Gladesville Bridge Marina, NSW

Noise Impact Assessment of Proposed Alterations and Additions

Gladesville Bridge Marina

380 Victoria Place

Drummoyne NSW 2047

20092 Gladesville Bridge Marina

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1 EXECUTIVE SUMMARY

Pulse Acoustics has been engaged by Gladesville Bridge Marina to prepare a Noise and Vibration Impact Assessment for the proposed alterations and additions of the Marina Dock. Gladesville Bridge Marina currently consists of 50 floating berths, 44 swing moorings and approval for 5 boat cradles. It is proposed to increase the amount of floating berths to 115, with 15 moorings. It is also proposed to decommission the slipway and provide an additional eight car spaces in this location.

This Noise Impact Assessment outlines the proposed noise generating activities, identifies the surrounding receivers and details the undertaken noise measurements. Noise criteria for the operational, road traffic and construction scenarios are given by the Noise Policy for Industry, Road Noise Policy and Interim Construction Noise Guideline respectively.

Operational, Road Traffic and Construction noise scenarios are modelled in iNoise V2020.0 modelling software. Assuming that a single boat is arriving or leaving during a 15 minute period, compliance is predicted with the operational criteria during the day, evening and night periods.

Construction noise impacts are predicted to exceed the noise management levels at a number of surrounding receptors during the piling activities. Construction noise and vibration mitigation measures are recommended in section 7 of this report.

Road traffic impacts are predicted to comply with the Road Noise Policy at all receivers. Cosmetic damage from vibration is not predicted during construction or operational activities.

2 INTRODUCTION

Pulse Acoustic Consultancy (Pulse Acoustics) has been engaged by Gladesville Bridge Marina (GBM) to prepare a Noise and Vibration Impact Assessment for the proposed alterations and additions of the Marina Dock. Gladesville Bridge Marina currently consists of 50 floating berths, 44 swing moorings and approval for 5 boat cradles. It is proposed to increase the amount of floating berths to 115, with 15 moorings. As part of the proposed works, the slipway will be discontinued and additional parking will be provided.

The principal noise sources associated with the development include vessels, patrons and vehicles using the carpark.

This report assesses the potential operational, road and construction noise and vibration impacts at the surrounding receptors. The results of background noise monitoring at the nearest receptors is presented. Project criteria have been derived with respect to the NSW Noise Policy for Industry (EPA, 2017), NSW Road Noise Policy (DECCW, 2011), NSW Interim Construction Noise Guideline (DECC, 2009), Assessing Vibration: A Technical Guideline (DEC, 2006), British Standard 7385-2: 1993 and British Standard 6472: 1992. The predicted operational, road traffic and construction noise scenarios have been modelled in the iNoise 2020.0 software.

This report provides recommended noise mitigation measures and management practices to address potential noise and vibration impacts.

2.1 Site Description

Gladesville Bridge Marina includes a water-based structure and a land-based building, which is located at 380 Victoria Place Drummoyne, formally known as Lot B DP401843, Lot 1 DP430123 and Lot 1 DP549352. Land based Marina activities fall within the Canada Bay Local Government Area (LGA). Within the Marina site, the land is zoned R3 Medium Density Residential and RE1 Public Recreation under Canada Bay Local Environment Plan 2013. The Water section of the Marina site is zoned as W1 Maritime Waters and W6 Scenic Waters Active Use under the Sydney Regional Environmental Plan (Sydney Harbour Catchment) 2005. The site is located on the eastern foreshore of the Parramatta River, to the south of the Gladesville Bridge.

The site is approximately 19,740m^2 in area, comprising an approximate 1,740m^2 land-based component and an approximate 18,000m^2 of lease area, which accommodates the water-based component. An aerial photo of the site is shown in Figure 1.

Figure 1 Site Layout

The summary of Gladesville Bridge Marina's current services is as follows:

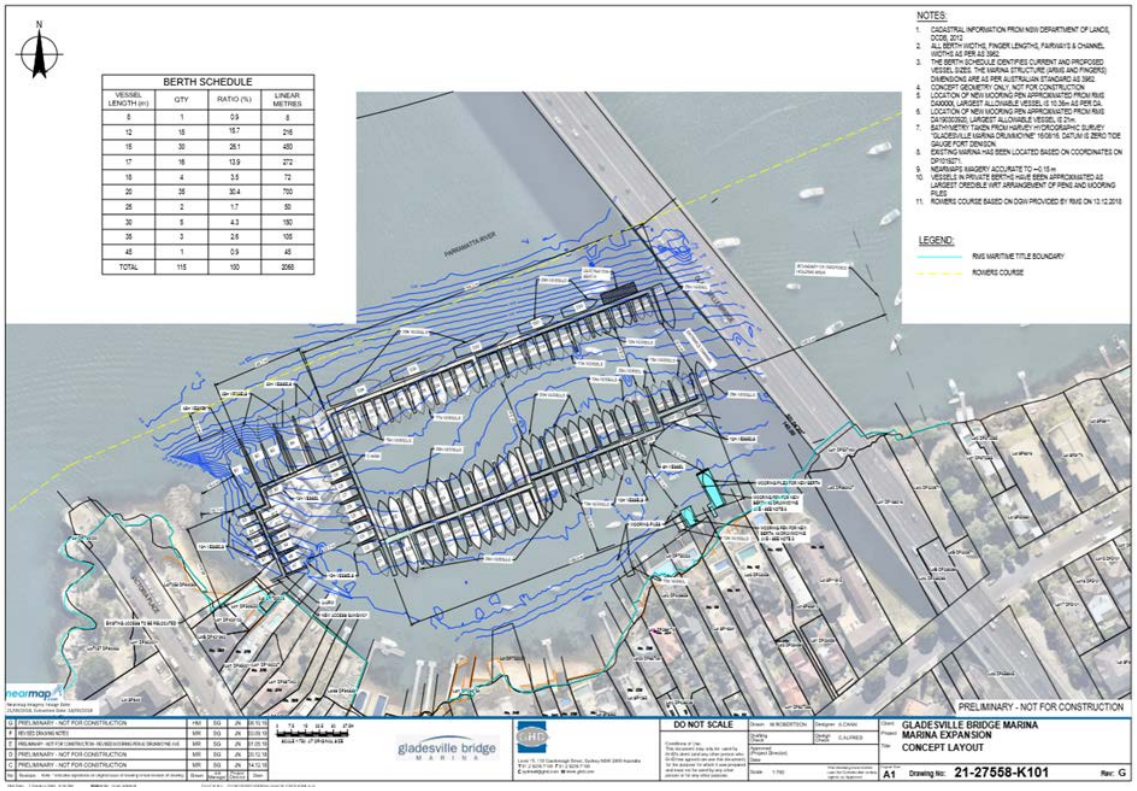
- 50 floating berths; berth sizes range from 7.6m to 23m
- 44 swing moorings; swing moorings are available for boats up to 15m in length
- Approval for 5 boat cradles
- Total capacity for 99 boats
- Complimentary tender service available 7 days a week, transporting customers to and from the marina pontoons to their vessels on the swing moorings
- Dinghies availability for after-hours use
- Slipways – antifouling, boat surveys and painting. The slipway can accommodate vessels up to 18m length overall and 5m beam. Non-flybridge power vessels of up to 13m are able to be housed in undercover slipway area for all weather painting and repairs
- Pump out facilities
- Food and beverage kiosk (currently machine based)
- Boat repairs
- Shipwright and mechanical services
- Work berths
- New and used boat sales
- Charter operation (back-of-house)

