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Epping to Thornleigh Third Track

Noise and Vibration Compliance Assessment Report

Report Number 610.16698-R01

3 October 2017

Transport for NSW

Locked Bag 6501

St Leonards NSW 2065

Version: v1.0

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DOCUMENT CONTROL

Reference	Date	Prepared	Checked	Authorised
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Executive Summary

The Epping to Thornleigh Third Track Project (ETTT) involved the construction of six kilometres of new and upgraded track within the rail corridor between Epping and Thornleigh Stations on the western side of the existing tracks.

Approval to construct and operate the ETTT was granted by the Minister for Planning for Infrastructure on 17 July 2013. The Project is subject to Conditions of Approval (CoA) which include requirements for noise and vibration monitoring and assessment to determine compliance with the noise and vibration objectives in the CoA and to verify the noise predictions and mitigations referenced in the *Epping to Thornleigh Third Track Operational Noise and Vibration* Review[1] (ONVR, 2014) and the addendum[2] to the ONVR (June 2016).

This report details the compliance of the ETTT Project to the noise and vibration CoA at 12 months from the commencement of operations. The assessment of compliance was based on the following methodology and conclusions.

- Consistent with the validation process detailed in the ONVR, SLR revised the noise model inputs for the current and future (year 2026) railway operations, updating train idling operation assumptions at Thornleigh and incorporating the final design of the constructed noise barriers.
- Following validation of the revised noise model, SLR monitored railway noise at 19 locations and vibration at 3 locations along the ETTT corridor in 2017 to quantify noise and vibration emissions associated with railway operations within 12 months of the opening of the ETTT Project.
- Monitored noise levels were compared to the noise predictions for the current operation of the ETTT Project and the noise model was successfully validated in accordance with the ONVR. The noise model was deemed appropriate for the determination of potential noise mitigation requirements.
- Airborne noise levels were predicted at all nearby sensitive receptors and the predicted noise levels for the future operation of the ETTT Project in 2026 assessed against the IGANRIP noise trigger levels to identify any requirements for noise mitigation.
- Noise levels at receptors in the vicinity of the constructed noise barriers achieved the objectives of the IGANRIP and did not trigger the investigation of further mitigation at the noise barrier locations.
- For 2026 operations a total of 22 receptors triggered the investigation of noise mitigation in accordance with the IGANRIP. At each of the 22 receptors, Transport for NSW (TfNSW) has already implemented acoustic property treatments as part of the ETTT Project to mitigate potential noise impacts. It was therefore determined that further noise mitigation in the form of new or extended noise barriers is not required.
- Noise emissions from the fixed facilities, Cheltenham Station and Pennant Hills Station, complied with the objectives of the NSW Industrial Noise Policy.
- Monitored vibration levels complied with the relevant vibration criteria and measures to mitigate ground vibration were not required.

The monitored and predicted noise and vibration level and the implemented noise mitigation measures have been assessed for compliance to the relevant CoA, as summarised in the following table.

[1] SLR Consulting Australia, 2014. Epping to Thornleigh Third Track Operational Noise and Vibration Review – August 2014.
[2] ETTT Alliance, 2016. Operational Noise and Vibration Review Addendum ,June 2016.

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Condition	Condition Requirements	Statement of Compliance
C1	Rail line components of the SSI shall be designed and operated with the objective of not exceeding the airborne and ground-borne noise trigger levels at existing development, at each stage of the SSI, as presented in IGANRIP or RING, whichever is the most conservative. For the purpose of this condition, existing development includes all development that at the date of this approval, has been carried out in the vicinity of the rail corridor and any such development approved prior to the determination of this SSI, but only to the extent that the location of the development is known.	Compliance achieved. Airborne noise levels do not exceed the more stringent IGANRIP triggers at all receptors, with the exception of 5 receptors for 2017 operations and 24 receptors for future operations in 2026. All eligible receptors predicted to trigger the IGANRIP have been provided with property treatments to ameliorate noise impacts. No exceedance of the ground-borne noise trigger levels occurred.
C2	Stationary facilities (including stations) shall be designed and operated with the objective of meeting operational noise levels derived from the NSW Industrial Noise Policy (NSW Government, 2000).	Compliance achieved.
C3	The SSI shall be designed and operated with the objective of not exceeding the vibration goals for human exposure for existing sensitive receptors, as presented in Assessing Vibration: a Technical Guideline (DECC, 2006).	Compliance achieved.
F2	The Proponent shall undertake noise and vibration compliance monitoring and assessments to confirm the predictions of the noise assessment and mitigations referred to in the ONVR (conditions C4). The noise and vibration compliance assessment shall be developed in consultation with the EPA and be undertaken at twelve months, 5 years and 10 years of the commencement of operation of the SSI, or as otherwise agreed by the Director-General. The assessment shall include, but not necessary be limited to:	
a.	*Noise and vibration monitoring and compliance assessment, to assess compliance with conditions C1 to C3 of the approval and the ONVR;*	The noise and vibration levels within 12 months of the ETTT Project opening have been assessed to meet the requirements of conditions C1 to C3.
b.	*An assessment methodology and the outcomes of the Source Noise Monitoring Plan and other relevant Rail Noise Initiatives developed and implemented for the SSI (condition F3);*	The Source Noise Monitoring Plan is managed by TfNSW, as required. TfNSW will provide the current outcomes of the plan.
c.	*Details of any complaints received relating to operational noise and vibration impacts;*	The details of all noise related complaints and enquiries are detailed in **Section 10** of this report.
d.	*An assessment of the performance and effectiveness of the applied noise and vibration mitigation measures;*	The constructed rail noise barriers have controlled rail noise levels to achieve the IGANRIP noise trigger levels at the majority of receptors for the year 2016 (current operations). For the year 2026, a total of 24 residential receptors have been identified for the consideration of property treatments. This is reduced from 40 receptors identified for property treatment in the ONVR.

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Condition	Condition Requirements	Statement of Compliance
e.	*Any required recalibration of the noise and vibration model, including consideration of freight train movements should the average number of night time trains exceed the projected value used for the noise mitigation design of the ONVR; and*	Consistent with the Post Operational Noise Testing and Validation Process the noise and vibration modelling has been updated for the as-constructed noise mitigation barriers, revised daily passenger train numbers for the year 2026, and revised night-time idling train assumptions. The noise prediction modelling has been validated against the monitoring noise levels.
f.	*Identification, if required, of further noise and vibration mitigation measures to meet the requirements of C1 to C3 of the approval and objectives identified in the ONVR.*	All properties eligible for property treatments have received treatments as part of the ETTT Project. No further noise and vibration mitigation is required on the basis of the compliance monitoring 12 months after opening.
F3	The Proponent shall ensure that the rail corridor associated with the SSI is considered in the development of initiatives to managed existing noise across the rail network. Where feasible and reasonable, initiatives that would address the broader rail noise should be implemented as they relate to the SSI corridor. The implementation of these initiatives shall be reported in the Operational Noise and Vibration Compliance and Monitoring Assessment Report (condition F2).	The initiatives implemented by TfNSW are detailed in **Section 9**.

In closing, the assessment has determined that the relevant CoA has been met by the ETTT Project at the initial 12 months from the commencement of operation. On this basis, no further noise mitigation is required to mitigate noise and vibration impacts from current operation. The requirement for further noise and vibration mitigation will be reviewed at 5 years and 10 years from the commencement of operation, as part of the future compliance assessments required by the CoA.

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1 INTRODUCTION

1.1 Epping to Thornleigh Third Track Project

The Epping to Thornleigh Third Track Project (ETTT) involved the construction of six kilometres of new and upgraded track within the rail corridor between Epping and Thornleigh Stations on the western side of the existing tracks.

The new (third) track separates northbound freight from all-stops passenger train movements along the steep incline between Epping and Thornleigh. This will help provide additional capacity for northbound interstate container freight trains, particularly during the daytime when passenger trains currently have priority.

Approval to construct and operate the ETTT was granted by the Minister for Planning for Infrastructure on 17 July 2013. The Project Approval is subject to Conditions of Approval (CoA) which include the requirement for noise and vibration monitoring and assessment to determine compliance to the noise and vibration objectives in the CoA and verify the noise predictions and mitigations referenced in the *Epping to Thornleigh Third Track Operational Noise and Vibration* Review[3] (ONVR, 2014) and the addendum[4] to the ONVR (June 2016).

The Project commenced operations in June 2016, this report details the compliance monitoring and assessment for operational noise and vibration completed within 12 months of the commencement of operation of the Project.

1.2 Noise and Vibration Monitoring and Compliance Assessment

The Conditions relating to operational noise and vibration are contained in the CoA *Schedule C – Environmental Performance* and in *Schedule F – Operational Environmental Management*. The relevant conditions for the compliance monitoring and assessment for noise and vibration are reproduced below in **Table 1**.

Table 1 Conditions of Approval for Operational Noise and Vibration from the ETTT Project

Condition	Condition Requirements
C1	Rail line components of the SSI shall be designed and operated with the objective of not exceeding the airborne and ground-borne noise trigger levels at existing development, at each stage of the SSI, as presented in IGANRIP or RING, whichever is the most conservative. For the purpose of this condition, existing development includes all development that at the date of this approval, has been carried out in the vicinity of the rail corridor and any such development approved prior to the determination of this SSI, but only to the extent that the location of the development is known.
C2	Stationary facilities (including stations) shall be designed and operated with the objective of meeting operational noise levels derived from the NSW Industrial Noise Policy (NSW Government, 2000).
C3	The SSI shall be designed and operated with the objective of not exceeding the vibration goals for human exposure for existing sensitive receptors, as presented in Assessing Vibration: a Technical Guideline (DECC, 2006).
F2	The Proponent shall undertake noise and vibration compliance monitoring and assessments to confirm the predictions of the noise assessment and mitigations referred to in the ONVR (conditions C4). The noise and vibration compliance assessment shall be developed in consultation with the EPA and be undertaken at twelve months, 5 years and 10 years of the commencement of operation of the SSI, or as otherwise agreed by the Director-General.

[3] SLR Consulting Australia, 2014. Epping to Thornleigh Third Track Operational Noise and Vibration Review – August 2014.
[4] ETTT Alliance, 2016. Operational Noise and Vibration Review Addendum ,June 2016.

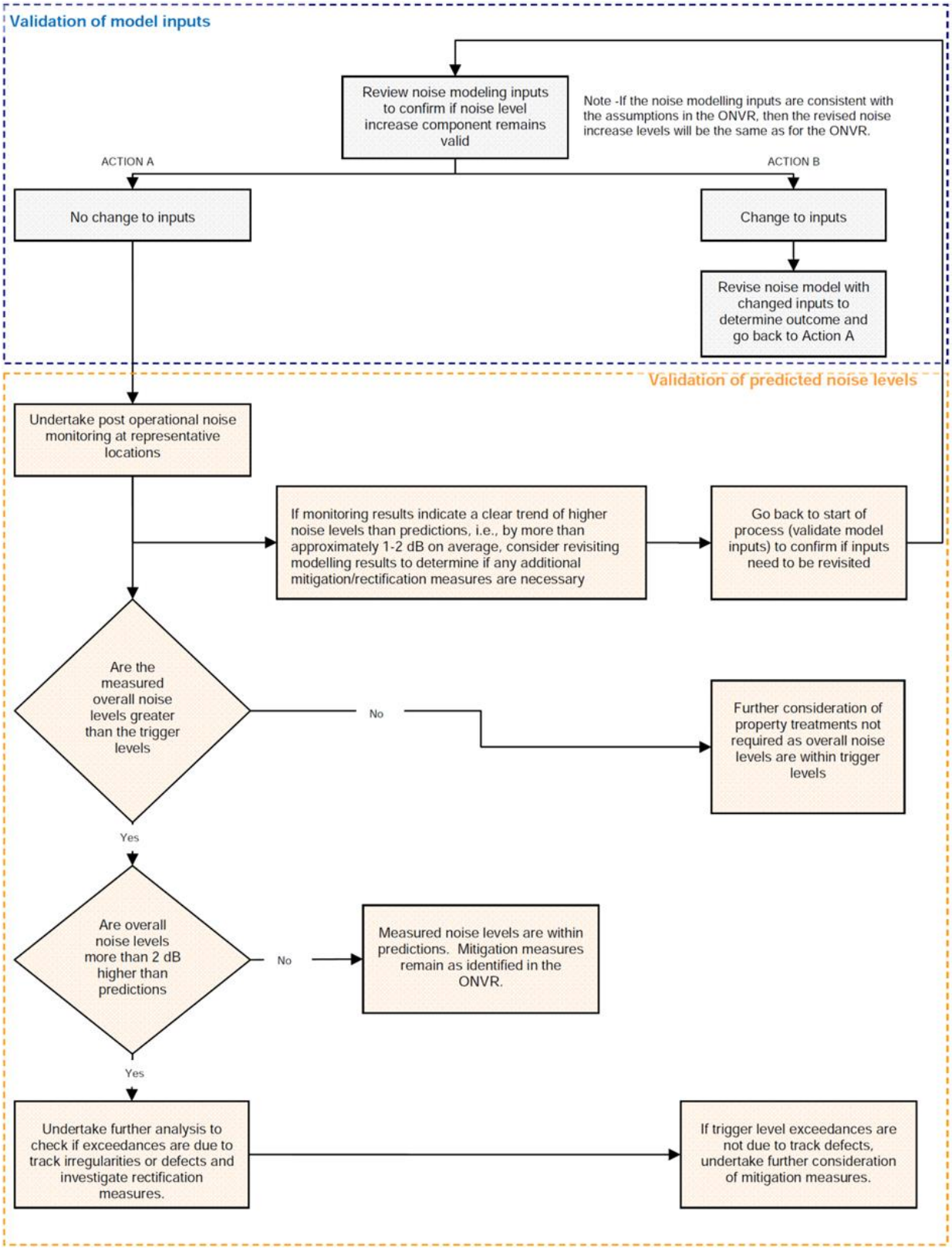
Condition	Condition Requirements
	The assessment shall include, but not necessary be limited to: a. *Noise and vibration monitoring and compliance assessment, to assess compliance with conditions C1 to C3 of the approval and the ONVR;* b. *An assessment methodology and the outcomes of the Source Noise Monitoring Plan and other relevant Rail Noise Initiatives developed and implemented for the SSI (condition F3);* c. *Details of any complaints received relating to operational noise and vibration impacts;* d. *An assessment of the performance and effectiveness of the applied noise and vibration mitigation measures;* e. *Any required recalibration of the noise and vibration model, including consideration of freight train movements should the average number of night time trains exceed the projected value used for the noise mitigation design of the ONVR; and* f. *Identification, if required, of further noise and vibration mitigation measures to meet the requirements of C1 to C3 of the approval and objectives identified in the ONVR.* An Operational Noise and Vibration Compliance Assessment Report providing the results of the assessment shall be submitted to the Director-General and the EPA within 60 days of its completion and made publically available. If the assessment indicates an exceedance of the noise and vibration objectives and predictions identified in the ONVR, the Proponent shall implement further feasible and reasonable measures to mitigate these exceedances in consultation with affected property owners (where required).
F3	The Proponent shall ensure that the rail corridor associated with the SSI is considered in the development of initiatives to managed existing noise across the rail network. Where feasible and reasonable, initiatives that would address the broader rail noise should be implemented as they relate to the SSI corridor. The implementation of these initiatives shall be reported in the Operational Noise and Vibration Compliance and Monitoring Assessment Report (condition F2).

1.3 ONVR Compliance Methodology

The ONVR provides a methodology for the post operational noise and vibration monitoring and the assessment of compliance to the CoA. Consistent with the requirements of CoA F2, the process includes the validation of noise prediction modelling, measurement of noise and vibration levels during operation and verification of any further mitigation measures required to meet the requirements and objectives of the CoA.

The key stages of the compliance methodology are outlined below with a flowchart of the post operational noise process detailed in **Figure 1**.

Figure 1 Post Operational Noise Testing and Validation Process (Source ETTT ONVR)



2 ETTT PROJECT NOISE AND VIBRATION CRITERIA

The CoA determined the noise and vibration requirements for the operation of the ETTT Project. A detailed review of the applicable noise and vibration trigger levels, objectives and criteria was undertaken in the ONVR.

The assessment criteria adopted by the ONVR are reproduced in this section and have been applied for the assessment of noise and vibration level against the requirements of the CoA.

Specific acoustic terminology is used within this report. An explanation of common acoustic terms is included provided in **Appendix A**.

2.1 Noise from Operation of the Rail Line

Condition C1 of the CoA requires the ETTT Project to be designed and operated with the objective of noise not exceeding the airborne noise trigger levels as presented in the *Interim Guideline for the Assessment of Noise from Rail Infrastructure Projects*[5] (IGANRIP) or the *Rail Infrastructure Noise Guideline*[6] (RING), whichever is the most conservative.

The ONVR determined that whilst the noise trigger levels for a redevelopment project were the same within the IGANRIP and RING, the IGANRIP was the more conservative guideline as it requires the assessment of the increase in noise due to the project including growth in rail traffic over time, as well as any immediate increase due to the physical construction of the project. The RING methodology specifically excludes natural growth in traffic, and includes only growth in traffic facilitated by the project.

The application of the IGANRIP as the more conservative guideline was verified in the ONVR through comparison of the receptor locations triggered for consideration of mitigation under the IGANRIP and RING (refer Section 5.8 of the ONVR).

The IGANRIP trigger levels for residential receive locations for a heavy rail redevelopment project are provided in **Table 2** and for other noise sensitive receptor locations in **Table 3**.

Table 2 Heavy Rail Redevelopment Noise Trigger Levels for Residential Land Uses

Type of Development	Residential Noise Trigger Levels, dBA		Commentary
	Daytime	Night-time	
	7.00 am to 10.00 pm	10.00 pm to 7.00 am	
Redevelopment of an existing rail line	Development increases existing rail noise levels, AND Resulting rail noise levels exceed:		These numbers represent level of noise that trigger the need for an assessment of potential noise mitigation measures to reduce noise levels from a rail infrastructure project.
	65 $L_{Aeq(15hour)}$	60 $L_{Aeq(9hour)}$	
	85 L_{Amax}	85 L_{Amax}	An increase in existing rail noise is taken to be an increase of 2.0 dB or more in the L_{Aeq} or an increase of 3.0 dB or more in the L_{Amax}.

Note LAmax refer to the maximum, noise levels not exceeded for 95% of rail pass-by events.

