Road Traffic Noise Guidelines

EHTM Attachment 7A

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Document Management

It is approved and authorised for use by Departmental staff and its authorised agents.

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http://www.dit.sa.gov.au/standards/home

Contents

Abbreviations

Term / Acronym	Meaning
AADT	Annual Average Daily Traffic
AAWDT	Annual Average Weekday Traffic
BMT	Base Metal Thickness
CoRTN	Calculation of Road Traffic Noise
Contract Documentation	Contract Scope and Technical Requirements; Functional and Operational Requirements; Contract or Project Scope
DIT	Department for Infrastructure and Transport (the Department)
EHIA	Environment and Heritage Impact Assessment
EHTM	Environment and Heritage Technical Manual
EPA	Environment Protection Authority
FTP	Facade Treatment Package
FTSW	Facade Treatment Scope of Works
$L_{Aeq, T}$	A-Weighted equivalent continuous sound pressure level over time period (T)
NAB	Noise Assessment Boundary
NSR	Noise sensitive Receiver
RIC	Relative Increase Criterion
RTNG	Road Traffic Noise Guidelines
R_W	Weighted Sound Reduction Index
$R_W + C_{tr}$	R_W with the addition of a low frequency sound correction factor C_{tr}
VDV	Vibration Dose Value

1 Introduction

The Road Traffic Noise Guideline (RTNG) have been developed by the Department for Infrastructure and Transport (the Department). The RTNG provides guidance to consultants and contractors in addressing road traffic noise as a key part of infrastructure project development.

The RTNG applies to new or major redeveloped roads and does not apply to traffic noise from the existing road network.

The RTNG sets out the general process to be followed and criteria to be applied when assessing the operational road traffic noise impacts of infrastructure projects involving new roads and/ or major redevelopment of existing roads/ road corridors.

The RTNG forms Attachment 7A of the Environment and Heritage Technical Manual (EHTM).

The purpose of a noise assessment is to determine the requirement for noise mitigation and treatment measures. Where treatment is required to be implemented, the Department's Noise Treatment Implementation Guideline applies.

1.1 Structure of the Guideline

The Guideline consists of the following Parts:

- Part A – Road Traffic Noise Assessment (operational traffic noise assessment)
- Part B – Road Traffic Vibration Assessment (operational vibration assessment).

1.2 Supporting Documentation

The following Departmental documentation support/ form part of assessments undertaken under this Guideline and are available via the Department's website:

- Noise Treatment Implementation Guideline
- Property Noise Mitigation: Facade Treatment Package Specification
- Factsheet: Reducing Transport Noise Impact - A Guide to Home Owners

1.3 Performance Outcomes

In order to meet the performance requirements under this Guideline, unless specified otherwise in the Contract Documentation, the following shall be achieved:

- Completion of a road traffic noise assessment that demonstrates compliance with this Guideline;
- Completion of an operational vibration assessment in accordance with this Guideline; and
- Identification of mitigation and treatments measures to be provided in accordance with this Guideline.

1.4 Legislative Context

The Department has a General Environmental Duty under Section 25 of the *Environment Protection Act 1993* to take all reasonable and practicable measures to reduce the impact of traffic noise that may result in environmental harm. The Road Traffic Noise Guidelines are the Department's response to satisfying the General Environmental Duty in relation to infrastructure works that have the potential to change the ambient noise environment due to road traffic.

1.5 Master specification

The Department's Master Specification sets out the requirements to achieve the quality and/or performance outcomes expected for planning/design, construction projects, maintenance and professional services.

This Guideline should be read in conjunction with the following Master Specification identified in Table 1-1.

Table 1-1 Departmental Master Specification Parts

Master Specification	Specification name
Project Controls:	PC-PL1 - Framework for Planning Studies
	PC-PL2 - Planning Investigations
	PC-PL3 - Concept Design Development
	PC-ENV3 - Environmental Design
	PC-ENV4 – Noise Assessment, Treatment Design and Implementation
	PC–SI2 - Site Investigations
	PC-EDM3 - Independent Design Certifier

PART A

Road Traffic Noise Assessment

2 Process for Assessing Road Traffic Noise

This section outlines the steps which, as a minimum, shall be undertaken when assessing road traffic noise and making decisions around reasonable and practicable noise mitigation. The steps outlined in this section are not stand-alone and are able to occur concurrently, when appropriate.

Should alternative methods for assessing road traffic noise be proposed, demonstration that the proposed approach is suitable must be provided and approved by the Department's Technical Services Environment and Sustainability Unit (and where necessary, the relevant authority's approval) prior to being adopted.

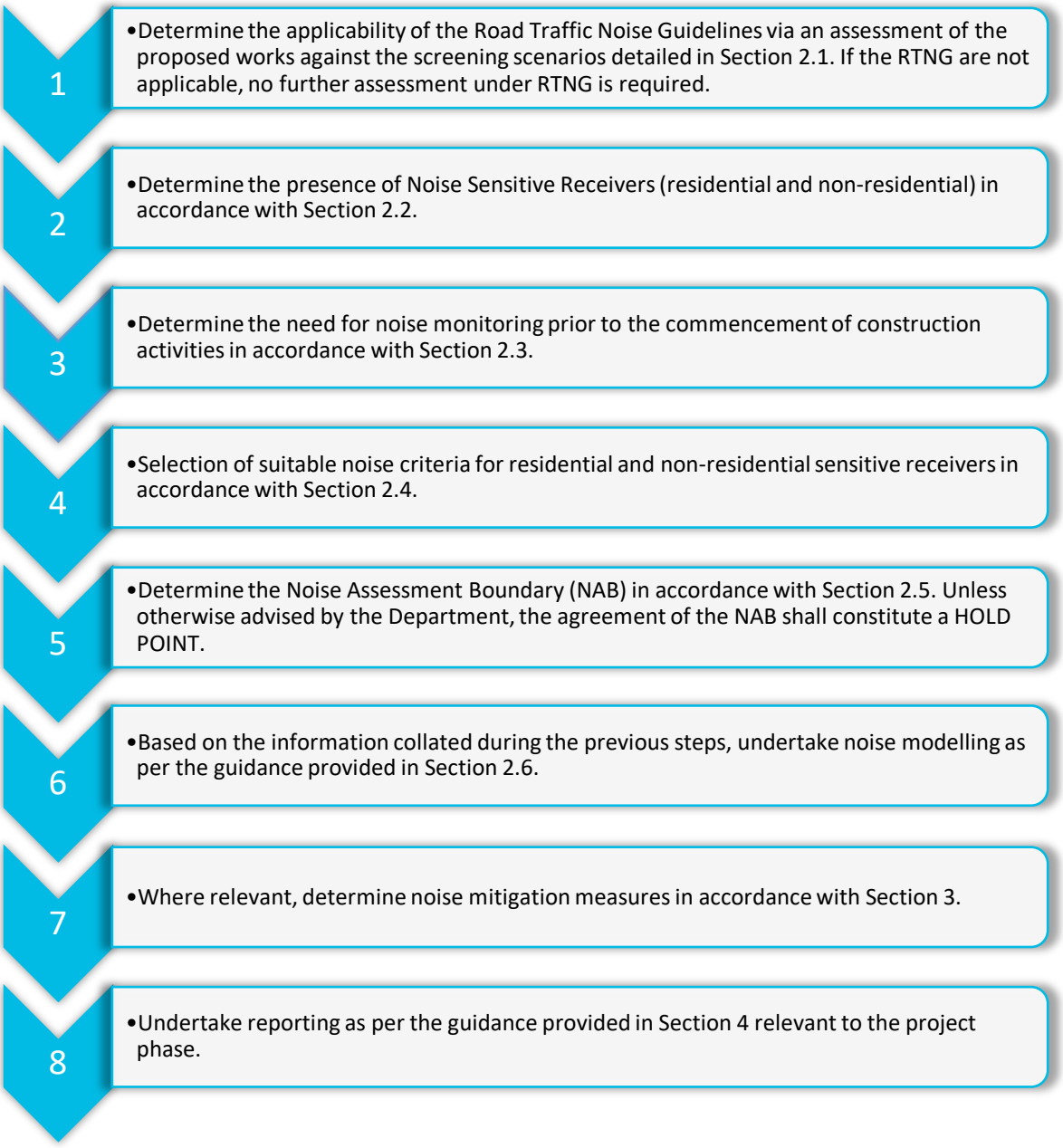

Figure 2-1 Summary of the Process for Assessing Road Traffic Noise

2.1 Applicability of the Road Traffic Noise Guidelines

An applicability assessment of the RTNG shall be undertaken in accordance with the circumstances outlined in Sections 2.1.1 to 2.1.3. Where the works do not fit any of the presented circumstances, a conservative interpretation of the works in context with the intent of the sections shall be made. The Department's Senior Responsible Officer or Project Manager may also direct the application of the RTNG to a project. Noise modelling is not required to be undertaken to determine the applicability of the RTNG.

Where agreement has been reached that the RTNG does not apply to a particular infrastructure project then no further action is required under the RTNG (i.e. the remainder of this document is not applicable) and it shall be documented in the project's Environment and Heritage Impact Assessment (EHIA) Report and subject to acceptance by the Department's Project Manager on advice from the Technical Services Environment and Sustainability Unit.

In some cases where the RTNG does not apply, alternative assessment may be required to satisfy the General Environmental Duty under Section 25 of the *Environment Protection Act 1993*. For example, a new or redeveloped rail line within the road corridor (without the demolition of building structures or existing roadside noise barriers) may require assessment in accordance with the Department's Guidelines for the assessment of noise from rail infrastructure.

Should a project's scope be subject to change (with respect to the outlined circumstances), further assessment of the applicability of the RTNG shall be undertaken.

2.1.1 New road

(a) When a new road is built, where no road previously existed.

2.1.2 Redeveloped road

(a) Where one or more lanes is added to an existing road, for the purpose of increasing the traffic carrying capacity of the road.

(b) Where the main traffic carrying section of an existing road (or intersection) is realigned such that traffic is moved closer to sensitive receivers by at least one lane width (e.g. moving closer by a minimum of 3.0m).

(c) Where the widening or realignment of an existing road or intersection requires the demolition of building structures or existing roadside noise barriers that results in receivers previously shielded from traffic noise becoming more exposed.

(d) Where a grade separation (i.e. vertical road realignment) is proposed to be built.

