Environment Protection Authority

Draft Construction Noise Guideline

This document is for public consultation purposes only

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The Construction Noise Guideline sets out a framework for the management of construction noise that ensures all feasible and reasonable mitigation measures are used to manage impacts.

It is not a statutory document but may be referenced in relation to the assessment and management of construction activities.

The NSW Environment Protection Authority will use this guideline to inform its decision making when regulating and managing noise from construction activities.

Where there is inconsistency between this guideline and the requirements of an environment protection licence or other statutory instrument, the provisions of a licence or other statutory instrument prevail to the extent of the inconsistency.

Glossary of terms

Term	Definition
appropriate regulatory authority	Defined in section 6 of the POEO Act and chapter 7, part 1 of the Protection of the Environment Operations (General) Regulation 2009 as the body responsible for regulating particular activities.
A-weighting	An adjustment made to the sound level measurement to approximate the response of the human ear.
background noise level	The underlying level of noise present in ambient noise when extraneous noise is removed. It excludes noise from the construction project. This is described using the L_{A90} descriptor.
blasting	To be assessed in accordance with the *Technical Basis for Guidelines to Minimise Noise Annoyance Due to Blasting Overpressure and Ground Vibration* (ANZEC 1990).
construction	Construction work is broadly interpreted to mean temporary activities to build, maintain, alter or demolish a structure or infrastructure, which will (or has) a temporary or permanent operational application. Examples include: • construction of residential, commercial or industrial buildings • construction and maintenance of transport infrastructure, such as roads and railways • building and maintenance of public infrastructure, such as water and electrical mains, dams, power stations, electrical substations and pylons. A specific definition of 'infrastructure' is provided in section 115T of the *Environmental Planning and Assessment Act 1979*.
consultation	Proponents actively seek the views and opinions of potentially affected receivers and the appropriate regulatory authority so that work design and scheduling take account of these views to manage potential noise impacts (refer to section 7 for specific advice).
dB(A)	Unit used to measure 'A-weighted' sound pressure levels.
DECC	Department of Environment and Climate Change.
DECCW	Department of Environment, Climate Change and Water.
decibel (dB)	A measure of sound level. The decibel is a logarithmic way to describe a ratio. The ratio may be power, sound pressure, voltage or intensity or other parameters. In the case of sound pressure, it is equivalent to 10 times the logarithm (to base 10) of the ratio of a given sound pressure squared to a reference sound pressure squared.
emergency works	Works carried out in response to a sudden natural event (including a storm, flood, tree fall, bushfire, land slip or coastal inundation) or accident, equipment failure or structural collapse, or damage caused by vandalism, arson or a pollution incident.
engagement	Interaction with the community to inform, communicate and consult on potential impacts associated with a project (refer to section 7 for specific advice).
Environmental Impact Assessment (EIA)	A broad term that covers the range of assessments required under the *Environmental Planning and Assessment Act 1979* and any related amendments to the Act. These environmental assessments may be referred to as Environmental Impact Assessments (EIAs) or Environmental Impact Statements (EISs). In this guideline these terms are used interchangeably.
Environmental Impact Statement (EIS)	See *Environmental Impact Assessment (EIA)* above.

Term	Definition
environmental management plan (EMP)	Environmental management plans describe the environmental impact of a project and set out commitments on how those impacts will be managed. This will typically include requirements in regulatory approvals for that project.
environmentally unsatisfactory manner	Defined in section 95 of the *Protection of the Environment Operations Act 1997* (POEO Act). '… [a]n activity is carried on in an environmentally unsatisfactory manner if: a. it is carried on in contravention of, or in a manner that is likely to lead to a contravention of, this Act, the regulations or a condition attached to an environment protection licence (including a condition of a surrender of a licence) or an exemption given under this Act or the regulations, or b. it causes, or is likely to cause, a pollution incident, or c. it is not carried on by such practicable means as may be necessary to prevent, control or minimise pollution, the emission of any noise or the generation of waste, or d. it is not carried on in accordance with good environmental practice.'
EP&A Act	*Environmental Planning and Assessment Act 1979*
extraneous noise	Noise resulting from activities that are not typical of the area. Atypical activities include traffic generated by holiday periods and special events, such as concerts or sporting events. Normal daily traffic is not considered to be extraneous.
feasible and reasonable mitigation measures	A feasible mitigation measure is one that can be engineered and is practical to build and/or implement, given project constraints, such as safety, maintenance and reliability requirements. A reasonable mitigation measure is one that involves judging whether the overall noise benefits from a feasible option outweigh the overall adverse social, economic and environmental effects (see section 7).
infrastructure	Defined in section 115T of the EP&A Act as: 'development for the purposes of infrastructure, including (without limitation) development for the purposes of railways, roads, electricity transmission or distribution networks, pipelines, ports, wharf or boating facilities, telecommunications, sewerage systems, stormwater management systems, water supply systems, waterway or foreshore management activities, flood mitigation works, public parks or reserves management, soil conservation works or other purposes prescribed by the regulations'.
L_{AFmax}	The A-weighted maximum noise level from only the construction works under consideration, measured using the fast time weighting on a sound level meter.
$L_{Aeq,15min}$	The A-weighted equivalent continuous (energy average) A-weighted sound pressure level of the construction works under consideration over a 15-minute period, excluding other noise sources, such as from industry, road, rail and the community. Other descriptors may be used providing they can be justified as representing the characteristics of the construction noise.
$L_{A90,15min}$	The A-weighted sound pressure level that is exceeded for 90% of the 15-minute measurement period, when measured in the absence of the construction works under consideration and excluding extraneous noise. This is considered to represent the background noise.
noise impact assessment (NIA)	The component of an Environmental Impact Statement, environmental assessment, statement of environmental effects, license application etc. that considers the impacts of noise resulting from a development or activity.
noise sensitive (land use)/noise sensitive receiver	Land uses that are sensitive to noise, such as residential areas, churches, schools and recreation areas.

Term	Definition
non-mandatory	Not required by legislation. The guideline specifies noise management levels that guide the need to apply work practices to minimise noise impacts, but the legislation does not make it compulsory to meet these noise levels. However, the guideline will be used when setting statutory (legally enforceable) conditions in a licence or consent.
notification	Providing information to potentially affected receivers on the proposed works to understand how this might affect the community. This should typically include the duration, working hours and key activities; and provide means to contact the proponent and the relevant authority. Notifications take the form of emails, advertisements, letterbox drops, websites and community forums (refer to section 7 for specific advice).
POEO Act	*Protection of the Environment Operations Act 1997*
prescribed determining authority	Defined in section 5.1(1) of the *Environmental Planning and Assessment Act 1979* 'Determining authority' means a Minister or public authority and, in relation to any 'activity', means the Minister or public authority by or on whose behalf the 'activity' is or is to be carried out or any Minister or public authority whose approval is required in order to enable the activity to be carried out. 'Activity' means: a. the use of land, and b. the subdivision of land, and c. the erection of a building, and d. the carrying out of a work, and e. the demolition of a building or work, and f. any other act, matter or thing referred to in section 3.14 that is prescribed by the regulations for the purposes of this definition but does not include: g. any act, matter or thing for which development consent under Part 4 is required or has been obtained, or h. any act matter or thing that is prohibited under an environmental planning instrument, or i. exempt development, or j. development carried out in compliance with an order, or k. any development of a class or description that is prescribed by the regulations or the purposes of this definition.
proponent	The developer of the construction works under consideration.
rating background level (RBL)	The overall single-figure background noise level for each assessment period. Determination of the rating background level is by the method described in the *Noise Policy for Industry* (EPA 2017).
residence	A lawful and permanent structure erected in a land-use zone that permits residential use (or for which existing use rights under the EP&A Act apply) where one or more people permanently reside and is not, nor associated with, a commercial undertaking, such as a caretaker's quarters, hotel, motel, transient holiday accommodation or caravan park.
routine work	Work that is undertaken on public infrastructure by public authorities (or their agents) in their role as 'prescribed determining authorities'.
vibration	Human comfort vibration to be measured and assessed in accordance with *Assessing Vibration: A Technical Guideline* (DEC 2006).

Part 1: About the guideline

This part sets out the principles and objectives of this guideline to managing construction noise impacts. Parts 2 provides technical advice on how to implement the guideline, and Part 3 (and the appendices) offers supporting information.

1. Guideline role and objectives

1.1. Introduction

The provision of infrastructure is a key priority of the NSW Government to ensure NSW residents can access transport, water, education, health, sports and arts infrastructure.

Infrastructure construction can occur close to residences or other sensitive land uses during sensitive time periods. If not managed, noise can cause stress and annoyance, interfere with daily activities (including talking, hearing and studying) and disturb sleep. These impacts, although temporary, need to be managed to protect the amenity and wellbeing of local communities.

Construction noise is caused by many activities, and at different parts of a worksite as work progresses. This means that noise levels can change over the course of the project and affect adjoining residents and other sensitive receivers over different periods. Because of this, construction projects are not usually amenable to purpose-built noise control measures typically applied to industrial processes.

With this in mind, the *Construction Noise Guideline* ensures that all feasible and reasonable work practices are applied to minimise construction noise impacts, rather than setting numeric noise limits.

1.2. Who is this guideline for?

This guideline is for construction proponents (both private and public), consent and/or approval authorities, designers, engineers, contractors, and commercial and industrial developers involved with the design, approval, construction and development of projects.

It is primarily aimed at managing noise from construction works regulated by the NSW Environment Protection Authority (EPA), who will use it to ensure proponents adequately assess and manage noise from proposed construction works.

The types of construction regulated by the EPA under the *Protection of the Environment Operations Act 1997* (POEO Act) include those activities related to construction and maintenance that are described in Schedule 1 of the Act. The EPA regulates these activities through an environment protection licence[1].

The EPA also regulates construction and maintenance activities carried out by a public authority (section 6 of the Act), such as the maintenance and repair of public roads, and scheduled development work that enables scheduled activities to be carried out (section 47 of the Act).

Local council is the consent authority for noise from 'non-scheduled' construction activities in its area, except as described in section 6(2) of the POEO Act. Councils are best placed to decide the level of assessment that should be applied to construction projects in their area. However, this guideline may be of assistance to local councils in guiding decision making. Some local councils

1. See the EPA's environment protection licences webpage (www.epa.nsw.gov.au/licensing/index.htm).

have their own policies and procedures for managing construction noise (for example, the City of Sydney council[2]).

Other determining and consent authorities, which are defined in the *Environmental Planning and Assessment Act 1979* (EP&A Act) and include the NSW Department of Planning, Industry and Environment ('the Department'), may also use the guideline when dealing with noise from construction and maintenance works that require planning approval. The Department may issue formal requirements to proponents of major construction projects to assess construction noise impacts.

Prescribed determining authorities (defined in section 5.6 of the EP&A Act) may consider the guideline when reviewing (and developing) industry management procedures (discussed in **sections 1.5** and **6**).

1.3. Guideline role in managing construction noise

The guideline's purpose is to ensure noise impacts associated with construction activities are identified, minimised and managed in a consistent and transparent manner. It provides flexibility to select appropriate work practices and mitigation measures to manage construction noise.

It describes procedures for assessing the potential impact of construction noise based on risk, and a management framework that prioritises community relations and implementation of all 'feasible' and 'reasonable' mitigation measures.

Feasible and reasonable mitigation

A **feasible** mitigation measure is one that can be engineered and is practical to build and/or implement, given project constraints, such as safety, maintenance and reliability requirements.

Selecting **reasonable** measures involves judging whether the overall noise benefits from a feasible option outweigh the overall adverse social, economic and environmental effects.

Proponents must provide transparent information to identify potential noise impacts, and fully justify the selection of feasible and reasonable work practices so the consent authority or regulator can consider the project on its merit when making consent and licensing decisions.

By encouraging development of industry management procedures, this guideline minimises the need for a public authority to prepare a formal construction noise assessment to identify feasible and reasonable mitigation for routine work on public infrastructure.

2. Search for construction site noise on the City of Sydney website (www.cityofsydney.nsw.gov.au).

How to use this guideline

This guideline should be considered in three parts:

1. Sections 1 and 2 provide the overall principles and objectives for managing noise impacts from construction projects.
2. Sections 3, 4, 5 and 6 provide detailed technical advice on how to implement the principles and objectives.
3. Sections 7 and 8 provide advice on managing construction noise, the role of industry management procedures and a description of the regulatory framework. The appendices provide additional information on strategies to manage noise impacts, including case studies.

Application of the technical advice in sections 3, 4, 5, 6, 7 and 8 (and appendices) must always be interpreted in the context of the principles in sections 1 and 2.

1.4. Guideline objectives

The key objective of this guideline is to ensure that noise impacts from construction and maintenance projects are kept to a minimum.

This is achieved by ensuring all reasonable and feasible mitigation measures are identified, their selection is justified, and the community is engaged in a transparent and honest manner on the likely impacts and the mitigation to manage noise from the proposal.

While some noise from construction is inevitable, this guideline seeks to ensure the effective management of potential noise impacts. It provides a framework for proponents to develop detailed noise mitigation solutions by using the following steps.

1. Minimise the impact of construction noise by
    a. ensuring construction is scheduled during the recommended standard hours to reflect greater sensitivity to noise during the evening and night-time and on weekends and public holidays, except where this is not practical and justified
    b. providing qualitative and quantitative assessment methods to identify construction noise impacts to guide the selection of feasible and reasonable mitigation measures
    c. requiring the proponent to justify their selection of feasible and reasonable work practices based on the likely risk of noise impacts.
2. Engage with the community, including provide information on the project, the expected noise impacts, what is being done to manage noise, and opportunities to accommodate community preference for respite where this is feasible and reasonable. This is considered a critical component in managing construction noise, particularly from major infrastructure projects that can significantly impact the community over prolonged periods and include extended periods of work outside of the recommended standard hours given in **Table 1** (see **section 7.3**).
3. Prepare work methods, plans and strategies to manage noise impacts.
4. Differentiate between the management of noise from infrastructure construction and noise from routine maintenance and construction work undertaken by public authorities on public infrastructure (see **section 1.5**).
5. Explain the regulatory regime underpinning the management of construction noise in NSW and advise on the noise management documentation required at various stages of the approvals process.

1.5. Construction projects to which this guideline applies

This guideline provides two paths to assess and manage construction noise impacts: one for infrastructure construction (discussed in **section 1.5.1**) and another for routine construction and maintenance (discussed in **section 1.5.2**).

It also applies to construction noise associated with mining and extractive industries, coal seam gas activities and site rehabilitation. Advice on these topics is provided in **Appendix A**.

1.5.1. Infrastructure construction

This guideline specifically applies to construction associated with activities described in Schedule 1 of the POEO Act, but can also be applied to major construction projects and other activities determined by regulatory and consent authorities under the EP&A Act (see **section 1.2**).

Construction work is broadly interpreted as temporary activities to build, maintain, alter or demolish a structure or infrastructure that will (or has) a temporary or permanent operational application[3]. Examples include:

- construction of residential, commercial or industrial buildings
- construction and maintenance of transport infrastructure, such as roads and railways
- building and maintenance of public infrastructure, such as water and electrical mains, dams, power stations, electrical substations and pylons.

Under this path, it is likely that a qualitative or quantitative assessment will be needed to assess impacts (see **section 3**) and identify feasible and reasonable mitigation (see **section 7**).

This assessment path may also be used by councils to manage activities where they are the appropriate regulatory authority.

1.5.2 Routine maintenance and construction work

This guideline encourages public authorities to develop and apply industry management procedures (see **section 6**) to manage noise impacts from routine activities to repair, maintain or construct public infrastructure.

Routine activities are taken to mean those generally undertaken on public infrastructure by public authorities (or their representatives) in their role as ‘prescribed determining authorities’. Advice is provided in **sections 6** and **8**.

Examples of routine activities are construction, maintenance or repair of sub-surface utilities (such as water supply pipelines or telecommunication cables) or maintenance (such as road resurfacing).

These activities are generally well-defined repetitive tasks with set work methods and equipment. Noise sources are well known and unlikely to vary between locations. A package of feasible and reasonable mitigation measures can be developed and documented within an industry management procedure, and applied each time these routine works take place.

Public authorities can use industry management procedures to streamline work by avoiding the need to prepare a detailed noise assessment every time routine work is scheduled.

Where public authorities undertake work on public infrastructure, the EPA is the appropriate regulatory authority under the POEO Act. The EPA can take regulatory action if these activities are undertaken in an ‘environmentally unsatisfactory manner’ (section 95 of the POEO Act). This is regardless of whether industry management procedures are applied.

3. A specific definition of ‘infrastructure’ is provided in section 115T of the EP&A Act.

The principles in this guideline – and those described in Australian Standard 2436–2010 *Guide to noise and vibration control on construction, demolition and maintenance sites* (AS 2436) – can be referenced by public authorities to develop industry management procedures.

Further advice on the role (and limitations) of industry management procedures is provided in **section 6**.

1.6. Occupational noise management

In addition to the requirements of this guideline, proponents must comply with their occupational noise management obligations under the NSW workplace health and safety legislation administered by SafeWork NSW.

Work practices that reduce noise levels at a workplace will generally reduce noise impacts on a neighbouring community and should be a high priority. In managing environmental noise impacts, proponents should also seek to ensure workers (and others) are not exposed to the risk of noise-induced hearing loss.

The Work Health and Safety Regulation 2001 (part 4.1):

- defines the exposure standard for occupational noise
- details the requirements to manage workplace noise and prevent the risk of hearing loss from occupational noise exposure
- details the duties of designers, manufacturers, importers and suppliers of equipment.

Practical advice on managing hazardous noise levels in the workplace is provided in the following Codes of Practice:

- *Managing Noise and Preventing Hearing Loss at Work* (SafeWork NSW 2016)
- *Moving Plant on Construction Sites* (WorkCover 2004).

Occupational noise control should focus on the hierarchy of controls: eliminating the hazardous noise, and where this is not practicable, implementing isolation, substitution or engineering controls. Administrative controls, such as safe work practices, and personal hearing protective equipment are the least effective options and should only be used to supplement the higher-level controls already implemented. Usually, a combination of controls is required.

1.7. Excluded from this guideline

This guideline does not apply to the assessment of:

- Occupational noise exposure. This is covered by workplace health and safety legislation administered by SafeWork NSW (see **section 1.6**).
- Noise from power tools and equipment used on residential premises. This is addressed by the Protection of Environment Operations (Noise Control) Regulation 2017. Clause 51 of this Regulation only applies where planning approval is not required for construction works at residential premises.
- Noise from public roads. This is assessed under the *NSW Road Noise Policy* (DECCW 2011). Advice on construction generating additional traffic on public roads is discussed in **section 5.9**.
- Noise from industrial sources. This is assessed under the *Noise Policy for Industry* (EPA 2017).
- Vibration. Advice on the preferred and maximum vibration values for use in assessing human responses to vibration is given in *Assessing Vibration: A Technical Guideline* (DEC 2006).
- Blasting. Advice on blasting and vibration is given in the *Technical Basis for Guidelines to Minimise Annoyance Due to Blasting Overpressure and Ground Vibration* (ANZEC 1990). The key provisions, of the ANZEC Guidelines and how they should be applied in the context of infrastructure construction are summarised in **section 2.4.1**.

