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50 HONEYSUCKLE DRIVE, NEWCASTLE

Acoustic Assessment for Development Application

29 November 2017

Doma Group

TJ586-01F02 Acoustic Assessment for Development Application (r4)

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1 Introduction

This report presents an assessment of noise intrusion into, and operational noise from the proposed mixed-use development at 50 Honeysuckle Drive, Newcastle.

This study examines the effects of external noise intrusion on the proposed development from nearby ambient noise such as traffic noise. Noise surveys have been conducted by Renzo Tonin & Associates between Friday 10 March 2017 to Thursday 16 March 2017 at the development site to determine the existing levels of ambient noise at the site. These levels were used to predict noise levels within the property, and then assessed against the recommended internal noise criteria for the project.

This assessment addresses the base building and residential apartments only. The use of the commercial tenancies has not been addressed. Noise associated with the commercial tenancy fit outs is to be addressed in the Development Applications for the individual use of these spaces.

As a result of our assessment, the following potential acoustic items were identified;

- Existing traffic noise from Honeysuckle Drive intruding into the development;
- Noise associated with Newcastle Port intruding into the development;
- Existing industrial noise sources (mechanical plant and equipment) impacting on the proposed development; and
- Noise emission from proposed mechanical plant impacting on existing residential and commercial receivers.

This report presents an assessment of the above acoustic components in terms of Council's Development Control Plans, State Environmental Planning Policy (Infrastructure) 2007 and Australian Standards.

The predicted traffic noise levels at the building facades were used to determine the sound insulation rating requirements for the external building elements in accordance with the acoustic criteria nominated for this development.

In regard to acoustic privacy, this is generally satisfied through the requirements of the National Construction Codes - Building Code of Australia which all new residential developments would need to comply.

Further detailed discussion of the identified acoustic factors is set out within this report.

The work documented in this report was carried out in accordance with the Renzo Tonin & Associates Quality Assurance System, which is based on Australian Standard / NZS ISO 9001. Appendix A contains a glossary of acoustic terms used in this report.

2 Site and Surrounds

The proposed development at 50 Honeysuckle Drive, Newcastle is to consist of three buildings, comprising of basement car parking, ground floor residential, commercial and car parking, and 6 levels of residential apartments.

The site is surrounded by commercial buildings to the south, across Honeysuckle Drive, and residential buildings to the east. Hunter River is located to the east of the site, with Newcastle Port located on the opposite side of the river.

Long-term noise monitoring has been undertaken at 16 Honeysuckle Drive to determine the existing acoustic environment.

Figure 1 below shows the site and surrounds.

Figure 1: Site location and surrounds

3 Internal Noise Criteria

3.1 Road Traffic Noise

A number of documents were taken into account when determining suitable criteria for the proposed development site. These included:

- State Environment Planning Policy (Infrastructure) 2007 (the "ISEPP')
- Department of Planning publication "Development Near Rail Corridors & Busy Roads – Interim Guideline" 2008
- Australian Standard AS2107:2016 "Recommended Design Sound Levels and Reverberation Times for Building Interiors"
- Newcastle City Council DCP 2012 ["DCP"]

It should be noted that Honeysuckle Drive is not identified as a road requiring a mandatory assessment (greater than AADT 40,000) or a recommended assessment (greater than AADT 20,000 but less than 40,000) on The Roads and Maritime Services (RMS) Traffic Volume Maps for ISEPP.

Nonetheless, given the urban environment surrounding the development, the Department of Planning publication "Development Near Rail Corridors & Busy Roads – Interim Guideline" 2008 is considered the most appropriate criteria for this development site and is summarised in the table below.

Table 1 below summaries the airborne traffic noise criteria recommended for the proposed developments.

Table 1: Recommended Internal Noise Criteria for Road Traffic Noise

Occupancy	Windows & Doors Condition	Design Noise Level	
		Day, $L_{Aeq\ (T)}$	Night, $L_{Aeq\ (T)}$
Bedrooms	Closed	-	35 dB(A), 9 hour
	Open	-	45 dB(A), 9 hour
All Other Habitable Areas	Closed	40 dB(A), 15 hour	40 dB(A), 9 hour
	Open	50 dB(A), 15 hour	50 dB(A), 9 hour

Notes:

Day and Night assessment periods are defined as follows.

1. Day is defined as 7:00am to 10:00pm
2. Night is defined as 10.00pm to 7.00am

Appendix C presents results of the unattended ambient noise survey conducted on site.

3.2 Port Activities

Newcastle Port has the potential to operate 24 hours a day, 7 days a week. As such, sleep arousal must be taken into consideration for the development at 50 Honeysuckle Drive.

3.2.1 Sleep disturbance

3.2.1.1 Background information

Noise emanating from project has been assessed for its potential to disturb sleep. The NSW EPA has made the following policy statement with respect to sleep disturbance:

> *Peak noise level events, such as reversing beepers, noise from heavy items being dropped or other high noise level events, have the potential to cause sleep disturbance. The potential for high noise level events at night and effects on sleep should be addressed in noise assessments for both the construction and operational phases of a development. The INP does not specifically address sleep disturbance from high noise level events.*
>
> *Research on sleep disturbance is reviewed in the NSW Road Noise Policy. This review concluded that the range of results is sufficiently diverse that it was not reasonable to issue new noise criteria for sleep disturbance.*
>
> *From the research, the EPA recognised that the current sleep disturbance criterion of an LA1, (1 minute) not exceeding the LA90, (15 minute) by more than 15 dB(A) is not ideal. Nevertheless, as there is insufficient evidence to determine what should replace it, the EPA will continue to use it as a guide to identify the likelihood of sleep disturbance. This means that where the criterion is met, sleep disturbance is not likely, but where it is not met, a more detailed analysis is required.*
>
> *The detailed analysis should cover the maximum noise level or LA1, (1 minute), that is, the extent to which the maximum noise level exceeds the background level and the number of times this happens during the night-time period. Some guidance on possible impact is contained in the review of research results in the NSW Road Noise Policy. Other factors that may be important in assessing the extent of impacts on sleep include:*
>
> - *how often high noise events will occur*
> - *time of day (normally between 10pm and 7am)*
> - *whether there are times of day when there is a clear change in the noise environment (such as during early morning shoulder periods).*
>
> *The LA1, (1 minute) descriptor is meant to represent a maximum noise level measured under 'fast' time response. The EPA will accept analysis based on either LA1, (1 minute) or LA, (Max).*
>
> *Source: http://www.epa.nsw.gov.au/noise/applicnotesindustnoise.htm Downloaded: 04.12.2014*

Where the background noise levels are less than 40 dB(A), some studies indicate that the above approach may result in noise limits that are unnecessarily strict.

