Planning Scheme Policy 5 - Environmental Emissions

5.1 Purpose

(1) The purpose of this policy is to set out the requirements for the preparation and submission of development applications, including technical reports, for sites that have the potential to emit, or be impacted adversely from, environmental emissions such as air or noise.

5.2 Applicability

(1) This policy applies to -

(a) development that is likely to have air or noise emissions with the potential to adversely impact on the surrounding environment; or
(b) development that is a sensitive land use likely to be adversely impacted by environmental emissions; or
(c) developments that are assessed against codes that specifically reference this policy; or
(d) a proposed development that has specific acceptable solutions relevant to air and noise emission impact issues.

Note -

- Where a development includes a devolved Environmentally Relevant Activity as defined under the *Environmental Protection Act 1994* (EPAct), this part of the development is assessed for environmental impacts in accordance with the EP Act.

5.3 Formulating a Development Proposal

(1) A detailed and comprehensive site analysis is the foundation of any good design and is carried out as the first step. This will help to identify the constraints and opportunities of the site as well as highlight the prominent features of the surrounding environment.

(2) For many developments a report assessing the development's environmental impacts, such as air and noise, is generally required prior to any decision. Therefore, it is essential that the recommendations of these reports are carefully considered and incorporated into the design of the development proposal, and are understood by the applicant and site operator/occupier.

5.4 Pre-lodgement Meetings

(1) It is strongly recommended that applicants arrange a pre-lodgement meeting to determine if a report assessing the development's environmental impacts from air and noise is required, the matters to be covered in the report and the timing of lodgement of the report. This will assist to ensure a more streamlined process can occur once an application is lodged.

5.5 Air Quality

(1) Air pollution can impact upon health, amenity, property, the environment and economy of the City. This section of the policy provides a framework to determine air pollution impacts, and guides applicants on matters they need to address to ensure their proposal meets the air quality requirements of the relevant planning scheme codes.

(2) This policy also seeks to provide guidance to prevent or minimise exposure to air pollution in the development of sensitive land uses.

(3) For a development that requires impact assessment, additional information may be requested by the assessment manager and/or referral agency to assist in assessing those proposals that have potential to cause significant environmental harm.

(4) Applicants are encouraged to take opportunities to reduce air emissions through the application of waste prevention and minimisation, cleaner production and best practice environmental management. Some examples are provided in Appendix 1.

(5) Where a development cannot achieve zero emissions, all acceptable solutions to minimise emissions beyond the boundary of the site are demonstrated, including emission control technology and adequate setback distances where a sensitive land use may be affected. In addition to the implementation of the most appropriate control technology, the applicant needs to address the construction, design, location, form, environmental performance and management of operations.

(6) For separation distances refer to Part 5 - Division 9 - Protection of the Poultry Industry Overlay and Part 6 - Division 16 - Intensive Agriculture Code. Part 11 - Planning Scheme Policy 11 - Rural Lands and Uses also provides details in relation to acceptable solutions for these rural type activities.

5.5.1 Air Quality Objectives

(1) Air quality objectives are contained in Schedule 1 of the *Environmental Protection (Air) Policy 2008* under the *Environmental Protection Act 1994*. These standards are required to protect human health and amenity.

(2) If the emissions from a proposed development include other air pollutants, odour criteria and ambient air quality standards set for Australian conditions will be accepted. If no suitable Australian ambient air quality standard exists, an ambient air quality standard from another country or organisation may be used with appropriate justification.

Note -

Additional reference material for assessment and measurement of air quality -

- *Australian Standard 4323.3:2001 Stationary Source Emissions - Determination of Odour Concentration by Dynamic Olfactory*.
- *Odour Impact Assessment from Development Guideline, Department of Environment and Heritage Protection.*

(3) Where the proposed development is a sensitive land use located within close proximity to an existing or proposed incompatible land use, there may be a requirement to demonstrate as a minimum, that the relevant ambient air standards will be achieved at this development site. In some instances the term “close proximity” may be referred to as the prescribed separation distance set out in a code that is either relevant to the proposed development or the nearby incompatible land use.

5.5.2 Who Should Prepare An Air Quality Report

(1) An air quality report is required for a proposed development that emits air pollutants that may have an adverse impact on air quality, because of the -

(a) volume or type of emissions to air;
(b) proximity of the development to a sensitive land use.

(2) An air quality report is required where a proposed development may create a sensitive land use within the trigger area of a relevant overlay code, or close to a premises that emits air pollutants that may have an adverse impact on the air quality of this receiving environment.

(3) The air quality report is prepared by a suitably qualified person who has demonstrated practical and theoretical knowledge of air quality assessments. A curriculum vitae should be provided detailing relevant experience with similar air quality assessments.

(4) The local government may require the proponent to fund a Third Party Review of the air quality report. The local government will select the Third Party Reviewer.

5.5.3 Air Quality Report

(1) An air quality report should contain enough information to adequately assess the potential air quality impact issues of the proposed development.

Note -

Development likely to emit or receive air emissions which are of a toxic or hazardous nature or emit offensive/noxious odours may be required to submit a more detailed air quality report than other developments at the discretion of the local government.

(2) A comprehensive air quality report should contain the following -

(a) A detailed site plan that shows the layout of the site including main emission sources and the surrounding environment, including local industries, sensitive receptors such as the nearest residences and schools, and topography;

(b) A detailed description of site activities. This may include such information as -
- (i) the type of emissions, such as stack, area/volume, fugitive;
- (ii) the operational parameters of all emission sources, including information such as variations to emission rates due to “peak” or “average” emissions, or upset conditions;
- (iii) a description of the processes conducted at site;
- (iv) the technology and design required to achieve Best Practice Environmental Management;

(c) A discussion of the prevailing meteorology based on on-site data where available, or the closest monitoring information representative of the proposed site. This should include wind roses and an analysis of wind characteristics that are important to the dispersion of pollutants;

(d) An estimation of emissions. Emissions can be estimated in various ways such as -
- (i) NPI manuals on emission estimation for the relevant activity;
- (ii) USEPA AP 42 Emissions estimations handbooks;
- (iii) from monitoring or stack testing of similar facilities;
- (iv) industry specific Best Practice guidelines such as those for feedlots and piggeries;

(e) An assessment of the existing air quality including a description of the surrounding industry that may affect ambient air quality. Where available, air quality information from a nearby monitoring station is included. The Queensland Department of Environment and Heritage Protection has accepted the use of the 95th percentile for determining background pollution concentrations;

(f) Dispersion Modelling -
- (i) modelling provides useful information for assessing the impact of emissions to the airshed. It can provide an initial assessment of localised effects through the prediction of ground level concentrations in the immediate vicinity of the emissions. The information generated from modelling can assist in the assessment of potential impacts at the start of the development avoiding uncosted and unplanned prevention measures.
- (ii) the Ministry for the Environment in New Zealand has released a *Good Practice Guide for Atmospheric Dispersion Modelling*, which is a comprehensive document on the different models and their strengths and weaknesses. The NSW EPA has released *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales*. Both documents are informative and may be used as reference documents for any air quality modelling. The most recent or updated edition of these documents should be applied.
- (iii) in cases where modelling is undertaken, the following is considered -
  - a. selection of an appropriate atmospheric dispersion model. The Australian regulatory dispersion model Ausplume is appropriate for most air quality assessments, ranging from poultry applications to service station emissions. There are specific conditions for which Ausplume may not be the most appropriate model, such as complex terrain and shoreline fumigation. In this instance, justification for the use of an alternative model is given. For larger applications requiring more intensive modelling, liaison with the relevant administering authority with respect to model setup is recommended;
  - b. meteorological data is site representative across all seasons over at least one year;

c. simulated meteorological files may be used provided the data is demonstrated to be generated using appropriate methodologies and is representative of conditions of the site;
d. building wake effects are included where there is an on-site or nearby building that may impact on plume dispersion;
e. terrain effects are accounted for where terrain may affect emission impacts;
f. Ausplume defaults for model settings;
g. roughness height;
h. cumulative impacts are accounted for either in the model or in background monitoring data;
i. variation to operating conditions and worst case scenarios. Apart from the normal suite of emission data such as emission rate, temperature, exit velocity or stack dimensions, the variation in process characteristics that impact on emissions need to be considered, such as hours of operation, upset conditions, different feedstocks and fuels, and changes in process controls;
j. the grid spacing of the receptor grid is chosen so that the predicted maximum concentration is not significantly underestimated. Discrete or elevated receptors are included in the assessment in order to assess the impact where applicable;
k. pollution contours for all pollutants, and tables summarising the predicted ground-level concentrations at sensitive receptors, are included with comparisons against relevant air quality standards.

5.6 Noise Management

5.6.1 General

(1) In addressing land use and development, the location of and relationship between various land uses and the effects of land use and development, including noise management issues, are required to be considered. The *Environmental Protection (Noise) Policy 2008* identifies environmental values to be enhanced or protected, these being qualities of the acoustic environment that are conducive to -

(a) the wellbeing of the community or a part of the community, including its amenity;
(b) the wellbeing of an individual, including the individual's opportunity to have sleep, relaxation and conversation without unreasonable interference from intrusive noise.

