Transport for NSW

Beaches Link and Gore Hill Freeway Connection

Appendix J – Construction noise strategy

November 2021

Contents

Glossary

CNVIS	Construction noise and vibration impact statement
dB(A)	A-weighted decibels, an expression of the relative loudness of sound as perceived by the human ear
EPA	NSW Environment Protection Authority
EPL	Environment Protection Licence
Feasible and reasonable	The feasible test relates to whether a solution can be engineered and is practical to build or install, considering issues such as safety, access and maintenance. The reasonable test relates to the overall noise reduction achieved when compared to the social, economic or environmental benefits. A measure may be feasible to install, but it's unreasonable due to the low noise benefit and high cost
$L_{Aeq(15minute)}$	The 'energy average noise level' evaluated over a 15-minute period. This parameter is used to assess potential construction noise impacts
L_{Amax}	The maximum A-weighted sound pressure level over a given period; used in the assessment of potential sleep disturbance during night-time periods
L_{A90}	The 'background noise level' in the absence of construction activities. This parameter represents the average minimum noise level during the daytime, evening and night-time periods respectively. The $L_{Aeq(15minute)}$ construction noise management levels are based on the L_{A90} background noise levels
NML	Noise management level
OOHW	Out of hours works
RBL	Rating background level
SWL	Sound power level

1 Introduction

The Beaches Link and Gore Hill Freeway Connection (the project) forms a core component of the broader Western Harbour Tunnel and Beaches Link program of works. The project comprises two main components:

- Twin tolled motorway tunnels connecting the Warringah Freeway at Cammeray and the Gore Hill Freeway at Artarmon to the Burnt Bridge Creek Deviation at Balgowlah and the Wakehurst Parkway at Killarney Heights, and an upgrade of the Wakehurst Parkway (the Beaches Link)
- Connection and integration works along the existing Gore Hill Freeway and surrounding roads at Artarmon (the Gore Hill Freeway Connection).

Transport for NSW recognises that during construction of the project there is potential for noise impacts to residential and other sensitive receivers, including during evening and night time periods where surface road works and supporting works at the temporary construction support sites are required. Transport for NSW is committed to minimising these construction noise impacts through the implementation of this Construction noise strategy which outlines the mitigation and management approach which would be taken.

2 Purpose and scope

2.1 Purpose

The purpose of this Construction noise strategy is to outline the overarching principles and strategies for the management of noise during construction of the project. It provides a single interface for the large number of policies, guidelines, standards and regulations which are applicable to the project, providing a consolidated reference for the community on how noise impacts would be managed.

2.2 Objectives

The key objectives of this Construction noise strategy are to:

1. Provide a consistent process for evaluating the construction noise impacts from the project by providing assessment methods, with a clear pathway to identifying the best approach for the project
2. Encourage contractor/s to carry out construction works during standard construction hours where feasible and reasonable to do so
3. Where out of hours works are required, provide contractor/s with a hierarchy of preferred working hours and a procedure for mitigating and managing impacts from these works through the application of the hierarchy of controls
4. Ensure proactive consultation with the community and other stakeholders, to facilitate effective project delivery with balanced stakeholder impacts
5. Implement feasible and reasonable noise mitigation measures on the project that take into consideration the time of works and the likely extent and duration of impact
6. Monitor the implementation and effectiveness of the project's noise mitigation measures.

3 Noise guidelines

3.1 Relevant guidelines

As noted in the environmental impact statement, there are a number of guidelines that are applicable to the project, especially during the construction phase, that provide guidance on the implementation of management measures to mitigate the impacts of noise. These include:

- *Interim Construction Noise Guideline* (Department of Environment and Climate Change (DECC), 2009)
- *Construction Noise and Vibration Guideline* (Roads and Maritime Services, 2016)
- *Noise Criteria Guideline* (Roads and Maritime Services, 2015)
- Australian Standards *AS2346:2010 – Guide to noise control on construction, maintenance and demolition site* (Standards Australia, 2010).

This Construction noise strategy outlines how the relevant sections of the above guidelines are proposed to be implemented during the construction of the Beaches Link and Gore Hill Freeway Connection project.

3.2 Construction noise metrics

A decibel (dB) is the unit that sound is measured in, with all noise measured with an A filter to simulate the response of the human ear to varying frequencies of sound, eg the human ear is not as effective at hearing low frequency sounds as it is in hearing high frequency sounds. Noise criteria for construction of the project use the A-weighted decibel (dB(A)) unit.

The three primary noise metrics used to describe construction noise emissions in the modelling and assessments are:

L_{Amax}	The maximum A-weighted sound pressure level over a given period; used in the assessment of potential sleep disturbance during night-time periods.
$L_{Aeq(15minute)}$	The 'energy average noise level' evaluated over a 15-minute period. This parameter is used to assess potential construction noise impacts.
L_{A90}	The 'background noise level' in the absence of construction activities. This parameter represents the average minimum noise level during the daytime, evening and night-time periods respectively. The $L_{Aeq(15minute)}$ construction noise management levels are based on the L_{A90} background noise levels.

The subscript 'A' indicates that the noise levels are A weighted.

3.3 Construction hours

Standard construction hours from the *Interim Construction Noise Guideline* (DECC, 2009) are:

- 7am to 6pm Monday to Friday
- 8am to 1pm Saturday
- No construction works on Sundays or public holidays.

However, the nature of the project means evening and night work are required throughout the construction program, with some construction activities occurring 24 hours a day / 7 days a week. Further detail on construction activities proposed during and outside standard construction hours is outlined in Section 6.9.1 of the environmental impact statement.