(e) Where widening or realignment (including grade separation) of an existing *transport infrastructure corridor (other than a road),* or the construction of new *transport infrastructure corridor (other than a road)*, requires the demolition of building structures or existing roadside noise barriers that results in receivers previously shielded from road traffic noise likely to become more exposed.

2.1.3 Circumstances not considered for noise assessment and treatment

Noise assessment and treatment would not normally be considered in the following circumstances:

(a) Upgrading or treating of road surfaces for maintenance, except where that road surface has been specifically placed as part of a noise treatment package and that surface is being changed (noting that where a road surface has been specifically placed as part of a noise treatment package, a similar performing surface should be used wherever possible).

(b) Minor upgrading work at an intersection, such as the creation of a left turn lane or a bus lane.

(c) Creation of a U-turn.

(d) Creation of a signalised pedestrian crossing.

(e) Signalising an existing intersection.

(f) Noise sensitive receivers located outside of the defined Noise Assessment Boundary to which the RTNG are applied.

(g) Implementation of hard shoulder running, where this is done for reasons other than increasing traffic carrying capacity (e.g. where the shoulder 'lane' is only operational during peak traffic times to reduce congestion).

(h) Minor road widening to accommodate Bike Lanes (where the traffic lane configuration does not change).

2.2 Noise Sensitive Receivers

The assessor shall determine the presence of Noise Sensitive Receivers which may be residential or non-residential.

Noise sensitive 'residential' receivers include:

- Properties that accommodate a National Construction Code (NCC) Class 1, 2, 3 building, a Class 4 part of a building or a Class 9c residential care building, where contemplated by the Planning and Design Code (refer to https://www.abcb.gov.au/Resources/Publications/Education-Training/Building-classifications for more information); and
- Caravan parks that accommodate existing long term residential use.

Noise sensitive 'non-residential' receivers include:

- Hospital wards;
- Churches/places of worship;
- Indoor teaching areas relating to educational institutions, childcare centres and kindergartens. Note that teaching areas may also include an outdoor space provided there are no alternative quiet locations for that space; and
- Passive recreational areas. A passive recreation area is generally an undeveloped space such as a park that is maintained for the health and well-being of the public.

Noise sensitive receivers to be assessed in accordance with the RTNG are limited to existing receivers or those for which a *Development Approval* under the *Planning, Development and Infrastructure Act 2016* has been granted before the date that the road project was publicly announced. Public announcement may entail a media release and/or contacting affected property owners/ stakeholders.

2.3 Noise Monitoring – Pre-Construction

Unless specified otherwise in the Contract Documentation, the need for noise monitoring to capture information on the existing road traffic noise/background conditions shall be determined in the preliminary stages of the assessment. It is important that noise monitoring be undertaken prior to any early project works to ensure that the existing conditions are measured accurately (i.e. not influenced by slowing/reduced traffic construction works etc.).

Monitoring at or adjacent to Noise Sensitive Receivers shall be undertaken at locations which provide an adequate level of information on the existing conditions. The monitoring scope shall also ensure that the noise model is able to be adequately validated post construction works/road opening. A minimum of three locations is generally required. Monitoring locations which have a direct line of sight to existing road traffic sources are typically preferred for model validation purposes.

The monitoring location selection shall be undertaken in accordance with Australian Standard AS1055:2018 *Acoustics – Description and measurement of environmental noise*, Environment Protection Authority (EPA) requirements and standard industry practice.

Noise monitoring shall be undertaken as follows:

- Logger locations and any property access requirements shall be agreed with the Department's Project Manager prior to installation;
- Log with intent to obtain a minimum of seven days measured data at each location that is not significantly affected by wind, rain, constructions works or atypical traffic conditions; and
- Logging to occur outside of holiday periods.

2.4 Applicable Noise Criteria

This section describes the approach to determining the applicable noise criteria at each Noise Sensitive Receiver (NSR) as defined in Section 2.2.

2.4.1 Noise Assessment Criteria Overview – Residential Receivers

An overview of the process to determine appropriate noise assessment criteria is provided in Figure 2-2.

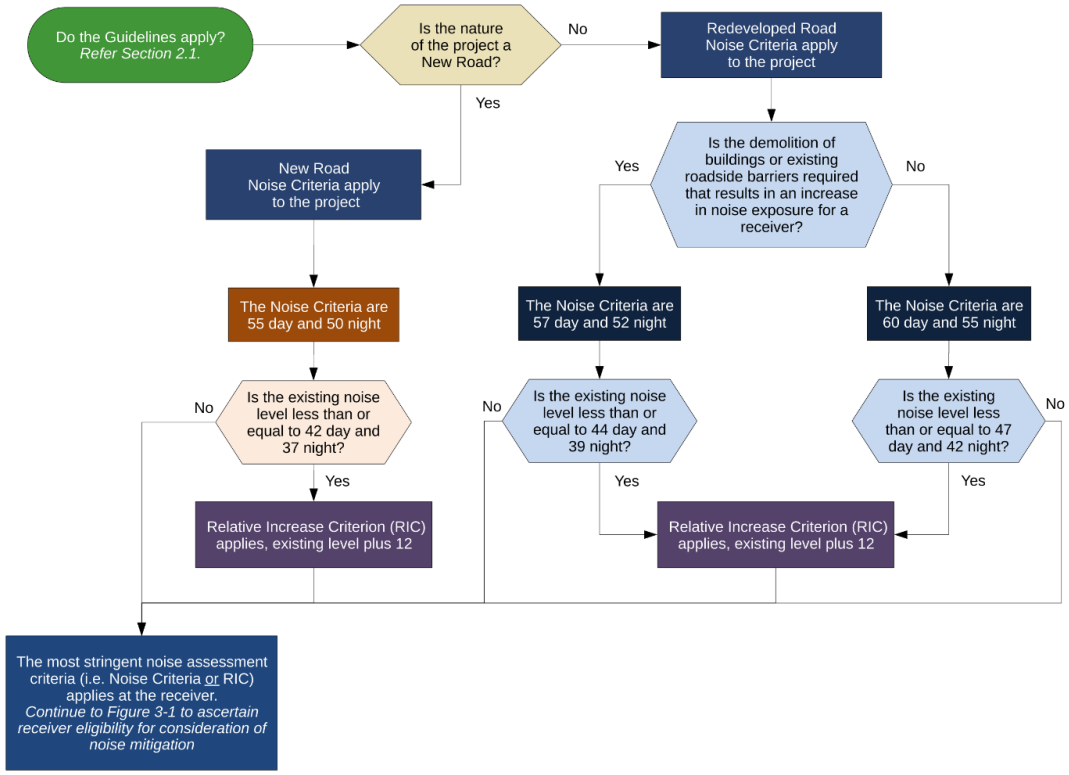

Figure 2-2 Determination of applicable Noise Criteria Flowchart – Residential Receivers

2.4.1.1 Noise Criteria for Residential Receivers

The Noise Criteria applicable to new and redeveloped roads are provided in Table 2-1.

The redeveloped road criteria are reduced by 3 decibel (dB) in situations where a NSR may experience a perceived increase in noise exposure due to the demolition of adjacent building structures or existing roadside noise walls (that are not replaced). This is typically applicable in situations where the front rows of houses or an existing noise barrier has been demolished to make way for the project, thereby exposing the rows behind to a further increase in noise. These Reduced Noise Criteria are not applicable in situations where an existing property fence has been removed.

Noise difference contours (with and without the structures to be demolished) may be used to assist the objective assessment of grouping receivers affected by the demolished structure(s), when determining the application of Reduced Noise Criteria.

Table 2-1 Noise Criteria for New Roads and Redeveloped Roads – Residential Sensitive Receivers

Project Type	Applicable situation	Noise Criteria(1) dB(A)L_{eq}	
		Day (7am to 10 pm) dB(A)$L_{eq\ (15hr)}$ or $L_{Aeq\ day}$	Night (10pm to 7 am) dB(A)$L_{eq\ (9hr)}$ or $L_{Aeq\ night}$
New Road	Existing receivers affected by noise from a new road	55	50
Redeveloped Road	Existing receivers affected by noise from a redeveloped road	60	55
	Existing receivers affected by noise from a redeveloped road and where demolition of building structures or existing roadside noise barriers(2) results in receivers previously shielded from traffic noise becoming exposed. (3)	57	52

Note: (A)L_{eq} = L_{Aeq} i.e. the A-weighted equivalent continuous sound pressure level

(1) Assessed at 1 metre from the facade

(2) Does not include property fencing

(3) Applies to rail projects where demolition of building structures or barriers removes shielding from road traffic noise.

A large increase in existing noise can cause a major change to the acoustic environment of a location. Under these guidelines, this is assessed using a Relative Increase Criterion (RIC). An explanation of the RIC and how to determine is provided in Section 2.4.1.2.

2.4.1.2 Relative Increase Criterion

In cases where the existing ambient noise level is very low, such as in a rural locality where no or negligible existing traffic noise exists, the Relative Increase Criterion (RIC) may apply. The intent of the RIC is to recognise residential receivers that are predicted to experience more than a 12 dB increase in ambient noise due to a project and the traffic noise level remains below the relevant Noise Criteria. The RIC is therefore applied to residential receivers where it is more stringent than the new or redeveloped road criteria.

For the purposes of determining the RIC, the lowest assessable existing ambient noise level (post assessment of the results from noise logging undertaken) is 30 dB(A)L_{eq}. Furthermore, the most stringent RIC of either the day or night time period is applicable. The RIC can be determined from noise logging results, or a validated noise model where appropriate.

The RIC is defined as:

- Day (7am to 10 pm) = Existing $L_{Aeq\ day}$ + 12 dB
- Night (10pm to 7 am) = Existing $L_{Aeq\ night}$ + 12 dB

2.4.2 Noise Assessment Criteria Overview – Non-Residential Receivers

An overview of the noise assessment process for non-residential receivers is provided in Figure 2-3.