In relation to maximum noise level events, the NSW Road Noise Policy (NSW EPA, 2012) identifies several investigations into the impacts of intermittent and emerging noise sources on the disturbance of

sleep. *Reference is made to enHealth report (2004)* **Invalid source specified.** *which notes the following in relation to maximum noise level events:*

> *As a rule in planning for short-term or transient noise events, for good sleep over 8 hours the indoor sound pressure level measured as a maximum instantaneous value should not exceed approximately 45 dB(A) LAmax more than 10 or 15 times per night.*

The NSW Road Noise Policy**Invalid source specified.** summaries the research on sleep disturbance to date as follows:

- *maximum internal noise levels below 50–55 dB(A) are unlikely to awaken people from sleep*
- *one or two noise events per night, with maximum internal noise levels of 65–70 dB(A), are not likely to affect health and wellbeing significantly*

The above references identify that internal noise levels of 45 dB(A) and up to 55 dB(A), may have the potential to impact sleep but are unlikely to cause awakenings. On the assumption that there is a 10 dB(A) outside-to-inside noise loss through an open window (see NSW Industrial Noise Policy, p17), the above references indicate that external noise levels of L_{Amax} 55 to 65 dB(A) are unlikely to cause awakening reactions.

3.2.2 Sleep disturbance assessment

To assess the likelihood of sleep disturbance, an initial screening level of (L_{Amax} or $L_{A1(1min))} \leq L_{A90(15min)}$ + 15 dB(A) is used. In situations where this results in an external screening level of less than 55 dB(A), a minimum screening level of 55 dB(A) is set. Note that this is equivalent to a maximum internal noise level of 45 dB(A) with windows open.

Where there are noise events found to exceed the initial screening level, further analysis is made to identify:

- the likely number of events that might occur during the night assessment period
- Whether events exceed an 'awakening reaction' level of $L_{A1(1min))}$ 65 dB(A).

The sleep disturbance assessment levels for the project are presented in Table 2.

Table 2: Sleep disturbance assessment levels, 10pm - 7am, , $L_{A1,1min}$ (or L_{Amax}), dB(A)

Address	Initial Screening Level $L_{A90(15min)}$ + 15	Awakening reaction level
50 Honeysuckle Drive - facing Port	55 (minimum 55)	65

4 Measured and Predicted Noise Levels

4.1 Long-term Noise Survey

One RTA Technology Environmental Noise Logger was set up for the ambient noise survey from Friday 10 March 2017 to Thursday 16 March 2017. The logger was set up from Level 3 outdoor area of 16 Honeysuckle Drive, Newcastle facing Honeysuckle Drive.

The noise logger records noise levels on a continuous basis and stores data every fifteen minutes. The noise logger was calibrated before and after measurements and no significant deviation in calibration was noted. The noise monitoring equipment used here complies with Australian Standard 1259.2-1990 "Acoustics - Sound Level Meters" and is designated as Type 2 instruments suitable for field use.

The dates of measurement and the results obtained from the logger survey are shown in APPENDIX D.

The unattended noise monitor was positioned to capture both noise from traffic, as well as the existing ambient noise at the development site, including the operation of Newcastle Port.

Noise levels from the monitoring have been used to determine design external noise levels impacting on the development site and the acoustic design of the various facades of the proposed development.

Recommendations for the acoustic design of the glazed facades of the development are presented in Section 5 of this report.

The design external traffic noise levels are presented below.

Table 3: Predicted external noise levels

Facade	Time Period	Design Noise Level $L_{Aeq,T}$
Facing Honeysuckle Drive	Day time (7am to 10pm)	65 dB(A)
	Night time (10pm to 7am)	59 dB(A)
Facing Port[2]	Day time (7am to 10pm)	64 dB(A)
	Night time (10pm to 7am)	57 dB(A)
	LA1 (night time)[3]	66 dB(A)

Note: 1. at 1m from façade, centrally positioned along the façade width

2: Including traffic noise from Honeysuckle Drive

3: Exceeded 10-15 times in the night time period

Results from the noise surveys were used to calculate internal noise levels within the proposed development. Noise calculations were performed using glazing design software developed in this office which take into account external noise levels, facade transmission loss and room sound absorption characteristics.

5 Control of External Noise

5.1 Glazing

To achieve the criteria outlined in Table 1 with windows closed, the following table presents the recommended glazing acoustic performances for the proposed development. The assessment is based on window areas and floor areas shown on the DA architectural plans.

Table 4: Recommended acoustic performance of glazing assembly

Facade	Level/Apartment	Room Description	Required Acoustic Rating of Glazing Assembly, R_w
Facing Honeysuckle Drive	All units	Bedrooms	R_w 32
	Corner units of the western and eastern buildings (See mark-up in Figure 2)	Living/Dining	R_w 35
	Other units	Living/Dining	R_w 32
Facing East/West	All units	Bedrooms	R_w 28
	All units	Living/Dining	R_w 28
Facing North	All units	Bedrooms	R_w 28
		Living/Dining	R_w 28

Notes:

The client is advised not to commence detailing or otherwise commit to partition construction systems which have not been tested in an approved laboratory or for which an opinion only is available. Testing of partition construction systems is a component of the quality control of the design process and should be viewed as a priority because there is no guarantee the forecast results will be achieved thereby necessitating the use of an alternative which may affect the cost and timing of the project. No responsibility is taken for use of or reliance upon untested partition construction systems, estimates or opinions. The advice provided here is in respect of acoustics only.

The information in this table is provided for the purpose of Council approvals process and cost planning and shall not be used for construction unless otherwise approved in writing by the acoustic consultant.

The design in this table is preliminary and a comprehensive assessment shall be conducted prior to Construction Certification.

Before committing to any form of construction or committing to any builder, advice should be sought from an acoustic consultant to ensure that adequate provisions are made for any variations which may occur as a result of changes to the form of construction where only an "estimate" is available for the sound insulation properties of recommended materials.

