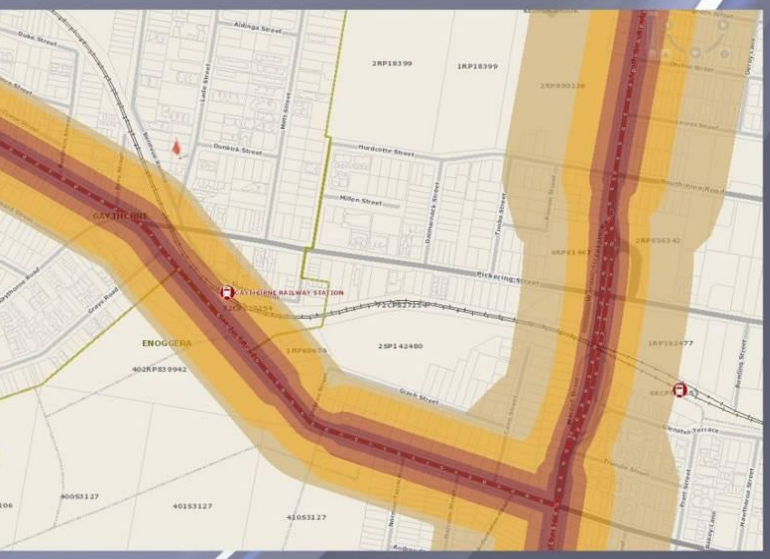
NOISE MEASUREMENT SERVICES

Acoustic Review Report
Byron Bay Bypass
Butler Street Upgrade
Byron Bay, NSW, 2481

Report No 3599R2 7th June 2016



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REPORT FOR **Byron Shire Council**

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Signed

Max Thorne
(Director)

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Contents

Executive Summary

This Report is in response to a request from Byron Shire Council for an Acoustic Review of the proposed Byron Bay Bypass – Butler Street Upgrade (Development Application #DA10.2016.77.1). Previous road traffic noise assessments have been conducted by GHD (GHD Report # 22/17484, dated June 2015), and by Renzo Tonin & Associates (RTA Report # TJ016-01F02 (r0), dated 3rd June 2016). The purpose of this Report is to review existing road traffic noise calculations, and to provide comment on proposed noise mitigation strategies as well as recommendations for Conditions if appropriate.

Conclusions

It is concluded that-

- Prediction of future road traffic noise involves an inherent degree of uncertainty. The GHD and RTA road traffic noise models utilize different calculation methodologies, and are based upon alternate defensible assumptions.
- Calculation uncertainty can be mitigated by selecting the higher of the two forecasts, providing a bias towards over-prediction. The conservative nature of this selection method is supported by additional modelling conducted by NMS. Predictions are considered more robust by employing multiple calculation methodologies.
- Traffic flows and the proportion of heavy vehicles during the night period are critical assumptions regarding noise forecasts.
- Based upon the reports of GHD and RTA, 23 properties qualify for consideration of noise mitigation in accordance with the Noise Mitigation Policy.
- An operational noise management plan (ONMP) is proposed as an open and transparent process to implement noise mitigation strategies at these qualifying receivers.
  - The effectiveness of low noise pavement is limited at the speed limits proposed, and deterioration of the road surface may lead to increased noise emissions into the design horizon. As such, low noise pavement is not recommended as a noise mitigation strategy.
  - Acoustic barriers are a preferred noise mitigation strategy, although the construction of noise barriers will be limited by access, safety and aesthetic considerations. Maximizing the screening from noise barriers will also provide community benefit to residences affected by increased road traffic noise, but forecast below criteria.
  - Acceptable acoustic barrier heights and locations should be established by Council in liaison with community stakeholders. Earth mounds are not considered appropriate due to space limitations.
  - Road traffic noise should be remodelled once the extent of reasonable and feasible acoustic screening has been established, to incorporate the effect of such screening, and to include more detailed design plans. Updated predictions should be reassessed to identify receivers qualifying for further or alternative noise mitigation.

  - Receivers qualifying for further or alternative noise mitigation should be individually assessed by a suitably qualified acoustic consultant, to identify reasonable and feasible 'at-property' treatments in accordance with the Noise Mitigation Guideline.
- The Construction Noise Mitigation measures recommended in the RTA report are considered to be appropriate for the mitigation of construction noise. Noise monitoring should be conducted during construction to assess and review mitigation strategies.

Recommendations

It is recommended that:

- The properties listed in **Table ES1** below be considered for noise mitigation in accordance with the RMS Noise Mitigation Guideline and the RTA noise assessment Report.
- A condition be imposed to proposes a fixed timeframe for resolution of noise mitigation matters; this should commence immediately upon approval.
- The operational noise management plan (ONMP) presented in **Appendix A** be adopted to implement noise mitigation strategies for qualified receivers and a condition be included accordingly.
- A construction noise and vibration management plan (CNVMP) be adopted to implement the construction noise and vibration mitigation measures recommended in the Renzo Tonin and Associates Report (RTA Report # TJ016-01F02 (r0), dated 3rd June 2016), and a condition be included accordingly.
- Noise monitoring be conducted during construction to re-assess the CNVMP and a condition be included accordingly.

Table ES1: Sensitive receivers qualifying for consideration of noise mitigation

Property	Description
Butler Street	Butler Street Reserve
1 Butler Street	The Australian Orthodox Home for the Aged
11 Butler Street	Byron Motor Lodge
52 Butler Street	Residential dwelling
54 Butler Street	Residential dwelling
56 Butler Street	Residential dwelling
58 Butler Street	Residential dwelling
60 Butler Street	Residential dwelling
62 Butler Street	Residential dwelling
68 Butler Street	Residential dwelling
69 Butler Street	Residential dwelling
70 Butler Street	Residential dwelling
71 Butler Street	Residential dwelling
72 Butler Street	Residential dwelling
73 Butler Street	Residential dwelling
74 Butler Street	Residential dwelling
75 Butler Street	Residential dwelling
76 Butler Street	Residential dwelling
77 Butler Street	Residential dwelling
80-86 Butler Street	Glen Villa Resort
2 Burns Street	Residential dwelling
131 Jonson Street	Ruskin House Accommodation
140-142 Jonson Street	Beachside Butter Apartments

1. Introduction

This Report is in response to a request from Byron Shire Council for an Acoustic Review of the proposed Byron Bay Bypass – Butler Street Upgrade (Development Application #DA10.2016.77.1). Previous road traffic noise assessments have been conducted by GHD (GHD Report # 22/17484, dated June 2015), and by Renzo Tonin & Associates (RTA Report # TJ016-01F02 (r0), dated 3rd June 2016). The purpose of this Report is to review existing road traffic noise calculations, and to recommend noise mitigation strategies as well as recommendations for Conditions if appropriate.

