant is to be used within the safe working distance for cosmetic damage (as per Table 7-13), works would not proceed until attended vibration measurements are undertaken.	Foreman, Environment Officer
OOHMM46	Where vibration intensive works are occurring for a continuous period of time within the safe working distance for cosmetic damage (as per Table 7-13), install a permanent vibration monitoring system to warn operators (via flashing light, audible alarm, SMS etc.) when vibration levels are approaching the cosmetic damage objective.	Environment Officer Operators
OOHMM47	Undertake pre-construction dilapidation surveys of buildings and structures where construction works will occur within safe working distances for cosmetic damage, at such a time that the report can be provided to the landowner at least one month prior to that work being undertaken.	Environment Officer
OOHMM48	Undertake post-construction dilapidation surveys of buildings and structures where construction works has occurred within safe working distances for cosmetic damage.	Environment Officer, Environment Manager
OOHMM49	Undertake surveys of buildings and structures immediately following a monitored exceedance of the relevant vibration criteria.	Environment Officer, Environment Manager

9 Compliance management

9.1 Roles and responsibilities

The Fulton Hogan Project Team's organisational structure and overall roles and responsibilities are outlined in Section 3.2 of the CEMP. Specific responsibilities for the implementation of environmental mitigation measures are detailed in Chapter 6 of this Plan.

9.2 Training

All employees, sub-contractors and utility staff working on site will undergo site induction training relating to noise and vibration management issues, including:

- Existence and requirements of this sub-plan
- Relevant legislation
- Standard, extended and out of hours construction hours
- The process for seeking approval for out of hours works, including consultation
- Location of noise sensitive areas and receivers
- General noise and vibration management measures
- Complaints reporting.

Further details regarding staff induction and training are outlined in Section 3.4 of the CEMP.

9.3 Monitoring and inspections

Weekly and other routine inspections by Environmental Officers, TfNSW, and ER will occur throughout construction. Details on the nature and frequency of these inspections are documented in Sections 3.7.1 and 3.7.2 of the CEMP.

Noise and vibration monitoring will also occur routinely for the duration of the Project. Monitoring will be undertaken by an Acoustic Consultant or the Environmental Officer during the construction phase of the Project. The Noise and Vibration Monitoring Plan for the Project is provided in the following sections with the monthly noise monitoring locations shown in Appendix D of this NVMP.

9.3.1 Noise monitoring

The following noise monitoring will be undertaken:

- Monthly noise monitoring at nominated sensitive receiver locations to determine the effectiveness of mitigation measures against predicted impacts;
- Where complaints are received, additional noise monitoring may be undertaken at sensitive receivers to determine if the actual construction noise generated exceeds the predicted 'worst case' construction noise levels identified in Section 7.3 and Appendix A of this NVMP;
- Noise monitoring may be carried out for the purpose of refining construction methods or techniques to minimise noise; and
- Ongoing spot checks of noise intensive plant and equipment will be undertaken throughout construction to ensure compliance with manufacturer's specifications.

Where actual noise levels are found to exceed the predicted worst case levels (i.e. an exceedance of more than 3 dB), the source of excessive noise generations will be identified, and any additional feasible and reasonable measures available will be implemented to either reduce noise emissions or reduce the impacts on receivers. At a minimum, the noise mitigation measures detailed in Section 8.2 for the measured exceedance of the relevant NML will be applied.

Details of site activity and equipment usage will be noted during construction noise monitoring.