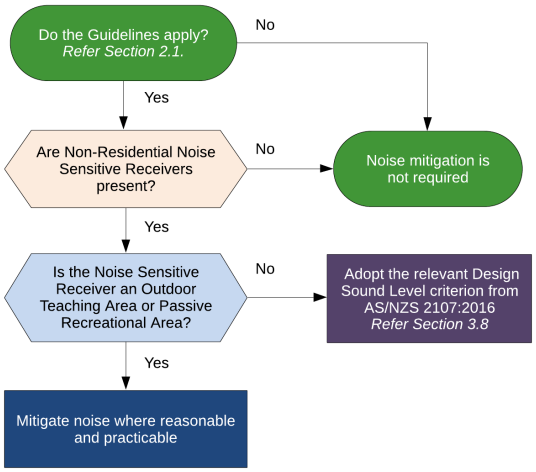

Figure 2-3 Determination of Applicable Noise Criteria Flowchart – Non-Residential Receivers

2.5 Noise Assessment Boundary

The boundary to which a noise assessment applies shall be determined using the following:

- The physical extent of project works that relates to a geometric change of the existing road alignment. Note that physical works does not include pavement reseals (other than as described in Section 2.1.3), or discrete elements of the project that fall outside the scope of the guidelines (as described in Section 2.1.3).
- The NAB must finish at a logical endpoint as near as practical to the extent of physical project works (as defined above). The logical endpoint must fairly consider the grouping of sensitive receivers (or Noise Catchment Areas) that are affected by noise from the project. This may be defined by an intervening local road, a rail corridor, commercial buildings, open space or the like. If a clear delineation is not possible, then the nearest property boundary to the extent of physical project works shall be adopted.
- The width either side of the project is to be set to the extent where the predicted noise level without noise mitigation equals the lowest applicable Noise Criteria, or the RIC in situations where an increase in existing traffic noise is expected to be 12 dB or more. Note that the width may be reduced where the noise levels from the project at opening year contribute no more than 2.0 dB(A) to the total traffic noise level, for example, where the assessed road project intersects other Arterial Roads (practitioner note: noise difference contours comparing the existing versus future opening conditions may assist with determining the NAB at intersections).
- In any case, the width either side of the project alignment shall generally be no more than 600 meters from the centre line of the outermost traffic lane on each side of the road project. This distance is based on the documented limit of accuracy of current road traffic noise models. In some cases, assessment may be required beyond 600 meters. Justification shall be provided for the need for assessment beyond 600 meters and the modelling method used. Note that the 600 meter distance is only applicable to each side of the project alignment, not the extent of works boundary at either end of the project (practitioner note: the modelling calculation area must extend sufficiently beyond the project extent of works boundary to ensure accurate noise level predictions at those receivers on the edge of the NAB).
- The NAB should be defined using property boundaries obtained from a current cadastral map where available and practical.
- The NAB must not be constrained to one side of the road and should fairly consider sensitive receivers located on both sides of the road where the eligible project works to be considered under the RTNG are located. For example, in the case where a major intersection upgrade has resulted in the demolition of properties on one side of an existing arterial road (thereby requiring an assessment

under the RTNG), receivers on the opposite side of the road, where no physical change to the existing road alignment has occurred, should also be included within the NAB. This is in recognition that both sides of the arterial road are exposed to the same traffic noise source.

The Acoustic Consultant shall provide sufficient information to the Department to facilitate a collaborative discussion with key Project Team members to agree the preferred approach. Information that should be provided would typically include noise contours at the project opening year (without noise mitigation) and noise difference contours comparing road traffic noise levels with and without the project at the opening year.

It is expected that the NAB will undergo refinement as part of the noise modelling process, as well as from project design refinements and new detailed information discovered over the delivery phase of a project.

2.6 Noise Catchment Areas and Grouping Receivers

Noise level predictions should be undertaken for each Noise Sensitive Receiver. However, in relation to determining noise mitigation requirements, Noise Sensitive Receivers may be considered on an individual basis or grouped where there is similar exposure to noise.

The intent of grouping receivers is to ensure a common assessment or mitigation approach for those receivers that have a similar exposure to noise to provide a more reasonable and practical approach.

Where individual receivers are grouped together, they are referred to as a Noise Catchment Area under the RTNG. A noise catchment should typically include:

- at least three Noise Sensitive Receivers in close proximity;
- all receiver facades are exposed to similar perceived noise levels (i.e. typically within 2 dB(A) of each other) and usually at a similar proximity to the noise source; and
- a logical delineation of the catchment area (e.g. by topography, cuttings, setbacks, road, rail or utility corridors, breaks in the landscape etc.).

When grouping Noise Sensitive Receivers (or facades) into a Noise Catchment Area, the decision to investigate or provide noise mitigation should be based on the extent of criteria exceedances across the group. If mitigation is required, applying a consistent approach across the catchment and wider project is required.

For example, if the predicted noise levels across a Noise Catchment Area indicates compliance with the noise assessment criteria at more than two-thirds of receivers, and the remaining receivers have minor exceedances of 2 dB(A) or less, then no further noise mitigation is required to be considered. In a similar way, each facade of a single or multi-storey sensitive receiver building may be considered individually or managed as a group.

2.6.1 Transitioning Between Noise Catchment Areas with Different Criteria

A criteria transition will need to be considered when a project spans across multiple noise catchments that have different noise assessment criteria. In these situations, the method of criteria transition can either be a gradual or an immediate transition depending upon how logical the delineation of the Noise Catchment Area is (e.g. delineation by topography, cuttings, setbacks, road, rail or utility corridors, breaks in the landscape etc.).

Situations when this applies includes, but is not limited to:

- A local road extends perpendicular to a ‘redeveloped’ road project between two Noise Catchment Areas, namely Catchment A and Catchment B. Catchment B has had the front row of houses demolished due to a shift in the road alignment, while Catchment A houses are untouched. In this case an immediate transition is likely to be the preferred approach i.e. where the Noise Criteria changes immediately from 55 dB(A) at Catchment A to 52 dB(A) at Catchment B.
- A ‘new’ road project merges into a ‘redeveloped’ road project. In this case a gradual criteria transition from 50 dB(A) (New Road) to 55 dB(A) (Redeveloped Road) in 1 dB(A) steps is likely to be the preferred approach.

2.7 Noise Modelling

Noise modelling shall be undertaken using an appropriate road traffic noise prediction software package that correctly implements the United Kingdom, Department of Environment (1988), Calculation of Road Traffic Noise (CoRTN) algorithm and/or that is acceptable to the Department. Where alternative models are proposed to be used, agreement shall be reached with the Department's Technical Services Environment and Sustainability Unit prior to being undertaken. Adequate justification for using alternative models shall be provided.

Inputs into the noise model will depend on the calculation algorithm being used but would generally require:

- traffic flow counts/predictions for day and night Annual Average Daily Traffic (AADT) flows. Note that Annual Average Weekday Traffic (AAWDT) may be appropriate in some cases, for example where low weekend traffic volumes could skew the results;
- traffic flow percentage splits day/night for light vehicles (Austroads Classes 1-2) and Heavy vehicles (Austroads Classes 3-12;
- a noise source line for each carriageway, as per additional advice for CoRTN procedures published in *UK Design Manual for Roads and Bridges Part 7 HD 213/11;*
- use of a three-source height model where the percentage of heavy vehicles exceeds 10% ;
- traffic flow control devices;
- traffic speeds;
- topographical features;
- property identification; and
- pavement surface type and corrections.

Table 2-2 Road Surface Corrections

This table details typical values of noise level corrections for different road surface types, relative to dense graded asphalt. Note that the values in the table should be used as a guide only, as variations in road texture and porosity may affect the actual result achieved.

Road Surface type	Increase (+) / Decrease (-) in Traffic Noise Level Relative to DGA (dB)[1]
Chip (Spray) seal, 14/7 or 14 millimetres (mm)	+ 4
Chip (Spray) seal, 7 mm	+ 2
Low Noise Diamond Ground Concrete (DGC)	0
Dense Graded Asphalt (DGA)	0
Open Graded Asphalt (OGA)	- 2
Stone Mastic Asphalt 7 (SMA7)	- 1
Stone Mastic Asphalt 10 (SMA10)	0
Stone Mastic Asphalt 14 (SMA14)	+ 1

(1) Source: Roads & Maritime Services, Model Validation Guideline, Version 1.1 (2018)

The outcome of the noise modelling and assessment process should demonstrate:

- definition of the Noise Assessment Boundary;
- identification of all Noise Sensitive Receivers within the Noise Assessment Boundary;
- grouping of receivers into Noise Catchment Areas relating to their applicable Noise Criteria;
- prediction of the existing road traffic noise levels, comparing these to noise logging results representative of the existing traffic noise environment;

- validation of the noise model using known corrections to adjust for Australian conditions, for example based on Austroads or peer reviewed literature. Amongst other factors, the modelling shall consider the appropriate road surface corrections to be applied;
- prediction of the future existing road traffic noise levels at the project-opening year for all sensitive receivers;
- prediction of the future project road traffic noise levels at the project-opening year without any project related noise barriers;
- comparison of the predicted noise level differences between the existing and project model situations at the project-opening year and identify those Noise Sensitive Receivers that are eligible for consideration of noise mitigation; and
- prediction of the future project traffic noise levels (10 years post-opening) and design of reasonable and practicable noise mitigation measures based on this modelling scenario.

2.8 Validation

Validation of the noise model is to be undertaken during preparation of the following:

- Preliminary Noise Assessment and Mitigation report undertaken during the Pre-Delivery phase;
- Noise Modelling and Mitigation Design report undertaken during the Delivery phase. Note that results from noise monitoring undertaken during the Pre-Delivery phase can be used where appropriate; and
- Noise Treatment Validation and Closure report undertaken post project completion.

The intent of the validation process is to verify that the modelling assumptions and methodology through each of the project phases is sufficiently accurate and representative of the existing and future project conditions.

Following opening of the project, noise modelling validation shall be undertaken to confirm that the implemented noise mitigation measures meet the intent of the RTNG.

Post project opening, noise monitoring shall be undertaken as a minimum at or as near as possible to the previously monitored locations to validate the accuracy of the noise modelling process. Noise monitoring shall only be undertaken once the project is at its ultimate operating speeds and traffic flow, with the final road surface installed. The noise monitoring undertaken must be sufficient to ensure that the results are statistically valid for reliable comparison to the noise model predictions.

Validation of the noise model is achieved by comparing the measured versus predicted noise levels determined at a number of representative sites for an existing situation noise model. The Austroads publication *An Approach to the Validation of Road Traffic Noise Models* may be used as a guide to determine an appropriate number of monitoring locations. A minimum of three locations is generally required, however, larger projects have required more locations to account for variations in traffic levels, topography, the presence of NSRs and other factors that were considered during the calibration of the model.

The model will be deemed to be validated if the median difference between the measured and predicted levels is no more than ± 2 dB(A) over the noise monitoring period, with a standard deviation of no more than 2 dB(A). Explanation for differences greater than ± 2 dB(A) at each logger location shall also be provided.