It is noteworthy that the noise trigger levels are very sensitive to small changes in noise levels since a change in the predicted or measured noise level of 0.1 dB can determine if a particular receptor is triggered or not.

[5] NSW Department of Environment and Climate Change, 2007. Interim Guideline for the Assessment of Noise from Rail Infrastructure Projects.
[6] NSW Environmental Protection Authority, 2013. Rail Infrastructure Noise Guideline.

Table 3 Rail Redevelopment Noise Trigger Levels for Other Sensitive Land Uses

Sensitive Land Use	Noise Trigger Levels, dBA (when in use) Redevelopment of Existing Rail Line
Development increases existing rail noise levels by 2.0 dB or more in L_{Aeq}, AND resulting rail noise levels exceed:	
Schools, educational institutions – internal	45 $L_{Aeq(1hour)}$
Places of worship – internal	45 $L_{Aeq(1hour)}$
Hospitals – internal	35 $L_{Aeq(1hour)}$
Hospitals – external	60 $L_{Aeq(1hour)}$
Open space – passive use (eg parkland, bush reserves)	65 $L_{Aeq(15hour)}$
Open space – active use (eg sports field, golf course)	65 $L_{Aeq(24hour)}$

2.2 Ground-borne Noise

Ground-borne noise in buildings adjacent to railway lines is most common in railway tunnel situations where there is an absence of airborne noise to mask the ground-borne noise emissions. The ETTT Project does not include sections of underground railway, for this reason the effect of ground-borne noise will not be significant for the ETTT Project. Consistent with the ONVR, further assessment is not warranted.

2.3 Noise from Fixed Facilities

The ETTT Project included upgrades to Cheltenham Station and Pennant Hills Station. In accordance with CoA C2, the stations are to be designed and operated with the objective of meeting operational noise levels derived from the NSW Industrial Noise Policy[7] (INP).

The ONVR assessed noise levels from the station upgrades and defined the INP noise criteria for station operations in **Table 4**.

Table 4 Summary of Operational Noise Criteria for Station Upgrades

Receptor Type	Assessment Period	Operational Noise Criteria, dBA		
		Intrusive $L_{Aeq,(15minute)}$	Amenity $L_{Aeq,(Period)}$	Sleep Disturbance $L_{A1,(1minute)}$
Residential (South of Pennant Hills Station)	Daytime	48	55	n/a
	Evening	47	45	n/a
	Night-time	43	43	53
Residential (North of Pennant Hills Station)	Daytime	53	55	n/a
	Evening	51	51	n/a
	Night-time	44	49	54
Residential (North of Cheltenham Station)	Daytime	48	55	n/a
	Evening	46	45	n/a
	Night-time	36	40	46
Commercial	When in use	n/a	65	n/a
Educational	When in use	n/a	45[1]	n/a
Active recreation area	When in use	n/a	55	n/a

Note External noise level based on internal levels specified in the INP plus 10 dB (assuming open windows).

[7] NSW Environmental Protection Agency, 2000. NSW Industrial Noise Policy.

2.4 Ground Vibration

CoA C3 requires the ETTT Project to be operated with the objective of not exceeding the vibration goals for human exposure for existing sensitive receptors, as presented in *Assessing Vibration: a Technical Guideline*[8] from the Department of Conservation and Climate Change (now the Environmental Protection Authority).

The guideline applies the Vibration Dose Value (VDV) parameter to assess vibration levels. The VDV is a measure of the total vibration exposure during the daytime and night-time period. It is a cumulative measure and indicates the combined effect of all train passby events within the daytime or night-time periods. The acceptable VDV criteria are provided in **Table 5**.

Table 5 Acceptable Vibration Dose Values for Intermittent Vibration (m/s$^{1.75}$)

Location	Daytime (7.00 am – 10.00 pm)		Night-time (10.00 pm – 7.00 am)	
	Preferred Value	Maximum Value	Preferred Value	Maximum Value
Residence	0.2	0.4	0.13	0.26
Offices, schools, educational institutions & places of worship	0.4	0.8	0.4	0.8

3 UPDATE OF THE NOISE MODELLING INPUTS

3.1 Overview

A rail noise prediction model was developed for the ETTT Project using SoundPLAN (version 7.1) noise prediction software. The predicted rail noise levels for the year 2016 (project opening) and for the year 2026 (10-year post project opening) were used in the ONVR to assess noise levels to the ETTT Project noise criteria and to recommend noise mitigation where required.

After the ONVR was completed in 2014, the detailed design of the rail noise barriers was finalised. The location, extent and height of the as-built noise barriers included some departures from the rail noise barriers assessed in the ONVR, and were reported in the addendum to the ONVR. The recommended rail noise barriers have subsequently been constructed and the as-built rail noise barriers have been incorporated in the noise prediction model.

In addition, the daily passenger rail operations forecast for in 2026 in the ONVR have been updated by Transport for NSW (TfNSW). This update included revisions to the total daily passenger rail movements and the mix of passenger train types that will operate on the ETTT Project. Consequently, the noise model for 2026 was required to be updated for the current forecast of future train operations, in addition to the model updated to incorporate the as-built noise barriers.

The daily freight train operations recorded by the TfNSW Source Noise Monitoring station, adjacent to Sutherland Road at Beecroft, were analysed for March and April 2017. The daytime (7.00 am to 10.00 pm) and night-time (10.00 pm to 7.00 am) freight train operations for April and May 2017 are summarised in **Table 6**. The daytime freight train operations are consistent with the daytime average and peak freight movements in the ONVR. The current night-time freight movements are less than the comparable to the train movements in the ONVR, with the current peak freight movements consistent with the average forecast train movements in the ONVR.

[8] NSW Department of Environment and Conservation, 2006. Assessing Vibration: a technical guideline.

The noise predictions in the ONVR for the daytime correlate well with current daytime freight movements. The night-time noise predictions in the ONVR are conservative for current rail operations and deemed valid for the assessment of noise levels and determination of noise mitigation. The train numbers used for this assessment are the baseline forecasts, i.e. the safety factor on train numbers included in the ONVR assessment as a precaution is not included.

Table 6 Freight Train Numbers from the Source Noise Monitoring Site

Source	Freight Train Numbers per Period (total for the Up and Down tracks)	
	Daytime 7.00 am to 10.00 pm	Night-time 10.00 pm to 7.00 am
ONVR 2016 Daily Freight Forecast Average	14	13
ONVR 2016 Daily Freight Forecast Peak	21	21
Source Noise Monitoring Station April 2017	15 (average) 21 (peak)	9 (average) 15 (peak)
Source Noise Monitoring Station May 2017	15 (average) 20(peak)	8 (average) 14 (peak)

One assumption from the ONVR has been subsequently found to be invalid. The ONVR assumed that freight trains would not idle at the northernmost signal in the project area during the night-time. Monitoring undertaken as part of this compliance assessment process has identified that some freight trains have been idling during the night-time at this location. Therefore, the ONVR model inputs need to be updated to incorporate noise from idling trains at night at this location.

TfNSW has confirmed that all other modelling assumptions from the ONVR remain valid.

The model updates and assessment of rail noise levels with the as-built rail noise barriers, changes to locomotive idling assumptions and the updated daily train operations are discussed below. Using this updated model, the daytime and night-time rail noise levels have been calculated for the following scenarios:

- Year 2016 – to assess compliance of ETTT Project operations at the opening of the project and inform the selection of the noise monitoring locations for the 12-month compliance assessment.
- Year 2026 – to assess compliance to the ETTT Project rail noise criteria for the 10 year planning horizon and confirm the design of rail noise mitigation is appropriate for the long-term control of rail noise at sensitive receptors.

3.2 As-Built Rail Noise Barriers

The addendum to the ONVR addressed the potential difference in rail noise levels between the noise barrier designs assessed for the ONVR and the constructed noise barrier designs. The following changes predicted noise level between the barriers designs and the as-built mitigation were deemed to be acceptable.

- Noise Barrier 1 to the east of Sutherland Road provided the same or better noise attenuation at all but two of the nearby receptors. A negligible deficit in barrier performance of 0.1 dB was predicted at the two locations.
- Noise Barrier 2 is located at the north of the rail corridor between Wongala Crescent, Beecroft and Brecks Way, Pennant Hills. The revised alignment of the barrier reduced the barrier performance and the height of the revised barrier was increased to achieve the same noise performance as the ONVR design.
- The design of as-built Noise Barrier 3 was consistent with the ONVR.

3.3 Revised Passenger Rail Operations for the ETTT Project

The revised daily passenger train numbers forecast supplied by TfNSW for 2026 are detailed in **Table 7**. For reference, the train movements applied in the ONVR are shown in brackets. The freight train operations were confirmed by TfNSW to be unchanged. The freight capacity average includes a safety factor as required by the CoA.

Table 7 Revised 2026 Daily Train Operations for Noise Modelling

Scenario	Train Type	Trains per Weekday Period			
		Day 7.00 am to 10.00 pm		Night 10.00 pm to 7.00 am	
		Up	Down	Up	Down
2026 Build	Electric Passenger	98 (109)	102 (111)	31 (28)	30 (30)
	Diesel Passenger	3 (5)	4 (5)	1 (0)	0 (0)
	Freight capacity daily average	11 (11)	14 (14)	13 (13)	10 (10)

Note: Refer to Table 8 of the ONVR for original modelling assumptions.

Note 1: Freight capacity daily average includes a safety factor as required by the CoA. Forecast daily freight operations have not changed since the time of the ONVR.

The passenger train fleet mix operating through the ETTT Project area has also been revised as per **Table 8**. The passenger train mix at the time of the preparation of the ONVR is shown in brackets.

Table 8 Electric Passenger ETTT Fleet Mix Assumed for Noise Modelling

Train Type	Fleet Mix 2026
Double deck suburban (C/K/S/L/R sets)	0% (1%)
A/M/T/H sets	65% (81%)
V-Set (Intercity)	0% (18%)
New Intercity Fleet	35% (0%)

Note Refer to Table 10 of the ONVR for original modelling assumptions.

The number of express and stopping passenger services has also been revised as per **Table 9** with the ONVR assumptions shown in brackets.

Table 9 Electric Passenger ETTT Express and Stopping Services for Noise Modelling

Train Type	2026	
	Express	Stopping
Double deck suburban (C/K/S/L/R sets)	0% (0%)	0% (100%)
A/M/T/H sets	0% (37%)	100% (67%)
V-Set (Intercity)	0% (100%)	0% (0%
New Intercity Fleet	100% (-)	0% (-)

Note: Refer to Table 11 of the ONVR for original modelling assumptions.

The revised daily train operations in **Table 8** and **Table 9** have introduced the New Intercity Fleet. In lieu of known noise emissions for this train type, it was agreed with TfNSW that the rail noise levels were modelled on the assumption the noise emission from the New Intercity Fleet would be the same as the V-Set train type.

3.4 Revised Train Idling for the ETTT Project

The ONVR assumed that freight services on the down track may be required to stop and stand at Thornleigh between the hours of 8.00 am and 3.00 pm. For ETTT operations in 2016, the ONVR forecast two train idling events each day, with each train consisting of three locomotives and be required, on average, to stand (idle) for 15 minutes.

A review of train idling events at Thornleigh in 2017 confirmed the above assumption to be reasonable for the current daytime train idling. Consequently, no updates were required to modelling of noise emissions from daytime train idling events at Thornleigh.

It was identified that freight trains are currently stopping and idling at Thornleigh during the night-time period of 10.00 pm and 7.00 am. On average there are seven trains idling during the night-time period each week, each train typically consists of three locomotives and the idling time is around 15 minutes on average, but varying up to 30 minutes.

The observed night-time train idling is not consistent with the ONVR which assumed train idling at Thornleigh would occur during the daytime only. TfNSW have confirmed that the current average of seven trains per week idling at Thornleigh is likely to continue in future. An idling time of 30 minutes per night has been determined to be an appropriate revised assumption for night-time train idling in both the 2016 and 2026 scenarios.

On this basis the noise prediction model has been revised to include night-time train idling at Thornleigh for current operations and the future ETTT project operations in 2026. All noise modelling assumptions regarding the location of idling locomotives and the source noise emissions per locomotive were consistent with Section 5.6.9 of the ONVR.

3.5 Predicted Rail Noise Levels – ETTT Project Year 2016

The predicted rail noise levels for the year 2016, including noise from the idling trains, were compared to the noise levels predicted for the 2016 'no build' scenario from the ONVR to identify the predicted change in noise levels with the commencement of the ETTT Project.

The predicted daytime $L_{Aeq(15hour)}$ night-time $L_{Aeq(9hour)}$ and L_{Amax} noise levels were assessed against the IGANRIP trigger levels. The predicted noise levels were above the trigger levels at three residential receptors as detailed in **Table 10**. Predicted noise levels which have triggered the investigation of noise mitigation are highlighted in bold.

A review of the noise prediction model confirmed the L_{Aeq} daytime, L_{Aeq} night-time and L_{Amax} noise levels were dominated by the daily train movements from the ETTT Project. Whilst idling trains at Thornleigh would influence the noise environment at nearby receptors for the duration of an idling events, the relatively low number of idling events were not sufficient to influence the 15-hour daytime and 9-hour night-time L_{Aeq} and L_{Amax} noise levels.

Table 10 Residential Receptors Triggering IGANRIP Year 2016

Receptor	2016 Before Opening[1]			2016 After Opening[2]			Increase Due to Project[3]		
	Day L_{Aeq}	Night L_{Aeq}	L_{Amax}	Day L_{Aeq}	Night L_{Aeq}	L_{Amax}	Day L_{Aeq}	Night L_{Aeq}	L_{Amax}
94 Yarrara Road	60	60	90	63	**63**	91	2.9	2.4	1.6
14 Yarrara Road	58	57	86	60	59	**89**	2.3	2.1	3.4
12 Yarrara Road	57	57	85	59	59	**89**	2.0	1.9	3.9

Note 1: Referenced from the ONVR

Note 2: As predicted with the as-built rail noise barriers.

Note 3: Increase in rail noise levels as required by the IGANRIP.

These predictions are consistent with ONVR which predicted noise levels for the ETTT Project in 2016 would trigger the IGANRIP at the same locations as detailed in **Table 10**. Following the noise mitigation strategy and the review of noise barrier feasibility and reasonability in the ONVR, these three properties were identified for investigation of suitable property treatments on a case by case basis.

The locations predicted to trigger the IGANRIP were referenced in determining the noise monitoring locations for the post operational noise monitoring, discussed further in **Section 4.1**.

3.6 Predicted Rail Noise Levels – ETTT Project Year 2026

The predicted rail noise levels for the year 2026 include the revised passenger train numbers, the as-built rail noise barriers and changes to the assumptions relating to the idling trains at night but exclude the safety factor considered in the ONVR. The revised predicted noise levels were compared to those predicted for the 2016 'no build' scenario in the ONVR to identify the predicted change in noise levels in the longer term after the commencement of the ETTT Project operations.

The predicted daytime $L_{Aeq(15hour)}$ night-time $L_{Aeq(9hour)}$ and L_{Amax} noise levels were assessed against the IGANRIP trigger levels. The predicted noise levels were above the trigger levels at 22 residential receptors as detailed in **Table 11**. Predicted noise levels that trigger the investigation of noise mitigation are highlighted in bold.

Similar to the noise predictions for the ETTT Project in 2016, it was determined that the relatively low number of daily trains idling at Thornleigh did not influence the daytime and night-time L_{Aeq} and L_{Amax} noise levels or increase the number of properties with trigger level exceedances.

Table 11 Residential Receptors Triggering IGANRIP Year 2026

Receptor	2016 Before Opening[1]			2026 After Opening[2]			Increase Due to Project[3]		
	Day L_{Aeq}	Night L_{Aeq}	L_{Amax}	Day L_{Aeq}	Night L_{Aeq}	L_{Amax}	Day L_{Aeq}	Night L_{Aeq}	L_{Amax}
18 The Crescent	61	61	89	62	**63**	90	1.5	2.1	1.2
94 Yarrara Road	60	60	90	62	**63**	91	2.3	2.9	1.3
24 The Crescent	60	61	89	62	**63**	90	1.8	2.0	0.4
58 Yarrara Road	61	61	90	63	**63**	91	2.1	2.5	1.0
56 Yarrara Road	61	61	89	63	**64**	90	2.2	2.6	0.9
28 Yarrara Road	60	61	88	63	**63**	89	2.2	2.5	0.7
26 Yarrara Road	61	61	89	63	**64**	90	2.1	2.5	0.6
1-3 Stevens Street	62	62	91	64	**65**	91	1.9	2.4	0.8
2 Stevens Street	62	62	90	63	**64**	91	1.8	2.3	0.8
22 Yarrara Road	59	58	87	61	**61**	88	1.6	2.4	0.7
18 Yarrara Road	59	58	87	61	**61**	89	1.8	2.7	2.0
16 Yarrara Road	58	58	87	61	**61**	90	2.6	3.4	2.8
14 Yarrara Road	58	57	86	61	**61**	**89**	3.0	3.6	3.4
12 Yarrara Road	57	57	85	60	60	**89**	2.9	3.4	3.9
56 The Crescent	62	62	89	64	**64**	92	1.4	2.0	2.2
102 The Crescent	59	59	88	60	**61**	89	1.7	2.2	0.5
104 The Crescent	58	58	87	60	**61**	88	2.3	2.7	1.0

Receptor	2016 Before Opening[1]			2026 After Opening[2]			Increase Due to Project[3]		
	Day L_{Aeq}	Night L_{Aeq}	L_{Amax}	Day L_{Aeq}	Night L_{Aeq}	L_{Amax}	Day L_{Aeq}	Night L_{Aeq}	L_{Amax}
25 Old Beecroft Road	60	60	88	62	**62**	90	1.7	2.1	1.3
25A Old Beecroft Road	60	60	88	61	**62**	89	1.6	2.1	1.3
29 Old Beecroft Road	61	61	88	63	**63**	90	1.5	2.1	1.5
31 Old Beecroft Road	60	60	88	61	**62**	89	1.7	2.2	1.5
33 Old Beecroft Road	60	60	87	62	**62**	89	1.4	2.0	1.6

Note 1: Referenced from the ONVR

Note 2: As predicted with the as-built rail noise barrier designs.

Note 3: Increase in rail noise levels as required by the IGANRIP.