The glazing supplier shall ensure that installation techniques will not diminish the Rw performance of the glazing when installed on site.

All openable glass windows and doors shall incorporate full perimeter acoustic seals equivalent to Q-Lon, which enable the Rw rating performance of the glazing to not be reduced.

The above glazing thicknesses should be considered the minimum thicknesses to achieve acoustical ratings. Greater glazing thicknesses may be required for structural loading, wind loading etc.

Figure 2: Mark-up of glazing requiring R_W 35

5.2 Typical Glazing Constructions to Achieve Acoustic Ratings

The following table presents typical glazing constructions to achieve the minimum acoustic ratings presented in Table 4above.

Table 5: Typical Glazing Constructions to Achieve Acoustic Ratings

Rw Rating	Typical Glazing System
Rw 25	Minimum 4mm monolithic glass in an aluminium double sliding window frame. Standard weather seals installed
Rw 28	Minimum 6mm monolithic glass in an aluminium double sliding window frame. Standard weather seals installed
Rw 32	Minimum 6.38mm laminated glass in an aluminium double sliding window frame. Q-lon seals perimeter seals are installed
Rw 35	Minimum 10.38mm laminated glass in commercial grade frames window frame. Full perimeter Q-lon seals perimeter seals are installed

The table presented above is intended as a guide only and should not be used for construction.

It is the responsibility of the sub-contractor to provide laboratory test reports for the glazed systems proposed for installation at the development site to show compliance with the acoustic ratings presented in Table 4.

The client is advised not to commence detailing or otherwise commit to partition construction systems which have not been tested in an approved laboratory or for which an opinion only is available. Testing of partition construction systems is a component of the quality control of the design process and should be viewed as a priority because there is no guarantee the forecast results will be achieved thereby necessitating the use of an alternative which may affect the cost and timing of the project. No responsibility is taken for use of or reliance upon untested partition construction systems, estimates or opinions.

5.3 Natural Ventilation

In accordance with the Department of Planning's publication "Development Near Rail Corridors & Busy Roads – Interim Guideline" 2008, it states;

> *If internal noise levels with windows or doors open exceed the criteria by more than 10dB(A), the design of the ventilation for these rooms should be such that occupants can leave windows closed, if they so desire, and also to meet the ventilation requirements of the Building Code of Australia.*

However, the Department of Planning's Apartment Design Guide, July 2015 Objective 4B-1 requires that all habitable rooms are naturally ventilated, within an apartment complex.

Section 4J, *Noise and Pollution*, of the Apartment Design Guide nominates design solutions that may assist with delivering both the natural ventilation requirements and the internal noise levels (windows open) through careful design solutions. These may include wintergardens with operable facades, partially shielded and insulated balconies, building design and orientation, apartment setbacks and selection of acoustic materials for the building construction.

It has long been industry standard to assume a 10dB loss of noise from external to internal through an opened window in a building facade. It is based on the average results of a number of test cases, experimental data and published papers. This assumption has been well documented in The Roads and Traffic Authority (RTA) publications, including the RTA's Environmental Noise Management Manual (ENMM), Table 4.2.

Recent studies on noise reduction through facades with open windows[1] have shown that noise transmission through an open window can vary greatly based on the construction of the facades and noise flanking paths, including exposed floors and roof constructions.

The study indicates that noise loss through an open window of a development consisting of masonry construction with no exposed flooring and a concrete roof will be in the range of 11-15dB.

The table below presents design noise levels at the facades of the buildings and predicted internal noise levels with windows opened and presents a comparison against the "windows opened" criteria as state above.

Table 6: Noise assessment to windows open criteria

Facade	Period	Predicted $L_{Aeq,T}$ Traffic Noise Level in dBA		Determined Criteria + 10 dB with Windows Open , $L_{Aeq,T}$	Compliance (Yes/No)
		1m from facade	Inside Apartment with Windows Open, $L_{Aeq,T}$		
Facing Honeysuckle Drive	Day (15-hour)	65dB(A)	50-54 dB(A)	50 dB(A)	Yes*
	Night (9-hour)	59 dB(A)	44-48 dB(A)	45 dB(A)	Yes*

Notes: * Further assessment required at detailed design to consider facade design, opening sizes, room volumes and finishes. Current assessment is based on details presented in DA drawings.

The predicted internal traffic noise levels with windows opened when assessed against the nominated criteria can be achieved for units within the development based on the current layout and design. Therefore, both the internal noise goals and natural ventilation requirements for the apartments can be achieved.

[1] Ryan, Lanchester and Pugh, 2011

6 External Noise Emission

6.1 EPA Requirements

The NSW Environment Protection Authority (EPA) sets out noise criteria in its Industrial Noise Policy (INP) to control the noise emission from industrial sources.

The NSW Industrial Noise Policy (INP) sets criteria to protect noise amenity for residential receivers. The basis for its policy relies on two components:

- controlling intrusive noise impacts in the short term for residences, and
- maintaining noise level amenity for particular land uses for residences and other land uses.

Noise intrusiveness ensures that industrial noise does not exceed the existing background noise level by an excessive margin. This is commonly referred to as the 'background plus 5' criterion, that is, that the noise level from the new industrial development should not exceed the existing background noise level (measured in the absence of that development) by more than 5dB(A).

Noise amenity ensures that industrial noise levels do not increase without limit, for if a number of industrial noise sources are permitted to increase the background noise level by 5dB(A), in turn there would be a point where the ultimate noise level is unacceptable. A limit on the ultimate acceptable noise level is therefore included in the INP as a way of ensuring that cumulative noise impact from industrial growth is curtailed. This limit is referred to as the amenity goal. The appropriate limit in any circumstance relates to the land use category, for example, there are different limits for rural, suburban and urban areas. The table below presents the amenity criteria relevant to the receivers surrounding the proposed development site.