2. Applying the guideline

2.1. Guideline overview

This guideline provides a framework to identify, assess and manage noise impacts from infrastructure construction. It promotes a risk-based approach to assess and manage construction noise. It ensures that the most appropriate site-specific noise mitigation methods are planned and implemented. This provides flexibility for proponents to apply innovative solutions to mitigate noise impacts – to the greatest extent reasonably practicable – without unduly restricting efficient infrastructure construction.

No single approach can minimise noise from all types of construction. The effort needed to assess impacts and identify ways to minimise noise will be guided by factors such as the:

- extent of the works and the type of equipment and processes required
- number of sensitive receivers
- proximity of work to sensitive receivers
- duration and period when work is scheduled
- opportunity (or otherwise) to manage noise.

The effort put into assessing and managing construction noise should be commensurate to the risk of impact and must be clearly documented and justified.

The process for construction noise management involves the following key steps:

6. **Identify sensitive land uses** that may be affected and the proposed **hours of work**.
7. **Select the appropriate assessment method** based on the likely **risk of noise impact**, including consideration of the proposed working hours and duration of the construction works (or as required by the consent or regulatory authority).
8. Determine the likely noise impacts using either the qualitative or quantitative assessment method.
9. Identify and justify the selection of feasible and reasonable work practices to minimise noise impacts.
10. **Document the outcome** of these steps, such as in a noise impact assessment or environmental assessment (or similar) report.
11. **During all steps, engage with the community** where appropriate and commensurate to the risk of noise impact.

Consultation with the relevant regulatory or consent authority may be required at each of the following stages depending on the project's complexity:

- prior to the project to identify assessment requirements
- during project assessment
- at approval stage.

The process for construction noise management generally applies to infrastructure construction (as described in section 1.5.1). During routine maintenance and construction of public infrastructure (as described in section 1.5.2) an industry management procedure may be used to manage noise impact.

Noise management plans can be used to consolidate and describe detailed noise management actions employed by the proponent during construction. If appropriate, these plans can include details of any noise management consent conditions or licence requirements set out by the appropriate regulatory authority. For major projects, a **noise management strategy** may be appropriate to consolidate and interpret noise assessment and management requirements over the pre- and post-approval stages. **Section 8** explains the roles of noise management plans and strategies.

Proponents must document actions adopted for each step. The level of detail should be commensurate to the risk of noise impact. Emphasis should be placed on justifying why these work practices are the most feasible and reasonable options.

2.2. Identifying sensitive land uses and construction hours

2.2.1. Identifying sensitive land uses

Sensitive land uses potentially affected by construction noise include:

- residences
- schools, educational institutions and childcare centres
- hospitals
- places of worship
- passive recreation areas, such as outdoor grounds used for teaching
- active recreation areas, such as parks and sports grounds.

Other land uses that may at times be sensitive to construction noise include:

- sensitive commercial premises, such as film, television and radio studios
- research facilities
- entertainment spaces, restaurants, office premises and retail spaces
- temporary accommodation, such as hotels, caravan parks and camping grounds
- certain industrial premises, such as those that house noise sensitive processes.

Residences and other sensitive land uses should be identified and documented in the proponent's assessment. Construction noise levels vary depending on the distance to each sensitive land use, as well as intervening topography or buildings. For this reason, care should be taken to identify sensitive land uses further from the construction site that may also be adversely affected.

2.2.2. Recommended standard hours

Work should be scheduled during the recommended standard hours for construction work shown in **Table 1** unless work outside these hours can be justified as described in **section 2.2.3**.

Table 1 Recommended standard hours for construction work

Work type	Weekday	Saturday	Sunday or public holiday
Normal construction	0700 to 1800	0800 to 1300	No work
Blasting	0900 to 1700	0900 to 1300	No blasting

The relevant authority (consent, determining or regulatory) may impose more or less stringent construction hours. Development subject to complying development certificates cited in clause 20C(6) of the *State Environmental Planning Policy (Infrastructure)* 2007 have alternative working hours to those in Table 1.

2.2.3. Construction outside the recommended standard hours

While every effort should be made to schedule work during the recommended standard hours, construction may be necessary outside these hours in certain situations, including:

- the **delivery of oversized equipment or structures** that police or other authorities determine require special arrangements to transport along public roads
- where a **road occupancy licence is required** for an activity likely to impact on traffic flow, such as road maintenance work or lane closures around a building site
- **emergency work** to protect human health or avoid the loss of life or damage to property, or to prevent environmental harm
- **maintenance and repair of public infrastructure** where disruption to essential services, required system conditions (such as low-flow conditions for sewers) and/or considerations of worker safety do not allow work within standard hours
- **public infrastructure works** where work outside the recommended standard hours is supported by the affected community to shorten the length of the project
- where a proponent is able to demonstrate and justify a need to work outside the recommended standard hours.

Except in emergencies, these circumstances are not to be interpreted as endorsement for work outside the recommended standard hours and should be justified in each case. Work schedule convenience or project expedience is not considered sufficient justification.

2.2.4. Hierarchy of working hours

The following hierarchy of working hours is only applicable where work cannot be scheduled during the recommended standard hours:

- Saturday afternoon periods between 1300 and 1700
- Sundays between 0800 and 1800
- weekday evening periods between 1800 and 2200
- weekday night periods between 2200 and 0700
- all other times outside the recommended standard hours.

The proponent should seek to minimise impacts by scheduling work during the above hierarchy of preferred working hours, as per community preferences or as approved by the relevant consent or regulatory authority.

Where work is scheduled during the weekday evening and night-time, proponents should endeavour to carry out the noisiest work during the early part of these periods to minimise sleep disturbance. For example, if work will involve a particularly noisy activity for a continuous four-hour period, it would be preferable to schedule this between 1800 and 2200 rather than between 2200 to 0200, where practicable.

Where out-of-hours works are proposed, the proponent should engage with the community (commensurate to the risk of impact) and the consent authority. The community may, for example, prefer relatively short periods of out-of-hours work rather than extended periods of work during the recommended standard hours.

The proponent should document in their assessment report, any:

- expected need to undertake work outside the standard hours
- community engagement undertaken and any preference expressed by the community, focusing on noise-sensitive receivers most impacted by construction work
- justification for proposed out-of-hours work other than convenience or work schedule.

2.3. Selecting the assessment method

Once sensitive receivers are identified and the proposed hours of work established, the next step is to select the appropriate assessment method based on potential noise impacts. **Section 3** provides advice on selecting the assessment method for the infrastructure construction assessment path, including the factors to be considered. In summary:

- A **qualitative assessment** involves a simplified procedure that is appropriate where activities undertaken are unlikely to cause significant noise impacts, for example when one or more of the following applies
  - The equipment or activities are relatively quiet.
  - The work is not close to noise sensitive receivers.
  - The work is generally undertaken during the recommended standard hours.

  A qualitative assessment might suit a small construction project regulated by a local council, for example.
- A **quantitative assessment** method predicts noise from activities at noise sensitive receivers. A quantitative assessment is necessary where equipment and activities are likely to generate high levels of noise at noise sensitive receivers and/or will take place outside the recommended standard hours. A quantitative assessment is typically needed for major construction projects that require an Environmental Impact Assessment (EIA).

Where public authorities have an effective industry management procedure to manage noise from work on public infrastructure, a qualitative or quantitative assessment (including consideration of the supplementary mitigation set out in Table 5) is not required unless otherwise directed by the appropriate regulatory authority.

The role of industry management procedures, and the circumstances where these apply, is discussed in section 6.

2.4. Evaluating noise impacts

Following selection of the assessment method, the next step involves determining the impact of construction noise so that appropriate feasible and reasonable mitigation can be identified. Depending on the assessment method, noise impacts can be described qualitatively or determined numerically using quantitative assessment.

Where a **qualitative assessment** applies, proponents should follow the advice that is given in **section 4**: to qualitatively evaluate potential construction noise impacts and identify feasible and reasonable mitigation.

Where a **quantitative assessment** applies, proponents should follow the procedures in **section 5** to quantitatively predict construction noise levels. These should be compared against the relevant noise management levels set out in **tables 3**, **4** and **6** (as appropriate) to identify feasible and reasonable mitigation. If appropriate, include consideration of the supplementary mitigation described in **Table 5**.

Advice on evaluating equipment noise levels for a quantitative noise assessment is provided in **Appendix B**.

The focus of this guideline is to minimise the impact of construction noise rather than achieve numeric noise levels. The qualitative and quantitative assessment methods are tools to help determine the likely construction noise impacts so that appropriate feasible and reasonable mitigation can be identified.

Where construction noise levels are found to be below the relevant noise management levels proponents should not consider the noise management levels as a target to make more noise. Rather all feasible and reasonable mitigation should be considered to reduce construction noise to as low as possible.

2.4.1. Blasting and vibration

Advice on assessing overpressure and vibration from blasting is provided in the ANZEC Guidelines.

The ANZEC Guidelines are appropriate for mines and quarries and other locations where ongoing scheduled blasting is necessary. The ANZEC Guidelines should be considered good practice rather than stringent criteria when blasting is undertaken in the context of infrastructure construction for a:

- single event, such as the demolition of structures
- limited number of events where it does not routinely affect the same sensitive receivers.

During demolition, care should be taken to avoid partial or failed demolition blasts. Thorough community engagement and consultation is usually necessary to manage the impacts of demolition blasting, particularly where vibration and overpressure at sensitive receivers is predicted to approach or exceed the ANZEC criteria.

Vibration (excluding blasting) associated with other construction activities (including continuous, intermittent or impulsive vibration) should be assessed in accordance with *Assessing Vibration: A Technical Guideline* (DEC 2006).

2.5. Selecting feasible and reasonable work practices

Once potential noise impacts have been determined, the proponent needs to consider the most appropriate feasible and reasonable work practices to manage impacts, including the considerations in **section 7** and the noise management strategies in **Appendix C**.

Managing noise impacts is likely to include a mix of administrative controls (such as working hours) and physical mitigation measures (such as mobile noise barriers). Where significant construction noise impacts are likely, community notification, engagement or consultation, as appropriate, is a critical and essential step in the decision-making process.

As more information becomes available for each stage of the project, the proponent is required to refine the selection of feasible and reasonable work practices and provide more detailed descriptions of those practices.

Case studies outlining how the principles described within this guideline can be applied in various circumstances are provided in **Appendix D**.

2.5.1. Justifying the selection of feasible and reasonable mitigation

Proponents must clearly justify and document the selection of feasible and reasonable mitigation as outlined in **section 7**. This is an important step to provide transparency to the community and allow the consent authority or regulator to consider the project on its merit when drafting conditions of consent or a licence.

2.6. Engaging with the community

Proponents should engage with the community during all project stages at a level commensurate to the risk of noise impact. Engagement broadly means interaction with the community to inform, communicate and consult (as appropriate) on potential impacts associated with the project.

Effective community engagement can lead to greater understanding and acceptance of construction noise by those affected. Proponents are encouraged to provide accurate information on the proposed work activities without understating the likely impact. Where appropriate, consider community input when selecting feasible and reasonable mitigation. Further information on community engagement is set out in **section 7**.

2.7. Developing and using industry management procedures

Prescribed determining authorities are encouraged to develop and use industry management procedures to manage noise impacts from routine maintenance and construction on public infrastructure. In these circumstances, every time routine work is scheduled, industry management procedures can be used in lieu of a qualitative or quantitative assessment, which are more appropriately applied to infrastructure construction works, as described in **sections 1.2** and **1.5.1**.

Industry management procedures should be consistent with the principles in this guideline and with Australian Standard 2436 in so far as they identify feasible and reasonable mitigation for the activity.

Further advice on industry management procedures is given in **section 6**.

2.8. Preparing construction noise assessment reports

Where a qualitative or quantitative assessment identifies feasible and reasonable noise mitigation, proponents must prepare a report that documents:

- the affected sensitive land uses and the proposed hours of construction work
- the likely noise impact
- the recommended feasible and reasonable mitigation
- any community notification, engagement or consultation already conducted and proposed
- any other requirements as determined by the appropriate regulatory authority.

These may be documented within an EIA for major construction projects and referenced by the consent authority or regulator as the basis to establish licence or consent conditions. Clear justification and supporting evidence should be provided to support the findings and recommendations of the report.

Any requirements issued by the regulatory authority may then be summarised in a **noise management plan** (or similar) to describe in detail the methods to ensure compliance with relevant licence or consent requirements.

Advice on regulation of construction noise is set out in **section 8**.

Part 2: Implementing the guideline

This part provides technical advice on how to implement the principles and objectives of the guideline as described in Part 1.

3. Selecting the appropriate assessment method

3.1. Qualitative and quantitative assessment methods

Two methods can be used to assess noise impacts for infrastructure construction (described in **section 1.5.1**), and inform identification of feasible and reasonable mitigation. These are the qualitative assessment method and the quantitative assessment method.

Public authorities can also use these methods to identify feasible and reasonable mitigation when preparing or reviewing industry management procedures. When selecting the appropriate assessment method, the principal consideration is the likely impact of construction noise on the community. The risk depends on several factors, including the:

- work activity, equipment and construction methods being used
- time period when work takes place and its duration
- proximity of noise sensitive receivers
- background noise level
- presence (or absence) of noise barriers, such as topography or buildings or other structures.

Another important factor is the likely community perception of the project. Establishing and maintaining good community relations is a key aspect of managing impacts.

The focus of this guideline is to select feasible and reasonable work practices to manage construction noise in the most effective and efficient manner considering the circumstances of each project. To that end, the qualitative and quantitative assessment methods guide proponents in the selection of feasible and reasonable mitigation to manage construction noise impacts.

A **qualitative assessment** is appropriate where work is unlikely to result in significant noise impacts. It is usually applicable for short-term infrastructure projects or minor construction works. Examples are where relatively quiet equipment is used during the recommended standard hours, noise sensitive receivers are distant from the worksite and/or equipment is well shielded.

A qualitative assessment is generally only appropriate in low-risk situations.

Table 2 provides a non-exhaustive list of factors that could be considered to determine whether a qualitative assessment would be appropriate.

Guidance on the qualitative assessment method is provided in **section 4**.

Table 2 Examples of work attributes and community considerations when selecting the assessment method

Work attributes and community considerations	Likelihood of noise impact: example of low-risk factors	Likelihood of noise impact: example of medium-risk factors	Likelihood of noise impact: example of high-risk factors
Time of construction[1]	Majority of work during the recommended standard hours[1]	Some work during the evening	A large amount of work during the night-time
Duration of works	Short-duration work (e.g. lasting several days) For linear projects (e.g. road and rail construction and maintenance), the duration is related to the total time that work is adjacent to sensitive receivers	Medium-duration work (e.g. lasting several weeks) For linear projects (e.g. road and rail construction and maintenance), the duration relates to the total time that work is adjacent to sensitive receivers	Lengthy construction periods (e.g. large linear infrastructure projects lasting several months or more) Where work is scheduled during the evening or night, consider the likely impact of the work on sensitive receivers based on its duration and whether the work will be continuous or non-continuous and will affect the same sensitive receivers
Noise-making equipment and process	Use of light equipment (e.g. hand-held tools) Infrequent use of hand saws or drills Light vehicles on the worksite Infrequent deliveries and removals	Use of medium-sized equipment (e.g. light to medium excavators, graders and loaders) Use of hand-held jack-hammers and small rock breakers and medium-sized drills and cutting machines Light and medium-sized vehicles on the worksite Occasional deliveries and removals by large vehicles	Use of large-sized equipment (e.g. medium to large excavators, graders, dozers, loaders and compactors) Use of rock breakers, piling equipment, power saws, grinders, explosives/ blasting and high-pressure equipment Medium- and large-sized vehicles on the worksite Regular deliveries and removals by medium and large vehicles
Proximity to sensitive receivers	Extended distances between the worksite and noise sensitive receivers of approximately 1km and greater	Reasonable distances between the worksite and noise sensitive receivers (e.g. several hundred metres)	Minimal distances between the worksite and noise sensitive receivers (e.g. tens of metres)
Containment of noise	Works within a contained building or remote location from sensitive receivers Many opportunities available to control noise at the source and in the path Natural barriers/topography to screen the source of noise from receivers	Outdoor works partially contained from sensitive receivers Some opportunities available to control noise at the source and in the path	Outdoor work with minimal isolation or containment from sensitive receivers Limited opportunities available to control noise at the source and in the path

Work attributes and community considerations	Likelihood of noise impact: example of low-risk factors	Likelihood of noise impact: example of medium-risk factors	Likelihood of noise impact: example of high-risk factors
Number of people affected[2]	Low numbers of sensitive receivers (e.g. up to 25 residences)	Moderate numbers of sensitive receivers (e.g. 25 to 100 residences)	Large numbers of sensitive receivers (e.g. greater than 100 residences)
Community views[3]	The community and consent authority or regulator consider the work uncontroversial or routine	The community and consent authority or regulator have some concern over certain aspects of the work, for example the need for occasional evening or night-time work and/or particularly noisy activities (e.g. rock breaking or piling)	The community and consent authority or regulator have significant concern over certain aspects of the work, for example the need for regular and ongoing evening or night-time work and/or particularly noisy activities (e.g. rock breaking or piling)

1. Table 1 provides the recommended standard hours for construction work.
2. This is only a consideration in so far as it helps a proponent determine whether certain mitigation options are reasonable, for example when evaluating whether the offer of relocation to a small number of residents (subject to agreement) is more reasonable and cost effective than physical mitigation measures (e.g. noise barriers).
3. Community views and determining whether the project is perceived as contentious are qualitative judgements.

A **quantitative assessment** is likely to be necessary where work is expected to generate high levels of construction noise in proximity to noise sensitive receivers, particularly when scheduled outside the recommended standard hours. **Table 2** can also be a guide to evaluate whether the likely impact warrants a quantitative noise assessment. A quantitative assessment would typically be required in medium- and high-risk situations.

A quantitative assessment is likely to be necessary for major construction projects subject to the EIA process. These projects are generally licenced by the EPA or managed and/or approved by other government agencies, such as the Department of Planning, Industry and Environment .

In some circumstances, a qualitative assessment might be suitable for specific activities undertaken as part of major projects where significant impacts are not anticipated. **Table 2** can be used as a guide to identify where this may be the case.

No assessment is necessary for emergency works, meaning any unforeseen construction or maintenance tasks immediately needed to protect human health and avoid the loss of life, prevent damage to property and prevent environmental harm. Proponents should endeavour to manage noise as best as the situation allows and notify the consent authority or regulator as soon as practicable or in accordance with the conditions of any licence or approval instrument.

Where the proponent is uncertain of the most appropriate assessment method, they should use the more accurate assessment method (that is, the quantitative method) to identify feasible and reasonable mitigation.

