

Table 6.2 External noise limits applied in Australian jurisdictions

Jurisdiction	Parameter	Noise Criteria (dB)	Comment
New South Wales	LAeq15h(day)	60	Trigger levels, with exceedance triggering detailed impact assessment
	LAeq9h(night)	55	
	LAm _{ax}	80	
South Australia	LAeq15h(day)	60	Draft guidelines. Where external noise level is not practical, internal criteria are specified as per AS2107 ⁵⁴
	LAeq9h(night)	55	
	LAm _{ax}	80	
Queensland	LAeq24h	65	Levels used a guide, if they cannot be met higher levels (70/90) must be met
	LAm _{ax}	87	
Western Australia	LAeq18h(day)	55	Where external noise level is not practical, apply internal criteria
	LAeq6h(night)	50	
Tasmania	LAeq15h(day)	60	Trigger levels, with exceedance triggering detailed impact assessment
	LAeq9h(night)	55	
	LAm _{ax}	80	

Mr Goddard also made reference to Appendix I of the NSW *Interim Guideline for the Assessment of Noise from Rail Infrastructure* (IGANRIP) that includes a table showing limits applied in international jurisdictions.

Mr Smith advised that there was also a ‘Victorian precedent’ in that the Planning Panel considering the Airport Rail Link recommended that noise from the railway at sensitive receptors be limited to 55 dB LAeq24h and 80 dB LAm_{ax}.

It was Mr Goddard’s view that quantitative noise standards should be applied and that the trigger levels in the IGANRIP for new railways provided appropriate external noise levels.

Mr Robin Brown of Renzo Tonin and Associates, called to give acoustic evidence by the Dennis Family recommended that noise impacts of the project on all existing and approved residential properties at a specified date be assessed against the IGANRIP.

The submission by the Dennis Family and the Davis Family by Mr Chris Townshend SC included the view that the standards included in the IGANRIP are the most relevant and appropriate benchmark on which to

⁵⁴ Australian Standard 2107-2000 Acoustics—Recommended design sound levels and reverberation times for building interiors

measure predicted noise levels. An identical submission on this matter was made by Mr Paul Connor for Amex Corporation Pty Ltd.

Under cross-examination, Dr Burgemeister expressed the view that, if quantitative standards are to be applied, the guidance provided in the IGANRIP was as good as any available.

It was noted by the EPA that the WHO Guidelines also include the guideline values for internal (inside dwellings) noise levels shown in the following table.

Table 6.3 WHO Guidelines on community noise (internal)

Location	Critical Health Effect(s)	Noise Level	
		Average dB	Maximum dB
Dwelling indoors	Speech intelligibility and moderate annoyance	35 LAeq16h(day)	-
Inside bedrooms	Sleep disturbance	30 LAeq8h(night)	45 LAmax

The matter of internal noise limits was also addressed by Mr Goddard making reference to a publication of the NSW EPA, *Environmental Criteria for Road Traffic Noise* (NSW-ECRTN), which Watson Moss Growcott Acoustics has relied on in the past.

Mr Goddard explained that the preparation of NSW-ECRTN included the review of numerous sleep disturbance studies leading to the following conclusions:

- Maximum internal noise levels below 50–55 dB LAmax are unlikely to cause awakening reactions
- One or two noise events per night with a maximum noise level of 65–70 dB LAmax are not likely to affect health and wellbeing significantly.

Mr Huybregts and Mr Smith provided evidence on what might be considered appropriate internal limits with the following ‘Victorian precedents’ being cited:

- VCAT No. 771/2002 in which it was determined that noise from a railway inside a dwelling should not exceed 50 dB LAmax
- VCAT No. 2470/2003 in which it was determined that the limit specified in VCAT 771/2002 was too stringent and that the limits should be 55 dB LAmax for sleeping areas and 60 dB LAmax for living areas.

Mr Huybregts’ evidence included a review of internal noise limits, generally used as requirements or guidance on dwelling construction rather than limits on noise emissions from railways or other sources, in other jurisdictions. The

limits or guidance identified by Mr Huybregts are summarised in the following table.

Table 6.4 Internal noise limits in other jurisdictions in dB(A)

	Living Areas		Bedrooms	
New South Wales	40	LAeq15h(day)	35	LAeq9h(night)
Kogarah NSW	40	LAeq1h	35	LAeq1h
South Australia	35–45	LAeq	30–40	LAeq
Western Australia	40	LAeq18h(day)	35	LAeq6h(night)
AS 2107	35–40	LAeq	30–40	LAeq
New Zealand	40	LAeq1h	35	LAeq1h

Mr Huybregts adopted the NSW criteria shown in the table above and what he considered to be the Victorian criteria for maximum internal noise levels from VCAT 771/2002, that is 60 dB LA_{max} for living areas and 55 dB LA_{max} for bedrooms for his impact assessment.

It was the submission of the RRLA that:

Any target noise level, if recommended by the Committee, should be an external noise level near the façade of affected dwellings, not internal noise levels as suggested by some of the submitters' expert witnesses. As Dr Burgemeister explained, there are inherent uncertainties regarding sleep disturbance criteria. More importantly however, none of the national or international rail noise guidance referred to in any expert evidence adopts an internal noise criterion, and we respectfully submit the Advisory Committee should not attempt to 'break new ground' by applying one to RRL2. Requiring compliance with an internal noise level would be subject to the vagaries of the design and construction of affected dwellings, and be very difficult if not impossible to monitor.⁵⁵

In contrast, Mr Brown's evidence included the following:

Furthermore as there is no legislated requirements for rail passenger noise, Victorian or project specific numerical noise standards I consider it reasonable in response to the Draft Policy that the numerical predictions be benchmarked against other well established and accepted design guidelines that apply to rail projects outside of Victoria. In particular it may be appropriate to apply the former NSW DECC document Interim Guidelines for the Assessment of Noise from Rail Infrastructure Projects.⁵⁶

⁵⁵ Regional Rail Link Authority – Reply at Hearing, Para 63 (Exhibit RRL58)

⁵⁶ Expert Witness Statement – Robin Brown of Renzo Tonin & Associates, 26 Oct 2011, Para 73
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6.3.2 Railway infrastructure

The evidence and submissions indicated general acceptance of the fact that noise emissions from railway infrastructure would and should be subject to the provision of SEPP N-1. A number of submitters noted that some activities that are conducted in stabling yards may be or are exempt from compliance with SEPP N-1 by virtue of section 251B of the *Transport (Compliance and Miscellaneous) Act 1983* (section 251B).

The submission by Ms Janine Young, Public Transport Ombudsman (PTO) took a different position on section 251B. Her submission included the following about noise problems at stabling yards:

- The majority of complaints received by the PTO relate to noise from trains being cleaned at the end of service or having maintenance work on them prior to re-entering service
- Generally the complaints involve trains idling in sidings for long periods of time in the late evening or early hours of the morning
- The transport industry position is that noise emanating from sidings due to trains idling while they wait to be cleaned, refuelled or for maintenance is exempt from the usual claims of nuisance or environmental controls under section 251B
- The PTO has obtained independent legal advice on the exemptions provided under section 251B and that advice indicates that:
 - While cleaning and maintenance may form part of the operator's process for shutting down a train once it has been in service, it does not form part of the shutting down process as intended in the Act
 - Even if these actions were exempt, there is still a requirement under the Franchise Agreement for the operator to act reasonably when emitting noise from sidings
- Careful consideration of issues around the extent of the exemptions should be undertaken in relation to new sidings built as part of the Regional Rail Link
- The PTO would welcome any clarification of the extent of the exemptions that the Committee could provide to limit the impact of noise emanating from sidings or to create appropriate standards for operator behaviour.

Mr Chris Canavan QC for DoT submitted that the PTO was requesting the Committee to consider matters that were outside of its Terms of Reference because:

- The advice sought by the PTO applies to rail sidings that, in the view of the DoT, were not part of RRL2

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- The Terms of Reference seek no advice in relation to section 251B but rather require the Committee to 'have regard to' existing legislation including section 251B.

The RRLA adopted the DoT's position on this matter as its own.

6.3.3 Road traffic noise

No direct evidence or submission on standards that should be applied to road noise were received, however numerous references were made to the VicRoads Noise Policy, which includes specification of target noise levels at sensitive receptors for noise from arterial roads and freeways.

It was Dr Burgemeister's evidence, however, that:

- There are different subjective responses to road and rail noise, with respondents in surveys tolerating rail noise levels more easily than road noise.
- For similar dissatisfaction levels, rail noise would have to be some 10 dB(A) higher than traffic noise.

6.4 Discussion

6.4.1 Peer review

We do not understand why the RRLA has chosen not to have the aspects of the NIMR relating to noise standards peer reviewed and see it as being contrary to the requirements for a peer review set out in the Minister's decision on the EES referral.

The Minister's decision clearly specifies that a noise impact management report is required and that it be accompanied by a report on a peer review by an independent specialist. The decision does not say a peer review of only certain aspects of the noise impact management report: it can only be interpreted as a requirement that all aspects of the NIMR be peer reviewed.

6.4.2 Train operation

Our consideration of operational noise standards, impact assessment and mitigation requirements is entirely focused on the protection of amenity at dwellings both existing and future rather than a wider group of sensitive land uses such as other residential types, schools etc. The reasons for this focus include the following:

- All submissions and evidence provided was directed at the potential impacts and consequences of noise at dwellings rather than any other buildings or facilities

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- We consider it safe to assume that the development of the Precinct Structure Plans (PSPs) will enable adequate consideration of the implications of noise from the project area in the location and design requirements of the other buildings and facilities.

Quantitative standards for operational noise

Are quantitative standards required?

We note that:

- The vast majority of submissions made both before and at the hearing advocated the application of quantitative noise standards to enable assessment of noise from RRL2
- All acoustic experts providing evidence, with the exception of Dr Burgemeister, either advocated the application of quantitative noise standards, utilised such standards in their assessment of noise impacts or both
- Dr Burgemeister's suggestion that quantitative standards should not be applied was not made on acoustic grounds but reflected the instructions given to him by the RRLA
- The RRLA's justification of the qualitative standards proposed is as follows:
 - There is no legislative requirements or guidance limits on noise from passenger trains in Victoria
 - The exclusion of noise from passenger trains from constituting nuisance and the requirements of the *Environment Protection Act 1970* and the *Local Government Act 1989* under Section 251B
 - The DGPF's principle-based approach is aimed at providing the required flexibility and hence prohibits the use of quantitative noise standards.

We do not accept the first part of RRLA's justification. We believe that the implication of the first argument, that the current lack of quantitative standards on noise from passenger trains is the result of extensive consideration of the matter leading to a policy position, is not correct. We agree with Mr Goddard that the likely reason why quantitative standards have not been established for passenger rail in Victoria is that there has been little or no development of new passenger rail infrastructure in recent times. The current lack of quantitative noise standards for passenger rail in Victoria does not provide justification for the continuation of that situation. We note that the Planning Panel considering the Airport Rail Link shared this view in that it recommended the application of quantitative noise standards. While we do not believe that the existing legislative and regulatory situation in Victoria necessarily calls for the application of quantitative noise standards,

neither do we consider that it justifies ignoring the possibility of their application.

We note the submission of the DoT that section 251B:

- Provides an exemption from nuisance actions being brought under common law and under specified legislation but does not preclude the consideration of noise impacts on residential amenity or the broader environment
- Deals with lawful responses to noise consequences whereas we are concerned with the mitigation and minimisation of such consequences.

We agree with that position. There would have been little point establishing this Advisory Committee if effective noise mitigation measures had no prospect of being implemented and the noise standards intended to be achieved were negated by this provision. We are also of the view that if we consider that the application of quantitative noise standards assists in the evaluation of mitigation measures and the minimisation of the consequences of noise emissions, we would be justified in recommending such application.

We acknowledge that the DGPF seeks to provide a flexible framework due to the fact that there is no universally 'right' approach and each new railway needs to be separately assessed. We do not believe that this prohibits the application of quantitative noise standards in the case of RRL2 or any other railway. The test is whether the application of quantitative noise standards is part of the 'right' approach for the particular railway development. If the DGPF was interpreted to say that quantitative standards must not be applied, it would be an inappropriate constraint on the flexibility the DGPF seeks to provide.

In our view the DGPF is silent on the question as to whether quantitative standards should be applied to RRL2 and therefore provides no justification for their exclusion or otherwise.

In light of the above, we are firmly of the view that the RRLA has not provided justification for the standards proposed in the NIMR.

The qualitative standards proposed by the RRLA are, in our view, best categorised as design parameters for the railway, most of which could be seen as typical for modern railway construction, rather than noise mitigation measures let alone standards. The serious deficiency with the RRLA approach is that no means of assessing the impact of the residual noise is provided so the effectiveness or otherwise of what is proposed cannot be determined. While there is no doubt that the measures embodied in the qualitative standards will result in lower noise levels than if those measures were not taken, the acceptability or otherwise of the impacts of residual noise remains unquantified and unknown.

Furthermore, a consequence of the approach taken by the RRLA is that the use of other possible mitigation measures, such as barriers, was not even considered in any meaningful way in the preparation of the NIMR.

It is clearly apparent that the approach adopted by the RRLA is not based on acoustic considerations. It appears to have been driven by consideration of cost and a desire to avoid responsibility for noise mitigation. In our view this approach is short-sighted and highly unlikely to yield the best result either cost wise or in terms of amenity protection.

It is our view that quantitative noise standards are required to enable:

- Noise impact assessment both prior to and during operations
- Consideration of alternative noise mitigation measures on a logical basis
- The community to be assured that amenity will be protected
- Information to be provided to stakeholders as to the potential impacts of noise from the railway.

Appropriate quantitative standards

While we acknowledge the fact that the WHO Guidelines provide guidance on noise limits for the elimination of health effects and annoyance, we also accept the evidence and submissions concerning the excessive stringency of these limits and their lack of practical application. As a result, we consider that the best available guidance on appropriate limits will be found in limits applied in other jurisdictions which we see as attempts to strike an appropriate balance between the conflicting interests of the various stakeholders.

Our review of the evidence provided on limits and guidance applied in other jurisdictions reveals the following:

- Most target levels or limits for noise from trains at dwellings (external) for new railways in Australia and overseas are within the following, relatively narrow, ranges:

Daytime average	58–60 dB LAeq15h(day)
Night time average	50–55 dB LAeq9h(night)
Average	55–65 dB LAeq24h
Maximum	80–87 dB LAmax

We have noted that the specified noise limits for Queensland do sit well outside this range but no submitter or expert supported their application.

- The most common approach used in Australia is to establish separate target average noise levels for the night and day and a maximum noise level applying at all times. This also appears to be a modern, more

comprehensive approach compared to defining limits in terms of 24 hour average noise levels.

- In many jurisdictions the levels are set as target levels and the fact that those levels may not be able to be met in all circumstances is acknowledged. A requirement to meet internal noise limits in dwellings is specified in such circumstances and the ranges of limits imposed on internal noise levels are as follows:

Living areas	35–45 dB LAeq (generally day time) 60–65 dB LAmax
Bedrooms	30–40 dB LAeq (generally night time) 50–60 dB LAmax

- A common approach is:
 - To require consideration of a wide range of possible noise mitigation measures at the source and between the source and the dwellings to test their engineering feasibility, practicability, reasonableness and cost effectiveness so as to enable appropriate measures to achieve compliance with the target noise levels to be selected
 - In circumstances where, despite implementation of all appropriate noise mitigation measures at the source and between the source and the dwelling, the external target noise levels will not be complied with, such compliance is not required but instead compliance with noise levels inside the dwelling is required.

Of all the limits and guidance from other jurisdictions, we believe that the NSW IGANRIP would be the most appropriate to apply to the present project for the following reasons:

- It appears to be based on a detailed analysis of information currently available
- It provides guidelines developed in Australia for application in Australian conditions
- It includes consideration of average noise levels for day and night plus a maximum noise level, each of which we see as important parameters
- All evidence and submissions suggested that, if quantitative noise standards are to be adopted, then the IGANRIP provides appropriate guidance.

We are therefore of the view that the target external noise levels for residential land uses specified in the IGANRIP for new railway lines should be adopted. Those target levels are as follows:

Day time (7:00–22:00)	60 dB LAeq15h(day)
Night time (22:00–7:00)	55 dB LAeq9h(night)
24 hours	80 dB LAmax

The IGANRIP does not provide specific guidance on appropriate noise limits inside dwellings.

On the basis that the difference between external and internal noise levels is 15 dB (with windows almost closed but open sufficiently for some ventilation), as stated in the WHO Guidelines, the target external noise levels would result in the following internal noise levels:

Day Time (7:00–22:00)	45 dB LAeq15h(day)
Night Time (22:00–7:00)	40 dB LAeq9h(night)
24 Hours	65 dB LAmax

While it is noted that these noise levels are at the upper end of the range of internal limits in other jurisdictions we believe that they will provide an adequate level of amenity protection because:

- They include a 5 dB(A) differential in the noise limit between day and night consistent with the approach in most other jurisdictions (particularly for bedrooms).
- The IGANRIP trigger levels were determined in part after consideration of social survey research on annoyance. It is highly unlikely that adoption of external noise levels to limit annoyance would have had the desired result if those external noise levels did not also result in unacceptable internal noise levels.
- The NSW ECRTN concluded that, for road traffic noise:

One or two noise events per night with a maximum noise level of 65-70 dB LAmax are not likely to affect health and wellbeing significantly.
- Dr Burgemeister's evidence and the EPA submission included the advice that noise from railways is less annoying than that from other forms of transport, including road traffic.

In light of the above we are of the view that the appropriate internal noise limits are:

Living areas	
Day time (7:00–22:00)	45 dB LAeq15h(day)
Night time (22:00–7:00)	45 dB LAeq9h(night)
24 hours	65 dB LAmax
Bedrooms	
Day time (7:00–22:00)	45 dB LAeq15h(day)
Night time (22:00–7:00)	40 dB LAeq9h(night)
24 hours	65 dB LAmax

Application to existing and new dwellings

RRL's closing submission put the proposition that if noise mitigation was to be adopted at all it should be directed only at existing receivers (Exhibit RRL17 page 47). This appears to be a statement underpinned by a concern about the extent of RRLA's financial responsibility for mitigation measures. The comment relates principally to external noise targets, but we note that RRLA also supported the use of architectural treatments at existing dwellings and went so far as to suggest that implementation of such treatments should be done by requiring offers to the owners of dwellings (by the RRLA) where noise predictions exceed 80 dB LAmax.

The Committee takes the view that the mitigation measures to be applied should be directed at achieving the same external noise targets and internal noise limits for existing and new dwellings. There is no reason to take a different approach to the amenity standard which should be applied as between the types of dwellings. The matter of financial responsibility for the provision of noise mitigation needs to be separately resolved. We discuss that matter in Chapters 8 and 9. We also discuss the issue of how to determine whether external noise targets can be practicably met in Chapter 9.

6.4.3 Railway infrastructure

We have earlier indicated our view, in Chapter 3, that stabling yards and sidings are part of the project. We do not agree with the submissions of the DoT and RRLA concerning the exclusion of those elements of the project from our consideration of noise impacts, consideration of standards and requirements for mitigation.

The DoT submission included that we are directed to consider the legislative context of our assessment of noise impacts and recommendations concerning mitigation. While we note the acceptance in the NIMR that SEPP N-1 applies to railway stations and stabling yards and other elements of railway infrastructure, it is relevant in determining our approach to noise standards to have regard to the exemptions provided by section 251B.

The effect of section 251B would seem to be that noise from trains using the proposed RRL2 railway would ordinarily largely be exempt from actions in nuisance and the regulatory measures available under the *Local Government Act 1989* and *Environment Protection Act 1970* and their associated subordinate instruments: the exemptions specified apply amongst other things to all operating trains when 'on a railway track'.

The exemptions provided at section 251B are quite specific, however, in terms of which legislation and legal actions do not apply to train noise. We do not see this exemption as precluding or giving no effect to the

identification of general operational noise standards for RRL2 and requirements for compliance with those limits in a FNMP if thought appropriate. Indeed if it was otherwise, the establishment of this Advisory Committee to make recommendations on such matters would have little point.

The relationship of section 251B to SEPP N-1, however, warrants special consideration. As we understand it, the SEPP is a subordinate instrument of the *Environment Protection Act* and therefore train noise is specifically exempted from its effect. It is clearly necessary to exempt **operating** train noise from any SEPP N-1 derived noise limits that might apply to stations, sidings or stabling yards, as the noise of trains entering and leaving stations or stabling yards (and perhaps when powering up and shutting down) could be normally expected to well exceed the SEPP limits.

The dispute between the PTO and DoT and train operators relates only to stabling yards (and possibly sidings). It centres not on what happens when trains are entering and leaving the yards but what occurs in them. The issue is whether the routine refuelling, cleaning of and minor repairs to passenger trains (apparently also involving train idling) in sidings both before and after running attract the section 251B exemptions. These activities appear to occur at night or in the early hours of the morning and reportedly are the subject of complaints to the PTO. As we have said the PTO say they have obtained legal advice to the effect that the cleaning etc is not exempt from compliance with SEPP N-1 but DoT and the railway operators prefer the opposite legal view.

It is clearly not our role to determine this legal matter but we have taken the disputed application of SEPP N-1 to these activities and its relationship to other activities into account in determining how we approach noise assessment and mitigation.

We believe that it is appropriate that the noise from the activities taking place in stabling yards and sidings should be considered as requiring regulation with the exception of the movement of trains into and out of the yard and powering up and shutting down.

We also believe, however, in light of the dispute, that it would be inappropriate to rely for the control of noise emissions from trains in sidings and stabling yards upon the operation of SEPP N-1 itself. We suggest that the derived limits, and the methodology for their derivation which SEPP N-1 establishes, should be instead adopted and incorporated into the FNMP. The exceptions made in section 251B as apply to operational noise when trains

are in, or entering and leaving, sidings and stabling yards and 'on tracks'⁵⁷ would also need to be included, but it is appropriate that the exemption applying to passenger trains powering up and shutting down when in the yards (in the same terms as in section 251B(2)(c)) should be defined as not extending to cleaning, refuelling, repair activities and the like.

The same derived limits as would apply to all other railway infrastructure under SEPP N-1 should also be incorporated directly in the FNMP.

6.4.4 Noise from road traffic

The questions of whether and what noise standards should be applied to noise from road traffic arise for the following reasons:

- The project includes the construction of a number of road-over-rail overpasses
- At each of these overpasses the height of the noise emanating from the road traffic will be increased above that at which would have been without the railway
- Increasing the height from which the traffic noise emanates will result in an increase in the noise level at locations where dwellings exist or have the potential to exist and any such increase is a direct result of the project.

We do not consider that the anticipated separate noise from road and rail can be combined in any meaningful way, given their very different character and the differences in likely subjective response to noise from the two sources. Each needs to be assessed separately against different standards.