3.4 Construction noise management levels

Construction Noise Management Levels (NML) for all the project would be determined in accordance with the procedures nominated in the *Interim Construction Noise Guideline* (DECC, 2009). Further detail on the NMLs which would be applied on the project is provided in sections 10.4.1 and 10.4.2 of the environmental impact statement.

3.5 Noise sensitive receivers

The sensitivity of occupants to noise varies according to the nature of the occupancy and the activities performed within the affected premises. For example, a residence is more sensitive to noise during the night time period than a commercial or educational facility.

Specific noise sensitive receivers relevant to individual construction sites would be identified and addressed in the construction noise and vibration impact statements for the project. Each receiver would be identified as falling into one of the following categories:

- Residential
- Mixed residential/commercial
- Commercial
- Educational
- Industrial
- Place of Worship
- Medical facilities
- Other sensitive receivers.

4 Applying the strategy

4.1 Types of noise assessment

The Secretary's environmental assessment requirements for the project require the environmental impact statement include an assessment of predicted construction noise impacts, addressing the nature of anticipated construction activities and the intensity and duration of impacts. As contractor/s would not be engaged until later in the project's timeline, the exact construction methodologies that would be used are not known at this stage in the environmental assessment process.

Conservative assumptions were incorporated in the noise assessment to not unduly restrict innovation (eg construction methods or mitigation) at later stages of refinement of the design and construction methodologies. This document therefore defines the strategies by which noise impacts would be minimised on the project, consolidating the large number policies, guidelines, standards and regulations applicable to the project and providing a single reference for the community. These strategies would be implemented throughout construction. Their inclusion in this document recognises the changing assessment requirements for each construction phase.

Table 4-1 outlines the level of detail expected from the assessment process (refer to Section 5) during the environmental impact statement and pre-construction / construction assessment stages of the project.

Table 4-1 Summary of assessment detail required during the stages of the project

Assessment Input	Environmental Impact Statement / Environmental Assessment	Pre-construction / Construction Impact Statements
Construction Scenarios / Equipment List	Construction scenarios defined by Transport for NSW, based on potential construction methodologies known at the time	Construction scenarios defined by the contractor/s. These are expected to include finalised equipment lists, itemising the realistic worst-case plant proposed to be used at any one time, and in any one location
Modelled works location	Works location by scenario (or group of scenarios) ie different locations for different works	Works location by works scenario ie specific locations for each works
Background noise monitoring	Background noise monitoring required to determine the rating background level (RBL) at locations representative of worst-affected receiver areas adjacent to the works areas	Supplementary noise monitoring, if required, to determine the RBL at locations representative of worst-affected receiver areas adjacent to the works areas where noise survey data is not current (ie more than 5 years old) This monitoring would also assist in the investigation and confirmation of shoulder periods

Assessment Input	Environmental Impact Statement / Environmental Assessment	Pre-construction / Construction Impact Statements
Study Area	The study area, as a minimum, includes receivers subjected to predicted $L_{Aeq(15minute)}$ ≥ RBL+5dB for the applicable time period	Predict noise and vibration levels at the sensitive receivers within the area surrounding the works, to include all receivers where the $L_{Aeq(15minute)}$ ≥ RBL +5dB is exceeded during the applicable time period
Reporting	N/A	Predictions would be carried out for the proposed time period of the works
Assessment of mitigation	Demonstration that the assessment stage includes feasible and reasonable mitigation measures	Based on the predictions the construction noise and vibration management plan shall identify all feasible and reasonable mitigation measures to minimise noise from construction. Sections 7 and 8 identify the standard and additional mitigation measures to be included where applicable in the plan.
Documentation	Environmental impact statement Submissions report Construction noise strategy (this document) Noise insultation program	Environment Protection Licence conditions, or as modified by subsequent variations Construction noise and vibration management plan Out of hours works protocol Construction noise and vibration impact statements (eg for out of hours works) Noise monitoring reports

4.2 Management documentation

A construction noise and vibration management plan will be prepared for the project in accordance with the requirements of the environmental management measures (refer to Table D2-1 of this submissions report) and this strategy, which will:

a) Identify relevant criteria and management levels in relation to noise

b) Identify noise sensitive receivers and features in the vicinity of the project

c) Include standard and additional mitigation from sections 7 and 8 and in the *Construction Noise and Vibration Guideline* (Roads and Maritime Services, 2016) and detail how and when these will be applied in the project

d) Describe the approach that will be adopted for carrying out location and activity specific construction noise and vibration impact assessments to assist with designing and selecting of the appropriate mitigation and management measures

e) Include protocols that will be adopted to manage works required outside standard construction hours

f) Detail the methodology and approach for managing construction noise impacts

g) Outline the approach for identifying and managing potential cumulative impacts, including ensuring appropriate respite for works outside standard construction hours

h) Outline the procedures and approach for noise monitoring to be carried out to confirm construction noise levels in relation to noise management levels

i) Detail how construction noise impacts from concurrent or consecutive nearby construction works associated with the project will be managed where feasible and reasonable.

In addition an out of hours works protocol will be developed for the construction of the project. The protocol will include:

a) Details of works required outside standard construction hours justifications of why the works are required outside standard construction hours

b) The noise impact assessment processes that will be followed to identify potentially affected receivers and clarify potential impacts

c) Mitigation and management measures that are to be considered and implemented where appropriate to manage potential impacts associated with works outside standard construction hours

d) Details of the approval process (internal and external) for works proposed outside standard construction hours.