A summary of the proposed modifications is as follows:

- Increasing overall storage for vessels from 99 to 130 storage spaces.
- Re-designing the marina structure to increase storage from 50 to 115 vessels on the marina floating pontoons
- Retaining 15 commercial swing moorings
- Decommissioning of the slipway, associated slipway infrastructure and maintenance activities, to allow the provision of eight additional car spaces.
- Improvements to marina amenities and the waste storage area
- Additional car parking facilities

The proposed changes intend to provide increased storage spaces for users, better management of customer behaviour by having fewer moorings and having improved amenity facilities. Noise levels at receivers closest to the Marina are predicted to be reduced in the worst case 15 minute scenario, as the slipway is being discontinued and maintenance activities will no longer occur. A site plan of the proposed development is shown in Figure 2.

Figure 2 Proposed Development



3 NEAREST SENSITIVE RECEPTORS

Several potentially impacted noise receivers are located in the vicinity of the subject site. The receptors in this report are considered representative of the closest off-site receivers for various proposed Marina activities. Receivers east of Gladesville Bridge and north of the Parramatta River are also considered in this report. The considered receivers are listed in Table 1 and presented in Figure 3.

Table 1 Nearest Potentially Affected Receivers

Receptor ID	Address	Lot and DP	Type of Receiver
R1	376 Victoria Place, Drummoyne	Lot 1 in DP 1205545	Residential
R2	356-362 Victoria Place, Drummoyne	SP 83737	Residential
R3	342 Victoria Place, Drummoyne	SP 1148	Residential
R4	332 Victoria Place, Drummoyne	SP 1265	Residential
R5	50 Drummoyne Avenue, Drummoyne	Lot A in DP 346659	Residential
R6	40 Drummoyne Avenue, Drummoyne	SP 11615	Residential
R7	22 Cambridge Roade, Drummoyne	Lot 1 in DP 872585	Residential
R8	25 Huntleys Point Road, Huntleys Point	Lot 25 in DP 6818	Residential
R9	23A Huntleys Point Road, Huntleys Point	Lot 2308 in DP 11411775	Residential
R10	13 Huntleys Point Road, Huntleys Point	Lot 450 in DP 1246906	Residential

Figure 3 Location of Nearest Potentially Affected Receivers

4 EXISTING ACOUSTIC ENVIRONMENT

The Noise Policy for Industry calls for the determination of the project noise trigger levels for a development, above which noise management measures are recommended. The project noise trigger levels are determined by two factors, the shorter-term intrusiveness due to changes in the noise environment and maintaining the noise amenity of an area.

The trigger levels due to short term intrusiveness requires the measurement of the background noise level or rating background noise level (RBL). The background noise level is defined as 'the underlying level of noise present in ambient noise, generally excluding the noise source under investigation, when extraneous noise is removed'. Sound levels contributing to background levels can include sound from nearby traffic, aircraft, birds, insects, animals, machinery and similar sources, if these sounds are a normal feature of the location. At this site, aircraft flights are a feature of the area and are taken into account when considering background noise levels.

To determine the background noise levels of the surrounding area, noise loggers were placed at nearby receptors to measure the existing environmental conditions. The unattended noise survey was conducted between 8th May 2019 and 16th May 2019 at the following locations (refer to Figure 3):

- Logger A, 380 Victoria Place Drummoyne: The noise logger is positioned at the border with 378 Victoria Place, the closest residential receptor to the land band section of the Marina.
- Logger B, 342 Victoria Place Drummoyne: The noise logger is positioned at one of the closest residential receptors to the floating berths section of the Marina.

Instrumentation for the survey comprised of two Svan 971 noise loggers (serial numbers 61521 and 74365). The loggers were set on A-weighted, fast response and measured over 15 minute periods. The microphones were placed between 1.2m and 1.5m above ground level and fitted with windsocks.

All equipment carried appropriate and current NATA or manufacturer calibration certificates. For quality control, calibration of the logger was checked prior to and following the measurements. There was not any significant variation between the pre-measurement calibration and post-measurement calibration, with drift not exceeding ±0.5 dB.

Charts presenting summaries of the measured daily noise data are attached in Appendix B. The charts present each 24-hour period and show the L_{A1}, L_{A10}, L_{Aeq} and L_{A90} noise levels for the corresponding 15-minute periods. The L_{A90} noise descriptor is used to measure the background noise level. This descriptor represents the noise level that is exceeded for 90% of the time over a relevant period of measurement using 'A' frequency weighting and fast time weighting. The L_{Aeq} descriptor represents the level of average noise energy over the relevant period of measurement and takes account of peak noise levels as well as the degree of noise fluctuation.

As per Appendix A4 of the Noise Policy for Industry, the gathered data has been filtered to exclude periods affected by adverse weather conditions. Weather data was sourced from the most representative Bureau of Meteorology Weather Station, being Sydney Olympic Park AWS (ID 066212). The Sydney Olympic Park AWS is located 7km west of the Gladesville Bridge Marina.

Measurement results for the unattended noise survey are summarised Table 2 below. The measured L_{Aeq} and L_{A90} noise levels are presented for the day, evening and night periods as per Table 2.2 of the Noise Policy for Industry.

The major background noise sources were background traffic from Victoria Road and other surrounding streets, aircraft overhead, local birds, and boats and ferries in the Parramatta River not associated with the Marina. The existing Marina on average has 1 boat arrive and leave per day, therefore the vast majority of Parramatta River traffic is not associated with the Marina.

Table 2 Measured ambient noise levels – unattended noise survey

Measurement Location	Daytime[1] 7:00 am to 6:00 pm		Evening[1] 6:00 pm to 10:00 pm		Night-time[1] 10:00 pm to 7:00 am	
	L_{A90}[2]	L_{Aeq}[3]	L_{A90}[2]	L_{Aeq}[3]	L_{A90}[2]	L_{Aeq}[3]
Logger A	45	56	44	56	35	51
Logger B	45	61	43	56	34	50

Note 1: For Monday to Saturday, Daytime 7:00 am – 6:00 pm; Evening 6:00 pm – 10:00 pm; Night-time 10:00 pm – 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

Note 2: The L_{A90} noise level is representative of the "average minimum background sound level" (in the absence of the source under consideration), or simply the background level.