The purpose of this review is not to reproduce existing work, but to identify and interpret variation between the two assessments, and to identify further potential issues. Additionally, this Review Report proposes a process for implementing noise mitigation measures in accordance with the NMG, based upon the available assessments.

1.1 Project Acoustic Assessment History

A noise and vibration impact assessment was conducted by GHD (GHD Report # 22/17484, dated June 2015), as part of an Environmental Impact Statement (EIS) in support of the project. Recent changes to New South Wales Roads and Maritime Services policy – namely, release of the Noise Mitigation Guideline (dated April 2015), which is considered to represent current best practice for this issue – were not included in the assessment. Subsequently, Renzo Tonin & Associates were engaged to undertake an environmental noise assessment of the project, which was conducted with reference to the Noise Mitigation Guideline (NMG).

While both noise assessment Reports reached broadly the same conclusions regarding noise impacts and mitigation strategies, differences in methodology and policy considerations led to variation in specific conclusions. Noise Measurement Services were engaged in May 2016 to review the preceding assessments, and to recommend noise mitigation processes going forward.

2. Review of Acoustic Assessment Reports

2.1 Roads and Maritime Services Policy

As noted in **Section 1.1**, the RMS Noise Mitigation Guideline 2015 was not considered as part of the GHD Noise and Vibration Assessment. Although different policies were referenced, the same 55/50 $L_{eq,T}$ day/night criteria was generally applied in both cases. The RMS Noise Mitigation Guideline (and by extension, the RMS Noise Criteria Guideline) is considered best practice in relation to the proposed bypass, and the assessment methodology used in the RTA report is thereby considered appropriate, although predictions of noise levels (and exceedances) were broadly commensurate between the two Reports.

2.2 Road Traffic Noise Predictions

Prediction of road traffic noise into a 10 year design horizon inherently carries a degree of uncertainty. Ideally, noise impacts are assessed through direct measurement, although such a methodology is not possible prior to development. As such, road traffic noise modelling – based upon available data – serves as the basis for future noise impact predictions.

Both noise assessments utilise an implementation of the Calculation of Road Traffic Noise (CoRTN) methodology, which is considered to be the industry standard road traffic prediction algorithm within the Australian context. Both implementations have been calibrated within standard (2dB(A)) tolerances to measurements undertaken by GHD during the initial noise survey. The noise modelling software CadnaA was used in both cases.

Future traffic volumes and the proportion of heavy vehicles are critical assumptions underlying road traffic noise forecasts. The same traffic data – as supplied by Byron Shire Council – appears to have been utilized in both models.

These similarities notwithstanding, some variance in methodological assumptions have been identified between the two road traffic noise models, and are discussed below.

2.2.1 Topography

The topographic resolution appears to vary between assessments, with the GHD model utilizing 0.5m interval data, and the RTA model using 2m contours. It is assumed that both sets of topographic data are in broad agreement, and the variance between resolution is not expected to significantly affect noise forecasts. Additionally, ground absorption was calculated differently, with the GHD model differentiating between hard (0.5) and soft (1) ground, while the RTA model assumed a single (0.75) value. Negligible prediction variance is expected between the two ground absorption assumption. It is therefore concluded that the topographic assumptions in both models are defensible.

2.2.2 Average Traffic Speed

A variance between the average traffic speed for Butler Street was identified, with the RTA model assuming 50 km/hr, and the GHD model assuming 45 km/hr. Both assumptions regarding average traffic speed are considered defensible, and a minor (less than 0.5 dB(A)) variance in forecast noise levels is expected from this difference.

2.2.3 Receiver Point Locations

It is assumed that the location of receiver points will be generally commensurate between the two models, although minor variance in specific placement is expected. The resulting variance in noise forecasts is not expected to be significant.

It is noted, however, that the RTA assessment includes consideration of upper floor receivers, which was not undertaken during the original assessment. Upper floor receivers typically receive reduced (if any) screening from acoustic barriers, and it is recommended that upper floor receivers be considered during assessment of possible acoustic mitigation.

2.2.4 Calculation of $L_{eq, T}$

Both noise assessments utilise an implementation of the CoRTN algorithm, which predicts road traffic noise as a $L_{10, 18hr}$ or $L_{10, 1hr}$ descriptor. RMS noise criteria are referenced to the $L_{eq, 15hr}$ and $L_{eq, 9hr}$ descriptors, and a calculation is required to convert forecasts from L_{10} to L_{eq}. Different methodologies were used for this conversion. The GHD assessment forecast traffic noise as a $L_{10, 18hr}$, and then converted to $L_{eq, 15hr}$ and $L_{eq, 9hr}$ in accordance with adjustments presented in the *Austroads Research Report – Modelling, Measuring and Mitigating Road Traffic Noise (2005).* In contrast, the RTA assessment forecast traffic noise as $L_{10, 1hr}$ assuming a 85%/15% split between day/night traffic volumes, and then converted the L_{10} to L_{eq} using a standard -3 dB(A) correction.

The precise distribution and character of future traffic is not known at this stage, and both calculation methodologies are considered defensible. However, the variance between noise forecasts as calculated through these methodologies is significant.

2.3 A Conservative Methodological Approach

As discussed above, both road traffic noise assessments are considered defensible, and the variation between noise forecasts is considered to be primarily due to variance in the underlying calculation methodologies. Prediction of future road traffic noise contains inherent uncertainties, as a result of the limitations of available data.

It is therefore concluded that a conservative approach is to mitigate prediction uncertainty by selecting the higher of the two forecasts for each sensitive receiver. This creates a bias towards over-prediction, which in turn provides additional protection of acoustic amenity while still being supported by a defensible prediction methodology.

Further calculations have been conducted by NMS using the noise modelling software SoundPlan 7.0 and appropriate modelling assumptions. Forecast $L_{10,\ 18hr}$ was converted to $L_{eq,\ 15hr}$ and $L_{eq,\ 9hr}$ according to a third defensible methodology[1]. The results of this additional modelling were broadly commensurate with the previous assessments.