3.2. Assessing noise from work scheduled outside the recommended standard hours

When work is scheduled outside the recommended standard hours, it is likely that a quantitative assessment would account for the greater sensitivity of the community to noise during the evening and night-time.

However, a qualitative assessment may be appropriate in circumstances where:

- a proponent has suitable procedures to manage noise impact, for example having a good understanding of the impacts through experience of similar tasks
- significant noise impacts are not anticipated, for example due to relatively quiet work activities and/or not being close to noise sensitive receivers.

Regardless of the assessment method used, the proponent should clearly explain and justify the basis for selecting feasible and reasonable mitigation to give the community and consent authority or regulator confidence that noise impacts will be managed adequately.

4. The qualitative assessment method

A qualitative assessment is suitable for projects unlikely to cause significant noise impacts, as described in **section 3**.

This guideline does not prescribe how to prepare a qualitative noise assessment. Rather, it requires a systematic evaluation of the key work attributes likely to contribute to noise impact. This will help determine feasible and reasonable mitigation.

Third-party standards – such as AS/NZS ISO 31000: 2009 *Risk management: principles and guidelines* and the *Internal Audit and Risk Management Policy for the NSW Public Sector* (NSW Treasury, 2012) –provide principles, frameworks and processes to identify and manage risks. These (and other) standards may help proponents evaluate noise impacts from construction activities.

As a minimum, a qualitative noise assessment should include the following steps:

- Identify the sensitive land uses potentially affected by the work.
- Identify the proposed hours of work.
- Identify what work will be undertaken during each work phase over the duration of the project.
- Determine work methods and equipment used to complete each work phase, including the likely duration and time period when work will take place, and the proximity of each work phase to noise sensitive land uses.
- Describe the sources of noise and the risk of noise impact on the community for each work activity.
- Identify feasible and reasonable mitigation, taking account of the advice in **section 7** of this guideline, Australian Standard 2436 and industry best practice.

Where necessary, a rough quantitative calculation can supplement the qualitative assessment, or it can be cross-checked with measurements or predictions from previous or similar projects. This helps ensure that the likely impact of work activities has been fully evaluated to identify appropriate feasible and reasonable noise mitigation measures.

A qualitative assessment may be appropriate for some aspects or work phases associated with large-scale projects where a quantitative assessment would typically apply. For example tasks that do not require noisy equipment or activities and/or where work is well separated or shielded from noise sensitive receivers and significant impacts are not anticipated. **Table 2** can be used as a guide to identify where this may be the case.

5. The quantitative assessment method

5.1. Quantitative assessment

The quantitative assessment method uses predicted noise levels for comparison with the noise management levels for airborne noise in **Tables 3** and **4** for residences and in **Table 6** for sensitive land uses other than residences. The outcome of this comparison guides the extent of mitigation measures to manage construction noise impacts on the community.

For construction likely to result in ground-borne noise at residences, advice is provided in **section 5.6**. If work is scheduled outside the recommended standard hours, the potential for sleep disturbance should be considered. Advice is provided in **section 5.7**.

Advice on predicting noise levels is in **section 5.8**. The level of detail provided should be commensurate to the potential size, complexity and risk presented by the project.

The noise management levels referenced in **Tables 3**, **4** and **6** – and, where appropriate, the supplementary mitigation described in **Table 5** – are not meant to be arbitrarily included in licence or planning approval conditions.

These noise management levels and, where applicable, the supplementary mitigation should only be referenced where a quantitative assessment is required. They are not required where a public authority undertaking routine work on public infrastructure has in place an effective industry management procedure.

Regulators and consent authorities will consider projects on a case-by-case basis when determining the most appropriate conditions to include within licences, approvals and consents. There may be site-specific situations that warrant deviation from the noise management levels and/or the mitigation described in this guideline. Where a proponent seeks to vary these, they should provide strong justification.

Applying the advice in this section must always be done in the context of the principles set out in **sections 1** and **2**.

5.2. Noise management levels

Reaction to construction noise depends on several factors, but people are usually more annoyed by work during the night-time as it has the potential to disturb sleep. Other sensitive times include evenings, weekends and public holidays when amenity can be interrupted.

The following noise management levels not only consider noise but are also guided by the sensitivity of the community to noise during different times:

- **Table 3** provides a noise affected management level and a highly noise affected management level for airborne noise at residences during the recommended standard hours.
- **Table 4** provides a noise affected management level and a highly noise affected management level for airborne noise at residences outside the recommended standard hours.
- **Table 5** provides supplementary mitigation that must be considered for airborne noise at residences outside the recommended standard hours.
- **Table 6** provides noise management levels for airborne noise at sensitive land uses (other than residences).

Advice on the application of noise management levels and supplementary mitigation is provided in **section 5.4**.

It is important to reiterate that this guideline seeks to ensure that construction is undertaken during the recommended standard hours, unless doing so is not practical and justified, and to manage construction noise impacts by identifying and applying feasible and reasonable work practices.

Where work outside the recommended standard hours is proposed, the proponent must justify:

- why it is necessary to schedule work outside the recommended standard hours and why it is not feasible to schedule work during the recommended standard hours
- how feasible and reasonable mitigation measures have been identified and evaluated aiming to meet the noise affected management level of RBL + 5dB
- where the noise affected management level of RBL + 5dB cannot be met, how the advice in this guideline has been considered to manage noise impacts.

5.3. Noise management levels for airborne noise: residences

This section sets out the noise management levels for airborne noise at residences as well as technical notes on how to apply these management levels. It also provides supplementary mitigation measures that must be considered in the circumstances described.

Table 3 Noise at residences using quantitative assessment – during the recommended standard hours: noise affected and highly noise affected management levels

Time of day	Management level $L_{Aeq, 15min}$ [1, 2, 3, 4, 5]	How to apply
Recommended standard hours Monday to Friday 0700 to 1800 Saturday 0800 to 1300 No work on Sundays or public holidays	Noise affected RBL + 10dB	Where the predicted or measured $L_{Aeq, 15min}$ is greater than the noise affected management level, the proponent shall apply all feasible and reasonable work practices to meet this level. As a matter of good practice, noise should be reduced as far as reasonably practicable. The proponent should notify all potentially impacted residents.
	Highly noise affected 75dB(A)	Where noise is above the highly noise affected management level, all feasible and reasonable mitigation shall be applied as well as engagement with the consent authority or regulator to identify other measures to manage noise impacts. Where appropriate, engagement with the community is encouraged to determine the preferred mitigation approach, such as: • negotiated agreements and/or respite periods to restrict work activity • identification of times when the community is less sensitive to noise, including options for longer periods of construction in exchange for restrictions on construction times.

Table 4 **Noise at residences using quantitative assessment – outside the recommended standard hours: noise affected and highly noise affected management levels**

Time of day	Management level $L_{Aeq, 15min}$ [1, 2, 3, 4, 5, 6]	How to apply
Outside recommended standard hours	Noise affected RBL + 5dB	Strong justification is required for works outside the recommended standard hours. The proponent shall apply all feasible and reasonable work practices to meet the noise affected management level. Where this cannot be met, residual impacts should be quantified, and potentially impacted residents notified. The supplementary mitigation described in Table 5 must also be considered, subject to the application notes in section 5.4.
	Highly noise affected 65dB(A)	The highly noise affected management level represents the point above which the supplementary mitigation described in Table 5 must be considered, subject to the application notes in section 5.4. The proponent must justify the selection of feasible and reasonable mitigation, including the supplementary mitigation, with emphasis on consultation with the community and the consent authority or regulator, and community views on work scheduling and respite periods, as described in section 5.4.

5.3.1. Technical notes to application of noise management levels for airborne noise at residences

1. The rating background level (RBL) used to determine the noise management level is the overall single-figure background noise level measured during each relevant assessment period. The assessment periods are either the recommended standard hours (see **Table 1**) or the period outside the recommended standard hours. The RBL should be determined using the procedure in the *Noise Policy for Industry* (NPfI). This includes the adoption of the minimum RBL outlined in Table 2.1 of the NPfI.
2. The shoulder period provisions described in the NPfI apply to construction activities outside the recommended standard hours where these activities do not occur over the entire assessment period (defined by the NPfI) and/or where there is a clear change in the noise environment.
3. The predicted noise levels are determined at the property boundary most exposed to construction noise at a height of 1.5m above ground level.
4. Where the property boundary is more than 30m from the affected residence, the location for measuring or predicting noise levels is at the most noise affected point within 30m of the residence. For multi-level residential buildings, the external points of reference for measurement and/or prediction are the two floors of the building most exposed.
5. Guidance on notification, engagement and consultation is provided in **section 7**.
6. The potential for sleep disturbance should be considered. Advice is provided in **section 5.7**.

Table 5 Noise at residences using quantitative assessment – outside the recommended standard hours: supplementary mitigation

Supplementary mitigation type	Description of supplementary mitigation	Guidance on circumstances where implementation of supplementary mitigation should be considered
Notifications	Notify the community of the location, type and duration of works and the mitigation measures. Consider using some or all of the following methods of notification as appropriate to the circumstances: letterbox drops project website social media channels telephone calls or text messages. Ensure notification is provided within reasonable timeframes and consider tailoring information to individual circumstances, including shift-workers, the elderly, parents or carers at home during the day and non-English speaking residents. Provide contact details for inquiries and complaints, for example via email, telephone and/or website.	Generally, notifications should be considered where works are predicted to exceed the noise affected management level of RBL + 5dB. However, the type and extent of any notification should be weighed against the: likely duration of activities that result in noise exceeding the noise affected management level of RBL + 5dB extent of noise from work activities exceeding the noise affected management level of RBL + 5dB. Notification means providing information to the affected community. The purpose of notification in these circumstances is to warn those who potentially will be affected that work may create temporary disruption and to manage community expectations and project risks. Advice on notifications is provided in section 7. Specific notification requirements set out within licences, consents or conditions must be complied with.
Auditing	Periodically audit noise where this has demonstrable benefits, for example to determine the effectiveness of feasible and reasonable mitigation and/or for community engagement, such as complaint response.	Generally, consider auditing where works are predicted to exceed the noise affected management level of RBL + 5dB, and where this will effectively contribute to managing noise impacts. Proponents are expected to provide justification where periodic noise monitoring is not undertaken. Where auditing is required within licences, consents or conditions these must be complied with.

Supplementary mitigation type	Description of supplementary mitigation	Guidance on circumstances where implementation of supplementary mitigation should be considered
Community engagement	Seek community views on the work via community meetings, websites and social media, or any appropriate method. The community may have preferences for working hours, respite periods or project-specific respite offers, such as movie tickets and meal vouchers. Community engagement must be carried out allowing sufficient time to ensure that views can be incorporated.	Community engagement is considered necessary where: activities are likely to result in noise of around RBL + 20dB or more and/or where the highly noise affected management level of 65dB(A) or more occurs. Community engagement means seeking the views of the affected community on feasible and reasonable supplementary mitigation measures. Emphasis should be placed on respite periods or respite offers. Advice is provided in section 5.4.
Consultation and evaluation of respite periods and alternative accommodation	The proponent must justify the selection of feasible and reasonable mitigation emphasising community views, particularly work scheduling and respite periods, as described in section 5.4. Alternative accommodation offers should be provided to give respite from potential sleep disturbance, if appropriate, and: any offers should be clearly communicated and negotiated with the affected individuals where alternative accommodation is not offered, the reasons must be fully justified to the relevant consent authority or regulator if required. Insufficient justification may result in specific mitigation measures being included within a licence or consent.	Where activities are likely to result in noise of around RBL + 20dB or more and/or where the highly noise affected management level of 65dB(A) or more is predicted, proponents are expected to: engage with, and seek feedback from, the affected community (and appropriate regulatory authority as appropriate) on preferred working hours, including respite periods evaluate whether the offer of alternative accommodation is feasible and reasonable. These steps should be documented, and the outcomes justified. Section 5.4 provides further advice.

Supplementary mitigation type	Description of supplementary mitigation	Guidance on circumstances where implementation of supplementary mitigation should be considered
Evaluation of respite periods and alternative accommodation (extenuating circumstances)	The offer of alternative accommodation (including temporary relocation) may be appropriate in extenuating circumstances and considered on a case-by-case basis, for example where works occur during evening or night-time, and if feasible and reasonable, and in consultation with the affected individuals. This can include consideration of project-specific respite offers, such as movie tickets and meal vouchers for use when work is scheduled during evening periods.	There may be extenuating circumstances where the offer of respite periods or alternative accommodation (including temporary relocation) is suitable, even where activities are not expected to result in noise of around RBL + 20dB or more and/or the highly noise affected management level of 65dB(A) is not predicted. Respite periods as well as alternative accommodation may be the most feasible and reasonable option (subject to community consultation) based on an evaluation of factors, such as: • the likely duration of activities • the time period when work will occur, and whether this is scheduled during the evening period when amenity can be impacted or at night when it has the potential to cause sleep disturbance • individual circumstances, such as impacts on shift-workers • where a relatively small number of noise sensitive receivers are affected • where significant noise impacts are expected, even after consideration of all feasible and reasonable mitigation. In these circumstances, and subject to community consultation, it may be preferable to offer respite and/or alternative accommodation on a case-by-case basis. This should not be interpreted to mean that an offer of respite and/or alternative accommodation can be used in lieu of feasible and reasonable mitigation.

5.4. Application of noise management levels and supplementary mitigation

When work is scheduled during the recommended standard hours, proponents should apply all feasible and reasonable mitigation, taking account of the advice in **section 7**: to achieve the **noise affected management level of RBL + 10dB** or less and the **highly noise affected management level of 75dB(A)** or less.

Where construction noise levels are predicted to be below the relevant noise management levels, proponents should endeavour to apply all feasible and reasonable mitigation to minimise noise as much as practicable. The noise management levels should not be regarded as an opportunity to make noise.

Where work is scheduled outside the recommended standard hours, the noise management levels for residences set out in **Table 4** and the supplementary mitigation set out in **Table 5** reflect the greater sensitivity of the community during these periods. The potential for sleep disturbance should also be considered (see **section 5.7**).

- In the first instance, proponents should seek to achieve the **noise affected management level of RBL + 5dB** or less by applying all feasible and reasonable mitigation. Where this cannot be met, the proponent should quantify the residual noise impact, provide appropriate notification to the community on the nature and duration of the works, and consider the supplementary mitigation described in **Table 5**, taking account of the advice in **sections 5.4.1** and **5.4.2**, as appropriate.
- Where noise levels are predicted to be at, or greater than, the **highly noise affected management level of 65dB $L_{Aeq,15min}$**, the proponent should seek to reduce construction noise to less than **65dB $L_{Aeq,15min}$** and aim to achieve the **noise affected management level of RBL + 5dB**. Where the highly noise affected management level cannot be met after applying all feasible and reasonable mitigation, the proponent must consider the supplementary mitigation described in **Table 5**, taking account of the advice in **sections 5.4.1** and **5.4.2**, as appropriate.

The noise affected and highly noise affected management levels (outside the recommended standard hours) seek to limit noise impacts as far as practicable. This does not mean no noise impacts will occur. Rather, the noise management levels represent a threshold for consideration of supplementary mitigation to protect the community from noise outside the recommended standard hours.

The noise management levels and the supplementary mitigation are not to be interpreted as conditions for licences, consents or approvals. Rather, this guideline requires proponents to evaluate the impact of noise from work activities and identify feasible and reasonable mitigation commensurate to the risk. The supplementary mitigation set out in Table 5 is not compulsory but will be considered by the appropriate authority when drafting licences, consents or approvals.

If a proponent considers that supplementary mitigation is not appropriate, the onus is on them to justify why this is the case and to investigate, document and justify alternative feasible and reasonable mitigation.

5.4.1. Noise affected and highly noise affected noise management level actions

Where the noise management levels reference the supplementary mitigation set out in **Table 5**, the proponent must document how these were considered within any assessment – evaluating factors such as the duration of the work and community views – and justify the recommended feasible and reasonable mitigation to manage noise impacts.

Where construction noise is at, or greater than, the **highly noise affected management level of 65dB(A) $L_{Aeq,\ 15min}$** outside the recommended standard hours, or the **highly noise affected management level of 75dB(A) $L_{Aeq,\ 15min}$** during the recommended standard hours, the proponent must consult with the consent authority and engage with the community to identify noise mitigation measures.

Emphasis should be placed on respite periods to limit noisy activities during certain times. This should be weighed against community views, including preferences for:

- work during times when they are less sensitive to noise, such as before and after school for works near schools, or mid-morning or mid-afternoon for works near residences
- longer construction periods but with restrictions on construction times.

There may be instances where the community expresses preference for higher noise levels if this means construction activities will be over sooner, for example:

- noisy work practices used over a shorter period rather than quieter methods over a longer period
- work scheduled and finished as soon as possible, rather than over a longer period.

Offers of alternative accommodation should take into account the period for which noise management levels are exceeded. For example alternative accommodation may not be feasible or reasonable where:

- the periods of out-of-hours work are relatively short
- work is scheduled for less sensitive periods, such as the evening rather than at night, which could affect sleep
- work is carried out in densely populated areas.

In these circumstances, alternative mitigation measures must be investigated and justified.

When selecting feasible and reasonable mitigation, consideration should also be given to impacts on the wider community, not just those affected by noise. Consider, for example, the impact of road diversions, changes to railway services or interruptions to power or water supplies.

Supplementary mitigation is not intended to place unreasonable constraints on construction projects. Where alternative (and effective) mitigation methods are available, these may be considered instead of the supplementary mitigation set out in **Table 5**. Where alternative mitigation methods are proposed, the proponent should justify the reason for their proposal.

If the consent authority or regulator is not satisfied that a decision to exclude the supplementary mitigation is justified, specific mitigation measures or work restrictions may be placed within licences, consents or conditions.

5.4.2. Engaging with the community

Where engagement with the community and/or appropriate regulatory or consent authority is necessary, proponents should:

- provide details on the nature and duration of the work and the proposed feasible and reasonable mitigation measures
- explore further opportunities to manage noise impacts
- seek community preferences on construction hours, respite periods or noise mitigation measures
- where appropriate, negotiate suitable consent and licence conditions.

Advice on community and stakeholder engagement is provided in **section 7**. In summary, where notifications are required, these should be given within reasonable timeframes and include information on construction times, the type of work taking place, mitigation measures and contact details for a nominated representative who can provide information and address complaints. Project-specific respite offers, for example dinner or movie tickets, may be appropriate for works taking place over consecutive evening periods.

Where project-specific respite offers are not accepted, alternative feasible and reasonable mitigation methods should be considered. This may require community engagement to identify suitable alternative mitigation.

Where offers of alternative accommodation are made to provide respite from potential sleep disturbance (in consultation with affected individuals), and these offers are not accepted, alternative feasible and reasonable mitigation methods must be considered. Where alternative accommodation is not accepted, residual noise impacts may occur even after all feasible and reasonable mitigation.