Note 3: The L_{Aeq} is the energy average sound level. It is defined as the steady sound level that contains the same amount of acoustical energy as a given time-varying sound.

5 APPLICABLE GUIDELINES AND RECOMMENDED CRITERIA

The following noise criteria are relevant for the assessment of noise emissions from the Gladesville Bridge Marina:

- For the assessment of the predicted noise emissions by the amended Marina: The criteria have been derived in accordance with the *Noise Policy for Industry* (EPA, 2017). Refer to Section 5.1.
- For the assessment of the road traffic noise impacts from the development: The criteria have been derived in accordance with the *NSW Road Noise Policy* (DECCW, 2011). Refer to Section 5.2.
- The assessment of the noise impacts of the construction noise on the sensitive receivers: The criteria have been derived in accordance with the *Interim Construction Noise Guideline* (DECC, 2009). See Section 5.3
- For the assessment of vibration impacts from the Marina: The criteria have been derived in accordance with Assessing Vibration: A Technical Guideline (DEC, 2006), BS 7385-2: 1993 and BS 6472: 1992. Refer to Section 5.4.

5.1 NSW Noise Policy for Industry

In NSW, the control of noise emissions is the responsibility of Local Government and the NSW Environment Protection Authority (NSW EPA). In October 2017, the NSW EPA released the *Noise Policy for Industry* (NSW NPI). The purpose of the policy is to ensure that noise impacts associated with particular industrial developments are evaluated and managed in a consistent and transparent manner. The policy aims to ensure that noise is kept to acceptable levels in balance with the social and economic value of industry in NSW.

The NSW NPI criteria for industrial noise sources have two components:

- Controlling the intrusive noise impacts for residential receivers in the short-term; and
- Maintaining noise level amenity of particular land uses for residents and sensitive receivers in other land uses.

The project noise trigger level is derived from the more stringent value out of the project intrusiveness noise level and the project amenity noise level.

5.1.1 Intrusive Noise Impacts (Residential Receivers)

The NSW NPI states that the noise from any single source should not intrude greatly above the prevailing background noise level. The intrusiveness of an industrial noise source may generally be considered acceptable if the equivalent continuous (energy-average) A-weighted level of noise from the source (L_{Aeq}), measured over a 15-minute period, does not exceed the background noise level by more than 5 dB(A). This is often termed the Intrusiveness Criterion, as shown below.

$$L_{Aeq,\ 15\ minute} = \text{rating background noise level} + 5\ dB$$

Using the rating background noise level approach results in the intrusiveness criterion being met for at least 90% of the 15 minute time periods.

5.1.2 Protecting Noise Amenity (All Receivers)

To limit continuing increase in noise levels, the maximum ambient noise level within an area from all industrial noise sources should not normally exceed the acceptable noise levels specified in Table 2.2 of the NSW Noise Policy for Industry. The recommended amenity noise levels have been subjectively scaled to reflect perceived differential expectations and ambient noise environments of rural, suburban and urban communities for residential receivers.

Existing plus new industrial noise levels are recommended to remain within the recommended amenity noise levels for an area. Therefore, a project amenity noise level applies for each new source of industrial noise as follows:

Project amenity noise level for industrial developments = recommended amenity noise level minus 5 dB(A)

5.1.3 Area Classification

The amenity noise levels presented in Table 2.2 of the Noise Policy for Industry categorise residential receivers into rural, suburban and urban noise amenity areas. Table 2.3 of the Noise Policy for Industry characterises the "Suburban Residential" noise environment as an area that has local traffic with characteristically intermittent traffic flows or with some limited commerce or industry. This area often has the following characteristic: evening ambient noise levels defined by the natural environment and human activity. Therefore, the suburban residential receiver category corresponds best with the residential receptors surrounding Gladesville Bridge Marina.

For the considered receptors in the suburban area, the recommended amenity noise level is shown in Table 3 below. When the existing noise level from industrial noise sources is close to the recommended "Amenity Noise Level" (ANL) given above, noise from the new source must be controlled to preserve the amenity of the area in line with the requirements of the NSW NPI.

Table 3 NSW NPI – Recommended L_{Aeq} Noise Levels from Noise Sources

Type of Receiver	Indicative Noise Amenity Area	Time of Day[1]	Recommended Amenity Noise Level ($L_{Aeq, period}$)[2]
Residence	Suburban	Day	55
		Evening	45
		Night	40

Note 1: For Monday to Saturday, Daytime 7:00 am – 6:00 pm; Evening 6:00 pm – 10:00 pm; Night-time 10:00 pm – 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

Note 2: The L_{Aeq} is the energy average sound level. It is defined as the steady sound level that contains the same amount of acoustical energy as a given time-varying sound

5.1.4 Project Trigger Noise Levels

The project trigger noise levels for the operational activities are derived from the amenity and intrusive criterion in Table 4. The amenity and intrusive criterion are nominated for the purpose of determining the operational noise limits for noise sources associated with the development which can potentially affect noise sensitive receivers.

For each assessment period, the project trigger noise levels are the lower (i.e. the more stringent) of the amenity or intrusive criteria. The project trigger noise levels are shown in bold text in Table 4.

Noise logger A has been associated with receivers R1 and R2 as they are the receivers closest to the existing Marina. Noise logger B is associated with all other receivers which are a further distance from the Marina.

Table 4 Extemal noise level criteria in accordance with the NSW NPI

Location	Time of Day	Project Amenity Noise Level, $L_{Aeq, period}$ [1] (dBA)	Measured $L_{A90, 15\ min}$ (RBL) [2] (dBA)	Measured $L_{Aeq, period}$ Noise Level (dBA)	Intrusive $L_{Aeq, 15\ min}$ Criterion for New Sources [3] (dBA)	Amenity $L_{Aeq, 15\ min}$ Criterion for New Sources (dBA) [3,4]
Residences R1-R2	Day	50	45	56	**50**	53
	Evening	40	44	56	49	**43**
	Night	35	35	51	40	**38**
Residences R3-R10	Day	50	45	61	**50**	53
	Evening	40	43	56	48	**43**
	Night	35	34	50	39	**38**

Note 1: Project Amenity Noise Levels corresponding to "suburban" areas, equivalent to the Recommended Amenity Noise Levels (Table 3) minus 5 dBA
Note 2: L_{A90} Background Noise or Rating Background Level
Note 3: Project Noise Trigger Levels are shown in bold
Note 4: According to Section 2.2 of the NSW NPI, the LAeq, 15 minutes is equal to the LAeq, period + 3 dB

Therefore, the noise criteria for the residential premises are indicated as shown below.