Importantly, although these supplementary forecasts were significantly lower at some receivers than those conservatively selected, at no receiver were they significantly higher. This supports the conservative selection methodology as described above. Forecasts selected through this conservative approach are considered additionally robust by virtue of comparison with multiple calculation methodologies.

It is therefore concluded that both the GHD and RTA road traffic noise assessments are methodologically defensible, and that the risk inherent in the uncertainty of choosing between differing future noise predictions can be reduced by selecting the highest of the two forecasts for each receiver.

2.4 Construction Noise

Both the GHD and RTA Reports include assessment of construction noise generally in accordance with the NSW Interim Construction Noise Guideline 2009. While both assessment processes are considered defensible, it is noted that the RTA assessment includes a more detailed methodology and approach to construction noise assessment and mitigation. It is therefore recommended that a Construction Noise and Vibration Management Plan (CNVMP) be adopted and implemented for the project, based upon the mitigation measures as recommended in the RTA Report.

It is further recommended that noise and vibration monitoring be conducted during construction, and that the CNVMP be subsequently reassessed with regards to noise measurements and the NSW Interim Construction Noise Guideline.

[1] **Huybregts and Samuels (1998).** *New relationships between L10 and Leq for road traffic noise.* Proceedings of Internoise 1998. November 16 -18th, Christchurch, New Zealand.

3. Assessment

As discussion in **Section 2.3** above, a conservative approach to mitigate the uncertainties of future noise prediction is to select the highest of the two forecasts for each receiver. This methodology is applied to the receivers identified for noise treatment in the RTA Report (**Table 11**), as presented below. The data presented below is explanatory of the discussions presented in **Section 2**, and does not constitute an exhaustive noise assessment.

Table 1: Showing the range of road traffic noise forecasts to identified qualifying receivers.

Receiver	'No Build' 2018		'Build' 2018		'No Build' 2028		'Build' 2028	
	Day	Night	Day	Night	Day	Night	Day	Night
Butler Street Reserve	52	-	57	-	53	-	58	-
1 Butler Street	57-59	51-56	61-61	53-58	58-60	52-57	61-62	54-58
11 Butler Street	55-57	51-52	59-60	53-57	56-58	51-53	60-61	54-57
52 Butler Street	56	50	59	52	57	50	60	53
54 Butler Street	53-56	50-50	58-60	52-55	54-57	50-51	58-61	53-55
56 Butler Street	54-59	51-52	60-62	54-57	55-60	53-52	61-63	55-58
58 Butler Street	54-61	51-52	59-60	53-56	55-60	53-52	60-62	54-57
60 Butler Street	53-57	50-51	58-59	52-55	54-58	51-51	58-60	52-55
62 Butler Street	53-56	50-50	57-59	51-54	54-57	50-51	58-60	52-55
68 Butler Street	48-50	44-45	53-56	48-50	49-50	44-46	54-56	49-51
69 Butler Street	47-50	44-44	57-59	51-54	48-51	44-45	58-60	52-55
70 Butler Street	48-50	44-45	57-59	51-54	49-51	45-46	58-60	52-55
71 Butler Street	46-49	43-43	56-58	51-53	47-49	43-44	57-59	51-54
72 Butler Street	46-49	43-43	55-57	50-52	46-50	44-43	55-58	51-52
73 Butler Street	45-48	42-43	56-58	50-53	46-49	43-43	57-58	51-54
74 Butler Street	47-50	44-44	58-59	51-55	48-51	44-45	59-60	52-56
75 Butler Street	45-48	42-42	56-57	50-53	46-49	42-43	56-58	51-54
76 Butler Street	47-50	44-44	58-60	52-55	48-51	45-45	59-61	53-56
77 Butler Street	45-48	42-42	57-58	51-54	45-49	42-42	57-59	52-55
80 Butler Street	42-45	39-39	57-55	48-54	43-46	39-40	58-56	49-55
80 Butler Street	41-44	38-38	57-55	48-54	42-45	39-39	58-56	49-55
2 Burns Street	50-50	44-47	54-56	49-51	50-51	45-47	55-57	49-52
131 Jonson Street	63-65	58-61	62-62	54-59	64-66	59-61	62-63	55-60
140-142 Jonson Street	65-67	60-63	64-65	57-61	66-68	61-63	64-66	58-61

Table 2: Showing conservatively selected road traffic noise forecasts and criteria from the RMS Noise Criteria Guideline. Forecasts are in dB(A) L_{eq}. Ground Floor.

Receiver	2018				2028						NCG Criteria		Qualifying Trigger
	'No Build'		'Build'		'No Build'		'Build'		Increase				
	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	
Butler Street Reserve	52	-	57	-	53	-	58	-	5	-	55	-	Cumulative Limit
1 Butler Street	59	56	61	58	60	57	62	58	2	1	55	50	Cumulative Limit
11 Butler Street	57	52	60	57	58	53	61	57	3	4	55	50	Cumulative Limit
52 Butler Street	56	50	59	52	57	50	60	53	3	3	55	50	Cumulative Limit
54 Butler Street	56	50	60	55	57	51	61	55	4	4	55	50	Cumulative Limit
56 Butler Street	59	52	62	57	60	53	63	58	3	5	55	50	Cumulative Limit
58 Butler Street	61	52	60	56	60	53	62	57	2	4	55	50	Cumulative Limit
60 Butler Street	57	51	59	55	58	51	60	55	2	4	55	50	Cumulative Limit
62 Butler Street	56	50	59	54	57	51	60	55	3	4	55	50	Cumulative Limit
68 Butler Street	50	45	56	50	50	46	56	51	6	5	55	50	Exceedance + 2 dB(A) Increase
69 Butler Street	50	44	59	54	51	45	60	55	9	10	55	50	Cumulative Limit
70 Butler Street	50	45	59	54	51	46	60	55	9	9	55	50	Cumulative Limit
71 Butler Street	49	43	58	53	49	44	59	54	10	10	55	50	Exceedance + 2 dB(A) Increase
72 Butler Street	49	43	57	52	50	44	58	52	8	8	55	50	Exceedance + 2 dB(A) Increase
73 Butler Street	48	43	58	53	49	43	58	54	9	11	55	50	Exceedance + 2 dB(A) Increase
74 Butler Street	50	44	59	55	51	45	60	56	9	11	55	50	Cumulative Limit
75 Butler Street	48	42	57	53	49	43	58	54	9	11	55	50	Exceedance + 2 dB(A) Increase
76 Butler Street	50	44	60	55	51	45	61	56	10	11	55	50	Cumulative Limit
77 Butler Street	48	42	58	54	49	42	59	55	10	13	55	50	Cumulative Limit
80 Butler Street	45	39	57	54	46	40	58	55	12	15	55	50	Cumulative Limit
80 Butler Street	44	38	57	54	45	39	58	55	13	16	55	50	Cumulative Limit
2 Burns Street	50	47	56	51	51	47	57	52	6	5	55	50	Exceedance + 2 dB(A) Increase
131 Jonson Street	65	61	62	59	66	61	63	60	-3	-1	60	55	Cumulative Limit
140-142 Jonson Street	67	63	65	61	68	63	66	61	-2	-2	60	55	Cumulative Limit