The ONVR identified a total of 40 residential receptors where 2026 noise levels, with rail noise barriers, were above the IGANRIP trigger levels. The receptors were recommended for consideration of property treatment in the ONVR (refer Section 8.12 of the ONVR).

The revised predicted noise levels have identified 22 properties should be considered for treatment, 18 fewer receptors than identified as being eligible for property treatment in the ONVR. The reduction in the number of predicted residual exceedances of the IGANRIP trigger levels is attributable partly to the as-built design of the rail noise barriers but also to the revised future passenger train numbers which reduced the passenger L_{Aeq} noise emissions by around 1 dB to 2 dB.

The predicted compliance of the ETTT Project to the IGANRIP trigger levels for the year 2026 (future operations) is discussed further in **Section 11**.

4 NOISE AND VIBRATION MONITORING METHODOLOGY

Noise and vibration levels from the ETTT Project were monitored in 2017. The noise and vibration monitoring locations and monitoring methodologies are detailed in this section.

4.1 Noise and Vibration Monitoring Locations

The operational noise monitoring has been undertaken near to the potentially most-affected noise sensitive receptors. The selection of noise and vibration monitoring locations was determined with consideration to the following:

- The assessed noise levels at sensitive receptors as presented in the ONVR, and the revised noise predictions for the year 2016 operations with updates to the model assumptions as discussed in **Section 3**.
- The predicted ground vibration levels at sensitive receptors as presented in the ONVR.
- Locations with tight-radius track curves with potential to cause noise characteristics such as wheel squeal.
- Locations where the rail corridor was visible to assist in the identification of train type, train length, train speed and operation on the up, down and ETTT tracks.
- Avoiding locations where the measurement of rail noise could have been affected by:
    - reflective surfaces and uncharacteristic topography that could screen rail noise emissions at the monitoring location;
    - road traffic noise;
    - other nearby sources of high ambient noise, for example car parks or air-conditioning units.

- Locations where rail noise barriers were constructed as part of the ETTT Project's noise mitigation strategy, to facilitate the verification of barrier effectiveness.
- Locations with safe access for monitoring and with appropriate consent to access private land.

Noise from the ETTT Project Area was monitored at 18 locations and vibration was monitored at three locations, as detailed in **Table 12** and presented in **Figure 2**.

Table 12 Noise and Vibration Monitoring Locations

Location ID	Address Adjacent to Monitoring Location	Details
N1	8 Cambridge Street, Epping	Noise levels monitored at a location representative of the sensitive receptors. Date of monitoring: 6 April 2017
N2	36 Cambridge Street, Epping	Representative location for noise sensitive receptors in Endensor Street. Date of monitoring: 22 March 2017
N3	23 Derby Street, Epping	Representative location for noise sensitive receptors in Derby Street. Date of monitoring: 20 March 2017
V4	25 Old Beecroft Road, Cheltenham	Vibration monitored at a location representative of the highest predicted vibration levels in the ONVR. Date of monitoring: 30 March to 4 April 2017
N5	104 The Crescent, Cheltenham	Representative location for noise sensitive receptors on The Crescent. Date of monitoring: 29 March and 19 May 2017
N6	86 The Crescent, Cheltenham	Representative location for noise sensitive receptors on The Crescent. Date of monitoring: 29 March 2017
N7	32 The Crescent, Cheltenham	Representative location for noise sensitive receptors on The Crescent. Date of monitoring: 24 March 2017
NV8	Cheltenham Scout Hall, Cheltenham	Noise monitoring representative of potential location of curve squeal. Vibration monitored at a location representative of the highest predicted vibration levels in the ONVR. Date of monitoring: 10 May 2017
N9	92 Sutherland Road, Beecroft	Representative of noise sensitive receptors adjacent to tight-radius track curve and Noise Barrier 1. Date of monitoring: 6 April 2017
N10	126 Sutherland Road, Beecroft	Representative of noise sensitive receptors adjacent to tight-radius track curve. Date of monitoring: 18 April 2017
N11	71 Wongala Crescent, Beecroft	Representative of noise sensitive receptors adjacent to tight-radius track curve and Noise Barrier 2. Date of monitoring: 18 April 2017
N12	83 Wongala Crescent, Beecroft	Representative of noise sensitive receptors adjacent to tight-radius track curve and Noise Barrier 2. Date of monitoring: 31 March 2017
N13	3 Wongala Crescent, Pennant Hills	Representative of noise sensitive receptors adjacent to tight-radius track curve. Date of monitoring: 31 March 2017

Location ID	Address Adjacent to Monitoring Location	Details
N14	27 Azalea Grove, Pennant Hills	Representative of noise sensitive receptors adjacent to Azalea Grove. Date on monitoring: 31 March 2017
V15	21 Binomea Place, Pennant Hills	Vibration monitored at a location representative of the highest predicted vibration levels in the ONVR. Date of monitoring: 5 April to 7 April 2017
N16	56 Yarrara Road, Pennant Hills	Representative of locations where modelling in the ONVR for 2016 and 2026 identified potential IGANRIP triggers. Date of monitoring: 8 May 2017
N17	1 Stevens Street, Pennant Hills	Representative of noise sensitive receptors where the ONVR identified exceedance of the IGANRIP in 2026. Date of monitoring: 18 April 2017 and 25 May 2017
N18	Cheltenham Station, Cheltenham	Monitoring of noise from the station (fixed facility) Date of monitoring: 8 May 2017
N19	Pennant Hills Station, Pennant Hills	Monitoring of noise from the station (fixed facility) Date of monitoring: 8 May 2017
N20	14 Yarrara Road, Pennant Hills	Location with idling freight trains and where modelled results for 2016 identified potential trigger of the IGANRIP. Date of monitoring: 23 March to 3 April 2017
N21	Thornleigh Seventh-day Adventist Church	Location with idling freight trains. Date of monitoring: 23 March to 3 April 2017

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ETTT Operational Noise and Vibration Assessment
Noise and Vibration Monitoring Locations

FIGURE 2a

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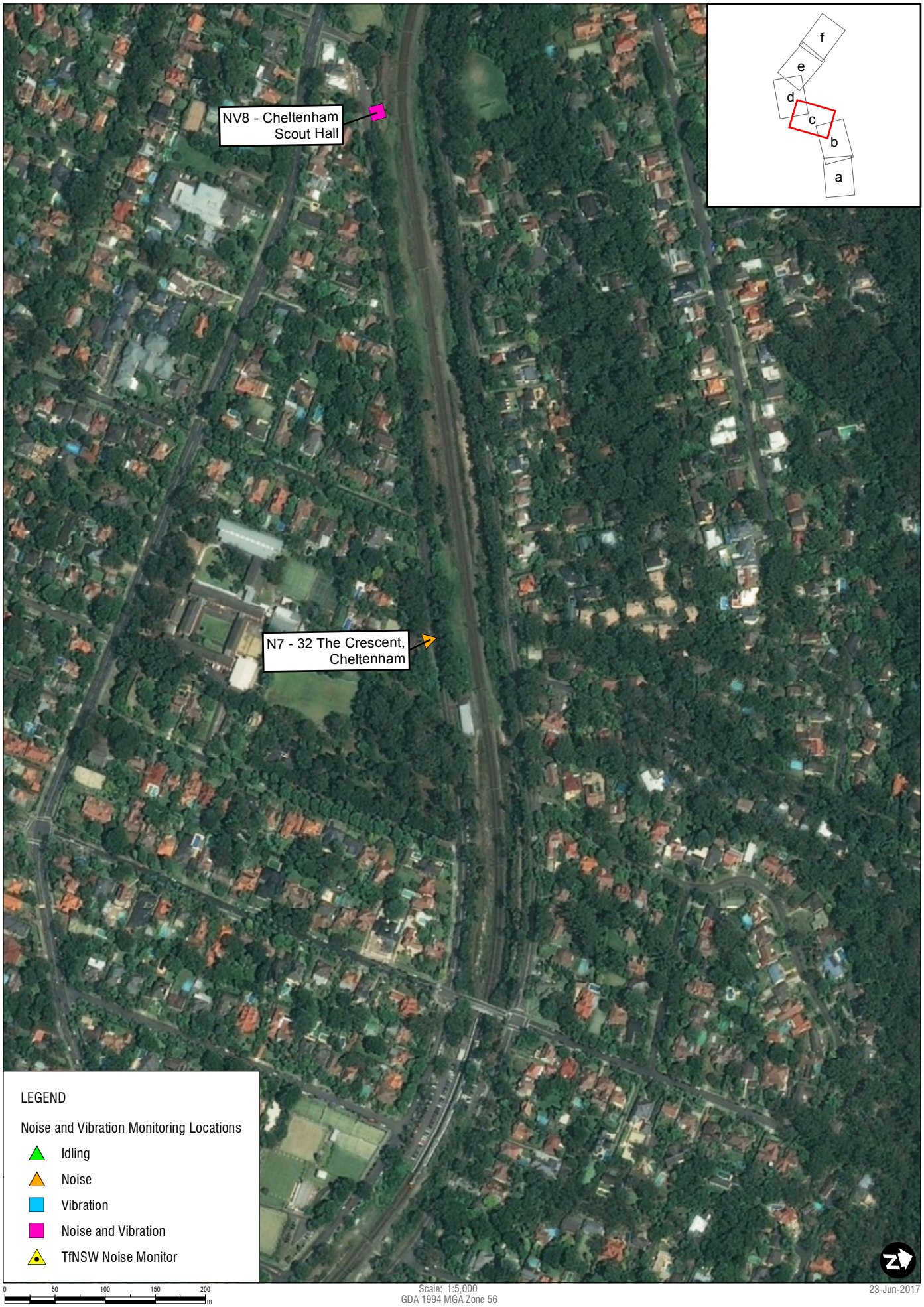
ETTT Operational Noise and Vibration Assessment
Noise and Vibration Monitoring Locations

FIGURE 2b



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ETTT Operational Noise and Vibration Assessment
Noise and Vibration Monitoring Locations

FIGURE 2c

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ETTT Operational Noise and Vibration Assessment
Noise and Vibration Monitoring Locations

FIGURE 2d

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ETTT Operational Noise and Vibration Assessment
Noise and Vibration Monitoring Locations

FIGURE 2e

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ETTT Operational Noise and Vibration Assessment
Noise and Vibration Monitoring Locations

FIGURE 2 f

4.2 Noise Monitoring Methodology

The noise monitoring methodology for this study is outlined in the following sections and has been undertaken in general accordance with Australian Standard AS2377: *Acoustics – methods for the measurement of rail bound vehicle noise*, as recommended by the RING.

4.2.1 Noise Monitoring Equipment

The noise monitoring deployed during the surveys is detailed in **Table 13**. All equipment was classified as a type 1 sound level meters or type 1 noise loggers conforming to Australian Standard AS1259.1-1990 *Sound level meters Part 1: Non-integrating.*

All noise monitoring equipment was calibrated to 94 dBA before each set of measurements with post-calibration confirming a shift in signal not greater than ± 1 dBA.

Table 13 Noise Monitoring Equipment

Equipment	Serial Number	Calibration Due
Brüel & Kjær 2260 Sound Level Meter	2414605	1/06/2018
Brüel & Kjær 2260 Sound Level Meter	2115053	18/10/2018
Brüel & Kjær 2250 Sound Level Meter	3008204	20/08/2017
Brüel & Kjær 2260 Sound Level Meter	2414604	8/07/2018
Brüel & Kjær 2270 Sound Level Meter	3003729	29/09/2017
Svan 957 Sound & Vibration Analyser	27523	4/04/2018
Svan 957 Sound & Vibration Analyser	27522	13/07/2018

Noise levels from train passbys, idling trains and noise from the station (fixed facilities) were measured with the sound level meters set to the Fast response and measuring one-third octave band noise levels between 12.5 Hz to 16 kHz. The sound level meters were operated by SLR's acoustic consultants with passby measurements started when the noise event was audible above the background noise environment and the measurement stopped when the noise event was no longer clearly audible.

Noise loggers were deployed at the same location as the operator attended sound level meters to continuously monitor noise levels and provide a supplementary dataset to cross reference the noise levels measured by the sound level meters.

The microphones of the sound level meters and noise loggers were deployed at a height of 1.5 m ± 0.2m above ground level. All measurements were in the free-field environment with no façade reflections.

4.2.2 Representative Sample of Train Passby Events

All noise measurements were conducted during calm wind conditions (<5m/s) and no precipitation. The noise monitoring at each location was typically undertaken over a 2-hour period to ensure a minimum of 20 train passby events were satisfactorily monitored. The monitoring period was extended when required to ensure that at least one freight train passby event was monitoring at each location. This approach ensured that a representative sample of noise measurements was undertaken as per the RING guidelines.

4.2.3 Analysis of Monitored Noise Levels

The sound level meters and noise loggers monitored L_{Aeq} and L_{Amax} noise levels on the A-weighted scale consistent with the requirements of the RING and AS2377. Monitoring of the L_{Aeq} and L_{Amax} metrics enabled direct comparison of the monitored noise levels to the IGANRIP and INP assessment criteria

Referencing the L_{Aeq} calculation methodology provided in the RING, the monitored noise levels for each train type were applied to calculate the overall L_{Aeq} daytime, L_{Aeq} night-time and L_{Amax} noise levels at each monitoring location.

The L_{Amax} noise levels for passenger trains were derived as the 95th percentile from all the L_{Amax} noise measurements for passenger trains at a location. Due to the lower frequency of freight train operations in the ETTT Project area, the highest L_{Amax} measurement for freight train passby noise was referenced. This approach ensured that the highest noise events associated with freight trains were not diminished by statistical analysis that included lower noise events from passenger trains. Furthermore, it provided a measurement of discrete high noise events such a curve squeal or locomotive exhaust noise.

The methodology applied the derived sound exposure level (L_{AE}) for the individual passenger and freight trains to calculate daily noise levels based on the number of trains in each assessment period (daily rail operations).

4.2.4 Observations

In addition to measuring the noise level from individual trains the following observations were made:

- Time of the train passby/ noise event.
- Rolling stock (train) type.
- Number of cars on passenger trains and the number of wagons on freight trains.
- Direction of travel (i.e. up or down line).
- The time taken for the train to pass a known point was recorded by stopwatch to estimate train speed as a function of the train length and time.
- Observed noise characteristics and any discernible noise source and/or defects that influenced the measurements.

4.3 Vibration Monitoring Methodology

Vibration levels were monitored at three sensitive receptor locations adjacent to the rail corridor. The vibration monitoring was undertaken using a PCB 393A03 IEPE accelerometer (serial number 23249) connected to a Rion DA-21 digital data recorder (serial number 01040132).

Unweighted time domain data was recorded continuously with a sampling frequency of 256 Hz, with anti-aliasing filters providing usable data up to 100 Hz. At each location, the accelerometer was magnetically mounted to a small stake which was driven into the earth such that the base of the accelerometer was flush with the surface of the earth, as shown in **Figure 3**. The stake was directly adjacent to the rail corridor to measure vibration from train passby events.

The vibration measurements were undertaken over a minimum 48-hour period at each monitoring location. The monitored vibration levels for the full monitoring period were then post-processed to calculate Vibration Dose Values (VDVs) in accordance with the requirements of the DECC guideline. The guideline is based on the British Standard BS 6472-1992, which fully describes the Vibration Dose Value and its respective calculation.

The VDV for the monitoring period were compared to the VDV assessment criteria from the DECC guideline as per CoA C3 (refer to **Table 1**).

Figure 3 Accelerometer Installation

5 NOISE MODEL VALIDATION

The Post Operational Noise Testing and Validation Process (**Figure 1**) required the monitored noise levels at representative locations to be compared to the predicted noise levels. If monitored noise levels identify a clear trend of being higher than the predicted noise levels, i.e. by more than approximately 1 dBA to 2 dBA on average, then the noise modelling should be reviewed.

The noise levels monitored adjacent to the rail lines in 2017 are detailed in the noise monitoring field sheets in **Appendix B**. For each location, the field sheets detail the individual train passby noise levels along with the commentary on any observed noise characteristics.

The noise levels monitored in 2017 have been compared to the noise prediction modelling for the ETTT Project for the year 2016 in **Section 3.5**, as this provides the closest comparison of predicted noise levels for the rail operations at the time of the 2017 noise monitoring. Further comparison has been undertaken between the freight noise levels monitoring by TfNSW's Source Noise Monitoring site

5.1 Noise Model Validation – ETTT Project 2016

As discussed above, the monitored SEL and L_{Amax} noise levels were applied to calculate daytime and night-time L_{Aeq} noise levels and the 95th percentile L_{Amax} noise levels at each monitoring location. The noise prediction model for the ETTT Project in the year 2016 was utilised to predict free-field rail noise levels at each monitoring location to allow direct comparison between monitored noise levels and predicted noise levels.

The calculated noise levels from the monitored noise levels are provided in **Table 14** along with the 2016 predicted noise levels. The monitored and predicted noise levels are presented for the locations where train passby noise levels and train idling noise levels were monitored as these rail operations are assessed under the IGANRIP.

Monitored noise levels from train idling at Pennant Hills and the noise levels monitored from Cheltenham Station and Pennant Hills Station (fixed facilities) are discussed in **Section 6**.

Table 14 Validation of the ETTT Project Noise Model

Monitoring Location		Rail Noise Levels from 2017 Noise Monitoring, dBA			Predicted ETTT Noise Levels Year 2016, dBA			Noise Model Validation[1], dBA		
		L_{Aeq} Day	L_{Aeq} Night	L_{Amax}	L_{Aeq} Day	L_{Aeq} Night	L_{Amax}	L_{Aeq} Day	L_{Aeq} Night	L_{Amax}
N1	8 Cambridge Street	57	56	89	62	61	87	+5	+5	-2
N2	36 Cambridge Street	60	60	80	62	60	85	+2	0	+5
N3	23 Derby Street	61	62	90	59	59	85	-2	-35	-5
N5	104 The Crescent	57	56	85	61	60	90	+4	+4	+5
N6	86 The Crescent	55	53	79	60	59	88	+4	+6	+9
N7	32 The Crescent	60	61	88	61	64	89	+1	+3	+1
N8	Cheltenham Scout Hall	65	66	98	64	64	93	-1	-2	-5
N9	92 Sutherland Road	66	67	95	66	66	103	0	-1	+8
N10	126 Sutherland Road	59	59	86	62	62	98	+3	+3	+12
N11	71 Wongala Crescent	56	57	85	55	55	91	-1	-2	+6
N12	83 Wongala Crescent	56	57	81	54	54	89	-2	-3	+8
N13	3 Wongala Crescent	61	62	85	61	60	88	+9	-2	+3
N14	27 Azalea Grove	50	51	68	47	47	76	+-2	-4	+8
N16	56 Yarrara Road	57	58	83	61	61	89	+3	3	+6
N17	1 Stevens Street	60	58	85	64	61	91	+4	+5	+6
				Arithmetic average difference between modelled and monitored rail noise levels				**+1**	**+1**	**+4**
Source Noise Monitoring Site – April 2017[2]		71	71	99	73	75	114	+2	+4	+15
Source Noise Monitoring Site – May 2017[2]		71	71	100	73	75	114	+2	+4	+14
		Arithmetic average difference between modelled and monitored rail noise levels at the TfNSW Source Noise Monitoring Site						**+2**	**+4**	**+15**

Note 1: A positive difference denotes the modelled noise levels were higher than the monitored noise levels.

