2013

Plan Topics

Managing Land Transport Noise Under the RMA

Managing Land Transport Noise Under the RMA

Land transport noise arises from vehicles travelling on road and rail corridors. It is an increasing issue in New Zealand affecting mainly urban areas. Prolonged noise exposure can impact on amenity values and health in some circumstances.

This guidance note provides information on planning options for addressing land transport noise. Data collection and monitoring approaches are also discussed.

Managing noise is just one element of transport and land use planning; for guidance on planning for the land transport system see the Land Transport Guidance Note. Further advice on managing the impacts of noise is contained in the Noise in Mixed Use Environments Guidance Note.

For the purposes of this guidance note, noise is defined as 'unwanted sound' and excludes ground transmitted vibration.

Guidance note

Background

Land transport noise is defined as noise arising from vehicles travelling on road and rail corridors and consists of a number of components. The need to effectively manage the noise effects associated with land transport activities is gaining prominence due to a range of factors, including:

- increased private vehicle use
- a greater number of vehicles and increasing traffic densities
- increased proportion of trucks and service vehicles
- changing travel patterns (ie, vehicles are on the road for more hours of the day and night, not just peak hours)
- growing population
- increasing population densities in most urban centres (particularly around transport nodes)
- increased community awareness of adverse factors in the environment.

The characteristics of sound determine the level of noise and its effects. Sound radiates from vehicles in waves. As sound makes contact with surfaces and objects it is refracted, reflected or absorbed. Noise levels decrease by half for every doubling of distance from the source.

Road transport noise consists of two key components: engine noise and tyre/road interaction. Engine noise arises from various mechanisms including the cooling fan, vehicle transmission and exhaust system. Faulty or modified exhausts and vehicle-braking systems in heavy vehicles are also a common source of noise.

Rail noise is created in a similar way to road transport noise. Train wheels, track vibration and engine mechanisms are the key components. Rail noise is also influenced by auxiliary equipment such as brakes and ventilation systems. Train frequency, speed, train type and infrastructure (such as curves and turbulence) also determine noise emissions.

Land use information and projections contained in regional land transport strategies, corridor plans prepared by New Zealand Transport Agency and specific studies commissioned by local authorities can play a useful role in helping identify the noise related impacts associated with these factors.

There are three stages in which the effects of land transport noise can be addressed. These are:

- reducing noise at the source
- reducing the transmission of noise
- avoiding or mitigating noise at the receiving end.

The primary focus of this note is on the last of these stages.

Land transport noise is predominantly experienced along major road corridors, particularly in built up, urban areas, and residential areas near road corridors.

Interestingly, road transport noise is considered to cause greater annoyance than rail noise. Unlike vehicle noise people appear to become accustomed to railway noise exposure and annoyance decreases over time. Although not as prominent an issue as road transport noise, noise associated with the movement of passengers and freight by rail also needs to be considered and managed.

Exposure to land transport noise can affect the health of people and communities, ranging from general interference with everyday activities through to more significant health issues. Excessive noise creates stress-type responses. The most common issues arising from exposure to noise is the interruption of speech, decreased concentration and sleep disturbance. Noise affects people in different ways and creates various reactions depending on the level of noise, the timing and the activities individuals are engaged in. Average noise levels above 65 dBA are highly undesirable.

Effects rise in tandem with the level of noise and length of exposure experienced. Noise exposure can also have temporary or permanent impacts on psychological and physiological functions. Acute noise exposure activates the nervous and hormonal systems leading to increased blood pressure, increased heart rate and the narrowing of blood vessels. After prolonged exposure susceptible individuals may develop permanent effects such as high blood pressure.

Land transport noise can also particularly affect activities that are sensitive to noise interference. Equally, such activities can have a reverse sensitivity affect on the nature and scale of operations within road and rail corridors.

Examples of sensitive activities include teaching, which requires communication and interaction through speech, and sleep, which generally requires peace and quiet.

Sensitive receivers have been defined as:

- residential activities
- education activities including pre-schools
- travellers accommodation
- hospitals and other healthcare facilities
- elderly person's accommodation.

International definitions extend this to include places of worship and areas preserved for their quiet value, such as parks and reserves. The World Health Organisation (WHO) noise guidelines on community noise recommend noise levels for sensitive activities.