Table 7: INP Amenity Criteria - Recommended LAeq Noise Levels from Industrial Noise Sources [NSW INP Table 2.1]

Type of Receiver	Indicative Noise Amenity Area	Time of Day	Recommended $L_{Aeq\ (Period)}$ Noise Level	
			Acceptable	Recommended Maximum
Residence	Rural	Day	50	55
		Evening	45	50
		Night	40	45
	Suburban	Day	55	60
		Evening	45	50
		Night	40	45
	Urban	Day	60	65
		Evening	50	55
		Night	45	50
	Urban/Industrial Interface - for existing situations only	Day	65	70
		Evening	55	60
		Night	50	55
Area specifically reserved for passive recreation (e.g. National Park)	All	When in use	50	55
Active recreation area (e.g. school playground, golf course)	All	When in use	55	60
Commercial premises	All	When in use	65	70
Industrial premises	All	When in use	70	75

Note:

Daytime 7.00 am to 6.00 pm; Evening 6.00 pm to 10.00 pm; Night-time 10.00 pm to 7.00 am

On Sundays and Public Holidays, Daytime 8.00 am - 6.00 pm; Evening 6.00 pm - 10.00 pm; Night-time 10.00 pm - 8.00 am.

The LAeq index corresponds to the level of noise equivalent to the energy average of noise levels occurring over a measurement period.

The modification factors in Table 2.2 of the INP (summarised in the table below) are to be applied where the total existing LAeq noise level from *industrial* sources are within 6dB of the acceptable noise level (ANL) presented in the table above.

Table 8: Modification to Acceptable Noise Level (ANL)* to Account for Existing Level of Industrial Noise [NSW INP Table 2.2]

Total Existing LAeq noise level from Industrial Noise Sources	Maximum L_{Aeq} Noise Level for Noise from New Sources Alone, dB(A)
≥ Acceptable noise level plus 2	If existing noise level is likely to decrease in future: acceptable noise level minus 10 If existing noise level is unlikely to decrease in future: existing noise level minus 10
Acceptable noise level plus 1	Acceptable noise level minus 8
Acceptable noise level	Acceptable noise level minus 8
Acceptable noise level minus 1	Acceptable noise level minus 6

Total Existing LAeq noise level from Industrial Noise Sources	Maximum L_{Aeq} Noise Level for Noise from New Sources Alone, dB(A)
Acceptable noise level minus 2	Acceptable noise level minus 4
Acceptable noise level minus 3	Acceptable noise level minus 3
Acceptable noise level minus 4	Acceptable noise level minus 2
Acceptable noise level minus 5	Acceptable noise level minus 2
Acceptable noise level minus 6	Acceptable noise level minus 1
< Acceptable noise level minus 6	Acceptable noise level

* ANL = recommended acceptable LAeq noise level for the specific receiver, area and time of day from Table 2.1 (INP)

From observations at the proposed development site, the current L_{Aeq} noise level measured at the proposed development site are dominated by existing industrial noise, therefore the modifying factors in Table 2.2 above have been applied to the measured L_{Aeq} noise levels.

The following table presents the site specific noise production criteria from industrial noise sources, namely mechanical plant.

Table 9: LAeq design criterion for noise production from mechanical plant (EPA INP)

	Column 1	Column 2	Column 3	Column 4	Column 5	Column 6	Column 7	Column 8
Time of Day	**Rating Background Level (RBL) L_{A90}**	**Intrusiveness Criterion (RBL+5)**	**Amenity Criterion - Acceptable**	**Measured L_{Aeq} Ambient Noise Levels**	**L_{Aeq} exceed amenity criterion?**	**Existing noise level likely to decrease in future?**	**Relevant modification to ANL?**	**Project Specific Design Criterion L_{Aeq}**
Day (7am to 6pm)	52	57	60	61	Yes 1dB	No	ANL minus 8 (52dBA)	52
Evening (6pm to 10pm)	52	57	50	61	Yes 11dB	No	Existing L_{Aeq} minus 10dB (51dBA)	51
Night (10pm to 7am)	46	51	45	55	Yes 10dB	No	Existing L_{Aeq} minus 10dB (45dBA)	45

Explanatory notes:

Column 3 – Recommended L_{Aeq} noise level based on 'Residence –urban' area in Section 2.2, Table 2.1 Amenity Criteria (Recommended L_{Aeq} noise levels from industrial noise sources) of the EPA's INP.

Column 4 - Measured in accordance with the INP

Column 7 - Determined from Table 2.2 of the INP

Column 8 – Project Specific Design Criterion based on EPA's INP.

Where necessary, noise amelioration treatment will be incorporated in the design to ensure that noise levels comply with the recommended EPA's INP noise emission criteria noted above.

At this stage details of mechanical plant have not been finalised, the following in-principal recommendations are provided.

Acoustic assessment of mechanical services equipment will need to be undertaken during the detail design phase of the development to ensure that they shall not either singularly or in total emit noise levels which exceed the noise limits in EPA's Industrial Noise Policy or Council's requirements;

As noise control treatment can affect the performance of the mechanical services system, it is recommend that consultation with an acoustic consultant be made during the initial phase of mechanical services system design in order to reduce the need for revision of mechanical plant and noise control treatment;

Mechanical plant noise emission can be controllable by appropriate mechanical system design and implementation of common engineering methods that may include any of the following:

- procurement of 'quiet' plant,
- strategic positioning of plant away from sensitive neighbouring premises, maximising the intervening shielding between the plant and sensitive neighbouring premises,
- commercially available silencers or acoustic attenuators for air discharge and air intakes of plant;
- acoustically lined and lagged ductwork;
- acoustic screens and barriers between plant and sensitive neighbouring premises; and/or
- Partially-enclosed or fully-enclosed acoustic enclosures over plant.

Mechanical plant shall have their noise specifications and their proposed locations checked prior to their installation on site; and

Fans shall be mounted on vibration isolators and balanced in accordance with Australian Standard AS2625 "Rotating and Reciprocating Machinery – Mechanical Vibration".

We recommend a full and detailed assessment with fully documented acoustic treatments be undertaken at the detailed design phase of the development, followed by construction/installation supervision of mechanical plant and equipment acoustic treatment. Compliance testing following the installation of the plant should also be undertaken.

7 Internal Sound Insulation

Internal walls and floors shall comply with the National Construction Code of Australia 2016 (formally Building Code of Australia). All services and doors shall comply with the requirements of the NCC 2016. APPENDIX C presents a summary of acoustic provisions outlined in Part F5 of the NCC 2016.

Separation of the residential component of the development and parts of a different classification, including the commercial spaces and car parking are to be designed to achieve the requirements of Part F5 of the BCA as a minimum. Further treatment may be required following individual assessment of the commercial tenancies that will form part of the Development Application for those spaces.