4. Noise Mitigation Measures

As discussed in **Section 2** and **Section 3** above, 23 properties have been identified as qualifying for noise mitigation under the Roads and Maritime Service Noise Mitigation Guideline (NMG), based upon existing acoustic assessments by GHD and RTA. Under the NMG, mitigation measures are presented in order of preference, which is in accordance with general principles of noise mitigation:

1. Quieter pavement surfaces
2. Noise mounds
3. Noise walls
4. At-property treatments

4.1 Low Noise Pavement

As noted in both GHD and RTA Reports, low noise pavement is of limited effectiveness at lower traffic speeds, as engine and exhaust noise becomes more dominant in relation to tyre noise. Limited research on low noise pavement in low speed environments is available, and indicates that minor to moderate noise reduction is achievable, although results vary. Importantly, the degree of comparative noise reduction declines significantly within a 6 to 18 month period as the road surface deteriorates. Increased wear (in comparison to dense graded asphalt) is observed, and road surface imperfections may even lead to increased noise emissions into the design horizon, depending on the breadth and frequency of maintenance activity (which involves additional noise generation).

Due to the limited effectiveness and substantial maintenance costs associated with low noise pavement in low speed environments, it is not considered to be a preferred noise mitigation strategy for this project.

4.2 Noise Mounds

The implementation of noise mounds is severely limited by land constraints and the relative proximity of sensitive receivers. Typically, a noise mound requires twice the width of its height, as a minimum. Accordingly, noise mounds are not considered to be a reasonable noise mitigation strategy for this project.

4.3 Noise walls

Noise walls, such as acoustically rated fencing, can be effective although implementation may be limited by access, safety and aesthetic considerations. It is recommended that noise walls be constructed where reasonable and feasible, as screening can provide additional community benefit beyond noise mitigation triggers. To appropriately assess the reasonableness and feasibility of noise walls - taking into account site specific considerations - an Operational Noise Management Plan (ONMP) is proposed, as presented in **Appendix A**. The ONMP is considered to provide an open and transparent process to maximize appropriate screening – in accordance with the intent of the RMS Noise Mitigation Guideline – and with the active consultation of local community stakeholders.

It is concluded that detailed assessment of site specific noise mitigation strategies is best conducted subsequent to development approval, when more detailed plans become available and community expectations have been established. A fixed timeframe is recommended.

4.4 At-Property Treatments

The least preferred noise mitigation measure under the NMG is at-property treatment, such as the construction of screen walls, reinforcement of walls, provision of upgraded glazing, or air-conditioning. It is however expected that some properties will qualify for noise mitigation beyond or in place of the construction of noise walls (4.3 above). To appropriately assess the reasonableness and feasibility of at-property treatments - taking into account site specific considerations - an Operational Noise Management Plan (ONMP) is proposed, as presented in **Appendix A**. The ONMP is considered to provide an open and transparent process to implement at-property treatment – in accordance with the RMS Noise Mitigation Guideline – and with the active consultation of local community stakeholders.

It is concluded that detailed assessment of site specific noise mitigation strategies is best conducted subsequent to development approval, when more detailed plans become available and community expectations have been established. A fixed timeframe is recommended.

4.5 Preliminary Investigation of Noise Mitigation Measures

It is recommended that detailed assessment of site specific noise mitigation be conducted through the ONMP subsequent to development approval. This notwithstanding, a preliminary investigation of potential noise mitigation measures has been conducted of the qualifying receivers identified in the RTA report. While not binding, this preliminary investigation is considered indicative of potential measures, although site specific mitigation strategies should be determined with the active consultation of relevant community stakeholders.

The preliminary investigation of noise mitigation measures is presented in **Appendix B**.

Appendix A: Operational Noise Management Plan (ONMP)

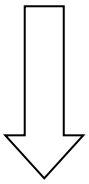
This operational noise management plan (ONMP) applies to the properties listed below, in relation to the proposed Byron Bay Bypass, Butler Street Upgrade. These sensitive receivers have been identified as qualifying for noise mitigation under the NSW Roads and Maritime Services Noise Mitigation Guideline, as presented in the Renzo Tonin & Associates Report (RTA Report # TJ016-01F02 (r0), dated 3rd June 2016). The purpose of the ONMP is to provide an open and transparent process for the implementation of the Noise Mitigation Guideline, which is considered current best practice. Timeframes are indicative, and are not meant to postpone construction where site specific agreements have been reached.

Property	Description
Butler Street	Butler Street Reserve
1 Butler Street	The Australian Orthodox Home for the Aged
11 Butler Street	Byron Motor Lodge
52 Butler Street	Residential dwelling
54 Butler Street	Residential dwelling
56 Butler Street	Residential dwelling
58 Butler Street	Residential dwelling
60 Butler Street	Residential dwelling
62 Butler Street	Residential dwelling
68 Butler Street	Residential dwelling
69 Butler Street	Residential dwelling
70 Butler Street	Residential dwelling
71 Butler Street	Residential dwelling
72 Butler Street	Residential dwelling
73 Butler Street	Residential dwelling
74 Butler Street	Residential dwelling
75 Butler Street	Residential dwelling
76 Butler Street	Residential dwelling
77 Butler Street	Residential dwelling
80-86 Butler Street	Glen Villa Resort
2 Burns Street	Residential dwelling
131 Jonson Street	Ruskin House Accommodation
140-142 Jonson Street	Beachside Butter Apartments

Operational Noise Management Plan Flowchart

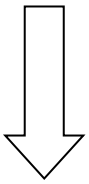
Stage 1 Approval to +6 months

Council liaises with stakeholders to establish the maximum reasonable barriers, with regards to access, safety and aesthetic considerations.