Reverse sensitivity refers to the effects of sensitive activities on nearby existing activities, for example road and rail corridors, and can lead to restraints on those activities. Noise is a key reverse sensitivity issue. When a new land use is established near a road or railway corridor the new land use may be affected to some degree.

Land use planning can address reverse sensitivity by restricting certain land uses near existing or planned road and rail corridors and placing conditions, where appropriate, on resource consents.

The WHO noise guidelines provide guidance levels for different activities and environments. The WHO levels are very low and are significantly exceeded in many environments. WHO recommend internal noise levels below 35dBA Leq for speech comprehension. For outdoor living areas in residential areas exposure levels should not exceed 50 55dBA Leq, and in internal sleeping areas =30dBA Leq (8hr) is recommended. Internationally, these levels have not been adopted for the design or management of land transport corridors, as these levels may be unachievable in areas next to major land transport corridors. This demonstrates the need for early land use planning to avoid exposing people and communities to excessive noise levels.

Satisfactory and maximum values are also included in AS/NZ 2107:2000 Acoustics Recommended Design Sound Levels and Reverberation Times for Building Interiors. The standard prescribes slightly higher levels of 30 to 40dBA Leq (8-hr) for sleeping areas on 'major' roads compared with 30 to 35dBA Leq (8-hr) in bedrooms near 'minor' roads. Like the WHO guidelines, these standards include recommended values for a variety of rooms and building uses.

In summary, there is a variety of guidance, particularly describing levels at which health effects are very unlikely to occur. To date no explicit national noise criteria have been developed. There is also no common international standard for roads or railway lines - most countries appear to base decisions on their local context, tempered by what is affordable. Typically, criteria for designing new infrastructure are more stringent than for managing existing infrastructure, however non-regulatory methods may be available to help manage existing noise.

Options for Addressing Land Transport Noise

There are a variety of alternatives to address land transport noise including technical and legal options, physical works and land use planning.

Technical options

Technical options are implemented through vehicle and infrastructure design, where noise is generally considered for reasons of user comfort. Noise also needs to be considered throughout the transport life-cycle. This involves addressing noise from the design stage and during vehicle use and movement. Controls on noise emitted from vehicles reduce the need for control at other stages. Vehicle manufacturers and government groups both play a role in controlling vehicle noise.

Technical options can achieve moderate noise reduction and include:

- Quiet tyre technology - tyre design affects noise levels, noise increases with the size of the rim and tyre width. Noise levels also change over the life of the tyre.
- Low noise road surface - noise emitted from road surfaces varies from 9-15 dBA depending on the type. Road texture also influences noise levels - smoother road surfaces generate less noise.
- Noise barriers - a noise barrier acts as an acoustic shield by interrupting the propagation of sound waves.
- Acoustic insulation on buildings - building can be insulated from noise through double glazing and sound-proofing material in wall cavities.
- Low vehicle speeds - noise increases with vehicle speed and engine size. By decreasing the speed limit, noise is reduced. However, in order to be effective a substantial reduction is necessary.
- Congestion controls - noise increases with vehicle numbers. However, substantial reductions are necessary for any real improvement. A reduction in traffic volume of 50% is necessary to achieve noise reduction of 3dBA.
- Rail track grinding or smoothing - rough railway tracks increase noise levels. By smoothing rail tracks noise from bumps and imperfections are reduced.
- Sound absorptive rail track beds - specifically designed railway beds can help to reduce noise emissions.

Technical options can be expensive, particularly when used for retrofitting along road corridors with noise problems.

Legal Options

Legal options revolve around the various enforcement mechanisms for noise. Section 16 of the RMA provides an overall requirement to adopt the best practicable option to avoid unreasonable noise.

There are a variety of issues with the application of section 16 to land transport noise, including establishing who is the "occupier", what the scope of the best practicable option may be and what constitutes a "reasonable level" of noise.

Local authorities are generally familiar with the RMA provisions controlling excessive noise. While land transport noise may be sufficient in some circumstances to "unreasonably interfere with the peace, comfort, and convenience of any person", noise emissions from vehicles on roads and trains are specifically excluded from this enforcement option.