Note 2: The LAeq and L_{Amax} noise levels from the TfNSW Source Noise Monitoring Site are for freight train noise levels only.

The ONVR noise model was validated against noise levels for the ETTT Project Environmental Impact Statement (EIS) and further monitoring undertaken for the ONVR. At that time, it was concluded that the noise model predicted rail noise levels higher than the monitored noise levels at some receptor locations by up to 2 dB L_{Aeq} daytime, 3 dBA L_{Aeq} night-time and by 3 dBA L_{Amax}.

At Sutherland Road the ONVR noise model validation identified an over prediction of L_{Amax} noise levels by 12 dBA.

It can be seen from **Table 14** that the predicted noise levels are, on average, up to 1 dBA L_{Aeq} daytime, 1 dBA L_{Aeq} night-time and 4 dBA L_{Amax} higher than the monitored noise levels. The higher over-prediction of up to 12 dB L_{Amax} at Sutherland Road remains evident in the noise model validation undertaken in 2017. By way of explanation for the higher predicted noise levels, Section 5 of the ONVR provides extensive discussion on the sensitivity of the noise prediction modelling to key factors such as train speed, locomotive notch settings, the noise source emission levels, rail roughness and the application of correction factors for location specific noise characteristics, such as curve squeal.

The monitored L_{Aeq} freight noise levels at the Source Noise Monitoring Site are 2 dBA to 4 dBA lower than the predicted noise levels at the Monitoring Site. This is understandable as the Source Noise Monitoring Site is located within 10 m of the nearest rail track with the microphone installed at a height representative of the freight train exhausts. The noise model prepared for the ONVR was validated against noise measurements made outside the rail corridor rather than near-field source measurements. Notwithstanding, the noise modelling is again showing a trend for over-prediction compared to measured rail noise levels.

Overall, the 2017 monitored rail noise levels are found to be consistent with the ONVR assessment. In accordance with the validation process the noise model is deemed appropriate for the forecast of property treatments and the noise model inputs do not need to be reviewed.

5.2 Noise Model Validation – Idling Trains at Thornleigh

The monitored noise levels at noise monitoring locations N20 14 Yarrara Road and N21 Thornleigh Seventh-day Adventist Church were analysed to identify the noise level from individual freight trains idling at Thornleigh.

Noise levels at these locations in the free-field at the northern boundary of the rail corridor were monitored continuously over a 12-day period and the average L_{Aeq} noise level during a train idling event is detailed in **Table 15**. The L_{Aeq} noise levels are for night-time idling events only because the daytime noise environment was at times influenced by road traffic noise which limited the monitoring of noise from idling trains.

The predicted noise emission levels for a train idling event at each monitoring location are provided in **Table 15**, the noise model validates to within 1 dBA of the monitoring noise emissions levels. The noise model for train idling events has been validated consistent with the ONVR validation process.

Table 15 Validation of the ETTT Model – Train Idling at Thornleigh

Monitoring Location	Average Monitored L_{Aeq} Noise Level during Idling Event, dBA	Average Predicted L_{Aeq} Noise Level during Idling Event, dBA	Noise Model Validation, dBA
N20 14 Yarrara Road	66	66	0
N21 Thornleigh Seventh-day Adventist Church	65	64	-1
Arithmetic average difference between monitored and predicted noise levels			**>-1 dB**

6 MONITORED NOISE LEVELS FROM FIXED FACILITIES

6.1 Cheltenham Station

Noise levels were monitored at Cheltenham Station on 8th May 2017 at 7.10 pm. The noise monitoring location was approximately 20 m from the nearest Station platform. The nearest sensitive receptors to the north are located approximately 50 m form the nearest platform.

At the time of the monitoring survey, the PA system was the only audible source of noise from the station during the noise monitoring. During the noise monitoring period the majority of PA announcements were not clearly audible at 20 m from the station. This was in part due to other noise sources from the station, including patrons accessing the station car park and the arrival and departure of trains.

A 15-minute statistical noise level of 59 dBA L_{Aeq} and 48 dBA L_{A90} were monitored at the monitoring location. Of the audible PA announcements, noise levels were monitored at 47 dBA at the monitoring location.

Based on a typical PA announcement duration of 10 seconds the noise contribution from the PA system has been calculated to be less than 30 dBA $L_{Aeq(15minute)}$ at the nearest receptors to the north of the station, allowing for at least 10 PA announcements per 15-minute period.

Compared to the noise predictions undertaken for the ONVR, the calculated noise levels are at least 10 dBA lower than predicted. The reason for this variance is considered to be the assumption that the PA systems would have an auto-gain function to elevated PA noise to be at least 10 dBA above the ambient noise level measured outside of the station premises. This assumption is conservative based on the monitored PA noise levels.

The monitored and calculated noise from the station has been assessed to comply with the daytime, evening and night-time intrusive and amenity criteria and sleep disturbance screening criteria from the INP (refer **Table 4**) at all nearby sensitive receptors. This outcome is consistent with the findings of the ONVR.

6.2 Pennant Hills Station

Noise levels were monitored at Pennant Hills Station on 8th May 2017 at 8.30 pm. The noise monitoring location was approximately 29 m from the nearest Station platform which is representative of the distance to the nearest sensitive receptors from the north of the station.

The PA system was the only audible source of noise from the station during the noise monitoring. At times when the ambient road traffic noise on Yarrara Road was negligible, the PA system was not always clearly audible at the noise monitoring location and was not audible above the noise from arriving and departing trains.

A 15-minute statistical noise level of 61 dBA L_{Aeq} and 52 dBA L_{A90} were measured at the monitoring location with at least five audible PA announcements occurring during the monitoring period. The audible PA noise contribution from an individual announcement was monitored to be not greater than 50 dBA at the monitoring location.

Based on a PA announcement of 10 seconds duration the noise contribution from the PA system has been calculated to be 40 dBA $L_{Aeq(15minute)}$ at the nearest receptors to the north of the station, if there are up to 10 PA announcements per 15-minute period.

The nearest sensitive receptors to the south are located approximately 125 m from the station. At this distance the PA noise contribution has been calculated to be 33 dBA $L_{Aeq(15minute)}$.

The calculated noise levels are at least 5 dBA lower than predicted. Similar to the assessment of noise for Cheltenham Station, the reason for this variance is the conservative assumption made in the ONVR that the PA systems would have an auto-gain function to elevate PA noise to be at least 10 dBA above the ambient noise level measured outside of the station premises.

The monitored and calculated noise from the station has been assessed to comply with the daytime, evening and night-time intrusive and amenity criteria and sleep disturbance screening criteria from the INP (refer **Table 4**) at all nearby sensitive receptors. This outcome is consistent with the findings of the ONVR.

7 MONITORED VIBRATION LEVELS FROM RAILWAY OPERATIONS

Ground vibration was monitored at three locations indicative of the locations where the ONVR identified the highest vibration levels may be experienced. At all three locations the VDV levels were negligible and well within the nominated vibration objectives from the DECC guideline referenced in CoA C3.

The monitored vibration levels at each location are presented in **Table 16**. It can be seen from the table that all vibration levels comply with the most stringent 0.13 $m/s^{1.75}$ night-time VDV objective from the DECC guideline.

Accordingly, at all times the potential vibration from the ETTT Project has been assessed to comply with the vibration goals for human comfort from the DECC guideline.

Table 16 Monitored Vibration Dose Values for the ETTT Project

Monitoring Location	Vibration Dose Values During Train Passby Events, $m/s^{1.75}$	
	Daytime	**Night-time**
NV4 25 Old Beecroft Road	0.014	0.009
NV8 Cheltenham Scout Hall	0.021	0.021
NV15 21 Binomea Place	0.012	0.008

8 RECOMMENDATION FOR MITIGATION

8.1 Noise Barriers

Analysis of the revised noise model predictions for 2026 determined the noise levels at all receptors in the locality of Noise Barrier 1, Noise Barrier 2 and Noise Barrier 3 meet the IGANRIP noise levels and do not trigger the investigation of further noise mitigation.

8.2 Property Treatment

Consistent with the ONVR, TfNSW is to consider the treatment of property where noise levels trigger the investigation of noise mitigation under the IGANRIP and rail noise barriers are deemed to not be reasonable or feasible.

For the future rail noise levels predicted for 2026, a total of 22 residential properties could be eligible for property treatment. The properties eligible for property treatment are identified in **Table 17**.

At the time of this report TfNSW had provided acoustic treatment to 40 properties as part of the ETTT Project, these properties are listed in **Appendix C**. All properties in **Table 17** have been provided acoustic treatment as part of the ETTT Project.

Table 17 Locations of Properties Eligible for Treatment

Proposed Property Treatment Locations				
18 The Crescent[1]	28 Yarrara Road[1]	18 Yarrara Road[1]	102 The Crescent[1]	31 Old Beecroft Rd[1]
94 Yarrara Road[1]	26 Yarrara Road[1]	16 Yarrara Road[1]	104 The Crescent[1]	33 Old Beecroft Rd[1]
24 The Crescent[1]	1-3 Stevens Street[1]	14 Yarrara Road[1]	25 Old Beecroft Rd[1]	-
58 Yarrara Road[1]	2 Stevens Street[1]	12 Yarrara Road[1]	25A Old Beecroft Rd[1]	-
56 Yarrara Road[1]	22 Yarrara Road[1]	56 The Crescent[1]	29 Old Beecroft Rd[1]	-

Note 1 Property treatment has been provided as part of the ETTT Project.

Based on the assessment of railway noise in the ONVR and this compliance assessment and the property treatments provided as part of the ETTT Project, no further property treatments are deemed to be required. It is recommended that TfNSW review the requirement for property treatments at time of the future noise and vibration compliance assessments required by the CoA.

9 RAIL NOISE INITIATIVES

TfNSW has advised SLR of the following rail noise initiatives that have been implemented as part of the ETTT project and the broader management of rail noise on the network.

9.1 Noise Monitoring Station

A noise monitoring station has been installed in Beecroft to provide real time publically accessible noise levels for passing freight movements. The data from the monitoring station has successfully allowed for noisier locomotives and wagons to be identified. The community has been able to monitor rail noise levels, identify individual freight movements and direct noise complaints to the private freight operators that are responsible.

The monitoring station has now been handed over to Sydney Trains for ongoing maintenance and operation, and will continue to monitor noise levels for the passing train movements.

9.2 Track Lubrication

Track lubricants have been installed and commissioned in accordance with ASA standard T-HR-TR-00111 ST Rail Lubrication. The ETTT area is the first section of track to be covered by a lubrication system that complies with this new standard.

TfNSW advised that the lubricators have continued to provide comprehensive coverage of the entire track section between Epping and Thornleigh. The lubricators are being maintained by Sydney Trains.

9.3 Freight Wagon Steering

The poor steering from freight wagons can be a key cause of wheel squeal. A new revision of ASA standard THR-RS-004-00ST Freight Vehicle Specific Interface Requirements will apply from 1 January 2018. The new steering requirements will see freight wagons progressively upgraded over the next 10 years to improve steering through curves and minimise the incidence of wheel squeal.

9.4 Publication of the Locomotive Noise Report

A report on high noise locomotives has been prepared and published on the TfNSW website. The report details noise measurements of more than 600 trains recorded under a range of operational conditions at six locations across the network, including at Cheltenham. The report provides the public with information on the noise emissions from train movements on the network.

9.5 Freight Noise Attenuation Program

To reduce the impact of high freight noise levels, the ETTT project provided acoustic treatments to eligible residences (refer **Appendix C**).

Similar to the acoustic treatments provided for the ETTT project, TfNSW launched the Freight Noise Attenuation Program (FNAP) in late 2015 as an initiative to assist in minimising the impact of freight noise. The FNAP is being progressively rolled out across the NSW Government managed rail network, with priority treatments given to areas experiencing the highest night time rail noise levels.

Whilst not specific to the ETTT, freight noise attenuation may be provided to neighbouring communities that are currently raising concerns about freight noise. Some areas adjacent to the ETTT project have already been assessed as eligible for the program and treatments will be provided in the coming years.

9.6 Strategic Noise Action Plan

TfNSW is implementing a range of at-source noise control programs under the Strategic Noise Action Plan to minimise the emission of rail noise. This includes partnerships with freight operators to fast-track the upgrade of freight wagon bogies to reduce wheel squeal.

10 ETTT PROJECT COMPLAINTS MANAGEMENT SYSTEM

TfNSW has received a total of 32 noise and vibration related complaints since the opening of the ETTT Project and May 2017. A review of the available complaint information identified the following breakdown of the nature of the noise complaints.

- A total of 23 complaints were received in relation to disturbance from noise emissions from idling trains at Pennant Hills/ Thornleigh.
- A total of six complaints were based on disturbance from discrete noise events from freight trains, such as train horns and freight train locomotives.
- Two complaints were received relating to wheel-squeal noise.
- One complaint was received relating to vibration from trains potentially causing property damage.
- One complaint was received regarding general rail noise and sought confirmation if a rail noise barrier was to be constructed in the local area.

It is noted that, whilst specific property addresses for the complaints regarding idling trains at Pennant Hills/ Thornleigh were not provided, many of the properties on Yarrara Road that area immediately adjacent to the idling trains have been provided property treatment as part of the ETTT Project.

11 COMPLIANCE TO THE CONDITIONS OF APPROVAL

11.1 Noise from Railway Operations on the ETTT Project (Condition C1)

Based on the noise predictions for the year 2016; all but three receptors at Yarrara Road comply with the IGANRIP. This outcome is consistent with the ONVR and the three properties are considered to be eligible for the investigation of property treatments.

Future rail noise levels for year 2026, comply with the IGANRIP at all receptors except 22 residential properties, as listed in **Table 11** which are triggered for the investigation of noise mitigation in accordance with the ONVR.

The properties identified as being eligible for property treatment have already received property treatments as part of the ETTT Project. It is concluded that the rail noise barriers constructed for the ETTT Project have provided effective control of noise from railway operations and any residual noise impacts have been addressed by the property treatments.

11.2 Noise from Fixed Facilities (Condition C2)

The monitored noise levels at Cheltenham Station and Pennant Hills Station were applied to calculate noise from the station PA systems at the nearest sensitive receptors. Noise levels have been assessed to comply with the noise criteria derived from the INP. Accordingly, the requirements of Condition C2 have been met by the ETTT Project.

11.3 Vibration Levels from Railway Operations on the ETTT Project (Condition C3)

The vibration levels monitored during train passby events complied with the vibration goals for human exposure specified in DECC guideline referenced in CoA C3. The requirements of CoA C3 have been met by the ETTT Project.

11.4 Requirements of Condition F2

Condition F2 includes requirements for the management of operational noise and vibration from the ETTT Project. Each requirement, and an assessment of compliance, is provided in **Table 18**.

Table 18 Statement of Compliance to CoA F2

Condition F2 Requirements	Statement of Compliance
The Proponent shall undertake noise and vibration compliance monitoring and assessments to confirm the predictions of the noise assessment and mitigations referred to in the ONVR (conditions C4). The noise and vibration compliance assessment shall be developed in consultation with the EPA and be undertaken at twelve months, 5 years and 10 years of the commencement of operation of the SSI, or as otherwise agreed by the Director-General. The assessment shall include, but not necessary be limited to:	
a. *Noise and vibration monitoring and compliance assessment, to assess compliance with conditions C1 to C3 of the approval and the ONVR;*	The noise and vibration levels within 12 months of the ETTT Project opening have been assessed to meet the requirements of conditions C1 to C3.
b. *An assessment methodology and the outcomes of the Source Noise Monitoring Plan and other relevant Rail Noise Initiatives developed and implemented for the SSI (condition F3);*	The rail noise initiatives, including the Source Noise Monitoring Plan are detailed in **Section 9**
c. *Details of any complaints received relating to operational noise and vibration impacts;*	The details of all noise related complaints and enquiries are detailed in **Section 9** of this report.
d. *An assessment of the performance and effectiveness of the applied noise and vibration mitigation measures;*	The constructed rail noise barriers have controlled rail noise levels to achieve the IGANRIP noise trigger levels at the majority of receptors for the year 2016 (current operations). For the year 2026, a total of 24 residential receptors have been identified for consideration of eligibility for property treatments. This is reduced from 40 receptors identified for property treatment in the ONVR.
e. *Any required recalibration of the noise and vibration model, including consideration of freight train movements should the average number of night time trains exceed the projected value used for the noise mitigation design of the ONVR; and*	Consistent with the Post Operational Noise Testing and Validation Process the noise and vibration model has been updated with the as-constructed noise barriers, revised daily passenger train numbers for the year 2026 and revised idling train assumptions. The noise prediction modelling has been validated against the monitoring noise levels.

Condition F2 Requirements	Statement of Compliance
f. Identification, if required, of further noise and vibration mitigation measures to meet the requirements of C1 to C3 of the approval and objectives identified in the ONVR.	All properties deemed eligible for property treatments have received treatments as part of the ETTT Project. No further noise and vibration mitigation has been deemed necessary.

11.5 Requirements of Condition F3

Condition F3 includes requirements for the future management of rail noise associated with the ETTT project and the wider rail network, as detailed in **Table 19**. Based on the initiatives implemented by TfNSW, compliance to the Condition F3 is considered to be achieved.

Table 19 Statement of Compliance to CoA F3

Condition F3 Requirements	Statement of Compliance
Proponent shall ensure that the rail corridor associated with the SSI is considered in the development of initiatives to managed existing noise across the rail network. Where feasible and reasonable, initiatives that would address the broader rail noise should be implemented as they relate to the SSI corridor. The implementation of these initiatives shall be reported in the Operational Noise and Vibration Compliance and Monitoring Assessment Report (condition F2).	Detailed in **Section 9** of this report, TfNSW has implemented a number of initiatives, specific to the ETTT project and the broader rail network to manage rail noise.