Periodic noise measurements may be required to determine compliance against noise management levels or any project requirements set out within licences, consents or conditions. Noise monitoring can also be used for community engagement purposes, such as complaint management.

5.5. Noise management levels for airborne noise: other sensitive land uses

Sensitive land uses are typically affected by noise during use, such as schools during school times. Noise management levels for sensitive land uses (other than residences) are based on the principle that the characteristic activities for each of these land uses should not be unduly disturbed. The proponent should engage with the occupiers and endeavour to schedule the project's work hours to minimise disruption.

Table 6 Noise at sensitive land uses (other than residences) using quantitative assessment

Land use	Management level $L_{Aeq,\ 15min}$ [1, 2, 3, 4, 5]
Classrooms at schools and other educational institutions	Internal noise level 45dB(A)
Hospital wards and operating theatres	Internal noise level 45dB(A)
Places of worship	Internal noise level 45dB(A)
Active recreation areas: characterised by sporting activities and activities that generate their own noise or focus for participants, making them less sensitive to noise intrusion	External noise level 65dB(A)
Passive recreation areas: characterised by contemplative activities that generate little noise and where benefits are compromised by noise intrusion, for example reading and meditation	External noise level 60dB(A)
Community centres	Depends on the intended use of the centre. Refer to the recommended 'maximum' internal levels for specific uses in Australian/New Zealand Standard 2107: 2000 *Acoustics: recommended design sound levels and reverberation times for building interiors*.
Industrial premises	External noise level 75dB(A)
Offices and retail outlets	External noise level 70dB(A)

5.5.1. Technical notes to application of noise management levels for airborne noise at noise sensitive land uses (other than residences)

1. Internal noise levels are to be assessed at the centre of the occupied room.
2. External noise levels are to be assessed at the most affected point within 50m of the area boundary. Where passive and active open spaces have a boundary of less than 50m, the proponent should select a more appropriate distance and justify the assessment location.
3. Where internal noise levels cannot be measured, external noise levels may be used. A conservative estimate of the difference between internal and external noise levels is 10dB. However, commercial buildings often have sealed windows and higher standards of noise mitigation than residential properties. Where a higher external to internal mitigation is assumed, this should be justified and supported by sufficient evidence.
4. Due to the broad range of sensitivities to construction noise on commercial or industrial land, different categories of noise management levels may apply. For example, a classroom for training purposes may be within an office or industrial premises and so a different noise management level will apply. The external noise levels are to be assessed at the most-affected occupied point.
5. The noise management levels only apply when the land use is being utilised.

Other businesses (for example theatres and child care centres) may be particularly sensitive to noise and should be investigated to determine suitable noise levels on a case-by-case basis. The recommended maximum internal noise levels described in Australian/New Zealand Standard 2107: 2000 *Acoustics: recommended design sound levels and reverberation times for building interiors* may help determine relevant noise management levels.

5.6. Ground-borne noise at residences

Ground-borne noise is noise generated inside a building by ground-borne vibration caused by activities such as tunnelling. The following ground-borne noise levels for residences indicate when management actions should be applied:

- evening (1800 to 2200), internal – $L_{Aeq,15min}$ 40dB(A)
- night-time (2200 to 0700), internal – $L_{Aeq,15min}$ 35dB(A).

These levels only apply when ground-borne noise levels are higher than airborne noise levels.

Ground-borne noise is to be assessed at the centre of the most affected habitable room and is only applicable during evening (1800 to 2200) and night (2200 to 0700) periods. This is because the objectives are to protect the amenity of people when they are at home.

Mitigation options to address ground-borne noise may include consultation to determine the acceptable management level, respite periods and alternative accommodation where appropriate.

The level of mitigation for ground-borne noise will depend on the extent of impacts and the scale and duration of works. Licence or consent conditions imposed by the relevant authority or regulator may consider whether the sensitive receivers:

- can identify when they are more sensitive to noise, for example evenings, Sundays or public holidays
- are willing to accept a longer period of construction in exchange for days of respite.

It may be necessary to consider potential vibration impacts where construction is likely to generate high levels affecting human comfort. Advice on the preferred and maximum vibration values to assess human responses to vibration is given in *Assessing Vibration: A Technical Guideline* (DEC 2006). Advice on blasting and vibration is given in **section 2.4.1**.

Where ground-borne noise affects commercial premises, appropriate management levels (including daytime levels when the premises are in use) will need to be established on a case-by-case basis. **Appendix D** provides a case study on management of ground-borne noise.

5.7. Sleep disturbance at residences

When construction takes place outside the recommended standard hours it has greater potential to cause annoyance and sleep disturbance. Sleep disturbance is considered to be both awakenings and disturbance to sleep stages. Proponents should consider the potential for sleep disturbance. Factors that may be important in assessing the extent of impact on sleep include:

- how often high noise events occur at night
- the distribution of likely events across the night-time period and the existing ambient maximum events in the absence of the work
- the predicted maximum noise levels at night
- whether there are times when there is a clear change in the noise environment, such as during early morning shoulder periods
- how much maximum noise levels exceed the background noise level at night
- current scientific literature available at the time of the assessment regarding the impact of maximum noise level events at night.

There is no definitive method to identify when noise will cause sleep disturbance. However, a screening test can indicate the potential for this to occur. For example this could be where noise exceeds the background noise level by more than 15dB(A) using the L_{Amax} descriptor.

More detailed advice on sleep disturbance is provided in the *NSW Road Noise Policy* (DECCW 2011) and the *NPfI* (EPA 2017)[4].

5.8. Quantifying noise levels

The proponent may choose to undertake an initial qualitative risk assessment (such as is shown in **Table 2**) as a framework to identify the key risks or undertake a rough quantitative calculation to determine expected noise levels.

If the outcome suggests that construction noise levels are likely to exceed the relevant noise management level – or if required by an appropriate regulatory authority – a detailed quantitative assessment will be necessary to inform the selection of feasible and reasonable mitigation.

5.8.1. Predicting noise levels

For low-risk construction activities or projects, it may be adequate to make a rough calculation of the distance from the source to the sensitive receiver and identify any barriers between them. For major construction projects, noise is generally predicted using computer models. These models can account for attenuation due to distance, atmospheric conditions, barriers and buildings, topographic effects and weather conditions. This information can be used to calculate overall noise levels at all affected noise sensitive locations.

Preference should be given to modelling approaches that have been peer reviewed and extensively used on other noise impact assessments. The selected modelling method will need to be validated by the proponent. Where construction noise is likely to affect a large area or population, a map showing predicted noise contours may help.

Procedures for predicting noise are provided in ISO 9613-2: 1996 *Acoustics: attenuation of sound during propagation outdoors*. Other methods also predict noise, and where these methods are

4. See the EPA's webpage on noise (www.epa.nsw.gov.au/your-environment/noise).

used they should be clearly described and validated before use. Examples are test measurements and calculations (including examples where they are successfully applied) and references to published peer reviewed studies, established industry standard databases and noise models using recognised calculation algorithms.

When predicting noise, the following parameters should be considered:

- all sources of construction noise, including vehicles that operate on site for each work stage
- equipment noise levels – references should be provided for all noise source levels (see **Appendix B**)
- the location and height of noise sources on site
- residences and other sensitive land uses likely to be affected, including their relative locations and heights
- construction hours and the duration that equipment and work activities will operate during each assessment period
- site features, including topography, buildings and surrounding land uses that affect noise propagation
- whether the noise is airborne or ground-borne
- intermittent sources of noise, such as movement alarms on equipment and vehicles.

The additional detail and accuracy gained using a computer model to predict noise levels for all relevant phases of work allow greater certainty when selecting feasible and reasonable mitigation measures. When deciding on the level of detail needed to predict noise levels, increased accuracy will generally require more effort and the proponent should consider the trade-off between these two factors.

To quantify the likely noise impact, realistic worst-case scenarios and conservative noise levels should be considered to predict noise at locations representing the most noise-exposed sensitive land uses. This can be refined as more information becomes available as the project progresses.

Where sufficient information is available, other concurrent construction works in the vicinity that may result in cumulative noise impacts should also be considered.

Where blasting is proposed, determine the number and timing of the blasts per day and week and refer to the advice given in **section 2.4.1**.

Adjustments for special audible characteristics

Special audible characteristics means noise that can be particularly annoying and disturbing, for example noise that contains discrete, noticeable factors, such as tonality, low-frequency noise, and impulsive or intermittent noise events. These characteristics do not necessarily need to be noisy in an absolute sense.

A single 5dB penalty should be added to the predicted quantitative assessment when (one or more) activities with special audible characteristics are expected during a relevant assessment period.

Examples of equipment and activities that can be particularly annoying to nearby residents include:

- ‘beeper’-style reversing or movement alarms
- power saws, such as those used for cutting timber, masonry, road pavements or steel
- grinding metal, concrete or masonry
- rock and line drilling

- vibratory rolling
- rail tamping and regulating
- jackhammering, rock hammering or rock breaking
- impact piling.

Other equipment or activities can also be annoying and should be identified on a case-by-case basis considering the context in which activities take place.

It is not necessary to determine special audible characteristics through a quantitative method if it is likely that certain equipment or activities will be perceived as particularly annoying or disturbing.

5.9. Assessing noise from construction traffic

The impact of projects generating additional road traffic on existing roads should be considered when noise levels are predicted to increase by 2dB or more in any hour.

Where construction traffic is likely to result in an increase in noise of 2dB or more in any hour on any part of the road network, apply the following assessment steps:

1. Assess road traffic noise for each work phase and for the time periods where traffic is scheduled. Assessment procedures are discussed in the *NSW Road Noise Policy* (DECCW 2011).
2. Where practical, consider the change in traffic volume on all relevant parts of the road network, for example in circumstances where vehicles are taking spoil from a construction site to a designated disposal site.
3. Compare predicted noise levels with the noise assessment criteria for residential land uses and non-residential land uses (based on the relevant road category) in tables 3 and 4 of the *NSW Road Noise Policy*.
4. Implement feasible and reasonable mitigation. These options will be limited because the proponent has no control over public roads. Consider routing and scheduling of construction traffic to minimise impacts. Ensure that vehicles are operated and maintained in a manner that minimises noise. Noise mitigation options to manage vehicle noise are provided in **Appendix C**.

6. The role of industry management procedures

This guideline gives flexibility to assess and manage noise impacts from routine maintenance and construction differently from other construction work, as defined in **section 1.5**.

Routine activities are taken to mean work undertaken on public infrastructure by public authorities (or their agents) in their role as **prescribed determining authorities**, for example to sustain public infrastructure (such as maintenance of roads, railways, power and water infrastructure).

Prescribed determining authorities

Industry management procedures should only be used by 'prescribed determining authorities' – defined in section 5.6 of the EP&A Act (see section 8) – to manage noise impacts from routine maintenance and construction work on public infrastructure.

Routine maintenance and construction comprise recurring activities that involve similar work methods and equipment and emit similar noise levels for each type of task at different sites.

Although the noise impact at sensitive receivers can vary depending on local factors (such as the proximity of sensitive receivers at each worksite) the feasible and reasonable noise mitigation measures are unlikely to differ significantly for each type of task. Because of this, a standardised package of feasible and reasonable mitigation can be developed, documented in an **industry management procedure** and applied to routine activities. This reduces the burden of performing a qualitative or quantitative assessment to identify feasible and reasonable mitigation every time routine work on public infrastructure occurs. For example public authorities repairing, replacing or laying new pipes or cables under a road may excavate a trench in the road. The work method and equipment used for this task is likely to be similar on each occasion, meaning that:

- the sources of noise for each key task, and hence noise emissions, are well defined (perhaps initially by a quantitative assessment)
- based on this, options for feasible and reasonable noise management procedures can be identified
- the effectiveness of the feasible and reasonable mitigation package can be continually evaluated and, where necessary, refined
- community notification and complaint-handling procedures can be established, including, for example, notification of work scheduled outside the recommended standard hours.

Public authorities are encouraged to develop and use industry management procedures to lessen the burden of detailed assessment every time routine work is scheduled.

Public authorities undertaking work on public infrastructure are regulated by the EPA. It is important to note that even when an industry management procedure is used, the EPA may take regulatory action if an activity is carried on in an 'environmentally unsatisfactory manner'. For example, it may issue a prevention notice under the POEO Act.

Industry management procedures should therefore only be used in circumstances where they will effectively manage noise impacts from the routine activity under consideration.

Where industry management procedures are prepared (and reviewed), they should consider the advice in this guideline, particularly with regards to selecting and justifying the feasible and reasonable mitigation.

6.1. When is it appropriate to use industry management procedures?

An industry management procedure includes feasible and reasonable work practices that will effectively manage noise impacts from work on public infrastructure undertaken by prescribed determining authorities. It should be applied where:

- the routine activity is well understood in terms of the work procedures and equipment required to complete a task
- feasible and reasonable mitigation to manage noise impacts from the specific activities and equipment have been identified
- procedures are in place to implement feasible and reasonable mitigation.

Applying the mitigation within an industry management procedure does not necessarily mean that noise will not be heard or that there will be no impact. Rather, as long as the industry management procedure has identified specific (feasible and reasonable) work procedures to manage noise impacts, it will be consistent with the objectives of this guideline.

It should not be used where the proposed work activities will vary significantly from those described in the industry management procedure, for example where there is a need to use alternative work methods or where different equipment is needed. Where different work procedures are required, a qualitative or quantitative assessment (as appropriate) is recommended to identify feasible and reasonable mitigation.

An industry management procedure should not be used where utility works are part of an infrastructure project licenced by the EPA. In this instance, the conditions in the environment protection licence will apply.

6.2. Preparing industry management procedures

Industry management procedures should be developed with reference to the principles in this guideline and in Australian Standard 2436 by defining feasible and reasonable mitigation to manage noise impacts from routine activities.

When industry management procedures are prepared (or reviewed) a quantitative noise assessment is recommended to identify, and justify, the selection of feasible and reasonable mitigation. This should consider notification, particularly for routine activities that take place outside the recommended standard hours.

An industry management procedure should provide a detailed method statement on how noise impacts will be managed. It can describe specific mitigation packages for well-defined work activities and/or may provide an assessment procedure to help select an appropriate noise mitigation package.

When developing or reviewing industry management procedures, public authorities are encouraged to consult with the public and consider any comments. Making the industry management procedure publicly available will provide transparency and could lead to greater community support and acceptance. It is recommended that existing industry management procedures are kept up to date and re-evaluated to ensure work practices and procedures are feasible and reasonable, and remain effective and relevant.

Although it is not necessary to document how feasible and reasonable mitigation is selected and justified within an industry management procedure, it is recommended that public authorities retain this information, and make it available on request to the relevant consent or regulatory authority.

Industry management procedures differ from noise management plans and noise management strategies, both of which are discussed in **section 8**.

Part 3: Supporting information

This part provides supplementary information and advice on how manage construction noise. It also provides an overview of how noise is regulated in NSW. This part may be helpful when implementing the principles and objectives of the guideline as described in part 1 of this guideline.

7. Managing noise from construction

This guideline promotes a risk-based approach to assess and manage noise. It provides flexibility to choose feasible and reasonable mitigation to manage noise impacts to the greatest extent practicable, without placing undue restrictions on necessary construction and maintenance.

The advice in this section does not prescribe mitigation measures that must be applied to all projects, nor is it an exhaustive list of mitigation options. Proponents are expected to justify, and document, that the mitigation they have selected is the most feasible and reasonable.

Feasible and reasonable options should not be limited to engineering controls. Administrative controls, such as effective community engagement, should also be considered.

The sections below explain what ‘feasible’ and ‘reasonable’ mitigation means and advise on community engagement. Advice on noise control measures, including ‘good practice’ work procedures, is in **Appendix C**. Case studies giving examples of how the principles described within this guideline can be considered in various circumstances are in **Appendix D**.

Where a quantitative noise assessment is undertaken, work practices should be selected to achieve a specific reduction in construction noise levels, for example to achieve the relevant noise management levels set out in **Table 3**, **4** or **6** or any noise criteria specified in a consent, approval or licence condition.

Where work outside the recommended standard hours takes place, the relevant supplementary mitigation set out in **Table 5** must be considered, where appropriate (see the advice given in **section 5.4**). Consideration should also be given to the potential for sleep disturbance (see **section 5.7**).

Where an activity is likely to contain special audible characteristics (see **section 5.8.2**), feasible and reasonable alternative methods to remove (or minimise) the need for that activity should be considered, including using alternative work methods or equipment to eliminate the source of special audible characteristics. Advice on managing noise from reversing alarms and on work health and safety considerations are provided in **Appendix E**.

The effectiveness of noise management can be maximised by following the hierarchy of noise control described in **section 7.2**.

There should also be recognition of instances where work practices resulting in greater noise impacts are preferable or necessary, for example community preference for noisy work to be scheduled over a shorter duration or consideration of impacts on the wider community and not just those affected by noise.

Such circumstances should be considered on a case-by-case basis in consultation with the community and, where appropriate, with the consent authority or regulator.

7.1. Feasible and reasonable mitigation

After qualitatively or quantitatively assessing the noise impact, feasible and reasonable work practices should be identified:

- **Feasible** means a mitigation measure that can be engineered and is practical to build and/or implement, given project constraints, such as safety, maintenance and reliability requirements.
- **Reasonable** means measures that involves judging whether the overall noise benefits from a feasible option outweigh the overall adverse social, economic and environmental effects.

7.1.1. Feasible

When determining whether a mitigation measure or work practice is feasible, consider engineering and safety constraints rather than the cost-benefit of noise mitigation; the latter is more appropriately assessed under the reasonableness test.

Implementing noise mitigation at the source is the preferred method as it reduces the impact on the surrounding area. Control of noise in the path (between the source and receiver) or mitigation at the receiver usually requires measures to block transmission of noise, such as barriers or architectural treatments to building facades. As the benefit from these measures only applies to a limited area, they should only be considered after exhausting all feasible options to control noise at the source.

7.1.2. Reasonable

Selecting reasonable measures from those that are feasible involves judging whether the overall noise benefits outweigh the overall adverse social and environmental effects, including cost. Consideration should be given to the following factors:

- likely noise impact, including
  - existing and future noise levels and projected changes in noise levels
  - the number of people likely to be affected
  - the duration and time period when work will affect noise sensitive receivers
  - any noise criteria specified in licences, consents or conditions
- noise mitigation benefits, including
  - the cumulative noise reduction from the proposed work practices or noise abatement measures
  - the likelihood of the work practices or noise abatement measures to reduce noise during construction, and preferably also the operational stage of the project
  - consideration of the total number of noise sensitive receivers benefiting from noise mitigation
- effectiveness and cost-benefit of noise mitigation, including
  - total cost of mitigation measures, considering the physical attributes of the site, such as topography, and the financial cost given the expected benefit
  - noise mitigation costs compared with total project costs, allowing for capital and maintenance
  - impact of disruption to essential transport and utility networks, such as roads, railways, water, gas and electricity supply
  - risk to worker safety, including during live traffic (road or rail) conditions
- community views, including

- engagement on the aesthetics, such as visual impact of barriers, and any other impact associated with work practices and abatement measures
- preferences for work scheduling and respite periods for work outside the recommended standard hours
- which practices or measures have support from the affected community.