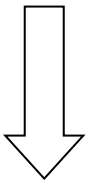
Stage 2 +6 months to +7 months

Road traffic noise is remodelled including screening from barriers and the most recent development plans. Receivers qualifying for additional noise mitigation are identified.



Stage 3 +7 months to +10 months

Construction of acoustic barriers. Site specific acoustic assessment for receivers qualifying for additional noise mitigation. 'At-property' treatment is determined.



Stage 4 +10 months to +15 months

Construction of 'at-property' treatments. Assessment of treatments against relevant building standards. ONMP is concluded.

Operational Noise Management Plan Detail

Stage 1

Acoustic barriers (Noise Walls) – such as acoustically rated fencing – is a preferred noise mitigation strategy, although implementation will be limited by various factors, including:

- Driveway access. Barriers will need to be discontinuous to allow property access from Butler Street, where required. Gaps between barriers will reduce – but not remove – the effectiveness of screening. Side and return barriers may be effective where gaps are required.
- Safety. In no instance should barriers create a safety risk by inappropriately blocking vehicle sight lines. Opportunities for casual surveillance may also be a security concern.
- Aesthetics. While protecting acoustic amenity, barriers can also affect visual amenity, especially with regards to items of heritage significance. The extent to which barriers would create an unreasonable visual impact should be determined by Council in liaison with community stakeholders.

The intent of the ONMP is to maximize screening from acoustic barriers where reasonable and feasible. Indicative barrier locations are presented in **Plate A1** and **Plate A2** below. Barrier locations will be removed from consideration where determined to be unreasonable or unfeasible on a site specific basis. Maximum reasonable barrier heights will be determined by Council in liaison with community stakeholders.

Plate A1: Potential acoustic barrier location, Northern Section

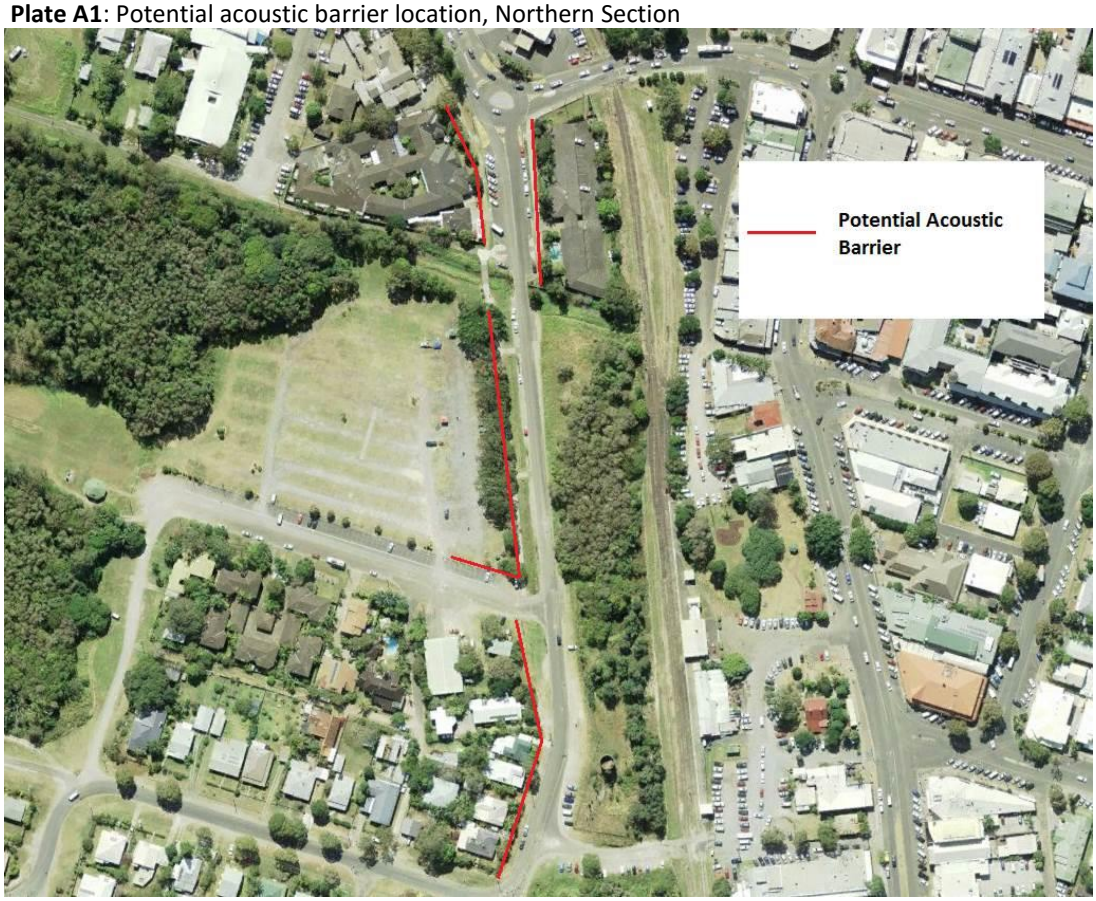
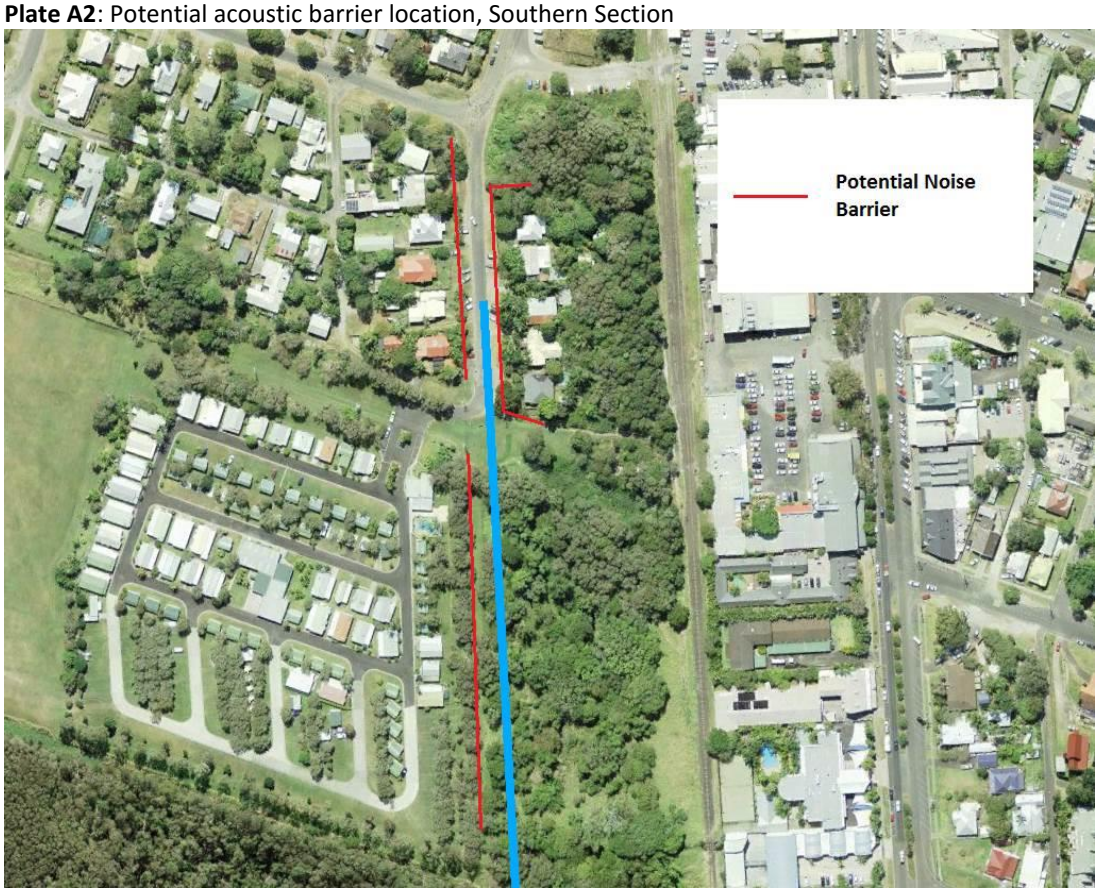