(2) The objective of this section of the policy is to enhance or protect acoustic environmental values of Redland City in a manner consistent with the objectives in the *Environmental Protection (Noise) Policy 2008* through -

(a) incorporating noise levels for the local area;
(b) ensuring appropriate acoustic information is obtained at the development assessment stage to assess impacts on the acoustic environmental values.

(3) This section of the policy also seeks to provide clear guidance to those seeking development approval, regarding the assessment provisions for projects which either emit noise or introduce a sensitive land use with the potential to be affected by a noise emitter.

(4) Noise can be defined as unwanted sound that unreasonably intrudes into our daily activities and can cause varying degrees of nuisance and annoyance. Many sources of noise are often associated with urban development including road, air and rail transport, industrial operations, neighbourhood and recreational pursuits, and agricultural activities.

(5) Noise can affect human health and well-being. This can occur in a number of ways, including annoyance reaction, sleep disturbance, interference with communication, performance effects, effects on social behaviour, and hearing loss. If it is allowed to continue it may cause severe mental stress. It can also cause very real physical problems such as chronic exhaustion, high blood pressure and heart disease. Noise that occurs at night is more likely to disturb a community than noise that occurs during the day. Noise may contain annoying characteristics, such as -

(a) tonality - "humming" and "whining";
(b) modulation - regular changes in level or pitch such as a siren;
(c) impulsiveness - "hammering".

(6) A proposed development should not result in significant deterioration of the existing acoustic environment.

(7) The development of a sensitive land use should not occur where existing noise sources would result in the acoustic environment of this new development being unreasonably compromised.

(8) Table 1 shows the subjective effects of changes in audible sound pressure levels.

Table 1 - Subjective Effects of Changes in Audible Sound Pressure

Change in Sound Pressure Level (dB)	Change in Apparent Loudness
+3 dB	Just perceptible
+5 dB	Clearly noticeable
+10 dB	Twice as loud

Reference: Bies D.A. & Hansen C.H. (1996) Engineering Noise Control Theory and Practice, Second Edition; Department of Mechanical Engineering, University of Adelaide: South Australia.

(9) Prior to lodging an application for a development an evaluation of the suitability of the proposal is conducted, including a review of the constraints and opportunities for that development. In doing this, at least the following is considered prior to finalising the proposal -

(a) location;
(b) interaction with the surrounding environment, both internal and external to the development.

(10) In particular, the various types of land uses such as nearest noise emitters and/or sensitive land uses are identified in the planning process. Prior to making an assessment an initial 'scoping' assessment is considered to determine the background noise levels of the surrounding environment. This assessment should be representative of the operation of existing or proposed noise generating activities. Information from this assessment would be valuable in determining the appropriateness of the development for that location.

(11) When considering the likely impact of a proposed development and the times when noise will be emitted or received, it is also important to note whether the noise emissions are likely to contain annoying characteristics. The different types of noise generating activities that need to be considered include -

(a) noise during construction phase;
(b) noise from normal plant operation;
(c) transport and traffic noise, including increased traffic movements;
(d) behavioural noise;
(e) music and entertainment, both live and recorded;
(f) public address systems;
(g) noises normally associated with the conduct of a particular industrial or commercial use.

(12) Other noise generating activities arising from within the development site should also be taken into consideration at the planning phase. For example, locating residential backyards with pools and lounge rooms with sound systems away from bedrooms of neighbouring houses. Developments with mixed uses need to consider noise impacts on residential components or other noise sensitive environments of the development. When considering noise attenuation measures, applicants should evaluate a range of acoustic treatments available to achieve the required noise criteria.

Note -

Acoustic fencing is the least preferred noise attenuation measure and should only be used where all other measures have been explored, or where necessary to supplement other measures.

(13) It should be noted that, depending on the issues, officers from different areas within council may need to be involved in the assessment of the noise component of a development application. For example the range of issues for a noise assessment that are likely to require input from different areas within council are -

(a) acoustic performance issues;
(b) wildlife and vegetation issues;
(c) landscaping and safety issues;
(d) amenity issues;
(e) road access;
(f) structural requirements, design and proposal layout issues;
(g) maintenance issues.

5.6.2 Noise Emitters

(1) This section of the policy seeks to provide a general approach for assessing noise impacts from a range of emitter sources, and encourages applicants to take opportunities to reduce noise emissions through the application of best practice environmental management measures. Such measures include noise minimisation technology, construction, design, location, form, environmental performance, and management considerations and alternatives. Examples are given in Appendix 2.

(2) Where the proposed development is considered likely to cause a noise impact on a sensitive land use, in addition to demonstrating the proposed best practice noise management measures as described in Appendix 2, a noise report may also be required to confirm that the development will

not adversely impact on the receiving environment. Refer to section 5.6.4 Noise Reports for more details.

5.6.3 Noise Receivers

(1) Uses which are potentially affected by intruding noise are defined as sensitive land uses - refer to Part 9 - Schedule 3 - Dictionary.

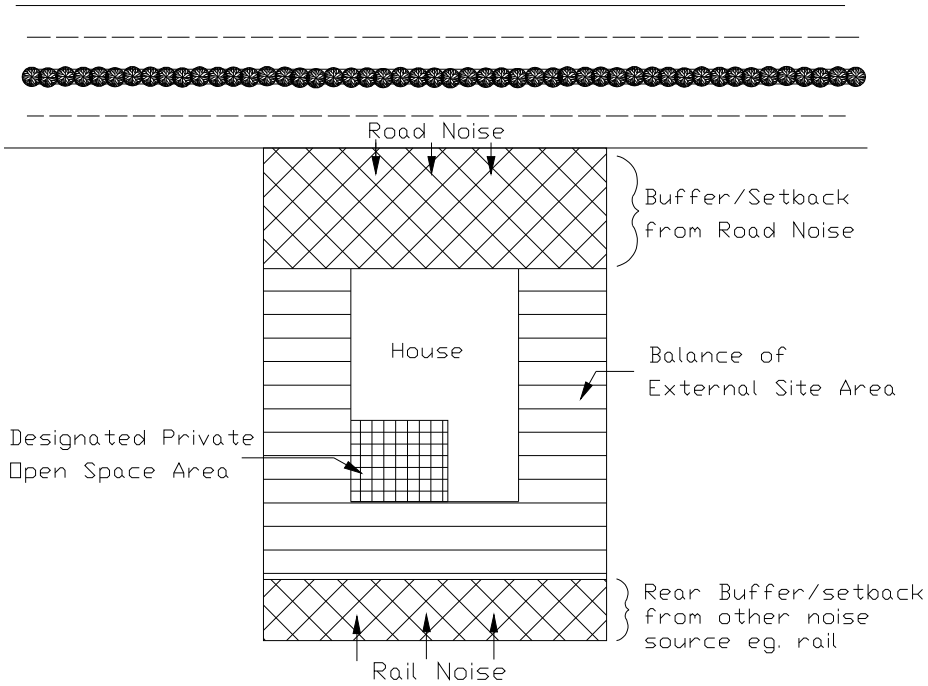
(2) Where a proposed development includes a sensitive land use and is located within close proximity to an incompatible noise emitting use, a noise report may be required to demonstrate that acceptable noise levels will be achieved at the proposed development site. Refer to section 5.6.4 Noise Reports for more details. In some instances the term “close proximity” may be referred to as the prescribed separation distance or a trigger area, identified in a code that is relevant to either the proposed development or the incompatible noise emitting land use.

(3) All acoustic matters for a development should be addressed at the earliest application stage. This means the application should address both the macro issues of lot design, set backs, noise assessments and noise barriers; and the micro issues of location of designated private open space areas, internal noise levels, and implementation of appropriate construction standards.

(4) Part 5 - Division 10 - Road and Rail Noise Impacts Overlay Code specifies design level noise criteria for the designated private open space areas of a dwelling unit. The intent of this provision is to ensure that there is sufficient space within the development where people can relax, entertain and recreate without being unduly affected by noise. This should also be addressed at the earliest design stage. An example showing a designated private open space area is shown in Diagram 1.

(5) In certain circumstances, covenants may be placed over land where it has been identified as being adversely affected by noise. Where noise levels for any part of a lot exceed the façade level or designated private open space area level as set out in Table 1 - Road Design Level Noise Criteria for Road and Rail of the Road and Rail Noise Impacts Overlay Code, it is declared “noise affected” and covenants may be applied to such lots or developments. This decision may need to be considered based on an assessment undertaken within a 10 year planning horizon, to factor in the changes to the receiving environment such as the future construction of intervening structures. It is recommended that the applicant check if such a covenant exists prior to submitting their development application. Development of sensitive receiving environments within areas predicted to be subject to noise in excess of the façade level, as set out in Table 1 - Road Design Level Noise Criteria for Road and Rail of the Road and Rail Noise Overlay Code, is unlikely to be permitted.