8 Construction Noise

8.1 Environmental protection authority's construction noise guidelines

The Environmental Protection Authority (EPA) released its Interim Construction Noise Guideline (ICNG) in 2009. This document is being referred to as EPA's standard policy for assessing construction noise on new projects.

The key components of the ICNG that can be incorporated into this assessment include:

1. Use of L_{Aeq} as the descriptor for measuring and assessing construction noise.

In recent years NSW noise policies including EPA's NSW Industrial Noise Policy (INP) and the NSW Environmental Criteria for Road Traffic Noise (ECRTN) have moved to the primary use of L_{Aeq} over any other descriptor. As an energy average, L_{Aeq} provides ease of use when measuring or calculating noise levels since a full statistical analysis is not required as when using, for example, the L_{A10} descriptor.

Consistent with the latest guideline (ICNG) the use of L_{Aeq} as the key descriptor for measuring and assessing construction noise may follow a 'best practice' approach.

2. Application of feasible and reasonable noise mitigation measures

As stated in the ICNG, a noise mitigation measure is feasible if it is capable of being put into practice, and is practical to build given the project constraints.

Selecting reasonable mitigation measures from those that are feasible involves making a judgement to determine whether the overall noise benefit outweighs the overall social, economic and environmental effects, including the cost of the measure.

3. Quantitative and qualitative assessment

The ICNG provides two methods for assessment of construction noise, being either a quantitative or a qualitative assessment.

A quantitative assessment is recommended for major construction projects of significant duration, and involves the measurement and prediction of noise levels, and assessment against set criteria.

A qualitative assessment is recommended for small projects with a short-term duration where works are not likely to affect an individual or sensitive land use for more than three weeks in total. It focuses on minimising noise disturbance through the implementation of feasible and reasonable work practices, and community notification.

Given the significant scale of the construction works proposed for this Project, a quantitative assessment is carried out herein, consistent with the ICNG's requirements.

4. Management Levels

Residences

Table 10 below (reproduced from Table 2 of the ICNG) sets out the noise management levels and how they are to be applied. The guideline intends to provide respite for residents exposed to excessive construction noise outside the recommended standard hours whilst allowing construction during the recommended standard hours without undue constraints.

The rating background level (RBL) is used when determining the management level. The RBL is the overall single-figure background noise level measured in each relevant assessment period (during or outside the recommended standard hours).

Table 10: Noise at residences using quantitative assessment

Time of Day	Management Level $L_{Aeq\ (15\ min)}$*	How to Apply
Recommended standard hours: Monday to Friday 7 am to 6 pm Saturday 8 am to 1 pm No work on Sundays or public holidays	Noise affected RBL + 10dB(A)	The noise affected level represents the point above which there may be some community reaction to noise. Where the predicted or measured $L_{Aeq\ (15\ min)}$ is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level. The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.
	Highly noise affected 75dB(A)	The highly noise affected level represents the point above which there may be strong community reaction to noise. Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account: times identified by the community when they are less sensitive to noise (such as before and after school for works near schools, or mid-morning or mid-afternoon for works near residences if the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
Outside recommended standard hours	Noise affected RBL + 5dB(A)	A strong justification would typically be required for works outside the recommended standard hours. The proponent should apply all feasible and reasonable work practices to meet the noise affected level. Where all feasible and reasonable practices have been applied and noise is more than 5dB(A) above the noise affected level, the proponent should negotiate with the community. For guidance on negotiating agreements see section 7.2.2.

* Noise levels apply at the property boundary that is most exposed to construction noise, and at a height of 1.5m above ground level. If the property boundary is more than 30 m from the residence, the location for measuring or predicting noise levels is at the most noise-affected point within 30 m of the residence. Noise levels may be higher at upper floors of the noise affected residence.

Sensitive Land Use

Table 11 below (reproduced from Table 2 of the ICNG) sets out the noise management levels for various sensitive land use developments.

Table 11: Noise at other sensitive land uses using quantitative assessment

Land use	Management level, $L_{Aeq\ (15\ min)}$ – applies when land use is being utilised
Classrooms at schools and other educational institutions	Internal noise level 45 dB(A)
Hospital wards and operating theatres	Internal noise level 45 dB(A)
Places of worship	Internal noise level 45 dB(A)
Active recreation areas	External noise level 65 dB(A)
Passive recreation areas	External noise level 60 dB(A)
Community centres	Depends on the intended use of the centre. Refer to the 'maximum' internal levels in AS2107 for specific uses.

8.2 General Construction Noise Control Methods

Implementation of noise control measures, such as those suggested in the Interim Construction Noise Guideline (ICNG) and Australian Standard 2436-1981 "Guide to Noise Control on Construction, Maintenance and Demolition Sites", are expected to reduce predicted construction noise levels. Reference to Australian Standard 2436-1981, Appendix E, Table E1 suggests possible remedies and alternatives to reduce noise emission levels from typical construction equipment. Table E2 in Appendix E presents typical examples of noise reductions achievable after treatment of various noise sources. Table E3 in Appendix E presents the relative effectiveness of various forms of noise control treatment.

Table 12: Relative Effectiveness of Various Forms of Noise Control, dB(A) below presents noise control methods, practical examples and expected noise reductions according to AS2436 and according to Renzo Tonin & Associates' opinion based on experience with past projects.

Table 12: Relative Effectiveness of Various Forms of Noise Control, dB(A)

Noise Control Method	Practical Examples	Typical noise reduction possible in practice		Maximum noise reduction possible in practice	
		AS 2436	Renzo Tonin & Assoc.	AS 2436	Renzo Tonin & Assoc.
Screening	Acoustic barriers such as earth mounds, temporary or permanent noise barriers	7 to 10	5 to 10	15	15
Acoustic Enclosures	Engine casing lagged with acoustic insulation and plywood	15 to 30	10 to 20	50	30
Engine Silencing	Residential class mufflers	5 to 10	5 to 10	20	20
Substitution by alternative process	Use electric motors in preference to diesel or petrol	15 to 25	15 to 25	60	40

The Renzo Tonin & Associates' listed noise reductions are conservatively low and should be referred to in preference to those of AS2436, for this assessment. Table 13 below identifies possible noise control measures which are applicable on the construction plant likely to be used on site.