Plate A2: Potential acoustic barrier location, Southern Section



Stage 2

Barrier designs are established in accordance with the Roads and Maritime Services Noise Mitigation Guideline, based upon the maximum reasonable barriers and barrier heights determined in Stage 1. Road traffic noise is remodelled by a suitably qualified acoustic consultancy, including screening from barriers, and the most recent development plans. Predictions are assessed under the Roads and Maritime Services Noise Mitigation Guideline to identify properties qualifying for additional noise mitigation.

Stage 3

Begin construction of the acoustic barriers determined in Stage 2. 'At-property' noise mitigation is considered for qualifying properties through the following process:

1. Affected property owners will be notified (by mail and phone call) that they have qualified for at-property noise treatments and to arrange an inspection of their property. If no response is received, a Council project officer will attend the property to attempt to arrange an inspection.

2. The inspection will include a sketch of the property floor plan including location of windows, fresh air access, existing glazing and window frames including their condition etc. The floor plan will identify if any of the affected rooms are habitable (i.e. not a bathroom, garage or laundry).

3. Council will engage a suitably qualified acoustic consultant to complete the inspections and then identify appropriate mitigation treatments for each receiver in accordance with the RMS Noise Mitigation Guideline. A communications specialist and/ or Council project officer will also attend these inspections to ensure that consultation is completed effectively and to record any outcomes of the consultation.

4. The acoustic consultant will develop a treatment plan for each receiver based on the individual set of circumstances for each property. The consultant's objective will be to provide noise mitigation resulting in at-property noise levels (measured post-construction with windows closed) similar to pre-construction noise levels with the windows open.
5. The treatment plan will be presented to each impacted property owner along with a contractual agreement for the treatment offer. The time required to respond to the agreement will be clearly communicated to the owner at this time. If the owner (and tenant if necessary) accepts the offer, the signed contractual agreement will permit access to the home for the works and the works can commence. The contractual agreement (Deed) will include:

a) That the owner has given Council permission to access the property and install the mitigation.
b) That the treatment will be installed to a professional standard.
c) A warranty for the works.
d) Advice to the limited nature of the offer i.e. one offer per property only.
e) The Deed will not commit to meeting a specific internal noise level and does not take away the right of the individual to make further noise complaints. This is in line with existing RMS procedures.

6. Owners may refuse to accept the treatment offer and enter into the contractual agreement with Council. Refusal to accept the offer within the specific timeframe will also be deemed refusal. Based on the advice and experience of RMS specialists, if the offer is refused, then the offer is withdrawn permanently and no other offer or treatment will be provided to that property. Council will be able to prove the offer has been made and that all other feasible and reasonable mitigation has been attempted.

7. Ideally this process will be completed and treatments will be installed before construction commences as the at-property treatment can also assist to manage construction noise. However, this may not be achievable.

As stated above, Council cannot commit ahead of time to a specific internal noise level for every affected property because retrofitting noise treatments to existing homes can have various levels of success, depending on the nature of construction. Given the character of the properties requiring treatments, with some being of local heritage significance, there may be limited capacity to effectively treat the properties with the Noise Mitigation Guideline suggested treatments, and there may be limited success if/when the treatments are installed.