The VicRoads Noise Policy objectives for noise levels at dwellings are set as limiting the LA10,18h (6:00-Midnight) to 63 dB, except where background noise levels are low (defined as an LA10,18h of less than 50 dB) in which case the objective is limiting a noise level increase to 12 dB or less.

While the VicRoads Noise Policy includes several provisions that limit its application, we see the objectives of the policy as a reasonable indication of traffic noise levels that, if complied with, limit the impact to what might be considered an acceptable level. We therefore consider that where there is an increase in road noise levels at dwellings as a result of the use of grade separated road-rail intersections, the application of these objectives as targets for the road noise emanating from the overpasses carrying road traffic over rail is appropriate.

⁵⁷ When the trains are not covered by the same limits as are derived from SEPPN N-1, they would instead be subject to the operational noise provisions of the FNMP.

We do not propose to apply the VicRoads Noise Policy directly (as some submitters were concerned we might) but rather adopt its noise targets for this project via their inclusion in the FNMP.

We think that this overcomes the objection raised by Mr Wren that to consider the impacts of any increased noise at the overpasses would create a precedent for VicRoads. VicRoads' policy only applies to roads for which it is responsible. At present none of the relevant roads are declared arterials, so there can be no applicable precedent for VicRoads. We are not recommending the application of the VicRoads Policy per se but the utilisation of the criteria in that policy to determine appropriate limits for the overpasses associated with this project.

Also, to the extent that it might be argued that consideration of the noise impacts of the overpasses would set a precedent for future rail projects with respect to undeclared roads under the care and management of local Councils, we do not believe this is the case. In our view there is a very special coincidence of the planning for rail construction and abutting development in the present case.

6.5 Conclusions and recommendations

Our conclusions in regard to the issues related to operational noise standards are as follows:

- The aspects of the NIMR dealing with standards to be applied has not been peer reviewed and therefore the conditions on the Minister's decision that an EES is not required have not been complied with.
- The Regional Rail Link Authority has not provided a clear justification for the standards proposed in the NIMR on noise from trains during operations.
- Quantitative operational noise standards for the project are required to enable:
 - Noise impact assessment both before and during operations
 - Consideration of alternative noise mitigation measures on a logical basis
 - Information to be provided to stakeholders about the potential impacts of noise from the railway operation.
- The quantitative noise standards required consist of:

Target external noise levels at dwellings of:	
Day time (7:00-22:00)	60 dB LAeq15h(day)
Night time (22:00-7:00)	55 dB LAeq9h(night)
24 hours	80 dB LAmax

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- Internal noise levels for dwellings, to be applied if achievement of target external noise levels cannot be achieved by feasible and reasonable means, of:

Living areas

Day time (7:00-22:00)	45 dB LAeq15h(day)
Night time (22:00-7:00)	45 dB LAeq9h(night)
24 hours	65 dB LAmax

Bedrooms

Day time (7:00-22:00)	45 dB LAeq15h(day)
Night time (22:00-7:00)	40 dB LAeq9h(night)
24 hours	65 dB LAmax

- The achievement of these noise standards by noise mitigation measures should apply to existing housing, lots for which subdivision approval has been granted, and to future dwellings in the areas adjacent to the project area where external noise levels of 80 dB LAmax or greater are expected.
- A noise standard applying to noise from railway infrastructure equivalent to that prescribed in *State Environment Protection Policy (Control of Noise from Commerce, Industry and Trade) No, N-1*, allowing for the same exemptions for train noise including in stabling yards and sidings as in section 251B of the of the *Transport (Compliance and Miscellaneous) Act 1983*, except that this should be expressed as not extending to the cleaning, refuelling and repair operations and the like in stabling yards.
- Where there is an increase of road traffic noise as a result of elevation of a roadway at a railway crossing when compared to the noise which would be generated by the road if at grade, target noise levels for road traffic at dwellings (equivalent to the objectives set in the *VicRoads Traffic Noise Reduction Policy*), of :

63 dB LA10,18h measured between 6:00 am and midnight, except where the noise level at a dwelling prior to road improvements is less than 50 dB LA10,18h, in which case a target noise level increase of a maximum of 12 dB will apply⁵⁸.

It is recommended that:

- The DNMP not be endorsed by the Minister unless it is modified to include the above noise standards and is peer reviewed.

⁵⁸ The VicRoads' policy provides in the latter case that consideration be given to only allowing a 12 dB increase.

7. Assessment of operational noise impacts

7.1 What are the issues?

The decision made by the Minister for Planning that an EES was not required for the RRL2 project included that the required NIMR was inter alia to:

- (ii) *Refine the assessment of noise sources and noise generation scenarios for both construction and operation of the railway...*
- (iv) *provide an assessment of the likely residual noise impacts of both construction activities and relevant operational scenarios on existing houses and residential estates in the vicinity of the preferred rail alignment, if proposed noise mitigation measures are implemented...*
- (vi) *be accompanied by a peer review report prepared by an independent specialist.⁵⁹*

The issues to be considered in relation to operational noise impacts include the following:

- The adequacy of the predictions of residual noise from the project
- The adequacy of the assessment of the impacts of the predicted noise levels outside the project area
- The acceptability of the impacts of residual noise levels from the project.

7.2 Noise Impact Management Report

7.2.1 Train noise

The consideration of operational noise detailed in NIMR included the following:

- Determination of the quantity and character of rolling stock that will use the Regional Rail Link by:
 - Consideration of the service plans provided in the *Regional Rail Link Capacity Upgrade Phases, Department of Transport, 2010* for two scenarios designated as:
 - Phase 1 Day 1 of the Regional Rail Link operation (2014)
 - Phase 4 Ultimate capacity (2030)

⁵⁹ Decision Under *Environmental Effects Act 1978* – Regional Rail Link West Werribee to Deer Park
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- Development of baseline hourly schedules from June-July 2009 V/Line working timetables for the Melbourne-Geelong line, scaled to the future peak-hour and off-peak/counter peak capacity
 - Application of the current fleet mix to Phase 1 plus the assumption that existing N and P class locomotives and carriages will be phased out by Phase 4 leaving a fleet of diesel multiple units (DMU)
 - Assuming that all trains are operating at the designated maximum speed of 160 km/h, including through stations, which is said to be a conservative assumption
 - Determination of sources noise levels by:
 - Obtaining source noise levels, that is the sound exposure level (SEL) of an individual train pass-by, for each of the components of the fleet from data contained in the Rail Noise Database: State 11 Noise Measurements and Analysis, Rail Access Corporation Report 00091 Version A, August 2000 (NSW Rail Noise Data Base)
 - Correction of the data obtained from the database for speed and train length plus the application of source noise level penalties of 10 dB to account for impact noise from points and crossings
 - Validation measurements of rail vehicle noise made adjacent to the existing Geelong, Ballarat and Bendigo lines. The results of the measurements were adjusted to the reference distance and standard train length for comparison with the source noise levels used as input to the model. The comparison was presented in plots of SEL vs. train speed and maximum noise level (L_{Amax}) vs. train speed together with the line representing the relationships used for the model. It is concluded in the NIMR that:

.....the source levels used for the predictions are broadly representative of the average noise level generated by existing rolling stock.⁶⁰
 - Noise propagation modelling using the Nordic Rail Prediction Method developed by Kilde as implemented in SoundPLAN version 7.0 to produce predictions of sound pressure levels in the area surrounding the rail alignment in terms of:
 - The average during the day, L_{Aeq15h}(Day)
 - The average during the night, L_{Aeq9h}(night)
 - The maximum, L_{Amax}

Modelling results were provided in Appendix E to the NIMR in the form of shaded noise contour plots on aerial photographs for each parameter for both Phase 1 and Phase 4 scenarios.

⁶⁰ Regional Rail Link Noise Impact Management Report Rev H, KBR Arup, 9 Dec 2010 Sec 7.2
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In addition, the model was used to provide predictions of the three noise parameters for two scenarios at 'sensitive receivers'. These were defined as buildings located within approximately 500 metres of the railway corridor. The results of these predictions were included in the NIMR as plots of predicted noise level at each residence vs. railway chainage. No further analysis of this data was provided and the report noted that:

The noise level predictions are estimates of the average and maximum noise levels likely to be experienced external to properties adjacent to the alignment based on the input variable described in Section 7. The predicted noise levels may change if the input variables, particularly the horizontal and vertical alignment, or number and type of rail vehicles, change during detailed design or operation of the railway.⁶¹

7.2.2 Railway infrastructure

The NIMR acknowledged the existence of the potential for noise to be generated from fixed infrastructure sites such as stations, transformers and signalling but did not include these facilities in the noise modelling because the specific locations of these services and the type of equipment were said to be unknown.

It was stated in NIMR that:

It is therefore not possible to undertake any detailed assessment. This will need to be undertaken by the Construction Contractor at the detailed design stage.⁶²

7.2.3 Peer review

The Wilkinson Murray peer review of a Revision C of the NIMR raised a number of issues about the prediction of operational noise. The peer reviewer's consideration of KBR-Arup's responses to the matters raised and Revision F of the NIMR, however, led the peer reviewer to the view that, with one exception, all matters of concern relating to operational noise had been fully addressed. The one exception was the following comment made by the peer reviewer.

The erroneous source level used for the wagons in the Phase 1 results would result in a small under-prediction of the total LAeq noise levels. This may not have an important impact on the results, but should be rectified in any further modelling.⁶³

In response to this comment KBR-Arup stated that:

⁶¹ Regional Rail Link Noise Impact Management Report Rev H, KBR-Arup, 9 Dec 2010 Sec 8.1

⁶² Regional Rail Link Noise Impact Management Report Rev H, KBR-Arup, 9 Dec 2010 Sec 10

⁶³ Regional Rail Link Peer Review of Acoustic Assessment, Wilkinson Murray, Nov 2010, Sec 3

A review of the use of SEL as LAeq source noise levels for locomotive wagons showed a negligible difference in overall predicted noise level. Updated modelling has not been undertaken for Section 2, however, the source levels for the modelling have been for Section 1. The use of SEL source levels does not affect the Phase 4 calculations in any case, since there are no locomotives or wagons in the 2030 fleet mix.⁶⁴

The report on the peer review states that at the request of RRLA, the report does not address matters of impact assessment or the adequacy of the NIMR.

7.3 Evidence and submissions

7.3.1 Train noise

Following the directions hearing, the Committee directed that clarification be provided on a number of issues relating to the operational noise modelling. The response to these directions was provided in the evidence given by Dr Kym Burgemeister of KBR-Arup. The matters raised by the Committee and Dr Burgemeister's responses are summarised in the following table.

Table 7.1 Committee directions for further information and responses

Direction	Dr Burgemeister's reply
Provide advice as to whether different analyses were undertaken for RRL Sections 1 and 2.	The noise analysis for RRL Section 1 and Section 2 were completed using essentially the same methodology.
Provide information as to whether any additional rail traffic arising from the mooted passenger (and freight) link to Avalon Airport was modelled and if not what the implications might be.	Additional railway traffic from unfunded projects has not been included but would be unlikely to significantly change the overall conclusions of the noise study.
Provide a detailed exposition of the sources of noise from trains and their operations and the variable attenuation effects of distance on different noise types.	Only DMU and passenger locomotives have been included. Maximum noise levels from freight locomotives would be less than the trains modelled because they travel at lower speeds, although their contribution to average noise levels would be similar. Noise levels from electrified metropolitan trains would typically be 5–10 dB quieter than DMUs modelled.

Dr Burgemeister also advised that the design parameters and maintenance measures outlined as the mitigation measures for RRL2 were already allowed for in the noise predictions.

⁶⁴ Regional Rail Link Response to Peer Review Rev B, 9 Dec 2010, KBR-Arup Sec 3.2

The modelling described in the NIMR was criticised in a number of written submissions received in response to the public notification. The following table summarises the criticisms made and the Dr Burgemeister's response in his statement of evidence.

Table 7.2 Criticisms of modelling in written submissions and responses

Criticism	Dr Burgemeister's evidence in response
Explanation of impacts of variables including source height, curving noise and climatic events is required.	Sensitivity analysis shows that the model is relatively insensitive to possible changes in alignment. Curving noise and meteorological effects are not expected to significantly influence the noise generated by the railway. It is generally accepted that curving noise is insignificant on curves of the radii proposed.
Modelling is not based on final design and therefore predictions may not be accurate.	Sensitivity analysis shows that the model is relatively insensitive to possible changes in alignment.
Noise prediction results are not legible.	This is the result of file compression for presentation on the DPCD website.
Modelling does not include trains stopping and starting.	This has not been included because noise levels of trains stopping and starting are lower than at full speed. As a result the predictions are conservative.
Noise from freight trains has not been included.	Freight trains have not been included because they are not part of the RRL2 project.
Modelling does not include noise made by horns.	Horn usage is generally not expected since all rail crossings are grade separated.

Mr Robin Brown of Renzo Tonin and Associates, called to give acoustic evidence by the Dennis Family, advised that he had been unable to complete a definitive review of the operational noise modelling as he was denied access to SoundPLAN files used. Despite this Mr Brown provided the following evidence:

- The source noise levels utilised are acceptable
- The resolution of rail height data is not provided
- The +2.5 dB(A) correction (for façade reflection) is not incorporated in all the predicted noise levels
- If train horns are to be used, they should be included in the modelling and assessment
- It seems likely that the additional impact noise at points associated with stabling areas or passing loops has not been taken into account thus resulting in under-prediction of noise levels at these locations
- Changes in noise levels resulting in changes from the reference design used for the modelling could result in significant variance between predicted and actual noise levels

- A true and fair representation of the noise impacts associated with the project would include the proposed metropolitan operations, the rail link to Avalon Airport and freight trains.
- The submission made at the hearing by the Dennis Family included the view that:

Activities and operations that have the capacity to operate on the RRL2 without further approval (for example, metro and freight trains, an increase in frequency) will increase the noise levels experienced, and should be addressed. Although only limited information may be available at this stage, it is submitted that more could be done now to accurately predict future noise.⁶⁵

- The evidence provided by Mr Neville Goddard of Watson Moss Growcott Acoustics Pty Ltd, called by Walsh Building Services, included comment on a number of issues relating to the modelling, including:
 - The lack of advice in the NIMR on the potential for additional noise radiation from trains crossing the bridge over the Werribee River
 - The potential for additional noise due to horn usage, braking and accelerating that had not been included in the modelling.

These matters were also responded to by Dr Burgemeister in his evidence and in the RRLA submission as follows:

- The reference design grade line is specified with some precision and the rail head is a constant distance from the grade line. The prediction results in the NIMR were explained as follows:
 - *The noise modelling results in the NIMR are presented in both 'free field' and 'façade' noise levels depending on whether they are presented as noise level contours or noise levels at individual properties, respectively.*
 - *The noise contours on Appendix E of the NIMR present the noise levels as 'free field' noise levels. However, the individual receiver results shown in the 'dotfield' graphs (Figures 9-14 of the NIMR) are shown as facade noise levels, and include the +2.5dB correction to account for the fact that they are predicted for individual residences.⁶⁶*
- Dr Burgemeister acknowledged that noise from horns could be included in the model. He advised, however, that this had not been done due to the fact that, as required safety devices, they are usually excluded from railway noise assessments. He also stated that the use of horns on the alignment is expected to be minimal because of the absence of level crossings that would require their use.

⁶⁶ Expert Witness Statement – Dr Kym Burgemeister if Arup Pty Ltd, 20 Oct 2011, Sec 6.1.5
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Under cross-examination Dr Burgemeister acknowledged that horns would be used on entry to and departure from stations.

The RRLA submitted that Dr Burgemeister's evidence in regard to horns should be relied on and furthermore, that, as mitigation measures for warning horns are limited for safety reasons, there is no real purpose for assessing them in the first place.

- Dr Burgemeister advised that noise from activities within the future stabling area for regional trains had not been included in the modelling but a 10 dB(A) allowance had been made for the points associated with the entry to and exit from such a stabling area.

On the matter of the possible impact on the predictions of variations between the reference design used for the modelling and the final design, it was Dr Burgemeister's evidence that:

- Assessments of operational noise for transport infrastructure are necessarily and commonly undertaken using relatively early design alignments but the noise predictions are relatively insensitive to small changes in railway alignment
- Sensitivity analysis has been completed and the results suggest that possible changes to the design alignment would only change predicted noise levels by 2–4 dB, depending on the extent of topographic shielding
- The design of the railway is subject to a large number of engineering and construction constraints which means that the final railway design will not be significantly different from the reference design with the maximum deviation in source locations being two metres
- An increase in rail height of plus two metres from at grade is unlikely to significantly change the predicted noise level while a reduction in rail height would result in decrease in predicted noise level if it introduced significant shielding
- At the Wyndham Vale cutting, which is the most critical area, modelling was undertaken to assess a raised vertical alignment. It was recognised that, due to geometric constraints introduced by nearby road crossings, the increase in rail height would be limited to 0.5–1.5 metres and that the modelling predicted that such height increase in the alignment would result in an increase in noise levels at the critical locations of 2–4 dB(A)
- It proposed to install crash barriers (called New Jersey kerbs) at the top of the cutting to prevent vehicle intrusion into the cutting. These concrete barriers, with a height of 1.2–1.5 metres, could and would provide additional noise shielding that has not been accounted for in the model.

Dr Burgemeister advised that neither freight, metropolitan rail, nor Avalon Airport rail traffic were included in the modelling because they are not proposed to be used on RRL2 as:

-
- RRL2 is a broad gauge line and therefore this would not allow interstate freight trains to use the line
 - Intra-state freight trains could use the line, however, such use is not proposed
 - RRL2 does not include the overhead electrification to run electric metropolitan trains
 - While it is acknowledged that a corridor is being preserved between West Werribee and Wyndham Vale to create the opportunity to extend the existing metropolitan system, modelling of the operation of such a service was not possible as neither the centreline of the track nor the number or timing of train movements were available
 - There is currently no firm information on the possible Avalon Airport rail link and no funding for that project.

The RRLA submitted that future metropolitan services would have a negligible impact on maximum noise levels because the regional trains are appreciably noisier than the electric multiple units (EMUs) that would be used for metropolitan services. It was acknowledged that the inclusion of EMUs would increase the average noise levels but the number of EMUs required to make an appreciable difference (3 dB(A)) would amount to an EMU every 3 to 5 minutes which is a fanciful scenario.

It was Dr Burgemeister's evidence that the modelling does account for the expected railway movements that are planned for the foreseeable future (to 2030) and that RRL2 would be at its 'ultimate capacity' in 2030 preventing additional trains from using the track.

Under cross examination, Dr Burgemeister acknowledged that ultimate capacity was a function of the currently planned network connections and signalling system and that these facilities could be upgraded in the future to allow additional traffic on the line.

In summary it was Dr Burgemeister's view that:

Overall, the noise level results presented in the NIMR are reliable predictions of noise levels expected to be generated by the as-constructed railway at its ultimate capacity, and form a reasonable basis for the assessment of potential impacts from the operation of the railway.⁶⁷

The expert evidence of Mr Goddard included an assessment of the impact of the predicted noise levels on the proposed development on the Walsh Building Services' land at 1170 and 1245 Sayers Road, Tarneit.

⁶⁷ Expert Witness Statement – Dr Kym Burgemeister if Arup Pty Ltd, 20 Oct 2011, Para 6.1.6.12
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Mr Goddard assessed the impact by overlaying the Phase 4 (2030) predictions provided in the NIMR on plans of proposed subdivisions of the land and reached the following conclusion:

Examination of the noise contour/subdivision overlays in relation to the daytime LAeq and LAmax noise contours has revealed that the greatest impacts will occur to at least 45 residences.⁶⁸

Mr Goddard noted that the predicted noise levels at the relevant location are 65–68 LAeq15h(day) and 85–88 LAmax and that:

- This conclusion is based on all residential allotments being occupied by houses, whereby houses nearer to the rail line provide acoustic shielding to the houses further from the line
- When the most affected allotments have residences on them, this will provide some noise reduction shielding. Until that time, however, the number of residential allotments which could experience railway noise levels that might be considered excessive will be significantly higher.

The evidence provided by Mr Michael Smith of Vipac Engineers and Scientists Ltd, called to give evidence by Lotus Oaks Pty Ltd, included an assessment of the impact of the predicted noise levels on Lotus Oaks' property, Ballan Road Wyndham, owned by the Bozzo group of companies.

Mr Smith advised that Vipac had performed its own modelling of the noise levels on the Lotus Oaks land based on:

- Source noise levels provided in the NIMR
- Train traffic flows as specified in the NIMR
- Site topography from VicLand
- Manual input of the rail alignment (horizontal and vertical) from indicative information provided by RRLA
- The uses of the Nordic Rail Prediction Method as implemented in SoundPLAN software to predict LAeq15h(day) and LAmax.

It was noted by Mr Smith that the results obtained from the Vipac modelling were in reasonable agreement with the equivalent results reported in the NIMR.

In addition to noise contours, Vipac used the model to predict noise levels at six noise receiver locations said to be representative of a future first row of lots in the residential and employment zone in the Lotus Oaks Property development site. The prediction results were 59–66 dB LAeq15h(day) and 82–93 dB LAmax.

⁶⁸ Expert Witness Statement – Mr Neville Goddard, Watson Moss Growcott Acoustics, 20 Oct 2011
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Mr Smith stated that such noise levels should be considered unacceptable.

7.3.2 Railway infrastructure

A number of written submissions received in response to the public notification criticised the noise impact assessment provided in the NIMR on the grounds that it does not include consideration of noise that would be produced at stabling yards.

Mr Goddard's evidence at the hearing also included criticism of the assessment on the grounds that the potential for additional noise from stations and from stabling yards had not been included in the modelling.

In response Dr Burgemeister stated that:

Noise from stabling yards has not been included in the model. This is because their design development is currently limited to preserving sufficient space for their future development, they are not proposed to be developed as a part of RRL2, and additional details of the stabling operations are not known at this time. Nevertheless, since stabling, in its most basic form, consists only of train parking and low-speed vehicle movements, I do not expect that noise from stabling in the RRL2 corridor would be significant compared to that generated by the wider railway operations.

In any event, I expect that the addition of stabling, and other features such as train maintenance or car-wash facilities, would be required to comply with the requirements of SEPP N-1.

7.3.3 Road traffic noise

A number of written submissions received in response to the public notification criticised the noise impact assessment provided in the NIMR on the grounds that it does not include consideration of additional road traffic noise that would result from the project.

Mr Goddard also expressed his view the road traffic noise should have been included in the assessment.

In reply to a question, Mr Trevor Blake for DCPD advised us that the combined impacts of rail and road noise were properly to be considered as a cumulative impact.