7.1.3. Justifying the selection of feasible and reasonable mitigation

The proponent should demonstrate that the selected mitigation is feasible and reasonable. This should be documented, such as within an EIA, to provide transparency to the community and allow the consent authority or regulator to consider the project on its merit when drafting conditions of consent or licence. Proponents should ensure that any reasonable and feasible mitigation is clearly justified as being commensurate to manage the risk of noise impacts on the community.

The consent authority or regulator may compare the proposed feasible and reasonable work practices against those applied to similar projects. Where appropriate, the consent authority or regulator may request additional information.

It may also require additional work practices that it considers feasible and reasonable, particularly where the proponent fails to demonstrate that noise impacts have been adequately evaluated.

An example template is provided in **Table 7** to assist proponents demonstrate and justify the selection of feasible and reasonable mitigation. Proponents do not need to use this template, but regardless of the method adopted, sufficient and clear supporting evidence must be provided to justify the selection of mitigation. This may include, where appropriate, reasons why specific mitigation options are not considered feasible and/or reasonable.

As more detail on the project becomes available following the environmental assessment stage and after project approval, it may be necessary to refine the identification of feasible and reasonable mitigation.

Table 7 Example template for demonstrating and justifying the selection of feasible and reasonable mitigation

Mitigation option	Feasible mitigation test	Reasonable mitigation test	Justification for adopting or disregarding this option
Mitigation at the source: option 1 option 2 etc.	Comment whether the option under consideration is feasible.	Comment whether the option under consideration is reasonable.	Provide details why the option under consideration will be adopted or disregarded. Consider: • the likely noise impacts with and without the mitigation option • the noise mitigation benefits and comparative benefits compared to other options • the cost effectiveness of noise mitigation • engineering feasibility • community views (or likely views) • experience using the proposed option on other projects.
Mitigation in the transmission path to the receiver: option 1 option 2 etc.	As above	As above	As above

Mitigation at the receiver: option 1 option 2 etc.	As above	As above	As above

7.2. Noise control engineering

Noise control engineering involves good systematic planning, management and knowledge of acoustic principles and may include the following steps:

1. Define the problem by identifying and ranking the most significant sources of noise and their cumulative impact. Cumulative noise levels from concurrent construction activities for all key work phases or tasks should be determined at the most affected noise sensitive receivers.
2. Identify feasible and reasonable mitigation options. It may be necessary to use a combination of work practices, such as alternative work methods or equipment, administrative controls and physical mitigation measures (for example enclosures or barriers).
3. In the case of a quantitative assessment, identify the noise level that can be met by implementing feasible and reasonable mitigation and compare this to the noise management levels set out in **tables 3**, **4** or **6**, as appropriate. Consider also sleep disturbance for work scheduled outside the recommended standard hours (see **section 5.7**).
4. Evaluate the effectiveness of the selected feasible and reasonable mitigation measures and, where necessary, amend or implement additional mitigation to achieve the desired outcome. Where residual noise impacts are expected, these should be reported.

When evaluating noise mitigation options, the proponent should prioritise feasible and reasonable mitigation using the following hierarchy of noise control:

5. **noise control at the source**, for example removal of the noise source or substitution with a quieter work method
6. **noise control in the transmission path**, for example use of mobile noise barriers or an acoustic enclosure around static equipment
7. **noise control at the receiver**, for example temporary accommodation or architectural treatment to a sensitive receiver.

The options are ordered from the most to least desirable, effective and beneficial.

The work practices described in this section and in **Appendix C** are not mandatory, but are provided as examples of good practice. Proponents are encouraged to identify innovative work practices to minimise noise impacts.

7.2.1. Trials

The impact of an activity can be evaluated through trials, such as a controlled test over a limited time period. This may be necessary where, for example, a new work method or equipment is proposed and its likely noise impact is unknown.

Feasible and reasonable mitigation must be adopted to manage potential noise impacts from the trial, which, where possible, should be undertaken at a less sensitive location and/or time. If appropriate, consult with the community before and after the trial to gauge response to the activity being trialled.

7.3. Management of noise from major infrastructure construction

Large scale infrastructure construction projects, such as motorways and railways, have the potential to significantly impact on communities. The construction of large infrastructure projects can take a long time to complete (sometimes 5 years or more),with significant periods of construction taking place outside the recommended standard hours, and often over the duration of

the project. This is because construction activity on major infrastructure project can impact the operation of existing roads and railways and utilities, and must be scheduled to minimise these impacts and for safety reasons.

This can result in significant disruption and noise impacts on the community, particularly when night-time and weekend work is frequent and ongoing and involves particularly noisy activities, such as jackhammering, non-invasive digging (vacuum excavation) and concrete and road sawing.

Proponents need to ensure that the management of noise impacts are viewed holistically, factoring in the duration of the project and the likely extent of out-of-hours work over the project's lifetime, and not only focusing on the management of impacts from each isolated night-work event.

Proponents should place themselves in the shoes of their neighbours, undertaking routine assessment of their impacts on surrounding communities, and adapt mitigation practices accordingly.

7.3.1. Work scheduling and community consultation

One of the most effective ways to manage noise impacts, particularly those from large infrastructure construction projects with ongoing out-of-hours works, is to engage and consult with the community during work scheduling. Advice on effective community consultation is provided in **section 7.4**.

Where possible, impacted communities should be given the opportunity to express preferences for when and how out-of-hours works are undertaken, including the scheduling of any respite periods. Proponents should ensure that the quantum of out-of-hours works for a reasonable timeframe is determined and provided to the community to gauge their preferences as part of an ongoing consultation process.

The implementation of meaningful community consultation to manage noise (and disruption) from large-scale infrastructure construction is essential for establishing credibility and building trust and respect between the proponent and the community in which they operate. Its importance should not be underestimated.

Providing impacted receivers the opportunity to express preferences for when works may be undertaken empowers them to manage the impact of night-time and weekend works on their lives, which may result in less disturbance and overall impact.

7.4. Community relations

Noise control engineering solutions – supplemented with effective community relations through notification, engagement or consultation – can lead to greater understanding and acceptance of construction noise. Proponents are encouraged to provide accurate information on the proposed work activities and not understate the likely impact.

In broad terms, community engagement is generally taken to mean interacting with the community. This can be in the form of:

- one-way communication through **notification** of upcoming works with details of what this will entail (such as its purpose and duration and who is responsible for undertaking the work)
- **engagement** with the community by notifying about, and encouraging feedback on, proposed activities (such as notifying the community of proposed works and seeking community views via email, a project website, social media, telephone etc., and considering these views to manage noise impacts)
- **consultation**, which means actively engaging with, and considering the views of, the community and the appropriate regulatory authority to manage potential noise impacts. The purpose of consultation is to reflect community views on feasible and reasonable mitigation, where appropriate.

Specialist advice on community and stakeholder engagement is provided by the International Association for Public Participation (IAP2, 2015) in the *Quality Assurance Standard for Community and Stakeholder Engagement*[5]. The IAP2 Public Participation Spectrum can be used to characterise public participation in any community engagement program[6]. Advice is also provided in Australian Standard 2436.

7.4.1. Purpose of community relations

The aim of community relations in the context of construction noise management is to establish good working relationships between the project proponent, the community and other stakeholders. This can include:

- communicating to the broader community any relevant information on the project and its environmental performance
- providing the community with feedback on the project's environmental performance, discuss community concerns and identify opportunities for the resolution of complaints
- work cooperatively towards beneficial outcomes for the project, immediate neighbours and the local and regional community and, where appropriate, consider the views of the community to effectively manage construction noise impacts.

These actions are not appropriate in all circumstances and should be considered on a case-by-case basis.

The following are considered good practice and should be applied commensurate to the risk of construction noise impact:

- Seek community views at the environmental assessment stage, following project approval and during the work.
- Notify of construction works. Include details of why the work is taking place, what work activities are involved, the hours of work and any information on particularly noisy or disruptive aspects, such as work scheduled outside the recommended standard hours or large deliveries. Notifications can include, but are not limited to
    - letterbox drops conducted a reasonable period before work begins
    - community briefings
    - newsletters (including email)
    - a project website and social media channels
    - individual briefings, phone calls or notifications, such as SMS messages.

Keep the community informed of progress, including delays or amendments to the scheduled program of works. Also implement a mechanism to manage and address complaints, including timely feedback, where required, for significant projects.

It is important not to understate the likely impact of work, particularly with respect to the duration and hours of work, and the type of work activities. Understatement could lead to lost credibility and trust with the community.

Depending on the scale of the project, it may be appropriate to appoint a dedicated community liaison officer and/or form a community liaison committee.

5. Search for *Quality Assurance Standard for Community and Stakeholder Engagement* on the IAP2 website (www.iap2.org.au).

6. A written request for approval must be submitted to the IAP2 to reproduce the Public Participation Spectrum where this is used in any public document.

7.4.2. Community consultation plans

The consent authority or regulator may require a community consultation plan for major projects. This can help where potentially noisy work outside the recommended standard hours is proposed, and/or where there may be periods of extended work producing high levels of noise in proximity to sensitive receivers.

The community consultation plan may include:

- establishment of one or more community liaison groups or community forums
- procedures for face-to-face consultation between the proponent and affected parties
- procedures for notifying residents and occupants of other sensitive land uses of forthcoming works likely to affect their noise amenity
- procedures for complaints, including maintaining a complaint register on site, and making this available to the consent authority or regulator for audit
- dispute resolution procedures.

7.4.3. Community liaison groups and forums

For major projects and in some circumstances, a community liaison group or forum established with an independent chair can be an effective way to engage with the community.

Community consultation groups or forums can provide input on how environmental impacts should be managed. The proponent should consider the issues raised by liaison groups or forums, provide a timely response and amend the project noise management plan as appropriate.

In some instances, the proponent may consider making a dedicated community liaison officer available to the affected community to:

- provide a designated point of contact
- attend local group or forum meetings
- manage and implement any community consultation obligations
- resolve complaints (to the greatest extent practicable).

The proponent should bear the costs of employing a community liaison representative and establishment and ongoing function of groups or forums, provided this is reasonable and commensurate with the risk of the project.

7.4.4. Negotiated agreements

Where a proponent holds an environment protection licence for the construction of major projects (see **section 8**), they may negotiate a community agreement for work scheduled outside the recommended standard hours under their licence conditions. Reaching this agreement can allow for work that would otherwise be prohibited or restricted under an environment protection licence. The option of a negotiated agreement between the proponent, community and consent authority is most suitable when:

- there is only a small number of affected sensitive receivers
- significant residual noise impacts are predicted after all feasible and reasonable mitigation has been identified.

Where large numbers of sensitive receivers are likely to be affected (for example during linear projects, such as construction of a road or railway) negotiated agreements may not be appropriate due to the likely diversity of community views and costs. However, negotiated agreements may be appropriate for certain aspects of these projects, such as when certain work phases are undertaken in defined geographical locations.

Where negotiated agreements are not feasible, the proponent may be required to prepare management plans, establish community liaison groups or forums and engage a community liaison representative, where appropriate, to enable ongoing management of noise issues.

Agreements should be prepared and implemented with due regard to the advice in this guideline, Australian Standard 2436 and the NPfI.

7.4.5. Investigating and managing complaints

The proponent should proactively manage noise in accordance with relevant consent or licence conditions. If complaints are received, proponents should manage noise impacts and community expectations by following these steps:

8. **Identify the source of the complaint**, for example deliveries, movement of material or use of power tools. Where necessary, validate by noise measurements.
9. Determine the characteristics of the noise. Consider the following questions
    a. Is the noise from the source loud either in an absolute sense or relative to other noise sources in the area?
    b. Does the noise include any tones or impulses (see **section 5.8.2**)?
    c. Does the noise occur during sensitive time periods, such as during evenings, at night-time or on weekends?
10. **Feasible and reasonable mitigation.** Determine what existing mitigation measures are in place to manage the source of the complaint and, where necessary, investigate and implement additional mitigation.
11. **Engage with the complainant/community.** Provide feedback on the cause of the noise and the actions taken.

7.4.6. Noise management plans

The conditions of consent for a project may require an environmental management plan (EMP). The consent authority may also require a noise management plan be prepared to set out the actions and processes to manage construction noise in accordance with the commitments made in a noise impact assessment and/or a consent condition. Further advice on noise management plans is provided in **section 8**.

A copy of the noise management plan should be kept on site and, as a minimum, should:

- identify nearby residences and other sensitive land uses
- state the approved hours of work and what work will be undertaken, and when
- describe what work practices will be applied to minimise noise, including any noise criteria (if applicable)
- explain the complaints handling process.

7.5. Recommended mitigation measures and work practices

Appendix C provides a non-exhaustive list of mitigation measures to manage the impacts of construction noise. These should be considered as examples of good practice rather than as comprehensive advice on noise control, but may be a useful reference when evaluating feasible and reasonable mitigation options.

The proponent should also consider other work practices and methods to manage noise impacts, including the advice in Australian Standard 2436.

8. Regulation of construction noise

The EP&A Act and the POEO Act form the framework for managing noise from construction in NSW. These Acts require authorities to examine and consider matters affecting the environment when making decisions about development and activities.

For larger construction projects, an assessment of noise impacts may be required as part of an EIA under the EP&A Act or a noise impact assessment under the POEO Act. This guideline provides advice on key considerations to prepare construction noise assessment for the relevant consent or planning authority. Specific requirements should be sought from this authority, as appropriate.

Construction noise can be formally regulated via different avenues depending on the development type:

- consent or approval conditions issued by a consent authority as part of the development approval process under the EP&A Act
- licence conditions issued by the EPA under the POEO Act
- requirements of a relevant State Environment Planning Policy
- conditions in other instruments under the POEO Act (such as a prevention notice or noise control notice) issued by the relevant regulator (such as the EPA or local council)
- offensive noise provisions under the POEO Act[7].

The role of 'prescribed determining authorities' is discussed in **section 8.2**.

The noise management levels described in section 5 are not intended to be applied directly as licence or consent conditions. They guide the need for, and selection of, feasible and reasonable work practices to reduce noise to (or below) the relevant noise management level. Conditions in licences or consents can, for example:

- define approved hours of work, including respite periods or other requirements for work outside the recommended standard hours
- set out specific feasible and reasonable mitigation measures, including administrative controls
- require noise monitoring, and periodic reporting of the outcomes
- include actions that must be taken to manage any exceedances, including reporting to the relevant regulatory or consent authority.

Where both the proponent and the consent or regulatory authority have sufficient confidence that noise levels (such as those described in an EIA) can be met, then the noise management levels set out in tables 3, 4 or 6 could be included as conditions in licences or consents, as appropriate.

In an emergency, where the health and safety of people or property or the environment is at risk, significant noise impacts, including exceeding the relevant noise management levels, may occur.

7. Refer to the *Noise Guide for Local Government* (EPA 2013)

The proponent should notify the consent authority or regulator of any likely exceedances or breaches of relevant conditions of consent, approvals or licences as soon as reasonably practicable and adopt all feasible and reasonable mitigation available to minimise disruption.

In some instances, an approval, consent or licence from more than one consent or regulatory authority may be required. Proponents should engage with each to ensure that conditions within these approvals, consents or licence conditions are, as far as practicable, consistent and complementary.

8.1. Managing noise impacts through the planning approval process

Construction noise impacts are most effectively managed when the project is being designed and planning approval is being sought.

Under development approval provisions of the EP&A Act, noise from construction activities can be assessed and regulated through requirements set in development consents by the Department of Planning, Industry and Environment or local council. The type of EIA that must be lodged with the application will differ depending on the likely impacts of the development. The proponent should contact the consent authority as early as possible to ascertain any specific requirements.

For major projects requiring an Environmental Impact Statement (EIS), the EP&A Act requires that the Department issues formal assessment requirements, which are known as the Secretary's Environmental Assessment Requirements (SEARs). When preparing SEARs, the Department must consult with other agencies that have a role in regulating the project.

SEARs can require preparation of a noise impact assessment in accordance with defined noise policies and guidelines and can specify noise management actions, such as a noise management plan. This guideline may be referenced within SEARs for the assessment of construction noise.

The assessment of noise impacts reported within the EIS can be described quantitatively or qualitatively. A quantitative noise assessment will likely be required for major construction proposals under the EP&A Act, or scheduled development works for which a licence is required to carry out activities identified in Schedule 1 of the POEO Act.

The noise assessment completed as part of an EIS should be based on the reasonable worst case noise generating work activities and should typically include the following information:

- a description of the proposed works and construction methods and identification of residences and other sensitive land uses likely to be impacted by the works
- a description of the proposed duration of noise at sensitive land uses from each phase of the works
- an estimation of the likely work required outside the recommended standard hours necessary to complete the project. This should include an estimate of the total duration of out-of-hours works over the project duration, including the number of evening, night and weekend periods and consecutive periods of out-of-hours works. If detailed information is not available, this estimate could be based on experience from similar projects
- the expected noise impacts at the most noise-exposed residences and other sensitive land uses, including for work scheduled outside the recommended standard hours. Where a quantitative method is used, the predicted noise levels should be presented
- a discussion of community engagement, if any, including any amendments to noise management measures in response to submissions and representations
- a description of feasible and reasonable work practices and mitigation measures to manage noise and any residual noise impacts
- a clear justification for the construction methods selected, particularly for work scheduled outside the recommended standard hours.

At the post approval stage, best practice environmental management requires consideration of:

- implementing the project's conditions of approval or consent and the commitments made during the EIA process
- reviewing the information on project environmental performance against the conditions and commitments, such as noise monitoring
- ensuring compliance with environmental legislation and statutory requirements
- proactive managing of environmental risks.

There are offences under the EP&A Act for non-compliance with the conditions of consent.

Early and ongoing community engagement is a critical component of management of construction noise impacts. When a construction noise management plan is drafted, it should be made public. This can help the affected community to understand the actions being taken to manage noise impacts and what redress is available, such as a complaints management procedure.

Table 8 provides a summary of the noise management documentation that may be required at the pre- and post-approval stages of the planning process.