In the event that the median difference between the measured and predicted levels is greater than ± 2 dB(A), or the standard deviation is greater than 2 dB(A), additional monitoring shall be undertaken. If, following additional monitoring, the median difference or standard deviation is still not within the acceptable range, re-examination of model inputs and re-prediction of noise levels at some or all locations is likely to be required. The need for further assessment and additional mitigation shall be considered on a case-by-case basis and agreed with the Department.

2.9 Non-Road Traffic Noise Sources

For the assessment of operational non-road traffic noise sources associated with the Department's infrastructure projects, the following are applicable:

- Tunnel ventilation fans – EPA Environment Protection (Noise) Policy
- Storm water pumps – EPA Environment Protection (Noise) Policy

- Active pedestrian crossings – EPA Guidelines for the assessment of noise from rail infrastructure; DIT Standard for Railway Pedestrian Crossings - CS4-DOC-000446
- Rail traffic noise – EPA Guidelines for the assessment of noise from rail infrastructure.

3 Noise Mitigation

3.1 Determining Noise Mitigation Eligibility

Receivers with exceedances (or residual exceedances) of the Noise Criteria or Relative Increase Criterion (RIC) shall be assessed as outlined below and in Figure 3-1 to determine if they are eligible for noise mitigation. Noise levels and noise increases shall be assessed at each affected receiver facade noting that the largest noise increase may not be at the noisiest facade.

The receiver's eligibility for consideration of noise mitigation shall be based on the change in noise level due to operational changes associated with the proposed road design at the project-opening year. For this comparison, project related noise barriers shall not be included, however road design measures such as road surface type and New Jersey type barriers shall be included. Existing local property fences shall also be included.

Once a receiver is determined to be eligible for consideration of noise mitigation, the mitigation measures shall then be designed to meet either the Noise Criteria or the RIC (whichever is the most stringent) for the predicted traffic volume 10 years post project opening, where reasonable and practicable.

When evaluating if a receiver is eligible (at the project-opening year), one or more of the following tests shall be satisfied:

1. is the predicted noise level greater than the RIC, if it is the most stringent noise assessment criteria?
2. is the project predicted noise level more than 2 dB(A) (i.e. ≥ 2.1 dB(A)) above the existing predicted noise level at the project opening year, and above the Noise Criteria?
3. is the project predicted noise level greater than or equal to 5 dB(A) (i.e. ≥ 5.0 dB(A)) above the Noise Criteria?

The above tests provide for a reasonable and practicable approach to identifying eligible receivers through managing large relative increases in noise, high noise exposure situations, as well as small noise increases not perceptible to the human ear (i.e. 2 dB(A) or less). The third point above also specifically addresses existing road traffic noise within the NAB.

Figure 3-1 provides the process to be followed for determining eligibility for noise treatment and designing reasonable and practicable noise treatment. Note that selecting the most reasonable and practicable noise mitigation measures may be an iterative process reflecting a mixture of treatment options.

3.2 Noise Mitigation Hierarchy

The following mitigation hierarchy is to be followed where reasonable and practicable:

1. Mitigation at the source (e.g. road design measures);
2. Mitigation along the transmission path (e.g. noise barriers/mounds); and
3. Mitigation at the receiver (e.g. property/facade treatment).

3.3 Responsibility for Mitigating Traffic Noise

Noise mitigation measures shall be provided to protect existing Noise Sensitive Receivers, eligible for treatment under the RTNG, within the defined Noise Assessment Boundary for a new and redeveloped road projects.

Noise mitigation measures shall also be provided to protect any Noise Sensitive Receivers for which a *Development Approval* under the *Planning, Development and Infrastructure Act 2016* has been granted before the date that the road project was publicly announced. In this case the approved building footprint and height should be used as the basis for noise predictions and eligibility for mitigation. Any property treatment would be determined in discussion with the owner/developer with the intent that the Project is responsible for the cost of any mitigation treatment that would not otherwise be required.

It is the property owner or developer's responsibility to provide noise mitigation measures for developments submitted for planning approval after a road project has been publicly announced. Developments should comply with relevant provisions of the *Planning and Design Code* and the Ministerial Building Standard MBS 010 *Construction requirements for the control of external sound*.

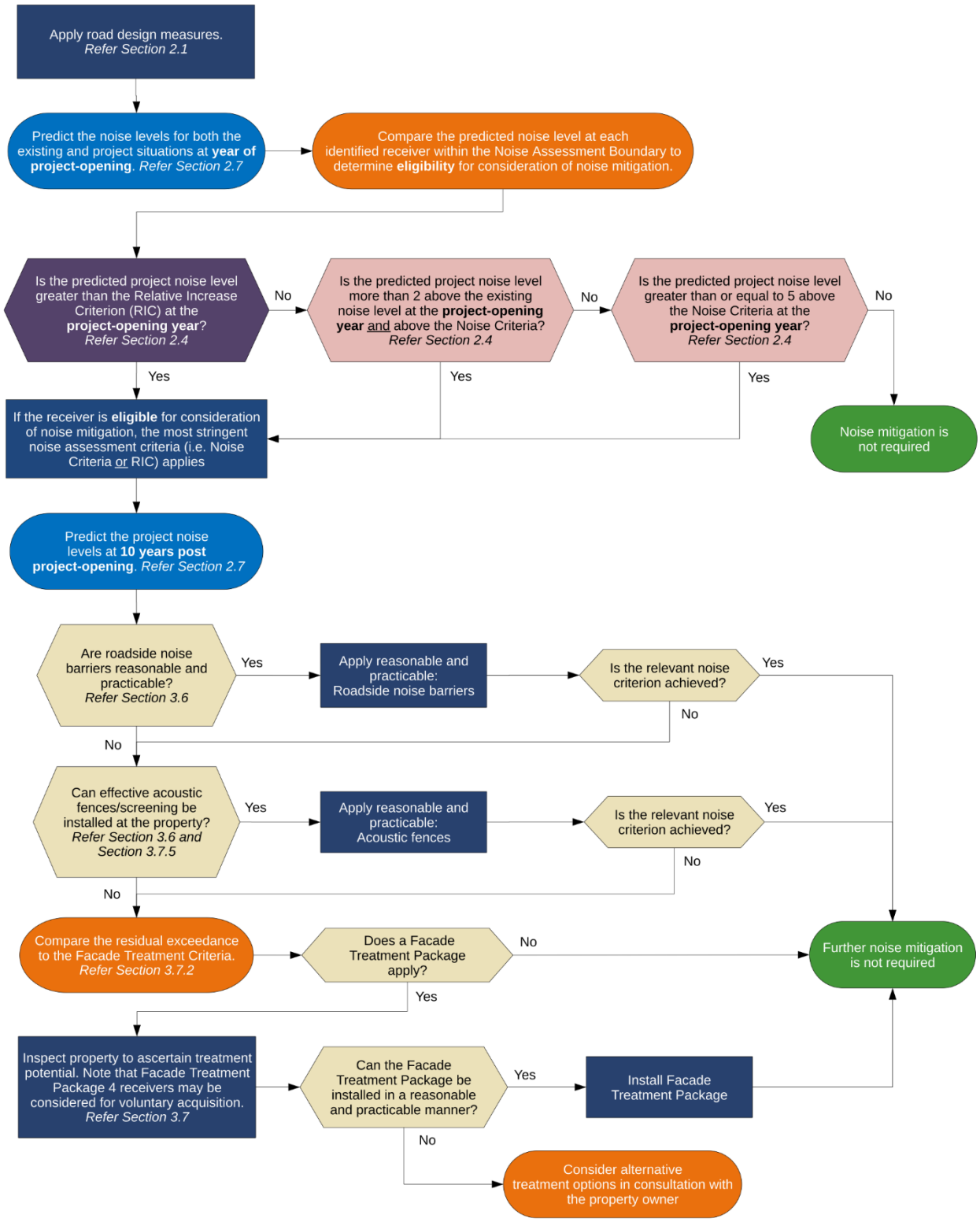

Figure 3-1 Noise Mitigation Flowchart – Residential Receivers

3.4 Determining Reasonable and Practicable Noise Mitigation

For all road projects where noise mitigation measures are proposed, it is necessary to consider what measures are reasonable and practicable. Noise mitigation can be provided in a range of ways and may be a combination of methods including roadside barriers, property treatments (i.e. fencing and/ or facade treatments) and design measures.

Selecting reasonable mitigation measures from those that are possible involves judging whether the overall noise benefits outweigh the overall adverse social, economic and environmental effects, including the cost of the measure.

Note: Determining what is reasonable and practicable

Judging what is reasonable and practicable noise mitigation includes:

- Application of the noise mitigation hierarchy, controlling noise at the source is preferable
- Community expectations and potential perception of the mitigation measure(s)
- Urban design objectives
- Environmental effects (e.g. cultural or vegetation impacts)
- Noise catchment area approach
- Engineering considerations including structural requirements, access, safety and maintenance
- Cost versus noise reduction benefit of the mitigation measure(s).

3.5 Road Design Measures

Road design measures to mitigate traffic noise shall be considered during early route options analysis, as well as through the concept and detailed design phases and shall include:

- adjustment to the vertical and horizontal alignments;
- low noise pavement surfaces;
- road gradient modifications;
- speed limit reduction;
- traffic management measures; or
- New Jersey style barriers.

The application of the above measures shall be considered for implementation where there are no significant impacts on other road design considerations such as cost, access, security, community acceptance and safety.

3.6 Noise Barriers

Roadside noise barriers are an effective noise mitigation measure for urban environments, particularly when receivers are located in close proximity to the noise barrier.

Roadside noise barriers are less effective in situations where dwellings are located further from the noise barrier, such as in rural areas where the property sizes may be larger. Furthermore, road noise barriers are generally only cost effective for grouped properties of three or more.

Where roadside noise barriers are not considered reasonable or practicable, property fencing may be investigated.

A guide to reasonable heights for roadside noise barriers and property fencing are detailed in Table 3-1.

Table 3-1 Reasonable Heights for Noise Barriers

Proposed Barrier Location	Height
Property boundary Access to property is through the barrier	Up to 2.4 with solid gates(1)
Property boundary Property access is from another road	Up to 4m(2)
Within road reserve	Up to 7m(2)

Notes:

(1) Fences with gates may be constructed to a height above 2.1 m as long as the gate is designed so as not to degrade the acoustic performance of the fence and the functionality of the gate is acceptable.