Table 5 Project Trigger Noise Level ($L_{Aeq(15\ min)}$)

Location	Time of Day	Project Trigger Level (dBA)
Residences (R1-R2)	Day	**50**
	Evening	**43**
	Night	**38**
Residences (R3-R10)	Day	**50**
	Evening	**43**
	Night	**38**

Note 1: Project Trigger Level is given in terms of an $L_{Aeq(15min)}$ noise levels

5.1.5 Sleep Arousal Criteria

The sleep arousal criterion, obtained from the NSW Road Noise Policy (RNP), provides an assessment criterion for the expected quality of sleep of residence during the night.

An accurate representation of sleep disturbance impacts on a community from a noise source is particularly difficult to quantify mainly due to differing responses of individuals to sleep disturbance – this is found even within a single subject monitored at different stages of a single night's sleep or during different periods of sleep.

In addition the differing grades of sleep state make a definition difficult, and even where sleep disturbance is not noted by the subject, factors such as heart rate, mood and performance can still be negatively affected.

An assessment of sleep disturbance should consider the maximum noise level or $L_{A1(1\ minute)}$, and the extent to which the maximum noise level exceeds the background level and the number of times this may happen during the night-time period. 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 10:00 pm and 7:00 am); and
- Whether there are times of the day when there is a clear change in the existing noise environment (such as during early morning shoulder periods).

Currently the information relating to sleep disturbance impacts indicates that:

- Maximum internal noise level below 50-55 dBA is unlikely to cause an awakening from a sleep state.
- One or two noise events per night with maximum internal noise levels of 65-70 dBA are not likely to affect health and wellbeing significantly.

As a result, the adopted sleep disturbance criterion for the project is an internal noise level of 50 – 55 dB L_{Amax}. This criterion is applicable for noise emissions generated by short term events occurring during the night time period. Therefore, allowing for a 10 dB reduction for open windows, **it is proposed that the noise screening criterion for sleep arousal should be 60-65 dB L_{Amax} external noise level at residential properties.**

5.2 NSW Road Noise Policy (RNP)

The NSW RNP aims to identify the strategies that address the issue of road traffic noise from:

- Existing roads
- New road projects
- Road redevelopment projects
- New traffic generating developments

The RNP also outlines the noise assessment criteria for the road traffic noise generated by the development.

5.2.1 Noise Assessment Criteria

Table 6 sets out the assessment criteria for residences to be applied to particular types of project, road category and land use. These criteria are for assessment against façade-corrected noise levels when measured 1m in front of a building façade. The relevant road category in Table 6 is a local road, corresponding to Victoria Place.

Victoria Place has been selected, as it is the road that will have the highest proportion of Marina traffic utilising it. For other roads such as Westbourne Street and Victoria Road, the proportion of traffic from the Marina on these roads will be negligible and therefore, road traffic noise is not proposed to be assessed.

Table 6 Road Traffic Noise Assessment Criteria for Residential Land Uses

Road Category	Type of project/land use	Assessment Criteria (dBA)	
		Day (7 am – 10 pm)	Night (10 pm – 7am)
Local Roads	1. Existing residences affected by noise from new local corridors 2. Existing residences affected by noise from redevelopment of existing local roads 3. Existing residences affected by additional traffic on existing local roads generated by land use developments	LAeq,(1 hour) 55 (external)	LAeq, (1 hour) 50 (external)

5.2.2 Relative Increase Criteria

For existing residences and other sensitive land uses affected by additional traffic on existing roads, the RNP states that for noise associated with increased road traffic generated by land use developments, any increase in the total traffic noise level should be limited to 2 dB during both day and night time periods. An increase of 2 dB represents a minor impact that is considered barely perceptible to the average person.

5.3 Interim Construction Noise Guideline

The Interim Construction Noise Guideline (ICNG) sets out ways to deal with the potential impacts of construction noise on residences and other sensitive land uses. The ICNG presents assessment approaches that are tailored to the scale of construction projects.

A portion of the main objectives from Section 1.3 of the ICNG are presented below:

- Promote a clear understanding of ways to identify and minimise noise from construction works
- Focus on applying all “feasible” and “reasonable” work practices to minimise construction noise impacts
- Encourage construction to be undertaken only during the recommended standard hours unless approval is given for works that cannot be undertaken during these hours
- Streamline the assessment and approval stages and reduce time spent dealing with complaints at the project implementation stage
- Provide flexibility in selecting site-specific feasible and reasonable work practices in order to minimise noise impacts

The ICNG contains a quantitative assessment method which is applicable to this project. Guidance levels are given for airborne noise at residences and other sensitive land uses, including commercial and industrial premises.

The quantitative assessment method involves predicting noise levels at sensitive receivers and comparing them with the Noise Management Levels (NMLs). The various NML categories for residential receivers have been reproduced from Table 2 of the Interim Construction Noise Guideline and are presented in Table 7 below.

Table 7 Noise Management Levels for Airborne Construction Noise at Residences

Location	Time of Day	Project Trigger Level (dBA)
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 + 10 dB	The noise affected level represents the point above which there may be some community reaction to noise. Where the predicted or measured • $L_{Aeq(15minute)}$ 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 75 dBA	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: 1. 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). 2. 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 + 5 dB	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 5 dB above the noise affected level, the proponent should negotiate with the community.

Note 1: Noise levels apply at the property boundary that is most exposed to construction noise, and at a height of 1.5 m 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.

Note 2: The RBL is the overall single-figure background noise level measured in each relevant assessment period (during or outside the recommended standard hours). The term RBL is described in detail in the NSW Noise Policy for Industry.

It is understood that no planned construction works are scheduled outside of standard construction hours. Regarding pile driving works, only poor weather or specific ferry requirements would push proposed activities outside of standard construction hours, but this is not expected.

5.3.1 Summary of the Noise Construction Criteria

The noise construction criteria (NML) for the receivers affected by the industrial development are outlined in Table 8. It is understood that construction works are proposed to take place during standard hours. However some activities such as pile driving of piers may need to take place during specific times due to tidal conditions. Therefore, construction criteria for standard construction hours and out of hours periods are presented in Table 8.

Table 8 Construction Noise Management Levels Criteria

Location	NML, dBA LAeq(15minute)			
	Standard Hours Monday to Friday: 7 am to 6 pm Saturday: 8 am to 1 pm	Outside Standard Hours (Day Period) Saturday: 7am to 8am and 1 pm to 6 pm Sunday 7am to 6pm	Outside Standard Hours (Evening Period) All days: 6pm to 10pm	Outside Standard Hours (Night Period) All days: 10pm to 7am
Receivers R1-R2	55	50	49	40
Receivers R3-R10	55	50	48	39

5.4 Vibration Criteria

5.4.1 Standard BS 7385 Part 2 - 1993

In terms of the most recent relevant vibration damage criteria, Australian Standard AS 2187.2 - 2006 "*Explosives - Storage and Use - Use of Explosives*" recommends the frequency dependent guideline values and assessment methods given in BS 7385-2: 1993 *"Evaluation and measurement for vibration in buildings Part 2*" be used as they are "applicable to Australian conditions".