The protocol will be prepared in consultation with Department of Planning, Industry and Environment and the NSW Environment Protection Authority. The protocol will be implemented during the duration of the construction of the project.

5 Environment protection licence

Construction noise from State significant infrastructure projects is regulated by the Department of Planning, Industry and Environment through project approval requirements under the *Environmental Planning and Assessment Act 1979* and by the NSW Environment Protection Authority through environment protection licences issued under the *Protection of the Environment Operations Act 1997*.

Environmental protection licences are a fundamental noise control requirement for large infrastructure projects. It is anticipated the environment protection licence for the project would provide detailed construction noise criteria and management measures which are tailored to the specifics of the project.

The general timeline for the project, including the process for application and implementation of the environment protection licence, with respect to noise from construction activities is outlined below (note this timeline is indicative only and some steps may occur concurrently):

1. Project concept developed with preliminary high-level construction noise impact statement
2. Department of Planning, Industry and Environment issues the Secretary's environmental assessment requirements for the project
3. Environmental impact statement includes a preliminary but more detailed construction noise impact statement based on the concept design
4. Department of Planning, Industry and Environment grant planning approval
5. Contactor/s engaged
6. Contractor/s carries out further design development and construction planning including a mature construction noise impact statement and construction noise and vibration management plan
7. Contractor/s applies for environment protection licence for the project
8. Environment protection licence issued by the Environment Protection Authority
9. Construction commences
10. Ongoing review of construction methodology and project noise impacts
11. Re-assess construction noise impact statement and construction noise and vibration management plan based on new inputs (if necessary)
12. Contractor/s applies for variations to the environment protection licence (if necessary)
13. Variations to the environment protection licence issued by the Environment Protection Authority.

This Strategy is applicable to the assessment, approval and construction stages of the project. Steps 10 through to 13 may be repeated as required during construction as the design and construction planning further develop.

6 Construction noise assessment methodology

All construction noise assessments must be quantitative, in accordance with the requirements of the *Interim Construction Noise Guideline* (DECC, 2009). The assessment for the environmental impact statement was based on a concept design and construction methodology for the project (prepared by Transport for NSW). In the future, when assessments are carried out prior to construction (eg construction noise and vibration impact statements) they would be based on a more detailed design and actual construction methodology (prepared by the contractor/s).

Detailed construction noise and vibration impact statements will be prepared and implemented for a number of construction activities including temporary construction support sties, works outside standard construction hours and works potentially resulting in highly noise affected residential receivers, in accordance with environmental management measure CNV2 (refer to Table D2-1 of this submissions report) and the process in Figure 6-1.

In order to develop accurate and comprehensive construction noise assessments for work components, specific detail of the construction methodology, including the size and type of equipment, is required. Detailed design, construction methodology and engineering solutions are progressively developed and applied throughout the life-span of the project. Consequently, construction noise assessments are developed to reflect the progressive nature of design and construction of the project.

Two different types of construction noise and vibration impact statements would be developed for the project:

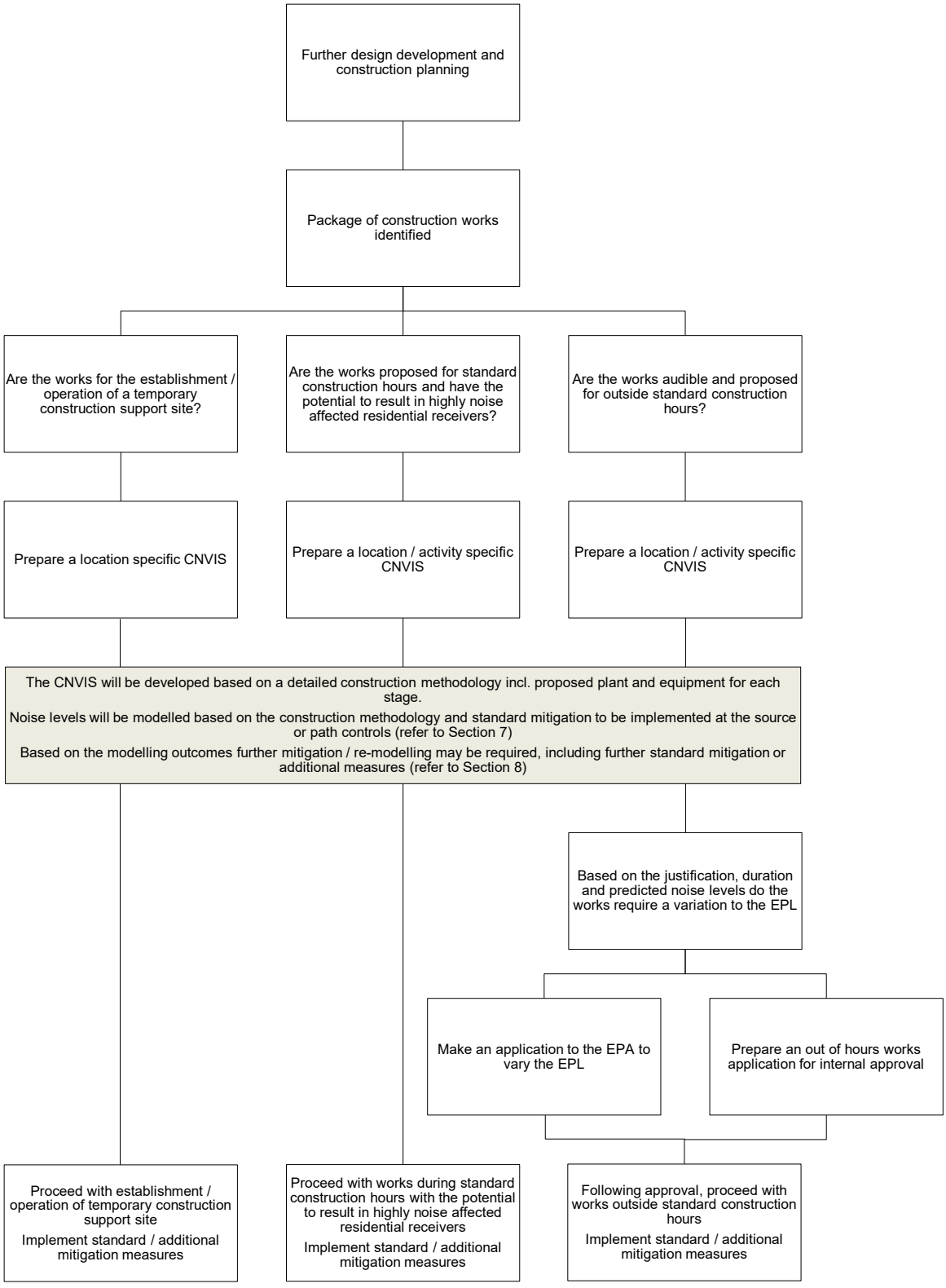
- Activity specific construction noise and vibration impact statements for construction scenarios that assess construction activities which are consistently the same and progressively move around the project, eg tunnelling, utility installation
- Location specific construction noise and vibration impact statements for construction scenarios that are specific to a location, eg temporary construction support sites, a scope of works required outside of standard construction hours.