Stage 4

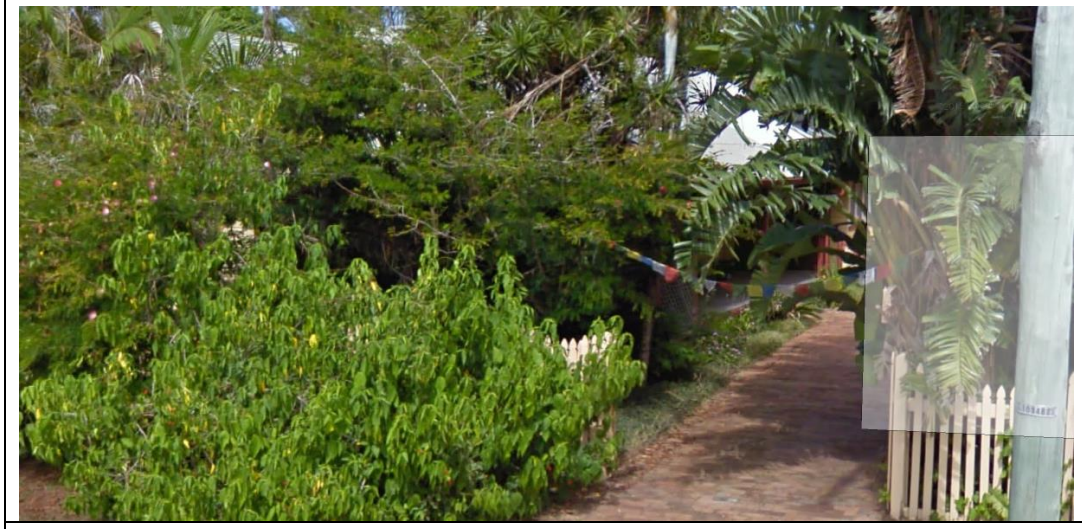
Begin construction of 'at-property' noise mitigation strategies, as determined in Stage 3. After construction, acoustic treatments are assessed to ensure they meet all relevant building standards and requirements.

Appendix B: Preliminary Investigation of Noise Mitigation Measures

Address	Construction Description	Mitigation Potential
Byron Motor Lodge 	Brick and tile, light weight aluminium sliders. Landscaping to front with hedge, no fence . Note already very exposed to road traffic noise and several comments to this effect on review website.	Heavier duty glazing, fence to boundary. Air conditioning where doors previously open must remain shut for acoustic amenity.
The Australian Orthodox Home for the Aged 	Rendered brick with sliders. Wrought iron (or aluminium) gate to boundary. Only communal space and service entrance appear to be on Butler Street. Already very exposed.	Full fencing, glazing but possibly not heavier sliders if aged persons are operating them. Air conditioning where doors previously open must remain shut for acoustic amenity.

52 Butler Street 	Lightweight removable shed, no fence	Fencing (access can be taken from side road)
54 Butler Street 	Units in brick with lightweight infill, aluminium glazing (1980s?) tin roof, possibly no roadside fence no fence but plenty of vegetation, unit 1 currently to let	unknown

56 Butler Street 	Fibro and Tin with wood windows, close to boundary with minimal fencing	Replacement windows and wall reinforcement, if fencing is not feasible.
58 Butler Street 	Picket fence, house close to boundary, short stumps, chamfer and tin, wood windows	Possible heritage issues. Replacement windows and wall reinforcement, if fencing is not feasible.

60 Butler Street 	Heritage house. Picket fence, chamfer and tin, low set, open verandah, wood windows	Fencing, possible air-conditioning if no physical alteration is feasible
62 Butler Street 	Heritage house with heritage fence. Timber short hipped colonial with tin roof and unenclosed verandah, double hung windows	Unknown, air-conditioning if no physical alteration to house or fence is feasible.

2 Burns Street (66 Butler Street) 	Chamfer boards, low set, no fence, aluminium windows, holiday let	Fencing, window replacement, air conditioning
68 Butler Street 	Rendered brick and tile, no fence, aluminium windows, low set	Fencing, window replacement, air conditioning

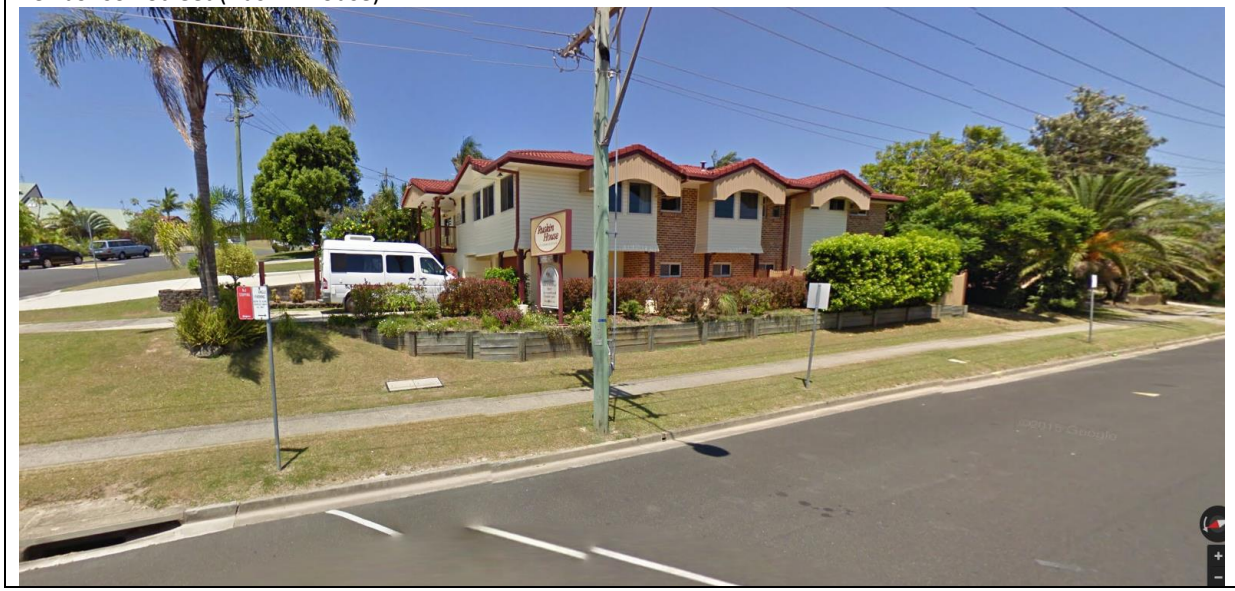
70 Butler Street 	Short hip on 2ft stumps, chamfer clad with aluminium sliding windows on verandah, tin roof	Fencing, window replacement, air conditioning
72 Butler Street 	No fence, 20s bungalow on short stumps, tin, chamfer and rendered brick, lightweight aluminium windows	Fencing, window replacement, air conditioning