12 CONCLUSION

This operational noise and vibration compliance assessment was undertaken 12 months from the commencement of the ETTT Project. In accordance with the methodology outlined in the ONVR, the noise prediction model has been updated and validated and the predicted noise levels deemed appropriate for the determination of potential noise mitigation requirements.

The noise levels at receptors nearby to Noise Barrier 1, Noise Barrier 2 and Noise Barrier 3 all comply with the IGANRIP and in this regard the as-built noise barriers are considered to have adequately controlled current noise levels.

The rail noise predictions for the year 2026 meet the requirements of the IGANRIP, as required by CoA C1, but trigger the investigation of noise mitigation under the IGANRIP at 22 properties. It was confirmed by TfNSW that property treatment has been provided to a total 40 properties as part of the ETTT Project, including the 22 properties deemed eligible by this compliance assessment.

The noise emissions from the upgraded Cheltenham Station and Pennant Hills Station have been assessed to meet the requirements of A C2. All monitored vibration levels complied with the vibration objectives and criteria specified in CoA C3.

All requirements of CoA F2 are considered to have been met. It is concluded that no further noise or vibration mitigation is required for the ETTT Project based on the monitoring undertaken after opening. The requirement for further noise and vibration mitigation will be periodically reviewed as part of the future compliance assessments required by the CoA.

ACOUSTIC TERMINOLOGY

1 Sound Level or Noise Level

The terms "sound" and "noise" are almost interchangeable, except that in common usage "noise" is often used to refer to unwanted sound.

Sound (or noise) consists of minute fluctuations in atmospheric pressure capable of evoking the sense of hearing. The human ear responds to changes in sound pressure over a very wide range. The loudest sound pressure to which the human ear responds is ten million times greater than the softest. The decibel (abbreviated as dB) scale reduces this ratio to a more manageable size by the use of logarithms.

The symbols SPL, L or L_P are commonly used to represent Sound Pressure Level. The symbol L_A represents A-weighted Sound Pressure Level. The standard reference unit for Sound Pressure Levels expressed in decibels is 2×10^{-5} Pa.

2 "A" Weighted Sound Pressure Level

The overall level of a sound is usually expressed in terms of dBA, which is measured using a sound level meter with an "A-weighting" filter. This is an electronic filter having a frequency response corresponding approximately to that of human hearing.

People's hearing is most sensitive to sounds at mid frequencies (500 Hz to 4000 Hz), and less sensitive at lower and higher frequencies. Thus, the level of a sound in dBA is a good measure of the loudness of that sound. Different sources having the same dBA level generally sound about equally loud.

A change of 1 dBA or 2 dBA in the level of a sound is difficult for most people to detect, whilst a 3 dBA to 5 dBA change corresponds to a small but noticeable change in loudness. A 10 dBA change corresponds to an approximate doubling or halving in loudness. The table below lists examples of typical noise levels

Sound Pressure Level (dBA)	Typical Source	Subjective Evaluation
130	Threshold of pain	Intolerable
120	Heavy rock concert	Extremely noisy
110	Grinding on steel	
100	Loud car horn at 3 m	Very noisy
90	Construction site with pneumatic hammering	
80	Kerbside of busy street	Loud
70	Loud radio or television	
60	Department store	Moderate to quiet
50	General Office	
40	Inside private office	Quiet to very quiet
30	Inside bedroom	
20	Recording studio	Almost silent

Other weightings (eg B, C and D) are less commonly used than A-weighting. Sound Levels measured without any weighting are referred to as "linear", and expressed as dB(lin) or dB.

3 Sound Power Level

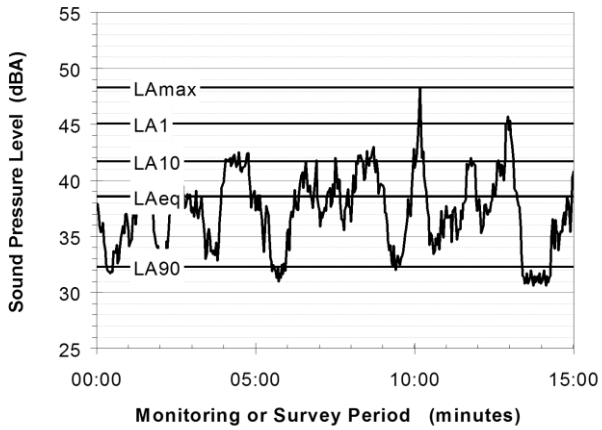
The Sound Power of a source is the rate at which it emits acoustic energy. As with Sound Pressure Levels, Sound Power Levels are expressed in decibel units (dB or dBA), but may be identified by the symbols SWL or Lw, or by the reference unit 10^{-12} W.

The relationship between Sound Power and Sound Pressure may be likened to an electric radiator, which is characterised by a power rating, but has an effect on the surrounding environment that can be measured in terms of a different parameter, temperature.

4 Statistical Noise Levels

Sounds that vary in level over time, such as road traffic noise and most community noise, are commonly described in terms of the statistical exceedance levels L_{AN}, where L_{AN} is the A-weighted sound pressure level exceeded for N% of a given measurement period. For example, the L_{A1} is the noise level exceeded for 1% of the time, L_{A10} the noise exceeded for 10% of the time, and so on.

The following figure presents a hypothetical 15 minute noise survey, illustrating various common statistical indices of interest.



Of particular relevance, are:

L_{A1} The noise level exceeded for 1% of the 15 minute interval.

L_{A10} The noise level exceed for 10% of the 15 minute interval. This is commonly referred to as the average maximum noise level.

L_{A90} The noise level exceeded for 90% of the sample period. This noise level is described as the average minimum background sound level (in the absence of the source under consideration), or simply the background level.

L_{Aeq} The A-weighted equivalent noise level (basically the average noise level). It is defined as the steady sound level that contains the same amount of acoustical energy as the corresponding time-varying sound.

When dealing with numerous days of statistical noise data, it is sometimes necessary to define the typical noise levels at a given monitoring location for a particular time of day. A standardised method is available for determining these representative levels.

This method produces a level representing the "repeatable minimum" L_{A90} noise level over the daytime and night-time measurement periods, as required by the EPA. In addition the method produces mean or "average" levels representative of the other descriptors (L_{Aeq}, L_{A10}, etc).

5 Tonality

Tonal noise contains one or more prominent tones (ie distinct frequency components), and is normally regarded as more offensive than "broad band" noise.

6 Impulsiveness

An impulsive noise is characterised by one or more short sharp peaks in the time domain, such as occurs during hammering.

7 Frequency Analysis

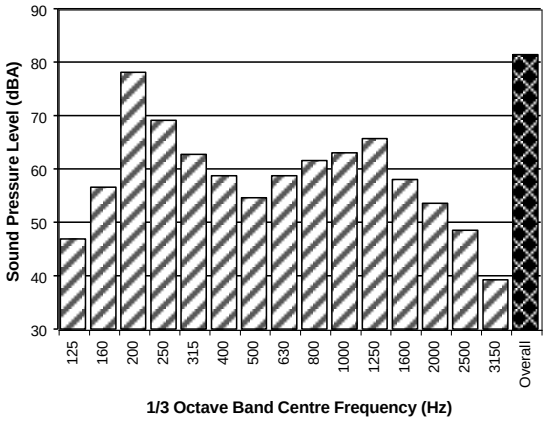
Frequency analysis is the process used to examine the tones (or frequency components) which make up the overall noise or vibration signal. This analysis was traditionally carried out using analogue electronic filters, but is now normally carried out using Fast Fourier Transform (FFT) analysers.

The units for frequency are Hertz (Hz), which represent the number of cycles per second.

Frequency analysis can be in:

- Octave bands (where the centre frequency and width of each band is double the previous band)
- 1/3 octave bands (3 bands in each octave band)
- Narrow band (where the spectrum is divided into 400 or more bands of equal width)

The following figure shows a 1/3 octave band frequency analysis where the noise is dominated by the 200 Hz band. Note that the indicated level of each individual band is less than the overall level, which is the logarithmic sum of the bands.



8 Vibration

Vibration may be defined as cyclic or transient motion. This motion can be measured in terms of its displacement, velocity or acceleration. Most assessments of human response to vibration or the risk of damage to buildings use measurements of vibration velocity. These may be expressed in terms of "peak" velocity or "rms" velocity.

The former is the maximum instantaneous velocity, without any averaging, and is sometimes referred to as "peak particle velocity", or PPV. The latter incorporates "root mean squared" averaging over some defined time period.

Vibration measurements may be carried out in a single axis or alternatively as triaxial measurements. Where triaxial measurements are used, the axes are commonly designated vertical, longitudinal (aligned toward the source) and transverse.

The common units for velocity are millimetres per second (mm/s). As with noise, decibel units can also be used, in which case the reference level should always be stated. A vibration level V, expressed in mm/s can be converted to decibels by the formula 20 log (V/V_o), where V_o is the reference level (10^{-9} m/s). Care is required in this regard, as other reference levels may be used by some organizations.

9 Human Perception of Vibration

People are able to "feel" vibration at levels lower than those required to cause even superficial damage to the most susceptible classes of building (even though they may not be disturbed by the motion). An individual's perception of motion or response to vibration depends very strongly on previous experience and expectations, and on other connotations associated with the perceived source of the vibration. For example, the vibration that a person responds to as "normal" in a car, bus or train is considerably higher than what is perceived as "normal" in a shop, office or dwelling.

10 Over-Pressure

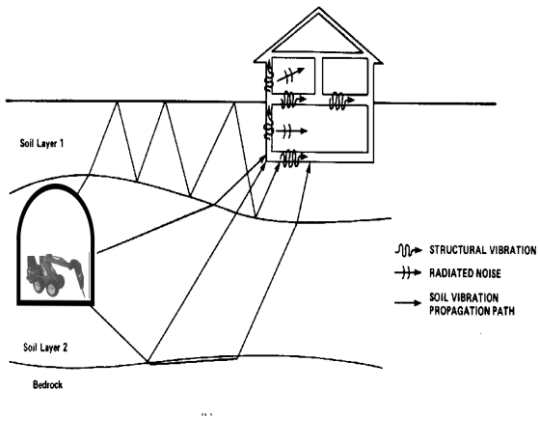
The term "over-pressure" is used to describe the air pressure pulse emitted during blasting or similar events. The peak level of an event is normally measured using a microphone in the same manner as linear noise (ie unweighted), at frequencies both in and below the audible range.

11 Ground-borne Noise, Structure-borne Noise and Regenerated Noise

Noise that propagates through a structure as vibration and is radiated by vibrating wall and floor surfaces is termed "structure-borne noise", "ground-borne noise" or "regenerated noise". This noise originates as vibration and propagates between the source and receiver through the ground and/or building structural elements, rather than through the air.

Typical sources of ground-borne or structure-borne noise include tunnelling works, underground railways, excavation plant (eg rockbreakers), and building services plant (eg fans, compressors and generators).

The following figure presents the various paths by which vibration and ground-borne noise may be transmitted between a source and receiver for construction activities occurring within a tunnel.

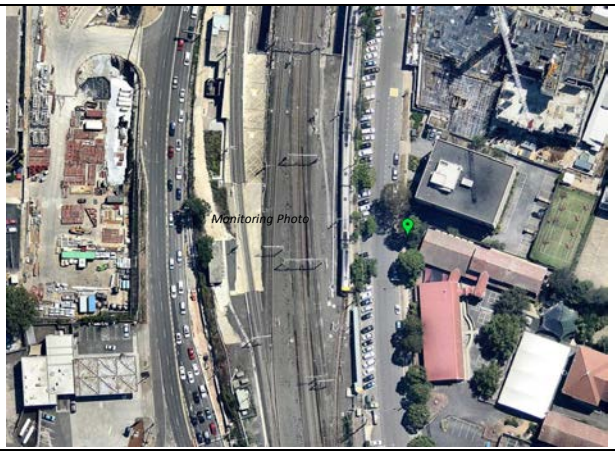


The term "regenerated noise" is also used in other instances where energy is converted to noise away from the primary source. One example would be a fan blowing air through a discharge grill. The fan is the energy source and primary noise source. Additional noise may be created by the aerodynamic effect of the discharge grill in the airstream. This secondary noise is referred to as regenerated noise

NOISE MONITORING FIELD SHEETS

Project	**ETTT Compliance Assessment**
Location ID	**N1**
Street	**8 Cambridge St, Epping**
Date	**Thursday, 6 April 2017**
Weather	**Sunny, calm 19°C**
Measurement Height	**1.5m above ground level**
Measurement Location	**Free-field**
Monitoring Equipment	**Brüel & Kjær 2260**
Equipment Serial No.	**2115053**

Note the LAE Ref and LAMax Ref are referenced at 15m from the track centreline and a 80kmh train speed.



Event No.	Passby Time	Duration (s)	LAE	LAMax	LAE Ref	LAMax Ref	Track	Class/ Type	No. Cars/Wagons	Notes On Ambient Noise
1	5:58:51 PM	17	78 dBA	71 dBA	85 dBA	81 dBA	Up	Oscar	8	No influence from other noise sources
2	6:16:20 PM	24	78 dBA	71 dBA	88 dBA	87 dBA	Down	K-Set	8	No influence from other noise sources
3	6:26:46 PM	21	79 dBA	71 dBA	88 dBA	84 dBA	Down	Oscar	8	No influence from other noise sources
4	6:28:09 PM	20	78 dBA	70 dBA	83 dBA	79 dBA	Up	K-Set	8	No influence from other noise sources
5	6:42:40 PM	24	76 dBA	66 dBA	84 dBA	79 dBA	Down	K-Set	8	No influence from other noise sources
6	5:00:39 PM	12	75 dBA	65 dBA	78 dBA	72 dBA	Down	Waratah	8	No influence from other noise sources
7	5:11:55 PM	15	76 dBA	68 dBA	79 dBA	74 dBA	Down	Oscar	8	No influence from other noise sources
8	5:12:44 PM	25	79 dBA	68 dBA	91 dBA	86 dBA	Up	K-Set	8	No influence from other noise sources
9	5:54:15 PM	21	79 dBA	68 dBA	86 dBA	80 dBA	Down	Waratah	8	No influence from other noise sources
10	5:58:03 PM	25	80 dBA	70 dBA	86 dBA	81 dBA	Up	K-Set	8	No influence from other noise sources
11	6:04:50 PM	30	81 dBA	71 dBA	89 dBA	83 dBA	Down	Waratah	8	No influence from other noise sources
12	6:08:53 PM	13	78 dBA	68 dBA	85 dBA	80 dBA	Down	Millennium	8	No influence from other noise sources
13	6:16:36 PM	25	83 dBA	74 dBA	91 dBA	86 dBA	Up	Waratah	8	No influence from other noise sources
14	6:23:51 PM	18	78 dBA	67 dBA	86 dBA	81 dBA	Down	Millennium	8	No influence from other noise sources
15	6:28:18 PM	16	80 dBA	74 dBA	91 dBA	91 dBA	Down	K-Set	4	No influence from other noise sources
16	6:31:27 PM	34	72 dBA	60 dBA	84 dBA	77 dBA	Up	Oscar	8	No influence from other noise sources
17	6:33:43 PM	31	77 dBA	68 dBA	88 dBA	84 dBA	Up	Waratah	8	No influence from other noise sources
18	6:39:14 PM	26	79 dBA	67 dBA	88 dBA	81 dBA	Down	Waratah	8	No influence from other noise sources
19	6:49:35 PM	26	78 dBA	72 dBA	87 dBA	86 dBA	Up	K-Set	8	No influence from other noise sources
20	6:51:29 PM	32	76 dBA	67 dBA	90 dBA	87 dBA	Up	Waratah	8	No influence from other noise sources
21	6:53:13 PM	26	80 dBA	73 dBA	88 dBA	87 dBA	Up	K-Set	8	No influence from other noise sources
22	6:54:20 PM	25	80 dBA	70 dBA	87 dBA	82 dBA	Down	Waratah	8	No influence from other noise sources
23	6:58:06 PM	13	76 dBA	70 dBA	82 dBA	80 dBA	Down	Oscar	4	No influence from other noise sources
24	7:02:26 PM	29	80 dBA	70 dBA	88 dBA	82 dBA	Up	Waratah	8	No influence from other noise sources
25	10:54:00 AM	75	89 dBA	89 dBA	95 dBA	94 dBA	Up	Freight	30	No influence from other noise sources

Project	**ETTT Compliance Assessment**
Location ID	**N2**
Street	**36 Cambridge Street, Epping**
Date	**Wednesday, 22 March 2017**
Weather	**Cloudy, Negligible Wind, 23°C**
Measurement Height	**1.5m above ground level**
Measurement Location	**Free-field**
Monitoring Equipment	**Brüel & Kjær 2260**
Equipment Serial No.	**2115053**

Note the LAE Ref and LAMax Ref are referenced at 15m from the track centreline and a 80kmh train speed.