The written submissions for the Amex Corporation Ltd, the Dennis Family and the Davis Family included the following:

Noise impacts from roads that are required to be materially altered by being bridged (by at least 4 metres) over the rail line need to be

considered. The Terms of Reference for the Advisory Committee allow it to consider the noise impacts of the RRL2, and it is submitted that this would include the net difference in traffic noise caused by the project.⁶⁹

In response Dr Burgemeister stated that:

Noise from road traffic or from roads modified as a result of the construction of RRL2 have not been included in the noise model or assessment. VicRoads would only consider mitigation for new or upgraded arterial roads or freeways in very specific circumstances, and its Traffic Noise Reduction Policy would not apply to roads modified as a result of the construction of RRL. Notwithstanding this, these roads are subject to relatively low road traffic flow rates compared to arterial roads and freeways, and noise levels are likely to be well below VicRoads limits for new freeways or arterial roads (63 dBLA_{1018h}).⁷⁰

The submissions for Amex Corporation Limited, the Dennis Family and the Davis Family also included:

Even if the VicRoads Traffic Noise Reduction Policy does not apply to these roads, it is submitted that this would not absolve the RRLA from taking measures to manage the combined noise impacts associated with the traffic generated on these elevated roads and the rail operations at their maximum capacity. The only way to know what those management measures should be is if the total noise impacts are measured and analysed in the NIMR.⁷¹

The RRLA submitted that the RRL2 project is not building grade separation for current freeways or arterial roads and under the VicRoads Noise Policy noise mitigation would not be required on any of the roads and that:

If these grade separated roads do become arterial roads at some point in the future, it may at that time be appropriate and desirable for VicRoads to consider whether noise mitigation is required in accordance with its noise reduction policy⁷².

⁶⁹ Submission for Amex Corporation Pty Ltd, Regional Rail Link Section 2, Noise Advisory Committee – 8 Nov 2011 Para 23

⁷⁰ Expert Witness Statement – Dr Kym Burgemeister if Arup Pty Ltd, 20 Oct 2011, Para 6.1.4.1

⁷¹ Submission for Amex Corporation Pty Ltd, Regional Rail Link Section 2, Noise Advisory Committee – 8 Nov 2011 Para 28

⁷² Regional Rail Link Authority – Reply at Hearing, Para 40, Page 6

7.4 Discussion

7.4.1 Peer review

It is clear from the report on the peer review that a review of the aspects of the NIMR dealing with the impact of the predicted residual noise levels was excluded from the peer review by the RRLA.

As we have said in Section 5.2.1, the reason for this limitation in the scope of the peer review is unclear and, in fact we find it extremely difficult to imagine what valid reason could be put forward. In our view the conditions attached to the Minister's decision on the EES referral clearly call for a peer review of the NIMR as a whole. The fact that the impact assessment aspects, which are a fundamental requirement of the NIMR, have not been peer reviewed is a clear breach of those conditions.

7.4.2 Adequacy of operational noise level predictions

Train noise

We note the universal support by the acoustic experts giving evidence at the Committee hearing for the use of the Nordic Rail Prediction Method to provide predictions of operating noise level. We agree with its use.

It is understood that, while the Nordic Rail Prediction Method is viewed as appropriate, the results obtained are dependent on the inputs to the model which include:

- The source noise levels
- The noise source locations, vertical and horizontal, determined by the alignment design and the assumed source height relative to the rail height
- The rail traffic flows.

In addition to appropriate inputs to the model, it is also essential that noise from all sources that are part of the project are considered in predicting operating noise levels and assessing their impact.

Source Noise Levels

On the matter of source noise levels for trains, we have significant doubts about the use of data from the NSW Rail Noise Database. While the database contains the results of measurements of noise from a large number of trains it does not include any such results for VLocity trains. It is understood that data taken from the database was for older style DMUs with significantly smaller engine size than the VLocity trains being modelled.

Adjustments to data from the database were made to account for speed and train length, however we have not been provided with a clear explanation of how these adjustments were made.

Our observations of the results of 'validation' measurements contained in the NIMR include the following:

- There is significant scatter of both the SEL and LA_{max} data indicating considerable variation between trains
- The data is scattered fairly evenly around the line representing the noise level-train speed equation used in the modelling indicating 'on average' agreement
- There is no clear correlation between train speed and noise level.

While the 'on average' agreement is comforting in regard to the SEL data as that is used to calculate average noise levels, this is not the case for the LA_{max} data because the LA_{max} over a particular time period is determined by the noisiest train.

We were advised by Dr Burgemeister that the source noise levels of VLocity trains used in the modelling for this project were also used for the modelling of the Regional Rail Link Stage 1. We note that, for that project, additional validation measurements were made and the results reported in *Regional Rail Link Technical Report Section 1 Rev B 13 July 2011*. The measurements made were of LA_{eq15h(day)} and LA_{max} at a number of locations along an existing rail and compared with model predictions. The comparison shows the following:

- Differences between predicted and measured LA_{eq15h(day)} ranging from -10.7 dB to 9.4 dB, with an average difference of close to zero (negative indicating measured being less than predicted)
- Differences between predicted and measured LA_{max} ranging from -3 dB to 8.6 dB with an average difference of approximately 2 dB.

This material suggests that while the model can be expected to provide reasonable predictions of average noise levels, it appears to provide under predictions of LA_{max} by approximately 2 dB.

The reason for the under prediction of LA_{max} is unknown, however it can be said that more accurate predictions would be provided if the LA_{max} source noise level was increased by 2 dB. In the absence of additional justification for the LA_{max} source noise levels used in the modelling it is considered appropriate that for any future modelling the LA_{max} source noise level should be increased.

Noise modelling omissions

There was considerable debate on whether the modelling included all of the noise that would be emitted. The matters raised included appropriate allowances for the additional noise made at points and crossings and the use of horns.

On the matter of allowances for additional noise at points and crossings, we are satisfied that the allowances made were sufficient.

The matter of horns is more complex.

We understand and accept the evidence of Dr Burgemeister that:

- The use of horns will be less than on some other railways because there are no level crossings involved
- The use of horns is prescribed for reasons of safety and therefore there may be considerable restrictions on what can be done to mitigate the impacts.

We do not agree that this means that the assessment should ignore the impact of noise from horns. There is no doubt that horns will be used and that the impact of such use is part of the noise impact of the project.

This is not to say that the inclusion of noise from horns in the assessment should involve its inclusion in the modelling. Nor should it be thought that it might lead to the complete elimination of such noise. Nevertheless it could have led to consideration of possible mitigation measures and a reduction in impact. By simply eliminating horn noise from the assessment, any opportunity that may exist for impact reduction is lost.

In the absence of any data on the noise levels of horns, a definitive assessment of the impact of horn noise cannot be made. Nevertheless we are of the view that future assessments of noise impacts should include:

- Quantification of horn noise and assessment of the impacts of such noise
- An analysis of possible mitigation measures that may be applied to horn noise to ensure the implementation of everything that is allowable, feasible and reasonable to minimise the impacts.

Noise source locations

We are aware that the alignment of the railway, both horizontal and vertical, is an important input to the model, that the modelling is based on what has been referred to as the 'reference design' and that the final design will vary somewhat from the reference design.

This situation is a natural consequence of the fact that is proposed to award contract(s) on a design and construct basis and contractors may and can be expected to vary the design. We do not see this as an unusual circumstance

and accept that, for the purpose of the NIMR there was no better choice than to base the modelling on the reference design which can be seen as the best available estimate at the time the modelling was undertaken.

We have significant doubts about the claims made, however, about the limited scope for change in vertical alignment and the limited impact of such changes on the predicted noise levels.

While it was Dr Burgemeister's evidence that possible changes in the alignment would only change predicted noise levels by 2-4 dB(A), he also said at the hearing that a two metre cut would result in 5 dB(A) reduction at a point 50 metres from the track. In addition we were advised by Mr Bret Summers, the project manager for RRL2, that the preferred tenderer was considering reductions in vertical alignment of up to 3.5 metres. There is an apparent inconsistency in the information provided as a change in noise level of 4 to 5 dB(A) cannot be considered insignificant and is well above the quantum of a perceptible change.

It is our view that the optimisation of the alignment that will occur in the development of the final design should include consideration of acoustic consequences and this matter is discussed in more detail in Chapters 8 and 9 of this report.

While we consider the possible variations from the reference design to be important, we accept that the modelling reported in the NIMR was based on the design provided at the time to KBR-Arup - the reference design.

During the hearing we sought information from Dr Burgemeister on the noise source heights, that is, their height above the rail, as used in the modelling. Dr Burgemeister indicated that a height of 0.5 metres was used. This information was contrary to that provided by Dr. Xun Li of Vipac Engineers and Scientists, who assisted Mr Smith in the preparation of acoustic evidence. He indicated that noise source height was not a model input but rather a parameter provided by the model itself. Our reason for requesting information on this matter was not aimed at questioning the modelling methodology but rather to increase our understanding of the relative contributions of various noise sources within a train - of which there are several - and the heights of those sources. Such information was considered important when considering the likely effectiveness of possible mitigation measures.

While the information provided on noise source height used in the modelling was not helpful, other evidence provided during the course of the hearing indicated that for a DMU travelling at 160 km/h the major source of noise (it was suggested 60 to 70 per cent) was from the rail-wheel interface. Other noise, some of which would be emitted from a greater height, would be

dominated by the lower height noise from the rail-wheel interface. It was indicated that, at lower speeds, the noise from the rail-wheel interface becomes less dominant but the total noise is also lower.

We conclude from this information that significant reductions in noise emissions at source will require reduction of the noise from the rail-wheel interface, whether through design modifications or baffling to suppress the noise.

Rail traffic flows

While we accept that the rail traffic flows input to the model are a reasonable and best available estimate of volume and character of regional passenger trains that will use the project area up to 2030, we do not believe that they are a reasonable best estimate of the total volume of train traffic that will use the project area.

As we have earlier noted, suggestions were made in submissions and evidence that other trains, including metropolitan trains, freight trains and trains servicing Avalon Airport, would also use the project area and should therefore be considered in the assessment.

Dr Burgemeister's and the RRLA's response to these suggestions can be summarised as follows:

- The other trains that may or may not use the project area are not part of the RRL2 development
- There is insufficient information on the other potential uses of the project area to enable meaningful modelling
- The traffic flow input to the model for the Phase 4 (2030) case represents the 'ultimate capacity' of the railway.

We find ourselves unable to accept any of these contentions for the following reasons:

- We have discussed the definition of 'the project' previously and have found that use of the project area by metropolitan trains and freight trains is part of the project and consideration of Avalon Airport trains would be prudent
- While the quality of the information on other potential uses of the project area is less than that on regional passenger trains, we believe that reasonable estimates of traffic flows, vehicle types and track alignments for metropolitan, freight and Avalon Airport trains could have been made and, if considered necessary, uncertainty in these estimates could have been dealt with using sensitivity analyses
- The contention that the traffic flow assumed for Phase 4 (2030) represents the ultimate capacity is based on the assumption that no upgrade of

networking or signalling facilities occurs. To accept this contention we would need to believe that no such upgrade is possible, which is clearly untrue. Alternatively we would have to recommend that such upgrading should be prohibited, which we think would be inappropriate in light of the need to enable best use of infrastructure.

We are firmly of the view that the assessment should be based on the best available estimate of the use of the project area and that such an estimate would include use by metropolitan, freight and Avalon Airport trains. This is because, as we later discuss, it is more cost effective and efficient to mitigate all expected noise at source at the outset rather than having to retro-fit or augment mitigation works or other measures.

Also while the modelling described in the NIMR did not include trains other than regional passenger trains, it was Dr Burgemeister's evidence that because of the noise levels of the EMUs that would be used for the metropolitan service and freight trains:

- The predicted maximum noise levels would not change if these other trains were included in the modelling
- While the predicted average noise levels (LAeqs) would increase, the increases would not be substantial.

The evidence of Dr Burgemeister on the impact on the prediction of maximum noise levels is accepted, but we believe that a judgment on the impact on the prediction of average noise levels requires quantification.

To obtain such quantification we:

- Selected a dwelling shown on Figures 12 and 13 of the NIMR where the predicted LAeq15h(day) and LAeq9h(night) are 54 dB and 47 dB respectively.
- Used the traffic flows provided for Phase 4 (2030) in the NIMR and the method for calculating the average noise levels given in the IGANRIP to back calculate single event Leqs for DMUs at the selected dwelling.
- Based on the evidence of Dr Burgemeister, assumed that:
 - The single pass LAeq120s for an EMU is 5 dB less than that of a DMU
 - The single pass LAeq120s for a freight train is equal to that of a DMU.
- Estimated that the traffic flow of EMUs by assuming that flow will be equal to the current traffic flow of such vehicles running between Laverton and Werribee. This data was obtained from the current Metlink timetable (Monday to Friday) and found to be 106 trains in the 15 hours between 7:00 am and 10:00 pm designated as the day and 24 trains in the other nine hours designated as the night.
- Estimated the traffic flow of freight trains by assuming it will be one quarter of that currently operating on the Albion to Sunshine section of

the RRL1 route⁷³. This data was obtained from Table 6 of Regional Rail Link – Technical Assessment Section 1 Rev. B, KBR-Arup 13 July 2011 and found to be seven trains in the day period and two trains in the night period. Based on current freight use on the Geelong line, we judge this to be a very conservative (over) estimate.

- Estimated that the traffic flow of Avalon Airport trains to be an average of two trains per hour each way, between 6:00 am and 11:00 pm resulting in 60 trains during the 'day' and eight trains in the 'night'.
- Calculated the pass-by LAeq120s for double car DMUs relative to that of eight car DMUs and found the difference to be 5.7 dB.
- Used the method for calculating the average noise levels given in the IGANRIP to calculate the predictions shown in the following tables.

Table 7.3 Impact of additional trains on average noise level–day (dB)

Scenario	Regional DMUs	Metro EMU	Freight Loco	Avalon	LAeq15h(day)	
				2 Car DMU	Predicted	Difference
1	90	0	0	0	54.0	0.0
2	90	106	0	0	55.4	1.4
3	90	0	7	0	54.3	0.3
4	90	106	7	0	55.6	1.6
5	90	0	0	60	54.7	0.7
6	90	106	0	60	55.9	1.9
7	90	0	7	60	55.0	1.0
8	90	106	7	60	56.1	2.1

⁷³ 25 per cent has been assumed because the Albion to Sunshine section includes a standard gauge line.

Table 7.4 Impact of additional trains on average noise level–night (dB)

Scenario	Regional DMUs	Metro EMU	Freight Loco	Avalon 2 Car DMU	LAeq9h(night)	
					Predicted	Difference
1	32	0	0	0	47.0	0.0
2	32	24	0	0	49.3	2.3
3	32	0	2	0	47.7	0.7
4	32	24	2	0	49.8	2.8
5	32	0	0	8	47.8	0.8
6	32	24	0	8	49.8	2.8
7	32	0	2	8	48.4	1.4
8	32	24	2	8	50.2	3.2

In considering the data in the tables above, we are mindful of the evidence of both Dr Burgemeister and Mr Brown that a change in noise level of less than 3 dB(A) is generally barely noticeable and would be unlikely to be detected as a change by most people, which we accept.

We make the following observation on the data in the tables above:

- The predicted LAeq15h(day) is not particularly sensitive to the addition of trains to the model. The addition of what are considered to be reasonable estimates of the possible traffic flows for additional trains results in only small increase in the predicted noise level, but it would result in additions to the area where non-compliance with the day time external noise targets at dwellings for operational noise would occur.
- The predicted LAeq9h(night) is more sensitive to the addition of trains to the model. While the addition of what are considered reasonable estimates of possible increased traffic flows of each type of train alone may not produce a significant increase in predicted noise levels, the addition of all trains would result in such an increase. It would also result in additions to the area where non-compliance with the exterior night time noise targets for operational noise at dwellings will occur.

We acknowledge that the accuracy of the calculations we have performed, and hence the validity of the resultant observations, are dependent on the accuracy of the assumptions we have made. While there is no doubt that more accurate calculations would be possible with additional work to refine the assumptions made, such work is beyond our capability.

Based on the results we have obtained, we can nevertheless comment that the modelling performed for the NIMR should have included the probability of metropolitan train services, freight trains and Avalon Airport trains using the project area but such inclusions:

-
- Would have had no impact on the predictions of maximum noise levels
 - Would have resulted in a larger area where non-compliance with the day and night time exterior noise targets for operational noise at dwellings would occur.

Railway infrastructure

Predictions of noise from railway infrastructure, including stations and stabling yards, were not provided in the NIMR, except to note that noise emissions from such elements of the project are required to comply with site-specific noise limits developed in accordance with SEPP N-1. Dr Burgemeister also said that he 'expected' that future stabling yards would have to comply with SEPP N-1.

We discuss the matter of the application of SEPP N-1 to the noise from stabling yards in the light of section 251B of the *Transport (Compliance and Miscellaneous) Act 1983* in Section 6.4.3 of this report. We have noted the dispute about whether train cleaning, refuelling and minor repairs which are undertaken in the stabling yard or siding preparatory to or after the running of passenger trains are exempt from the effect of SEPP N-1. We recommend as a result of the consideration of the legislative context that standards for railway infrastructure noise generally equivalent to those which are derived from application of SEPP N-1 should be mandated through their inclusion as part of the FNMP. These standards, however, would need to allow for noise exemptions from the standard equivalent to those given effect by section 251B (which would not apply to the FNMP), but should not include the activities discussed as problematic by the PTO - cleaning, refuelling, minor repairs etc.

Further below in this section we go on to illustrate the limits that should be imposed through the FNMP at stabling yards and stations.

We do not accept the view expressed in the NIMR that the lack of definition of these infrastructure facilities prevents further consideration of the potential noise emissions from them. It is our view that similar facilities in the existing railway system could have been used to make best estimates of potential noise emissions enabling reasonable predictions of noise and impacts to be included in the NIMR.

At the very least, the NIMR could and should have included greater definition of the noise levels that would be permitted under SEPP N-1 to enable impact assessment.

We are prepared to accept that the operation of stations and stabling yards in compliance with the limits established in SEPP N-1 (except for train noise generally and passenger train noise in stabling yards as discussed above and

in Section 6.4.3 of this report) is possible and can be reasonably expected. There is nothing in the NIMR, however, that provides any explanation of what this means in terms of noise levels.

In an attempt to overcome this, we have used the provisions of SEPP N-1 to calculate the noise limits that might apply at dwellings at the following locations:

- Location A On the north-eastern corner of the railway reserve at Tarneit station assuming the land outside the reserve is zoned Residential 1 representing a residential location immediately adjacent to a station.
- Location B 200 metres to the north of Location A assuming the land is zoned Residential 1 representing a residential location close to but not immediately adjacent to a station.
- Location C On the western boundary of the railway reserve at Wyndham Vale station where the land to the west is zoned Residential 1 and that to the east of the reservation is zoned Business 1 representing residential location adjacent to a station and close to a non-residential (Business) zoning.
- Location D 200 metres to the west of Location C where the land is zoned Residential 1 representing a residential location immediately adjacent to a station.
- Location E The most westerly point of the railway reserve adjacent to Hobbs Road assuming the land to the west of the reserve is zoned Industrial 1 representing a industrial location adjacent to a train stabling facility.
- Location F The eastern boundary of Hobbs Road directly to the east of Location E assuming the land to the east of Hobbs Road is zoned Residential 1 representing a residential location adjacent to a train stabling facility.

To make a preliminary estimate of the SEPP N-1 limits we have examined Figures 2–5 inclusive and Figure 15 of Appendix C to the NIMR which show, amongst other data, the results of measurements of the background noise levels as LA90s (the noise levels exceeded for 90 per cent of the time). The LA90 is the noise parameter prescribed in SEPP N-1 as the measurement of background noise level. We estimate the background levels at those locations to be in the order of:

	Residential	Industrial
Day	40 dB(A)	50 dB(A)
Evening	35 dB(A)	45 dB(A)
Night	32 dB(A)	35 dB(A)

The SEPP N-1 limits for railway infrastructure for which we have made some preliminary estimates for dwellings at Locations A to F, which are a function of the zoning and the background noise levels, are shown in the following table.

Table 7.5 SEPP N-1 Noise Limits

Location	SEPP N-1 Noise Limit (dB LAeq30min)		
	Day	Evening	Night
A	53	44	42
B	50.0	44.0	39.0
C	53	46	42
D	50.0	44.0	39.0
E	56.0	49	45
F	52	45.0	41

It is our view that the noise levels shown in the above table give some preliminary indication of the maximum allowable future noise levels from railway infrastructure at dwellings at those locations, and will be equivalent to a prediction of the maximum noise levels at the nearest sensitive receptor to stations and stabling yards. If the stations or stabling yards are not built for some years, the ambient noise levels may increase as urban development takes place, and the allowable noise limits will also increase.

Road traffic noise

It is acknowledged that there are some different views as to the need for road traffic noise predictions or an assessment of the impacts of road traffic noise. We note Dr Burgemeister's evidence that road traffic noise from grade separations is not normally addressed in rail noise modelling, however we also note that Mr Goddard and Mr Brown both made reference to road traffic noise as a matter that should be assessed.

It is apparent to us that the potential exists for traffic noise at some locations to be higher as a consequence of the project. We note, for example, that the traffic volume on Derrimut Road is forecast to be 25,000 vehicles per day in 2021 and that an existing dwelling north of the project area may be exposed to greater traffic noise as a result of the road overpass at the railway. Any such increase in noise level would be a product of the project and therefore a

full assessment of the impacts of noise from the project should include an assessment of the impacts of any increase in traffic noise.

While the NIMR did not include any predictions of road traffic noise, we note that it was Dr Burgemeister's evidence that the traffic flows on roads in question are relatively low compared to freeways and arterial roads and noise levels are likely to be well below VicRoads limits for new freeways or arterial roads.

While it was generally accepted that Dr Burgemeister's evidence was correct at current road traffic volumes, the continuation of that situation in the future was questioned. We find ourselves unable to resolve this difference of opinion by analysis of the information provided. We must therefore conclude that the road traffic noise predictions as provided are inadequate for the purposes of impact assessment.

7.4.3 Adequacy of operational noise impact assessment

Train noise

While the NIMR provides predictions of noise levels resulting from trains on the project area, it includes little or no analysis or discussion on the impact of such noise levels.

In our view this is a serious deficiency in the NIMR.

The NIMR provides no assessment of impacts on land that is currently in the Urban Growth Zone and has the potential to be developed for residential purposes in the foreseeable future.

The GAA have stated that:

- There will be 25.7 km of abuttal between the project area and land that is expected to be ultimately used for residential and residential related purposes
- 1500–2000 new dwellings will be built on land immediately abutting the project area
- 4000–6000 new dwellings will be built on land within 100 metres of the project area.

Our consideration of the predicted noise levels and other evidence presented leads to the view that:

- Virtually all dwellings located on land immediately abutting the project area are predicted to be subject to maximum noise levels in excess of our recommended L_{Amax} target noise level of 80 dB.