Diagram 1 - Designated Private Open Space Area



5.6.4 Noise Reports

(1) Development that has the potential to generate noise or receive intrusive noise, as discussed in the previous sections, may be required to address these noise issues in a noise report. A noise report is to be prepared by a suitably qualified and experienced acoustic consultant. A noise report should discuss the following issues in relation to the development, where applicable -

(2) For industrial or commercial development, in demonstrating that Best Practice Environmental Management is implemented to minimise noise emissions, the following information may be required with the application -

(a) Orientation of buildings and facilities -
- (i) plans showing the location of openings directed away from sensitive land uses, and acoustic screening of outside activities such as deliveries or refuse collection;
- (ii) plans showing location of noise generating plant such as air conditioning, pumps, compressors and fans with respect to adjacent sensitive land uses, and details of proposed noise attenuation devices;

(b) Design and construction materials used -
- (i) sketch plans and elevations showing building design and materials;
- (ii) the façade noise level used as the basis for calculating building attenuation requirements at each location including reduction weightings (Rw) for the building;

(c) Proposed operations -
- (i) a comprehensive description of -
  - a. plant and equipment to be used, including its location, time and period of operation, and frequency of use;
  - b. other noise sources which may exist, including the location, time, nature and frequency;
- (ii) the operating sound power level in dB(A) and frequency analysis for all proposed equipment and plant;
- (iii) a description of any behavioural noise;
- (iv) an accurate description of any noise with annoying characteristics, described in terms of the noise level, frequency and duration of occurrence;
- (v) if an exact description of equipment cannot be supplied, noise data from equivalent equipment operating at similar operating conditions may be accepted as a substitute;

(vi) details of the frequency of proposed road, rail, air or water borne transport to and from the site. Transport or haul routes are located to cause minimum noise impact in surrounding areas and are identified on a suitable map;

(d) Noise issues -
- (i) all noise issues associated with a proposed development are clearly defined, preferably in a table or list;
- (ii) minor noise issues which do not justify a full analysis should still be identified and reasons given to explain their insignificance;

(e) Noise control strategy -
- (i) a clear and concise statement is required which sets out the proposed strategy or strategies to deal with each of the identified noise issues. This may include a combination of -
  - a. source control - such as plant selection;
  - b. source modification - such as acoustical treatments or management measures;
  - c. propagation control - such as buffers and barriers;
  - d. receptor modification - such as a dwelling upgrade;

(f) Control at the source -
- (i) use of low-noise equipment such as refrigeration condensers, packaged low-noise air compressors or generator sets;
- (ii) use of alternative, quieter technology, for example replacing sirens with flashing lights, using electric cranes in preference to diesel-powered cranes and using mobile phones or personal pagers instead of telephone extension bells;
- (iii) use of more appropriate control technologies such as variable speed drives on cooling tower fans or two-speed fans on air-cooled condensers in order to avoid stop/start operations and to reduce noise emission levels at night;
- (iv) use of carbon monoxide monitors to control fan operations in carpark exhaust systems, again matching fan performance to demand to effectively reduce noise emissions at night;
- (v) use of solid-state switching in preference to relays;
- (vi) use of soft-start electric motors on drives which require cyclic operation;
- (vii) the report describes any recommended or proposed low-noise plant. Where the make and model of specific plant selections can be identified, their noise performance is detailed in terms of their sound power levels or sound pressure levels at nominated distances. Where schematic or conceptual designs only are available, the typical performance and improvements are stated;

(g) Source modification -
- (i) this may include technical treatments such as acoustical enclosures around plant, or may rely on staff implementing appropriate procedures to minimise noise -
  - a. there are a number of firms specialising in noise control, offering both off the shelf and purpose-designed acoustical treatments. Such treatments have the potential to interfere with the performance and/or efficiency of plant operation. It is therefore recommended that specialist advice be sought in the planning and design of these measures;
  - b. the report describes the intended noise reduction measures and their anticipated performance;
  - c. management measures include all noise control actions which rely on people to behave in a particular way. This may require delivery drivers to use a specific route or curtail particular activities such as the use of exhaust brakes. It may require staff to restrict certain activities to certain times or to intervene by closing doors or re-directing activities;
  - d. if management measures are proposed, a site-specific noise management plan is required. This plan should include at least one contingency action in the event that the primary noise plan fails to achieve or maintain the nominated outcome;

(h) Propagation control includes the use of buffer zones and/or noise barriers to achieve noise attenuation. The report shall include plans showing the locations and heights of all noise sources, and the locations and heights of any proposed noise barriers. Where buildings are relied on to provide barrier screening, the elevations and locations of openings such as doors and windows are also provided;

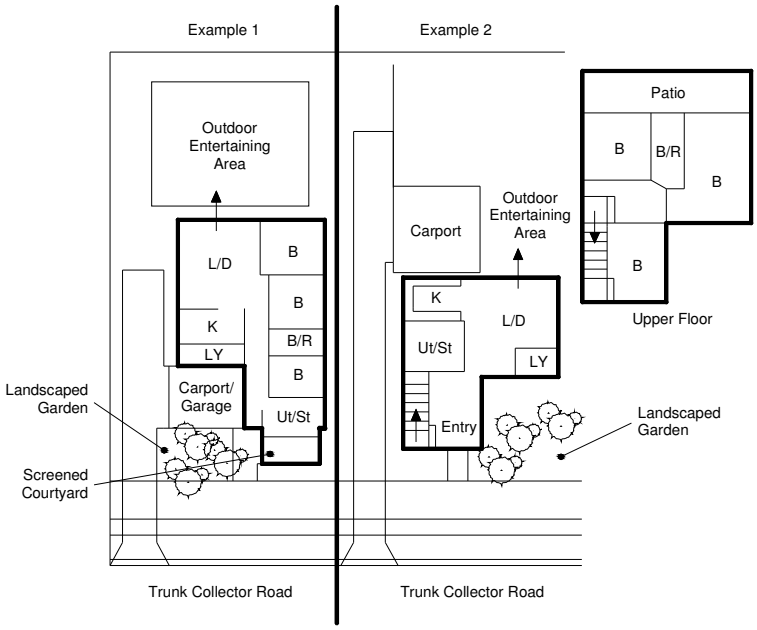
(i) Information on noise monitoring and/or noise predictions, modelling and results including -
  (i) a description of the existing noise climate including -
    a. ambient noise levels during day, evening and night periods on both weekdays and weekends;
    b. prevailing atmospheric conditions;
  (ii) location of monitoring sites and rationale for its selection;
  (iii) noise prediction results for when attenuation measures are provided and where no attenuation measures are provided;
  (iv) details and assumptions used in the model for predictions;
  (v) criteria established for assessment purposes;

(j) When including details of attenuation measures identified to achieve compliance with noise criteria, also provide the methods used to calculate this attenuation.

(3) For development of sensitive land uses adjacent to roads and railways, as identified in the Road and Rail Noise Overlay -

(a) Describe the noise attenuation measures to be implemented to reduce traffic noise affecting the proposed adjoining development. Noise nuisance should be ameliorated in the first instance through the design, orientation and layout of the site - refer to Diagram 2. As stated earlier, to achieve the design level noise criteria it should be demonstrated that a range of acoustic treatments available for application at the site were evaluated;

Diagram 2 - Design and layout for rooms sensitive to noise



(b) For developments including a sensitive land use adjacent to roads and railways, the noise report should also include a suitably scaled plan indicating the following -
  (i) for road noise -
    a. predicted 60 (or 63) dB(A) $L_{A10\ (18\ hour\ or\ less)}$ contour with and without noise attenuation measures;
    b. predicted 55 dB(A) $L_{Aeq\ (1hr)}$ contour with and without noise attenuation measures;
    c. the noise contours are plotted for both lowset and two-storey dwellings. For dwellings, the receptor height is taken to be 1.5 metres above each finished floor level;
  (ii) for rail noise -
    a. predicted 87dBA $L_{A\ max}$ contour with and without noise attenuation measures;
    b. predicted 65 dB(A) $L_{Aeq\ (24\ hour)}$ contour with and without noise attenuation measures;
    c. predicted 55 dB(A) $L_{Aeq\ (1hr)}$ contour with and without noise attenuation measures;
    d. the noise contours are plotted for both lowset and two-storey dwellings. For dwellings the receptor height is taken to be 1.5 metres above each finished floor level;

(iii) location of proposed barriers indicating heights of barriers and portion of land required to accommodate mounds, where applicable;
(iv) floor plan / layout of proposed development, where applicable;
(v) the noise measurement location and its rationale for selection;
(vi) calculations must indicate the attenuation provided by each alternative through distance, barrier, building and angle of exposure;
(vii) show cross sections of the design and proposed location of the acoustic barriers where not in compliance with the policy;
(viii) the option for the use of acoustic barriers is supported by an assessment of the public safety and visual amenity of the structures;
(ix) provide indicative elevations of "cross sections and plans" to indicate that the barriers will "fit" on the site and that adequate park dedication is provided to "fit" the barrier.

(4) General requirements for developments that include sensitive land uses -

(a) Buildings are designed and constructed to reduce the intrusion of noise, by locating rooms most sensitive to noise such as those for sleeping, relaxation or study, furthest from existing and potential noise sources.

(b) Buildings are constructed using materials including insulation and glazing materials with a high noise transmission loss. For example, where sites are potentially affected by road noise, buildings are constructed in accordance with *Australian Standard 3671:1989 Acoustics - Road traffic noise intrusion - Building siting and construction*.

(c) Reduce the area covered by openings such as windows and doors that face existing and potential noise sources.

(d) Provide mechanical ventilation to rooms most sensitive to noise such as those for sleeping, relaxation or study.

(e) Provide adequate setback or buffer distances between noise sources and the sensitive land use -
(i) in providing setback or buffer distances between noise sources and sensitive land uses, site specific distances are calculated by a suitably qualified acoustic consultant. Issues including topography, climate and all current and predicted impacts from incompatible adjacent land uses, during day and night time periods, are considered in determining these buffer distances;
(ii) where buffer distances are incorporated within the lot or premises, sensitive land uses are indicated on proposal plans and are not located within the buffer.