The vehicle noise enforcement provisions of the Land Transport Act 1998, the Land Transport [Road User] Rule 2004, vehicle testing at Warrant of Fitness and Certificate of Fitness (under Land Transport Rule: Vehicle Equipment 2004) and the possibility of bylaws to control vehicle noise, are intended to control individual vehicle noise, rather than the RMA.

By laws under the Local Government Act 2002 provide many local authorities with a means to control motor vehicle noise emissions, particularly heavy vehicles. This is usually done by controlling heavy vehicle movements along certain routes and restricting the use of "engine brakes".

A combination of technical and land use planning solutions is usually necessary to achieve effective noise management although the emphasis in this note is on the latter.

Land use planning options attempt to address noise in a strategic manner. They provide consistency and certainty when implemented early in the planning process. Land use planning approaches to control the effects of land transport noise can occur at national, regional or local levels and can be complemented by other measures such as bylaws (eg, restrictions on engine braking) and urban design.

Options include:

- **Local approaches:** district plan objectives, policies, rules and associated standards, noise barriers, building design, setbacks, site layout and building orientation.
- **Regional planning approaches:** regional land transport plans, district and regional planning policies such as restrictions on sensitive activities along transport corridors, urban design and mixed use development.
- **National approaches**: National environmental standards, the Government Policy Statement on Land Transport and New Zealand Land Transport Programme, Transport Strategy, New Zealand standards, building codes, Urban Design Protocol.

This guidance note focuses on local approaches to planning for land transport noise. Further information on other approaches is provided in the Land Transport guidance note.

Local approaches - district plan response

District plans should manage local scale effects of land transport noise and ensure long term, cumulative impacts of noise are prevented. The choice of land use planning options depends largely on the existing environment, planning provisions and available funding. For example, a busy central city area will require a different approach compared with areas subject to future residential subdivision and semi-rural living.

District plan responses can involve the following steps:

1. Setting acceptable noise levels

It is important to establish existing noise levels when developing objectives, policies and rules on land transport noise.

Noise can be modelled for transport corridors to estimate existing and future noise levels. Understanding the noise baseline assists with the implementation of appropriate policy measures such as objectives and rules. A number of tools are available to predict noise levels from transport corridors. The UK Calculation of Road Traffic Noise (CRTN) is the most widely recognised in New Zealand.

Most urban councils will have a good understanding of current noise prone areas. These tend to be along key transport routes where there is a high level of land use development, particularly residential. Monitoring of traffic related noise complaints can help identify problem areas but to date such monitoring has not been applied in any systematic manner.

Establishing existing and predicted noise levels is a crucial aspect of noise management. Territorial authorities should:

- gather baseline information on land transport noise
- identify and map noise 'hotspots '
- calculate long term noise levels
- identify suitable methods to manage the effects of land transport noise
- work with NZTA, the regional council and other councils within their region to implement the regional land transport strategy, any existing corridor plans and to identify potential growth areas and their associated road and rail corridors
- implement improvement programmes in road and rail corridors where necessary
- develop monitoring programmes using baseline information.

Plan options

Specific district planning options include:

- Location policies - such as recognising the hierarchy of roads within the district, locating new housing in close proximity to public transport (ie, reducing the need to travel by private motor vehicle and the magnitude of noise generated), or specifying suitable setbacks from major arterial roads. Policies can also be developed to address reverse sensitivity (ie, restricting certain land uses near existing or planned road and rail corridors, placing conditions on resource consents).
- Control based measures - such as zoning, site layout to reduce the transmission of, or exposure to, noise or performance standards for noise sensitive activities

(eg, demonstrating that the recommended internal sound levels outlined in AS/NZS 2107:2000 - Acoustics can be met).

Control based measures can be used in combination to achieve a specific performance standard such as setback provisions which may be increased or decreased depending on the presence or absence of technical methods, such as noise bunds or acoustic insulation.

- Building controls and standards - such as acoustic insulation requirements (like Compliance Document for the New Zealand Building Code Clause G6 - Airborne and Impact Sound).
- Urban design - such as mixed used development that aims to reduce private vehicle use or the siting, orientation and design of buildings that reduces noise impacts.

Urban design and building controls can be used to mitigate land transport related noise effects in newly developed areas by restricting vehicle access or influencing building orientation and layout.

- Strategic land use planning - such as development of planning approaches that promote land use patterns that reduce dependency on private vehicles.