-
- Compliance with our recommended target noise levels for LAeq15h(day) and for LAeq9h(night) is not expected and the area where non-compliance occurs will be more extensive should a greater number of trains use the project area as is likely.
 - Based on elements of the project as described by RRLA, without noise mitigation measures, there will be several thousands of future dwellings subject to operational noise levels exceeding the external noise targets.

By our estimations, including allowances for some non-residential use of land in the Urban Growth Zone abutting the railway corridor, areas where the railway is in deep cut and road overpass embankments, the number of potential dwellings that are likely to be compromised in some way is 1400–1500.

This is not to say that these dwellings cannot or should not be developed but that limiting the impact of the railway to what might be considered an acceptable level would require considerably more noise mitigation measures to be implemented than are currently proposed in the DNMP. Such mitigation may be by works on the railway reserve, by control of train operation or by mitigation works to dwellings themselves. Irrespective of how the mitigation is achieved there will be a cost involved. This is a matter discussed in Chapters 8 and 9 of this report.

We note that the approach taken to the assessment of impacts at existing dwellings in the NIMR is quite different to that taken by KBR-Arup in providing an impact assessment of RRL1. Their report, *Regional Rail Link – Technical Assessment Section 1 Rev. B, KBR-Arup 13 July 2011*, includes an analysis of the predicted noise levels in comparison to criteria applied in both NSW and Queensland. It provides a table showing the number of dwellings along the route at which the interstate guidelines are predicted to be exceeded. In our view a similar analysis of the project by the proponent would have been valuable for this Section 2 of the RRL project as it would have provided an assessment of the impact of the predicted noise levels at existing residences.

The data required to perform such an analysis has been used to produce Figures 9 to 14 inclusive of the NIMR. The resolution of these figures, however, is not sufficient to enable accurate determination of the number of dwellings at which noise is predicted to be above particular levels. Despite this we have made our best efforts to complete such an exercise to produce the following results.

Table 7.6 Number of existing dwellings at which noise levels from RRL2 are predicted to exceed recommended target external noise levels

Recommended External Target Noise Levels			Dwellings at which Target Exceeded	
Parameter		Level dB	Phase 1 2014	Phase 4 2030
Daytime average	L _{Aeq} 15h(day)	60	6	11
Night-time average	L _{Aeq} 9h(night)	55	6	6
Maximum	L _{Amax}	80	62	62

While it might be considered that the data in the table above enables an assessment of the impact at existing dwellings in Phase 1, the data on Phase 4 is quite incomplete given the area around the project area is expected to be extensively developed for housing by 2030.

Railway infrastructure

As earlier noted, the NIMR provides no assessment of the impact of noise from railway infrastructure.

In the absence of other information, the SEPP N-1 limits we have determined could be used as a basis for an impact assessment of noise from railway infrastructure.

To assess the impact of noise from railway infrastructure it is necessary to establish criteria on which it could be determined whether an existing or future dwelling should be considered to be impacted by the noise. It is our view that the criteria should be based on perceptibility and, on that basis, any existing or future dwelling at which the resultant noise level will be 3 dB(A) or greater than the background noise level should be considered to be affected by noise. This occurs when the L_{Aeq}30min of the noise from railway infrastructure is equal to or greater than the L_{Aeq}30min of the background noise level.

Road traffic noise

While no assessment of the impact of road traffic noise has been provided, if Dr Burgemeister's evidence, that the noise levels at sensitive receptors would be below the standard we recommend of 63 dBLA₁₀18h, is accepted, then an assessment that the impact would be low could be made.

Unfortunately Dr Burgemeister's view is not supported by the results of any detailed consideration of the matter. This makes such an assessment questionable.

7.4.4 Acceptability of residual operational noise

Train noise

It is our view that subjecting something like 60 existing dwellings to noise levels in excess of 80 dB LAmax and compromising the future development of around 1500 or more dwellings is an unacceptable impact.

As a result we are of the view that mitigation works beyond the limited measures currently included in the DNMP will be required to limit the impact to an acceptable level.

Railway infrastructure

While we are aware that compliance with SEPP N-1 limits does not mean nil impact, we are also of the view that SEPP N-1 limits provide an appropriate balance between the legitimate and yet conflicting interests. We therefore conclude that if noise emissions from railway infrastructure are required to comply with limits generally equivalent to those derived from SEPP N-1, the impact will be acceptable.

Road traffic noise

The acceptability of the impacts from road traffic noise cannot be determined as the extent of those impacts has not been assessed.

7.5 Conclusions and recommendations

Our conclusions on the issues related to the operational noise impact assessment provided in the NIMR are as follows:

- **The NIMR does not satisfy the conditions placed on the decision by the Minister for Planning that an EES was not required for the project because:**
 - No report on a peer review of the assessment of the impacts of residual noise has been provided
 - The assessment of noise sources and noise generation scenarios has not included noise from the following:
 - All trains that can be expected to utilise the project area
 - Railway infrastructure including stations and stabling yards
 - Warning horns
 - Road traffic noise
 - The assessment of impacts of residual noise during operations has been limited to that on existing dwellings.
- **The predictions of operational noise from regional passenger trains provided in the NIMR have been made on the basis of reasonable**

assumptions, except for the assumptions concerning source noise. Subject to correction for source noise under-prediction or verification of levels currently used, they can be accepted as a fair representation of noise levels at sensitive receptors from that source alone but not from all operational activity.

- Without noise mitigation measures in addition to those proposed in the DNMP, the impact of residual noise levels from operation of regional passenger trains would be unacceptable with noise levels at perhaps 60 or more existing dwellings being greater than the target external noise levels and the development of 1400 or more future dwellings would be compromised.
- We would expect that when noise from all aspects of the project is modelled, there would be a small but not insignificant increase in the extent of the area where non-compliance with the recommended external noise targets would occur.

It is recommended that:

- The RRLA be required to prepare a Final NIMR that, in addition to the further omissions referred to in other chapters of this report, includes:
 - The results of modelling of the noise from all anticipated train traffic expected to use the project area including metropolitan, freight and Avalon Airport trains.
 - Quantitative predictions of noise levels from all railway infrastructure at current and potential sensitive receptors on, at least, a 'typical case' basis for comparison with those limits which might be derived from *State Environment Protection Policy (Control of Noise from Commerce, Industry and Trade) No. N1* to support a reasonable expectation of compliance with those limits.
 - Quantitative predictions of road traffic noise levels at current and potential dwellings using road traffic flows expected in 2030 with and without the railway.
 - Impact assessments of the following:
 - The residual operational noise in terms of the number of existing and potential dwellings that would be subject to noise levels in excess of the target external noise levels
 - The increase in road traffic noise resulting from the elevation of roads required for the project, in terms of the number of existing or potential dwellings at which the noise level is increased from below to above the road noise target level

-
- **Maximum noise levels at current and potential dwellings resulting from activities at railway infrastructure sites calculated on the basis that SEPP N-1 is to be met.**
 - **Views on the acceptability of the various impacts and justification of those views.**

8. Mitigation of operational noise impacts

8.1 What are the issues?

The issue addressed in this chapter is what are the options available for mitigation of operational noise from the project. This involves consideration of the acoustic benefits of the various options and the cost of their provision.

8.2 Noise Impact Management Report

8.2.1 Available mitigation measures

Corridor selection

The NIMR states at Section 4.2 that: *'the primary way that noise impacts from the railway have been mitigated is by careful selection and optimisation of the railway corridor and proposed track alignment.'* It also states that *'The corridor has been selected on the basis of a wide range of design constraints, including minimising the potential noise impacts to residential receivers.'*

Track design and maintenance

The mitigation measures adopted by RRLA are set out in the NIMR at Section 4. They are the use of concrete bridges and viaducts, continuous welded rail, large-radius curves, and regular maintenance of the track profile and wheels to reduce noise caused by track and wheel roughness.

Train speed

The NIMR provides information on the relationship between noise level and train speed for different types of trains.

Depressing the vertical alignment

The NIMR makes no mention of optimising the vertical alignment to minimise the impacts of noise, save for brief mention of the cutting at Wyndham Vale Station, which is adjacent to existing housing development. It states that the cutting has been provided to *'reduce severance, access and visual amenity impacts'* and then states that it *'provides a secondary benefit of significant mitigation of noise emission from the railway.'*

Bunds and noise barriers

Section 251B of the *Victorian Transport (Compliance and Miscellaneous) Act 1983* is quoted in Section 4.3 of the NIMR, referring to the exclusion of noise from trains from constituting a nuisance. The report continues:

Therefore, the project authority does not propose to provide noise barriers to control noise emissions from the railway as part of the RRL project.

Section 4.3 of the NIMR also states other difficulties with the use of noise barriers, namely that they lead to overshadowing and loss of solar access, they are visually obtrusive, and they are subject to vandalism. From the railway operator's perspective, noise barriers can be a security hazard and can affect signal sighting distances.

Lot layout and architectural measures at individual houses

The exhibited NIMR at Section 4.3 states that:

'Off-reservation treatments, such as architectural acoustic treatments to individual properties (e.g. double glazing, building design) do not result in increased external amenity but may be incorporated into new developments as urban change occurs.'

Buffers and planning controls

Section 4.4 of the NIMR recommends that planning authorities adopt appropriate buffers and planning controls. It states:

The Growth Area Framework Plans (2006) for Melton/Caroline Springs and Wyndham set out broad strategic directions for those areas including focussing urban development along the rail corridor, including commercial, residential and community uses. The precinct structure plans will give further definition to these principles.

It further states:

This assessment concluded that as urban development proceeds around the rail corridor, strategic land use decisions and mitigation measures will be required to ensure that new sensitive land uses are appropriately located and designed. This reflects the balance required by planning policy for development to be integrated with the railway while providing reasonable levels of amenity.

Section 4.4 of the NIMR also says that planning controls such as a Design and Development Overlay (DDO) may be applied to adjoining land to provide reasonable protection of amenity of occupants of new buildings.

Section 4.5 of the NIMR summarises the Regional Rail Link Urban Design Strategy (Section 4.0 RRL Elements). It provides discussion of elements such as retaining walls, embankments and earthworks, barriers and fencing. These are proposed for reasons of security and visual amenity. The NIMR comments that these may have noise benefits and can be read as suggesting that these will be located off the project area.

The DNMP at Section 3.2, *Specific Operational Noise Controls*, reiterates the above position.

8.2.2 Acoustic benefits and costs of measures

The NIMR does not discuss the costs and benefits of any mitigation measures.

8.3 Evidence and submissions

8.3.1 Available mitigation measures

Corridor selection

The opening submission by Mr Wren for RRLA stated (Exhibit RRL17, para 25): *'Notably, from an acoustic perspective there was minimal difference between any of the alignment options considered by the Department of Transport'*. The footnote to this advice referenced an earlier KBR-Arup report, part 6 of *Delivering Melbourne's Newest Sustainable Communities: Regional Rail Link: West of Werribee to Deer Park Specialist Report – Noise and Vibration (June 2009)*.

This view was supported by Dr Burgemeister in his verbal evidence.

A further reference to this matter was made by Mr Wren in paragraph 181 of this submission:

A primary way that the noise impacts from RRL2 have been mitigated is by the careful selection and optimisation of the railway corridor and proposed track alignment.

Mr Wren qualified this statement by repeating some of the material in paragraph 25 quoted above, by referring to the deep cut at Wyndham Vale, and indeed by citing the Advisory Committee process.

Track design and maintenance

These are already discussed in Section 6.2. Apart from the advice that concrete sleepers would be used for the project, no further submissions were made or evidence was provided.

Train speed

Mr Bret Summers, the project manager for RRL2, advised us that a 115 km/h speed restriction would be applied to DMUs at the connection to the Geelong line at the southern end of RRL2 and at the northern curved section of the RRL2 track. This was for reasons of operational safety. Apart from those two instances, RRLA mentioned no other use of speed restrictions, whether or not for noise mitigation purposes. Indeed Mr Summers and Mr Wren for RRLA both argued that speed limitations would defeat one of the main objects of the project – that of providing a faster regional passenger rail service.

Depressing the vertical alignment

At the Advisory Committee directions hearing, a booklet of maps was made available, including one showing where the vertical alignment in the reference design would be in cut and where it would be on fill. A revised version of the booklet was later provided at the hearing (Exhibit RRL1). A longitudinal section of the reference design track indicating vertical alignment was also provided upon our request (Exhibit RRL9).

During the site inspection we enquired if there was potential to further depress the vertical alignment west of Skeleton Creek through to say Leakes Road. Mr Summers replied that flooding, the need to have stations level and other constraints precluded such amendment. When this matter was again raised at the hearing, Mr Summers provided information (Exhibit RRL40) on an option for lowering of the vertical alignment from just east of Skeleton Creek (reaching a 7m cut at Derrimut Road), returning to the at grade reference design near Tarneit Road. An additional cut of almost 300,000 cubic metres was associated with the proposal. Mr Summers advised that on cost and urban design constraints such an alignment was not practicable.

In particular, Mr Summers suggested that the utility of a pedestrian subway below the railway line at Tarneit Station would be compromised by the adoption of the cutting: it would be further depressed, leading to a situation where a pedestrian would not be able to see through from one end of the underpass to the other, increasing both the perception and reality of danger.

In relation to depressing the vertical alignment, the written submissions by Minter Ellison on behalf of the Davis Family (Submission No 2) and the Manor Commercial Company Pty Ltd and Manor Lakes (Werribee) Pty Ltd (Submission No 3) attached a report on noise impacts by Renzo Tonin & Associates, which refers to an earlier Marshall Day Acoustics noise and vibration report. The Marshall Day Acoustics report advocated putting the railway in a 6m cut opposite the Manor Lakes development at Wyndham Vale and the proposed Rose Grange development at Tarneit to meet the trigger levels in the IGANRIP.

On the last day of the hearing, Mr Summers advised that the RRLA had progressed to having a preferred tenderer for construction of the project. He said tenderers had reviewed the reference design which aimed to balance cut and fill over the length of the route and had noted that the Werribee River presented an obstacle to hauling cut material from the southern end of RRL2 (in particular from the Wyndham Vale Station cutting) to the northern end of RRL2. As a consequence, the grade lines east and west of Werribee River had been separately assessed by them, with a general lowering of greater than one metre being proposed over about half the length from the Werribee River to Skeleton Creek, with a cut of up to 3.5m some 700m east of Davis Creek. He advised, however, that at that point, the basalt was within 0.5m of the surface, and in his view the grade line was unlikely to drop down too much.

Mr Summers also mentioned the many infrastructure service lines that would need to be considered in any wholesale lowering of the grade line. These included a major water main, a myriad of smaller water supply and drainage pipes, sewerage pipes, and a culvert at the future Davis Road station requiring a 700m channel to the south.

Bunds and noise barriers

The Wyndham City Council submission (Exhibit WCC3) included:

It is requested that the Advisory Committee consider the area around Lollypop Creek, Wyndham Vale in greater detail, in terms of potential mitigation measures for existing and future dwellings, the cultural sensitivities of the area, the proposed/potential construction methods for both road and rail, and appropriate urban design outcomes.

Mr Canavan for DoT submitted that section 251B does not preclude noise barriers being considered for this project.

In his evidence Dr Burgemeister advised that he had been instructed by RRLA to prepare conceptual noise mitigation designs based on achieving the noise trigger levels documented in the IGANRIP. A L_{Amax} of 80 dB was adopted as the critical trigger level, as, at the low volumes of train traffic modelled, the areas where L_{Aeq15h(day)} and L_{Aeq9h(night)} exceed the trigger level in IGANRIP for those indices, are contained well within the boundary of the larger area in which the L_{Amax} of 80 dB is exceeded.

Eight noise barriers were shown in Dr Burgemeister's evidence (Exhibit RRL20, page 60, Figure 1). Barriers 1 to 6 inclusive were designed to mitigate noise at an existing single house (or two houses in one case) and were deemed by Dr Burgemeister 'to not be a cost-effective or practical solution'. The remaining two barriers (Barriers 7 and 8) were 'for areas. . . at the southern end

of the Wyndham Vale cutting where the railway emerges from the cutting onto a bridge structure over Lollypop Creek' and continues on the east side, past Greens Road and halfway to Black Forest Road. It was predicted that 80 existing residences would experience noise levels in excess of 80 dB LA_{max} without barriers.

Barrier 7 provides mitigation to 31 residences, is from 1.2m to 1.5m high, is 400m long, and has an area of approximately 1500 square metres. Barrier 8 provides mitigation to 42 residences, is from 1.5m to 2.5m high, is 1150m long, and has an area of approximately 2800 square metres.

Mr Wren advised that if we were of a mind to recommend such barriers at Wyndham Vale, consideration would need to be given to the urban design implications of providing noise barriers up to 5m high, the cultural heritage sensitivities of Lollypop Creek, as well as the outlook of residences to the noise barriers and the management of graffiti and safety implications.

In his reply (Exhibit RRL58, para 86)) Mr Wren also cautioned that placing bunds (earthen mounds) on each side of the track within the rail corridor might not be feasible, given the need for four tracks, a maintenance access track, signalling communication, drainage, and a shared-user path. The width of a 2m high bund was given as 9-10m at its base.

Most presentations for and expert evidence called by submitters drew attention to the limited discussion of noise mitigation by RRLA, and said that almost no consideration had been given to possible measures that could be used by RRLA to assist with noise mitigation. Measures that were supported in the evidence and presentations included both depressing the vertical alignment of the railway and providing noise barriers within the project area.

In relation to barriers, the submission on behalf of Lotus Oaks Pty Ltd by Mr Ian Pitt asserted that the devaluation of land as a result of unmitigated noise would be substantial and more than the cost of barriers. This is demonstrated, he said, by the many cases where land owners with no entitlement to compensation for disaffection by noise from major roadways, had chosen to erect barriers at their own cost to enable development to proceed.

The evidence by Mr Smith of Vipac Engineers & Scientists Ltd called on behalf of Lotus Oaks Pty Ltd (Exhibit B50) examined the effects of barriers at six locations within the Lotus Oaks' holding. Mr Smith determined that a 5m high wall or earth mounding would be required along the 2497m project area frontage to the land, and a 6m high wall or earth mounding along the Werribee River frontage east of the track to reduce the LA_{max} and LA_{eq15h} to the IGANRIP trigger levels.

The Wyndham City Council submission to the hearing (Exhibit WCC3) stated that the 5 to 6m noise walls or earth mounding proposed in the Vipac Report appeared to be an excessive approach to noise mitigation. In the vicinity of Werribee River, it would not be an ideal urban design outcome and would effectively block the views of the Werribee River from abutting dwellings. Further, it was said, the proposed 5m high barriers are not needed abutting the proposed employment area occupying the Lotus Oaks land.

Lot layout and architectural measures at individual houses

Ms Adele Patterson for GAA set out three development scenarios for land adjacent to the project area (Section 7.1 of Exhibit GAA24) which were described as:

- **Rear Exposure:** a development layout involving detached houses backing onto the project area, with external living areas at the rear, and 5m clearance between the project area and the rear of dwellings
- **Frontage Road:** a development layout involving detached dwellings facing onto the project area across a street, with a landscaped area on the railway side and a conventional footpath and nature strip on the housing side, resulting in a 25m setback between the project area boundary and the front façade of dwelling
- **Continuous Apartments:** a building or buildings (probably of two or more storeys) containing noise protected apartments or townhouses built on or close to the project area boundary, with external living areas located away from the railway. It was suggested that this option would be possible in town centres or to act as a noise buffer to other development.

The Frontage Road scenario is preferred in principle by GAA due to:

- the ability to provide landscaping and cycle and pedestrian access along the railway
- the location of external living space furthest from the railway and shielded by the dwelling
- its requiring only minimal initial use of noise fencing, but retaining the ability to add noise barriers shielded by landscaping if future rail upgrades or changed noise standards require this.

The GAA advised that the Frontage Road scenario had already been adopted in some PSPs such as that for Toolern in the Shire of Melton.

Buffers and planning controls

Mr Wren in his submission (Exhibit RRL17) stated that the RRLA does not consider mandatory separation distances (buffers) between the railway and sensitive uses such as dwellings to be justified. He also submitted that the strategic and planning scheme amendment process for each PSP for which

GAA will take the lead provides an opportunity to include a DDO to address rail noise.

In relation to the extent of any DDO, Mr Wren in his reply (Exhibit RRL58) stated that a Committee recommendation to restrict the DDO to those proposed residential lots that have a frontage to the project area would be a proportional planning response:

...that would minimise the concerns of the property developers regarding the marketability of residential lots that are subject to the DDO, but ensure that the most impacted dwellings are designed in such a way so as to provide reasonable amenity to the occupants of these dwellings.

Mr Wren also stated that such an approach to the DDO would be consistent with the NSW Infrastructure SEPP. Clause 87 of that SEPP addresses development immediately adjacent to rail corridors, and requires that a permit must not be granted for any residential building unless it meets an internal noise level for bedrooms of 35 dB(A) Leq, and elsewhere in the building (other than a garage, kitchen, bathroom or hallway) of 40 dB(A) Leq.

The GAA submission to the hearing (Exhibit GAA24) also considered the issues of planning controls, subdivision layout and noise mitigation at some length. The very wide separation buffers believed necessary to meet the NSW noise standard (quoted as 63m wide) were dismissed as too expensive.

It should be noted that setbacks quoted by others (see for example the submissions for the Dennis Family, Exhibits D42 and D46) are up to 250m, while the RRLA (RRL58, para 50) itself specified that the LAmax level of 80 dB would be exceeded up to 210m from the centre of the rail corridor (ignoring any shielding from the front row housing).

The GAA outlined objectives applicable to any planning and building controls considered for new development, including that the controls should:

- Adopt an integrated approach
- Resolve as far as possible mitigation treatments at the subdivision stage
- Minimise costs to the parties
- Provide some flexibility for home builders/buyers
- Minimise the burden for all parties including responsible authorities
- Unambiguously identify land that requires noise mitigation
- Use existing institutional arrangements.

Options suggested by the GAA included:

- The use of permits – we were advised that for a project in Cardinia Shire, a 3.2m high noise barrier along the rail reservation and double glazing of

abutting properties was implemented to mitigate noise from an existing railway

- PSP based controls
- Planning scheme overlays (including a DDO) and building controls.

In the absence of a noise standard, and to obtain some uniformity in outcomes along the length of RRL2, the GAA preferred a DDO, and submitted an outline of a possible DDO.

Wyndham City Council supported use of a DDO and the GAA draft DDO schedule as an interim measure. Wyndham's preference, however, was for a new overlay to be developed similar to the Airport Environs Overlay, in combination with defined noise contours. It further stated that the FNMP should define the mitigation measures and specify the appropriate distances from the RRL corridor where they should be applied.

The submission on behalf of the Dennis Family (Exhibit D42) stated that there are issues with an enduring DDO applying to land along the rail alignment, namely:

- The decrease in value of land due to its being identified as noise affected
- The need, at the time of a house sale to a new owner, for the purchaser to establish that the dwelling complies with the DDO
- The possibility that building measures may not continue to comply with the DDO with increased noise from future rail traffic and such future noise may be impossible to mitigate.