Table 8 Summary of noise management documentation at the pre- and post-approval stages of the planning process

Planning approval stage	Type and function of document	Example of information provided within the document
Pre-approval	**EIA documentation** Provides a conceptual description of the project, the likely noise impacts, and identification of feasible and reasonable work practices to minimise noise impacts. Addresses the requirements of any regulatory requirement set out by the relevant consent authority or regulator, including the SEARs issued by the Department.	Description of proposed works, including duration Identification of nearby residences and other sensitive land uses Assessment of likely noise impacts Conceptual (or detailed, if available) description and justification of feasible and reasonable mitigation Changes made to the proposal in response to submissions or representations.
Post-approval	**Construction noise management plan** Provides a detailed description of the methods that will be implemented for the construction phase of the whole project to minimise noise impacts. This may include a strategy to manage work outside the recommended standard hours, and include any statutory requirements set out within licences, consents or conditions.	Identification of nearby residences and other sensitive land uses Assessment of expected noise impacts Detailed examination of feasible and reasonable work practices that will be implemented to minimise noise impacts Specific protocols to manage noise outside the recommended standard hours of work

Planning approval stage	Type and function of document	Example of information provided within the document
Post-approval	**Construction method statement** Provides a detailed description of the methods to be implemented to minimise a range of impacts from the works. Although noise is often a key issue, it is not the only consideration.	Strategies to promptly acknowledge and resolve noise complaints Details of performance evaluation procedures, such as noise monitoring or auditing of work practices and equipment
Post-approval	**Community consultation plan** Provides a detailed description of the methods that will be used to liaise with affected community members. Outlines how to respond to noise-related complaints and disputes	Procedures for community engagement, including notifying nearby residents of forthcoming works likely to result in noise impacts. Reference to relevant licence and consent conditions

Notes

The construction noise management plan, construction method statement and community consultation plan may be consolidated into a single document.

A construction noise strategy (see section 8.6) may be developed to consolidate and interpret noise assessment and management requirements through the pre- and post-approvals stages.

8.2. Prescribed determining authorities

For some work undertaken by public authorities on public infrastructure (such as construction and maintenance of transport, power and water infrastructure) the proponent may also be the 'determining authority' under Part 5 of the EP&A Act. Where this is the case, a consent, approval or licence from a separate regulatory authority may not be required.

Section 5.5(1) of the EP&A Act requires a determining authority to '…examine and take into account to the fullest extent possible all matters affecting or likely to affect the environment by reason of that activity'.

The terms 'determining authority' and 'activity' have specific meanings and are defined in section 5 of the EP&A Act: see the breakout box below.

In broad terms, a determining authority can assess and 'self-determine' activities it undertakes, including routine maintenance or construction, that are not likely to significantly affect the environment. In these circumstances, a consent, licence or approval from a regulatory authority, such as the Department, EPA or council will not be required. In some cases, routine work may already be covered by an existing licence under the POEO Act held by a public authority. Consents and development controls for certain activities are also exempt under the *State Environmental Planning Policy (Infrastructure)* 2007.

Where a public authority does not have an industry management procedure in place to manage noise from routine work on public infrastructure the principles in this guideline should be applied. **Section 6** discusses the role of industry management procedures.

The EPA is the appropriate regulatory authority for construction and maintenance carried out by a public authority and can take regulatory action, for example if an activity is carried out in an 'environmentally unsatisfactory manner'. This regulatory action can be taken regardless of whether public authorities carry out work in accordance with an industry management procedure.

EP&A Act: section 5.1
"… *activity* means:

a. the use of land, and

b. the subdivision of land, and

c. the erection of a building, and

d. the carrying out of a work, and

e. the demolition of a building or work, and

f. any other act, matter or thing referred to in section 3.14 that is prescribed by the regulations for the purposes of this definition,

but does not include:

g. any act, matter or thing for which development consent under Part 4 is required or has been obtained, or

h. any act, matter or thing that is prohibited under an environmental planning instrument, or

i. exempt development, or

j. development carried out in compliance with a development control order, or

k. any development of a class or description that is prescribed by the regulations for the purposes of this definition …

[d]etermining authority means a Minister or public authority and, in relation to any activity, means the Minister or public authority by or on whose behalf the activity is or is to be carried out or any Minister or public authority whose approval is required in order to enable the activity to be carried out."

8.3. Regulating projects through licences

The information in this part is specifically aimed at major construction projects regulated by the EPA. The EPA issues environment protection licences to authorise scheduled activities described under Schedule 1 of the POEO Act. All licence holders must:

- comply with the conditions of their licence
- prepare pollution incident response management plans
- publish and/or otherwise make available pollution monitoring data
- pay annual administrative fees and, in some cases, additional fees
- submit annual returns.

The EPA also issues environment protection licences for 'scheduled development works', where work is carried out to enable scheduled activities, under section 47 of the POEO Act.

The EPA will require proponents to use this guideline to assess construction noise impacts as part of an EIS or noise impact assessment. The EPA will consider appropriate licence conditions based on the outcome of these assessments. A range of actions and processes can be incorporated into licences to reduce noise impacts from construction activities.

Proponents are required to provide sufficient information to justify their selection of feasible and reasonable work practices. This will enable the EPA to include conditions within licences to reflect the risk of noise impact associated with the project.

Where insufficient information is provided, the EPA may place more stringent requirements within environment protection licences to protect the community from adverse construction noise impacts.

Where a construction activity will be licenced by the EPA, work outside the recommended hours is permissible where it can be demonstrated that construction noise will be less than RBL + 5dB (and where consideration is given to potential for sleep disturbance – see section 5.7). However, the proponent will need to justify why work is necessary outside the recommended hours, and measure noise to validate compliance.

8.4. Evaluating performance

A consent or licence may require the proponent to publish a compliance report at defined intervals. Evaluating performance and compliance involves:

- identifying the relevant consent and licence conditions, and determining compliance with these conditions (such as auditing noise levels from different activities, where appropriate)
- using the findings of the evaluation to improve environmental performance and decisions about work methods and associated impacts
- investigating noise complaints arising from the works.

Where there is a consent or licence, the consent authority or regulator can evaluate the performance and compliance of a project from information provided by the proponent and/or through independent monitoring and evaluation.

8.4.1 Evaluating performance for a qualitative assessment

Where noise management levels or limits are not prescribed in a consent or licence, the most appropriate method to evaluate performance is to examine whether the work practices described in a consent or licence are being applied.

Reference should also be made to any requirements specified in the project noise management plan (or other project commitments) and the examples of best practice outlined in **section 7** and **Appendix C**.

8.4.2 Evaluating performance for a quantitative assessment

Where a quantitative assessment has been undertaken, consents may specify noise criteria. Noise management levels or other noise criteria will likely require validation by measuring project noise levels to ensure that feasible and reasonable mitigation measures are effective.

Good practice methods to measure noise are provided in Australian Standard 2436 and in Australian Standard 1055: 2018 *Acoustics: description and measurement of environmental noise.*

Without specific requirements in a licence (or consent), a noise monitoring program should consider the scale of the project and the extent of expected noise impacts, including whether the:

- project is being undertaken at one or more locations, for example a linear project or a fixed worksite
- type of work activity

- time period when construction is scheduled
- proximity of work to noise sensitive receivers.

In some cases, permanent monitoring may be appropriate. In other cases, measurements over representative periods (typically 15-minute intervals) will be sufficient.

Noise monitoring programs should take into account different activities and work stages and the time when work takes place. Measurements should be undertaken at the most noise affected sensitive land uses when noise levels are likely to be the highest. If measurements are being taken in response to a complaint, the location should be representative of the complainant's location.

Noise monitoring results should be clearly reported and evaluated to improve performance. An environment protection licence may require publication of noise monitoring data. Where this is not the case, it is recommended that a summary of the results be published and made accessible.

8.4.3 Monitoring reports

A report by a proponent on project performance and compliance should include the following information:

- any consent and/or licence conditions (including any vibration and blasting conditions) or the relevant noise management objectives
- the type of monitoring conducted, such as for a certain project stage or following complaints
- a description of the measurement methodology, such as measurements in accordance with Australian Standard 1055 or Australian Standard 2436
- a description of the nearest affected residences and other sensitive land uses and, in the case of complaints, a description of the complainant's location and the nature of the complaint; for privacy reasons, it may be necessary to keep the complainant's details confidential so the complainant cannot be identified
- a map, plan or diagram showing the monitoring location and the noise generating work/s for each key work stage
- the name and relevant qualifications and/or professional memberships of the report author and monitoring personnel to demonstrate their competence
- the date, time and duration of monitoring, including the weather conditions
- a clear description of the construction activities taking place during all reported measurements
- the measurement results, including a comparison with the consent or licence conditions or relevant noise management objectives
- a statement outlining the project's compliance or non-compliance with the conditions or objectives
- where measured levels exceed relevant conditions or objectives, the reason for non-compliance should be stated, and strategies for minimising noise identified along with the actions to implement the mitigation.

8.5. The role of noise management plans

Consent conditions for a project may require an EMP, including a noise management plan. Proponents are encouraged to develop noise management plans as good practice. These typically include the key issues considered at the EIA stage, but in greater detail as more information and certainty on the project becomes available. Noise management plans can be used to set out:

- actions to explain how feasible and reasonable work practices will be implemented to manage noise
- actions to manage residual noise impacts
- procedures for community engagement, including complaint management

- actions to ensure compliance with specific requirements set out within a licence or consent.

Consent authorities may require the preparation of a noise management plan as a way to consolidate all project noise management requirements, planning and noise mitigation measures. They can be referenced to audit performance and demonstrate compliance with project noise requirements.

For activities regulated by the EPA, the development and implementation of noise management plans is encouraged as a tool to ensure that noise management requirements are met.

The EPA does not approve or endorse the contents of noise management plans.

8.6. The role of noise management strategies

Construction noise management strategies explain the overarching principles and strategies for managing noise for the different assessment stages of a project, including the EIS, approval, pre-construction and construction phases.

This guideline encourages the development of noise management strategies to consolidate and interpret noise assessment and management requirements over the different (pre- and post-approval) stages of a project.

Examples of construction noise management strategies are:

- Transport for NSW (TfNSW) *Construction Noise Strategy and Vibration Strategy* (April 2019). This applies to projects managed by TfNSW and provides '… practical guidance on how to minimise, to the fullest extent practicable, the impacts on the community from airborne noise, ground-borne noise and vibration generated during the construction of [TfNSW] projects through the application of all feasible and reasonable mitigation measures'.
- Roads and Maritime Services (RMS) *Construction Noise and Vibration Guideline* (August 2016). This applies to projects managed by the RMS and '… outlines the approach [RMS] takes to assessing and mitigating construction noise'.

Construction noise management strategies can describe procedures to assess noise impacts, and feasible and reasonable mitigation for a range of activities and situations. They differ from industry management procedures, which provide tailored mitigation packages for specific activities.

Noise management strategies are particularly useful for community engagement because they describe how noise will be managed, including any residual noise impacts.

Construction noise management strategies can be applied to manage impacts from certain industry sectors or program delivery, such as the TfNSW or RMS examples above. They can also be required or applied for a specific project, for example the Sydney Metro project (see *Chatswood to Sydenham Construction Noise and Vibration Strategy*, August 2016).

A noise management strategy differs from a noise management plan, which is typically required as part of a project approval and documents specific management actions to comply with the requirements of a development consent. Where construction noise management strategies are prepared, consider the principles in this guideline and in Australian Standard 2436.

Appendix A: Extractive industries, coal seam gas and rehabilitation sites

This guideline applies when assessing and managing noise from construction associated with mining and extractive industries, coal seam gas exploration and rehabilitation sites. The *Noise Policy for Industry* (NPfI) applies when assessing noise from the operational phases of these industries.

In situations where it is difficult to delineate between the construction and operational phases, determining whether the guideline or the NPfI applies can be a problem.

A1. Assessing construction noise from mining and other extractive industries

Delineation between an initial construction phase and subsequent operational phase of mining and extractive industries can be difficult as there may be little difference in the activity and the noise levels.

For example, establishing haul roads to access new coal seams is considered an operational activity necessary to enable mining. This is similar to the method of construction used to prepare an access road to a mine site. Both are likely to require heavy earth moving machinery and similar work practices. However, the former should be assessed as industrial noise (using the NPfI) because it is part of the operation of the mine; whereas the latter should be assessed as construction noise because it is a temporary activity to facilitate mine operation.

The scenario described in the above example may not be applicable in all circumstances. Delineating between operation and construction activities will depend on a number of factors, and not just whether the activity is temporary. Identifying the appropriate assessment methodology on a case-by-case basis could lead to unintended or inconsistent outcomes.

To ensure the appropriate assessment and noise management procedures are applied consistently, all activities associated with mines and quarries should be assessed as though they are part of the project's operations.

This should apply except where:

- 'defined activities' (identified below) occur and are clearly being undertaken for construction
- after all feasible and reasonable mitigation, the project noise trigger level (PNTL) (defined by the NPfI) cannot be met, in which case the noise management levels (in **section 5**) and the recommended standard hours for construction work (in **Table 1**) will apply.

Where the work is predicted to comply with the PNTL or any relevant consent or licence requirements after all feasible and reasonable mitigation is applied, then no change in requirements is necessary.

The 'defined activities' associated with mining and extractive industries that may be assessed as construction noise include the construction of the following infrastructure:

- tailings dam or sediment basin
- water management structure
- stockpile pad or other pad
- ventilation shaft or similar
- service or monitoring bore
- mine portal

- buildings and structures
- processing plant
- conveyor or loading facilities
- other ancillary infrastructure
- noise barriers and mounds
- roads, including dispatch and access roads but excluding haul roads
- rail infrastructure, except where the provisions in Appendix 3 of the *Rail Infrastructure Noise Guideline* (EPA 2013) applies

This list is not intended to be exhaustive; additional activities may be assessed as construction activities as long as they fall within the meaning of 'construction of infrastructure necessary to support an operational activity' and have a specific outcome or endpoint that is clearly differentiated from an operational activity. The proponent should consider the following circumstances as a guide when delineating between construction and operational activities:

- Is the activity necessary to support or facilitate the commencement of an operational activity?
- Is the activity temporary where purpose-built noise mitigation measures may not be feasible or reasonable?

If the answer to either question is 'yes', then it is likely to be defined as a construction activity.

Where the proponent is assessing noise from the mining and extractive industry, the proponent will need to assess whether the activity producing the noise is a construction or operational activity. The relevant consent or regulatory authority will need the proponent to clearly set out their reasoning for assessing the activity as construction or operational.

Where an activity is assessed as operational, it may take place during day, evening and night periods providing it can meet the relevant PNTL. Where the activity is assessed as construction, it is generally limited to the recommended standard hours for construction work unless there are exceptional circumstances (such as community preference).

A1.1. Relationship between construction noise from mining and extractive industries and the NSW Voluntary Land Acquisition and Mitigation Policy

The government's policy on the use of voluntary mitigation and land acquisition to address noise impacts from state significant extractive industry developments is set out in the *Voluntary Land Acquisition and Mitigation Policy for State Significant Mining, Petroleum and Extractive Developments* (*NSW Government Gazette* No. 126, December 2015).

The policy does not apply to construction noise, but where noise from extractive industries is assessed as operational noise rather than construction noise, the provisions of the policy will apply.

A2. Assessing construction noise from coal seam gas activities

Exploration and operational activities associated with coal seam gas may involve work over 24-hour periods, such as exploratory drilling and generator operation. Coal seam gas related activities should be assessed as part of the project's operations except where:

- 'defined activities' (those identified above) occur and are clearly being undertaken for construction

- after all feasible and reasonable mitigation, the PNTL or consent (or licence) noise requirements cannot be met; in that case the noise management levels (in **section 5**) and the recommended standard hours for construction work (in **Table 1**) will apply.

Where the work is predicted to comply with the PNTL or any relevant consent or licence requirements after all feasible and reasonable mitigation is applied, no change in requirements is necessary.

A3. Assessing construction noise from rehabilitation sites

There may be circumstances where work is required to rehabilitate sites. This means sites such as:

- former industrial sites, including remediation of contaminated land
- rehabilitation and infill of disused mines, quarries and landfills
- one that is no longer operating in accordance with its previous use and/or has changed ownership and/or has become the responsibility of a third party, such as local council or state government.

Rehabilitation of these sites should be considered as construction work and should be limited to the recommended standard hours only.

Some supporting activities, such as dewatering or use of pumps and generators, may be necessary over 24-hour periods. These supporting activities should be considered as operational unless the PNTL cannot be met after all feasible and reasonable mitigation has been considered. In such cases, the noise management levels and the recommended standard hours for construction work should apply.

Appendix B: Equipment noise levels

Equipment noise levels can be described in two ways:

- sound power level – Lw (or sometimes SWL) or
- sound pressure level at a given distance – Lp (or sometimes SPL).

The sound power level is the intrinsic noise output of equipment, and does not depend on distance or orientation of the machine. There are Australian and international standards that define methods for determining the sound power level of a machine, such as the Australian Standard 1217 series.

The sound pressure level is the noise level at a given distance. When comparing the sound pressure level of equipment, a reference distance is required to make a meaningful comparison. Measurements of an equipment's sound pressure level must ensure that other sources of noise are excluded, and any variations associated with orientation of the noise source are considered.

Because of this, sound power level data is often preferred to sound pressure level as it is easier to compare noise levels without having to account for distance or orientation.

When selecting equipment, the proponent should contact manufacturers or suppliers and ask for the noise level data of a range of suitable equipment. The proponent may also wish to compare the noise level data of similar equipment from different manufacturers or suppliers. There are broadly four responses to a request for equipment noise level data:

- sound power level, for example Lw 115dB(A)
- sound pressure level for a given distance, for example Lp 82dB(A) at 7.5m
- sound pressure level without specifying the distance, for example Lp 78dB(A)
- no noise level data available.

The first two responses are useful to compare the noise output of suitable equipment. The last two responses are not useful, and in this case the proponent should either ask the manufacturer or supplier to provide more information (such as the distance at which the sound pressure level was measured) or obtain noise level data from another manufacturer or supplier.

The noise output of equipment may vary depending on operating conditions, such as idle or under load. Where possible, noise levels should be compared for similar operating conditions. When undertaking on-site compliance checks, the proponent should obtain exact noise level data from the equipment manufacturer or supplier.

There are several published databases of construction equipment noise levels:

- the UK's Department of Environment, Food and Rural Affairs (DEFRA) published L_{Aeq} and L_{Amax} sound pressure levels in 2005 (*Update of Noise Database for Prediction of Noise on Construction and Open Sites*, DEFRA 2005)
- the US Federal Highway Administration published maximum (L_{max}) sound pressure levels for a range of construction equipment in the *Construction Noise Handbook* (US Department of Transportation, Federal Highway Administration, August 2006)
- the European Commission (2000) issued Directive 2000/14/EC (amended by Directive 2005/88/EC) on equipment sound power levels
- the South Australian Government's *Management of Noise and Vibration: Construction and Maintenance Activities – Environmental Instruction 21.7* (Government of South Australia, Department of Planning, Transport and Infrastructure, March 2017).

Proponents should reference and justify any equipment noise levels sourced from any database, including those listed above.

Appendix C: Strategies to manage noise

The following noise management strategies should be considered and implemented on a case-by-case basis. This is a non-exhaustive list and other methods to manage noise may be appropriate.