Although land transport noise is currently not an issue in every district it is important to recognise that it has the potential to be in the future. Plans and policies need to be deliberately developed with this in mind. For example, plans should include measures to manage future transport and land use developments that may impact on sensitive receivers or create reverse sensitivity effects.

Noise management in future growth areas

Given the direct correlation between noise and urban growth, transport noise should be considered when forecasting and planning for future growth and development in a district or region.

Increased noise levels are directly related to ongoing increases in private car ownership and heavy vehicle use. Consequently, new development that increases traffic volumes in an area may also increase the level of noise experienced by those already living in the area, particularly those who live along major roadways. Noise management approaches need to take into account these cumulative effects.

Another means of addressing noise is to consider the wider transport network itself. Sustainable transport planning aims to reduce reliance on private vehicle use and encourage the use of public transport by establishing land use patterns that reduce the dependency to travel long distances. For example, new subdivisions may be required to develop facilities for cyclists, pedestrians and passenger transport. Increased public transport patronage may also help to reduce noise levels.

2. Policies

District plans should describe why noise is an issue and how it will be addressed. Policies should:

- seek to maintain acceptable levels of noise while addressing future growth impacts
- recognise the relationship between land use and transport planning.

Key policy aims might include:

- restricting the development of sensitive activities close to transport corridors
- applying specific targets based on an assessment of ambient noise levels
- setting performance standards for sensitive activities
- setting performance standards for outdoor living areas (such as school playgrounds)
- reducing existing noise exposure through non-regulatory methods and incentives
- encouraging mixed used development in urban areas (to reduce the need to travel).

The development of a clear policy position is also a useful means to ensure that reverse sensitivity issues are appropriately managed to prevent conflicts arising by limiting or prohibiting the establishment of new land uses where the effects from current activities are likely to result in complaints from new neighbours.

3. Regulatory and Non-Regulatory Methods - Optional

Methods should describe how noise management policies will be implemented and explain how acceptable noise levels can be met.

Methods might include, amongst others:

- rules that set out specific performance standards to mitigate the effect of noise generated along transport corridors on new dwellings. resource consent conditions may be applicable for some developments
- rules to manage the establishment of sensitive activities in noisy environments (ie. reverse sensitivity)
- performance standards and design guidelines for new buildings, or additions to existing buildings, located near road or rail corridors
- structure plans or concept plans that require land use/road buffers and appropriate landscape treatment (eg, bunding).

Specific tools might include controlling land transport noise effects by:

- using setbacks from roads
- setting performance standards for sensitive activities
- zoning to recognise ambient noise levels and associated policies that reflect these levels
- combining building and land use controls (eg, requiring new developments or extensions to existing buildings to include acoustic insulation or double glazing)
- providing guidance on how to 'build out' noise (eg, using acoustic insulation)
- linking to other policies that reduce reliance on private travel.

Under s.31(1)(d) local authorities can set controls on noise levels in plans or through resource consent conditions for any land located outside a designated road corridor.

Although land transport noise is not an issue in every area, consideration should be given to whether rules need to be developed to ensure long term cumulative effects of noise do not arise.

Things to consider include:

- What are the predicted transport growth levels for the area and the nature of this growth (eg, car, heavy transport)?
- How will development affect transport demand and volumes and what will be the corresponding effect on noise levels?
- Is there land available for setbacks?
- What is an appropriate setback distance based on land use types/traffic density?
- What are the types of effects and/or activities anticipated or provided to occur within an area?
- Do any designations exist and are the controls and land area adequate?
- Are there any potential 'hotspots ' or new land use proposals that would create land transport noise issues in future?

The types of rules that can be included in district plans to control the effects of land transport noise are:

- performance based rules for sensitive receivers in urban areas
- performance standards based on the activity (eg, as per the WHO guidelines)
- area based performance standards
- performance standards for roads and rail.

Use of a performance based approach involves establishing an acceptable noise level for particular activities or areas. For example, noise levels in bedrooms should be lower than those in outside play areas.

There are advantages and disadvantages associated with this approach. Advantages include simplicity and universal application. Disadvantages often relate to costs and the inability to cater for future noise levels. This reiterates the importance of long term predictions.