Within the construction noise assessment the noise impacts are assessed based on construction scenarios (essentially a construction activity), with a number of construction scenarios potentially included in the one assessment. In undertaking an assessment of the noise impacts from a construction scenario(s) in the following steps are to be taken:

- Identify all noise sensitive receivers which may be affected by the construction scenarios
- Determine the appropriate noise management levels (NML) for each noise sensitive receiver based on the rating background levels (RBL) in the environmental impact statement (and construction noise and vibration management plan if applicable)
- Determine the source noise levels (Sound Power Levels) of each noise generating plant and equipment item required to carry out the construction scenario. Note: Sound Power Levels for each plant and equipment would be less than the maximum allowable levels found in Table 7-2
- Clearly indicate which mitigation measures identified in Section 7 have or would be incorporated into the noise assessment. Noise mitigation measures to be implemented would vary for reasons such as safety and space constraints and the noise model would be adjusted accordingly

- For Location specific construction scenarios, and where applicable for Activity specific scenarios, include the effects of noise shielding provided by site offices, residential fences, noise barriers or natural topographic features
- Where applicable include the effects of noise reflections and ground attenuation
- On the basis of the duration of each activity (over a typical “worst case” 15-minute period), determine whether any correction between the L_{Amax} and the L_{Aeq} is required
- Calculate the L_{Aeq} noise levels from construction scenarios at sensitive receiver groups, with the use of noise contour maps where appropriate and/or at 10 m, 25 m, 50 m, 75 m,100 m and 200 m for more general construction activities
- Compare these predicted L_{Aeq} noise levels against the NML for each noise sensitive receiver and identify exceedances
- For night-time activities, calculate the L_{Amax} noise levels and compare with the RBL + 15 dB(A) sleep disturbance screening criterion (refer to Section 3.4.1.3 of Appendix G (Technical working paper: Noise and vibration)). On the basis of the ambient noise environment during the night-time period, the predicted L_{Amax} noise levels and the number of expected L_{Amax} noise events would be assessed to determine the likelihood of potential sleep disturbance

On completion of the construction noise assessment, where standard noise mitigation measures in Section 7 have been applied, noise levels may still exceed noise management levels. Where exceedances remain the additional mitigation measures in Section 8 would be implemented, where feasible and reasonable.



Note: CNVIS – Construction Noise and Vibration Impact Statement; EPL – Environment Protection Licence; EPA – Environment Protection Authority

Figure 6-1 Construction noise assessment and approval process

7 Standard noise mitigation measures

This section sets out the standard construction noise mitigation measures to be implemented on the project and delivered via the construction noise and vibration management plan and relevant procedures, systems, environmental assessment, construction environmental management and contractor/s documentation.

The project would mitigate noise through a hierarchy of controls, with endeavours to eliminate the noise impact of the works in the first instance. If this is not possible the project would investigate measures to substitute the risk eg by completing the works during standard construction hours, or the implementation of engineering controls eg selection of quieter plant and equipment. The standard mitigation measures in Table 7-1 shall be applied in order to minimise the potential noise impacts at the surrounding noise sensitive receivers. Additional mitigation measures are provided in Section 8.