The BS 7385-2: 1993 standard sets guide values for building vibration based on the lowest vibration levels above which damage has been credibly demonstrated. These levels are judged to give a minimum risk of vibration induced damage, where minimal risk for a named effect is usually taken as a 95% probability of no effect.

Sources of vibration that are considered in the standard include demolition, blasting (carried out during mineral extraction or construction excavation), piling, ground treatments (e.g. compaction), construction equipment, tunnelling, road and rail traffic and industrial machinery.

The recommended limits (guide values) for transient vibration to ensure minimal risk of cosmetic damage to residential and industrial buildings are presented numerically in Table 9 and illustrated in Figure 4. It should be noted that the criteria are based on peak particle velocity (mm/s) which is to be measured at the base of the building.

Table 9 Transient vibration criteria as per standard BS 7385 Part 2 - 1993

Line in Figure 4	Type of Building	Peak Component Particle Velocity in Frequency Range of Predominant Pulse	
		4 Hz to 15 Hz	15 Hz and Above
1	Reinforced or framed structures Industrial and heavy commercial buildings	50 mm/s at 4 Hz and above	
2	Unreinforced or light framed structures Residential or light commercial type buildings	15 mm/s at 4 Hz increasing to 20 mm/s at 15 Hz	20 mm/s at 15 Hz increasing to 50 mm/s at 40 Hz and above

Standard BS 7385-2: 1993 states that the values in Table 9 relate to transient vibration which does not cause resonant responses in buildings.

Where the dynamic loading caused by continuous vibration events is such as that results in dynamic magnification due to resonance (especially at the lower frequencies where lower guide values apply), then the values in Table 9 may need to be reduced by up to 50% (refer to Line 3 in Figure 4).

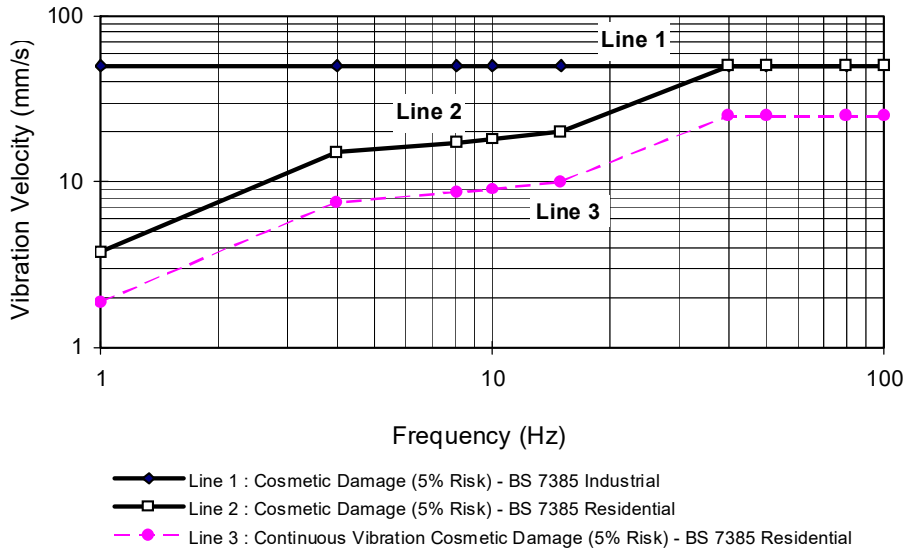
In the lower frequency region where strains associated with a given vibration velocity magnitude are higher, the recommended values corresponding to Line 2 are reduced. Below a frequency of 4 Hz where a high displacement is associated with the relatively low peak component particle velocity value, a maximum displacement of 0.6 mm (zero to peak) is recommended. This displacement is equivalent to a vibration velocity of 3.7 mm/s at 1 Hz.

The standard also states that minor damage is possible at vibration magnitudes which are greater than twice those given in Table 9, and major damage to a building structure may occur at values greater than four times the tabulated values.

Fatigue considerations are also addressed in the standard and it is concluded that unless calculation indicates that the magnitude and number of load reversals is significant (in respect of the fatigue life of building materials) then the values in Table 9 should not be reduced for fatigue considerations.

In order to assess the likelihood of cosmetic damage due to vibration, AS2187 specifies that vibration measured at the base of the building and the highest of the orthogonal vibration components (transverse, longitudinal and vertical directions) should be compared with the criteria curves presented in Table 9.

Figure 4 BS 7385 Part 2 – 1993, graph of transient vibration values for cosmetic damage



5.4.2 Human Comfort Criteria for Intermittent Vibration

Guidance in relation to assessing potential disturbance from ground-borne vibration is set out in British Standard 6472-1992 “Evaluation of Human Exposure to Vibration in Buildings (1 Hz to 80 Hz)”. This standard has recently been revised and the current standard is dated 2008. This 1992 version of the standard is however still recommended for use by the EPA.

BS 6472 includes detailed guidance on the use of Vibration Dose Values (VDVs) which allow an assessment of the severity of intermittent vibration to be carried out. These analysis and assessment procedures are most relevant to the character of the vibration generated during construction works.

The permissible rms particle velocity levels corresponding to the vibration dose value vary according to the duration of exposure. Table 10 shows the range of satisfactory vibration dose values for which various degrees of adverse comment may be expected in residential premises and office buildings. The most stringent of which are the levels of building vibration associated with a "low probability of adverse comment" from occupants.

Table 10 Vibration Dose Values ($m/s^{1.75}$) above which Various Degrees of Adverse Comment May Be Expected in Residential Buildings, Offices

Location	Low Probability of Adverse Comment	Adverse Comment Possible	Adverse Comment Probable
Residential buildings 16-hour day	0.2 to 0.4	0.4 to 0.8	0.8 to 1.6
Offices 16-hour day	0.4 to 0.8	0.8 to 1.6	1.6 to 3.2

Situations exist where motion magnitudes above the dose levels given in BS 6472 can be acceptable, particularly for temporary disturbances and infrequent events of short-term duration (e.g. construction project).

When short-term works such as piling, demolition or compaction give rise to impulsive vibrations, it should be borne in mind that undue restriction on vibration levels can significantly prolong these operations and result in greater annoyance.

In certain circumstances, the use of higher magnitudes of acceptability may be considered, e.g. for projects having social worth or broader community benefits or in view of the economic or practical feasibility of reducing vibration to the recommended levels. In such cases, best management practices should be employed to reduce levels as far as practical.

6 OPERATIONAL NOISE ASSESSMENT

Predictive noise modelling was carried out using the ISO 9613 algorithm within iNoise 2020.0. The iNoise software package allows a 3D computational model of the site and surrounding area to be created. Inputs into the noise model included terrain, ground absorption, surrounding buildings, receiver locations and noise sources.

6.1 Noise Generating Scenarios

This Noise Assessment includes assessment of boat use on the Parramatta River, patron activities and the use of the carpark. As the boat marina spans over 200m in length, five noise generating scenarios are utilised to locate noise sources at a worst case location for selected nearby receivers.