C1. Universal work practices: noise mitigation options

Common complaints about construction noise can be minimised by at all times applying the following universal work practices:

- Train workers and contractors on the best practice use of equipment and work methods in order to minimise noise.
- Ensure workers and contractors are aware of the noise management requirements in any consents, approvals or licences, for example through site inductions and 'toolbox talks' and by providing a summary of relevant project requirements for quick reference (such as on a noticeboard).
- Include appropriate clauses and conditions within tenders, employment contracts, subcontractor agreements and work method statements that require all workers and contractors to observe (noise management) directions from the site manager.
- Periodically check the site, nearby residences and other sensitive land uses to proactively identify noise issues and feasible and reasonable mitigation.
- Avoid the use of radios, stereos, open two-way radios and public address systems outdoors where they are likely to be audible at sensitive receivers beyond the site boundary.
- Avoid shouting, talking loudly, slamming vehicle doors or making any other unnecessary noise.
- Inform truck drivers of designated vehicle routes, parking locations, acceptable delivery hours or other relevant practices, such as minimising use of engine brakes and avoiding engine idling.
- Avoid the use of equipment that generates impulsive, tonal or irregular noise.
- Minimise or avoid the need for reversing or movement alarms. Advice is provided in **Appendix E**.
- Avoid unnecessary dropping of materials from a height and metal-to-metal contact on equipment.
- Avoid mobile equipment clustering near residences and other sensitive land uses.

The following work practices are relevant at all times, but have particular relevance for managing noise when work is scheduled outside the recommended standard hours:

- Where appropriate, consider prefabricating items off site.
- Where appropriate, consider the use of 'quiet' communication methods, such as personal radio headsets.
- Where practicable, restrict deliveries to the daytime. Where deliveries must be made during the evening or night-time (or on weekends or public holidays), schedule vehicle movements to avoid residential streets, if possible.
- Offer periods of respite to the community where unavoidable maximum noise level events are anticipated. In some circumstances, offers of alternative accommodation or temporary relocation may be appropriate (see **section 5**).
- Ensure procedures are in place to address noise at unattended sites, for example unattended equipment operating over 24 hours and security alarms. The use of guard dogs is discouraged where worksites are adjacent to residential areas.

C2. Consultation and notification: noise mitigation options

The following should be considered in the context of the advice in **sections 5** and **7** if supplementary mitigation is required for work scheduled outside the recommended standard hours.

Adverse community reaction to construction noise can occur even with all feasible and reasonable mitigation. This can be intensified if there are poor (or non-existent) community relations.

Effective consultation and notification is likely to lead to greater community acceptance of disruption and disturbance arising from the work. The proponent should ensure those affected by the work are informed about the project, including:

- when the work will take place and its expected duration
- the likely noise impact of the work without understating its effect
- any work activities or equipment that will be particularly noisy or noticeable
- mitigation measures to manage noise impacts, including complaints handling procedures.

In some instances, the community may express preference for noisier work over a shorter duration instead of relatively quieter work over a longer duration. This should be evaluated on a case-by-case basis in consultation with the community and consent authority or regulator.

Any notification should be provided before and during construction through an appropriate method, within reasonable timeframes and commensurate to the risk of noise impact. Where appropriate, information should also be provided on a site information board displayed in a prominent location with the name and contact details of the organisation responsible for the site. Include:

- after-hours contact details, including a contact phone number and email address for enquiries and complaints
- basic information on the conditions of approval, such as the hours of work
- contact details for the consent authority responsible for regulating environmental issues, such as the local council or the EPA Environment Line.

For larger projects, consider a project website and/or provision of a regular newsletter. In some instances, a community liaison officer and/or community liaison group may be appropriate.

A complaints procedure can be a helpful tool to manage community concerns and may be required as part of a project consent, approval or licence. Proponents should:

- provide a prompt response to complaints
- ensure complaint handling staff have a good knowledge of the project and its environmental and noise management procedures
- provide feedback to the complainant on the actions taken to investigate and address noise problems
- maintain a register of complaints to include
    - the name of the person making the complaint
    - the date and time the complaint was made
    - a description of the complaint
    - action taken to respond to and address the complaint.

Where appropriate, or required, it may be necessary to notify the consent authority or regulator when a complaint is received.

C3. Plant and equipment: noise mitigation options

Controlling noise at the source is the most effective way to manage noise. Specific mitigation strategies are discussed below.

C3.1. Adopt quiet work methods

Where feasible and reasonable, implement quiet work methods. Examples include alternatives to:

- rock breaking (such as hydraulic splitters, hydraulic jaw crushers, chemical rock and concrete splitting, and controlled blasting, for example penetrating cone fracture)
- percussive piling (such as rotary bored or vibratory piling)
- diesel and petrol engines and pneumatic units (such as hydraulic or electric-controlled units). Where there is no electricity supply, consider an electrical generator away from residences or within an acoustic enclosure.

C3.2. Use quiet equipment

Where practicable, identify and use equipment with the lowest noise emissions in its class to complete a specific task. See **Appendix B** for advice on equipment noise levels.

The 2011 NSW Work Health and Safety Regulation (clause 59) requires manufacturers of equipment to provide information on noise emission levels. Suppliers are obliged to make this information available.

Prioritise the use of super-silenced compressors, silenced jackhammers and damped bits.

Select the most effective mufflers, enclosures and low-noise tool bits and blades. Seek the manufacturer's advice before modifying to reduce noise.

C3.4. Operate equipment in a quiet and efficient manner

Reduce throttle setting and turn off equipment when it is not being used.

Minimise reversing or movement alarms (refer to the advice in **Appendix E**).

C3.5. Inspect and maintain equipment

Regularly inspect equipment to ensure it is in good working order and operated in accordance with the manufacturer's instructions.

For equipment fitted with enclosures, check that acoustic doors and seals are in good working order and that doors close properly against the seals.

Ensure that air lines on pneumatic equipment do not leak.

Where atypically high noise levels and/or annoying characteristics occur because of inappropriate use, or due to faults or poor maintenance, the equipment should not be operated until repaired or replaced.

C4. On-site work practices: noise mitigation options

Design the worksite to maximise noise mitigation through careful location of equipment and work activities, using shielding and site layout to mitigate noise. Some measures are listed below:

- Maximise the distance between noise-making equipment and activities and the most affected noise sensitive receivers.
- Use natural barriers, such as landforms or existing non-sensitive infrastructure, and design the site so that site offices, storage containers etc. are situated between noise sources and noise sensitive receivers. Examples are given below.
    - Re-use existing structures rather than demolish them and construct new ones.
    - Use full enclosures, such as large sheds, with good seals fitted to doors to control noise.
    - Use temporary site buildings and material stockpiles as noise barriers.

    - Schedule construction of permanent walls so that they can be used as early as possible as noise barriers.
    - Use natural landforms as a noise barrier. For example, place fixed equipment in cuttings or behind earth berms.
- Restrict areas in which mobile equipment can operate. Avoid work in proximity of noise sensitive receivers.
- Locate site vehicle entrances away from noise sensitive receivers.
- Where feasible and reasonable, carry out fabrication work at another site, such as enclosed factory premises.

Examine, and where feasible and reasonable, implement alternatives to transporting material at night-time. For example stockpile material in an acoustically treated shed at night-time and load out the following day.

Although barriers, acoustic sheds and enclosures can effectively reduce noise, they are generally suited to long-term stationary activities and should supplement feasible and reasonable noise mitigation measures at source.

Avoid placing noise-producing equipment where surfaces will reflect noise or reduce the effectiveness of mitigation.

Where practicable, seek alternatives to the use of audible reversing alarms within a construction site:

- Avoid the need for vehicles to engage reversing alarms by designing the site to eliminate the need to reverse. This could include one-way systems and drive-throughs for parking and deliveries.
- Where feasible and reasonable, adopt less-annoying alternatives to ‘beeper’ alarms, such as smart alarms that adjust their volume to the ambient level of noise and ‘broadband’ alarms. Further advice is provided in **Appendix E**.

C5. Work scheduling: noise mitigation options

This guideline recommends construction work be scheduled during the recommended standard hours; scheduling noisy work during periods when people are least affected is an effective way to minimise impacts.

C5.1. Schedule activities to minimise noise impacts

Consult with noise sensitive receivers about scheduling of activities, as appropriate.

Prioritise work during the least sensitive time period. For example commercial premises, colleges and schools are not typically in use outside regular business hours or on weekends.

Where possible, schedule noisy activities around times of high background noise (local road traffic or when other local noise sources are active) to make the most of opportunities to reduce construction noise intruding above background noise.

Avoid times when there are special events (such as sports events, concerts or parades) in the vicinity.

For tunnelling works, examine whether stockpiling excavated material overnight in an enclosure and restricting load-out to daytime is feasible and reasonable.

C5.2. Consider respite periods

Respite can protect noise sensitive receivers from prolonged periods of noisy work.

Consult with noise sensitive receivers, particularly where work is scheduled outside the recommended standard hours.

Consult with affected schools to ensure that noise-generating construction works near school buildings are not scheduled during examination or other sensitive time periods, unless other acceptable arrangements can be made, such as the school relocating pupils to classrooms unaffected by the noise. Similar arrangements may also be needed with other (non-residential) sensitive land uses.

C5.3. Organise deliveries and access

Designate access and egress to minimise noise impacts on noise sensitive receivers. Ensure all drivers are made aware of nominated routes.

Schedule deliveries to defined hours and ensure these requirements are clearly communicated. Where deliveries arrive before the site is open, identify a parking area away from noise sensitive receivers, where possible.

Encourage staff ride-sharing to minimise traffic and, where possible, provide parking and on-site truck waiting areas away from noise sensitive receivers.

Optimise the number of vehicle trips to and from the site. For example to minimise noise and congestion, where possible, organise amalgamated loads rather than using several vehicles with smaller loads.

C6. Mitigation measures in the transmission path: noise mitigation options

Mitigation to reduce noise transmission between the worksite and noise sensitive receivers is generally suited to fixed sources of noise.

Erect temporary noise barriers before work commences to reduce noise as early as possible. Barriers can take different forms:

- Temporary noise barriers can be constructed from hoarding at the site boundary.
- Stockpiles, shipping containers and site office transportables can be effective and/or supplement temporary barriers.

Where high-rise dwellings adjoin the construction site, a barrier is unlikely to be sufficient to effectively mitigate noise at the upper levels. Identify and implement alternative feasible and reasonable noise mitigation.

C7. Mitigation at residences and other sensitive land uses: noise mitigation options

Noise mitigation at the affected residence or other sensitive land use should only be considered in the following circumstances:

- after all feasible and reasonable mitigation measures have been exhausted at the source and in the transmission path
- subject to consultation with the affected noise sensitive receivers and, where appropriate (or required), the consent authority or regulator.

C7.1. Implement architectural treatments

Identify, and where feasible and reasonable, implement architectural treatment to residential premises affected by construction noise. Architectural treatment would ordinarily only be

considered in instances where significant construction noise impacts over prolonged periods are predicted after all feasible and reasonable mitigation.

This may mean bringing forward proposed architectural treatments to mitigate noise during the operational phase of the project.

Alternative ventilation may be needed so that windows can be kept closed while allowing airflow into the building to meet building requirements.

Where residents do not wish to accept any offer of architectural treatment, the proponent must nevertheless identify and implement all feasible and reasonable mitigation to manage noise impacts.

C7.2. Consider temporary relocation

Where feasible and reasonable, offer to relocate noise affected occupants for short periods of time, such as when high noise levels occur during evening or night-time periods and there are no other feasible and reasonable ways of reducing noise to avoid unacceptable impacts. For example the proponent could offer alternative accommodation or other respite measures, such as movie tickets during evening periods.

Where residents do not wish to accept alternative accommodation (or other respite measures), the proponent must identify and implement all feasible and reasonable mitigation to manage noise impacts.

Subject to consultation and approval from the affected parties, it may be appropriate to offer temporary relocation instead of feasible and reasonable mitigation at the source and in the transmission path where noise affects a small number of people, commensurate to the risk of noise impact (refer to the advice provided in **sections 5** and **7**).

Appendix D: Case studies

The following case studies show how the principles described in this guideline can be applied in various circumstances to identify and manage noise impacts. The case studies are not prescriptive, and projects should be assessed on a case-by-case basis. In all instances, the advice in **section 7** of this guideline, particularly regarding community engagement and the ongoing review and management of noise impacts, should be considered.

D1. Case study 1: construction within Sydney's central business district

A former commercial building in Sydney's central business district (CBD) is being converted to a hotel and residential units. Significant internal alteration is needed to reconfigure the building, including extensive demolition work and construction of replacement floors and new lift shafts and new building services.

The building adjoins professional service businesses (such as financial, legal and engineering businesses). Numerous commercial buildings, cafes and restaurants are also on the street, but no residential development or other sensitive land use (such as a child care centre) is near the building.

Significant demolition work using percussive hammers and drilling equipment is required, and this phase is estimated to take approximately six weeks to complete. The work is predicted to result in noise levels of up to 60 dB $L_{Aeq,15min}$, and for some days, peaks of up to 70 dB $L_{Aeq,15min}$ for up to one hour, within the adjacent buildings. Vibration will also be perceptible at times.

The work has the potential to cause disruption to staff working in the adjacent buildings during office hours, affecting concentration, speech, and the ability to undertake detailed tasks. Feasible and reasonable mitigation considerations to manage these impacts included:

- using alternative work methods to reduce the noise at the source
- scheduling the noisy work during the evening and/or on weekends when the offices are not in use
- significantly restricting the hours that noisy demolition work can take place, including respite periods subject to consultation with building managers.

Relocating staff from the adjacent businesses is impractical due to the large number of staff, lack of available alternative work spaces and unreasonable disruption to business.

Although the work can be done by using quieter work methods, doing so would increase the overall duration of the project by an additional four weeks and at significant additional cost. In this instance, scheduling the demolition work during weekday evenings and weekend daytime periods is considered the most feasible and reasonable method to manage noise impacts, principally because there are no noise sensitive receivers during these times.

D1.1. What if the construction work were being undertaken next to residential premises instead of commercial premises?

If the construction work were being undertaken next to residential premises instead of commercial premises, alternative feasible and reasonable mitigation would need to be considered. In this example, the most appropriate solution would be to work during the recommended standard hours. Alternative, quieter work methods would also likely be necessary. This would likely increase the duration (unless community consultation results in a negotiated agreement) because demolition works of this nature have the potential to cause significant noise impacts.

D1.2. What if the construction work is affecting residential and commercial premises?

Where demolition works are in a building immediately adjoining a residential building and a commercial building, a number of mitigation options would need to be considered to determine what is feasible and reasonable. This could include consideration of:

- alternative, quieter work methods
- temporary relocation of residents and/or businesses to allow a concentrated period of noisy works
- restricting work to defined hours and using respite periods, for example working during defined evening periods outside business hours and providing respite to residents, subject to negotiation (for example periods of 'quiet' or no work and respite offers, such as movie tickets).

In this example, it is unlikely that noise impacts can be eliminated and a combination of feasible and reasonable mitigation options will be necessary. The mitigation selected is likely to depend on the outcome of consultation with affected parties and the regulatory authority to identify the most appropriate solution.

D2. Case study 2: managing public infrastructure work at night through community engagement

This case study highlights the actions taken by Sydney Water to manage noise impacts when working on public infrastructure at night.

Sydney Water needed to upgrade a pumping station (SP0484) at Narellan to cater for the South West Growth Centre. Pipe work in the pumping station needed to be reconfigured and the pumping station taken off line. This could only be done on a Sunday night when system flows were at their lowest. Tankers were needed to transport the wastewater from the pumping station to other locations around Narellan before the work on the pipes could start.

The planning phase identified a number of issues for the local community, including high levels of noise at the site from construction and tankers, and noise at several other Narellan locations due to tanker movement and operation. Furthermore, the pumping station was responsible for odour complaints from residents due to several failures of odour control units, which led to negative community perceptions of Sydney Water.

If noise was not managed properly, the work had the potential to keep residents awake all night and result in complaints to Sydney Water. To manage construction impacts, Sydney Water engaged with stakeholders well in advance of construction, and before the night-time work was scheduled.

The project team set out to form collaborative relationships with local stakeholders to develop ways to minimise construction impacts. The team was particularly concerned about the impact of the night-time work and wanted to ensure it was managed in the best way possible.

D2.1. Noise study and monitoring

A noise study was done early in the planning stage to determine the area of potential impact. A noise consultant was on site during the night-time to monitor noise. Noise loggers were placed on the pumping station site and at various locations throughout Links Estate.

The results of this monitoring indicated that the whole suburb of Narellan would have some level of noise from the proposed construction works, but Links Estate would be highly impacted. Even with all feasible and reasonable measures in place, including a noise barrier erected on the boundary adjoining the estate, construction noise levels were predicted to be well above relevant noise management levels.

This outcome of the study identified the residents likely to be adversely affected by night-time noise so that offers of temporary relocation could be made.

D2.2. Community engagement

The local MP, Camden Council, emergency services and Links Estate strata and residents were informed of the night-time work and notification was sent to residents within the Narellan postcode via Adpost. An advertisement was also placed in local papers to inform the wider community of the night-time work and the tanker activities.

A community open day was held a month before night-time work to talk to residents about the work and the findings of the noise study and to discuss the option of relocation for the night.

The relocation offer was taken up by about 20% of residents, most of whom opted to stay locally but some stayed closer to their workplace at their request. The offer to relocate pets was also made. Where residents chose to stay at home, noise monitoring was conducted.

Feedback from residents indicated appreciation for the effort Sydney Water made to address their concerns and for the offer of relocation.

D2.3. Site management

The project engineer, community relations representative and noise consultant were on site for the night-time work. This was to ensure that any issues during the night-time could be dealt with immediately.

Many residents left the estate for the night, so a private security guard was engaged to patrol the area and reassure owners of vacant homes and those elderly and vulnerable residents who had decided to stay. The local police were also alerted to the night-time work and undertook additional patrols.

Following completion of the work, residents were updated on the project's progress.

D2.4. Key outcomes

The night-time work was completed with no complaints, and complimentary feedback was received from residents.

Sydney Water's work in Narellan demonstrates the benefits of building trust with local stakeholders. It shows that Sydney Water considered the feedback and concerns of residents and was prepared to respond to and address those concerns to achieve the best outcome.

Sydney Water will also benefit long term from the goodwill developed when future construction work is required.

D3. Case study 3: managing the impact of ground-borne noise from demolition in a commercial area

This case study considers ground-borne noise arising from demolition work.

This guideline provides management levels for ground-borne noise affecting residences (see **section 5.6**). These management levels do not apply to commercial premises.

The ground-borne noise management levels for residences apply during evening and night periods to protect residents at home. Due to the different sensitivity of occupants in commercial premises, it is necessary to consider relevant ground-borne noise management levels and mitigation measures on a case-by-case basis in consultation with potentially affected receivers.

This case study draws on a situation where occupiers of a commercial building affected by ground-borne noise instigated action at the Land and Environment Court to restrict demolition works, and considers how the advice in this guideline can be applied to manage ground-borne noise impacts.

D3.1. Background

Planning consent for the demolition work was granted with a requirement to prepare a noise management plan to ensure a criterion of 50dB(A) (internal) $L_{Aeq,15min}$ not be exceeded within the neighbouring commercial property. Note that this criterion was derived from superseded guidance.