7.1 Minimum requirements

7.1.1 Management strategies during construction

- The standard construction hours adopted by the project would be in accordance with the *Interim Construction Noise Guideline* (DECC, 2009), planning approval and the environment protection licence
- When working adjacent to schools, medical facilities, childcare centres and places of worship the project would tailor the noise management approach to best suit individual needs and minimise impacts wherever possible, in accordance with Appendix E (Community consultation framework)
- Where feasible and reasonable, the offset distance between noisy plant items and nearby noise sensitive receivers would be as great as possible
- Regular compliance checks on the noise emissions of all plant and machinery used for the project would indicate whether noise emissions from plant items comply with the maximum levels in Table 7-2 or are higher than predicted. This also identifies defective silencing equipment on the items of plant
- Ongoing noise monitoring during construction at sensitive receivers during critical periods (ie times when noise emissions are expected to be at their highest - eg piling and hammering) to identify and assist in managing high risk noise events.
- Where feasible and reasonable heavy vehicle movements would be limited to daytime hours
- The implementation of procedures to maximise the night-time onsite spoil storage capacity where spoil is produced between the hours of 10.00 pm and 7.00 am.

7.1.2 Site induction for all employees, contractors and subcontractors

The site induction would include the following as a minimum:

- All project specific and relevant standard noise mitigation measures
- Relevant licence and planning approval conditions
- Permissible standard construction hours of work
- Any limitations on high noise generating activities

- Location of nearest sensitive receivers
- Construction employee parking areas
- Designated loading/unloading areas and procedures
- Environmental incident reporting and management procedures.

7.1.3 Source Noise Control Strategies

- Ensure vehicles are fitted with a maintained Original Equipment Manufacturer exhaust silencer or a silencer that complies with the National Transport Commission's *National Stationary Exhaust Noise Test Procedures for In-Service Motor Vehicles* (2006) and standard.
- Regular maintenance of all plant and machinery used for the project would assist in minimising noise emissions, including the reporting of the results
- Acoustic enclosure of plant items, if required, as identified during compliance monitoring
- Limit the use of engine compression brakes at night and in residential area
- Non-tonal reversing beepers (or an equivalent mechanism) must be fitted and used on all construction vehicles and mobile plant regularly used on site and for any out of hours work. Whilst the use of non-tonal reversing alarms is suggested to ensure noise impacts are minimised, it is noted that health and safety requirements must also be fully satisfied.

7.1.4 Noise barrier control strategies

Temporary noise barriers, including noise blankets, are recommended between the noise sources and nearby potentially affected noise sensitive receivers, wherever feasible.

7.1.5 Acoustic enclosures

Where significant noise impacts are predicted and/or long periods of construction works are planned, acoustic enclosures can be used as an effective mitigation method. Acoustic enclosures act to contain the sources of noise, whilst also providing the benefit of screening the construction site from view.

7.1.6 Community Consultation

Active community consultation and the maintenance of positive, cooperative relationships with schools, local residents and building owners and occupiers assists in managing impacts from noisier operations and in alleviating concerns and thereby minimising disturbance and complaint. This includes, for example:

- Periodic notification or work activities and progress (eg regular letterbox drops, e-mails)
- Specific notification (letter-box drop) prior to especially noisy activities
- Comprehensive website information
- Project information and construction response telephone line
- Email distribution list.

7.2 Summary of standard mitigation measures

The standard mitigation measures set out in Table 7-1 would be implemented on the project

Table 7-1 Standard mitigation measures

Action required	Applies to	Details
Management measures		
Implementation of any project specific mitigation measures required.	Airborne noise	Implementation of project specific environmental mitigation measures within Table D2-1 of Part D.
Implement community consultation or notification measures	Airborne noise Ground-borne noise & vibration	Notification detailing work activities, dates and hours, impacts and mitigation measures, indication of work schedule over the night time period, any operational noise benefits from the works (where applicable) and contact telephone number. Notification should be a minimum of seven calendar days prior to the start of works. For projects other than maintenance works more advanced consultation or notification may be required. The contractor/s is to contact Transport for NSW Communication and Stakeholder Engagement for guidance. Website Contact telephone number for community Email distribution list Community information sessions
Site inductions	Airborne noise. Ground-borne noise & vibration	All employees, contractors and subcontractors are to receive an environmental induction (refer to Section 7.1.2)
Behavioural practices	Airborne noise	No swearing or unnecessary shouting or loud stereos/radios on site. No dropping of materials from height, throwing of metal items and slamming of doors.
Verification	Airborne noise Ground-borne noise & vibration	Where specified under Section 8 a noise verification program is to be carried out for the duration of the works in accordance with the construction noise and vibration management plan and any approval and licence conditions.
Update to Construction Environmental Management Plan	Airborne noise. Ground-borne noise & vibration.	The construction environmental management plan must be regularly updated to account for changes in noise and vibration management issues and strategies.

Action required	Applies to	Details
Source controls		
Construction hours and scheduling	Airborne noise. Ground-borne noise & vibration.	Where feasible and reasonable, construction should be carried out during the standard construction hours. Work generating high noise levels should be scheduled during less sensitive time periods.
Construction respite period during normal hours and out- of-hours work	Ground-borne noise & vibration. Airborne noise.	Please refer to Section 8 for more details on the following respite measures: • Respite Offers (RO) • Respite Period 1 (R1) • Respite Period 2 (R2) • Duration Respite (DR)
Equipment selection.	Airborne noise. Ground-borne noise & vibration	Use quieter and less vibration emitting construction methods where feasible and reasonable. For example, when piling is required, bored piles rather than impact-driven piles would minimise noise and vibration impacts. Similarly, diaphragm wall construction techniques, in lieu of sheet piling, would have significant noise and vibration benefits. Ensure plant including the silencer is well maintained.
Plant noise levels.	Airborne-noise.	The noise levels of plant and equipment must have operating Sound Power or Sound Pressure Levels compliant with the criteria in Table 7-2 and the *Construction Noise and Vibration Guideline* (Roads and Maritime Services, 2016). Implement a noise monitoring audit program to ensure equipment remains within the more stringent of the manufacturers specifications or *Construction Noise and Vibration Guideline* (Roads and Maritime Services, 2016).
Rental plant and equipment.	Airborne-noise.	The noise levels of plant and equipment items are to be considered in rental decisions and in any case cannot be used on site unless compliant with the criteria in Table 7-2 and the *Construction Noise and Vibration Guideline* (Roads and Maritime Services, 2016).
Use and siting of plant.	Airborne-noise.	The offset distance between noisy plant and adjacent sensitive receivers is to be maximised. Plant used intermittently to be throttled down or shut down. Noise-emitting plant to be directed away