Instead the submission preferred the option of having noise mitigation measures considered at the PSP stage, allowing the noise mitigation measures to be known prior to the finalisation of the relevant PSP.

Road traffic noise

There were no submissions or evidence about what mitigation measures could be used for road noise.

8.3.2 Acoustic benefits and costs of mitigation measures

Track design and maintenance

Dr Burgemeister advised that older style steel bridges can add 10 dB(A) to noise emissions but RRLA propose to use ballasted concrete structures for all bridges to avoid this potential additional noise.

Mr Wren expanded on 'qualitative standards which must be observed' in his presentation (Exhibit RRL17, paras 72 and 73), advising that the use of concrete sleepers, continuous welded rail and large-radius curves will

deliver an acoustic benefit of 1-3dB along the entire alignment. He said also that track and wheel maintenance to manage track roughness will deliver a *'benefit of 1-3dB along the entire route alignment, and 5-10dB in the vicinity of defects, when compared to a poor maintenance regime.'*

Depressing the vertical alignment

Dr Burgemeister gave evidence that in general it was too costly to lower the grade line of a planned railway simply to provide noise protection. He suggested that lowering the grade to achieve the same acoustic benefit as a barrier was 10 times more expensive.

Bunds and noise barriers

The RRL1 Noise Impact Assessment Report, revised in July 2011 after consultation with EPA, was also made available to the Committee. It provides a scenario to meet a night time external noise level of 60dB LAeq9h(night). Further detail of noise barrier cost estimates was provided in Table 4 (page 53) and is reproduced below:

Table 8.1 Noise Barrier Cost Estimates for RRL1

Mitigation Measure	Typical Reduction in noise level dB(A)	Approximate costs
Noise barriers – 2 m	3-8	\$6,200/linear metre \$45,000-\$75,000 per residence \$20,000-\$50,000 per dB per residence reduction
Noise barriers – 4 m	8-12	\$12,400/linear metre \$85,000-\$150,000 per residence \$20,000-\$25,000 per dB per residence reduction
Earth bunds	3-8	\$450/linear metre \$3,500-\$4,600 per residence \$1,200-\$1,500 per dB per residence reduction
Low level trackside noise barriers	3-6	≈\$650/linear metre ≈\$5,500 per residence ≈\$3,500 per dB reduction

The costs above allow for the difficulty in constructing noise barriers along a working railway. The report notes at page 53:

The cost estimates are based on VicRoads data for installed barriers plus allowances for inflation and contingency. The estimate includes the cost of four weekend occupations of the rail corridor in locations where works cannot be undertaken safely. The costs also include for shiftwork rates for after-last-before-first train working.

In relation to Noise Barriers 7 and 8 included in Dr Burgemeister's evidence, Mr Wren advised that they would cost between \$8 million (concrete/acrylic) and \$12 million (acrylic) at a cost of \$110,000 - \$180,000 per house. The cost per square metre for the 4,300 square metres of these barriers is \$1860 (concrete/acrylic) and \$2790 (acrylic).

The evidence of Mr Neil Huybregts of Marshall Day Acoustics (Exhibit GAA25) sets out some indicative costing for noise barriers. A 2m high noise barrier could be built for \$500 per linear metre. If a 15m house block width is assumed, the noise barrier would cost some \$7500 per dwelling (figures provided by a contractor who has done barrier construction for VicRoads).

We note that it would appear that the conclusions reached in Exhibit GAA25, Table 2, Treatment Summary are based on calculations that do not take into account the additional 5 dB resulting from adjusting from a reference speed of 80 km/h to the design speed of 160 km/h, and the need to add on the 2.5 dB façade reflection.

The Advisory Committee also wrote to VicRoads seeking advice about the cost of 2m and 4m high barriers, constructed of wood and concrete. Mr George Mavroyeni, Executive Director – Major Projects, replied, advising that in a green field site, timber fences range from \$400 to \$500 per square metre, while concrete fences range from \$600 to \$700 per square metre.

Lot layout and architectural measures at individual houses

In oral submissions, Mr Wren provided advice that US costs for architectural treatments to protect a home are \$60,000 per dwelling and NSW costs are \$15,000 to \$20,000 per dwelling.

Mr Huybregts' evidence (Exhibit GAA25) sets out some indicative costing for architectural measures at individual homes. Double glazing costs of \$3000 per bedroom window (2 windows assumed) combined with ceiling sound insulation costs of \$1200 per bedroom (2 bedrooms assumed) gives a total cost of \$8,400 per dwelling. The quoted costs are in addition to the normal construction costs of fences and windows, but exclude any allowance for ventilation or air conditioning. He said that the costs were taken from Rawlinsons Australian Construction Handbook (edition 28, 2010).

The GAA submission to the hearing provided an estimate of costs if a dwelling was constructed immediately adjacent to the project area as a noise barrier, namely costs in the order of \$9,000 to \$14,000 more than similar dwellings. At the hearing, Ms Patterson referred to costs of \$15,000 per dwelling for architectural noise mitigation measures for a dwelling.

In relation to the Frontage Road scenario (see Section 8.3.1), the GAA estimated that the cost of a 10m strip of land, with the development bearing 50 per cent of the cost adjacent to a Level 1 Access Street, would be about \$600 to \$1000/m frontage. For a 15m wide house lot, that would equate to \$9,000 to \$15,000 per dwelling. An alternative calculation based on an estimation of lost development profit yielded figures of about \$8,000 to \$13,000 per dwelling.

Buffers and planning controls

As noted above, the GAA dismissed very wide buffers (quoted as 63m) to meet the NSW noise standard as too expensive as did other submitters.

8.4 Discussion

8.4.1 Available mitigation measures

Corridor selection

We acknowledge that noise was considered in the selection of the RRL2 corridor. We do not accept, however, Mr Wren's assertion that corridor selection acted as an effective noise mitigation measure for this project. We were advised by Dr Burgemeister that so far as noise impact is concerned there was little difference between the corridor options. We also note that alignment variations were principally considered in the northern section of the project area which generally does not abut existing or future residential land.

Track design and maintenance

We accept that the design parameters and maintenance measures proposed by the RRLA (track and bridge construction and rail and wheel quality) are effective albeit limited measures to control noise at source. As discussed, alone they do not produce an acceptable noise impact outcome.

It is nevertheless important that the design parameters are applied and maintenance of track and wheel roughness is rigorously carried out. Our concern is that the necessary level of maintenance may decline over time and the noise levels at source may creep upwards.

Train speeds

We are aware that a significant advantage of the project is the ability to run VLocity and Sprinter trains, which have maximum speeds of 160 km/h and 130 km/h respectively, unhindered into the centre of the metropolitan area. However we also note that, when operational conditions require, speed limits can be imposed.

We have also calculated that the time taken for deceleration from say 160 km/h to 80 km/h - involving slowing, travelling at a lower speed for say 1000 metres and then accelerating back to 160 km/h. This would provide a noise reduction of LA_{max} of perhaps 5 dB, but would probably add only about one minute to the travel time along the total RRL2 route.

We consider that speed restrictions should be part of the mix of operational noise mitigation measures to be considered for the project.

Depressing the vertical alignment

We were somewhat taken aback at the scale of the cutting submitted by RRLA in Exhibit RRL40 (up to 7 metres), given that we had only asked about the possibility of lowering the grade line a metre or two in this section of track. The request on behalf of the Davis Family may have influenced the response by the RRLA. However as the proposal has been put, we consider it here.

A pipeline runs from the east to the Melbourne Water header tanks just south of Hummingbird Boulevard. The line passes under the project area, forming a narrow chord mainly under the curved horizontal alignment over a distance of one and a half kilometres (see Exhibit RRL1). The lowering of this pipeline to pass under the railway will be required at least east of Skeleton Creek, although the option of relocating the pipeline around the southern side of the RRL2 alignment may be financially attractive. The lowering of the grade line in accordance with Exhibit RRL40 would require either a further crossing of the alignment towards Tarneit Station, or the relocation mentioned above.

So far as Mr Summers concerns about this lowering of the alignment leading to an unacceptably deep pedestrian crossing at Tarneit Station is concerned, we would comment that he did not appear to have considered the straight-forward alternative of putting a pedestrian crossing above the railway tracks.

A key issue to be addressed in considering the depressing of the vertical alignment is the cost. As we have said, we suggested that a much shallower cut might be considered in this location. Even if a 7m cut is considered, however, the additional 300,000 cubic metres of cut, most of which may be hard rock, might not be the considerable financial burden it appears. From a broader perspective, given that large amounts of crushed rock for road works and drainage works are likely to be in demand for the adjacent urban development, the cost of the rock excavation could well be offset by a ready market.

We would observe that as well as potential sales of cut material for road making and the like off site, further potential advantages of lowering the

grade line are the creation of additional fill which might be used to construct bunds as a further noise mitigation measure, and allowing a reduction in the height of the road overpasses, reducing costs and adverse noise and visual impacts.

More broadly again, we would comment that it is surprising that, in choosing the vertical alignment of the reference design, not only were these engineering offsets apparently not considered, but no consideration was given by RRLA to the significant societal benefits that may accrue from a depressed grade line in terms of noise mitigation. Depressing the vertical alignment to minimise noise impacts is an approach commonly seen as good practice for new freeways through urban areas.

This appears to have been the result of the narrow criteria for the reference design, where the alignment optimisation had simply the aim of balancing cut and fill along the total track length. We do not know the full gamut of the criteria that were used by the preferred tenderer to define a revised track alignment⁷⁴ (which we expect has been included as part of the now awarded construction contract) but it is clear that even other engineering practicalities and costs can drive a change.

While we do not have all the information necessary to determine what lowering of the grade line might accomplish in terms of noise mitigation, we are of the view that this is a noise mitigation measure which warrants consideration.

We have looked carefully at the vertical alignment and, excepting only the Wyndham Vale cutting, see opportunities throughout the length of RRLA for a lower grade line which, on more detailed examination, and bearing in mind the advantages that may accrue to both noise levels inside houses and outside them, may prove to be worthwhile. Two examples are at Chainage 21740 and at Chainage 34720. The reference design response to a local short rise in topography at the first of these locations was to go over the hillock at grade. At the second of these chainages, we understand, the tenderers have suggested a 3.5m cut.

Bunds and noise barriers

We have earlier set out our assessment of the appropriate noise targets and limits which should be adopted for this project.

The noise mitigation bunds and barriers required for any particular section of the track to assist in meeting those targets and limits cannot be definitively

⁷⁴ We understand that the alignment has been revised at least partly in response to separate consideration of excavation and haulage for the sections of the railway to the east and west of the Werribee River.

specified until the final grade line and nature of adjoining land use are established. We have been advised that a reconsideration of the grade line by the preferred tenderer based only on engineering considerations has already led to a design different to the reference design. When the broader issues of noise mitigation and amenity are taken into account, it is likely that there will be further changes. The bunds and barriers should be applied to the revised grade line and in response to the revised noise impacts.

We do expect, however, that the design for RRL2 will be of a high standard, and visual quality will receive due attention. Importantly, such attention should extend to landscaping, and the visual amenity impacts of mounds and barriers. There are a number of examples of mounds and wooden barriers that have been in service for many years on Victorian freeways, many of which are quite visually pleasing. More recently concrete barriers, with transparent acrylic sections (either forming the top 2m of a barrier, or providing an occasional vista through the barrier) have been adopted.

The matter of the desirability of avoiding a 'tunnel' effect such as can occur with high barriers along long stretches of freeways was raised at the hearing. This would suggest that barriers should be restricted in height, and that a combination of mounds and barriers may be visually preferable to high barriers alone. However, given the relatively short time it will take to traverse the full length of RRL2, the relatively short lengths of the expected barrier sections, and the visual 'breaks' provided by stations and river crossings (where opaque barriers are not likely to be used), this problem should not be significant.

In relation to matters of access and safety, the adoption of noise barriers quite widely on railways in a number of countries including Australia (in New South Wales) suggests that these issues are not likely to present insuperable problems. The other risk factors relating to cost, topography, structural sufficiency and heritage considerations will be accommodated by normal engineering, cost estimating and environmental considerations. It would be surprising if risk assessment proves to be a decisive factor in determining barrier outcomes.

We requested advice on the likely impact of noise barriers on sight distances, given the large curve radii adopted, the height of both the train driver's eye and the signals, and the offset and height of any noise barrier. The RRLA response to this request stated that 450m sight distance was required, and that signals in the Works Package E area of the track are spaced at around 450m. It does not seem that sight distance to signals would become a problem with noise barriers or bunds.

In our view it is clear that mounds and noise barriers will need to be part of the solution to achieving a satisfactory noise outcome for the project. LAm

noise levels for houses separated by a 'Frontage Road' from the project area boundary are likely to be subjected to noise levels of about 86 dB(A) when the railway is in a 2m cut, and about 91 dB(A) when the railway is at grade or elevated up to 2m, and the surrounding terrain is flat⁷⁵. To achieve the 6 dB(A) to 11 dB(A) reduction required to meet the external target noise levels at dwellings, barriers between 2m and 4m high would be required. Alternative combinations of cut, bunds and noise barriers are considered in Section 8.4.2 below.

Where the 'Rear Exposure' scenario would apply to adjoining land, similar to the pattern of development adjacent to the Ballarat Rail line at Edmondshaw Drive, Deer Park⁷⁶, the distance from the project area boundary to the house rear façade is about 6m and the project area boundary would again be 21m from the nearest rail. The predicted noise level would be about 96 dB LAmax. For the required 16 dB reduction to meet the LAmax 80 dB target, it is likely that a cut and/or a barrier combination of not less than 8m in height would be required. It is unlikely that any such arrangement would be cost effective, unless a deep cutting was required for other reasons.

Clearly the use of bunds will depend on the availability of fill (which should not be a problem if the grade line is further depressed).

With respect to Mr Wren's assertions about the insufficient room for noise mounds within the 60m wide project area given that four rail tracks, a maintenance track, signalling communications, drainage and shared user path also needing to be accommodated, the following widths are relevant:

- Four tracks might take 23m (see Exhibit B52c)
- An access road for vehicles say 6m
- Communications (trenching and signal structures) say 2m
- Drainage say 2m
- The shared pathway 5m.

Even if there was a 2m cut in the grade line, batters for that depression would only take another 4m each side, leaving 14m overall for any noise mounds. This would likely mean that the bunds would have to be less than 2m in height. Alternatively the bunds could be partially sited offsite: they could be integrated into the GAA Frontage Road scenario, for example by siting the shared pathway on the lower outside part of the bund just outside the rail corridor.

⁷⁵ See RRL57, with 2.5 dB(A) façade reflection added, allowing the 25m setback from the rail corridor boundary specified by GAA, and assuming the nearest rail is 21m from the corridor boundary

⁷⁶ Inspected by the Committee

It is our view that opportunities would exist for use of bunds for noise mitigation.

The issue of graffiti on barriers is acknowledged, and Section 5.6 of the NSW Department of Planning publication *Development near Rail Corridors and Busy Roads – Interim Guideline 2008* recommends the use of anti-graffiti paint or coating materials and landscaping as means to avoid graffiti. In our view, dealing with graffiti on barriers is not an insurmountable problem.

Lot layout and architectural measures at individual houses

The GAA submission characterised its preferred layout, the Frontage Road, as ‘minimising the use of noise fencing’.

As can be seen from the earlier parts of this report, the noise levels reported in Mr Huybregts’ evidence as relied upon by the GAA were too low by perhaps 7 or 8 dB(A). As the lower value also applied to the other scenarios, it has been assumed that the GAA preferred scenario has not changed because of this factor.

We agree that there may be a place for all three scenarios suggested by the GAA: the Frontage Road, the Rear Exposure and Continuous Apartments. The Frontage Road option offers the most benefits acoustically given it would assist in achieving external acoustic amenity as well as for dwelling interiors. The separation of the dwellings from the railway by the fronting roadway would also generally assist acoustically though only marginally. It also offers good urban design outcomes. It comes at a cost given housing only abuts one side of the road. The architectural acoustic measures required to achieve satisfactory internal amenity for the other two development layouts would be significant and no external noise buffering would be available to private open space of dwellings under the Rear Exposure arrangement.

Whatever development layout is adopted, however, the row of lots closest to the railway should be developed first and in such a manner as provides a noise barrier for housing further from the project area. Desirably the housing should create a continuous barrier and there should be a continuity of design. In this respect while the Frontage Road and Rear Exposure scenarios contemplate detached dwellings, in order to create the barrier effect for other dwellings, those ‘first row’ dwellings would need to be closely situated in relationship to each other, as they indeed are in most contemporary housing developments at the urban fringe.

We note that if a DDO is used to achieve this outcome, there will need to be some care in designing its provisions so that any houses further away from the rail corridor not protected by the first row due to topography or

subdivision layout, are adequately protected in terms of noise amenity by other means.

Buffers and planning controls

We support the view of GAA and others, that the cost in terms of loss of housing land if separation buffers were used alone (or principally) to achieve the desired 80 dB LA_{max} would be prohibitive. We also note that another undesirable consequence of this approach would be that dwellings would be located further from the rail services.

Road traffic noise

We do not consider that the anticipated separate noise from road and rail can be combined in any meaningful way, given their very different character and likely subjective response. Each needs to be judged on its individual merit.

We nevertheless consider that if as a result of the RRL2 construction, road traffic noise is exacerbated in the vicinity of the overpasses, mitigation should be provided. We have recommended the noise limits that should be adopted against which the need for mitigation can be determined. Barriers would appear to be the most appropriate option.

8.4.2 Acoustic benefits and costs of measures

Speed of trains

Information on the relationship between noise level and train speed contained in the NIMR shows that, for VLocity and Sprinter trains, a reduction in speed from 160 km/h to 80 km/h would result in a reduction in the LA_{max} of 5dB.

It was also Dr Burgemeister's evidence that the LA_{max} from a three car train would be 3dB less than that of an eight car train.

Bunds and noise barriers

The cost estimates for barriers and bunds provided to us have varied significantly.

We note the estimate of \$450 per linear metre (for RRL1) for a 2m bund, which would translate to \$6,750 for each fronting 15m wide house lot. However this figure related to a project where fill would have to be imported, and where the work would be done adjacent to an operating railway, with fairly tight corridor constraints.

Along RRL2, however, the grade line can be adjusted to ensure there is sufficient fill for noise bunds at a cost which is likely to be significantly less. We note also that earth moving and compacting equipment will be in use along the alignment to cut, transport, form and compact the base for the track, and the profiling of a noise bund within the relevant chainages would not add significantly to the cost of these operations.

We suggest a value of one third of that for RRL1 would apply for RRL2, namely \$150 per linear metre of bund. A one metre bund has only one third of the cross-sectional area of a 2m bund, and hence could be expected to cost \$50 per linear metre.

Whatever form barriers might take, the opportunity exists to also construct them in a green field site (that is a site where there is no operating railway and often no abutting residential development), and hence construction costs should again be considerably lower than those quoted for RRL1.

For the purpose of comparing the costs of alternative mitigation measures, we have reviewed the costs of barriers provided, noting that for a 2m high barrier they range considerably - from \$6,200 per linear metre to \$500 per linear metre. The VicRoads' advice for 2m high concrete barriers was that they ranged between \$600 and \$700 per square metre. We are satisfied that a value of about \$1300 per linear metre at a greenfield site such as RRL2 is realistic for a 2m high concrete barrier.

For a 4m high barrier the costs range from \$12,400 per linear metre to the VicRoads' cost of \$2,800 per linear metre (using the higher VicRoads' figure here). Again we are satisfied that the latter is a realistic value, and would add a further \$200 per linear metre to allow the provision of occasional acrylic windows.

The relative costs of providing bunds and barriers can be summarised as follows:

Table 8.2 Summary of likely bund and barrier costs

Mitigation Measure	Approximate costs
1m bund	\$50/linear metre \$750/house lot
2m bund	\$150/linear metre \$2,250/house lot
1m concrete barrier	\$600/linear metre \$9,000/house lot
2m concrete barrier	\$1,300/linear metre \$19,500/house lot
4m barrier with occasional acrylic window	\$3,00/linear metre \$45,000/house lot

Lot layout and architectural measures at individual houses

We are guided by the experience in NSW, as reported by Mr Wren, and accept that architectural measures at individual dwellings may cost in the order of \$15,000 to \$20,000 per house. Such measures would only provide noise mitigation in the rooms treated, and the amenity of outside areas would not be protected.

So far as lot layout is concerned, we note that the Frontage Road option comes with the added cost of \$9000 to \$15000 per 15m wide dwelling lot (see Exhibit GAA24, Section 9.2).

Buffers and planning controls

We note that using the indicative land costs provided in the GAA submission, the cost of land for a 63m buffer would be in the order of \$113,000 to \$169,000 per 15m frontage. It follows that the cost of providing a buffer in the order of 200m deep, as may be required to avoid the L_{Amax} level of 80 dB at some locations, would be of the order of three times greater, say \$300,000 to \$500,000 per 15m frontage.

These values are so high that they can be ruled out immediately - a conclusion consistent with all the submissions that addressed this issue.

Road traffic noise

The cost of concrete noise barriers quoted in the section headed 'Bunds and noise barriers' above are relevant.

Comparative acoustic effectiveness of bunds, barriers and depressing the vertical alignment

The Advisory Committee has put together the following table showing the relative effectiveness of the noise mitigation measures which could be deployed on the project area allowing for the Frontage Road scenario on abutting residential areas.

Table 8.3 L_{Amax} noise reductions for different mitigation measures within the rail corridor for the GAA Frontage Road scenario

Mitigation Measure	L _{Amax} (dB) reduction
At grade with a 4m barrier	12
At grade with a 2m barrier	7
1m cut (shallow batter)	0
2m cut (shallow batter)	5
2m cut + 1m bund (shallow batter)	8
2m cut + a 2m bund (shallow batter)	10
2m cut + 2m barrier (shallow batter)	11
4m cut (shallow batter)	9
4m cut + 2m bund (shallow batter)	13
4m cut (steep batter)	12
6m cut (shallow batter)	11
6m cut (steep batter)	15
8m cut (shallow batter)	12
8m cut (steep batter)	16

The content of the table was mainly derived from material provided by Dr Burgemeister both during and after the hearing upon our request.

The material provided by Dr Burgemeister after the hearing was on the acoustic performance of certain specified bunds and barriers. Advice was received on 14 November, 29 November and 2 December 2011. The later received predicted levels were inconsistent with those previously provided as Exhibit RRL57 at the hearing. When the Committee sought an explanation of the differences, RRLA's lawyers, Freehills, advised in writing that Dr Burgemeister had normalised the noise predictions to set the noise level at 200m across flat ground from an at grade track at 80 dB(A). No reflection adjustment had been included.