(2) Barriers that are greater than 3.5 m in height must take into account factors such as the noise reduction benefit versus cost, practical construction limitations, visual amenity and overshadowing issues. Generally, these barriers should be set back from an adjacent property boundary taking into account the ability to maintain the space and the potential to reduce the impact of the barrier by using clear barrier material.

Note: Property Fencing Considerations

Where property fences are to incorporate gates for access reasons, the fence would not normally be constructed to a height greater than 2.1 metres as the gate may degrade the acoustic performance of the fence and be difficult to open. However, a higher fence incorporating a gate may be constructed where it can be demonstrated that the gate will not degrade the acoustic performance of the fence and the functionality is acceptable (e.g. the gate is automated).

Safety aspects for access to the property, such as ability to open the gate with the vehicle off the road shall also be considered, i.e. situations that would present a danger for the resident to stop and exit a vehicle on an arterial road to open the gate manually.

3.6.1 Noise Barrier Benefit (Insertion loss)

As a general guide, noise barriers or mounds are considered to be a reasonable noise mitigation option where they are capable of providing an insertion loss at the nearest affected receiver(s) of:

- minimum 5 dB(A) for heights up to 3 metres;
- > 5 dB(A) to 10 dB(A) for heights ranging > 3 metres to 5 metres; or
- >10 dB(A) for heights above 5 metres and up to 7 metres high.

When considering the above insertion loss requirements, the following provides additional clarification:

- Where a location exceeds the noise assessment criteria by less than 5 dB(A) this could lead to designing to achieve an insertion loss of less than 5 dB(A). Under these circumstances, where two-thirds of the noise sensitive residences no longer require property treatment a noise barrier should not be abandoned because it did not provide 5 dB(A) insertion loss.
- Small barriers that are low cost to install, such as New Jersey style barriers, but do not provide an insertion loss of 5 dB(A), may also form part of an overall noise mitigation strategy.
- Where noise barriers greater than 5 metres in height do not provide 10 dB(A) of noise reduction, additional consideration should be given to the number of receivers that benefit and whether the barrier placement could be improved. If it is not reasonable to provide a barrier with height above 5 metres then lower heights shall be considered.
- Noise barrier designs can vary in height along the barrier length, subject to urban design and community views. However, if a barrier is to vary in height along its length it shall achieve an equivalent noise outcome for the community as a constant height noise barrier.
- Before assessing barrier height, the location of the barrier shall be reviewed to ensure that it provides the best opportunity to use the topography and road geometry to maximise shielding.

In cases where barriers are considered a potential mitigation option, an assessment of the barrier insertion loss versus height shall be undertaken for each individual property to assist with comparing the noise benefit to other factors, such as:

- urban design considerations, such as overshadowing;
- impacts to passive surveillance and potential crime prevention issues; and
- cost.

When undertaking a noise barrier insertion loss versus height assessment, the following shall be considered:

- Property fences – the resultant insertion loss, residual exceedance, and associated Facade Treatment Package (FTP) is to be assessed in 300 mm increments up to the maximum reasonable height shown in Table 3-1 for each individual receiver. If an existing property fence is present, and a higher fence is to be considered for noise mitigation purposes, the change in insertion loss associated with the change in height shall be presented.
- Transport corridor noise barriers and/or earth mounds - the resultant insertion loss, residual exceedance, and associated FTP is to be assessed in 500 mm increments up to the maximum reasonable height shown in Table 3-1 for each individual receiver.
- For each height modelled, the resultant insertion loss shall be compared to the minimum insertion loss requirements presented earlier in this section.
- The summary of the total number of potential FTPs shall also be provided for each barrier height modelled.

Noise treatments, including height of noise barriers versus number of house treatments (where applicable) shall be provided to the Department for acceptance.

Note: Community Considerations

It is important to consider the potential community expectation and perceptions of the proposed noise barrier solution, such as:

- Recent similar project precedence e.g. adopted barrier heights, material choice and urban design.
- Visual perception of a noise barrier e.g. does the barrier block line of sight to passing vehicles, including heavy vehicles?
- Potential overshadowing issues.
- Community feedback (where available).
- Ultimately, the formulation of a preferred barrier design requires a holistic and collaborative approach.

3.6.2 Barrier Materials

Where barrier materials are specified for a project, these shall be documented in the Contract Documents or a project's Urban Design Framework. Where not specified the following shall apply:

- A noise barrier should generally be constructed from the most cost effective materials that will not degrade the acoustic performance of the barrier.
- For residential fences that do not form part of the roadside barrier, the material shall generally be sheet steel with a nominal base metal thickness (BMT) of at least 0.48 mm and preferably 0.6 mm. Double skinned 0.42 mm BMT steel may also be used.
- If there is an existing fence it shall be replaced with similar materials to existing. However, other criteria such as maintenance, longevity, existing fencing, amenity, urban design and streetscape issues, Council requirements in relation to the character of the area and heritage issues may also need to be considered in the material selection process.

3.7 Noise Mitigation at the Residential Receiver

This section describes the various property treatments that may be used to treat receivers that have been identified as eligible for consideration of noise mitigation. Property noise mitigation measures may substitute road corridor mitigation, subject to a reasonable and practicable assessment, and only in the following circumstances:

- isolated single residences or isolated groups of closely spaced residences;
- where the affected community expresses a preference for at-property treatment and the cost is less than a combination of a barrier and at-property treatment;
- where noise barriers cannot achieve the level of noise mitigation (insertion loss) required; or
- where other noise mitigation measures have been shown not to be reasonable or practicable.

These treatments are generally limited to facade treatments, however, on a case-by case basis the installation of acoustic screening close to the dwelling may be considered in lieu of facade treatments.

Unless otherwise advised by the Department, the decision to adopt noise mitigation at the receiver in lieu of noise mitigation at the source or along the transmission path shall be discussed with and approved by the Department.

The project team and/or Acoustic Consultant shall provide sufficient information to the Department to facilitate a collaborative discussion to agree the preferred mitigation approach.

3.7.1 Facade Treatment Packages

Once the decision has been made to treat individual properties, dwelling facade treatment provides an effective means for reducing indoor traffic noise levels. The intent of the treatment is to improve the amenity of sleeping and living areas, where required as determined by an acoustic engineer. Facade treatment involves the targeted acoustic upgrade of windows and doors and for higher noise exposed facades, ceilings and ventilation.

Facade treatment packages outlined below have therefore been developed to provide the targeted reduction in traffic noise levels based on the required acoustic performance. They are referred to as Facade Treatment Package (FTP) 1, 2, 3 and 4.

Table 3-2 outlines the acoustic performance requirements for each FTP in addition to deemed-to-satisfy facade upgrades.

Note that the Facade Treatment Packages are a deemed-to-satisfy solution to meet the requirements of the RTNG i.e. no monitoring is required to determine if the solution achieves the required dB reduction. While due care must be taken in the design and selection of acoustic treatments the Department makes no guarantee that any particular facade internal noise level will be achieved. An alternative solution is not required to be designed by an acoustic engineer, however, an acoustic engineer may design alternative treatment options to achieve an equivalent acoustic performance to the specified package treatments to suit more unusual dwelling facades.

For further information on standard facade treatment scopes of work that have been developed on recent projects undertaken by the Department, as well relevant construction specifications, refer to the Property Noise Mitigation: Facade Treatment Package Specification available for download from the Department's website.

Table 3-2 Facade Treatment Package – Acoustic Performance Requirements

Facade Treatment Package	Acoustic Performance Requirements
1	**Windows and external glass doors** *Window = $R_W + C_{tr}$ 31* For example, the acoustic equivalent of an existing window system incorporating 3 mm thick glass, with the addition of a 4.5 mm or 10mm thick acrylic panel separated by a ≥100mm or ≥50mm air gap respectively, or a single window system incorporating at least 6 mm thick laminated glass. *Door = $R_W + C_{tr}$ 28* For example, the acoustic equivalent of a glass door system incorporating at least 6 mm thick laminated glass. *Acoustic Seals* To achieve the acoustic performance, acoustic grade seals will need to be incorporated into the above secondary or replacement window or door systems.
	External doors other than external glass doors *Door = R_W 29* For example, the acoustic equivalent of a solid timber core door with acoustic grade seals to head and jamb.
	External Flanking Paths Inspect the facade for external noise flanking paths that could potentially degrade the installed treatment. Rectify where reasonable and practicable. For example, block internal wall vents that have a direct path to the external wall facade. Note that external wall or floor cavity vents required for moisture control do not need to be treated.
2	**Windows and external glass doors** *Window = $R_W + C_{tr}$ 34* For example, the acoustic equivalent of an existing window system incorporating 3 mm thick glass, with the addition of a 10 mm thick acrylic panel separated by a 100 mm air gap or a single window system incorporating at least 10 mm thick laminated glass. *Door = $R_W + C_{tr}$ 31* For example, the acoustic equivalent of a sliding glass door system incorporating at least 10 mm thick laminated glass. *Acoustic Seals* To achieve the acoustic performance, acoustic grade seals will need to be incorporated into the above secondary or replacement window or door systems.
	External doors other than external glass doors *Door = R_W 29* For example, the acoustic equivalent of a solid timber core door with acoustic grade seals to head and jamb.
	External Flanking Paths Inspect the facade for external noise flanking paths that could potentially degrade the installed treatment. Rectify where reasonable and practicable. For example, block internal wall vents that have a direct path to the external wall facade. Note that external wall or floor cavity vents required for moisture control do not need to be treated.