Action required	Applies to	Details
		from sensitive receivers. Only have necessary equipment on site.
Plan worksites and activities to minimise noise and vibration.	Airborne noise. Ground-borne vibration.	Locate compounds away from sensitive receivers and discourage access from local roads. Plan traffic flow, parking and loading/unloading areas to minimise reversing movements within the site. Where additional activities or plant may only result in a marginal noise increase and speed up works, consider limiting duration of impact by concentrating noisy activities at one location and move to another as quickly as possible. High noise impact activities should be scheduled during standard construction hours where feasible and reasonable. If the work cannot be carried out during standard construction hours, it should be completed before 11:00pm or as early as possible. Where practicable, work should be scheduled to avoid major student examination periods when students are studying for examinations such as before or during Higher School Certificate and at the end of higher education semesters. If programmed night work is postponed the work should be re-programmed and the approaches in this guideline apply again.
Reduced equipment power	Airborne noise. Ground-borne vibration.	Use only the necessary size and power
Non-tonal and ambient sensitive reversing alarms	Airborne noise.	Non-tonal reversing beepers (or an equivalent mechanism) must be fitted and used on all construction vehicles and mobile plant regularly used on site and for any out of hours work. Consider the use of ambient sensitive alarms that adjust output relative to the ambient noise level.
Minimise disturbance arising from delivery of goods to construction sites.	Airborne noise.	Loading and unloading of materials/deliveries is to occur as far as possible from sensitive receivers. Select site access points and roads as far as possible away from sensitive receivers. Dedicated loading/unloading areas to be shielded if close to sensitive receivers. Delivery vehicles to be fitted with straps rather than chains for unloading, wherever possible.

Action required	Applies to	Details
		Avoid or minimise these out of hours movements where possible.
Engine compression brakes	Construction vehicles	Limit the use of engine compression brakes at night and in residential areas. Ensure vehicles are fitted with a maintained Original Equipment Manufacturer exhaust silencer or a silencer that complies with the National Transport Commission's *National Stationary Exhaust Noise Test Procedures for In-Service Motor Vehicles* (2006) and standard.
Path controls		
Shield stationary noise sources such as pumps, compressors, fans etc.	Airborne noise.	Stationary noise sources should be enclosed or shielded where feasible and reasonable whilst ensuring that the occupational health and safety of workers is maintained. Appendix D of Australian Standard *AS2436:2010 Guide to noise and vibration control on construction, demolition and maintenance sites* (Standards Australia, 2010) lists materials suitable for shielding.
Shield sensitive receivers from noisy activities.	Airborne noise.	Use structures to shield residential receivers from noise such as site shed placement, earth bunds, fencing, erection of operational stage noise barriers (where practicable) and consideration of site topography when situating plant.
Receptor controls		
See Section 8 for additional measures	Airborne noise. Ground-borne vibration.	In some instances additional mitigation measures may be required.

7.3 Maximum allowable plant sound power levels

Plant or equipment operating on the project shall have an operating sound power level (SWL) which is no higher than the corresponding SWL presented in Table 7-2. The SWLs presented in Table 7-2 have been compiled from Table F1 of the *Construction Noise and Vibration Guideline* (Roads and Maritime Services, 2016). Where construction equipment not listed in Table 7-2, reference should be made to the typical noise levels in Australian Standard *AS2436:2010 Guide to noise and vibration control on construction, demolition and maintenance sites* (Standards Australia, 2010), *British Standard BS 5228-1 Code of practice for noise and vibration control on construction and open sites – Noise* (British Standard, 2009) or the *Update on noise database for prediction of noise on construction and open sites* (Department for Environment Food and Rural Affairs, 2005).

The noise levels in Table 7-2 can also be used as a guide in the prediction of $L_{Aeq(15minute)}$ construction noise. In doing so, the predicted $L_{Aeq(15minute)}$ noise levels would be dependent on several factors including, but not limited to the duration of the construction activities, the number of plant items and their location on site in relation to the nearest receivers.

Attended measurements are to be carried out within a period of 14 days of equipment arriving on site to confirm that the operating noise levels of all plant items comply with the maximum levels in Table 7-2. The attended measurements are to be repeated on a three-monthly basis to ensure that noise from individual plant items are still within the acceptable noise range.