Table 13: Noise Control Measures for Expected Construction Plant

Plant Description	Screening	Acoustic Enclosures	Silencing	Alternative Process
Concrete Saw	✔	✔	x	x
Jack hammers	✔	x	✔	x
Mobile Crane	✔	✔	✔	x
Front End Loader	✔	x	✔	x
Pneumatic Hand Tools (general)	✔	✔	✔	✔
Bulldozer	✔	x	✔	x
Tracked Excavator	✔	x	✔	x
Concrete Trucks	✔	x	✔	x
Delivery Trucks	✔	x	✔	x
Dump Trucks	✔	x	✔	x
Truck (> 20 tonne)	✔	x	✔	x
Welders	✔	✔	x	x
Cherry Picker	✔	x	✔	x
Concrete Pump	✔	✔	✔	✔
Power Generator	✔	✔	✔	x
Light commercial vehicles	✔	x	✔	x
Silenced Air Compressor	✔	✔	✔	✔

To ensure efficient noise attenuation performance is achieved using any of the methods listed above, it is recommended acoustic engineers work closely with the construction contractors and carry out preliminary testing prior to commencement of works.

In addition to physical noise controls, the following general noise management measures should be followed:

- Plant and equipment should be properly maintained
- Provide special attention to the use and maintenance of 'noise control' or 'silencing' kits fitted to machines to ensure they perform as intended
- Strategically position plant on site to reduce the emission of noise to the surrounding neighbourhood and to site personnel
- Avoid any unnecessary noise when carrying out manual operations and when operating plant
- Any equipment not in use for extended periods during construction work should be switched off
- Noise compliance monitoring for all major equipment and activities on site should be undertaken prior to their commencement of work on site.

In addition to the noise mitigation measures outlined above, a management procedure would need to be put in place to deal with noise complaints that may arise from construction activities. Each complaint would need to be investigated and appropriate noise amelioration measures put in place to mitigate future occurrences, where the noise in question is in excess of allowable limits.

Good relations with people living and working in the vicinity of a construction site should be established at the beginning of a project and be maintained throughout the project, as this is of paramount importance. Keeping people informed of progress and taking complaints seriously and dealing with them expeditiously is critical. The person selected to liaise with the community should be adequately trained and experienced in such matters.

Where noise level exceedances cannot be avoided, then consideration should be given to implementing time restrictions and/or providing periods of repose for neighbouring receptors.

9 Conclusion

Renzo Tonin & Associates have completed an assessment of the potential noise impacts to and from the proposed mixed-use development at 50 Honeysuckle Drive, Newcastle.

In order to control airborne traffic noise intrusion and comply with the nominated criteria, glazing recommendations have been made in Section 5 above.

Recommendations to comply with noise emission criteria for the site, including mechanical plant and construction noise have also been presented in the body of this report.

In conclusion, the proposed site is capable of complying with all relevant acoustic criteria through means of standard acoustic treatment and management.

APPENDIX A Glossary of terminology

The following is a brief description of the technical terms used to describe noise to assist in understanding the technical issues presented.

Adverse weather	Weather effects that enhance noise (that is, wind and temperature inversions) that occur at a site for a significant period of time (that is, wind occurring more than 30% of the time in any assessment period in any season and/or temperature inversions occurring more than 30% of the nights in winter).
Ambient noise	The all-encompassing noise associated within a given environment at a given time, usually composed of sound from all sources near and far.
Assessment period	The period in a day over which assessments are made.
Assessment point	A point at which noise measurements are taken or estimated. A point at which noise measurements are taken or estimated.
Background noise	Background noise is the term used to describe the underlying level of noise present in the ambient noise, measured in the absence of the noise under investigation, when extraneous noise is removed. It is described as the average of the minimum noise levels measured on a sound level meter and is measured statistically as the A-weighted noise level exceeded for ninety percent of a sample period. This is represented as the L90 noise level (see below).
Decibel [dB]	The units that sound is measured in. The following are examples of the decibel readings of every day sounds: 0dB The faintest sound we can hear 30dB A quiet library or in a quiet location in the country 45dB Typical office space. Ambience in the city at night 60dB CBD mall at lunch time 70dB The sound of a car passing on the street 80dB Loud music played at home 90dB The sound of a truck passing on the street 100dB The sound of a rock band 115dB Limit of sound permitted in industry 120dB Deafening
dB(A)	A-weighted decibels. The A- weighting noise filter simulates the response of the human ear at relatively low levels, where the ear is not as effective in hearing low frequency sounds as it is in hearing high frequency sounds. That is, low frequency sounds of the same dB level are not heard as loud as high frequency sounds. The sound level meter replicates the human response of the ear by using an electronic filter which is called the "A" filter. A sound level measured with this filter switched on is denoted as dB(A). Practically all noise is measured using the A filter.
dB(C)	C-weighted decibels. The C-weighting noise filter simulates the response of the human ear at relatively high levels, where the human ear is nearly equally effective at hearing from mid-low frequency (63Hz) to mid-high frequency (4kHz), but is less effective outside these frequencies.
Frequency	Frequency is synonymous to pitch. Sounds have a pitch which is peculiar to the nature of the sound generator. For example, the sound of a tiny bell has a high pitch and the sound of a bass drum has a low pitch. Frequency or pitch can be measured on a scale in units of Hertz or Hz.
Impulsive noise	Having a high peak of short duration or a sequence of such peaks. A sequence of impulses in rapid succession is termed repetitive impulsive noise.
Intermittent noise	The level suddenly drops to that of the background noise several times during the period of observation. The time during which the noise remains at levels different from that of the ambient is one second or more.
L_{Max}	The maximum sound pressure level measured over a given period.
L_{Min}	The minimum sound pressure level measured over a given period.

L_1	The sound pressure level that is exceeded for 1% of the time for which the given sound is measured.
L_{10}	The sound pressure level that is exceeded for 10% of the time for which the given sound is measured.
L_{90}	The level of noise exceeded for 90% of the time. The bottom 10% of the sample is the L90 noise level expressed in units of dB(A).
L_{eq}	The "equivalent noise level" is the summation of noise events and integrated over a selected period of time.
Reflection	Sound wave changed in direction of propagation due to a solid object obscuring its path.
SEL	Sound Exposure Level (SEL) is the constant sound level which, if maintained for a period of 1 second would have the same acoustic energy as the measured noise event. SEL noise measurements are useful as they can be converted to obtain Leq sound levels over any period of time and can be used for predicting noise at various locations.
Sound	A fluctuation of air pressure which is propagated as a wave through air.
Sound absorption	The ability of a material to absorb sound energy through its conversion into thermal energy.
Sound level meter	An instrument consisting of a microphone, amplifier and indicating device, having a declared performance and designed to measure sound pressure levels.
Sound pressure level	The level of noise, usually expressed in decibels, as measured by a standard sound level meter with a microphone.
Sound power level	Ten times the logarithm to the base 10 of the ratio of the sound power of the source to the reference sound power.
Tonal noise	Containing a prominent frequency and characterised by a definite pitch.