While this normalisation could not easily be cross-checked with any of the previous work on noise predictions, we have been able to use it to compare each case presented with the base case.

Table 8.3 sets out the result of our analysis of the material provided. The estimates of the acoustic performance of the specified mitigation measures have been calculated using the unmitigated noise prediction for the at grade reference level (91 dB(A)) at a distance of 50m (equivalent to the approximate distance of the nearest house for the GAA preferred scenario), and subtracting the predicted noise level with each measure in place at the same distance.

8.5 Conclusions and recommendations

It is concluded that:

- **Depressing the vertical alignment is one effective measure to mitigate operational train noise. It can be used alone or in combination with the other on-site mitigation measures of bunds, barriers and speed restrictions as required.**
- **Depressing the vertical alignment for reasons of noise mitigation alone would ordinarily be cost prohibitive.**
- **The noise mitigation benefits of depressing the vertical alignment should be a factor considered in any further review of that alignment..**
- **Further on-site noise mitigation measures for the various sections of the track can be drawn from the following as appropriate:**
 - **Earth bunds**
 - **Noise barriers**
 - **Combinations of barriers and earth bunds**
 - **Train speed restrictions.**
- **The provision of separation buffers between the project area and dwellings would not alone be a viable means of ensuring acceptable noise outcomes due to the loss of very large tracts of developable land which would result and the distancing of dwellings from the rail services.**
- **The Frontage Road development scenario proposed by the GAA, which places a road between the project area and housing lots, is an acoustically beneficial arrangement in areas adjacent to the project area. The other two housing layout scenarios may be appropriate in certain circumstances, such as within town centres, or where the developer wishes to minimise land take. They will require, however, major noise mitigation for the dwellings closest to the project area.**

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- **Whatever development arrangement is adopted, the row of lots closest to the railway should be developed first and in such a manner as they provide a noise barrier for housing further from the project area.**
 - **At some locations architectural treatments of dwellings will be required at an estimated cost of around \$17,500 per dwelling.**
 - **Should traffic noise from road traffic on the overpasses exceed the target limits proposed, the use of barriers can be expected to mitigate the impact.**

9. Implementation of operational noise mitigation

9.1 What are the issues?

The earlier chapters of this report have:

- Identified the need for quantitative standards for the control of operational noise from the project area and, in the case of train noise, recommended appropriate standards for dwellings in the form of external noise targets and internal noise limits.
- Identified deficiencies in the NIMR due to:
 - Incomplete validation of source noise levels for modelling
 - All noise sources from operations not being considered
 - Impact assessment being limited to that on existing dwellings
 - The matters of standards, impact assessment and adequacy of the NIMR not being subjected to peer review.
- Assessed the impact of noise levels predicted to result from train operations under the DNMP to be unacceptable.
- Provided information on possible noise mitigation measures that could be implemented to limit the impact of noise from operating trains

It is therefore evident that, in our view, further work is required to address the deficiencies in the NIMR identified previously and produce a Final Noise Impact Management Report (FNIMR). It is expected that the FNIMR will include descriptions of the additional noise mitigation measures to be included in the Final Noise Management Plan (FNMP) so that the impact of operational train noise is limited to an acceptable extent.

A major purpose of this chapter is to consider the process required to produce the FNIMR and the FNMP.

In addition, implementation of the FNMP needs to be considered so as to ensure its effectiveness.

The noise standards proposed recognise the fact that noise mitigation works will be required both on the project area and, for residual noise above the target external noise levels, to adjacent dwellings. As a result controls on specified housing also require consideration.

The issues considered in this chapter are therefore:

- The question of who should pay for noise mitigation
- The methodology to be applied in selecting appropriate noise mitigation measures

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- The process to be utilised to identify specific additional noise mitigation to be implemented including:
 - Noise prediction requirements
 - The application of noise mitigation selection criteria
 - The consideration of abutting land use
 - The implementation of the FNMP including responsibility for implementation of performance monitoring and quality control
 - The controls required on residential development.

9.2 Who should pay for noise mitigation?

A question that may have some bearing of the identification of additional noise mitigation measures is that of who should pay for such mitigation.

Lotus Oaks Pty Ltd provided a detailed submission on the provisions of the *Land Acquisition and Compensation Act 1986* and how those provisions would apply in the case of land acquired in for this project and submitted that:

- Any loss in value of land, including reduction in developable land, change in the use of land, change in market value due to perceptions of noise affection and any increase in development cost such as the need to provide noise mitigation, are compensable.
- For the Lotus Oaks land the cost of noise mitigation within the project area would be less than that of noise mitigation measures outside that area.
- It is misconceived to contemplate that the expenses and devaluation resulting from the acoustic impacts of RRL2 will not ultimately have to be borne in full by the acquiring authority and, accordingly the only responsible position is for the RRLA to minimise overall cost to the community by including acoustic protection as part of the project.

The submission made by Amex Corporation Pty Ltd raised as key questions:

If predicted noise levels exceed the appropriate standard, what is necessary to mitigate these levels? Where should such mitigation measures or treatments be located and who should bear the costs of these?⁷⁷

In answer to these questions Amex Corporation Pty Ltd submitted that:

If noise mitigation measures are to be provided outside the project area (for example architectural/building and other treatments to future dwellings), these requirements will not be at no cost to the public purse.

⁷⁷ Submission for Amex Corporation Pty Ltd, Regional Rail Link 2 Noise Advisory Committee, Para 14 (a)

In all cases of compulsory acquisitions, these additional requirements will form part of the compensation claims by individual landowners, following an analysis of the costings for such measures.⁷⁸

This position was supported by the submission for the Dennis Family Corporation (and related entities) and the Davis Family in which it was put:

With respect to mitigation measures that have no option but to be outside of the project area (for example, road frontages), although this is not preferred to noise barriers, the loss of value to this urban land would be considered as part of the compensation claim.⁷⁹

Walsh Building Services submitted that under the *Land Acquisition and Compensation Act 1986*:

... If the impact of noise as a consequence of the purpose for which part of an owner's land is compulsorily acquired results in a reduction in the value of the balance of the owner's land after acquisition, that reduction in value is fully compensable.⁸⁰

The RRLA submitted that the views expressed in submissions made by land developers presume that the loss attributable to disturbance is solely attributable to noise emissions and not from other factors and:

It is far from clear that the cost of noise mitigation will result in a commensurate reduction in the amount of compensation payable for injurious affection. It is submitted that the recommendations of this Committee should not commit the State to making large investments – such as in 6 metre noise barriers – on the basis of unsubstantiated assertions about compensation implications of RRL2⁸¹.

Having considered the submissions made in regard to the operation of the *Land Acquisition and Compensation Act 1986* and the provisions of the Act itself, it appears that where part of a lot is being acquired:

- Compensation is payable not only for the land acquired, but also for any injurious effect of the project for which the land was acquired upon the remaining land
- Any impact on the value of the land, the potential profit from the development of the land and additional costs in developing the land are all injurious effects and therefore compensable

⁷⁸ Submission for Amex Corporation Pty Ltd, Regional Rail Link 2 Noise Advisory Committee Para 64

⁷⁹ Submission for Dennis Family Corporation (+related entities) & Davis Family 11 Nov 2011, Para 73

⁸⁰ Submission for Walsh Building Services, Noise Impacts of Regional Rail Link Section 2 9 Nov 2011 Para 59

⁸¹ Regional Rail Link Authority – Reply at Hearing, Para 75, Page 12

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- If less money is spent on noise mitigation now by the RRLA, then any 'saving' to the State purse would be offset, or probably outweighed, by later additional compensation payments.

It would therefore seem that the State will necessarily have to either directly meet the costs of noise mitigation or alternatively the consequential additional compensation costs of not implementing noise mitigation.

The above situation only applies, of course, when land (potentially impacted by noise) is being partially acquired. It does not address the situation of how noise mitigation is to be paid for in the case of potentially noise affected lots and holdings for which no acquisition is proposed.

The information provided by the RRLA suggests that perhaps 99 per cent of potential residential land abutting the project area that will be subject to noise levels in excess of the target external noise levels comprises lots to be partially acquired for RRL2.

Since the proportion of the noise-affected land not subject to compensation arrangements is so small, we consider it appropriate to treat that land as if compensation were payable with the responsibility for mitigation also falling to the State.

In this respect we would comment that we believe that this outcome of State responsibility is not inappropriate.

There was some considerable discussion at the hearing of this issue of the responsibility for payment for mitigation (at least initially on the assumption that at least some costs may not have to be borne by the State). Some expressed the view that the equitable approach would be that if the train line proceeded ahead of urban development, the urban developers should fund mitigation; and the reverse should also apply – mitigation responsibility should lie with RRLA if urban development was in place ahead of the development of the rail line.

This 'agent of change' approach is not unknown when planning proposals are being considered. The approach is perhaps rather simplistic, however, in as much as it fails to consider where the broader costs and benefits of a proposal lie. More significantly, in the case of RRL2, we agree with the view of Mr Rob Milner, who was called to give expert planning evidence by Lotus Oaks Pty Ltd, that the circumstances are properly to be characterised as the railway and the housing areas developing concurrently.

While Mr Wren made submissions supporting the view that the RRLA should not have to accept financial responsibility for noise mitigation except in the case of existing houses on the basis that future housing should be

viewed as coming to the rail, we were not persuaded to this view. Consideration of the issue raised by Mr Wren, of whether the area is in Part A or Part B of the Urban Growth Zone, does not in our view detract from the fact that the area was designated for urban growth at the same time as the rail corridor was first reserved (via Amendment VC68). To the extent that it is an accurate claim, it is not to the point that none of the strategic and structure planning for the nearby land has been subject to public scrutiny. We were advised that the PSPs are well in hand and in our view the railway planning is only travelling marginally ahead of the planning of land use in the abutting areas.

Also, while it is clear that the land through which the new rail service will pass (and hence its developers and future owners) will be benefitted in terms of transport services (the more so the closer the land is to a new rail station), the State-wide rail system will also benefit significantly. As was described to us, the RRL project as a whole has three key outcomes: not only the provision of passenger services to the developing western suburbs, but it will afford the ability to move regional trains faster through the metropolitan area on their own tracks and consequently free-up the capacity of the metropolitan lines. The latter two benefits will be shared across all users of the State rail system.

9.3 Train Noise

9.3.1 Selection of noise mitigation measures

In light of the foregoing discussion on who should pay for noise mitigation measures it is clear that the selection of noise mitigation measures should be based primarily on cost effectiveness with due regard to acoustic outcomes. This can be expressed as the selection of practicable noise mitigation measures and the following discussion provides a methodology for determination of practicability.

Some guidance on the assessment of practicability is provided in *VicRoads Road Design Note RDN06-01, Interpretation and Application of VicRoads Traffic Noise Reduction Policy 2005* (VicRoads DN) and the IGANRIP.

The VicRoads DN suggests that practicability should be tested in a two stage process. The first stage is a test of feasibility which relates to engineering considerations and includes consideration of the effects of noise mitigation barriers in terms of:

- The cost of abatement
- The provision of required access including to roads and driveways and to noise barriers for maintenance
- Safety effects for motorists, construction workers, residents and the public

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- Topographic restrictions including road geometry, soil types, floodway and stormwater flow obstructions, and the presence of other structures
 - Structural matters including the need to be able to withstand additional weight and wind loads and the need for protection or relocation of underground services
 - Protection of the heritage values of properties
 - Maintenance including the cost of ongoing maintenance and the resources required to maintain abatement measures.

The VicRoads DN states that, if the risks associated with the feasibility factors cannot be mitigated, then the noise mitigation measure should be considered infeasible and its implementation rejected on that basis.

If the noise mitigation measure is found to be feasible, then its reasonableness must be tested in terms of the following:

- Noise abatement benefits, that is the extent of noise protection achieved
- Project approval, that date of public knowledge of the approval of the project
- Change in noise levels
- Opinions of impacted residents including opinions in regard to visual impact and the 'fit' with the existing land use
- Urban design objectives
- Environmental impacts including effects on the natural environment such as wildlife, ecology, disruption to water bodies and drainage patterns and the minimisation of noise during construction.

The IGANRIP does not use the term 'practicability' but provides the following definitions of feasibility and reasonableness:

'Feasibility' relates to engineering considerations and what can practically be built or modified, given the opportunities and constraints of a particular site.

'Reasonableness' relates to a judgement which takes into account the following factors:

- *noise-mitigation benefits – noise reduction provided, number of people protected*
- *cost of mitigation – total cost and cost variation with level of benefit provided*
- *community views*
- *aesthetic impacts*
- *noise levels for affected land uses – existing and future levels, and expected changes in noise levels*

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- *benefits arising from the development or its modification.*

The two definitions are similar but the IGANRIP definition places costs in the area of reasonableness whereas costs are included in the feasibility test applied under the VicRoads DN.

Assessing feasibility

We are of the view that the question of feasibility should be limited to what could be termed engineering feasibility involving questions of the following nature:

- Can it be built safely?
- Will it be of sufficient strength and last for an appropriate length of time?
- Is there sufficient room?
- Will it interfere with railway operation including matters of access and lines of sight?
- Can it be readily maintained?
- Will there be unacceptable impacts on the natural environment including drainage, stormwater flows and floristic and faunal values?
- Will there be unacceptable impacts on the built environment including pipelines and roads
- Will there be unacceptable impacts on built heritage and cultural heritage values?

Assessing reasonableness

Once it has been determined that a noise mitigation measure, or combination of measures, is feasible, the cost of its implementation and the benefit it produces need to be determined to enable its reasonableness to be assessed.

The first stage of the reasonableness test must be the question of whether the noise mitigation measure, or combination of measures, will result in a residual noise level at existing or future dwellings that are at or below the target external noise levels. While noise mitigation measures within the project area are preferred, because they protect both external and internal amenity, if such measures do not achieve the target external noise levels then it would be unreasonable to require both those on-site measures and architectural treatment of dwellings for a similar result to that of architectural treatments alone.

Given that the target external noise levels are achieved by the mitigation measure, or combination of measures, the reasonableness needs to be further tested by consideration of the following:

- The opinions of potentially impacted residents and land owners

- Urban design objectives
- Aesthetic impacts.

If the consideration of these factors does not provide a strong reason against implementation then the cost effectiveness needs to be tested.

Comparing cost effectiveness as part of the reasonableness test

The cost effectiveness of noise mitigation measures can be assessed by comparison of their cost with that of architectural treatment of dwellings to achieve the internal noise targets. It should be noted, however, that, since architectural treatments do not provide any protection of external amenity, the comparison of costs should not be made on a 1:1 basis because the results produced are not equivalent. We therefore propose the use of a multiplier to the cost of architectural treatments to provide the appropriate weighting toward the use of noise mitigation measures within the project area.

To illustrate this approach we have:

- Taken the costs discussed in the previous chapter and shown in the following table.

Table 9.1 - Noise mitigation costs for various measures based on a 15m wide house lot

Mitigation Measure	Approximate costs
1m bund	\$750/house lot
2 m bund	\$2,250/house lot
1m concrete barrier	\$9,000/house lot
2m concrete barrier	\$19,500/house lot
2m bund with 2m barrier	\$21,750/house lot
3m concrete barrier	\$29,250/house lot
4m barrier with occasional acrylic window	\$45,000/house lot
Architectural features	\$17,500/house lot

- Assumed the cost of lowering the grade line is zero because:
 - The reference design shows significant lengths along which the line is in cut
 - The preferred tenderer has already indicated further lengths at which the grade line will be below that of the reference design
 - A redesign taking into account other advantages of depressing the grade line can be expected to show further lengths where the cost of

additional lowering will be negligible and others where acceptable costs might be incurred.

- Assumed a project area width of 60 metres with the centre of the rails being on the centreline of the project area.
- Assumed the nearest dwelling is 25 metres from the boundary of the project area, which corresponds to the GAA's preferred 'Frontage Road' lot arrangement where a road abuts the project area.
- Assumed flat ground between the rail and the dwelling.
- Determined the noise reduction achieved by various mitigation measures by interpolation of data provided by Dr Burgemeister.

While the noise level at the nearest dwelling will vary along the length of the railway depending on the width of the project area, the height of the rail relative to the natural surface and the topography, on the assumptions listed above, the L_{Amax} noise level at the nearest dwelling (50 metres from the nearest rail) is estimated to be 91 dB.

Potential noise reductions by a variety of measures within the project area, chosen to meet the external L_{Amax} target of 80dB are shown in Table 9.2 below, along with the estimated costs.

Table 9.2 Noise reductions and costs of various mitigation measures with dwelling 25 metres from the project area boundary

Mitigation Measure	L _{Amax} reduction	Residual noise at house facade	Cost per 15m house lot
At grade with a 1 m bund with a 3 m barrier	≈11 dB	80	\$30,000
At grade with a 2m bund with a 2m barrier	11 dB	80	\$21,750
At grade with a 4m barrier	*12 dB	79	\$45,000
1m cut with a 1m bund and a 2m barrier	≈11 dB	80	\$20,250
1m cut with a 3m barrier	≈12 dB	79	\$30,000
1m cut with a 2m bund and a 1m barrier	≈11 dB	80	\$11,250
2m cut with a 2m barrier	*11 dB	80	\$19,500
2m cut with a 1.5 m bund and a 1m barrier	≈11 dB	80	\$10,500
2m cut with a 1 m bund and a 1.5m barrier	≈11 dB	80	\$15,500

Note: In the table the reduction values with an asterisk (*) are provided in advice from Dr Burgemeister. Other values with an approximately equal symbol (≈) are estimates by the Committee based on interpolations between the figures provided.

The costs of mitigation measures that do achieve the target noise level must then be compared with that of architectural treatment with the comparison weighted with a cost multiplier applied against architectural treatment

because it does not protect external amenity. The following table shows the cost comparison with a range of cost multipliers applied.

Table 9.3 Cost effectiveness of mitigation measures within the project area compared with architectural mitigation, using a range of multipliers, for the Frontage Road scenario

Mitigation Measure	Cost per 15m house lot	Cost effectiveness compared with architectural treatment (house with 15m frontage)		
		1.5 multiplier (\$26,250)	1.33 multiplier (\$23,333)	1.25 multiplier (\$22,875)
At grade with a 1 m bund with a 3 m barrier	\$30,000	NO	NO	NO
At grade with a 2m bund with a 2m barrier	\$21,750	YES	YES	YES
At grade with a 4m barrier	\$45,000	NO	NO	NO
1m cut with a 1m bund and a 2m barrier	\$20,250	YES	YES	YES
1m cut with a 3m barrier	\$30,000	NO	NO	NO
1m cut with a 2m bund and a 1m barrier	\$11,250	YES	YES	YES
2m cut and having a 2m barrier	\$19,500	YES	YES	YES
2m cut with a 1.5 m bund and a 1m barrier	\$10,500	YES	YES	YES
2m cut with a 1 m bund and a 1.5m barrier	\$15,500	YES	YES	YES

We note that using cost multipliers of 1.33 and 1.25 to test the sensitivity of the 1.5 value, the rail corridor mitigation measures that are cost effective do not alter.

For those parts of the rail corridor which are greater than 60m wide, it is likely that the Lmax noise level at the frontage road scenario will be less than 91 dB(A), and cheaper combinations of mitigation measures on the rail corridor will be available.

In order to change the assessments of any of the noise mitigation measures for the Frontage Road scenario, a cost multiplier of less than 1.25 would need to be applied and such a low value is not considered sufficient to reflect the value of the protection of external amenity. On this basis a cost multiplier of 1.5 is considered appropriate.

For the Rear Exposure scenario, where a noise reduction of 16 dB(A) is required (see Section 8.4.1 above), potential interpolated noise reductions for two measures within the rail corridor to meet this value at 21 m from the nearest rail are shown in Table 9.4 below, along with the estimated costs:

Table 9.4 L_{max} noise reductions for different mitigation measures within the project area for the Rear Exposure scenario

Mitigation Measure	L _{Amax} reduction	Estimated cost per 12m house lot*
depressing the grade line 4m (steep batter) with a 2m barrier	≈16 dB	\$15,600
depressing the grade line 2m with a 3m barrier	≈16 dB	\$27,000

Allowing the same architectural treatment cost per dwelling (which may be an over-estimation) and the 1.5 cost multiplier, only the combination above with a 4m cut with a steep batter and a 2m high noise barrier would meet the cost-effectiveness test. It is unlikely that cuts of this magnitude would be employed on noise mitigation grounds alone. Generally train noise at the Rear Exposure scenario cannot be brought into conformity with the target level for external noise by cost-effective measures on the project area.

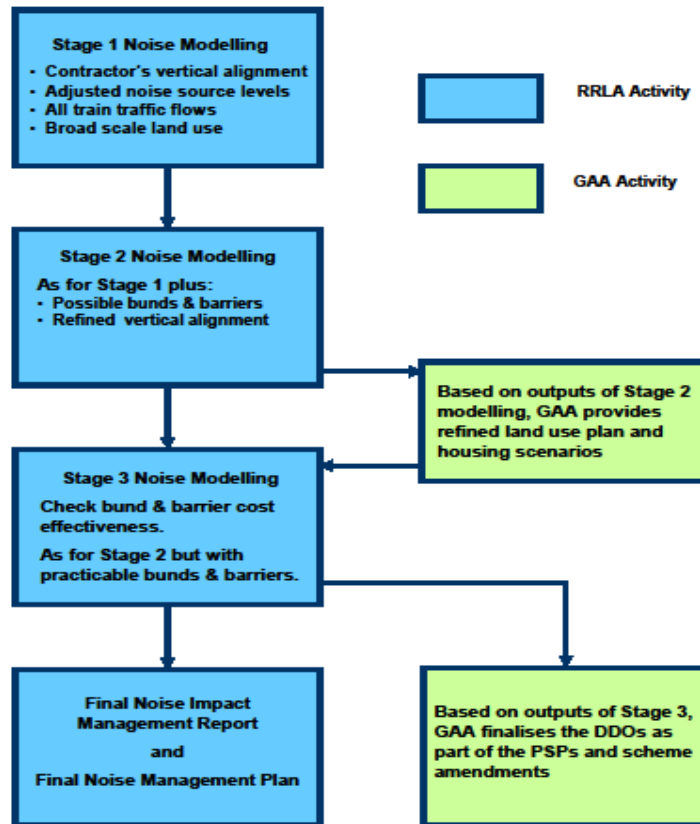
9.3.2 Overall process to produce the FNMP and the DDO.

The essential end products required include:

- The FNMP to be endorsed by the Minister for Planning with the implementation of that plan being a requirement of the construction and operation of railways and related infrastructure in the project area.
- A DDO with a design objective of ensuring development of dwellings near the project area is undertaken with appropriate noise attenuation measures to protect internal amenity and encouraging housing arrangements whereby the first row of dwellings along the railway provides effective acoustic buffering for those further away.

The overall process to produce these products that we envisage is illustrated in Figure 3 below.