Table 7-2 Highest allowable noise levels for construction equipment

Activity	Description of Activity	Plant/ Equipment	L_{Aeq} SWL	L_{Aeq} at 7m
Mobilisation & Site Establishment	Installing construction boundary hoardings/ fences and traffic barriers	Truck (medium rigid)	103	78
		Road truck	108	83
		Scissor Lift	98	73
		Franna crane	98	73
Utility, property, service adjustment	Adjustment of property boundaries (where required); relocation of services	Excavator (tracked) 35t	110	85
		Dump truck	110	85
		Franna crane 20t	98	73
		Pneumatic hammer	113	88
		Concrete saw	118	93
		Vacuum truck	109	84
		Backhoe	111	86
		Power generator	103	78
Corridor Clearing	General land clearing, tree and stump removal, topsoil stripping, loading	Bulldozer D9	116	91
		Excavator (tracked) 35t	110	85
		Chainsaw 4-5hp	114	89
		Tub grinder/ mulcher 40-50hp	116	91
		Dump truck	110	85
		Excavator (tracked) 35t	110	85
	House/ building demolition	As above + hydraulic hammer	122	97
		Front end loader 23t	112	87
		Dump truck	108	83

Activity	Description of Activity	Plant/ Equipment	L_{Aeq} SWL	L_{Aeq} at 7m
Rock crushing	Crushing and screening of building waste/ rock material for re-use on site	Rock crusher	118	93
		Bulldozer D9	116	91
		Excavator (tracked) 35t	110	85
		Dump truck	110	85
Bulk earthworks	Formation of road alignment Excavation of soil and rock, hammering/rock breaking, drilling, loading, haulage, compaction of fill areas, grading	Bulldozer D9	116	91
		Scraper 651	110	85
		Excavator (tracked) 35t	110	85
		As above + hydraulic hammer	122	97
		Grader	113	88
		Dump truck	110	85
		Compactor	106	81
		Roller (large pad foot)	109	84
		Water cart	107	82
Drainage infrastructure	Excavation of trenches and pits; delivery and placement of precast pipes and pits; filling and compacting	Backhoe	110	85
		Franna crane 20t	98	73
		Excavator (tracked) 35t	110	85
		Concrete truck	109	84
		Truck compressor	75	50
		Vibratory roller	109	84
		Road truck	108	83
Bridge works	Casting; concrete pours; placement of pre-cast elements; Piling (mainly bored); demolition	Franna crane 20t	98	73
		Piling rig - driven	116	91
		Piling rig - bored	112	87
		Power generator	100	75
		Concrete pump	102	77
		Concrete truck	109	84
		Compressor	109	84
		Pneumatic hammer	115	90

Activity	Description of Activity	Plant/ Equipment	L_{Aeq} SWL	L_{Aeq} at 7m
		Welding equipment	105	80
Retaining walls/ noise walls	Construction of retaining walls & noise walls	Piling rig - bored	112	87
		Power generator	103	78
		Mobile crane	113	88
		Concrete vibrator	113	88
		Concrete pump	109	84
		Welding equipment	105	80
		Excavator (tracked) 35t	112	87
		Air track drill	124	99
Paving/ asphalting (inc concrete sawing)	Delivery of raw materials Placement of surface material Saw cutting	Pavement laying machine	114	89
		Dump truck	110	85
		Asphalt truck & sprayer	103	78
		Concrete truck	109	84
		Smooth drum roller	107	82
		Concrete saw	118	93
Compounds	Deliveries Plant and equipment Maintenance Office areas Storage areas	Front end loader	91	66
		Excavator (tracked) 35t	110	85
		Road truck	108	83
		Compressor	109	84
		Welding equipment	105	80
		Light vehicles	88	63
		Power generator	103	78
Road furniture installation	Signposting and line marking	Road truck	108	83
		Scissor lift	98	73
		Franna crane 20t	98	73
		Line marking truck	108	83
Construction Compound	Site Establishment	Chainsaw 4-5hp	114	89
		Pneumatic hammer	113	88

Activity	Description of Activity	Plant/ Equipment	L_{Aeq} SWL	L_{Aeq} at 7m
		Fixed crane	113	88
		Front end loader	112	87
		Excavator (tracked) 35t	110	85
		Grader	113	88
		Vibratory roller	109	84
		Concrete truck	109	84
		Dump truck	110	85
		Water cart	107	82
		Concrete vibrator	113	88
		Concrete pump	109	84
		Power generator	103	78
		Light vehicles (eg 4WD)	103	78
Local Roads Works		Bulldozer D9	116	91
		Excavator (tracked) 35t	110	85
		Chainsaw 4-5hp	114	89
		Tub grinder/ mulcher 40-50hp	116	91
		Front end loader	112	87
		Scraper 651	110	85
		Backhoe	111	86
		Compactor	106	81
		Dump truck	110	85
		Road truck	108	83
		Water cart	107	82
Re-surfacing works	Milling the asphalt to expose the underlying concrete, then laying new asphalt	Daymakers	98	73
		Pavement profiler	117	92
		Dump truck	110	85
		Front end loader	112	87
		Pavement laying machine	114	89

Activity	Description of Activity	Plant/ Equipment	L_{Aeq} SWL	L_{Aeq} at 7m
		Asphalt truck & sprayer	106	81
		Smooth drum roller	107	82

Note: SWL – Sound Power Level

8 Additional noise mitigation measures

After standard noise mitigation measures (refer to Section 7) have been applied noise levels may still exceed the NML. Where exceedances remain the approaches in Table 8-1 and Table 8-2 would be implemented where feasible and reasonable. Note that assistance from Transport for NSW Communication and Stakeholder Engagement is available to coordinate and deliver community consultation and notification.

The additional measures in Table 8-2 are described below. In instances where there are many receivers above the NML it may not be practical to discuss the project with every receiver recommended below. Instead the community would be proactively engaged so they have an incentive to participate in discussion.

Support from the community may be demonstrated from surveys, online feedback, contact phone numbers and community events.