Facade Treatment Package	Acoustic Performance Requirements
3	**Windows and external glass doors** *Window = $R_W + C_{tr}$ 37* For example, an acoustically rated single or double-glazed window system that can achieve the acoustic performance requirement. Alternatively, upgrading the existing external window with 6 mm thick laminated glass (including flanking paths sealed) with the addition of a 10 mm thick acrylic panel separated by a ≥100 mm air gap will suffice. *Door = $R_W + C_{tr}$ 34* For example, an acoustically rated single or double-glazed door system that can achieve the acoustic performance requirement. It is likely that a new door system will be required. *Acoustic Seals* To achieve the acoustic performance, acoustic grade seals will need to be incorporated into the window or door system.
	External doors other than external glass doors *Door = R_W 32* For example, the acoustic equivalent of a solid timber core door of not less than 28 kg/m^2 surface density, acoustic grade seals around the head and jamb acoustically equivalent to Raven RP-10Si perimeter seals, and Raven RP-99Si to the sill with a Raven RP-95 aluminum threshold. Double doors require Raven RP-16Si to the meeting stile (Astragal). Alternative door seals may be used; however, they must have an equivalent acoustic performance to that specified.
	Roof and Ceiling Provide insulation batts (minimum R4.0) to ceiling cavity if no insulation or poor/degraded insulation is present on inspection.
	External Flanking Paths Inspect the facade for external noise flanking paths that could potentially degrade the installed treatment. Rectify where reasonable and practicable. For example, block internal wall vents that have a direct path to the external wall facade. Note that external wall or floor cavity vents required for moisture control do not need to be treated.
	Ventilation An alternative source of ventilation shall be provided in accordance with the Building Code of Australia and complying with *AS 1668.2 - The use of mechanical ventilation and air-conditioning in buildings* and should be designed such that the facade acoustic performance is not degraded. Note that in some cases borrowed ventilation from other less affected areas may be sufficient. An appropriate solution may be determined by a mechanical engineer.
4	**Package 3 architectural treatments (above) are applicable.** In consideration of acoustic and non-acoustic factors, where reasonable and practicable, an offer for voluntary acquisition of the property may be considered on a case-by-case basis. Note that voluntary acquisition is only to be considered when other options for noise mitigation have been explored and weighed against property acquisition costs and the predicted post treatment amenity.

3.7.2 Facade Treatment Criteria for Residential Receivers

Under the RTNG, facade treatments to habitable spaces are applicable to an NCC Class 1, 2, 3 building, a Class 4 part of a building or a Class 9c residential care building, where contemplated by the Planning and Design Code.

Transportable buildings (or similar) are not eligible for treatment unless it can be demonstrated that upgrade of the facade is likely to result in a noticeable noise reduction for the resident.

Noise sensitive receivers that do not fall under the above NCC classes are assessed on a case-by-case basis in accordance with Sections 2.4.2 and 3.8.

If residential receivers have been identified as eligible for consideration of noise mitigation as per the above process, the facade treatment package is determined from the Table 3-3.

Table 3-3 Facade Treatment Packages for habitable spaces

Habitable Space	Applicable Facade Treatment Package for Noise Levels above the Noise Criteria or Relative Increase Criterion			
	2 - 5 dB(A)	6 - 9 dB(A)	10 - 13 dB(A)	>14 dB(A)
Bedroom	1	2	3	4
Other habitable rooms	n/a	1	2	3

Notes:

(1) Predictions must be at 1 m from the facade, include the 2.5 dB(A) facade reflection correction and rounded to the nearest decibel for the purpose of determining the facade treatment package. Note the *unrounded* (1 decimal place) predicted noise levels should be used to determine eligibility for mitigation.

(2) For Facade Treatment Package 3 and 4, alternative ventilation in addition to openable windows may be provided in accordance with the National Construction Code and complying with *AS 1668.2 - The use of mechanical ventilation and air-conditioning in buildings*.

(3) Non-habitable rooms include walk-in wardrobes, ensuites and enclosed kitchens. However, where these spaces are part of an open plan arrangement with adjoining habitable rooms, such as a living/dining area or bedroom, they need to be treated as part of the habitable room.

(4) Treatments to residential dwellings will be restricted to bedrooms, studies, living, dining and kitchen areas that have windows or doors in the facade being treated. Corridors, laundries, bathrooms, garages, sheds and workshops will not be treated.

(5) When the Noise Criteria is less than 50 dB(A), treatments to residential dwellings will be restricted to bedrooms that have windows or doors in the facade being treated.

3.7.3 Facade Treatment Considerations

The following should be considered before and during the application of facade treatments:

- Only facades of habitable rooms being used at the time of the project will be treated. Future renovations (not yet approved by Council) that will change the use of a space will not be considered during the treatment process.
- Facades of rooms that are not habitable and/or in a considerable state of disrepair will not be treated.
- Facades that contain asbestos can be treated under the provision that the owner pays for cost of asbestos removal and clean up.
- Electrical wiring that is considered not safe to supply a mechanical ventilation system can be repaired at the owners cost.
- Architectural treatments may be substituted with alternative treatments at the discretion of the Deaprtment, where the alternative provides an equivalent level of noise reduction.
- Noise treatment is only considered to rooms associated with facades that qualify for FTP as determined in Table 3-3. The FTP for different rooms on the same facade may differ depending on the noise exposure level and room use (e.g. bedroom versus living room).

3.7.4 Mechanical Ventilation

The provision of mechanical ventilation is required to be considered for Facade Treatment Packages 3 and 4, where no suitable existing mechanical ventilation exists, and where sufficient fresh air cannot be provided from other parts of the building.

Note that mechanical ventilation is not required for Facade Treatment Packages 1 and 2, although may be provided at the discretion of the Department, upon recommendation of the acoustic engineer.

Where a mechanical ventilation system is required, the ventilation system must be installed:

- in accordance with the Building Code of Australia and complying with *AS 1668.2 - The use of mechanical ventilation and air-conditioning in buildings*;
- the relief air path/s should be fully ducted to allow operation of the system with windows and external doors closed; and
- the fresh air (or make up air) inlets and exhaust air outlets shall be at a point on the building furthest from the road corridor where practicable.

3.7.5 Acoustic Screening

As an alternative to facade treatments (for eligible receivers), property treatments can also utilise acoustic screening situated close to the dwelling for the purpose of shielding an outdoor entertainment area (and associated facade) if this is considered a preferred approach. Acoustic screening is considered on a case-by-case basis where practical and in consultation with the resident.

Acoustic screening should be treated in the same way as a property boundary fence in terms of height limits, materials and value for money insertion loss performance.

3.8 Noise Mitigation to Non-Residential Sensitive Receivers

Noise mitigation provided to non-residential sensitive receivers shall be determined on a case-by-case basis utilising the criteria described in Section 2.4.2

For each identified and relevant receiver (noting Figure 2-3), an Indoor Noise Criterion shall be derived from *AS/NZS 2107:2016 Acoustics – Recommended design sound levels and reverberation times for building interiors* by an Acoustic Consultant for each relevant sensitive space (or room use). The noise mitigation hierarchy outlined in Section 3.2 shall also be followed and assessed in a similar manner to the process for Residential Receivers. The noise metrics for undertaking the assessment shall be the same as that used for Residential Receivers (i.e $L_{Aeq\ day}$, $L_{Aeq\ night}$).

An overview of the assessment process to be followed for these receivers is outlined in Figure 3-2.

Note that where facade treatment is required, provision of mechanical ventilation should also considered for non-residential sensitive receivers, where no suitable existing mechanical ventilation exists, and where sufficient fresh air cannot be provided from other parts of the building.

3.9 Noise Mitigation Provision Constraints

The following shall apply when providing noise mitigation:

- Under no circumstances will the Department offer monetary compensation to property owners instead of noise mitigation treatments.
- A property owner can reject offered noise mitigation treatments but must sign an ‘Election to Decline Offer to Undertake Noise Reduction Treatment to Residence’ form which is available in the Department’s Noise Implementation Guideline
- Alternative treatments providing less acoustic attenuation may be provided where the property owner prefers the alternative and understands they will not be provided with an equivalent level of noise mitigation. In this case, a waiver must be signed by the property owner.
- Mitigation treatments shall consist of constructions and materials that are deemed by the Department to be reasonable and practicable. If the property owner desires an alternative construction or material, any additional cost will be the responsibility of the owner.

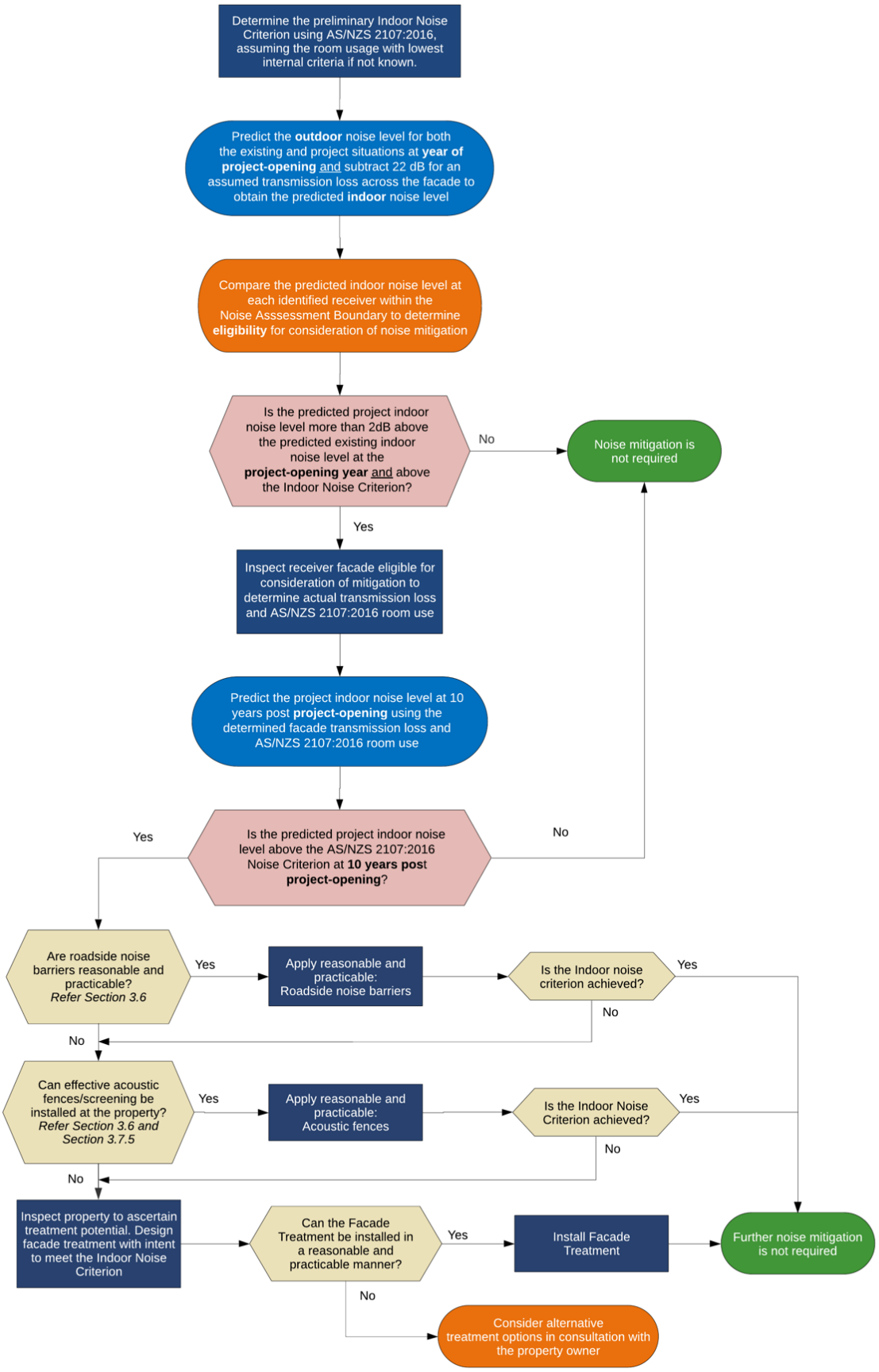

Figure 3-2 Noise Mitigation Flowchart – Non-Residential Receivers

4 Reporting and Deliverables

Subject to the project lifecycle phase and Contract Documentation, the following deliverables would be provided to the Department for review and acceptance. The Department's Project Manager will engage with the Technical Services Environment and Sustainability Unit to assist with the review, where necessary. An Independent Design Certifier (IDC), where appointed for the project/ program, would be required to review and accept the deliverables.