APPENDIX B Criteria and design methodology

B.1 State Environment Planning Policy (ISEPP)

The State Environment Planning Policy – Infrastructure 2007, Clause 102 states:

102 Impact of road noise or vibration on non-road development

(1) This clause applies to development for any of the following purposes that is on land in or adjacent to the road corridor for a freeway, a tollway or a transitway or any other road with an annual average daily traffic volume of more than 40,000 vehicles (based on the traffic volume data published on the website of the RTA) and that the consent authority considers is likely to be adversely affected by road noise or vibration:

(a) a building for residential use,

(b) a place of public worship,

(c) a hospital,

(d) an educational establishment or child care centre.

(2) Before determining a development application for development to which this clause applies, the consent authority must take into consideration any guidelines that are issued by the Director-General for the purposes of this clause and published in the Gazette.

(3) If the development is for the purposes of a building for residential use, the consent authority must not grant consent to the development unless it is satisfied that appropriate measures will be taken to ensure that the following LAeq levels are not exceeded:

(a) in any bedroom in the building—35 dB(A) at any time between 10 pm and 7am,

(b) anywhere else in the building (other than a garage, kitchen, bathroom or hallway)—40 dB(A) at any time.

(4) In this clause, freeway, tollway and transitway have the same meanings as they have in the Roads Act 1993.

B.2 Department of Planning – Development near Rail Corridors and Busy Roads

The Guideline provides direction for developments that may be impacted by rail corridors and/or busy roads and consideration for the Guideline is a requirement for development specified under the Infrastructure SEPP.

The Guideline recommends an acoustic traffic assessment be undertaken for roads having an AADT of greater than 20,000 and less than 40,000 vehicles per day and states an assessment is mandatory for roads having an AADT of greater than 40,000 vehicles per day.

Table 3.1 of the Guideline summarises noise criteria for noise sensitive developments

Residential Buildings		
Type of occupancy	**Noise Level dBA**	**Applicable time period**
Sleeping areas (bedroom)	35	Night 10 pm to 7 am
Other habitable rooms (excl. garages, kitchens, bathrooms & hallways	40	At any time
Non–Residential Buildings		
Type of occupancy		**Recommended Max Level dBA**
Educational Institutions including child care centres		40
Places of Worship		40
Hospitals	- wards	35
	-other noise sensitive areas	35

Note: airborne noise is calculated as Leq (9h) (night) and Leq (15h)(day). Ground-borne noise is calculated as Lmax (slow) for 95% of rail pass-by events.

APPENDIX C Internal sound insulation

C.1 National Construction Code of Australia 2016

The National Construction Code of Australia (NCC) outlines minimum requirements for inter-tenancy (party) walls and ceiling/ floors to maintain privacy. This includes the incorporation of penetration of a service through a floor or through more than one sole-occupancy unit.

NCC nominates required Weighted Sound Reduction Indexes (R_w) and spectrum adaptation factor (C_{tr}) for partition constructions, of different space/ activity types in adjoining units. The R_w and $R_w + C_{tr}$ are single number descriptors for quantifying the attenuating performance of partitions for typical intrusive noises produced inside residences. The higher the rating, the greater the isolation provided by the partition.

Spectrum adaptation factors are commonly used to compensate for the fact that certain kinds of sounds are more readily transmitted through insulating materials than others insulate.

The adaptation factor C_{tr} has now been introduced for most building elements which require an airborne sound insulation rating. The only exception is a wall which separates a dwelling from a plant room, lift shaft, stairway, public corridor, public lobby or the like, or parts of a different classification. Therefore, both the C_{tr} factor and the R_w of the building element will need to be considered in most cases.

The C_{tr} factor takes into account lower frequency level sounds, and has been chosen in large part, in recognition of the problem of the high bass frequency outputs of modern home theatre systems and music reproduction equipment.

The Deemed-to-Satisfy Provisions also have impact sound insulation requirements for floors. The terms to describe the impact sound insulation of the floor is the weighted normalised impact sound pressure level ($L_{n,w}$). The lower the $L_{n,w}$ of the floor, the better the performance of the floor in terms of impact sound insulation.

The following section represents a summary of acoustic provisions outlined in the Part F5 of the NCC.

C.2 Sound Insultion Provision of NCC of Australia 2016

The acoustic provisions for inter-tenancy walls and floors in Class 2 and 3 buildings are outlined in the National Construction Code of Australia and the following is an extract from the NCC:

"F5.2 Determination of airborne sound insulation ratings

A form of construction required to have an airborne sound insulation rating must –

a. have the required value for weighted sound reduction index (R_w) or weighted sound reduction index with spectrum adaptation term ($R_w + C_{tr}$) determined in accordance with AS/NZS 1276.1 or ISO 717.1 using results from laboratory measurements; or

b. comply with Specification F5.2.

F5.3 Determination of impact sound insulation ratings

a. A floor in a building required to have an impact sound insulation rating must –

i. have the required value for weighted normalised impact sound pressure level with spectrum adaptation term ($L_{n,w}$) determined in accordance with AS/ISO 717.2 using results from laboratory measurements; or

ii. comply with Specification F5.2.

b. A wall in a building required to have an impact sound insulation rating must –

i. for a Class 2 or 3 building be of discontinuous construction;

c. For the purposes of this part, discontinuous construction means a wall having a minimum 20 mm cavity between 2 separate leaves, and

i. for masonry, where wall ties are required to connect leaves, the ties are of the resilient type; and

ii. for other than masonry, there is no mechanical linkage between leaves except at the periphery.