Event No.	Passby Time	Duration (s)	LAE	LAMax	LAE Ref	LAMax Ref	Track	Class/ Type	No. Cars/Wagons	Notes On Ambient Noise
1	9:06:28 AM	29	78 dBA	72 dBA	89 dBA	89 dBA	Down	Waratah	8	Pedestrian Nearby
2	9:09:14 AM	26	80 dBA	73 dBA	92 dBA	91 dBA	Down	Waratah	8	Up train approaches at end of measurement
3	9:12:31 AM	34	81 dBA	71 dBA	92 dBA	88 dBA	Down	Millennium	4	Up train approaches at end of measurement
4	9:16:07 AM	27	78 dBA	70 dBA	89 dBA	87 dBA	Up	Millennium	8	No influence from other noise sources
5	9:18:01 AM	19	78 dBA	68 dBA	87 dBA	83 dBA	Down	Waratah	8	No influence from other noise sources
6	9:22:28 AM	28	78 dBA	66 dBA	87 dBA	82 dBA	Down	Millennium	8	No influence from other noise sources
7	9:26:08 AM	28	84 dBA	76 dBA	94 dBA	91 dBA	Up	Waratah	8	No influence from other noise sources
8	9:29:10 AM	20	81 dBA	72 dBA	89 dBA	85 dBA	Up	K-Set	8	No influence from other noise sources
9	9:39:20 AM	15	84 dBA	78 dBA	93 dBA	93 dBA	Down	Millennium	8	Up train approaches at end of measurement
10	9:41:53 AM	30	77 dBA	68 dBA	86 dBA	82 dBA	Down	Millennium	8	No influence from other noise sources
10.5	9:41:53 AM	30	75 dBA	67 dBA	87 dBA	86 dBA	Down	K-Set	4	No influence from other noise sources
11	9:51:18 AM	23	78 dBA	68 dBA	87 dBA	83 dBA	Down	Waratah	8	No influence from other noise sources
12	9:54:16 AM	25	85 dBA	79 dBA	93 dBA	93 dBA	Up	Waratah	8	No influence from other noise sources
13	9:59:36 AM	14	73 dBA	64 dBA	79 dBA	76 dBA	Up	Millennium	4	No influence from other noise sources
14	10:01:31 AM	25	78 dBA	68 dBA	86 dBA	82 dBA	Down	Tangara	8	No influence from other noise sources
15	10:11:32 AM	26	84 dBA	79 dBA	94 dBA	94 dBA	Up	Waratah	8	No influence from other noise sources
16	10:14:24 AM	14	72 dBA	68 dBA	81 dBA	82 dBA	Down	Oscar	4	No influence from other noise sources
17	10:16:30 AM	91	94 dBA	80 dBA	99 dBA	89 dBA	Up	Freight	74	Passenger train on Down track at the same time
18	10:24:05 AM	25	84 dBA	78 dBA	93 dBA	93 dBA	Up	Waratah	8	No influence from other noise sources
19	10:28:15 AM	20	80 dBA	73 dBA	88 dBA	86 dBA	Up	K-Set	8	No influence from other noise sources
20	10:32:36 AM	20	77 dBA	67 dBA	86 dBA	82 dBA	Down	Waratah	8	No influence from other noise sources

Project	**ETTT Compliance Assessment**
Location ID	**N3**
Street	**Derby Street**
Date	**Monday, 20 March 2017**
Weather	**Fine, 28°C**
Measurement Height	**1.5m above ground level**
Measurement Location	**Free-field**
Monitoring Equipment	**Brüel & Kjær 2260**
Equipment Serial No.	**2414605**

Note the LAE Ref and LAMax Ref are referenced at 15m from the track centreline and a 80kmh train speed.

Event No.	Passby Time	Duration (s)	LAE	LAMax	LAE Ref	LAMax Ref	Track	Class/ Type	No. Cars/Wagons	Notes On Ambient Noise
1	12:46:55 PM	24	73 dBA	64 dBA	82 dBA	79 dBA	Down	Waratah	8	No influence from other noise sources
2	12:49:50 PM	24	71 dBA	62 dBA	81 dBA	79 dBA	Down	K-set	8	No influence from other noise sources
3	12:54:07 PM	15	76 dBA	67 dBA	83 dBA	80 dBA	Up	Tangara	8	No influence from other noise sources
4	12:59:07 PM	13	76 dBA	70 dBA	82 dBA	81 dBA	Up	Millennium	4	No influence from other noise sources
5	1:08:57 PM	20	75 dBA	67 dBA	83 dBA	80 dBA	Up	Waratah	8	No influence from other noise sources
6	1:10:58 PM	15	69 dBA	63 dBA	76 dBA	75 dBA	Down	Millennium	4	No influence from other noise sources
7	1:15:25 PM	103	97 dBA	90 dBA	105 dBA	102 dBA	Up	Freight	72	No influence from other noise sources
8	1:24:49 PM	19	75 dBA	66 dBA	84 dBA	80 dBA	Up	Waratah (v)	8	Noise measurement affected by gardening noise
9	1:28:05 PM	13	78 dBA	70 dBA	85 dBA	82 dBA	Up	K-set	8	No influence from other noise sources
10	1:31:49 PM	16	70 dBA	63 dBA	78 dBA	77 dBA	Down	Waratah (v)	8	Motorbike passby occurred at the same time
11	1:38:58 PM	16	74 dBA	65 dBA	82 dBA	79 dBA	Up	Waratah	8	No influence from other noise sources
12	1:42:38 PM	53	87 dBA	77 dBA	90 dBA	85 dBA	Up	Freight	53	No influence from other noise sources
13	1:44:22 PM	12	71 dBA	64 dBA	80 dBA	79 dBA	Down	K-set	4	No influence from other noise sources
14	1:46:47 PM	16	70 dBA	61 dBA	78 dBA	75 dBA	Down	Waratah	8	No influence from other noise sources
15	1:47:59 PM	152	87 dBA	77 dBA	101 dBA	98 dBA	Up & Down	Freight	72	Two freight trains passing on up & down tracks
16	1:54:21 PM	16	73 dBA	65 dBA	82 dBA	79 dBA	Up	Waratah	8	No influence from other noise sources
17	1:59:10 PM	17	76 dBA	68 dBA	85 dBA	82 dBA	Up	Millennium	8	No influence from other noise sources
18	2:01:57 PM	14	70 dBA	62 dBA	78 dBA	75 dBA	Down	Waratah	8	No influence from other noise sources
19	2:09:11 PM	13	75 dBA	67 dBA	82 dBA	79 dBA	Up	Waratah	8	No influence from other noise sources
20	2:14:01 PM	71	79 dBA	66 dBA	86 dBA	79 dBA	Down	Freight	49	No influence from other noise sources

Project	**ETTT Compliance Assessment**
Location ID	**N5**
Street	**104 The Crescent**
Date	**Wednesday, 29 March 2017**
Weather	**Overcast, 23°C**
Measurement Height	**1.5m above ground level**
Measurement Location	**Free-field**
Monitoring Equipment	**Brüel & Kjær 2260**
Equipment Serial No.	**2414605**

Note the LAE Ref and LAMax Ref are referenced at 15m from the track centreline and a 80kmh train speed.

Event No.	Passby Time	Duration (s)	LAE	LAMax	LAE Ref	LAMax Ref	Track	Class/ Type	No. Cars/Wagons	Notes On Ambient Noise
1	7:54:46 AM	18	72 dBA	64 dBA	79 dBA	77 dBA	Up	Waratah	8	No influence from other noise sources
2	7:57:25 AM	19	72 dBA	65 dBA	78 dBA	76 dBA	Up	Tangara	4	No influence from other noise sources
3	8:02:41 AM	18	73 dBA	64 dBA	81 dBA	78 dBA	Down	Waratah	8	No influence from other noise sources
4	8:09:08 AM	20	73 dBA	65 dBA	78 dBA	76 dBA	Up	Waratah	8	No influence from other noise sources
5	8:11:31 AM	20	79 dBA	72 dBA	84 dBA	82 dBA	Up	K-Set	8	No influence from other noise sources
6	8:12:21 AM	19	76 dBA	68 dBA	83 dBA	80 dBA	Down	Millennium	8	No influence from other noise sources
7	8:14:33 AM	26	71 dBA	60 dBA	83 dBA	79 dBA	Up	Millennium	8	No influence from other noise sources
8	8:17:20 AM	19	74 dBA	64 dBA	81 dBA	77 dBA	Down	Waratah	8	No influence from other noise sources
9	8:24:30 AM	16	74 dBA	67 dBA	79 dBA	78 dBA	Up	Tangara	8	No influence from other noise sources
10	8:28:09 AM	24	83 dBA	76 dBA	89 dBA	87 dBA	Up	K-Set	8	No influence from other noise sources
11	8:33:57 AM	18	75 dBA	67 dBA	81 dBA	78 dBA	Down	Waratah	8	No influence from other noise sources
12	8:36:44 AM	18	74 dBA	66 dBA	81 dBA	78 dBA	Down	Waratah	8	No influence from other noise sources
13	8:38:56 AM	16	73 dBA	68 dBA	79 dBA	79 dBA	Up	Waratah	8	No influence from other noise sources
14	8:44:34 AM	23	80 dBA	72 dBA	89 dBA	87 dBA	Down	K-Set	8	No influence from other noise sources
15	8:49:32 AM	21	78 dBA	69 dBA	84 dBA	80 dBA	Down	K-Set	8	No influence from other noise sources
16	8:52:59 AM	18	77 dBA	68 dBA	84 dBA	80 dBA	Down	K-Set	8	No influence from other noise sources
18	8:57:35 AM	26	81 dBA	75 dBA	87 dBA	87 dBA	Up	K-Set	8	No influence from other noise sources
19	9:05:12 AM	21	75 dBA	66 dBA	81 dBA	78 dBA	Down	Waratah	8	No influence from other noise sources
20	9:07:49 AM	19	74 dBA	65 dBA	82 dBA	79 dBA	Down	Waratah	8	No influence from other noise sources
21	9:09:16 AM	17	72 dBA	65 dBA	78 dBA	75 dBA	Up	Waratah	8	No influence from other noise sources
23	9:19:25 AM	24	74 dBA	66 dBA	82 dBA	78 dBA	Down	Waratah	8	No influence from other noise sources
24	9:22:58 AM	23	74 dBA	66 dBA	82 dBA	79 dBA	Down	Tangara	8	No influence from other noise sources
25	9:23:39 AM	19	73 dBA	65 dBA	79 dBA	76 dBA	Up	Waratah	8	No influence from other noise sources
27	11:44:00 AM	69	85 dBA	72 dBA	92 dBA	85 dBA	Up	Freight	55	Additional measurement 19 May 2017
28	12:09:00 PM	114	90 dBA	85 dBA	98 dBA	99 dBA	Up	Freight	50	Additional measurement 19 May 2017

Project	**ETTT Compliance Assessment**
Location ID	**N6**
Street	**86 The Crescent, Cheltenham**
Date	**Wednesday, 29 March 2017**
Weather	**Overcast, 23°C**
Measurement Height	**1.5m above ground level**
Measurement Location	**Free-field**
Monitoring Equipment	**Brüel & Kjær 2260**
Equipment Serial No.	**2115053**

Note the LAE Ref and LAMax Ref are referenced at 15m from the track centreline and a 80kmh train speed.

Event No.	Passby Time	Duration (s)	LAE	LAMax	LAE Ref	LAMax Ref	Track	Class/ Type	No. Cars/Wagons	Notes On Ambient Noise
1	8:03:50 AM	15	78 dBA	71 dBA	84 dBA	83 dBA	Down	Waratah	8	Possible wheel flat on one carriage
2	8:09:46 AM	19	71 dBA	63 dBA	77 dBA	74 dBA	Up	Waratah	8	No influence from other noise sources
3	8:12:09 AM	23	78 dBA	71 dBA	84 dBA	82 dBA	Up	Intercity	8	No influence from other noise sources
4	8:13:27 AM	18	78 dBA	71 dBA	84 dBA	83 dBA	Down	Waratah	8	No influence from other noise sources
5	8:15:05 AM	24	70 dBA	63 dBA	78 dBA	77 dBA	Up	Millennium	8	No influence from other noise sources
6	8:18:25 AM	21	76 dBA	69 dBA	83 dBA	81 dBA	Down	Waratah	8	Includes noise as train negotiated turnout
7	8:25:06 AM	20	72 dBA	65 dBA	78 dBA	77 dBA	Up	Tangara	8	No influence from other noise sources
8	8:28:51 AM	24	81 dBA	74 dBA	87 dBA	85 dBA	Up	Intercity	8	No influence from other noise sources
9	8:34:59 AM	18	78 dBA	73 dBA	85 dBA	85 dBA	Down	Waratah	8	Includes noise as train negotiated turnout
10	8:37:47 AM	22	76 dBA	69 dBA	83 dBA	82 dBA	Down	Waratah	8	Includes noise as train negotiated turnout
11	8:39:32 AM	22	71 dBA	62 dBA	76 dBA	73 dBA	Up	Waratah	8	No influence from other noise sources
12	8:43:05 AM	18	74 dBA	67 dBA	77 dBA	75 dBA	Up	Millennium	8	No influence from other noise sources
13	8:45:41 AM	25	81 dBA	73 dBA	90 dBA	88 dBA	Down	Intercity	8	Includes noise as train negotiated turnout
14	8:50:36 AM	21	80 dBA	72 dBA	87 dBA	85 dBA	Down	K-Set	8	Includes noise as train negotiated turnout
15	8:53:59 AM	28	80 dBA	76 dBA	87 dBA	89 dBA	Down / Up	K-Set / Waratah	8	Two train passed simultaneously
16	8:58:15 AM	21	79 dBA	73 dBA	85 dBA	84 dBA	Up	Intercity	8	No influence from other noise sources
17	9:06:19 AM	15	83 dBA	85 dBA	89 dBA	97 dBA	Down	Waratah	8	No influence from other noise sources
18	9:08:56 AM	20	77 dBA	70 dBA	84 dBA	82 dBA	Down	Waratah	8	No influence from other noise sources
19	9:09:52 AM	22	72 dBA	67 dBA	78 dBA	78 dBA	Up	Waratah	8	No influence from other noise sources
20	9:12:33 AM	21	73 dBA	70 dBA	78 dBA	80 dBA	Up	Millennium	8	No influence from other noise sources
21	9:13:08 AM	14	74 dBA	69 dBA	81 dBA	81 dBA	Down	Millennium	4	Includes noise as train negotiated turnout
22	9:20:31 AM	19	78 dBA	72 dBA	84 dBA	84 dBA	Down	Waratah	8	Includes noise as train negotiated turnout
23	9:24:05 AM	33	78 dBA	70 dBA	85 dBA	83 dBA	Up / Down	Tangara / Waratah	8	Two train passed simultaneously
24	9:28:47 AM	22	81 dBA	76 dBA	86 dBA	87 dBA	Up	Intercity	8	No influence from other noise sources
25	11:16:00 AM	60	85 dBA	74 dBA	94 dBA	90 dBA	Down	Freight	30	Additional measurement 19 May 2017

Project	**ETTT Compliance Assessment**
Location ID	**N7**
Street	**32 The Crescent, Cheltenham**
Date	**Friday, 24 March 2017**
Weather	**Drizzle near end. Calm, 20°C**
Measurement Height	**1.5m above ground level**
Measurement Location	**Free-field**
Monitoring Equipment	**Brüel & Kjær 2260**
Equipment Serial No.	**2414605**

Note the LAE Ref and LAMax Ref are referenced at 15m from the track centreline and a 80kmh train speed.

Event No.	Passby Time	Duration (s)	LAE	LAMax	LAE Ref	LAMax Ref	Track	Class/ Type	No. Cars/Wagons	Notes On Ambient Noise
1	10:21:03 AM	24	73 dBA	65 dBA	80 dBA	77 dBA	Down	Waratah	8	No influence from other noise sources
2	10:23:44 AM	10	69 dBA	61 dBA	76 dBA	73 dBA	Up	Waratah	8	No influence from other noise sources
3	10:27:48 AM	10	78 dBA	72 dBA	85 dBA	83 dBA	Up	K-Set (v)	8	Potentially influenced by background noise
4	10:34:27 AM	21	73 dBA	64 dBA	82 dBA	81 dBA	Down	Waratah	8	No influence from other noise sources
5	10:36:56 AM	21	70 dBA	61 dBA	76 dBA	72 dBA	Up	Waratah	8	No influence from other noise sources
6	10:43:07 AM	59	91 dBA	84 dBA	99 dBA	97 dBA	Up	Freight	38	K-set on Down track, not signficant
7	10:49:28 AM	22	74 dBA	66 dBA	80 dBA	77 dBA	Down	Waratah	8	No influence from other noise sources
8	10:52:01 AM	18	69 dBA	60 dBA	76 dBA	72 dBA	Up	Waratah	8	No influence from other noise sources
9	10:55:44 AM	145	95 dBA	88 dBA	104 dBA	103 dBA	Down	Freight	74	4-car Millenium on Up track, not signficant
10	11:00:09 AM	14	71 dBA	66 dBA	76 dBA	75 dBA	Up	Millennium	4	No influence from other noise sources
11	11:04:26 AM	21	73 dBA	65 dBA	81 dBA	79 dBA	Down	Waratah	8	No influence from other noise sources
12	11:06:48 AM	14	70 dBA	63 dBA	75 dBA	72 dBA	Up	Waratah	8	No influence from other noise sources
13	11:12:36 AM	13	72 dBA	66 dBA	76 dBA	75 dBA	Down	Millennium	4	No influence from other noise sources
14	11:17:23 AM	60	86 dBA	78 dBA	91 dBA	89 dBA	Up	Freight	38	No influence from other noise sources
15	11:20:59 AM	25	73 dBA	66 dBA	80 dBA	77 dBA	Down	Oscar	8	No influence from other noise sources
16	11:23:30 AM	15	71 dBA	71 dBA	77 dBA	80 dBA	Up	Waratah	8	No influence from other noise sources
17	11:29:40 AM	16	77 dBA	69 dBA	83 dBA	79 dBA	Up	K-Set	8	No influence from other noise sources
18	11:34:37 AM	21	75 dBA	68 dBA	84 dBA	84 dBA	Down	Millennium	8	No influence from other noise sources
19	11:36:44 AM	16	69 dBA	61 dBA	74 dBA	71 dBA	Up	Waratah	8	No influence from other noise sources
20	11:42:41 AM	22	83 dBA	75 dBA	89 dBA	87 dBA	Down	K-Set	8	No influence from other noise sources

Project	**ETTT Compliance Assessment**
Location ID	**NV8**
Street	**Cheltenham Scout Hall**
Date	**Wednesday, 10 May 2017**
Weather	**Sunny, calm 15°C**
Measurement Height	**1.5m above ground level**
Measurement Location	**Free-field**
Monitoring Equipment	**Brüel & Kjær 2260**
Equipment Serial No.	**2414604**

Note the LAE Ref and LAMax Ref are referenced at 15m from the track centreline and a 80kmh train speed.