(f) Design, orientate and construct buildings to effectively screen external private open space areas from the noise source.

(g) Use appropriate buffer distances between the noise source and external private open space areas.

(h) Provide suitable noise attenuation barriers where needed.

Note -

Setbacks and building design are the preferred noise management measures and the consideration of these and other noise management options should be demonstrated prior to proposing barrier attenuation.

(i) Where requested, also provide noise monitoring information and/or noise prediction and modelling including noise assessment results, as previously outlined.

5.6.5 Noise Assessment

(1) A noise report prepared to assess noise nuisance potential must include the following information as a minimum -

(a) A site analysis plan at a scale of 1:100 or 1:200 indicating the location of the development, noise sources and sensitive land uses;

(b) A site layout and surrounds plan at an appropriate scale indicating -
- (i) the location and direction of noise sources and sensitive land uses and the location of noise attenuation devices and appropriate buffer distances;
- (ii) the layout and/or elevations of the built environment including walls, ceilings or room contents, if appropriate, and other structures. If outdoors, trees, reflective objects, topographic features and any other relevant features are indicated on the plan;
- (iii) where maximum noise levels are expected at the affected premises;
- (iv) where relevant barriers, mounds, vegetation and ground cover in buffer or separation distance are to be installed;
- (v) identification of other existing and proposed land uses in the vicinity of the noise affected premises;

(c) Design and construction details include -
- (i) for sensitive land uses -
  - a. show the location of bedrooms, living rooms, windows and other openings, designated private open space areas and setback distances to noise emitters;
  - b. describe the acoustic treatments proposed for the building to reduce noise impacts;
- (ii) for a noise emitter, show -
  - a. the location of all noise sources such as dining areas, air conditioning, pumps, compressors, fans;
  - b. the location of building openings with respect to adjacent sensitive land uses;
  - c. details of proposed noise attenuation devices;
- (iii) a description of the noise sources, including use operating hours and operating conditions, where applicable;
- (iv) noise attenuation measures including, where necessary, fences, barriers and mounds;
- (v) landscaping associated with noise attenuation measures, including buffer areas;
- (vi) photographs, where appropriate, to support the assessment conclusions;

(d) Noise levels -
- (i) a map showing the location of measurement positions, detailing microphone height and orientation, and including details of any obstructions or interference such as reductions in the angle of view;
- (ii) reflective surfaces and atypical barriers are avoided where possible when taking measurements;
- (iii) the type of sound being measured and the character of the sound field;
- (iv) the sound power levels obtained, including frequency analysis, where relevant;
- (v) the sound pressure levels measured at each monitoring location, including output data such as log files, traces, and charts from the noise monitoring equipment;
- (vi) frequency weighting and response time, fast/slow/impulsive, used for each measurement;
- (vii) duration of each measurement period. Measurement intervals shall not be less than 15 minutes;
- (viii) date and time at which each measurement was performed. It is important the monitoring is carried out at times and over periods that adequately characterise the noise under investigation and the local acoustic climate. Justification of times and periods selected should be included;
- (ix) relevant meteorological conditions and other site considerations during assessment. These include, for example, air temperature, relative humidity, barometric pressure, wind speed and direction, rain, aircraft noise, vehicle noise and insect noise;
- (x) noise level or noise contour predictions in the locality both with and without noise attenuation;
- (xi) the assessment should include an evaluation of a range of noise attenuation options and recommendations to mitigate potential noise nuisance;
- (xii) provide details and justification of the methodology used, including all assumptions made as part of the assessment;
- (xiii) name of manufacturer, type and serial numbers of all monitoring and calibration equipment;
- (xiv) last laboratory calibration date, internal reference check and external calibration results before and after measurement;
- (xv) name of the person who conducted the assessment and the name of the report author, if different;

(e) Noise modelling and calculations -
- (i) details of noise measuring and modelling procedures, calculations and assumptions;
- (ii) name of the model used for the predictions;
- (iii) monitoring data which supports calculations resulting from modelling;
- (iv) information on calibration of the model and the model's accuracy is provided. Where it is not provided, it is assumed that the model's accuracy is that reported in literature;
- (v) an example of calculations showing effectiveness of proposed noise attenuation measures is also provided;

(f) Other information -
- (i) in certain cases the assessing officer may request information on additional matters. Such requirements would normally be identified at a pre-lodgement meeting or through the Information Request Period for a Development Application;
- (ii) provide enough information to justify the noise level criteria you have chosen. Where there are no specific measures for evaluating noise under consideration, the following noise levels are used -
  - a. Community Noise - Table 2 provides desirable levels for community noise or where Table 2 cannot be practicably achieved the comparison of like parameters is applied;
  - b. Blast noise - Table 3 provides noise level criteria for blasting;

Table 2 - Desirable levels for community noise

Sleep disturbance objective	Sleep disturbance criteria
■ 30dB LA_{eq} for continuous noise ■ 45dB LA_{max} for single sound events	Where the sleep disturbance objective can not be practicably achieved, other criteria for sleep disturbance may be used, providing it can be demonstrated the criteria is suitable for assessing likelihood of sleep disturbance.
Conversation disturbance objective	**Conversation disturbance criteria**
■ 35 dB LA_{eq}	Where the conversation disturbance objective can not be practicably achieved, other criteria for conversation disturbance may be used, providing it can be demonstrated the criteria is suitable for assessing likelihood of conversation disturbance.

Table 3 - Criteria values for noise from blasting

Airblast overpressure	Ground vibration
115 dB(Lin) peak for any 4 out of 5 consecutive blasts at any noise sensitive environment	■ >35Hz maximum of 25mm/s ■ <35Hz maximum of 10mm/s

- (iii) intrusive noise impact can be measured using long-term, cumulative noise exposure criteria and/or short-term, emission/immission criteria, depending on the receiving environment. The choice of criteria will depend on the sensitivity of the receiving environment at particular times of the day. For example, a school will have a requirement for suitable noise levels within the classrooms only during their use. Therefore a 24 hour criteria would not be appropriate for such a use, and a short-term criteria should be used;
- (iv) for short duration noise events of a minimum measurement interval of 15 minutes or for blasting, include -
  - a. the number of discrete noise events from the source and in the existing environment;
  - b. the time of occurrence;
  - c. the character of the noise source;
  - d. whether this type of noise would normally be present in the area;
  - e. the likely impact of the noise on the receiver;
- (v) monitoring results should include presentation of a range of descriptions. Where percentile levels are used, such as $L_{A10,T}$ $L_{A90,T}$, include a cumulative distribution of percentile levels for both the source and background noise;
- (vi) for each report, environmental noise and vibration must generally be assessed and measured in accordance with the relevant guidelines outlined in the references listed in Table 4.

Table 4 - Australian Standards and other reference material for assessment and measurement of environmental noise

Australian Standards and other reference material for assessment and measurement of environmental noise
■ *Guidelines for Community Noise, World Health Organisation, Geneva, 1999.* ■ *Australian Standard 1055.1 - Acoustics - Description and Measurement of Environmental Noise-General Procedures.* ■ *AS/NZS 2107: Acoustics - Recommended Design Sound Levels and Reverberation Times for Building Interiors.* ■ *Australian Standard 2702 - Acoustics - Methods for the Measurement of Road Traffic Noise.* ■ *Australian Standard 2021 - Acoustics - Aircraft Noise Intrusion - Building, Siting and Construction.* ■ *AS/NZS3817 - Acoustics - Methods for the Description and Physical Measurement of Single Impulses or Series of Impulses.* ■ *AS ISO 2631.2 –Mechanical Vibration and Shock - Evaluation of Human Exposure to Whole-body Vibration - Vibration in Buildings.* ■ *Australian Standard 3671 - Acoustics - Road Traffic Noise Intrusion - Building Siting and Construction.* ■ *Australian Standard 2659 - Guide to the Use of Sound Measuring Equipment Part 1: Portable Sound Level Meters.* ■ *AS/NZS4476: Acoustics - Octave-band and fractional-octave-band filters.* ■ *Transport Noise Management Code of Practice by QLD Department of Transport and Main Roads.* ■ *Noise Measurement Manual Queensland Department of Environment and Heritage Protection, 2013.* ■ *Environmental Protection Act 1994* and subordinate legislation. **Note -** The most recent or updated edition of these references should be applied.

5.6.6 Noise Prediction and Modelling

(1) Noise prediction modelling is generally used to predict noise levels generated by noise sources, to calculate propagation and attenuation, or a combination of both. These are often theoretical models used to predict the pattern of the sound field for a given configuration of source and boundary conditions. Most predictions are done with a computer model, however hand calculations may be acceptable provided that the principles for computer modelling are followed. The noise prediction should involve the following -

(a) An estimate of the cumulative sound pressure level at the boundaries of the proposed site and at the boundaries of existing and future land uses likely to be affected by the noise sources. The values are plotted on a contour map at 5 dB(A) intervals. This should include consideration of all potential noise sources, including during the construction phase, normal plant operation, behavioural noise, P.A. announcements and increased traffic movements;

Note -

It should be noted that the presentation of model output data in the form of noise contours is generally not suitable for determining noise levels at individual locations or determining compliance with noise criteria. Noise contours should be supported with detailed predicted levels at critical locations such as houses, schools and hospitals.