The first scenario assesses noise from the largest berth B1. This is also the closest berth to a number of receivers on the north side of the Parramatta River.

The second scenario predicts noise from berth A7, the worst case berth in the A1-A12 range. This scenario is the closest berth to receiver R1.

The third scenario assesses noise from berth E28, the worst case berth in the C1-C10 and E28-E39 ranges. This is also the closest berth to receiver R2.

The fourth scenario predicts noise from berth E49, the closet berth to the shoreline from the eastern edge of the Marina.

The fifth scenario predicts noise from the berth D29, the most north easterly berth in the marina. It is also the closest berth to a number of receivers on the north side of Parramatta River.

Noise levels at receivers closest to the Marina are predicted to be reduced in the worst case 15 minute scenario, as the slipway is being discontinued and maintenance activities will no longer occur. The noise generating scenarios and included noise sources and sound power levels are listed below in Table 11. The noise data has been obtained from noise measurements on the subject site as well as from Pulse Acoustics extensive noise database.

Table 11 Operational scenarios and associated noise sources

Operation scenario	Equipment Type	Number	Height (m)	Duration per 15 minute period	Sound power level $L_{Aeq(15min)}$ dBA	LAMax dBA
1. Marina Use Berth B1	Boat engine warm up (<45m vessel)	1	1	5 minutes	90	95
	Boat at no wash limit (<45m vessel)	1	1	2 minutes	95	100
	Boat bow thruster	1	1	0.5 minutes	95	100
	Boat patron with raised voice	1	3	5 minutes	73	78
	Shore patron with raised voice	1	1.5	5 minutes	73	78
	Car engine start up, door close and manouvering	2	1.5	1 minute	82	92
2. Marina Use Berth A7	Boat engine warm up (<15m vessel)	1	1	5 minutes	80	85
	Boat at no wash limit (<15m vessel)	1	1	2 minutes	85	90
	Boat patron with raised voice	1	3	5 minutes	73	78
	Shore patron with raised voice	1	1.5	5 minutes	73	78

	Car engine start up, door close and manouvering	2	1.5	1 minute	82	92
3. Marina Use Berth E28	Boat engine warm up (<25m vessel)	1	1	5 minutes	85	90
	Boat at no wash limit (<25m vessel)	1	1	2 minutes	90	95
	Boat patron with raised voice	1	3	5 minutes	73	78
	Shore patron with raised voice	1	1.5	5 minutes	73	78
	Car engine start up, door close and manouvering	2	1.5	1 minute	82	92
4. Marina Use Berth E49	Boat engine warm up (<15m vessel)	1	1	5 minutes	80	85
	Boat at no wash limit (<15m vessel)	1	1	1 minute	85	90
	Boat patron with raised voice	1	3	5 minutes	73	78
	Shore patron with raised voice	1	1.5	5 minutes	73	78
	Car engine start up, door close and manouvering	2	1.5	1 minute	82	92
5. Marina Use Berth D29	Boat engine warm up (<25m vessel)	1	1	5 minutes	85	90
	Boat at no wash limit (<25m vessel)	1	1	0.5 minutes	90	95
	Boat patron with raised voice	1	3	5 minutes	73	78
	Shore patron with raised voice	1	1.5	5 minutes	73	78
	Car engine start up, door close and manouvering	2	1.5	1 minute	82	92

Noise sources are modelled in the following locations for the five noise generating scenarios