As rail noise is generally more tolerable than road noise, performance standards for new rail corridors are often more lenient compared with roads. In many countries, noise limits for railway corridors are around 5dBA higher than those set for roads.

Specific examples of performance based standards used to control the effects of land transport noise, along with their respective pros and cons, are outlined below. Many of these controls can also be used as conditions on designations.

Setbacks and buffer zones

- Site layout can be specified for particular zones through setback provisions. Setbacks provide for noise dissipation reducing the effect of noise on receivers. Setback requirements can be applied to transport corridors as well as buildings.
- By making long term transport and development projections, planning authorities can plan for growth and related noise by establishing setback provisions or environmental buffer zones along existing transport corridors or land proposed for urban development. Additionally, transport requiring authorities can designate and acquire corridors of sufficient width to mitigate the adverse effects of noise on future growth areas (eg, through bunding and landscape treatment).
- An added benefit of setbacks is that they can subsequently be utilised to provide for walking or cycling tracks, or reserves which can add amenity value.
- Setbacks can be inefficient in terms of land loss and cost of purchase and may be costly to maintain.
- Districts need to identify who is responsible for these costs (ie, landowner, transport authority, local authority).
- Existing land use patterns may preclude the practical imposition of setbacks in urban situations.

Zoning

Zoning can be used to restrict noise sensitive activities in a particular zone and to direct less sensitive activities to locations close to corridors.

Defining zones based on the character and function of an area involves applying a specific ambient noise level to a wider zone, based on the character and function of the area. In using this approach local authorities should identify:

- types of uses that are appropriate/not appropriate in areas affected by land transport noise
- assessment criteria relevant to different uses
- whether impacts can be appropriately managed
- potential reverse sensitivity issues arising from planned subdivisions near future road or rail corridors.

Rezoning may be necessary where noise levels are increasing to an unsustainable level and cannot be controlled through other means. While it provides guidance as to the future use of the area it can take time to implement and may be unpalatable to existing land owners. Noise affecting existing land owners may also need to be addressed through additional technical measures such as acoustic insulation.

Structural restrictions

Structural controls such as building height or orientation can be used to address noise. Alternatively, the resource consent process can be used if issues are complex or it is difficult to define a single standard or measurable solution. These measures are particularly relevant where development occurs near a road that has barriers or bunds. As barriers need to block the 'line of sight ' to be effective a barrier next to a multi storey building will provide little benefit to residents on upper levels.

4. Environmental Effects Expected - Optional

One of the environmental results expected with the management of noise in plans should be the protection of people and communities from the impacts of land transport noise exposure. Reliance on established acceptable noise levels may help establish whether environmental results expected are being achieved.

5. Monitoring Noise

Territorial authorities need to undertake noise measurement for monitoring purposes, particularly in urban areas. Territorial authorities should state what monitoring will be undertaken and this should form part of a dedicated monitoring programme. Equally, noise provisions included in plans need to be appropriately enforced to ensure their ongoing effectiveness.

- noise levels should be assessed at the outset of policy development to provide baseline information to help determine future policy improvements and to establish priorities for ongoing monitoring
- the number and type of people affected should be established
- territorial authorities should commit to regular reviews of monitoring programmes.

Monitoring options include:

- monitoring individual consent conditions where noise levels are stipulated
- maintaining a noise complaints register
- measuring noise levels at individual sites
- noise mapping.

6) Noise mapping

Developing noise maps can be one of the most effective means of monitoring land transport noise and deciding on management strategies.

Noise mapping is a systematic process to 'map' noise in a given area. Noise maps provide a visual interpretation of the location and number of people affected by noise in an area. They are produced for different purposes (eg, the identification of areas where a specific limit value is exceeded), and range from basic contour maps to more sophisticated approaches that incorporate datasets on population density, building fabrication and the location of artificial structures such as noise barriers.

The key steps in the noise mapping process are:

- collecting, preparing, storing and querying raw data

- computing noise levels using computer models
- cumulating noise levels (when there are different sources)
- determining noise contours
- determining noise effects
- presenting the impacts of noise.

Existing noise mapping in New Zealand is currently limited to noise contour mapping around ports and airports but can be extended to include other sensitive environments. Contour maps are less effective at assessing any changes that might affect the noise contours. GIS based mapping that is regularly verified and updated is far more useful.