(b) A description of the modelling methods applied;

(c) Where noise originates from the interior of proposed buildings, engineering drawings showing building dimensions, wall and roof materials with the location and size of any openings are provided. Plan and sectional elevations should show any openings in the building façade;

(d) Topographical maps of scale 1:10000 are included where topography and/or permanent structures could greatly affect the propagation of noise to surrounding areas. Reduction in noise due to natural and artificial screening from buildings and other structures should be included in the modelling exercise;

(e) A description of the nature of ground cover, for example, thick grass, shrubbery and dense vegetation between the proposed development site and the area likely to be influenced;

(f) An estimation and description of the L_{A10}, L_{Amax}, L_{A90}, L_{Aeq} and maximum instantaneous (L_{pA}) levels, as appropriate for periods representative of day, evening and night times for both weekdays and weekends;

(g) Noise levels should represent normal day to day operations. Circumstances giving rise to periods of higher noise levels are described with details of these levels and the estimated duration and frequency of occurrence of these levels;

(h) Where tonal components are expected to be present, one-third octave band predictions are required to adequately describe the contribution from these noise sources. The level and frequency of occurrence of impulsive noise, or noise with other annoying characteristics such as amplitude or frequency modulation or information content[1], should be provided;

(i) Predictions should be based on atmospheric conditions prevailing at the time of the assessment. An estimate should be provided of the expected increase in noise level at receptor premises under meteorological conditions conducive to noise propagation, with a down wind component or temperature inversion. Representative meteorological data, such as that from a local weather station, are reviewed and weather conditions characteristic of the site for different times of the year should also be included in the assessment;

(j) Individually predicted components are combined to produce the predicted cumulative noise impact at each receptor site;

(k) Predicted noise levels are compared with acceptable levels and/or the acceptable solutions specified in the relevant codes. Exceedances are identified separately and the relevant degree of noise reduction required to achieve compliance with the appropriate criteria is specified;

(l) The model applied should comply with the Australian Standards and Noise Measurement Manual listed in Table 4.

[1] Voice or music

5.6.7 Noise Reduction

(1) Details are provided about the proposed noise control measures to be applied at the site, including the expected noise reduction where the earlier assessment of predicted levels shows adverse local and remote noise impact.

(2) The scale of the improvements to be provided by the noise control measures is predicted to confirm compliance with the appropriate criteria. For example, this could be demonstrated by providing contour predictions on a site plan for each of the attenuation options.

(3) If acceptable noise levels cannot be achieved, additional information is provided to justify approval of the development.

5.6.8 Noise Attenuation Barriers

(1) The use of barriers for noise attenuation is the least preferred option, however, the following should be considered during the design of the development where noise attenuation measures in the form of barriers, fences and vegetated buffers are required.

(2) The design of these noise attenuation measures should not -

(a) compromise the ability to protect property from crime and vandalism;
(b) obstruct or reduce passage by pedestrians to public transport nor contribute to deterioration of accessibility to public transport;
(c) create sterile areas that are unusable, unsafe and negatively affect the streetscape;
(d) result in continuous barrier fencing along roadways which has both visual impacts and also impacts on people and wildlife movement;
(e) obstruct the overland flow of stormwater or cause increased flooding or ponding of stormwater;
(f) compromise the requirements of *State Planning Policy – state interest guideline - Biodiversity*;
(g) compromise the Redland City Council's Koala Conservation Agreement Program.

(3) Noise attenuation measures for dwellings or building façades should be designed as architectural features including the stepping of buildings, angling wall alignments, and roof line variation to add interest to the form and enhance the appearance to the street frontage.

(4) Noise attenuation measures are designed to facilitate wildlife movement while maintaining noise attenuation effectiveness by ensuring -

(a) vegetated earth mounds are considered in preference to fences or barriers;
(b) suitable vegetation is provided adjacent to noise attenuation mounds, barriers and fences to facilitate wildlife movement;
(c) attenuation barriers and fencing incorporate wildlife movement measures that are suitable to the species expected to use the area;
(d) vegetation species selected are locally native species. Refer to Redland City Council's Vegetation Enhancement Strategy and Policy 2007, or the most recent or updated edition/version.

Note -

For more detailed guidance on movement of native animals refer to Part 11 - Planning Scheme Policy 4 - Ecological Impacts.

(5) Continuous barrier fencing is avoided along trunk collector and sub-arterial roads so as to not create sterile traffic corridors.

(6) Views are retained where possible by using appropriate buffer distances, height, orientation and materials.

(7) Where fencing is used it is articulated, landscaped and incorporates multiple access points for pedestrians and cyclists.

(8) Acoustic fencing is of low maintenance design.

(9) When using measures such as earth mounds, fences or a combination of these, refer to Table 5 - Specifications for Noise Attenuation Measures (Barriers, Fences and Mounds).

(10) It should be noted that a covenant may also be applied where an acoustic barrier is required to be maintained on land to protect the amenity of the greater neighbourhood for example an acoustic fence which runs along the boundary of several individual properties.

(11) As stated earlier, it should be demonstrated that other attenuation measures have been considered first as alternatives to structural barriers. For example, at the design phase of a development, consideration should be given to the use of land between the source and receiver which can increase buffers and assist in attenuation. Such land uses could be minor roads and/or parks.

Table 5- Specifications for Noise Attenuation Measures (Barriers, fences and mounds)

Type of Measure	Specifications
Earth Mounding - Landscaped **See Diagram 3**	■ Area required from property boundary to pavement kerb is a minimum of 11.6 metres - buffer zone plus road reserve/ verge. ■ Mound set at 3.6 metres from back of kerb. ■ Standard street tree planting to apply in 3.6 metre zone. ■ Mound width at base equal to 8 metres. ■ Maximum mound height at apex ranges from 1 metre to 2 metres. ■ Mound batters do not exceed 1:2 (V:H) slope. ■ Earth mound is clean, compacted fill with topsoil capping to minimum 300mm depth and minimum 100mm mulch layer over mound. ■ Mound is planted with a mixed range of local native species including large shrub/ small tree species and an under-storey of small shrub and groundcover species. ■ Mature height of - ▸ large shrub/ small trees is 6 metres; ▸ under-storey shrubs is 1 metre. ■ Density of planting is one plant per square metre with ratio one large shrub/ small tree to six under-storey shrubs. ■ All mounding is designed to avoid localised ponding with run-off directed towards suitable areas.

Type of Measure	Specifications
Earth Mounding - Landscape and Barrier Fencing **See Diagram 4**	■ Minimum area required from property boundary to back of kerb is 7.6 metres - buffer zone and road reserve / verge. ■ Minimum mound set at 3.6 metres from back of kerb / road edge. ■ Standard street tree planting to apply in 3.6 metre zone. ■ Mound width at base equal to 8 metres with 4 metres to extend within property boundary[2]. ■ Mound height at apex ranges from 1 metre to 2 metres maximum. ■ Mound batters do not exceed a 1:2 slope (V:H) slope. ■ Earth mound is clean, compacted fill with topsoil capping to minimum 300mm depth and minimum 100mm mulch layer over mound. ■ Mound is planted with a mixed range of local native species including large shrub/ small tree species and an under-storey of small shrub species and groundcover species. ■ Mature height of - ‣ large shrub/ small trees of 6 metres; ‣ under-storey shrubs of 1 metre. ■ Planting density is one per square metre with a ratio of one large shrub/ small tree to six under-storey shrubs. ■ Fence is of timber materials or other approved materials with height between 1.2 metres to 2 metres. ■ All mounding is designed to avoid localised ponding with run-off directed towards suitable areas.
Fence and Planted Buffer **See Diagram 5**	■ Area required from property boundary to back of kerb is a minimum 5.5 metres - buffer zone and road reserve / verge. ■ Dedicated land for planting buffer is a minimum of 2 metres wide. ■ Standard street tree planting to apply in 3.6 metre zone. ■ Planted buffer is clean, cultivated top soil to minimum 300mm depth with minimum 100mm mulch layer over ground. ■ Irrigation system satisfies the local government's standard specifications. ■ Buffer is planted with a mixed range of locally native species including large shrub/ small tree species and an under-storey of small shrub and groundcover species. ■ Mature height of - ‣ large shrub / small trees is 4 metres; ‣ under-storey shrubs is 1 metre. ■ Planting density is one plant per square metre with a ratio of one large shrub / small tree to eight under-storey shrubs. ■ Fence is of timber construction or other approved fencing products with a maximum height of 2 metres. ■ Fence colour enhances visual amenity.

[2] Alternative designs to Diagram 4 which utilise less land area may be considered, where appropriate.