The noise assessment identified a risk that ground-borne noise from certain aspects of the work could exceed this criterion, and recommended feasible and reasonable mitigation to manage potential impacts. These recommendations were not fully implemented. During demolition works, there were significant and sustained exceedences within the adjacent commercial property.

Initial attempts at a resolution between the parties were unsuccessful, and the affected occupier instigated proceedings at the Land and Environment Court. The outcome was a negotiated settlement where ground-borne noise from the works was limited to noise management levels during nominated times (see **Table 9**).

Table 9 Noise criterion during nominated times

Time period	Noise level, dB(A)
0800 to 1000	N/A
1000 to 1100	50
1100 to 1200	60
1200 to 1400	N/A
1400 to 1500	50
1500 to 1700	60

Rather than permitting demolition throughout the recommended standard hours, the negotiated outcome restricted work ground-borne noise levels between 1000 and 1200 and between 1400 and 1700 to offer respite to the occupants of the commercial premises.

Demolition work was permitted with no restrictions on ground-borne noise levels between 0800 and 1000 and between 1200 and 1400 to allow the work to be completed within a reasonable timeframe.

This outcome is likely to have extended the time, and hence cost, of the demolition work.

D3.2. Using the guideline to manage ground-borne noise

The noise assessment highlighted the risk of ground-borne noise impact. Applying the principles in this guideline may have resulted in different outcomes, and the following key issues should be considered:

- Identify the sensitive land use, including the times when it is sensitive to ground-borne noise. In this situation, because demolition and the occupancy of the commercial premises coincided, there was a clear risk of impact.
- In these circumstances, consideration could have been given to scheduling demolition outside the recommended standard hours (such as in the early evening or on the weekend), particularly when ground-borne noise was likely to exceed the consent criteria, providing it would not adversely affect residential neighbours.
- The proponent could have undertaken some trials of the work to quantify the likely ground-borne noise impact (see **section 7.2.1**) and determined whether it was feasible to meet the 50dB(A) (internal) $L_{Aeq,15min}$ criterion (set out in the planning consent). The outcome of a trial could:
    - have informed identification of feasible and reasonable mitigation options, including possible alternative work methods and equipment

- be used to negotiate with the regulator and the occupiers of the surrounding sensitive land uses to determine the acceptable management level, and mitigation (such as the provision of respite periods) and consideration of temporary relocation, where appropriate.

The outcome could have resulted in a more favourable negotiated agreement, but without the expense and risk of legal action. Following this, continuous monitoring of ground-borne noise and ongoing engagement can be applied.

D3.3. Discussion

This case study highlights the need for project proponents to do the following:

- Identify sensitive receivers, assess potential impacts, and identify and justify the selection of feasible and reasonable mitigation.
- Establish and maintain relationships with potentially affected receivers to identify mutually acceptable mitigation measures as early as possible.
- Have a plan to manage ground-borne noise during work, such as complaints management and monitoring.

Although the outcome of the negotiated settlement might have been the same had the proponent negotiated with the affected party at the outset, early engagement would have likely given the proponent more opportunities to investigate alternative work methods.

This example illustrates issues to consider when managing the potential impact of ground-borne noise on non-residential uses. The noise criteria and time periods set out in this case study are not to be interpreted as guidance on ground-borne noise management levels and/or working hours for commercial premises.

D4. Case study 4: medium-sized road upgrade project

In this scenario, a new road by-pass is being built near a small number of residential premises unaffected by existing road traffic noise. Construction will also take place near a town where the new by-pass will link with an existing road.

The projects has three sequential stages:

1. work on the new by-pass taking place distant from the town, and affecting a few residential premises during the recommended standard hours over a period of four weeks
2. work taking place close to numerous residential premises in the town where it links with the existing road. The work was scheduled during the recommended standard hours over a one-week period
3. upgrades to the existing road close to residential premises in the town. Due to access constraints (a road occupation licence), this work is scheduled outside the recommended standard hours for three non-consecutive nights over a one-week period.

D4.1. Stage 1

Although background noise levels are relatively low in this area, a qualitative assessment (using **Table 2** as a guide) determined that implementing the universal work practices set out in **Appendix C**, along with notification, was sufficient to manage noise in most instances. However, it was anticipated that for approximately four days of the four-week construction period, construction noise was predicted to exceed the noise affected management level of RBL + 10dB (see **Table 3**) for several hours.

For these periods, the proponent assessed the feasibility and reasonableness of using the following options to reduce noise to the noise affected management level of RBL + 10dB or less:

- quieter equipment

- alternative work practices
- portable noise enclosures around static equipment
- temporary screening between the worksite and the receivers.

The outcome indicated that using quieter equipment, noise enclosures and temporary screening was not feasible or reasonable. Instead, careful work scheduling, limiting particularly noisy aspects of the works to a defined timeframe and notifying the community were the most reasonable approaches.

Although some aspects of the work were unavoidably noisy, the proponent managed these by providing timely and clear updates to the affected parties on the nature and duration of the work.

D4.2. Stage 2

The approach to noise management for stage 2 was similar to that for stage 1, but greater consideration was given to feasible and reasonable mitigation where the new by-pass tied into the existing road because of its proximity to sensitive receivers.

This included identifying mitigation using the hierarchy of noise control (see **section 7**) to meet the noise affected management level of RBL + 10dB or less. The noisiest equipment and work practices were identified, but it was not feasible or reasonable to amend work activities or substitute equipment for quieter work activities. Instead, work was scheduled so that noisy activities were undertaken concurrently and for the shortest duration possible when close to noise sensitive receivers. Temporary mobile barriers were also introduced to control noise from certain tasks in the transmission path.

As with stage 1, emphasis was placed on notifying the community about the nature and duration of the work, and providing them with contact details for complaints or questions. This was supplemented with administrative controls (scheduling of noisy activities) and noise control engineering (use of temporary noise barriers).

D4.3. Stage 3

Stage 3 required further consideration of feasible and reasonable mitigation due to the greater sensitivity of the community to work scheduled outside the recommended standard hours in proximity to residential premises.

It was not feasible to schedule work during the recommended standard hours because of the constraints in a road occupation licence limiting access to the hours of 2030 to 0500. The predicted noise levels were predicted to exceed the RBL by 15dB and exceed the highly noise affected management level of 65dB $L_{Aeq,15min}$ for one night (see **Table 4**).

In addition to all feasible and reasonable mitigation, the following supplementary management mitigation packages (see **Table 5**) were considered:

- consultation with residents to determine preferences for work scheduling; working consecutive nights would reduce construction to two nights rather than three non-consecutive nights
- consultation to offer respite periods
- scheduling the noisiest aspects during the early part of the night (such as 2100–0000 rather than 0000–0300) to minimise sleep disturbance.

Offering alternative accommodation was not considered feasible and reasonable because the duration of work exceeding the highly noise affected management level of 65dB $L_{Aeq,15min}$ was limited to the hours of 2100–0000 for one night.

Permanent mitigation measures at the source or transmission path were not considered feasible and reasonable because of the relatively short duration of the work, and because the main sources of noise were mobile equipment.

In this instance, the option of working in 'blocks' to provide respite was not viable from an engineering or cost perspective. Community preference indicated preference for:

- completing work over three non-consecutive nights rather than two consecutive nights to offer some respite
- scheduling the noisiest activities during the early part of the night.

D4.4. What if the work was undertaken in accordance with the Roads and Maritime Services Construction Noise and Vibration Guideline?

The *Construction Noise and Vibration Guideline* (CNVG) (August 2016) provides detailed advice to manage the impact of construction and maintenance activities from Roads and Maritime Services. (RMS) projects.

It follows the principles of this guideline by requiring the identification of feasible and reasonable mitigation, community engagement and encouraging work to take place during the recommended standard hours. The CNVG also:

- requires a description of the work, including its duration and identification of potentially affected receivers
- provides assessment methods based on the likely risk of noise impact
- sets out a package of standard mitigation measures for all projects, and additional mitigation where the standard mitigation is insufficient to manage noise to the relevant noise management levels.

The CNVG differs from this guideline in terms of its methodology, noise management levels and other technical aspects, but offers an effective method to manage noise from routine maintenance activities managed by the RMS.

D5. Case study 5: Sydney Metro City and Southwest

The Sydney Metro project is delivering more than 65km of metro rail lines between Sydney's North West and South West, travelling under Sydney Harbour and through new underground stations in the CBD.

The project planning approval for Sydney Metro City and Southwest – Chatswood to Sydenham, includes the following conditions to manage construction noise and vibration:

- preparation of a construction noise and vibration strategy setting out how the proponent will meet the requirements in the planning approval
- permission to work outside the recommended standard hours where there is a negotiated agreement with a 'substantial majority' of affected receivers
- requirement to appoint a suitably qualified and experienced independent acoustics advisor to, principally, review all noise and vibration plans, assessments and reports; make recommendations for improvements to manage noise, as appropriate; and oversee implementation of all noise and vibration requirements.

Due to the need for tunnelling in the CBD the planning consent includes conditions to manage noise. These include consultation with receivers likely to be affected to determine appropriate hours of respite to ensure construction noise, including ground-borne noise, does not exceed the following internal noise levels:

> $L_{eq(15\ minute)}$ 60dB(A) inclusive of a 5dB penalty if rock breaking or any other annoying activity likely to result in ground-borne noise or a perceptible level of vibration is planned between 7am–8pm for more than 50 percent of the time

> $L_{eq(15\ minute)}$ 55dB(A) inclusive of a 5dB penalty if rock breaking or any other annoying activity likely to result in ground-borne noise or a perceptible level of vibration is planned between 7am–8pm for more than 25 percent of the time.

This condition is not applicable where an agreement is reached with affected receivers or to noise generated by a tunnel boring machine as it passes beneath receivers. It also contains the following provision to require that:

> … noise levels be less than $L_{eq(15\ minute)}$ 60dB(A) for at least 6.5 hours between 7am–8pm, of which at least 3.25 hours must be below $L_{Aeq(15\ minute)}$ 55dB(A). Noise equal to or above $L_{eq(15\ minute)}$ 60dB(A) is allowed for the remaining 6.5 hours between 7am–8pm[8].

Furthermore, the proponent must ensure that:

> residential receivers, located in non-residential zones, likely to experience an internal noise level exceeding $L_{eq(15\ minute)}$ 60dB between 8pm–9pm or $L_{eq(15\ minute)}$ 45dB between 9pm–7am (inclusive of a 5dB penalty if rock breaking or any other annoying activity likely to result in regenerated noise, or a perceptible level of vibration is planned [including works associated with utility adjustments]) must be offered additional mitigation
>
> … residential receivers in residential zones likely to experience an internal noise level of $L_{eq(15\ minute)}$ 45dB or greater between 8pm–7am (inclusive of a 5dB penalty if rock breaking or any other annoying activity likely to result in ground-borne noise, or a perceptible level of vibration is planned [including works associated with utility adjustments]) must be offered additional mitigation[9].

These conditions seek to balance the need for major construction works in the vicinity of commercial and residential premises in and around Sydney's CBD with respite periods for amenity.

In this instance, there is no ideal solution where construction works can be undertaken without causing disruption. The respite periods and noise management levels seek to minimise the total duration of construction at any one location while managing noise impacts on sensitive receivers.

This case study emphasises the flexibility of this guideline to identify the selection of feasible and reasonable mitigation (subject to justification), rather than focusing on meeting specified noise management levels on a case-by-case basis.

This case study should not be interpreted to mean the conditions for this project can be applied to other similar projects. The noise management levels and the respite periods are considered feasible and reasonable for these circumstances. They take account of the higher insertion loss within commercial premises, but applying these conditions in a different context, particularly if no engagement is undertaken, could result in adverse outcomes.

8. *Critical State Significant Infrastructure. Sydney Metro City and Southwest. Chatswood to Sydenham Conditions of Approval*, 9 January 2017 – Condition E38

9. *Critical State Significant Infrastructure. Sydney Metro City and Southwest. Chatswood to Sydenham Conditions of Approval*, 9 January 2017 – Conditions E41 and E42

D6. Case study 6: maintenance activities during a weekend track possession

This case study highlights the actions taken by Sydney Trains to manage noise impacts associated with rail infrastructure maintenance works during a planned weekend track possession. Sydney Trains is a government agency regulated through an environment protection licence.

D6.1. Background

As part of programmed regular maintenance on the metropolitan rail network, Sydney Trains carried out a variety of works during a weekend track possession on the Cronulla line from 0200 Saturday morning until 0200 Monday morning, including:

- re-railing work
- turnout replacement
- rail tamping.

D6.2. Noise assessment

The project manager responsible for each individual scope of work followed Sydney Trains' internal environmental management system procedures. This included developing a site EMP, a component of which is to undertake an initial assessment of potential noise impacts.

For routine activities, an environmental work method statement (EWMS) is applied to mitigate potential environmental impacts, including noise emissions. Should the site EMP identify higher potential noise impacts, a more detailed desktop quantified noise assessment will take into account site conditions and equipment being used as well as the timing of the activities.

Due to higher noise equipment and the proximity of the sensitive receivers, additional quantified noise assessments were triggered for the turnout replacement and re-railing works. Following the desktop noise predictions, the feasibility of mitigation measures was assessed and recommendations developed.

The tamping works did not require additional noise assessment. The mitigation measures outlined in the respective EWMS were applied. These included carrying out setup and equipment start up procedures away from sensitive receivers. Regular inspections and service of the equipment were also carried out to identify any operational faults that could lead to increased noise emissions.

D6.3. Site management

The noise control measures identified in the site EMPs were provided to the respective site managers. They included the following:

- The use of high-noise equipment, such as jack hammers and rail saws, was scheduled to occur during daylight hours and operation was limited during the most sensitive periods of the weekend.
- All stationary equipment was to be throttled down or turned off when not in use and placed as far as practically away from sensitive receivers.
- All mobile equipment on site was to be fitted with broadband reversing alarms.
- In preparation for the works, the replacement turnout was prefabricated off site to reduce the amount of high noise work within the corridor.
- The delivery of the new turnout and rails was to occur during non-sensitive periods of the day either during the weekend possession or a prior period.

Due to the limited time to carry out the scope of the maintenance works along with the nature of the activities, certain noise mitigation measures (such as temporary noise barriers) could not feasibly be implemented. All site inductions and toolbox talks outlined noise impacts as an

important consideration for the maintenance workers. This included reducing noise, where practical, during access to and from the site, along with all staff and equipment movements throughout the weekend.

As a requirement of the environment protection licence conditions, Sydney Trains carried out a letterbox drop at the affected receivers five to 14 days before the maintenance, which outlined the scope and length of works as well as any expected impacts, including an expected qualitative noise impact.

D6.4. Key outcomes

The night-time works were completed on schedule allowing the infrastructure to be returned to a functioning state while reducing the noise impacts on the neighbouring sensitive receivers.

Sydney Trains' engagement with the community through the letterbox drop provided information about the scheduled maintenance works and expected impacts along with the benefits of these works to the wider community. Feedback from residents was taken on board and, where reasonable and feasible, suggestions will be implemented for future weekend possessions.

Appendix E: Managing noise from reversing alarms and work health and safety considerations

Clause 215(4) of the Work Health and Safety Regulation 2011 (the WHS Regulation) requires that mobile equipment –where there is a possibility of colliding with pedestrians or other mobile equipment – have a warning device to warn persons who may be at risk from movement of the equipment.

Where equipment includes an emergency warning device, the WHS Regulation also requires it to be positioned to ensure it will work to the best effect. This applies to a designer of powered mobile equipment (clause 192) and a person with management or control of it (clause 212).

The WHS Regulation does not specify the format warning devices must take. Audible movement alarms, such as reversing 'beepers', are not mandatory but are simply one of a range of movement alarms.

Manufacturers may have a range of alternative audible movement alarms appropriate for the specific operation of the equipment. Where the manufacturer has fitted them, they must be maintained and operated as intended. Changing the type of alarm could affect proper use and may be contrary to clause 206(3) of the regulation, which requires warning devices to be used in accordance with the manufacturer's instructions.

The following applies in the event that an alteration to a fitted alarm is required:

- A safety risk assessment must be undertaken to determine whether it is practicable to implement less-annoying alarms on powered mobile equipment.
- If the safety risk assessment determines that alternative alarms are practicable without compromising safety, then those alarms must be functional while undertaking the construction works.

The safety risk assessment must be undertaken by a competent person, and be based on an assessment of the site and its conditions as well as the equipment involved. The alternative audible movement alarms must be compatible with the equipment, and not adversely affect its operation. The competent person must specify the procedures to change the warning measures, and the maintenance necessary for correct operation. When a movement alarm is replaced by a different type of audible movement alarm, all site personnel should be advised of this change and the manner in which it functions. Advice on operation of audible reversing alarms on construction sites at night-time and near residences is provided in the *Moving Plant on Construction Sites: Code of Practice* (WorkCover 2004).

Note that the WHS Regulation (clause 59) also requires that equipment must be designed so that its noise emission is as low as reasonably practicable, and that information on the noise emissions levels of the equipment be made available.

References

Standards

Australian/New Zealand Standard 2107: 2000 *Acoustics: recommended design sound levels and reverberation times for building interiors*

Australian/New Zealand Standard 3100: 2009 *Risk management: principles and guidelines*

Australian Standard (AS) 1055: 2018 *Acoustics: description and measurement of environmental noise*

Australian Standard (AS) 1217: 1985 *Acoustics: determination of sound power levels of sources* (part 1 to part 7)

Australian Standard (AS) 2436: 2010 *Guide to noise and vibration control on construction, demolition and maintenance sites*

ISO 9613-2: 1996 *Acoustics: attenuation of sound during propagation outdoors*

Legislation

Environmental Planning and Assessment Act 1979

Protection of the Environment Operations Act 1997

Protection of the Environment Operations (Noise Control) Regulation 2017

State Environmental Planning Policy (Infrastructure) 2007

Work Health and Safety Regulation 2011

Noise policies and guidelines

Assessing Vibration: A Technical Guideline, DEC, 2006

Noise Guide for Local Government, EPA, 2013

Noise Policy for Industry, EPA, 2017

NSW Road Noise Policy, DECCW, 2011

Rail Infrastructure Noise Guideline, EPA, 2013

Technical Basis for Guidelines to Minimise Annoyance Due to Blasting Overpressure and Ground Vibration, ANZEC (Australian and New Zealand Environment Council), September 1990

Other policies and guidelines

Chatswood to Sydenham Construction Noise and Vibration Strategy, Sydney Metro, August 2016

Construction Hours/Noise within the Central Business District. City of Sydney Code of Practice, City of Sydney, 1992

Construction Noise and Vibration Guideline, Roads and Maritime Services, August 2016

Construction Noise Handbook, US Federal Highway Administration, US Department of Transportation, August 2006

Construction Noise and Vibration Strategy, Transport for NSW, April 2019 (ST – 157/4.1)

Directive 2000/14/EC (amended by Directive 2005/88/EC) on Equipment Sound Power Levels, European Commission, 2000

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