Figure 5 Scenario 1 – Marina Use Berth B1

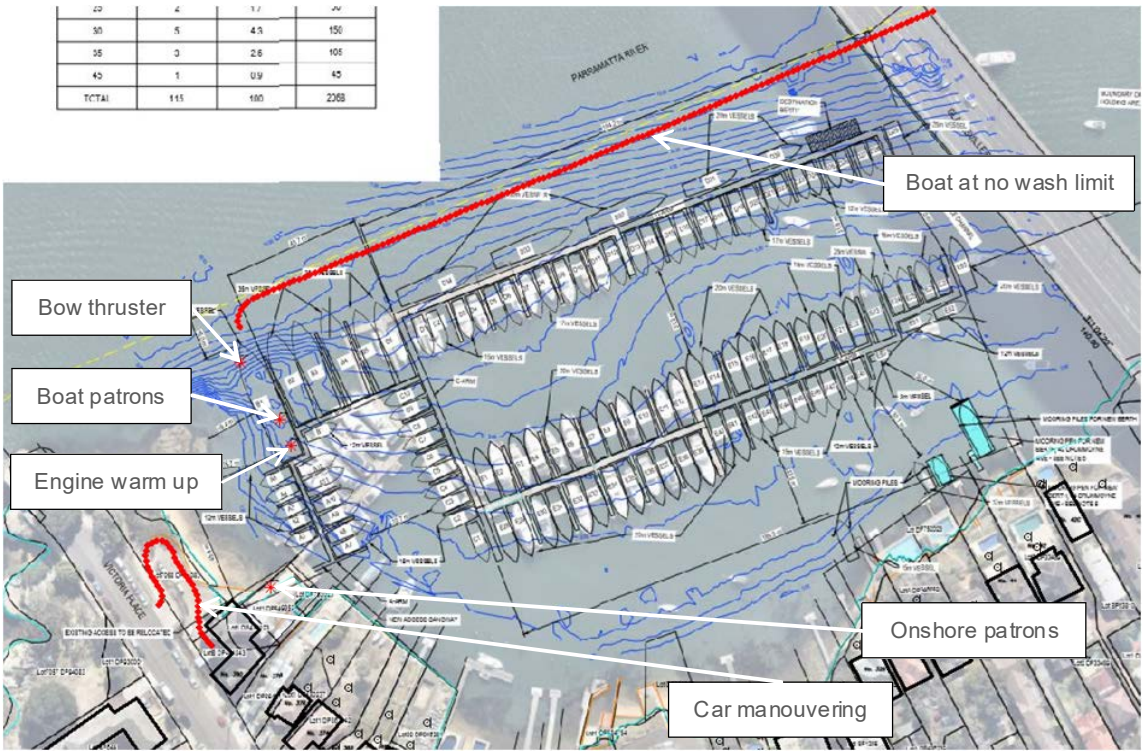


Figure 6 Scenario 2 – Marina Use Berth A7

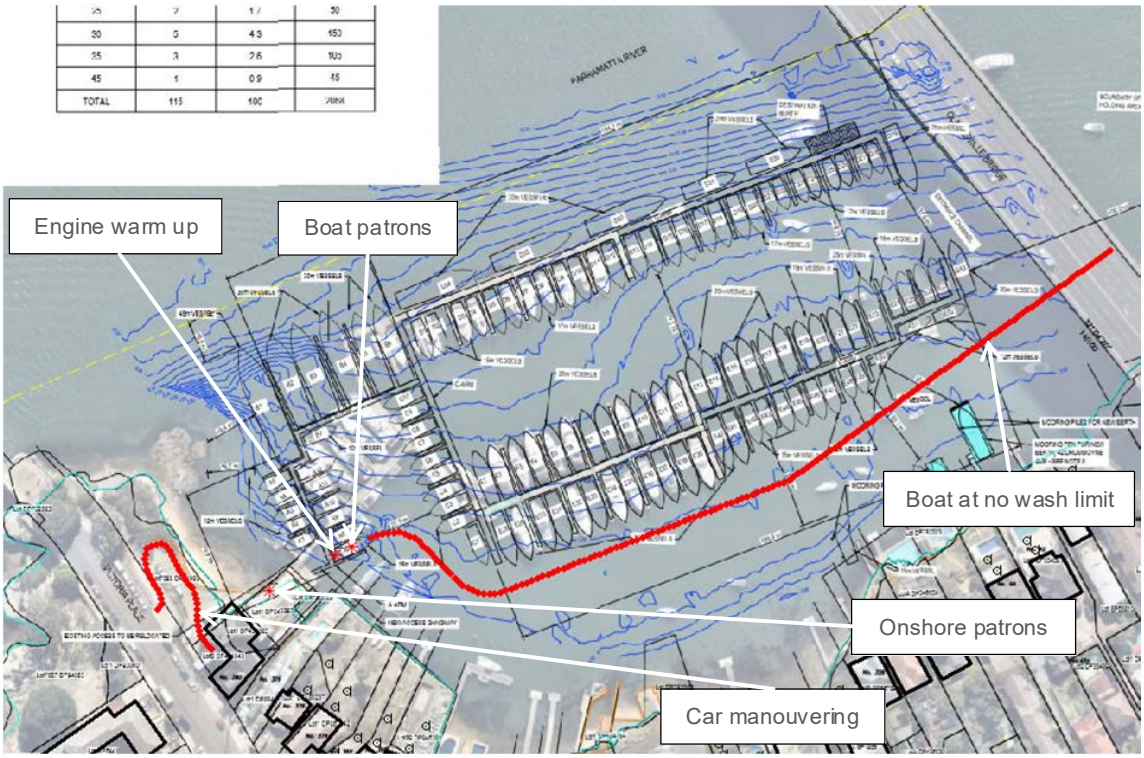


Figure 7 Scenario 3 – Marina Use Berth E28

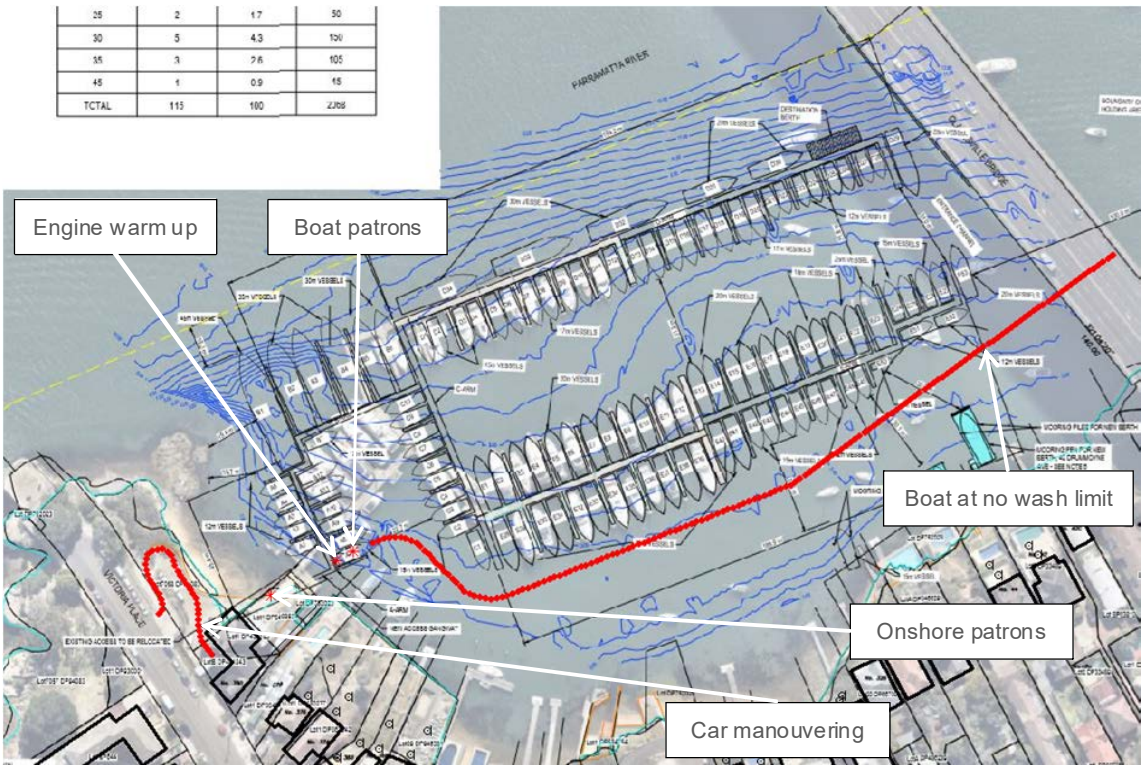


Figure 8 Scenario 4 – Marina Use Berth E49

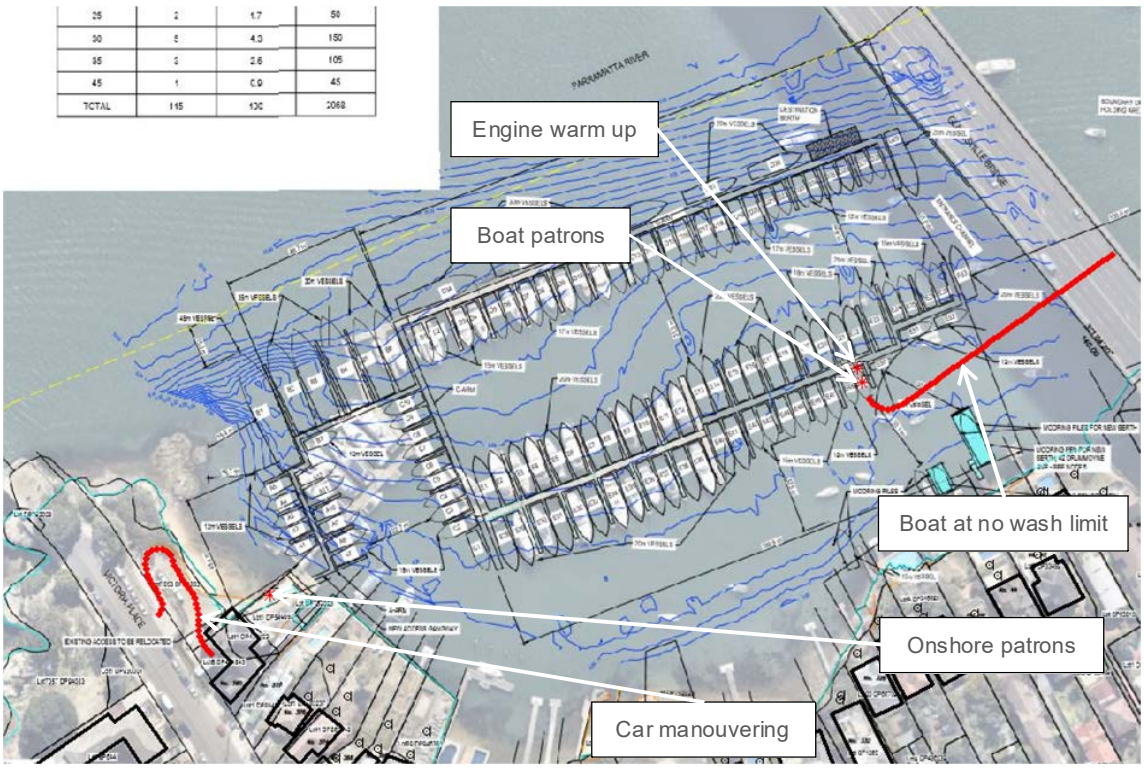
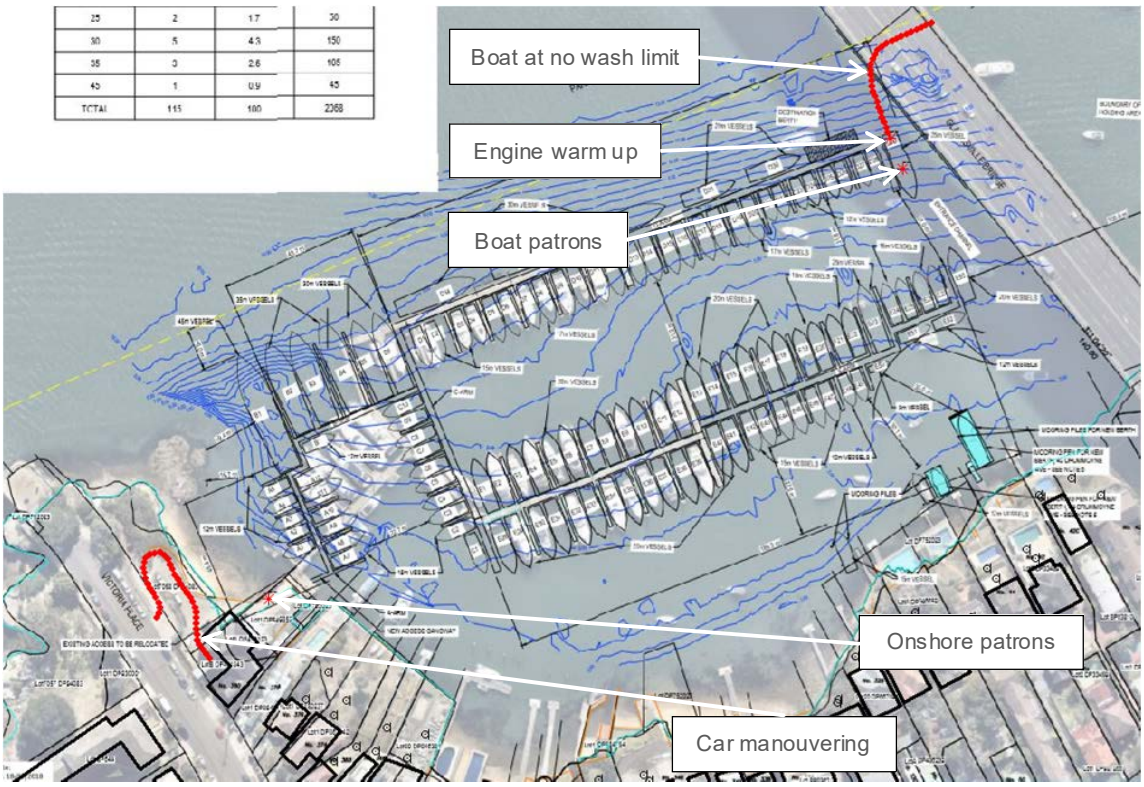


Figure 9 Scenario 5 – Marina Use Berth D29



6.2 Modelling Assumptions

The following modelling assumptions are utilised in this noise impact assessment:

- Noise generating scenarios are modelled on a worst case 15 minute period;
- Terrain has been sourced from the NSW Land and Property Information database Sixmaps;
- Ground Absorption has been included in the model with water areas having an absorption factor of 0 (hard) and land areas having an absorption factor of 0.25;
- All residents include a receiver modelled at the property boundary or within 30m of the residence, 1.5m above the ground;
- All multi-storey buildings also include a receiver modelled for each level. The receivers are located on the balconies/upper stories with adjustments for free field results;
- Off-site structures such as buildings have been included in the model;
- The noise sources, sound power levels, heights and durations have been modelled with respect to the information presented in Table 11;