Some good practice tips for noise mapping include:

- Accurate data on noise exposure provides valuable information for impact assessments and for formulating and reviewing noise strategies in district plans.
- Noise mapping provides a useful mechanism for measuring and monitoring noise levels. It can also be used to monitor the effectiveness of noise abatement technology. The results can then be compared with predictions made during the noise abatement design stage, or to test predictions made in environmental impact assessments for projects. This is useful for future reference and allows any necessary improvements to be made to abate noise.
- Noise mapping can be linked to air quality data mapping
- Noise calculations should be backed up by actual measurements when they are taken
- Where maps are used to develop a noise mapping strategy, regular updates of the noise maps and comparison between different moments in time are necessary.
- Sophisticated noise maps can assist transport and land-use planning by identifying areas exceeding or reaching maximum acceptable noise levels. They can also identify the effect of different types of building layouts on noise dispersal and any quiet zones that need to be preserved, further assisting planning and design.

Local Approaches - other mechanisms

- Urban design strategies outline the principles of good urban design and provide strategic actions to translate these principles into policy and practice. Urban design considers the relationship between roads and the character and functioning of urban and rural environments through which they pass. The location and form of roads and buildings may also be considered.
- Bylaws can address matters such as heavy vehicle and engine braking through the use of signage and the establishment of vehicle entry restrictions.
- NZ Standards can provide technical guidance (eg, NZS 6805:1992 Port noise management and land use planning and NZS 6805:1999 Airport noise management and land use planning). The standards outline methods and guidance for establishing noise assessment and land use planning provisions through district plans.
- Building guidance or codes of practice set out performance criteria for buildings.
- Roading authority guidance such as NZTA's Environmental Plan and the Noise Guideline in its Planning Policy Manual. The plan and guideline contain performance criteria to assist NZTA to design new roads and address existing noise problems.

Noise definitions

Leq

Energy equivalent noise level. It is a time-averaged sound level; a single-number value that expresses the time-varying sound level for the specified period as though it were a constant sound level with the same total sound energy as the time-varying level. Expressed over a set period of time (e.g. 5-min, 8-hr, 24-hr etc), known as the "time base".

Source: European Environment Agency

Percentile level

The noise level equalled or exceeded for a certain percentage of time, x, during the measuring period. Percentile levels are written Lx. For example, L10 is the level which is equalled or exceeded for 10% of the measurement time.

Source: Standards New Zealand

Ldn

Day/night level or day-night average sound level. Is the time-average sound level, in decibels, over a 24 hour period (from midnight to midnight), obtained after the addition of 10 decibels to sound levels in the night (from midnight to 7.00am and from 10.00pm to midnight). A frequency weighting shall be assumed unless otherwise stated. When the day/night level is measured it is not necessary that the measurement period begin at midnight.

Source: Standards New Zealand

Lmax

The maximum noise level measured with a sound level meter having a "fast" response, or an equivalent method.

Source: Standards New Zealand

Decibel (dB)

A dimensionless unit used to express the relative magnitude of sound powers and sound pressures. The number of decibels is ten times the logarithm (to base 10) of the ratio of the sound powers and twenty times the logarithm (to base 10) of the ratio of the sound pressures.

Source: Standards New Zealand

Useful websites

- NZ Transport Agency | NZ Transport Agency Ministry of Transport
- The World Health Organisation Guidelines for Community Noise
- UK Planning Policy Guidance 24: Planning and Noise
- UK Calculation of Road Traffic Noise 1988
- New South Wales Road Transport Authority – Environmental Noise Management Manual
- Austroads