Event No.	Passby Time	Duration (s)	LAE	LAMax	LAE Ref	LAMax Ref	Track	Class/ Type	No. Cars/Wagons	Notes On Ambient Noise
1	10:15:03 AM	23	81 dBA	73 dBA	85 dBA	80 dBA	Up	Waratah	8	No influence from other noise sources
2	10:17:12 AM	60	100 dBA	98 dBA	106 dBA	106 dBA	Down	Freight	2	Curve squeal noise present
3	10:20:06 AM	20	81 dBA	74 dBA	86 dBA	82 dBA	Down	Waratah	8	No influence from other noise sources
4	10:24:21 AM	32	81 dBA	74 dBA	85 dBA	82 dBA	Up	Waratah	8	No influence from other noise sources
5	10:27:04 AM	58	78 dBA	74 dBA	94 dBA	97 dBA	Up	Intercity	8	Curve squeal noise present
6	10:35:10 AM	23	80 dBA	73 dBA	84 dBA	81 dBA	Down	Waratah	8	No influence from other noise sources
7	10:36:11 AM	22	76 dBA	72 dBA	82 dBA	81 dBA	Up	Waratah	8	No influence from other noise sources
8	10:44:48 AM	18	80 dBA	74 dBA	87 dBA	85 dBA	Down	Intercity	4	No influence from other noise sources
9	10:49:45 AM	22	79 dBA	71 dBA	83 dBA	79 dBA	Down	Waratah	8	No influence from other noise sources
10	10:51:39 AM	32	81 dBA	78 dBA	86 dBA	88 dBA	Up	Waratah	8	Curve squeal noise present
11	10:56:07 AM	27	82 dBA	78 dBA	87 dBA	85 dBA	Up	Oscar	4	Curve squeal noise present
12	11:05:50 AM	27	79 dBA	72 dBA	84 dBA	81 dBA	Down	Waratah	8	Curve squeal noise present
13	11:06:33 AM	17	80 dBA	75 dBA	85 dBA	83 dBA	Up	Waratah	8	Curve squeal noise present
14	11:12:00 AM	98	93 dBA	83 dBA	98 dBA	91 dBA	Up	Freight	4	No influence from other noise sources
15	11:18:44 AM	166	99 dBA	92 dBA	107 dBA	103 dBA	Down	Freight	76	Curve squeal noise present
16	11:21:43 AM	16	80 dBA	74 dBA	85 dBA	82 dBA	Up	Waratah	8	Curve squeal noise present
17	11:25:07 AM	58	94 dBA	89 dBA	102 dBA	100 dBA	Down	Freight	2	Curve squeal noise present, Intercity of Up track
18	11:36:08 AM	53	78 dBA	72 dBA	82 dBA	81 dBA	Up	Waratah	8	Curve squeal noise present
18.5	11:36:08 AM	53	81 dBA	73 dBA	86 dBA	81 dBA	Down	Waratah	8	Curve squeal noise present
19	11:46:14 AM	25	91 dBA	87 dBA	98 dBA	97 dBA	Down	Intercity	8	Curve squeal noise present
20	11:50:08 AM	22	81 dBA	74 dBA	85 dBA	82 dBA	Down	Waratah	8	No influence from other noise sources
21	11:51:05 AM	20	78 dBA	69 dBA	83 dBA	77 dBA	Up	Tangara	8	No influence from other noise sources

Project	**ETTT Compliance Assessment**
Location ID	**N9**
Street	**92 Sutherland Rd**
Date	**Thursday, 6 April 2017**
Weather	**Slight breeze, some cloud, 17°C**
Measurement Height	**1.5m above ground level**
Measurement Location	**Free-field**
Monitoring Equipment	**Brüel & Kjær 2260**
Equipment Serial No.	**2414605**

Note the LAE Ref and LAMax Ref are referenced at 15m from the track centreline and a 80kmh train speed.

Event No.	Passby Time	Duration (s)	LAE	LAMax	LAE Ref	LAMax Ref	Track	Class/ Type	No. Cars/Wagons	Notes On Ambient Noise
1	10:58:51 AM	70	95 dBA	85 dBA	109 dBA	112 dBA	Down	Freight	30	No influence from other noise sources
2	11:04:44 AM	27	84 dBA	76 dBA	108 dBA	110 dBA	Down	Waratah	8	No influence from other noise sources
3	11:06:03 AM	22	88 dBA	83 dBA	98 dBA	101 dBA	Up	Waratah	8	No influence from other noise sources
4	11:12:26 AM	92	98 dBA	95 dBA	102 dBA	102 dBA	Up	Freight	40	No influence from other noise sources
5	11:12:26 AM	106	98 dBA	95 dBA	93 dBA	92 dBA	Down	Millennium (v)	4	Influenced by background noise
6	11:21:26 AM	18	89 dBA	86 dBA	94 dBA	96 dBA	Up	Waratah	8	No influence from other noise sources
7	11:24:24 AM	32	85 dBA	76 dBA	84 dBA	83 dBA	Down	Waratah	4	Train passby speed uncharacteristically slow
8	11:41:28 AM	30	83 dBA	77 dBA	91 dBA	91 dBA	Down	Waratah	8	No influence from other noise sources
9	11:43:15 AM	18	81 dBA	76 dBA	88 dBA	89 dBA	Down	K-Set	3	No influence from other noise sources
10	11:50:44 AM	12	76 dBA	69 dBA	99 dBA	97 dBA	Down	Waratah	8	No influence from other noise sources
11	11:56:24 AM	12	81 dBA	76 dBA	121 dBA	119 dBA	Up	Millennium	4	No influence from other noise sources
12	12:05:03 PM	25	80 dBA	75 dBA	91 dBA	93 dBA	Down	Waratah	8	No influence from other noise sources
13	12:07:08 PM	17	90 dBA	82 dBA	85 dBA	82 dBA	Up	Waratah	8	No influence from other noise sources
14	12:10:55 PM	211	101 dBA	91 dBA	89 dBA	87 dBA	Up	Freight	30	No influence from other noise sources
15	12:17:27 PM	7	83 dBA	79 dBA	112 dBA	113 dBA	Down	Millennium (v)	4	Influenced by background noise
16	12:20:39 PM	22	76 dBA	67 dBA	82 dBA	79 dBA	Down	Waratah	8	No influence from other noise sources
17	12:27:29 PM	22	82 dBA	75 dBA	91 dBA	90 dBA	Up	K-Set	8	No influence from other noise sources
18	12:28:18 PM	221	92 dBA	84 dBA	92 dBA	91 dBA	Down	Freight	50	No influence from other noise sources
19	12:35:25 PM	15	72 dBA	63 dBA	103 dBA	105 dBA	Down	Waratah	8	No influence from other noise sources
20	12:37:40 PM	16	85 dBA	79 dBA	107 dBA	115 dBA	Up	Waratah	8	No influence from other noise sources
21	12:46:24 PM	26	82 dBA	76 dBA	85 dBA	86 dBA	Down	K-Set	8	No influence from other noise sources
22	12:52:22 PM	32	89 dBA	84 dBA	94 dBA	93 dBA	Up	Tangara	8	No influence from other noise sources
23	12:57:04 PM	37	93 dBA	94 dBA	106 dBA	100 dBA	Up	Tangara	4	Train horn at 94dBA

Project	**ETTT Compliance Assessment**
Location ID	**N10**
Street	**126 Sutherland Road, Beecroft**
Date	**Tuesday, 18 April 2017**
Weather	**Slight breeze, 21°C**
Measurement Height	**1.5m above ground level**
Measurement Location	**Free-field**
Monitoring Equipment	**Brüel & Kjær 2250**
Equipment Serial No.	**3008204**

Note the LAE Ref and LAMax Ref are referenced at 15m from the track centreline and a 80kmh train speed.

Event No.	Passby Time	Duration (s)	LAE	LAMax	LAE Ref	LAMax Ref	Track	Class/ Type	No. Cars/Wagons	Notes On Ambient Noise
1	9:42:34 AM	28	75 dBA	67 dBA	80 dBA	78 dBA	Down	Tangara	8	No influence from other noise sources
2	9:44:46 AM	60	79 dBA	68 dBA	81 dBA	75 dBA	Down	Intercity	8	No influence from other noise sources
3	9:48:03 AM	46	74 dBA	66 dBA	88 dBA	88 dBA	Down	Tangara	8	Includes train braking noise event
4	9:49:34 AM	32	77 dBA	73 dBA	84 dBA	85 dBA	Up	Millennium	8	No influence from other noise sources
5	9:52:23 AM	27	79 dBA	72 dBA	86 dBA	84 dBA	Down	Millennium	8	Includes train braking noise event
6	9:54:55 AM	29	81 dBA	75 dBA	87 dBA	86 dBA	Up	Oscar	4	No influence from other noise sources
7	9:59:33 AM	28	81 dBA	75 dBA	90 dBA	88 dBA	Down	Endeavour	5	Includes train braking noise event
8	10:04:07 AM	37	84 dBA	76 dBA	92 dBA	89 dBA	Up	Waratah	8	No influence from other noise sources
9	10:06:59 AM	39	79 dBA	73 dBA	85 dBA	84 dBA	Down	Tangara	8	Includes train braking noise event
10	10:12:05 AM	75	91 dBA	80 dBA	95 dBA	89 dBA	Up	Freight	42	No influence from other noise sources
11	10:14:26 AM	55	76 dBA	71 dBA	83 dBA	83 dBA	Down	Oscar	4	No influence from other noise sources
12	10:19:30 AM	31	74 dBA	65 dBA	83 dBA	79 dBA	Up	Millennium	8	No influence from other noise sources
13	10:22:10 AM	32	82 dBA	76 dBA	88 dBA	88 dBA	Down	Waratah	8	No influence from other noise sources
14	10:25:44 AM	118	93 dBA	86 dBA	98 dBA	95 dBA	Down	Freight	45	No influence from other noise sources
15	10:35:58 AM	51	77 dBA	72 dBA	87 dBA	87 dBA	Up	Tangara	8	No influence from other noise sources
16	10:37:38 AM	28	82 dBA	75 dBA	90 dBA	88 dBA	Down	Waratah	8	No influence from other noise sources
17	10:47:41 AM	28	80 dBA	76 dBA	89 dBA	90 dBA	Down	Intercity	4	No influence from other noise sources
18	10:49:22 AM	25	74 dBA	66 dBA	81 dBA	77 dBA	Up	Waratah	8	No influence from other noise sources
19	10:52:10 AM	26	78 dBA	72 dBA	84 dBA	82 dBA	Down	Waratah	8	No influence from other noise sources
20	10:58:15 AM	28	76 dBA	71 dBA	84 dBA	84 dBA	Up	Oscar	4	No influence from other noise sources
21	11:04:46 AM	30	82 dBA	75 dBA	88 dBA	87 dBA	Up	Millennium	8	No influence from other noise sources

Project	**ETTT Compliance Assessment**
Location ID	**N11**
Street	**71 Wongala Crescent, Beecroft**
Date	**Tuesday, 18 April 2017**
Weather	**Sunny, calm, 21°C**
Measurement Height	**1.5m above ground level**
Measurement Location	**Free-field**
Monitoring Equipment	**Brüel & Kjær 2260**
Equipment Serial No.	**2414604**

Note the LAE Ref and LAMax Ref are referenced at 15m from the track centreline and a 80kmh train speed.

Event No.	Passby Time	Duration (s)	LAE	LAMax	LAE Ref	LAMax Ref	Track	Class/ Type	No. Cars/Wagons	Notes On Ambient Noise
1	9:48:29 AM	40	70 dBA	60 dBA	84 dBA	81 dBA	Down	Tangara	8	No influence from other noise sources
2	9:49:27 AM	18	70 dBA	66 dBA	77 dBA	80 dBA	Up	Millennium	8	No influence from other noise sources
3	9:52:31 AM	23	69 dBA	60 dBA	75 dBA	70 dBA	Down	Millennium	8	No influence from other noise sources
4	9:54:51 AM	16	69 dBA	62 dBA	75 dBA	73 dBA	Up	Oscar	4	No influence from other noise sources
5	9:59:44 AM	27	74 dBA	65 dBA	82 dBA	78 dBA	Down	Endeavour	5	No influence from other noise sources
6	10:04:10 AM	23	73 dBA	66 dBA	80 dBA	79 dBA	Up	Waratah	8	No influence from other noise sources
7	10:07:16 AM	23	72 dBA	62 dBA	77 dBA	72 dBA	Down	Tangara	8	No influence from other noise sources
8	10:12:03 AM	61	85 dBA	77 dBA	89 dBA	85 dBA	Up	Freight	42	No influence from other noise sources
9	10:14:38 AM	15	68 dBA	61 dBA	75 dBA	72 dBA	Down	Oscar	4	No influence from other noise sources
10	10:19:25 AM	15	65 dBA	55 dBA	73 dBA	69 dBA	Up	Millennium	8	No influence from other noise sources
11	10:22:27 AM	18	73 dBA	63 dBA	78 dBA	73 dBA	Down	Waratah	8	No influence from other noise sources
12	10:25:46 AM	19	71 dBA	63 dBA	76 dBA	71 dBA	Up	K-Set	8	No influence from other noise sources
13	10:26:10 AM	101	91 dBA	85 dBA	98 dBA	97 dBA	Down	Freight	45	No influence from other noise sources
14	10:35:52 AM	19	68 dBA	62 dBA	78 dBA	77 dBA	Up	Tangara	8	No influence from other noise sources
15	10:37:51 AM	19	71 dBA	62 dBA	79 dBA	75 dBA	Down	Waratah	8	No influence from other noise sources
16	10:47:54 AM	20	72 dBA	64 dBA	80 dBA	78 dBA	Down	Intercity	4	No influence from other noise sources
17	10:49:14 AM	18	69 dBA	64 dBA	75 dBA	75 dBA	Up	Waratah	8	No influence from other noise sources
18	10:52:20 AM	19	71 dBA	62 dBA	76 dBA	71 dBA	Down	Waratah	8	No influence from other noise sources
19	10:58:13 AM	15	69 dBA	62 dBA	76 dBA	74 dBA	Up	Oscar	4	No influence from other noise sources
20	11:04:43 AM	19	71 dBA	64 dBA	78 dBA	75 dBA	Up	Millennium	8	No influence from other noise sources

Project	**ETTT Compliance Assessment**
Location ID	**N12**
Street	**83 Wongala Crescent, Beecroft**
Date	**Friday, 31 March 2017**
Weather	**Sunny, occasional gusts, 16°C**
Measurement Height	**1.5m above ground level**
Measurement Location	**Free-field**
Monitoring Equipment	**Brüel & Kjær 2260**
Equipment Serial No.	**2414604**

Note the LAE Ref and LAMax Ref are referenced at 15m from the track centreline and a 80kmh train speed.

Event No.	Passby Time	Duration (s)	LAE	LAMax	LAE Ref	LAMax Ref	Track	Class/ Type	No. Cars/Wagons	Notes On Ambient Noise
1	10:30:14 AM	107	91 dBA	81 dBA	107 dBA	114 dBA	Down	Freight	3	No influence from other noise sources
2	10:37:08 AM	18	75 dBA	68 dBA	80 dBA	85 dBA	Down	Waratah	8	No influence from other noise sources
3	10:41:04 AM	108	80 dBA	70 dBA	98 dBA	107 dBA	Up	Freight	3	No influence from other noise sources
4	10:43:21 AM	20	75 dBA	69 dBA	84 dBA	89 dBA	Down	Intercity	4	No influence from other noise sources
5	10:48:28 AM	19	69 dBA	60 dBA	75 dBA	80 dBA	Up	Waratah	8	No influence from other noise sources
6	10:52:00 AM	24	70 dBA	62 dBA	77 dBA	82 dBA	Down	Waratah	8	No influence from other noise sources
7	10:54:41 AM	13	67 dBA	60 dBA	76 dBA	81 dBA	Up	Oscar	4	No influence from other noise sources
8	11:03:34 AM	19	69 dBA	63 dBA	76 dBA	81 dBA	Up	Waratah	8	No influence from other noise sources
9	11:07:35 AM	14	70 dBA	62 dBA	78 dBA	83 dBA	Down	Waratah	8	No influence from other noise sources
10	11:10:10 AM	93	82 dBA	70 dBA	92 dBA	98 dBA	Up	Freight	4	No influence from other noise sources
11	11:14:01 AM	12	67 dBA	62 dBA	73 dBA	77 dBA	Down	Oscar	4	No influence from other noise sources
12	11:18:59 AM	20	67 dBA	60 dBA	76 dBA	82 dBA	Up	Waratah	8	No influence from other noise sources
13	11:22:52 AM	25	74 dBA	66 dBA	80 dBA	85 dBA	Down	Oscar	8	No influence from other noise sources
14	11:34:07 AM	21	69 dBA	61 dBA	77 dBA	82 dBA	Up	Waratah	8	No influence from other noise sources
15	11:37:24 AM	20	72 dBA	64 dBA	78 dBA	82 dBA	Down	Waratah	8	No influence from other noise sources
16	11:44:06 AM	29	76 dBA	67 dBA	83 dBA	89 dBA	Down	Intercity	8	No influence from other noise sources
17	11:48:56 AM	18	71 dBA	66 dBA	78 dBA	83 dBA	Up	Tangara	8	No influence from other noise sources
18	11:52:18 AM	22	72 dBA	63 dBA	77 dBA	81 dBA	Down	Waratah	8	No influence from other noise sources
19	11:54:46 AM	16	67 dBA	59 dBA	75 dBA	80 dBA	Up	Oscar	4	No influence from other noise sources
20	12:03:43 PM	23	70 dBA	62 dBA	79 dBA	84 dBA	Up	Waratah	8	No influence from other noise sources
21	12:06:35 PM	17	72 dBA	63 dBA	77 dBA	81 dBA	Down	Waratah	8	No influence from other noise sources

Project	**ETTT Compliance Assessment**
Location ID	**N11**
Street	**3 Wongala Crescent, Pennant Hills**
Date	**Friday, 31 March 2017**
Weather	**Sunny, occasional gusts, 16°C**
Measurement Height	**1.5m above ground level**
Measurement Location	**Free-field**
Monitoring Equipment	**Brüel & Kjær 2260**
Equipment Serial No.	**2115053**

Note the LAE Ref and LAMax Ref are referenced at 15m from the track centreline and a 80kmh train speed.