Diagram 3 - Earth Mounding - Landscaped

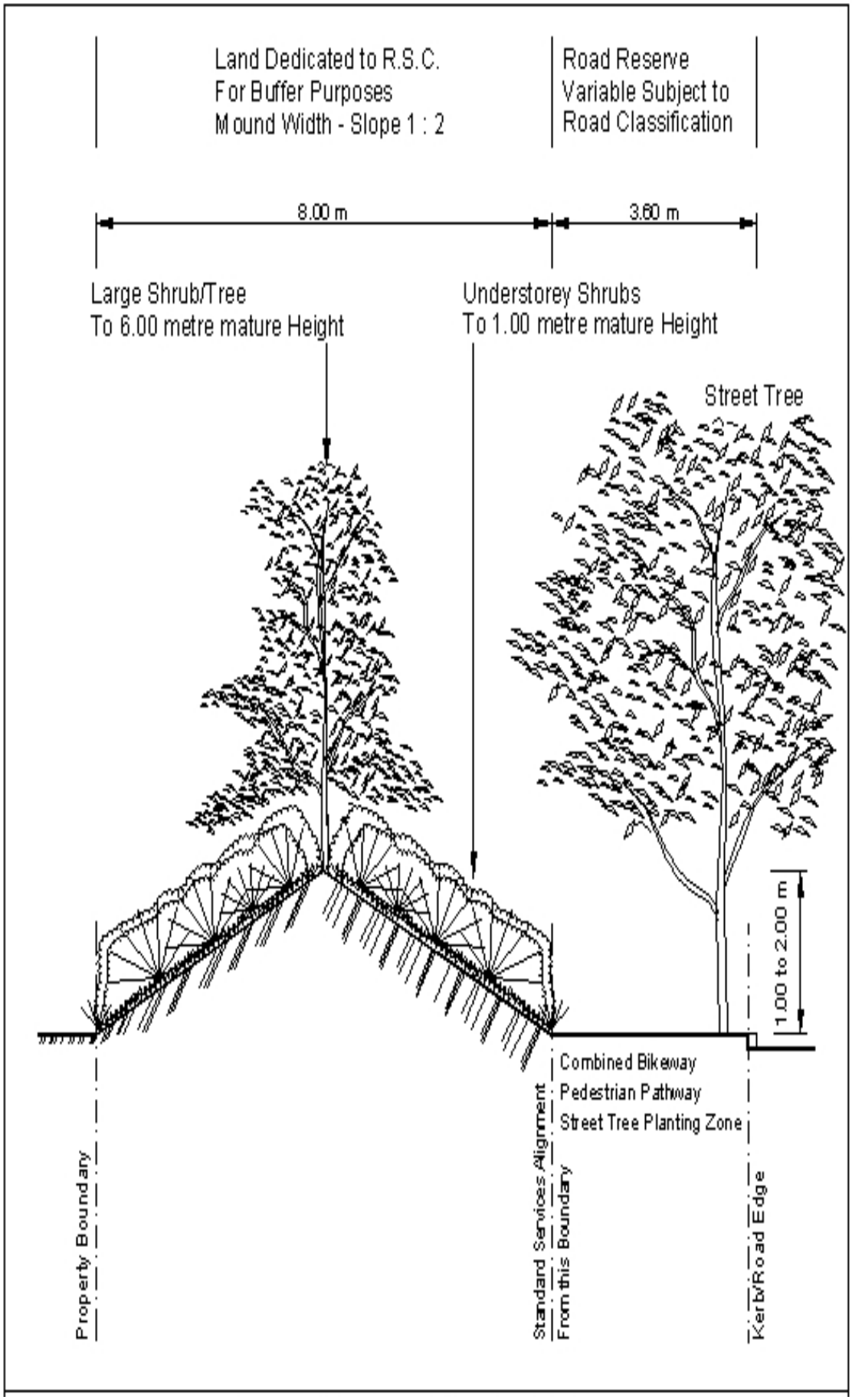
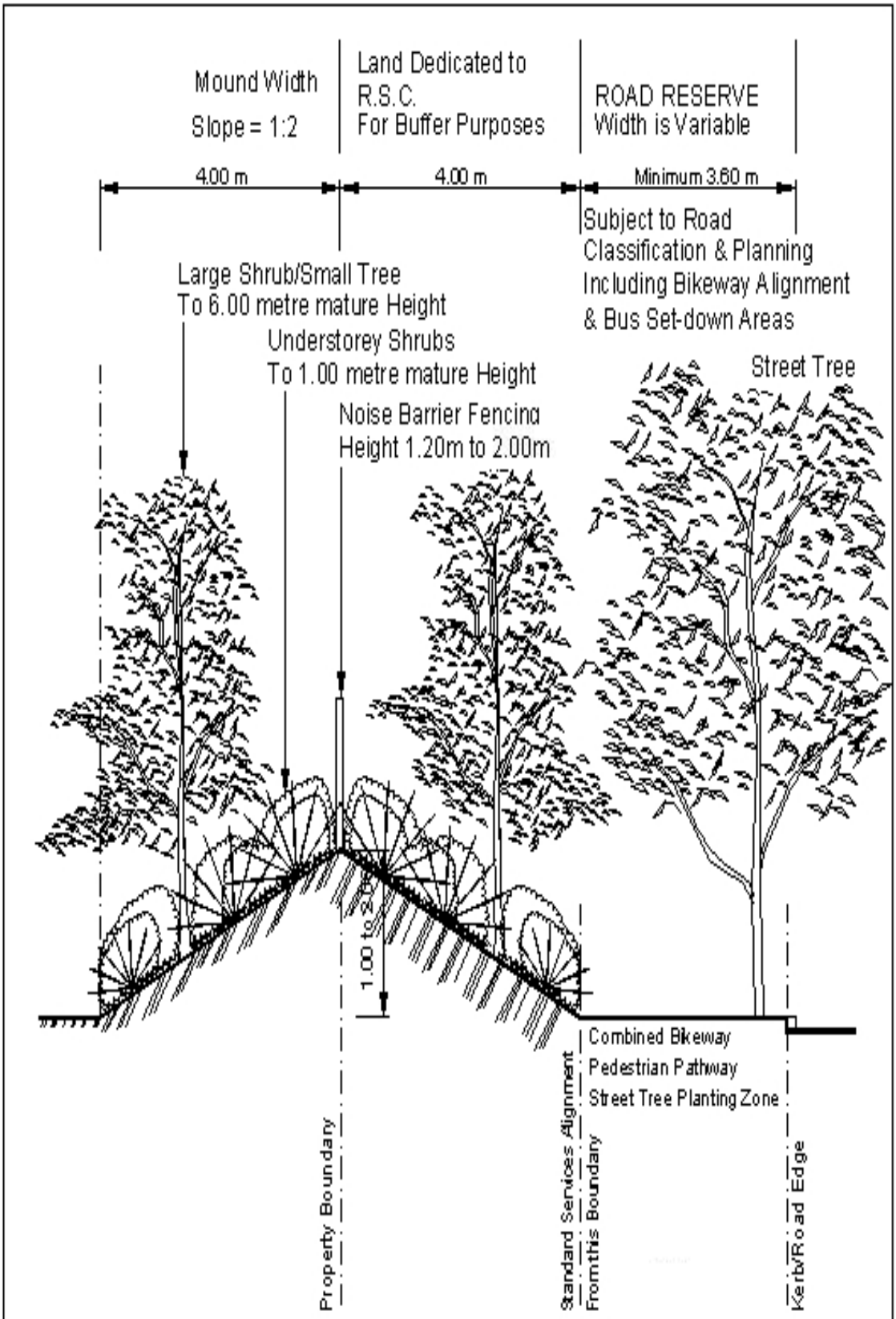
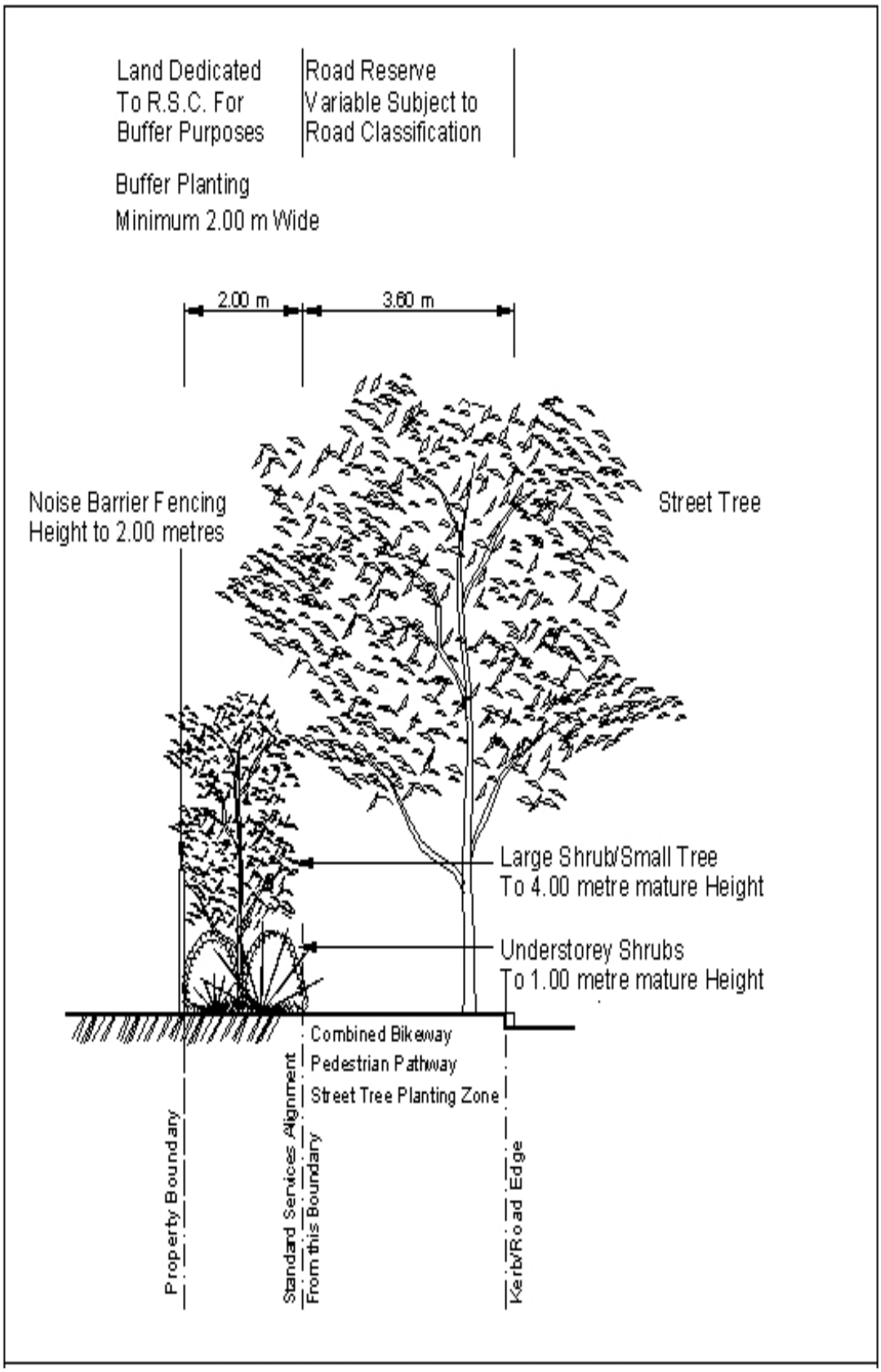