4.1 Proving Phase

During the Proving Phase (planning/concept development/route selection) of a project, information may be required for input into planning study documentation (or similar), the Environment and Heritage Impact Assessment (EHIA) Report and to inform the cost estimation of the project.

An assessment to determine the applicability, or otherwise, of the RTNG, based on the scope of the project and the principles of application of the above noise guideline/s, shall be undertaken and used to identify the need for further assessment upon selection of the preferred design. This assessment shall be included as part of the preliminary and detailed EHIA documentation.

Where traffic noise is a component of the options selection or short-listing, a high level assessment of each option using the RTNG may be required to be undertaken to assist in the options selection process.

4.2 Pre-delivery/Delivery Phase

4.2.1 Preliminary noise assessment report

During the Pre-delivery Phase of the project or once a preferred (or reference) design has been selected, the applicability of RTNG must be assessed, or reassessed. Where there is a change in the scope of the project, traffic volumes or design modifications, the applicability of the RTNG must be reassessed.

During the Pre-delivery Phase, where the noise guidelines are deemed to apply, a Preliminary Noise Assessment and Mitigation Report will be undertaken in accordance with the requirements of the Master Specification Part PC-ENV4. The outcomes of this assessment will be included in the project's Detailed EHIA Report. Where relevant, the Preliminary Noise Assessment and Mitigation Report shall also include the outcome of the Screening Process for the road traffic vibration assessment as described in Part B.

Preliminary Noise Assessment and Mitigation Report

The report as a minimum include:

- Noise Assessment Boundary.
- All identified assumptions and modelling inputs (including calibration factors and existing and proposed pavement type, traffic volumes etc).
- Noise logging results of existing conditions. The following shall also be provided to the Department for record keeping:
  - Spreadsheet format of all raw results suitable for additional processing if required;
  - GPS coordinates of logger locations;
  - Detailed site installation photos; and
  - Calibration certificates of measurement equipment.
- Identification of properties with multi-storey dwellings.
- Identification of properties with multiple dwellings e.g. units and townhouses.
- Predicted noise level results (existing, on opening [or other agreed time] and 10 years post opening), the relevant Noise Criteria and the noise level achieved at each noise sensitive property (each property to be identified by an ID number that corresponds to a plan).

- Validation of the existing conditions noise model for both day and night scenarios.
- Identification of the Noise Sensitive Receivers eligible to be considered for noise mitigation treatments under the RTNG.
- Noise contour plots of the predicted noise level results for existing conditions, on opening and 10 years post opening as well as noise difference contours comparing the predicted existing conditions and project opening noise levels with/without project noise barriers (where relevant).
- Details on noise mitigation options that could be investigated/ implemented during the detailed design/construction phase of the project (e.g. pavement type, barriers, facade treatments, etc). The details provided should be sufficient to assist preliminary project cost planning.
- Noise mitigation treatment plans i.e. preliminary noise barrier locations and identified properties eligible for consideration of facade treatments.
- Barrier height analysis in accordance with Section 3.6.1. The preferred barrier solution and residual number of property facade treatments shall be undertaken in the Proving/Pre-delivery Phases and will inform the preliminary cost plan and guide the mitigation approach to be undertaken during the detailed design and delivery process.
- Other supporting information as required.

4.2.2 Detailed design noise assessment report

When the project moves into detailed design, a *Noise Modelling and Mitigation Design Report* shall be prepared in accordance with Master Specification Part PC-ENV4.

Prior to undertaking noise modelling the design basis for the detailed noise assessment shall be agreed with the Department.

Noise Modelling and Mitigation Design Report

The *Noise Modelling and Mitigation Design Report* shall address the requirements for Design Reports of the Department's Master Specification Part PC-EDM1 Design Management and include:

- Noise Assessment Boundary.
- All identified assumptions and modelling inputs (including calibration factors and existing and proposed pavement type, traffic volumes etc).
- A summary of the noise logging results obtained from the pre-delivery phase monitoring. Note that further noise monitoring is not required to be undertaken during the delivery phase, unless otherwise agreed with the Department.
- Identification of properties with multi-storey dwellings.
- Identification of properties with multiple dwellings e.g. units and townhouses.
- Predicted noise levels results (on existing, on opening and 10 years post opening), the relevant Noise Criteria and the noise level achieved at each noise sensitive property (each property to be identified by an ID number that corresponds to a plan).
- Validation of the existing conditions noise model (for both day and night scenarios) using the noise logging results obtained from the pre-delivery phase.
- Identification of the Noise Sensitive Receivers eligible to be considered for noise mitigation treatments under the RTNG.
- Details of the noise mitigation to be implemented to achieve the intent of the RTNG (e.g. road surface, barriers and / or facade treatments). Note that the preferred mitigation approach documented in the *Preliminary Noise Assessment and Mitigation Report* shall be used as the preliminary basis for detailed design. Clear justification and approval from the Department must be sought if the mitigation approach is significantly varied e.g. noise barriers are eliminated from the design in favour of additional property treatments.
- Noise contour plots of the predicted noise level results for existing conditions, on opening and 10 years post opening (with/without road corridor noise mitigation treatments) as well as barrier insertion loss (where relevant).
- Noise mitigation treatment plans e.g. areas of road surface treatment, noise barrier locations/heights and identified properties eligible for consideration of facade treatments, including the maximum FTP level applicable for each dwelling.

Where noise barriers or mounds are identified within the *Noise Modelling and Mitigation Design Report*, detailed design drawings including details of barrier locations, heights, materials, finishes, drainage and maintenance considerations, urban design, typical construction details, start and end chainage, total length shall be included in the relevant multi-discipline design reports.

4.2.3 Facade treatment reports

Where facade treatment to Noise Sensitive Receivers has been identified in the *Noise Modelling and Mitigation Design Report* and agreed as a mitigation measure, each property is to be inspected to determine eligibility for treatment. Those properties identified to receive facade treatment are then eligible to be issued a *Facade Treatment Scope of Works* (FTSW) document for approval by the property owner prior to the implementation of the treatment measures.

The FTSW deliverable requirements are outlined below.

Facade Treatment Scope of Works (FTSW)

The *FTSW* document prepared for each eligible property shall, at a minimum, include:

- A floor plan detailing building orientation, room use and applicable treatment package.
- Scope of noise mitigation treatment to be offered.
- Information regarding fixtures identified for treatments (measurements, photographs, observations regarding practical implications for installation).
- Photographs of pre-existing conditions and work area.
- Ensure that when designing mitigation treatments, consideration is given to the existing property features to ensure that (where reasonable and practical) proposed treatments conform to the existing style and character.

Note that the *FTSW* document must be suitable for issue to both the property owner for approval and the building contractor to implement the works. Where a property has been inspected and determined to be ineligible for treatment, a report should be prepared describing the inspection and reason(s) why no treatment should be implemented.

4.2.4 Validation

The intent of the validation process at project completion is to confirm that the projects implemented noise treatment strategy meets the requirements of the RTNG. Further to the documented validation of the noise modelling predictions, the closure report also serves as a consolidated record of the ‘as-built’ noise treatment undertaken for future reference by the department should community queries arise.

Noise Treatment Validation and Closure Report

The *Noise Treatment Validation and Closure Report* shall, at a minimum, include:

- Verification that the noise model and the mitigation implemented complies with the requirements of the RTNG. Refer Section 2.8 for more information.
- Summary of noise mitigation measures implemented across the project, that is: noise barriers, fences, and facade treatments.
- Detailed record of the ‘as built’ noise treatment implemented. In addition to the report, the detailed record must also include the provision of GIS shapefiles for a complete visual record of the noise mitigation process for future reference, that is: noise barrier locations and heights, individual properties which received or waived facade treatment, properties that were eligible for an inspection but either waived the inspection or failed to respond to repeated contact requests, future design year noise contours. As-built drawings of roadside noise barriers shall also be provided (where relevant).
- Summary table of all sensitive receivers for opening year and future (10 year) scenario.

PART B

Road Traffic Vibration Assessment

5 Process for Assessing Road Traffic Vibration

Vibration from road traffic does not generally have the potential for significant impact in comparison to noise. Typically, operational vibration from vehicle movements is not noticeable at distances greater than a few metres from the road.

Vibration from road traffic is often only perceived at times when heavy vehicles pass over discontinuities in the road surface (such as expansion joints, potholes or access covers). Vibration of lightweight building elements such as windows or wall-hung items may also be caused by low-frequency airborne noise, rather than ground-borne vibration.

Detailed assessment of road traffic vibration is therefore only typically necessary where vibration sensitive receivers exist in close proximity to the road, or where discontinuities in the road surface are expected to result in elevated vibration levels at receiver locations.

Vibration Sensitive Receivers include the following:

- Properties that accommodate a National Construction Code (NCC) Class 1, 2, 3 building, a Class 4 part of a building or a Class 9c residential care building, where contemplated by the Planning and Design Code (refer to https://www.abcb.gov.au/Resources/Publications/Education-Training/Building-classifications for more information);
- Caravan parks that accommodate existing long term residential use;
- Hospital wards;
- Churches/ places of worship;
- Indoor teaching areas relating to educational institutions, childcare centres and kindergartens; or
- Research, healthcare or manufacturing facilities containing equipment that is sensitive to vibration.