F5.4 Sound insulation rating of floors

a. A floor in a Class 2 or 3 building must have an $R_w + C_{tr}$ (airborne) not less than 50 and an $L_{n,w}$ (impact) not more than 62 if it separates –

i. sole-occupancy units; or

ii. a sole-occupancy unit from a plant room, lift shaft, stairway, public corridor, public lobby or the like, or parts of a different classification.

F5.5 Sound insulation rating of walls

a. A wall in a Class 2 or 3 building must –

i. have an $R_w + C_{tr}$ (airborne) not less than 50, if it separates sole-occupancy units; and

ii. have an R_w (airborne) not less than 50, if it separates a sole-occupancy unit from a plant room, lift shaft, stairway, public corridor, public lobby or the like, or parts of a different classification; and

iii. comply with F5.3(b) if it separates:

(A) a bathroom, sanitary compartment, laundry or kitchen in one sole-occupancy unit from a habitable room (other than a kitchen) in an adjoining unit; or

(B) a sole-occupancy unit from a plant room or lift shaft.

b. A door may be incorporated in a wall in a Class 2 or 3 building that separates a sole-occupancy unit from a stairway, public corridor, public lobby or the like, provided the door assembly has an R_w not less than 30.

c. Where a wall required to have sound insulation has a floor above, the wall must continue to –

i. the underside of the floor above; or

ii. a ceiling that provides the sound insulation required for the wall.

F5.6 Sound insulation rating of services

a. If a duct, soil, waste or water supply pipe, including a duct or pipe that is located in a wall or floor cavity, serves or passes through more than one sole-occupancy unit, the duct or pipe must be separated from the rooms of any sole-occupancy unit by construction with an $R_w + C_{tr}$ (airborne) not less than –

i. 40 if the adjacent room is a habitable room (other than a kitchen); or

ii. 25 if the adjacent room is a kitchen or non-habitable room.

b. If a storm water pipe passes through a sole-occupancy unit it must be separated in accordance with (a)(i) and (ii).

F5.7 Sound insulation of pumps

A flexible coupling must be used at the point of connection between the services pipes in a building and any circulating or other pumps."

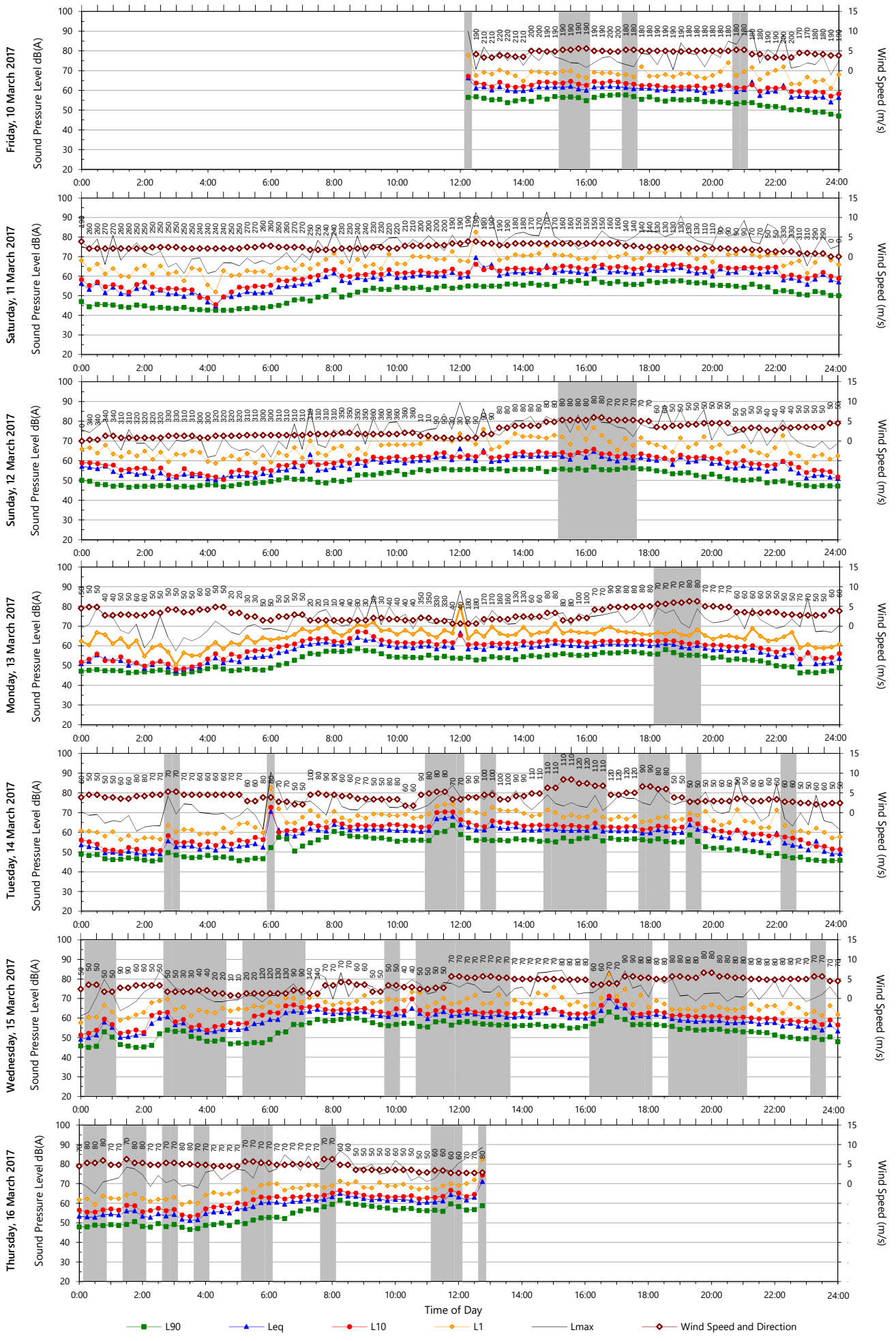
APPENDIX D Location and results of the noise survey

Figure 3: Photograph of noise monitoring location

Figure 4: Logger location facing Newcastle Port

D.1 Long-term monitoring details

Noise Logger Location	Survey Period, T
Level 3, 18 Honeysuckle Drive, Newcastle - facing Honeysuckle Drive	Friday 10th March 2017 to Thursday 16th March 2017



Data File: 2017-03-10_SLM_000_123_Rpt_Report.txt

Template: QTE-26 (rev 15) Logger Graphs Program