Figure 3 Overall process to FNMP and DDO (Source: Advisory Committee)



Detailed explanations of the each of the activities included in the diagram above are provided in the report sections that follow.

9.3.3 The process for identification of additional noise mitigation measures

The previous chapter of this report identified lowering of the grade line, noise barriers, noise bunds and train speed as viable additional noise mitigation measures that might be taken on the project area to reduce noise levels at dwellings to that which would produce an acceptable impact. The following process description relates to the review of the grade line recommended in Section 8.5, and the use of bunds/barriers because determination of the applicability and need for speed restrictions at an early stage is less critical than it is for bunds/barriers and grade alteration..

Noise modelling: Stage 1

It will be noted from the flow diagram in Figure 3 above that the process envisaged is one in which noise modelling to produce predictions and inform the selection of bunds/barriers is required at three stages. The modelling required in the first stage is aimed at providing the starting point for the identification of practicable bunds/barriers and requires the inputs for the modelling described in the NIMR for Phase 4 in 2030 except that:

- The horizontal and vertical alignment in the design developed by the design and construct contractor should be used instead of the reference design. This new alignment is expected to have been optimised from an engineering perspective and in particular will have taken into account cut and fill balance on either side of the Werribee River.
- Best available estimates of all train traffic flows within the project area up to 2030 should be used, including metropolitan services, freight services and Avalon Airport services in addition to regional passenger services
- The L_{Amax} source noise levels for all trains should be 2 dB greater than that used previously unless further justification of the source noise levels is provided.

All noise level predictions in this and subsequent stages must include a façade reflection correction of +2.5 dB(A).

The modelling should be used to predict, at least, the L_{Amax} at the project area boundary, and at 25 and 60 metres from that boundary for the lengths of the project area that are shown in Figure 2 to be residential or proposed for residential development. These three distances correspond to the location of the closest façades for Continuous Apartments, the Frontage Road housing and the second row houses behind the Frontage Road respectively, and will allow the appreciation of the degree to which potential shielding by the frontage road housing might apply to the second row of houses.

Noise modelling Stage 2

The data provided by the stage 1 noise modelling together with the data contained in Tables 8.3 and 9.2 can be used to identify areas where a L_{Amax} of 80 dB will be exceeded even with bunds/barriers. The tables show that the reduction in noise level provided by a 4 metre barrier is 12 dB(A). Since barriers of greater height than 4 metres are not considered appropriate, a predicted L_{Amax} noise level of 92 dB or greater at 25 metres from the project area means that the provision of barriers to protect a dwelling located according to the Frontage Road option would not be an option.

It would be possible to determine the locations at which bunds/barriers of lesser heights may be used. For example, if the predicted L_{Amax} at a location 25 metres from the project area is 86 dB or less due the track being in a cut of 2m or greater, a 2 metre high bund/barrier giving a 6 dB reduction might be a means of reducing the noise to L_{Amax} of 80 dB or less.

At this stage a further review of the vertical alignment could also be undertaken to identify opportunities for lowering the height of the rail as suggested in Chapter 8 of this report.

The Stage 2 noise modelling would then be required with the same inputs as in the Stage 1 noise modelling but with the addition of bunds/barriers that may be practicable (and any changed vertical alignment).

The results of this modelling together with a plan showing the locations where bunds and barriers may be practicable and cost effective could then be provided to the GAA.

Noise modelling Stage 3

The practicability of barriers and bunds is also dependent on their cost relative to that of architectural treatments of the dwellings to meet the internal noise limits in the standard.

The identification of locations where bunds and barriers might be practicable, as described above, assumes that all land abutting the project area that has been designated for residential use will in fact be used for dwellings.⁸² This is clearly not the case as, in the development of the PSPs, the GAA are already attempting to locate non-residential uses on the land abutting the project area.

The precise locations of dwellings within each PSP will not be finalised until the PSPs are adopted. We understand, however, that such matters are currently the subject of discussions led by the GAA and that in some cases those discussions are at an advanced stage. The information provided to the GAA as described above, that is the output of the Stage 2 modelling, could then be used to inform further consideration by the GAA, in consultation with the municipalities and the land owners and developers of the use, of the land abutting the project area.

The GAA will be required to provide the RRLA with a statement of known and likely sites for dwellings on land abutting the project area.

⁸² As we understand it perhaps 50 per cent of the length of the project area boundary (both sides considered) may be abutted by residential development areas.

The GAA will need to be able to complete this task within a timeframe which would not unreasonably delay further steps to be taken to implement the rail project. This may mean that decisions on dwelling siting are somewhat provisional in some instances and may be subject to later change in the final PSPs. This would mean that bunds or barriers may be built where they are not required or architectural treatment of more dwellings than is necessary will be required. While we recognise that neither of these consequences is ideal, we do not believe that they will be extensive. The only alternative available would be to delay the selection of bunds and barriers and hence the commencement of construction until the PSPs are finalised. We do not believe such a delay would be acceptable.

The more detailed information on land use provided by the GAA would then be an input to the Stage 3 modelling. It would be used to make estimates of the number of dwellings at which each possible bund or barrier would result in a L_{Amax} of less than 80 dB thus enabling the cost of the bund or barrier to be determined on cost per dwelling basis.

As discussed previously bunds/barriers for which the cost per dwelling is less than \$26,400 should be considered practicable and therefore constructed. The value of \$26,400 is based on an estimated cost of the architectural treatment of a dwelling of \$17,600 and should be used unless a clear justification is provided for a different cost.

This process is expected to result in the elimination or reduction in length of some bund/barriers due to the abutting land being used for something other than dwellings. Off-setting this is the requirement that bunds and barriers will need to be somewhat longer than the area to be protected because noise is propagated at greater than right angles to the receiver.

Noise modelling will then be required with the inclusion of practicable bunds and barriers to produce predictions of the locations of the 80, 60 and 55 dB contours for L_{Amax} , $L_{Aeq15h(day)}$ and $L_{Aeq9h(night)}$ respectively.

These noise predictions will then be provided to the GAA to enable definition of the area to which the DDO will be required. The DDO is discussed at Section 9.8.1 below.

Final Noise Impact Management Report

Some of the requirements of the FNIMR relating to railway noise are detailed in Chapter 7 of this report, in particular the need for an assessment of the impacts of such noise. The predictions obtained in the last modelling stage described above will provide the basis for that assessment.

The FNIMR also needs to record the details of the work completed in determining the practicable bunds and barriers and to recommend the inclusion of those bunds and barriers in the FNMP.

Final Noise Management Plan

The limited noise mitigation measures aimed at railway noise that are included in the DNMP have been discussed previously. The DNMP was prepared on the basis of 'qualitative standards' being applied to the design and operation of RRL2 which made the plan a very simple one. It was made even simpler by the fact that the one area of operation for which quantitative standards were proposed, stations was ignored as were what we consider to be further elements of the project such as certain other aspects of railway infrastructure, warning horns and road traffic overpasses.

The critical conclusion is that after the application of measures included in the DNMP, the residual noise would create what is considered to be an unacceptable impact. The task therefore in preparing the FNMP is to include additional noise mitigation measures to reduce the impact of train noise to an acceptable level. In the main the additional measures will be in the form of practicable bunds and barriers identified by the process described above. There are, however, a number of other aspects to be considered including horn noise, performance monitoring and responsibility for implementation. Performance monitoring and responsibility for implementation are discussed later.

It will be noted that, in Chapter 7, it is recommended that, for the FNIMR, the impact of all noise from operating trains, including horn noise, should be assessed. If this assessment leads to the identification of measures to reduce the impact of horn noise then any such measures should be included in the FNMP as requirements.

9.4 Railway infrastructure

The DNMP makes no reference to the control of noise from railway infrastructure. Submissions related to the need to consider impacts of this kind. It is our view that the FNMP should include requirements for the control of such noise.

The FNMP should include a requirement for noise from railway infrastructure sites to comply with specified standards set for such noise (based on the derived standards from SEPP N-1).

Also, in Chapter 7, it is recommended that the FNIMR include predictions of noise levels at dwellings resulting from the noise generated in the operation of railway infrastructure and an assessment of the impact of such noise. This

may lead to the identification of noise mitigation measures required to be applied at railway infrastructure sites and such measures should also be included in the FNMP as requirements.

9.5 Road traffic noise

The DNMP makes no reference to the control of noise from road traffic.

It will be noted that, in Chapter 7, it is recommended that, for the FNIMR, the impact of road traffic noise should be assessed. This assessment should be undertaken in such a way that the road traffic volume at which the target road traffic noise level could be expected to be exceeded. If the road traffic volume can realistically be expected to be reached, then the mitigation requirements should be determined and included in the FNMP as a requirement.

At an absolute minimum the FNMP should include a note that there is a requirement that noise from road traffic noise increasing as a result of the elevation of vehicles travelling on overpasses should be limited to the road traffic target noise level where practicable.

9.6 Performance monitoring

The DNMP makes no reference to the monitoring of operational noise and it was Mr Burgemeister's evidence that such monitoring is not common. Despite this we see a significant need for performance monitoring for three reasons:

- While noise level predictions will be based on the best available input information and modelling techniques, the only real test of actual noise levels resulting from railway operations in the project area is by measurement
- The maintenance of wheels and tracks is a critical noise mitigation measure and, since the effectiveness of this measure is dependent on operator diligence, it is essential that any lack of diligence that results in an increase in noise levels is detected to trigger rectification
- The need exists to assure members of the community that the noise levels they are being subjected to are in line with what is required of the railway

The monitoring program, the implementation of which should be included in the FNMP, should include the following aspects:

- Measurement of LAeq15h(day), LAeq9h(night) and LAm_{ax} in such a way that results can be compared with modelling predictions based on actual train numbers, train speed and train length
- At dwellings in the vicinity of railway infrastructure:

-
- Measurement of background noise levels in accordance with the SEPP N-1 methodology to establish SEPP N-1 noise limits
 - Measurement of noise levels at dwellings during the 'day', 'evening' and 'night' as defined in SEPP N-1
 - Measurement of the road traffic noise level at housing along the railway overpasses if it is thought that the adopted criteria might be met, using the procedures prescribed in Appendix C to VicRoads DN.

The initial design of the monitoring program should be completed by the acoustic specialist preparing the FNIMR and should include, at least, specification of the following:

- The frequency of monitoring
- Measurement procedures including equipment to be used
- The data to be recorded
- Reporting procedures which should include:
 - Immediate reporting of any exceedance of limits to the relevant municipal authority
 - Regular reporting of all monitoring results by an acoustic specialist to the Minister for Planning and municipal authorities
 - Reporting of monitoring results to the community in a suitable form to the satisfaction of the municipal authorities

To provide assurance of the integrity of the monitoring program the implementation of the program should be audited, at least annually, by a suitably qualified independent acoustic specialist with audit reports being provided to the Minister for Planning, the municipalities and the community.

Modifications to the monitoring program, such as changes to monitoring frequency and locations, may be proposed at any time by submission of a proposal for modification prepared by a suitably qualified acoustic specialist to the Minister for Planning.

Since one of the purposes of the monitoring program is to detect non-compliance with noise limits and excessive noise levels, it is appropriate that plans for action in the event of such detections are developed as part of the preparation of the FNIMR and included in the FNMP as requirements.

9.7 Responsibility for implementation of the FNMP

In addition to the information provided by the RRLA on 'ownership' of the land within the project area the RRLA also made reference to the planning controls contained in the Incorporated Document of the Melton and Wyndham planning schemes noting that the development and use must be undertaken in general accordance with a Development Plan that:

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- Incorporates an Environmental Management Plan
 - Must be consistent with, *inter alia*, any noise impact management plan required by the Minister for Planning
 - May be prepared and approved in stages.

The RRLA submitted that the noise impact management plan referred to in the Incorporated Document is in fact the FNMP and that, in the future, additional infrastructure could be added to what is currently considered the RRL2 project, by amendment of the Development Plan. The approval of any amendment to the new noise impact management plan would be by the Minister for Planning.

We are of the view that the FNMP should be a plan for the management of all noise from the project area and not be limited to noise from regional passenger train services and infrastructure directly associated with such services. The reasons for our view are as follows:

- Our assessment of the noise impacts indicate that the most significant impacts are principally caused by ongoing railway operations and it is ordinary households in the residential areas closest to the project area that will be impacted. Use of the project area by other train services does not change either of these considerations.
- With few exceptions, the householders impacted by noise from the project area will not distinguish between the noise of regional passenger trains and that from any other trains using the line: their expectations and perceptions will relate to all trains operating in the project area, irrespective of the service those trains are providing.
- The Incorporated Document of the planning schemes, while it by condition limits the use and development of the project area to activities for Section 2 of the Regional Rail Link Project or activities ancillary to or undertaken in conjunction with that project, is structured in such a way that other railway activities which could alter the acoustic regime might be authorised as falling within that ambit without further noise assessment.

It is clear that responsibility for implementation of the FNMP during the approval, design and construction stage lies with the RRLA albeit it expected that the RRLA will pass many of the duties that must be fulfilled to its engineering consultants, acoustic consultants and construction contractors.

We note that upon completion of construction the RRLA will cease to exist and ownership and/or control of the land in the project area will pass to VicTrack. The land required for regional passenger rail tracks and infrastructure will then be leased to the Director of Public Transport by

incorporation in the Regional Infrastructure Lease-Head Lease and then to V/Line under the Regional Infrastructure Lease-Sub Lease.

We understand that in this process on-going responsibility for implementation of the FNMP as far as regional passenger rail is concerned will be passed to V/Line with a requirement to implement the plan being a condition of the lease.

Such arrangements would appear to be satisfactory if the use of the project area was limited to regional passenger rail services operated by V/Line alone.

In this respect it is noted, however, that, while the Incorporated Document of the planning schemes restricts exempt uses and developments on the project area to those for, or in conjunction with, RRL2:

- The operative provision of the Incorporated Document relates to the use of the land and there is no reference to regional rail passenger services. The main exemption reads:

Despite any provision to the contrary or any inconsistent provision in the Planning Schemes, no planning permit is required for, and nothing in the Planning Schemes operates to prohibit or restrict:

- *The use or development of the Section 2 Project Land for:*
 - *A passenger and freight railway, which includes but is not limited to railway stations (including community uses and the selling of food, drinks and other convenience goods and services), transport interchanges, car parking facilities, utility infrastructure, signalling, communications and electrical infrastructure, train stabling and maintenance facilities and storage facilities.⁸³... (our emphasis)*
- The condition imposed on the use and development at Paragraph 5 of the document would apparently allow other passenger and freight railways to also use the project area if authorised to be part of the Section 2 project by the Victorian Government.
- 'The project' as a whole is described at Paragraph 2 of the document only in general terms – merely as 'a railway connection' between west of Werribee and Southern Cross Station⁸⁴

We have earlier said in Chapter 3 that we think that the scope of the project as even now envisaged goes beyond the mere provision of regional rail passenger services.

⁸³ Regional Rail Link Section 2 Incorporated Document , June 2011 Sec 4

⁸⁴ Regional Rail Link Section 2 Incorporated Document , June 2011 Sec 2

Use of the project area by another Accredited Rail Operator, by freight trains and possibly by Avalon Airport trains would most likely involve the use of the tracks and other infrastructure leased to V/Line. In such circumstances V/Line's responsibility for implementation of the FNMP would be unchanged and would require agreements between V/Line and other users to ensure compliance. In the case of the use of the project area for metropolitan services, and possibly for the other uses, new tracks and infrastructure would be required and separately leased to an Accredited Rail Operator other than V/Line. It would seem possible, and indeed likely, that more than one rail operator could be using the project area with different rules and requirements applying to them. Such a situation could well lead to operational conflicts and, relevant to the issue at hand, could also lead to enforcement difficulties if noise standards were breached. In our view it is desirable that such a situation be avoided.

In this respect it should be noted that the only party with continuing responsibility for the entire project area is VicTrack. As a result, we believe that ultimate responsibility for the implementation of the FNMP should be given to that organisation. VicTrack may elect to take some action itself to implement the FNMP. In all likelihood, however, implementation will at least in part be effected by including a condition in the lease granted to the Director of Public Transport that requires that implementation of the FNMP that is in turn a condition of any sub-lease granted to an Accredited Rail Operator.

Future changes to usage and to the FNMP

It is also noted that, in reference to the plans required by the condition of paragraph 5 of the Incorporated Document that the required Development Plan for the use and development must be generally in accordance with 'any noise impact management plan required by the Minister for Planning' and that both plans:

... may be prepared and approved for stages of Section 2 of the Project and may be amended from time to time to the satisfaction of the relevant approval authority.⁸⁵

The possibility therefore exists not only for amendments to the FNMP but other noise impact management plan or plans may be produced and implemented, subject to the approval of the Minister for Planning.

For reasons of simplicity, clarity, transparency, and thus minimisation of disputes and effective enforcement, we suggest that more than one noise management plan for the project area would be undesirable. We suggest that

⁸⁵ Regional Rail Link Section 2 Incorporated Document , June 2011 Sec 5
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any changes in circumstances requiring changes in the measures to be implemented can be adequately handled by amendment to the one plan rather than by creation of a potentially conflicting plan.

We also believe that amendments to the plan should be limited to changes in the way the noise standards in the plan are met rather than allowing changes to those standards. The plan should be for management of impacts of noise from all railway operations and railway-related infrastructure within the project area. We do not believe our recommendations in relation to appropriate noise standards would be altered by the purpose of the trains using the project area.

In our view, the mechanism for amendments to the noise impact management plan should include a requirement for a report by a suitably qualified acoustic specialist detailing the reason for the proposed change(s), an assessment of the resultant change in noise impacts and the need for and nature of further noise mitigation measures. Such a report should be accompanied by a report on a peer review conducted by an independent suitably qualified acoustic expert.

It is our view that the Incorporated Document should be amended to clarify:

- The full extent of the railway uses permissible and remove the uncertainty caused by the condition 'must be for Section 2 of the Project' when 'the Project' is only generally described
- That there is to be only one noise management plan
- That the noise management plan may be modified with the approval of the Minister for Planning and such approval will not be given if the modification involves an increase to the noise standards
- That request for approval of changes to the plan must include a report by suitably qualified acoustic consultant detailing the changes proposed, the reason for the changes and an assessment of any resultant change in impacts and be accompanied by a report on a peer review.

9.8 Noise mitigation at dwellings

The evidence, submissions and our consideration of the options available for the application of planning or architectural controls are detailed in Chapter 8 of this report. The point with specific relevance to implementation is the need for a planning mechanism to ensure that the required architectural treatments are applied to dwellings at which the target external noise levels cannot be met by practicable means on the project area.

Other submissions made included the following:

- The GAA advised that PSP preparation is well underway with seven of the 10 PSPs for areas of the Urban Growth Zone (UGZ) abutting the

project area being expected to be completed in 2012, two in 2013 and one in 2014; and that the approach already being adopted in the PSPs includes:

- Minimisation of residential use of land abutting the project area by location of non-residential uses on such land.
- Adoption of the 'Frontage Road approach' as the preferred subdivision/road layout where dwelling use of land adjacent to the project area is unavoidable.
- The draft Growth Corridor Plans – Managing Melbourne's Growth, which includes the Melbourne West Growth Corridor Plan, was published on the 9 November 2011. This plan shows current and future land use on land abutting the project area but the GAA noted that the published plan may be subject to changes resulting from an extensive consultation and review project.
- The GAA also provided an outline of a possible DDO (the DDO Outline) to require noise mitigation by architectural means and building layout if required.
- Lend Lease submitted that the RRLA should be required to provide a proposal for noise mitigation treatment for land owned by Lend Lease that would contain a flexible approach allowing maximisation of land development and best amenity outcomes.
- Lotus Oaks Pty Ltd submitted that it is unfortunate that the hearing was not part of a much earlier consideration of affordability and equity, the financial costs of ameliorating impacts and to enable a best fit solution to be developed.
- The RRLA submitted that restricting the DDO to the location of proposed residential allotments that have frontage to the project area would be a proportional planning response and minimise concerns regarding marketability while ensuring reasonable amenity to occupants.

As discussed previously, the location of buildings and facilities other than dwellings on land abutting the project area during the preparation of PSPs, an approach already adopted by the GAA, will reduce the number of dwellings that require architectural treatment to meet the internal noise limits.

It is understood that the development of a PSP involves input from the GAA, the municipal council, the land developer(s) and the community in general. In this case it is apparent that the RRLA also needs to provide input and to be a party to negotiations that will occur in the development of the PSPs for land abutting the project area. An important aim of such negotiations should be the cost effective provision of housing which will require noise mitigation costs to be minimised by the selection of the most appropriate measures.

While much can and needs to be done during the development of the PSPs, the need will remain for design and development controls on residential development and we are of the view that the most appropriate way of applying such controls is by a DDO.

While the Wyndham City Council submission preferred a new overlay to be developed akin to the Airport Environs Overlay, we believe that it would be less suitable. Aircraft noise is propagated downwards – no house shields another. With the horizontal propagation of noise from the railway, noise shielding effects by first row housing can be expected and should be accommodated by the planning control.

9.8.1 The form of the DDO

Some time was spent at the hearing discussing what matters might be included in the DDO for adjoining areas and the principles upon which it should be based.

The DDO Outline provided by the GAA included the following:

- The design objective of ensuring that development of land near the project area includes appropriate noise mitigation measures to minimise the impact of noise on noise sensitive areas.
- Specification of circumstances where:
 - A permit is not required for building and works associated with a noise sensitive use specified in terms of the mitigation measures required; and
 - A permit is not required for a subdivision being where certain setbacks from the project area are provided or certain mitigation measures are taken.
- Specification of noise levels that must be met for a building or subdivision in order for a permit to be granted if one is required.
- The application requirements including an acoustic assessment by and acoustic specialist demonstrating how the desired noise levels will be met.
- Decision guidelines including whether:
 - Appropriate standards are taken into account;
 - The development has been sited to reduce potential noise intrusion; and
 - The development can take advantage of natural noise attenuation features.

We make the following comments about the DDO outline.

Description of the affected area

The design objective in the DDO Outline describes the subject land as that 'near the future alignment of the Regional Rail Link'. We consider this description lacks definition as the future alignment of the Regional Rail Link it is open to interpretation in that:

- It could mean the location of the tracks or the project area; and
- It may or may not be include stations and stabling yards.

We believe that what was intended by the GAA was land adjacent to the project area. We favour definition of the land by reference to the area designated as the project area for Regional Rail Link Section 2 under section 59 of the *Major Transport Projects Facilitation Act 2009* on the 14 July 2011.

This is nevertheless not a major issue given the DDO boundary would be shown on the planning scheme maps. The boundary of the DDO would be defined by the outer edge of those planned housing areas on either side of the project area, where residual noise levels of 80 dB L_{Amax} would be predicted to occur by the further modelling and consultation process we recommend is required to identify effective and practicable noise barriers to be located on the project area.