Table 8-1 Additional management measures

Measure	Description	Abbreviation
Specific notifications	Specific notifications are letterbox dropped (or equivalent) to identified stakeholders no later than seven calendar days ahead of construction activities that are likely to exceed the noise triggers. The specific notification provides additional information when relevant and is informative for more highly affected receivers than covered in general letterbox drops. The exact conditions under which specific notifications would proceed are defined in the relevant Additional Mitigation Measures (refer to Table 8-2). This form of communication is used to support periodic notifications, or to advertise unscheduled works.	SN
Phone calls	Phone calls detailing relevant information made to identified/affected stakeholders within seven calendar days of proposed work. Phone calls provide affected stakeholders with personalised contact and tailored advice, with the opportunity to provide comments on the proposed work and specific needs. Where the resident cannot be telephoned then an alternative form of engagement should be used.	PC
Individual briefings	Individual briefings are used to inform stakeholders about the impacts of high noise activities and mitigation measures that would be implemented. Project representatives would visit identified stakeholders at least 48 hours ahead of potentially disturbing construction activities. Individual briefings provide affected stakeholders with personalised contact and tailored advice, with the opportunity to comment on the project. Where the resident cannot be met with individually then an alternative form of engagement should be used.	IB

Measure	Description	Abbreviation
Respite offers	Respite Offers should be considered made where there are high noise and vibration generating activities near receivers. As a guide work should be carried out in continuous blocks that do not exceed 3 hours each, with a minimum respite period of one hour between each block. The actual duration of each block of work and respite should be flexible to accommodate the usage of and amenity at nearby receivers. The purpose of such an offer is to provide residents with respite from an ongoing impact. This measure is evaluated on a project-by-project basis, and may not be applicable to all projects.	RO
Respite Period 1	Out of hours construction noise in out of hours period 1 (refer to Table 8-2) shall be limited to two consecutive evenings, three non-consecutive evenings per week and ten evenings per month, except where there is a Duration Respite to the extent practicable to minimise impacts on sensitive receivers. Note: alternative respite periods would apply if project specific approval or licence conditions allow.	R1
Respite Period 2	Night time construction noise in out of hours period 2 (refer to Table 8-2) shall be limited to two consecutive nights, three non-consecutive nights per week and ten nights per month, except for where there is a Duration Respite to the extent practicable to minimise impacts on sensitive receivers. Where possible, high noise generating works shall be completed before 11pm. Note: alternative respite periods would apply if project specific approval or licence conditions allow.	R2
Duration Respite	Respite offers and respite periods 1 and 2 may be counterproductive in reducing the impact on the community for longer duration projects. In this instance and where it can be strongly justified it may be beneficial to increase the work duration, number of evenings or nights worked through Duration Respite so that the project can be completed more quickly. The project team would engage with the community where noise levels are expected to exceed the NML to demonstrate support for Duration Respite. Where there are few receivers above the NML each of these receivers should be visited to discuss the project to gain support for Duration Respite.	DR
Alternative Accommodation	Alternative accommodation options may be offered to residents living in close proximity to construction works that are likely to experience highly intrusive noise levels (refer to Table 8-2). The specifics of the offer would be identified in the construction noise and vibration management plan and out of hours works protocol. Additional aspects for consideration shall include whether	AA

Measure	Description	Abbreviation
	the highly intrusive activities occur throughout the night or before midnight.	
Verification	Verification of noise levels as part of routine checks of noise levels or following reasonable complaints. This verification should include measurement of the background noise level and construction noise.	V

Table 8-2 Triggers for additional mitigation measures

Predicted airborne $L_{Aeq(15min)}$ noise level at receiver			Additional mitigation measures type (refer to Table 8-1)
Perception	**dB(A) above RBL**	**dB(A) above NML**	
All hours			
75 dB(A) or greater			N, V, PC, RO
Standard Hours: Mon – Fri (7am-6pm), Sat (8am-1pm), Sun/Pub Hol (Nil)			
Noticeable	5 to 10	0	-
Clearly audible	10 to 20	<10	-
Moderately intrusive	20 to 30	10 to 20	N, V
High intrusive	> 30	>20	N, V
OOHW Period 1: Mon-Fri (6pm-10pm), Sat (7am-8am and 1pm-10pm), Sun/Pub Hol (8am-6pm)			
Noticeable	5 to 10	<5	-
Clearly audible	10 to 20	5 to 15	N, R1, DR
Moderately intrusive	20 to 30	15 to 25	V, N, R1, DR
High intrusive	> 30	>25	V, IB, N, R1, DR, PC, SN
OOHW Period 2: Mon-Fri (10pm-7am), Sat (10pm-8am), Sun/Pub Hol (6pm-7am)			
Noticeable	5 to 10	<5	N
Clearly audible	10 to 20	5 to 15	V, N, R2, DR
Moderately intrusive	20 to 30	15 to 25	V, IB, N, PC, SN, R2, DR
High intrusive	> 30	>25	AA, V, IB, N, PC, SN, R2, DR

Note: RBL – Rating Background Level; NML – Noise Management Level; OOHW – Out of Hours Work

9 References

British Standard (2009) *British Standard BS 5228-1 Code of practice for noise and vibration control on construction and open sites – Noise.*

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Roads and Maritime Services (2015), *Noise Criteria Guideline,* Road and Maritime Services, North Sydney.

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Standards Australia (2010) *AS2346:2010 – Guide to noise control on construction, maintenance and demolition site.*