Event No.	Passby Time	Duration (s)	LAE	LAMax	LAE Ref	LAMax Ref	Track	Class/ Type	No. Cars/Wagons	Notes On Ambient Noise
1	10:31:35 AM	274	96 dBA	85 dBA	88 dBA	120 dBA	Down	Freight	3	Curve squeal noise present, slow passby speed
2	10:37:35 AM	13	70 dBA	60 dBA	63 dBA	82 dBA	Up	Waratah	8	No influence from other noise sources
3	10:38:14 AM	20	77 dBA	69 dBA	68 dBA	87 dBA	Down	Waratah	8	No influence from other noise sources
4	10:40:46 AM	141	84 dBA	71 dBA	81 dBA	112 dBA	Up	Freight	3	No influence from other noise sources
5	10:44:23 AM	25	80 dBA	73 dBA	75 dBA	95 dBA	Down	Intercity	4	No influence from other noise sources
6	10:48:50 AM	24	70 dBA	61 dBA	64 dBA	83 dBA	Up	Waratah	8	No influence from other noise sources
7	10:53:13 AM	22	74 dBA	66 dBA	69 dBA	87 dBA	Down	Waratah	8	No influence from other noise sources
8	10:55:04 AM	19	69 dBA	60 dBA	63 dBA	81 dBA	Up	Oscar	4	No influence from other noise sources
9	11:03:54 AM	26	70 dBA	62 dBA	63 dBA	83 dBA	Up	Waratah	8	No influence from other noise sources
10	11:08:38 AM	18	75 dBA	68 dBA	71 dBA	88 dBA	Down	Waratah	8	Minor influnece from background road traffic
11	11:10:27 AM	85	85 dBA	74 dBA	77 dBA	103 dBA	Up	Freight	4	No influence from other noise sources
12	11:15:05 AM	9	73 dBA	66 dBA	69 dBA	84 dBA	Down	Oscar	4	Car passby towards end
13	11:19:16 AM	19	70 dBA	60 dBA	65 dBA	83 dBA	Up	Waratah	8	No influence from other noise sources
14	11:24:03 AM	23	79 dBA	71 dBA	73 dBA	91 dBA	Down	Oscar	8	No influence from other noise sources
15	11:25:28 AM	22	76 dBA	68 dBA	72 dBA	91 dBA	Up	Intercity	8	No influence from other noise sources
16	11:34:24 AM	24	72 dBA	66 dBA	67 dBA	86 dBA	Up	Waratah	8	No influence from other noise sources
17	11:38:32 AM	19	76 dBA	67 dBA	69 dBA	87 dBA	Down	Waratah	8	No influence from other noise sources
18	11:45:19 AM	20	86 dBA	82 dBA	82 dBA	100 dBA	Down	Intercity	8	Curve squeal noise present
19	11:49:16 AM	21	75 dBA	68 dBA	68 dBA	87 dBA	Up	Tangara	8	First carrage had possible wheel flat
20	11:53:28 AM	16	76 dBA	67 dBA	70 dBA	87 dBA	Down	Waratah	8	No influence from other noise sources
21	11:55:09 AM	14	69 dBA	62 dBA	64 dBA	81 dBA	Up	Oscar	4	No influence from other noise sources
22	12:04:03 PM	20	69 dBA	60 dBA	64 dBA	82 dBA	Up	Waratah	8	No influence from other noise sources
23	12:07:41 PM	19	76 dBA	70 dBA	70 dBA	87 dBA	Down	Waratah	8	No influence from other noise sources
24	12:15:25 PM	25	86 dBA	78 dBA	78 dBA	97 dBA	Down	Endeavour	8	No influence from other noise sources

Project	**ETTT Compliance Assessment**
Location ID	**N14**
Street	**27 Azalea Grove, Pennant Hills**
Date	**Friday, 31 March 2017**
Weather	**Sunny, occasional gusts, 16°C**
Measurement Height	**1.5m above ground level**
Measurement Location	**Free-field**
Monitoring Equipment	**Brüel & Kjær 2260**
Equipment Serial No.	**2414605**

Note the LAE Ref and LAMax Ref are referenced at 15m from the track centreline and a 80kmh train speed.

Event No.	Passby Time	Duration (s)	LAE	LAMax	LAE Ref	LAMax Ref	Track	Class/ Type	No. Cars/Wagons	Notes On Ambient Noise
1	10:31:02 AM	117	85 dBA	74 dBA	102 dBA	99 dBA	Down	Freight	3	Curve squeal noise present, slow passby speed
2	10:36:42 AM	21	66 dBA	59 dBA	72 dBA	70 dBA	Up	Waratah	8	No influence from other noise sources
3	10:37:24 AM	19	68 dBA	60 dBA	74 dBA	71 dBA	Down	Waratah	8	No influence from other noise sources
4	10:40:02 AM	84	74 dBA	64 dBA	93 dBA	91 dBA	Up	Freight	3	No influence from other noise sources
5	10:43:39 AM	20	72 dBA	65 dBA	80 dBA	79 dBA	Down	Intercity	4	No influence from other noise sources
6	10:48:06 AM	17	65 dBA	56 dBA	70 dBA	68 dBA	Up	Waratah	8	No influence from other noise sources
7	10:52:25 AM	19	67 dBA	60 dBA	73 dBA	71 dBA	Down	Waratah	8	No influence from other noise sources
8	10:54:17 AM	14	63 dBA	63 dBA	69 dBA	75 dBA	Up	Oscar	4	No influence from other noise sources
9	11:03:08 AM	18	65 dBA	58 dBA	70 dBA	67 dBA	Up	Waratah	8	No influence from other noise sources
10	11:07:54 AM	17	70 dBA	62 dBA	73 dBA	70 dBA	Down	Waratah	8	No influence from other noise sources
11	11:09:37 AM	86	77 dBA	64 dBA	86 dBA	79 dBA	Up	Freight	4	No influence from other noise sources
12	11:14:18 AM	12	64 dBA	55 dBA	68 dBA	66 dBA	Down	Oscar	4	No influence from other noise sources
13	11:18:30 AM	17	67 dBA	60 dBA	70 dBA	70 dBA	Up	Waratah	8	No influence from other noise sources
14	11:23:16 AM	21	72 dBA	64 dBA	78 dBA	76 dBA	Down	Oscar	8	No influence from other noise sources
15	11:24:43 AM	21	67 dBA	58 dBA	74 dBA	70 dBA	Up	Intercity	8	No influence from other noise sources
16	11:33:40 AM	16	64 dBA	55 dBA	70 dBA	68 dBA	Up	Waratah	8	No influence from other noise sources
17	11:37:44 AM	18	67 dBA	59 dBA	73 dBA	70 dBA	Down	Waratah	8	No influence from other noise sources
18	11:44:34 AM	18	75 dBA	68 dBA	82 dBA	83 dBA	Down	Intercity	8	No influence from other noise sources
19	11:52:43 AM	14	71 dBA	61 dBA	75 dBA	71 dBA	Up	Waratah	8	No influence from other noise sources
20	11:54:23 AM	14	64 dBA	57 dBA	68 dBA	69 dBA	Down	Oscar	8	No influence from other noise sources
21	12:03:21 PM	13	61 dBA	53 dBA	67 dBA	64 dBA	Up	Waratah	4	No influence from other noise sources
22	12:06:58 PM	13	72 dBA	65 dBA	76 dBA	76 dBA	Up	Waratah	8	No influence from other noise sources
23	12:14:32 PM	34	77 dBA	69 dBA	83 dBA	81 dBA	Down	Endeavour	8	No influence from other noise sources
24	12:18:19 PM	22	68 dBA	58 dBA	73 dBA	70 dBA	Down	Waratah	8	No influence from other noise sources
25	12:23:14 PM	20	72 dBA	68 dBA	76 dBA	75 dBA	Down	Waratah	8	No influence from other noise sources
26	12:25:52 PM	13	60 dBA	50 dBA	112 dBA	106 dBA	Down	Oscar	8	No influence from other noise sources

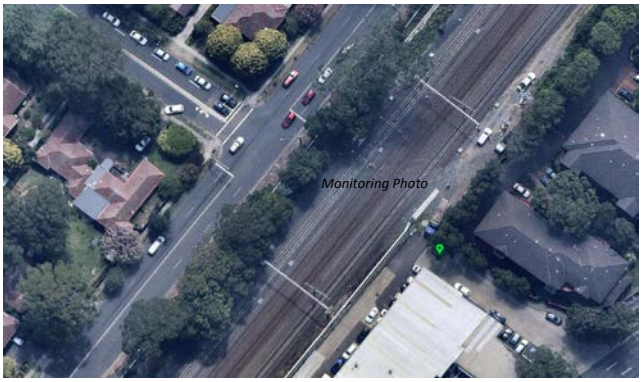
Project	**ETTT Compliance Assessment**
Location ID	**N16**
Street	**56 Yarrara Road, Pennant Hills**
Date	**Monday, 8 May 2017**
Weather	**Sunny, occasional gusts, 16°C**
Measurement Height	**1.5m above ground level**
Measurement Location	**Free-field**
Monitoring Equipment	**Brüel & Kjær 2260**
Equipment Serial No.	**2414604**

Note the LAE Ref and LAMax Ref are referenced at 15m from the track centreline and a 80kmh train speed.

Event No.	Passby Time	Duration (s)	LAE	LAMax	LAE Ref	LAMax Ref	Track	Class/ Type	No. Cars/Wagons	Notes On Ambient Noise
1	10:01:48 PM	29	82 dBA	76 dBA	91 dBA	92 dBA	Up	Waratah (v)	8	Influenced by road traffic, not used
2	10:10:28 PM	16	77 dBA	73 dBA	86 dBA	87 dBA	Down	Waratah (v)	8	Influenced by road traffic, not used
3	10:16:09 PM	11	70 dBA	64 dBA	73 dBA	71 dBA	Down	Oscar	4	No influence from other noise sources
4	10:18:17 PM	13	72 dBA	63 dBA	79 dBA	74 dBA	Down	Waratah	8	No influence from other noise sources
5	10:24:39 PM	15	71 dBA	62 dBA	75 dBA	72 dBA	Up	K-Set	8	No influence from other noise sources
6	10:29:10 PM	28	70 dBA	63 dBA	79 dBA	76 dBA	Down	Waratah	8	No influence from other noise sources
7	10:33:12 PM	24	77 dBA	75 dBA	89 dBA	94 dBA	Up	Waratah (v)	8	Influenced by road traffic, not used
8	10:36:20 PM	25	69 dBA	60 dBA	78 dBA	74 dBA	Down	Waratah	8	No influence from other noise sources
9	10:38:06 PM	109	85 dBA	74 dBA	99 dBA	96 dBA	Up	Freight	37	No influence from other noise sources
10	10:52:46 PM	18	71 dBA	62 dBA	74 dBA	69 dBA	Up	Millennium	8	No influence from other noise sources
11	11:01:49 PM	29	69 dBA	58 dBA	80 dBA	77 dBA	Up	Waratah	8	No influence from other noise sources
12	11:06:01 PM	25	70 dBA	60 dBA	79 dBA	75 dBA	Down	Waratah	8	No influence from other noise sources
13	11:15:25 PM	15	70 dBA	65 dBA	77 dBA	77 dBA	Down	Intercity	4	No influence from other noise sources
14	11:29:09 PM	71	92 dBA	83 dBA	107 dBA	106 dBA	Down	Freight	2	No influence from other noise sources
15	11:31:51 PM	24	66 dBA	57 dBA	76 dBA	72 dBA	Up	Waratah	8	No influence from other noise sources
16	11:35:48 PM	17	71 dBA	70 dBA	82 dBA	86 dBA	Up	Intercity	4	No influence from other noise sources
17	11:38:41 PM	26	68 dBA	60 dBA	77 dBA	75 dBA	Down	Waratah	8	No influence from other noise sources
20	11:57:10 PM	17	71 dBA	62 dBA	76 dBA	72 dBA	Up	Millennium	8	No influence from other noise sources
21	11:58:02 PM	90	93 dBA	83 dBA	108 dBA	106 dBA	Down	Freight	3	No influence from other noise sources
22	12:05:37 AM	27	69 dBA	60 dBA	78 dBA	75 dBA	Down	Waratah	8	No influence from other noise sources
23	12:08:42 AM	30	66 dBA	55 dBA	79 dBA	76 dBA	Down	Waratah	8	No influence from other noise sources

Project	**ETTT Compliance Assessment**
Location ID	**N17**
Street	**1 Stevens St**
Date	**Tuesday, 18 April 2017**
Weather	**Sunny, occasional gusts**
Measurement Height	**1.5m above ground level**
Measurement Location	**Free-field**
Monitoring Equipment	**Brüel & Kjær 2270**
Equipment Serial No.	**3003729**

Note the LAE Ref and LAMax Ref are referenced at 15m from the track centreline and a 80kmh train speed.



Event No.	Passby Time	Duration (s)	LAE	LAMax	LAE Ref	LAMax Ref	Track	Class/ Type	No. Cars/Wagons	Notes On Ambient Noise
1	7:08:44 AM	27	85 dBA	75 dBA	89 dBA	85 dBA	Up	Oscar	8	Noise in measurement
2	7:15:14 AM	18	78 dBA	73 dBA	82 dBA	81 dBA	Down	Oscar	4	Good
3	7:16:57 AM	26	81 dBA	74 dBA	89 dBA	87 dBA	Up	Waratah	8	Good
4	7:24:18 AM	20	89 dBA	86 dBA	95 dBA	98 dBA	Up	Intercity	8	Some singing
5	7:24:43 AM	20	79 dBA	71 dBA	85 dBA	82 dBA	Down	Waratah	8	Good
6	7:32:42 AM	29	81 dBA	72 dBA	87 dBA	84 dBA	Up	Waratah	8	Noise in measurement, leaf blower
7	7:38:28 AM	16	84 dBA	76 dBA	87 dBA	84 dBA	0	Oscar (v)	8	Noise in measurement, leaf blower
8	7:39:51 AM	27	89 dBA	80 dBA	95 dBA	90 dBA	Down/Up	Waratah/Tangara	8	Noise in measurement, leaf blower
9	7:42:46 AM	33	87 dBA	81 dBA	99 dBA	99 dBA	Down	XPT	7	Good
10	7:46:59 AM	38	80 dBA	71 dBA	87 dBA	83 dBA	Up	Waratah	8	Good
11	7:48:25 AM	30	87 dBA	81 dBA	93 dBA	91 dBA	Down	Intercity	8	Good
12	7:53:52 AM	16	83 dBA	77 dBA	98 dBA	100 dBA	Up	Tangara	4	Good
13	7:54:34 AM	28	82 dBA	75 dBA	88 dBA	85 dBA	Down	Tangara	8	No influence from other noise sources
14	8:02:06 AM	24	80 dBA	73 dBA	86 dBA	84 dBA	Up	Waratah	8	No influence from other noise sources
15	8:05:56 AM	29	89 dBA	83 dBA	100 dBA	100 dBA	Up	Intercity (v)	8	Curve squeal noise present
16	8:09:40 AM	21	81 dBA	76 dBA	87 dBA	86 dBA	Down	Waratah	8	No influence from other noise sources
17	8:12:29 AM	22	87 dBA	81 dBA	93 dBA	91 dBA	Up	Intercity	8	No influence from other noise sources
18	8:15:42 AM	23	81 dBA	75 dBA	85 dBA	82 dBA	Down	Oscar	8	noise in measurement
19	8:17:04 AM	22	84 dBA	78 dBA	91 dBA	89 dBA	Up	Tangara	8	Possible wheel flat spot
20	8:24:52 AM	23	80 dBA	71 dBA	86 dBA	82 dBA	Down	Waratah	8	No influence from other noise sources
21	8:26:38 AM	19	83 dBA	74 dBA	89 dBA	85 dBA	Up	Intercity	8	No influence from other noise sources
22	8:31:40 AM	29	81 dBA	74 dBA	86 dBA	83 dBA	Up	Waratah (v)	8	Curve squeal noise present
23	8:34:14 AM	19	82 dBA	74 dBA	86 dBA	82 dBA	Down	Waratah (v)	8	No influence from other noise sources
24	8:38:53 AM	20	83 dBA	77 dBA	87 dBA	86 dBA	Up	Oscar	8	No influence from other noise sources
25	8:40:36 AM	29	78 dBA	70 dBA	84 dBA	80 dBA	Down	Waratah	8	No influence from other noise sources
26	8:45:51 AM	24	89 dBA	85 dBA	96 dBA	97 dBA	Down	Intercity	8	Curve squeal noise present
27	8:46:50 AM	23	80 dBA	72 dBA	86 dBA	83 dBA	Up	Waratah	8	Curve squeal noise present
29	11:17:29 PM	10	82 dBA	74 dBA	89 dBA	86 dBA	Down	K-Set	8	Additional 25 May 2017
30	11:36:21 PM	12	78 dBA	71 dBA	85 dBA	83 dBA	Down	Waratah	8	Additional 25 May 2017
31	11:58:39 PM	113	89 dBA	78 dBA	105 dBA	101 dBA	Down	Freight	26	Train coming to a stop and idling
32	12:19:45 AM	92	81 dBA	71 dBA	99 dBA	97 dBA	Down	Freight	48	Departing from idle [idling anaylsed separately]

PROPERTY TREATMENTS PROVIDED BY THE ETTT PROJECT

Property Address	Suburb
26 The Crescent	Cheltenham
28 Yarrara Road	Pennant Hills
1-3 Stevens Road	Pennant Hills
16 The Crescent	Cheltenham
20 The Crescent	Cheltenham
17 Old Beecroft Road	Cheltenham
22 The Crescent	Cheltenham
21 Old Beecroft Road	Cheltenham
72 Yarrara Road	Pennant Hills
18 The Crescent	Cheltenham
29 Old Beecroft Road	Cheltenham
1 Fulbourne Avenue	Pennant Hills
108 The Crescent	Cheltenham
54 The Crescent	Cheltenham
58 Yarrara Road	Pennant Hills
10 Yarrara Road	Thornleigh
22 Yarrara Road	Pennant Hills
56 The Crescent	Cheltenham
102 The Crescent	Cheltenham
19 Old Beecroft Road	Cheltenham
24 The Crescent	Cheltenham
Scout Hall – The Crescent	Cheltenham
56 Yarrara Road	Pennant Hills
14 Yarrara Road	Pennant Hills
26 Yarrara Road	Pennant Hills
2 Steven Street	Pennant Hills
25 Old Beecroft Road	Cheltenham
33 Old Beecroft Road	Cheltenham
25A Old Beecroft Road	Cheltenham
18 Yarrara Road	Pennant Hills
2/94 Yarrara Road	Pennant Hills
70 Yarrara Road (library)	Pennant Hills
106 The Crescent	Cheltenham
23 Old Beecroft Road	Cheltenham
104 The Crescent	Cheltenham
12 Yarrara Road	Thornleigh
16 Yarrara Road	Pennant Hills
2/74 Yarrara Road	Pennant Hills
1/78 Yarrara Road	Pennant Hills
31A Old Beecroft Road	Pennant Hills