Internal noise: performance measures v specified treatments

We also note that the DDO outline suggests that exemptions from requirements for permits for building and works would apply to dwellings (and other sensitive uses) if particular noise attenuation measures are included or that a restriction on title requiring implementation of those measures exists.

We do not believe that such an approach can or should be taken for following reasons:

- While it would be possible to establish the effectiveness of architectural measures in reducing noise levels between external and internal locations, the magnitude of the reduction required varies from building to building depending on a range of factors including the railway noise level, the building design and building orientation.
- We believe that, where possible, performance based controls should be applied and, in this case, the target external noise level, the internal noise limits and the requirement for the RRLA to produce predictions of residual noise levels and specifications of architectural treatments required, makes performance based controls possible.

We believe that the exemption in Clause 2 of the DDO Outline is best drafted in terms of compliance with the external noise targets only.

A consequence of applying an exemption specified in this manner is that acoustic assessment would need to be made in the case of each dwelling to establish whether or not a permit exemption applies. We cannot see any means by which a requirement for an acoustic report by an applicant and an assessment of that report by the responsible authority can be avoided - unless the meeting of the noise standard (allowing the permit exemption) was expressed as 'to the satisfaction of the responsible authority'. This might allow the GAA or Councils to be satisfied that the noise standard will be met without requiring an acoustic report. This might apply, for example, in the case of housing development some rows behind first row 'barrier' housing which has already been developed and/or where earlier acoustic reports have been undertaken. Whether this approach of having a discretionary trigger for a permit meets statutory requirements is something which would have to be considered.

We would also say, in relation to a concern about this resulting in very large numbers of acoustic reports for dwellings having to be prepared and assessed, that the area of application of the DDO is likely to be much reduced after the remodelling of residual noise would be undertaken as recommended Section 9.3.2 above. The remodelling that we have recommended would include additional inputs of other noise types and additional train traffic. This may result in an initial output of an even larger area and potentially more dwellings affected by unacceptable external noise levels. Bunds and barriers would also be applied in the later stages of the modelling, however, and we believe that the actual numbers of future dwellings affected by the residual noise at an unacceptable level is likely to be considerably more modest than current information would suggest. This is for two reasons:

- On-site mitigation works will have been adopted to the extent assessed as reasonable and feasible substantially reducing the noise affected area
- Parts of the residential frontage to the project area will have been allocated to other land uses.

Setback exemptions for subdivision

Our third observation relates to the suggested provision in the DDO Outline for exemptions from requirements for permits for subdivision of land, providing a frontage road reserve or a tree reserve of a particular width is provided between lots and the project area or particular noise attenuation measures are taken.

As we have earlier indicated, increasing separation distances between the project area and dwellings will not result in compliance with target external noise levels unless the separation distance becomes much greater than that provided by a frontage road or what might be considered a reasonable width

for a tree reserve. It was universally accepted by all parties to the Committee hearing that separation buffers of sufficient size to result in compliance with target external noise levels would result in an unacceptable cost given the large loss of developable land. The separation distance assumed when the DDO Outline was prepared would likely have been the 63m included in Mr Huybregt's evidence, which we have indicated was an underestimation of the area affected by the unacceptable noise levels. Nevertheless the setback exemption may become possible if the remodelling of the rail noise from an optimised vertical alignment with practicable bunds and barriers added results in a much reduced area of required application for the DDO.

More generally we would say that a setback approach is one which needs to be adopted early in the process for developing mitigation measures for the railway noise. We have suggested above that there should be consultation between the GAA and the land developer(s) to determine the land use arrangements along the track as an input to the modelling of noise. Setbacks are best considered at that stage of the implementation process and would be determined having regard to other suitable uses which might be made of the setback areas.

In light of the above, and the fact that the controls on buildings and works that are proposed are sufficient to achieve the desired result, we are of the view that the suggested provisions related to subdivision of land should not be included in the DDO.

Permit requirements

Clause 3 of the DDO Outline then imposes requirements on any permission which might be granted in situations where the condition(s) for exemption from permission in Clause 2 are not met.

If the Clause 2 exemption is limited to circumstances where external noise targets are met, Clause 3 could then sensibly apply a permit requirement to meet the internal noise limits. Again an acoustic report would be required to be prepared and assessed and the application requirements at Clause 4 should address this.

In this clause of the DDO provision might be made for a restriction or an agreement on title enabling deferred provision.

We would observe, however, while the permit requirement in the proposed DDO schedule is expressed as mandatory, the provisions of the DDO head clause at Clause 43.02-2 would negate the mandatory effect. This can and should be overcome by adding a further provision to the schedule to the effect that a permit cannot be granted for a dwelling not in accordance with the requirement.

Decision guidelines

The decision guidelines in the DDO should include a more comprehensive list of considerations when permits are required, including whether reasonable efforts have been taken to site and orientate the dwelling so as to provide some acoustic shielding from the railway noise for external areas and bedrooms, the absolute level of external noise applying, the shielding effects of nearby buildings.

The alternative of a lesser area for the DDO

An alternative approach to all of this would be to apply the DDO only to the first row of housing along the project area as suggested by RRLA. This would positively respond to some submitters' concerns about the effect on land values of placing land in a 'noise affected area'.

We accept that the shielding provided by the first row of dwellings would normally be sufficient to result in noise levels below the target external noise levels at the second row of houses provided the first row comprised attached dwellings, an apartment building or closely situated detached dwellings.

The problems associated with applying the DDO only to the first row of housing are that:

- There is no guarantee that the row of dwellings closest to the project area will be built first though this might be required by PSP provisions or the DDO itself (either as a permit exemption or as a permit requirement).
- The shielding provided by the first row of houses is by no means uniform as it depends on the relative heights of the railway and the dwellings and the form of the dwellings particularly in terms of the gaps between the dwellings. There is also the issue of the less effective shielding towards the ends of rows to be accounted for. These factors make it extremely difficult if not impossible to satisfactorily define an area where acoustic shielding by first row housing to the extent required to meet the standards would occur. It would in our view be therefore impossible to satisfactorily define a more limited DDO area relating only to first row housing and poorly shielded areas.

Other DDO issues

The Committee makes two further comments in relation to the DDO:

- It was said at the hearing that a savvy developer would voluntarily adopt the approach of developing the row of housing closest to the rail line first as it would reduce the need for acoustic treatment at other dwellings. Hence it was said that this matter does not need to be dealt with in the DDO. We agree with that view point. The role of the first row housing in

the DDO therefore should be confined to being included as a decision guideline.

- The DDO will of course only be effective in relation to new dwellings (or lots). Treatment of existing dwellings will have to be managed by offers by RRLA to existing householders.

9.8.2 Paying for architectural treatments

In as much as architectural acoustic measures will need to be applied to some dwellings whether through the application of the DDO to new dwellings or to existing dwellings, the FNMP will also need to include requirements for the RRLA and/or subsequent managers of the activity within the project area to meet the cost of both the design and installation of those architectural treatments.

For existing dwellings it will be necessary for the RRLA to commission a suitably qualified acoustic specialist to determine the architectural treatments required to meet the internal noise limits at each dwelling where the noise levels outside are predicted to exceed the target external noise levels, and obtain quotations for those treatments. The RRLA will then need to make offers to the owners of the dwellings to have the treatments completed by an organisation contracted by the RRLA; or offer to meet the owner's costs for the works if the owner instead arranges for the work to be done (up to the RRLA's own cost estimate). Since this process requires successful negotiations with the owners and the success of such negotiations cannot be guaranteed, provisions for mediation and, if required, arbitration by the relevant municipal authority will be required.

The cost of architectural treatments for new dwellings may form part of the compensation outcomes in relation to land along the project area. This approach has the difficulty that determination of the cost of architectural treatments on future dwellings may not be clear at the time compensation is considered. What is required in the way of mitigating works will likely need to await a definite proposal for construction of a dwelling at which stage the architectural treatment required and its cost can be determined by a suitably qualified acoustic specialist retained by the RRLA or its successor as the manager of the project. As with existing dwellings an agreement between the RRLA, or its successor, and the property owner as to the installation of the architectural treatments will then be required and provision will need to be made for mediation and arbitration by the relevant municipal authority.

These arrangements would need to be included in the FNMP or put in place by a form of agreement with landowners.

9.9 Conclusions and recommendations

It is concluded that:

- For 99 per cent of the land affected by noise from the project area, the State will be required to meet the cost of all noise mitigation whether that will be by payment for actual mitigation works or as compensation for the impacts of noise. As a result the selection of appropriate noise mitigation measures can and should be made on the basis of cost effectiveness.
- For the purpose of selecting appropriate noise mitigation measures, all land affected by noise, including that which is not subject to acquisition procedures associated with this project, should be treated as if all costs are borne by the State.
- The Noise Impact Management Report does not satisfy the conditions placed on the decision by the Minister for Planning that an EES was not required for Regional Rail Link Section 2 because it does not identify other feasible noise mitigation measures or assess their cost effectiveness
- Possible noise mitigation measures can and should be assessed on the basis of practicability involving the assessment of feasibility and reasonableness with feasibility being an engineering assessment and reasonableness being determined on the basis of cost and acoustic benefit.
- All options for noise mitigation should be considered but only practicable noise mitigation measures should be taken.
- Assessment of practicability requires a number of stages of noise modelling to inform decisions on use of land abutting the project area with such decisions being used for subsequent modelling and identification of practicable noise mitigation measures.
- Noise mitigation measures that do not result in noise levels below the target external noise levels, and those for which the cost per dwelling protected is greater than 1.5 times the cost of architectural treatments on the dwelling to meet the internal noise limits, should not be considered practicable.
- It is not cost effective to employ a mixture of mitigation measures on the project area and control of internal noise through a scheme provision such as a DDO. The scheme provision should only be used when mitigation measures on the project area are not practical or cost effective.

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- **Actual noise levels need to be monitored to measure performance, trigger additional action and inform the relevant authorities and community members**
 - **Responsibility for the implementation of the Final Noise Management Plan should be assigned to the Regional Rail Link Authority until the completion of construction and then be passed to the Victorian Rail Corporation.**
 - **The Incorporated document in the Wyndham and Melton planning schemes requires amendment to clarify permissible uses, specify a single noise management plan and provide clear provisions on allowable modifications to the plan.**
 - **A Design and Development Overlay is the most appropriate means of ensuring that where residual noise levels exceed 80 dB LAmax, residential development includes noise mitigation at dwellings required to achieve compliance with internal noise limits.**

It is recommended that:

- **The Regional Rail Link Authority be required to prepare a Final Noise Impact Management Report that includes:**
- **Evaluation of possible noise mitigation measures and identification of practicable measures by:**
 - **Noise modelling to predict LAmax noise levels, including a 2.5 dB(A) allowance for façade reflection, at locations 25 metres from the project area boundary where the GAA has designated the current or future land use to be residential with the modelling to be based on:**
 - **The alignment provided by the design and construct contractor**
 - **All possible use of the project area by trains**
 - **LAmax source noise levels 2 dB greater than that used in the modelling reported in the NIMR or a clear justification the use of a different LAmax noise source level**
 - **On the basis of the predictions noise modelling, identification of locations where bund and/or barriers may be practicable because the bund or barrier would result in a LAmax at a location 25 metres from the project area of 80 dB or less**
 - **Noise modelling as per the above, but assuming the barriers identified as possibly practicable are in place, with the predictions being provided to the GAA.**

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- Upon receipt of information from the GAA on proposed use of land abutting the project area, determination of the cost of bunds and/or barriers per dwelling for dwellings where the L_{Amax} is 80 dB or less a result of the bund or barrier, and final assessment of the practicability of bunds and or barriers on the basis that practicability requires the cost to be \$26,400 or less per dwelling or some other value based on the recommended architectural treatment cost multiplied by 1.5.
 - The results of noise modelling as per the above but assuming only the bunds and/or barriers found to be practicable, with results showing, at least, predictions of the locations of the 80, 60 and 55 dB contours for L_{Amax} , $L_{Aeq15h(day)}$ and $L_{Aeq9h(night)}$ respectively, including a 2.5 dB(A) allowance for façade reflection.
 - Determination of mitigation measures required to achieve noise targets and limits set for noise from railway infrastructure and road traffic noise from overpasses, unless they prove to be impractical or are not cost effective.
 - Evaluation of the possible mitigation measures to limit the impact of train horn noise and identification of appropriate measures.
 - Development and specification of an operational noise monitoring program including
 - The frequency of monitoring
 - Measurement procedures including equipment to be used
 - The data to be recorded
 - Reporting procedures which should include:
 - Immediate reporting of any exceedance of limits to the relevant municipal authority
 - Regular reporting of all monitoring results by an acoustic specialist to the Minister for Planning and municipal authorities
 - Reporting of monitoring results to the community in a suitable form to the satisfaction of the municipal authorities
 - Actions to be taken in the event of detection of an exceedance of prescribed limits or excessive noise levels.
 - Recommendations for inclusion in the Final Noise Management Plan of all noise mitigation measures found to

be practicable and/or appropriate and a requirement for the implementation of the operational noise monitoring program.

The Final Noise Management Plan should not be approved unless it includes:

- Specification of the recommended noise standards including target external noise levels for train operation and road noise at dwellings, internal noise limits for train operation noise for dwellings and limits as would be determined under *State Environment Protection Policy (Control of Noise from Commerce, Industry and Trade) N-1* for railway infrastructure subject to exemptions equivalent to those in section 251B but not including cleaning, refuelling or repairs to passenger trains in yards.
- Requirements for the implementation of:
 - The noise mitigation measures included in the Draft Noise Management Plan
 - All noise mitigation measures recommended the Final Noise Impact Management Report
 - The noise monitoring program recommended in the Final Noise Impact Management Report
- A requirement for the appointment of suitably qualified and independent specialist to audit the implementation of the noise monitoring program, at least, annually and provide reports on such audits to the Minister for Planning, the City of Wyndham and the Shire of Melton
- Allocation of responsibilities for all aspects of its implementation by direct acceptance by the Regional Rail Link Authority, the Victorian Rail Corporation or some other entity allowing for delegation of responsibilities to other parties by that authority, corporation or entity.
- A requirement to meet all costs of the design and installation of architectural treatments of dwellings to ensure internal noise limits are complied with in situations where the residual L_{Amax} noise external levels are still above 80 dB by:
 - Commissioning the services of a suitably qualified acoustic specialist to provide design and cost estimates for the architectural treatments required to comply with internal noise limits in existing dwellings and future dwellings, when definite proposal for the construction of such dwellings are made.

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- Obtaining the agreement of the owners of existing dwellings and future dwelling sites for arrangements for installation of the architectural treatments with the cost of such treatments up to the estimated cost provided by the suitably qualified acoustic expert being paid by the Regional Rail Link Authority, or its successor or delegate, or in the absence of such agreement, evidence that:
 - All reasonable efforts have been made to reach such an agreement to the satisfaction of the relevant authority and
 - The acceptance by the relevant authority of the proposed specification and cost estimate as fair and reasonable.
 - The Growth Areas Authority:
 - Use its best endeavours to, in consultation with relevant stakeholders, expeditiously develop definitive plans for the use and as far as is possible housing lot arrangement for land abutting the project area that it has indicated will be developed for residential purposes
 - Prepare a Design and Development Overlay to implement the necessary planning controls.
 - The Incorporated Document of the Wyndham and Melton planning schemes be amended to clarify:
 - The full extent of the railway uses permissible and remove the uncertainty caused by the condition 'must be for Section 2 of the Project' when 'the Project' is only generally described
 - That there is to be only one noise management plan
 - That the noise management plan may be modified with the approval of the Minister for Planning and such approval will not be given if the modification involves a change to the noise standards
 - That requests for approval of changes to the plan must include a report by suitably qualified acoustic consultant detailing the changes proposed, the reason for the changes and an assessment of any resultant change in impacts and be accompanied by a report on a peer review.

10. General conclusions and recommendations

10.1 Conclusions

Our conclusions in relation to the project to be assessed, noise standards for operational noise, operational noise impacts, mitigation options for that noise and implementation of mitigation measures for operational noise are set out in detail at the end of each of Chapters 3 and 6 to 9 of this report. In Chapter 5 we deal with separately with all aspects of construction noise and vibration (both during construction and operation). Detailed findings and recommendations are also found at the end of that chapter.

We do not propose to repeat the detailed conclusions here.

In broad summary we have found that:

- The noise which presents the greatest challenge in terms of mitigation is the noise of the train operations. The operational noise which will be generated by this project is expected to be considerably higher than the noise generated by other existing rail system in the metropolitan area. This is due in the main to the fact that trains will be travelling much faster through the urban area than they do at present. Trains on the lower speed, electrified metropolitan system generate considerably less noise. Also while diesel-powered trains (including those carrying freight) do pass through the urban areas, they generally travel at much lower speeds than the maximum speed of trains proposed for RRL2 of 160 km/h.
- The Noise Impact Management Report (NIMR) and Draft Noise Management Plan (DNMP) prepared for the RRL2 project by the proponent have not met the requirements of the Minister as set out in his conditional decision that no EES was required for the project.

They fail to meet the requirements on a number of bases:

- They do not relate to the whole project which was the subject of the EES referral and the Minister's decision and thus do not account for all operational train noise
- Some other noise sources associated with the project are also not adequately considered including road noise and train horns
- Not all parts of the content was peer reviewed
- While the NIMR reports on noise predictions it does not report on impacts. In particular, there is no identification of the extent of outdoor and indoor amenity impacts for dwellings
- No adequate justification is provided for the adoption of the qualitative noise standards proposed for the project neither is it

possible to apply those standards to identify required mitigation measures to deal with impacts as required

- The noise mitigation measures suggested in the DNMP are extremely limited and are an inadequate response to the anticipated levels of noise, operational noise in particular, that will be associated with the railway. While already there is some limited housing abutting the project area for RRL2, it is proposed that, within a few decades, along perhaps half of its length, there will be thousands more nearby dwellings. Without significant mitigation measures being adopted along the project area boundary, much of this housing will experience unacceptably high levels of operational train noise.
- The noise modelling methodology employed in the NIMR is largely satisfactory and based on reasonable assumptions except for some concern about inadequate justification of train source noise levels.
- Quantitative noise standards are required for the project – they enable an assessment of impacts to be made and allow on going compliance to be managed.
- Deployment of arrange of mitigation measures to achieve the quantitative noise standards is appropriate as it enables a response to be made to the different geographic characteristics and development circumstances along the length of the railway. Practicable, cost effective mitigation measures need to be chosen from amongst the options.
- We nevertheless endorse the attenuation of noise at source as the most efficient and effective means to ameliorate operational noise problems for nearby sensitive uses via the use of cuts, low barriers and bunds.
- The responsibility for meeting the cost of mitigation works will, it seems, flow to the State through the compensation processes that will apply.
- There is a need for a further modelling and consultation process to resolve the final choice of mitigation measures to deal with operational noise as key information, to enable that choice to be made, has not been available to date.
- Whatever on-site mitigation measures are identified as appropriate by that further process, we expect that there will be instances where residual impacts of operational noise will not meet the prescribed external targets outside the project area. These will need to be addressed by architectural treatment of dwellings and lot and building layouts managed through planning mechanisms involving the GAA and municipalities.
- We are satisfied that for the most part construction noise and vibration as well as operational vibration either do not present problems for nearby sensitive land uses or can be adequately managed under arrangements specified in a Final Noise Management Plan (FNMP).

10.2 Recommendations

As with our conclusions these are set out in detail at the end of each of Chapters 3 and 5 to 9.

Broadly our recommendations are:

- The NIMR and DNMP should not be approved. The RRLA should be required to prepare revised versions of both documents (a final Noise Impact Management Plan (FNIMR) and FNMP).
- Those final documents should be prepared after and as an outcome of the further modelling and consultation process we have recommended. The objective of the further process is to identify the most cost effective on-site acoustic mitigation measures for sections of the project area within the framework set by external acoustic targets for dwellings. It is also expected that it will identify some residual noise impacts outside the project area even after on-site mitigation measures are applied. These will need to be managed through planning approaches involving the GAA and municipalities. We see that a Design and Development Overlay would be an appropriate mechanism.
- The further process has a number of clearly defined steps which involve reconsideration of the vertical grade line, remodelling of noise projections both with and without barriers, comparative selection processes for practicable mitigation measures and inputs concerning future residential land use near the project area by the GAA and others.
- Our recommended quantitative noise standards for operational train noise associated with the project to be met at dwellings should be adopted and applied in the FNMP and in the further consideration process above. They are:

External noise targets at dwellings:

Day Time (7:00–22:00)	60 dB LAeq15h (day)
Night Time (22:00–7:00)	55 dB LAeq9h (night)
24 Hours	80 dB LAmax

Internal noise limits for dwellings:

Living areas

Day time (7:00–22:00)	45 dB LAeq15h (day)
Night time (22:00–7:00)	45 dB LAeq9h (night)
24 hours	65 dB LAmax

Bedrooms

Day time (7:00–22:00)	45 dB LAeq15h (day)
Night time (22:00–7:00)	40 dB LAeq9h (night)
24 hours	65 dB LAmax

- The noise standards should apply to existing housing, lots for which subdivision approval has been granted, and for future dwellings in the residential areas adjacent to the railway.
- The costs and acoustic effectiveness of various combinations of bunds, cuts and barriers set out in this report should be adopted in the further process of consideration unless improved information becomes available.
- Speed restrictions may also contribute to noise management and should be considered as a mitigation option.
- A noise monitoring and auditing system needs to be put in place through the FNMP.
- A maintenance plan also needs to be incorporated in the FNMP as careful track and wheel maintenance are elements of the required operational noise management regime.
- The FNMP should clearly allocate the responsibilities for all aspects of its implementation.
- The Incorporated document in the Wyndham and Melton planning schemes should be amended to clarify permissible uses, specify a single noise management plan and provide clear provisions on allowable modifications to the plan.

10.3 Committee comment:

Adoption of our recommendations for further work to be undertaken before the final NIMR and FNMP are approved will necessarily delay approval of these key documents relating to noise management. Given the requirement in the Minister's decision on the EES referral that the approval of the FNMP must precede commencement of works, this has implications for the commencement of construction of the railway.

The Advisory Committee is aware that a contract for construction of RRL2 has now been entered into. The further work we recommend is expected to

result in further changes to the vertical alignment of the railway. These changes together with the inclusion of additional noise mitigation works within the project area will likely necessitate construction contract variations.

We are minded of the submission made on behalf of one of the owners of land adjoining the track⁸⁶ - that it is 'unfortunate that these hearings were not part of a much earlier consideration...'

While immediate progress on the project's implementation may be constrained, we believe that the recommended further work can be done expeditiously within the framework of implementation we have suggested. We believe that the further work recommended is critical to achieving a project outcome which fairly deals with the noise impacts, will be less costly in the long run, and will provide a better living environment for the thousands of future residents along the railway.

⁸⁶ Mr Pitt for Lotus Oaks Pty Ltd.