Diagram 4 - Earth Mounding - Landscape and Barrier Fencing



NOTE: Combination of minimum 1.00 metre high mound with 1.20 to 2.00 metre high fence can be considered as the minimum requirement.

Diagram 5 - Fence and Planted Buffer



5.6.9 Additional guidance on specifications

In addition to the specifications listed in Table 5, which provide guidance to applicants about how to design and construct acoustic barriers, the following design elements are also provided to supplement these specifications.

Diagram 6 - Wildlife Movement 1

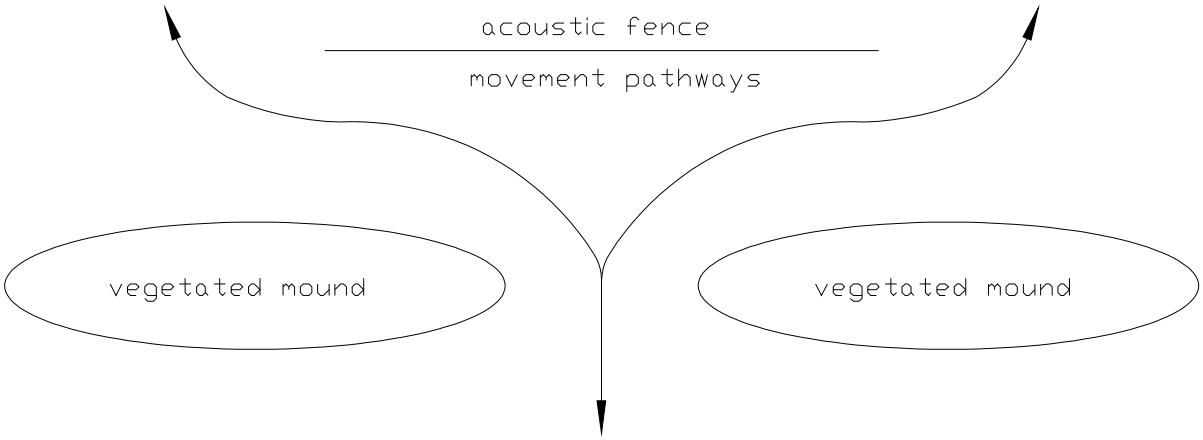


Diagram 7 - Wildlife Movement 2

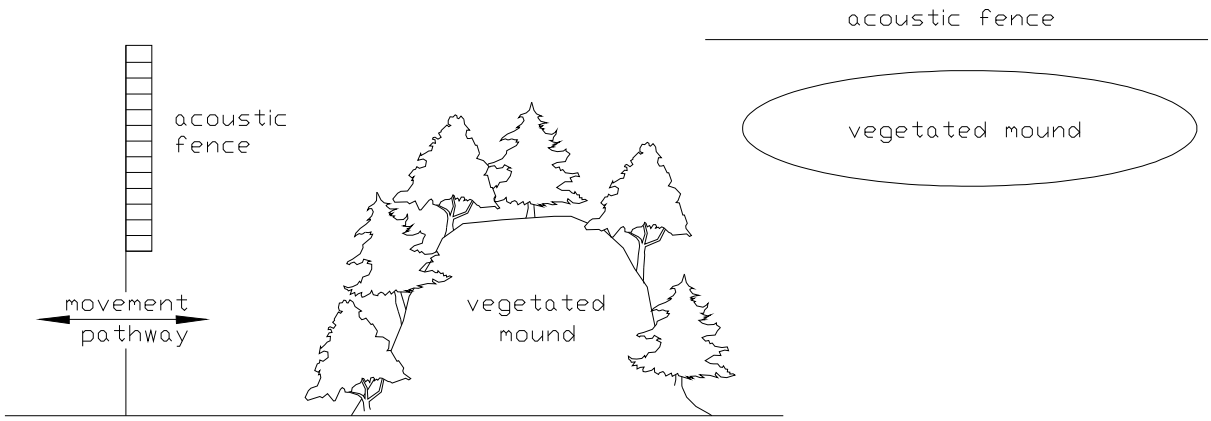
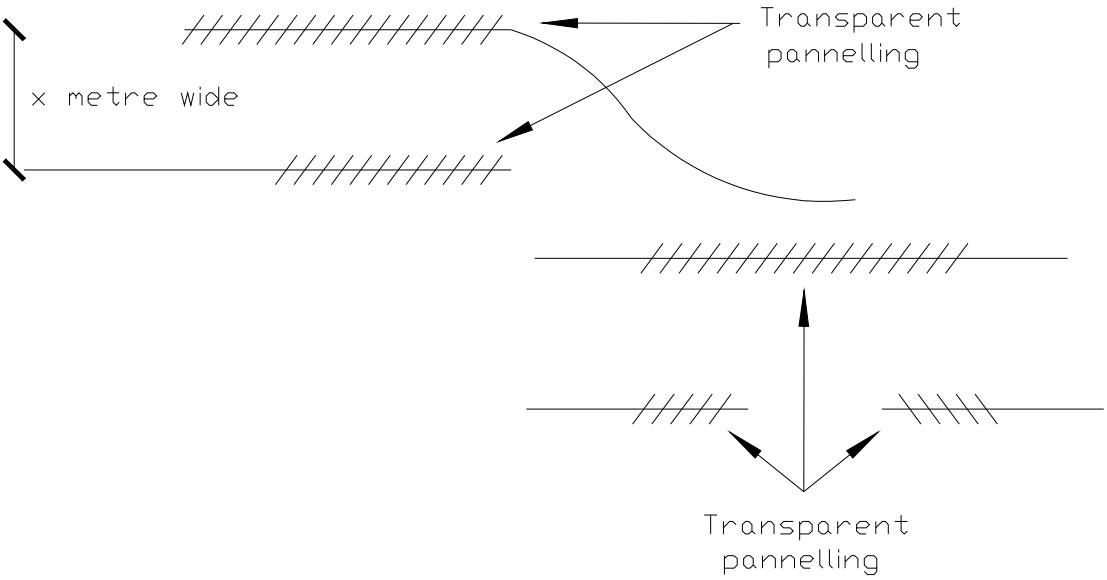


Diagram 8 - Pedestrian/Cyclist Movement



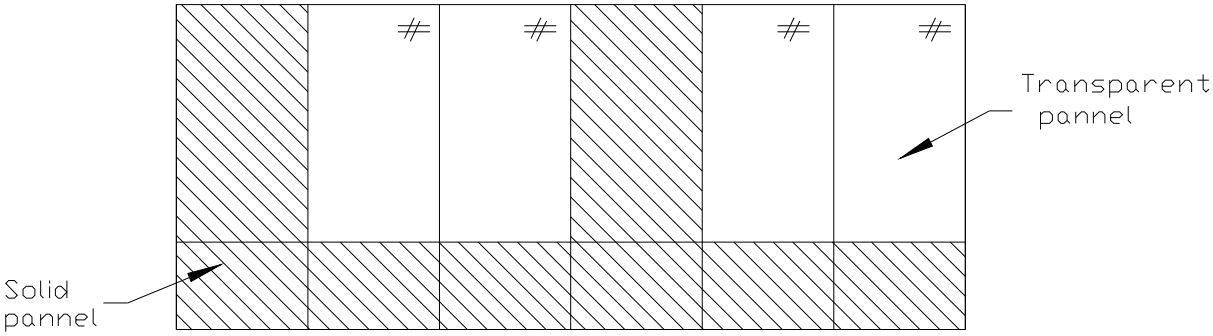
5.6.10 Alternative Fencing Products

(1) Transparent panelling such as glass or plastic may have application in certain circumstances. These may provide benefits where acoustic fencing is required for noise attenuation and other issues require consideration such as visual amenity, scenic constraint areas and the prevention of crime and increased safety.