Performance based options for rules

Rules for sensitive receivers

Rule option	Advantages	Disadvantages
Performance standard based on the activity. Require specific noise performance levels to be met in buildings and areas occupied by sensitive receivers. May request an acoustic report as proof.	• Reasonably simple, approach but greater flexibility than a blanket level • Can provide protection from night-time sleep disturbance. • Allows flexibility and innovation in providing solutions that meet stipulated levels. • May require protection of outdoor areas for "residential" activities. • Easy to enforce.	• Adds cost to building design and construction. • High cost of site-by-site acoustic reports (may be reduced through design guides). • May be difficult to achieve any given outdoor noise levels, particularly in existing urban areas. • Is a snap-shot in time (the time of construction) increasing noise levels over time are not necessarily considered.
Performance standard for zoned areas Where zoning exists performance standards may be linked to the zone e.g. commercial, residential, mixed use. This approach takes into account the expected noise levels of different zones.	• Allows recognition of different noise expectations in different environments. • Allows flexibility and innovation in providing solutions to meet the levels. • Can ensure protection of outdoor areas.	• External noise levels may prove difficult to achieve over time. • Enforcement would be very difficult. • Impractical for any existing urban development areas - only really applicable to "green fields" sites.
Setback rule for new residential subdivisions Setback rules are useful where land is currently undeveloped and available. They may be used for existing roads, and proposed roads. One approach might be to a set a performance standard and incorporate external	• Provides comfort to councils and roading authorities that substantial noise protection is being undertaken. • Allows developers to maximise the use of the site. • Provides basic protection of outdoor	• The most complex and prescriptive rule, with potentially high cost of site-by-site acoustic reports and treatment. • Based around an achievable reduction in noise levels, not an absolute level. • May be restricted to larger green-field

measures to address noise such as acoustic insulation or noise barriers.	areas, and better protection of indoor areas. • Easy to enforce but relies on modelling of the noise transmission.	developments.

Rules for road and rail corridors

Rules option	Advantages	Disadvantages
Performance standard for new roads or rail lines Requires conformance with a set performance standard. For example, maximum noise levels based on WHO Guidelines for Community Noise.	• Sets a simple level for all roads and rail lines. • Recognises future development areas, where development is likely. • Will result in protection of both indoor and outdoor areas. • Resource consent could still be an option for roads and rail lines that do not meet this rule.	• The noise levels included in the rule may prove difficult to achieve • Only applies to new roads or rail lines. • Some noise descriptors e.g. Leq (24hr) measure are not ideal for describing the noise actually experienced by noise sensitive receivers, particularly single event noises from heavy vehicles or excessively noisy cars.
Performance standard for new roads An alternative option is to set the performance standard in relation to the ambient noise based on projected vehicle numbers for the road type This is essentially similar to the existing NZTA Noise Guidelines approach, but would include stricter noise levels and an upper limit.	• Ignores low volume roads where noise is not significant. • Recognises future development areas, where development is likely. • Will result in protection of both indoor and outdoor areas. • Recognises existing ambient noise levels.	

WHO guideline values for community noise in specific environments

Specific environment	Critical health effect(s)	Leq [dBA]	Time base [hours]	Lmax, fast [dBA]
Outdoor living area	Serious annoyance, daytime and evening	55	16	-
	Moderate annoyance, daytime and evening	50	16	-
Dwelling, indoors	Speech comprehension and moderate annoyance, daytime and evening	35	16	45
Inside bedrooms	Sleep disturbance, night-time	30	8	45
Outside bedrooms	Sleep disturbance, window open (outdoor values)	45	8	60
School class rooms and pre-schools, indoors	Speech intelligibility, disturbance of information extraction, message communication	35	during class	-
Pre-school bedrooms, indoors	Sleep disturbance	30	sleeping-time	45
School, playground outdoor	Annoyance (external source)	55	during play	-
Hospital, ward rooms, indoors	Sleep disturbance, night-time	30	8	40
	Sleep disturbance, daytime and evenings	30	16	-
Hospitals, treatment rooms, indoors	Interference with rest and recovery	#1		
Industrial, commercial shopping and traffic areas, indoors and outdoors	Hearing impairment	70	24	110
Ceremonies, festivals and entertainment events	Hearing impairment (patrons:<5 times/year)	100	4	110
Public addresses, indoors and outdoors	Hearing impairment	85	1	110

Music through headphones/ earphones	Hearing impairment (free-field value)	85 #4	1	110
Impulse sounds from toys, fireworks and firearms	Hearing impairment (adults)	-	-	140 #2
	Hearing impairment (children)	-	-	120 #2
Outdoors in parkland and conservation areas	Disruption of tranquillity	#3		

#1: as low as possible

#2: peak sound pressure (not Lmax, fast), measured 100 mm from the ear

#3: existing quiet outdoor areas should be preserved and the ratio of intruding noise to natural background sound should be kept low

#4: under headphones, adapted to free-field values