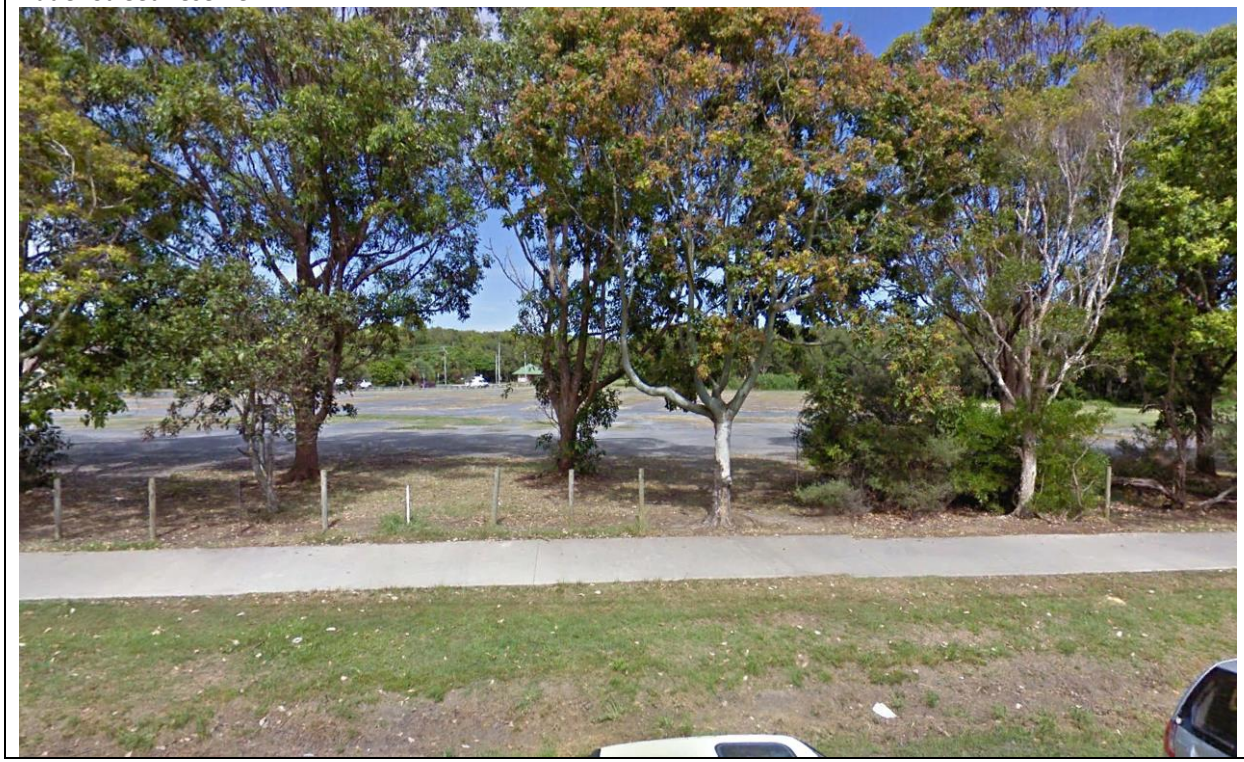
74 Butler Street 	Fibro and chamfer with tin roof on 2ft stumps, open verandah and no fence	Fencing, window replacement, air conditioning
76 Butler Street 	Chamfer and tin with wood windows, no fence, holiday let	Fencing, window replacement, air conditioning

69 Butler Street 	Chamfer and fibro and tin post war, timber windows, no fence	Fencing, window replacement, air conditioning
71 Butler Street 	Fibro and tin, wood windows, low set, no fence	Fencing, window replacement, air conditioning

73 Butler Street 	Double storey chamfer and tin with wood windows, good quality lightweight fence	window replacement, air conditioning, assuming fencing is to be retained.
75 Butler Street 	Timber and tin with light weight 6ft fence	Fencing (reinforcement), window replacement, air conditioning

77 Butler Street 	60s weatherboard & tin, 5ft picket fence, good quality aluminium windows, holiday let	Fencing (reinforcement), window replacement (not considered likely), air conditioning
80-86 Butler Street (Glen Villa Resort) 	Small cottages and tents (camping ground)	Fencing to boundary

140-142 Jonson Street (Byron Butter Factory Apartments) 	Not visited	Not known
131 Jonson Street (Ruskin House) 	Not visited	Not known

Butler Street Reserve 	Open Space	Possible noise mounds or noise walls. Areas are forecast to meet criteria at 25m and further back from the road edge (approximate end of the tree line).

Appendix C: Glossary

"Peak" maximum level (LAmax,T).

The peak maximum level is the absolute highest (1 second or less) sound level within the whole of the measurement time.

Event maximum sound pressure level (LA%,adj,T), L01

The L01 level is calculated as the noise level equalled and exceeded for 1% of the measurement time, for example 9 seconds in any 15 minute interval. L01 is an appropriate level to characterise single events, such as from train bypass.

In this Report, the measured L01 levels for day/evening/night are not averaged but are arranged from low to high in the relevant day/evening/night interval and the value that is found at the 90th percentile (L10 of L01 sample) in the interval is recorded as its "L01" level.

Average maximum sound pressure level (LA%,adj, T), L10

The "L10" level is an indicator of "steady-state" noise or intrusive noise conditions from traffic, music and other relatively non-impulsive noise sources. The L10 level is calculated as the noise level equalled and exceeded for 10% the measurement time, for example 90 seconds in any 15 minute interval. The measured L10 time-intervals for day/evening/night are arithmetically averaged to present the "average maximum" levels of the environment for day/evening/night. The level can be adjusted for tonality or impulsiveness.

Background sound pressure level (LA90,T), L90

Commonly called the "L90" or "background" level and is an indicator of the quietest times of day, evening or night. The L90 level is calculated as the noise level equalled and exceeded for 90% the measurement time. The measured L90 time-intervals are arithmetically averaged to present the "average background" levels of the environment for day/evening/night. The level is recorded in the absence of any noise under investigation. The level is not adjusted for tonality or impulsiveness.

Equivalent Continuous or time average sound pressure level (LAeq,T), Leq

Commonly called the "Leq" level it is the logarithmic average noise level from all sources far and near. The maximum 1-hour levels within the day/evening/night time intervals are referenced for building design. The level can be adjusted for tonality.

Façade-adjusted level

A sound level that is measured at a distance of 1.0 metre from a wall or facade. The level is nominally 2.5 dB higher than the free-field level.

Free-field level

A sound level that is measured at a distance of more than 3.5 metres from a wall or facade.