5.1 Screening Process

An overview of the vibration assessment Screening Process is shown in Figure 5-1. The need for a quantitative road traffic vibration assessment shall be based on the following:

- A vibration assessment shall only be undertaken on road infrastructure projects where the RTNG apply based on Section 2.1;
- If there are research, healthcare or manufacturing facilities within the Noise Assessment Boundary (NAB) with equipment (for example lithography or microscopy equipment) that is sensitive to vibration at levels below the threshold of human perception, a specialist vibration assessment shall be undertaken assessing vibration against the specific criteria for that equipment;
- If there are discontinuities in the road surface (such as expansion joints), and there are vibration sensitive receivers within 15 metres of a discontinuity, a vibration assessment is required for those receivers in accordance with the below; or
- For other sections of new or redeveloped road (with no road surface discontinuities), a vibration assessment is required for vibration sensitive receivers within 6 metres from the edge of the carriageway.

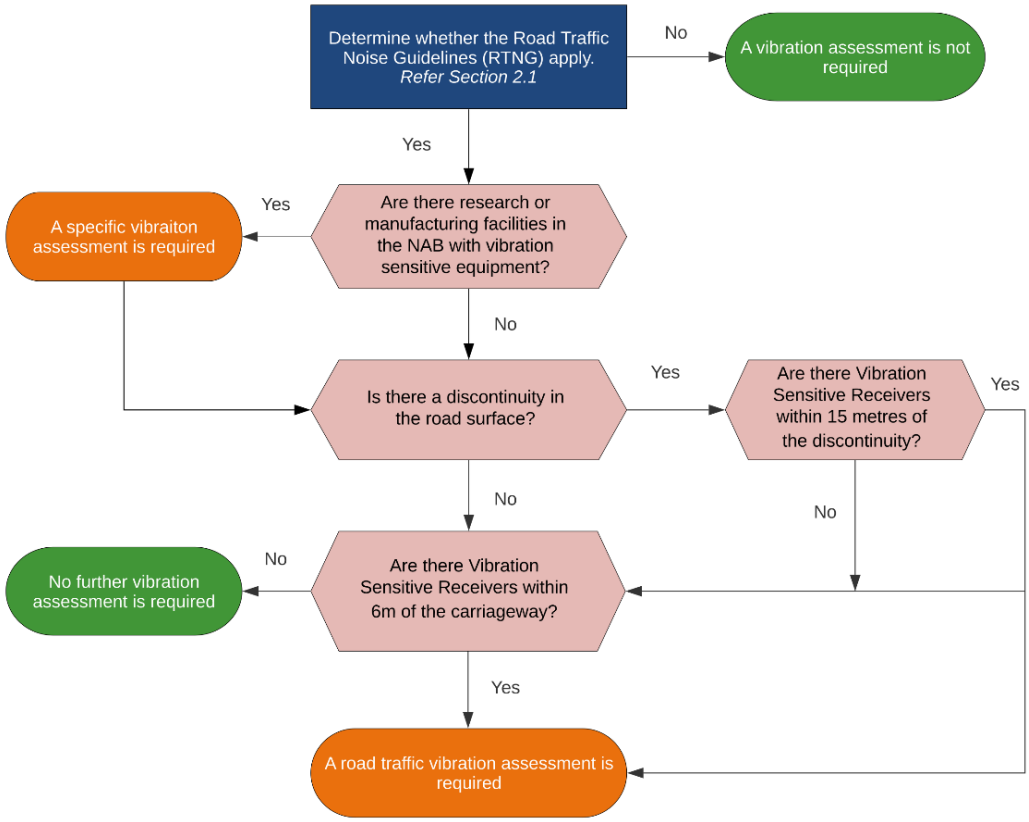

Figure 5-1 Vibration Assessment Screening Process Overview

5.2 Assessment criteria

Where a road traffic vibration assessment is required, the following Vibration Criteria shall apply to occupied spaces within buildings as detailed in the table below. Vibration criteria do not apply to outdoor teaching or passive recreation spaces.

Criteria for intermittent road traffic vibration are expressed as Vibration Dose Values (VDV), as described in British Standard BS 6472-1:2008 *Guide to evaluation of human exposure to vibration in buildings*, and *Assessing Vibration: A technical guideline* (NSW Department of Environment and Conservation, 2006).

Criteria are given as a range with the lower value indicating the preferred vibration level and the upper value representing the maximum.

Assessment against alternative criteria (for example root-mean-square (rms) acceleration or peak vibration velocity), may be acceptable in some cases.

Table 5-1 Road Traffic Vibration Criteria

Sensitive receiver	Vibration assessment criterion, VDV m/s$^{1.75}$	
	Day	Night
Critical working areas(1) (for example, hospital operating theatres)	0.1 – 0.2	
Residential	0.2 – 0.4	0.13 – 0.26
Other non-residential buildings	0.4 – 0.8	

(1) This does not include sensitive research or manufacturing equipment (for example lithography or microscopy) which may be affected by vibration levels below the threshold of human perception. Specialist advice should be sought where this equipment exists within the project Noise Assessment Boundary.

Note: Building damage due to road traffic vibration

Compliance with the vibration criteria shown in Table 5-1 for protection of human comfort and critical vibration sensitive work will result in significantly lower vibration levels than those associated with building damage, for example in *German Standard DIN 4150-3:2016 Vibrations in buildings - Part 3: Effects on structures*.

The risk of building damage occurring as a result of road traffic vibration is therefore negligible and no further assessment on the risk of building damage is required.

5.3 Vibration Assessment

Where a road traffic vibration assessment is required, the following steps shall be taken to demonstrate compliance with the relevant criteria:

- measurement of existing vibration levels;
- prediction of road traffic vibration;
- reasonable and practicable vibration mitigation measures where required;
- post-construction validation measurements; and
- reporting of assessment procedure and results.

Further details regarding each of these steps is presented in the following subsections.

5.3.1 Existing vibration level measurements

Unless specified otherwise in the Contract Documentation, the need for vibration monitoring to capture information on the existing road traffic noise/baseline shall be determined in the preliminary stages of the assessment.

The purpose of existing vibration level measurements is to quantify the existing vibration environment and, in some cases, to inform prediction of road traffic vibration from the new or redeveloped road.

The vibration levels from road traffic shall be measured along three orthogonal axes (ie x-, y- and z-directions as defined by *AS 2670.2*). It is generally preferable to measure vibration at locations representative of sensitive receivers within buildings, or on the building structure at ground level. In situations where this is not practicable, measurement at alternative representative locations may be acceptable.

Mounting of vibration transducers (i.e. accelerometers or geophones) is to be conducted in general accordance with *Australian Standard AS 2775–2004: Mechanical vibration and shock–mechanical mounting of accelerometers*.

The quantity and location of vibration measurements shall provide an adequate level of information on the existing situation. In most cases, existing vibration levels shall be logged over several days (typically a minimum of seven days is preferred).

5.3.2 Prediction

There is no widely used and accepted model for the prediction of ground-borne vibration from road traffic. Procedures currently used for predicting ground-borne vibration are typically based on a combination of measurement and the use of empirical equations derived from actual experience. Examples of such assessment procedures are included in documents such as the *US Federal Transit Administration's Transit Noise and Vibration Impact Assessment Manual (2018)*.

In many cases, measurements undertaken under conditions representative of the proposed project and at setback distances representative of the most affected vibration sensitive receivers, can provide sufficient information to quantify the expected vibration levels from the new or redeveloped road.

5.3.3 Mitigation

Where predicted vibration levels exceed the relevant criteria, mitigation measures shall be considered and implemented where reasonable and practicable.

Typically, vibration associated with road traffic results from heavy vehicles moving over discontinuities in the road surface. Mitigation techniques are therefore often limited to reducing the occurrence of surface irregularities i.e. providing a smooth road surface.

Where mitigation is not reasonable and practicable, or where vibration levels remain above the criteria following mitigation, the need for further action shall be determined in discussion with the Department, taking into account:

- the magnitude, frequency, time of occurrence and duration of any exceedances;
- the number of persons affected;
- the existing road traffic or baseline vibration levels; and
- any other relevant factors as agreed.

Note: Prediction of Vibration Levels

Generally, it is preferable that for any decision regarding the need for additional vibration mitigation is based on vibration measurements undertaken within the affected space(s), where practicable. This is because it is not typically feasible to accurately predict vibration losses associated with transmission between the ground and the building, and any effects associated with the building structure.

Predicted vibration levels within buildings are generally conservative to account for this uncertainty. In some cases, this will mean that it may be appropriate to defer a decision for further action until after project opening so that actual vibration levels can be verified.

5.3.4 Post-construction validation measurements

Post-construction validation measurements would only be undertaken in extenuating circumstances such as when the assessment indicates that vibration levels are likely to be above the criteria and above the existing (pre-construction) levels.

Monitoring (where required) shall be undertaken as a minimum at or as near as possible to the previously monitored locations to validate the accuracy of vibration predictions. The vibration monitoring undertaken must be sufficient to ensure that the results are statistically valid for reliable comparison to the predictions.

Post-construction vibration monitoring should generally follow the procedure outlined in Section 5.3.1 for existing vibration level measurements in relation to measurement position, instrumentation, and monitoring duration.

5.3.5 Reporting

Where a road traffic vibration assessment is required, the assessment process and results shall be described within the each of the following noise assessment reports as detailed in Section 4, where relevant:

- Environment and Heritage Impact Assessment Report
- Preliminary Noise Assessment and Mitigation Report;
- Noise Modelling and Mitigation Design Report; and
- Noise Treatment Validation and Closure Report.

Separate reporting for road traffic vibration is not generally required.

Note: Vibration Reporting Requirements

As a minimum, the following information shall be included in reports:

- Vibration criteria applied to the project
- Details of any existing vibration level measurements that have been undertaken
- Details of instruments and methodology used for measurements (including descriptors used and calibration details)
- A site map showing location of the project alignment, measurement locations and any vibration sensitive receivers (where appropriate)
- Vibration predictions, including the prediction methodology and details of any measurements that have been used as the basis for predictions
- Assessment of predicted vibration levels against the relevant criteria
- discussion of any proposed mitigation measures, the vibration reduction likely and the practicability and reasonableness of these measures
- Details of validation measurements, including instrumentation, methodology and locations
- Comparison if validation measurement results with predictions and vibration criteria.