(2) However, the following matters should be considered -

(a) the “fishbowl effect” created by large expanses of transparent panels is minimised. This may be achieved by incorporating solid panels into the barrier so to improve visual amenity and wildlife safety - refer to Diagram 9;
(b) where transparent noise barriers exceeding 2 metres in height are proposed, further evaluation of alternative attenuation methods is undertaken considering visual, environmental and economic factors, including long term maintenance.

Diagram 9 - Use of transparent panelling.



5.6.11 Noise Barrier Maintenance

(1) Noise attenuation measures and associated landscaping should be easily maintained, have long term durability and will not create ongoing maintenance resource demands for the local government.

(2) Noise attenuation measures and associated landscaping are designed and constructed to prevent and discourage graffiti and vandalism by, in areas where graffiti and vandalism have been experienced in the past, avoiding noise attenuation measures that obstruct and prevent surveillance from residential areas.

Appendix 1 - Methods to Minimise Impacts from Air Emissions

(1) This is not an exclusive list but merely provides a range of examples for minimising air emission impacts.

(2) Design and operations management -

(a) Maintain adequate buffers between operations and nearest sensitive land use;
(b) Incorporate alternative attenuation measures into the development to reduce nuisance impacts at sensitive land use;
(c) Locate and design the buildings and infrastructure to reduce potential impacts on adjacent land uses, for example locate building openings, exhaust vents, stacks, and refuse storage areas furthest from sensitive land uses;
(d) Provide sealed areas on site for vehicle manoeuvring and access;
(e) Clean equipment, work and traffic areas regularly to minimise the sources of dust and clean spilt materials immediately;
(f) At sites which have potential organic vapour emissions such as bulk fuel storage facilities and service stations, where practicable, install vapour recovery systems. Vent pipes are located as far away as possible from sensitive land uses;
(g) Develop and implement an environmental management plan that details the procedures for air quality management and pollution prevention, staff training, role definition and responsibilities and monitoring of performance.

(3) Dry materials/stockpile handling -

(a) Maintain exposed stockpiles of raw or processed material to prevent fugitive dust emissions.
(b) Maintain stockpiles with walls on three sides and use water sprays to keep material damp where practicable;
(c) Keep stockpile materials 0.5 metres below wall tops and 0.5 metres inside open ends of stockpile walls;
(d) Enclose conveyors and chutes to minimise wind-generated dust emissions and provide a belt scraper on each conveyor;
(e) Use water sprays at receival areas and transfer points to keep material damp. Minimise drop height between conveyors;
(f) Store materials which are of fine or small particle sizes in sealed containers where practical.

(4) Surface cleaning and/or coating -

(a) Surface coating by spraying is conducted in spray booths fitted with adequate filters to catch overspray. Filters can be waterwash, fibre or baffle. A baffle filter is only acceptable for small paint rates where paint is applied electrostatically. Where practicable surface coating and cleaning are conducted inside of buildings or enclosures;
(b) Spray booths are fitted with a stack of adequate height to ensure there is sufficient dispersion of exhaust gases. Stack outlets should not be fitted with conical weather caps, spinning tops or the like which would interfere with the free vertical discharge of the exhaust gases.
(c) Where possible, use water-based coatings or those which produce low emissions;
(d) Replace lids or cover odorous materials promptly after use to minimise evaporation, off site impacts and wastage;
(e) For surface coating processes, train staff in proper application techniques of materials to improve drying times and minimise odour impacts;
(f) Surface finishing equipment using abrasive and water blasting, sanding and grinding should have dust collection devices fitted, such as an enclosed booth, unless the object is too large or too heavy to fit in the booth or a fixed structure. Outdoors blast cleaning should preferably be carried out using a blasting gun or an airless applicator which sucks away the blasting agent together with any dust generated to a dust collector. Outdoor abrasive blasting should also be avoided during high wind conditions. Where impractical, adequate buffer distances are provided with effective barriers or screens to prevent adverse particulate emissions.

(5) Emission controls -

(a) Point source particulate and odour emissions are vented through a filter to minimise the discharge. Filters include devices such as: wet scrubber, cyclone, bag, electrostatic, paper,

activated carbon, and fibre. Odour control equipment can include one or a combination of technologies including condenser, scrubber biofilter and/or afterburner;

(b) Use mechanical ventilation systems and activated carbon filters or scrubbers to prevent the release of any uncontrolled and objectionable odours from buildings or rooms;

(c) Fabric or bag filters are installed to vent silos. Silos should also include automatic level sensors, air tight inspection hatch and an alarm or shut off valve to prevent overfilling and a burst bag detector system with ducting to ground level near tanker filling point;

(d) Dust extraction systems exhausting through fabric filters may be an effective alternative to water sprays. Water spray systems are installed for outdoor operations with a high dust generating potential;

(e) Fuel burning should not be carried out under reducing conditions which has the potential to cause smoke nuisance;

(f) Where facilities include bulk storage facilities for organic liquids, such as petroleum, implement design features and install suitable controls to manage organic vapour emissions;

(g) Volatile liquids are pumped instead of poured.

(6) Waste management -

(a) Putrid or tainted organic materials should be stored in enclosed containers and refrigerated until removed from premises;

(b) The transportation of odorous wastes including sewage effluents, food processing waste, offal, manure or carcasses is in covered vehicles or containers/bins to minimise odours or dust emissions;

(c) Wastes are recycled and reused where possible. No wastes are burned as a disposal method, except where it can be demonstrated it is a form of energy recovery.

Appendix 2 - Methods to Minimise Impacts from Noise Emissions

(1) This is not an exclusive list but merely provides a range of examples for minimising noise emission impacts.

(2) Siting and design -

(a) Select an appropriate site for the use considering the proximity to sensitive land uses and the local meteorological conditions;
(b) Design site layout to ensure building openings, roads, parking areas and other major activities and operational areas are located away from current or future sensitive land uses;
(c) Where possible use the layout of the buildings, site infrastructure and natural topography as noise barriers;
(d) Where possible confine noisy processes to areas protected by enclosures or barriers;
(e) Locate noisy processes such as loading bays and entrances/exits away from sensitive land uses;
(f) Locate noise sources such as air compressors, pumps and similar in areas furthest from sensitive land uses, provide effective noise barriers or enclosures, and keep doors on enclosures closed when operating.

(3) Construction standards -

(a) Vehicle traffic areas are paved, have low gradients and are maintained in good condition;
(b) Install double-glazing to windows and sound locks to doors facing sensitive land uses;
(c) Buildings housing noisy operations, activities or equipment are constructed of suitable materials to reduce noise transmission such as ceilings and walls lined with sound absorbing material;
(d) Reduce structure-borne noise and vibration by mounting equipment on appropriate isolation systems designed by a specialist in this field.

(4) Operation standards -

(a) Install noise suppression devices to equipment according to the manufacturer's specifications and ensure the efficiency of these devices is maintained;
(b) Design and maintain adequate noise buffers between noise sources and sensitive land uses. In particular, install noise barriers such as screens around noisy equipment, operations and activities;
(c) Fit all diesel engines and noisy vehicles with efficient exhaust mufflers;
(d) Avoid installing machinery that may have humming or whirring components or impulses, or annoying tonal or hammering noises. If such machinery is installed, noise suppression devices are applied to mitigate potential nuisance;
(e) Fit effective inlet and exhaust silencers to air compressors and ensure that air pressure operated controls and air operated valves on silos and hoppers are equipped with silencers;
(f) Where possible, substitute equipment with an equivalent quieter/lower sound power level piece of equipment, for example, electric rather than diesel or air powered;
(g) Where possible replace alarms, horns and telephone bells with visual signs, mobile phones or pagers;
(h) Where blasting of rock or hard ground is involved, use technologies that minimise airblast overpressure and ground vibration.

(5) Noise management measures -

(a) Ensure that openings including windows and roller-doors facing sensitive land uses are kept closed and all unnecessary openings are sealed. Install signage to alert staff and/or visitors to their responsibilities to minimise the generation and propagation of unnecessary noise;
(b) Limit noisy routine operations to standard working hours of 7am to 6pm Monday to Friday, and 7am to 1pm Saturday. Noisy work should not be carried out on Sundays or public holidays, except where approved as part of the land use or another approval such as an activity under the *Environmental Protection Act 1994*;
(c) Conduct noisy activities at times when the likelihood for nuisance is minimised, for example, the middle of the day;
(d) Work outside of standard working hours is limited to quiet "finishing off" work and generally conducted within buildings;

(e) Limit vehicle movements, especially deliveries and truck movements, to standard working hours;
(f) Where possible, activities such as concrete pours are restricted to standard working hours. If activities are required to occur outside of these hours, affected premises are notified of the duration and times in advance of the event;
(g) Employ regular inspection and maintenance programs to ensure noise control fittings such as seals, doors and exhaust systems are in good working order and prompt attention is given to loose or rattling covers, worn bearings and broken equipment;
(h) Develop and implement an Environmental Management Plan including procedures for -
  (i) noise management;
  (ii) pollution prevention;
  (iii) staff training;
  (iv) customer education where applicable;
  (v) definition of roles and responsibilities;
  (vi) monitoring of performance;
  (vii) contingency actions.