- Based on observations from site and discussions with GBM, boats are conservatively assumed to be at maximum idling for one minute before leaving. Boats travel a distance between 50m and 250m to leave the Marina, which at a no wash speed of 4 knots, corresponds to an additional 0.5 minutes to 2 minutes of operation;
- Based on observations from site and discussions with GBM, it is assumed that a single boat arrives or leaves the Marina during a 15 minute period;
- It is assumed that boats may leave and arrive at the Marina 24 hours a day; and

- It is understood that very rarely, clients stay on their boats at the Marina overnight, and may have conversations on their boats, or transporting luggage to/from their boat. To assess the worst case scenario, a group of patrons has been located on the boat and a group of patrons has been located on shore for all scenarios.

6.3 Predicted Noise Levels

6.3.1 L_{Aeq} Results

The L_{Aeq} results of the modelled operational scenarios are presented below in Table 12.

Table 12 Predicted Noise Levels, Operational Scenarios, $L_{Aeq\,(15\ minute)}$

Receiver	Criteria			Predicted Noise Levels, Scenario				
	Day	Evening	Night	1	2	3	4	5
R1	50	43	38	38	36	38	28	28
R2	50	43	38	35	29	33	23	23
R3	50	43	38	34	29	33	24	25
R4	50	43	38	34	28	32	27	26
R5	50	43	38	35	29	34	31	30
R6	50	43	38	33	29	33	31	30
R7	50	43	38	30	23	28	26	28
R8	50	43	38	30	18	22	19	25
R9	50	43	38	33	20	24	19	25
R10	50	43	38	31	19	23	17	22

Noise contours of the five operational scenarios are shown below in Figure 10 to Figure 14.

Figure 10 Operational Scenario - Marina Use Berth B1

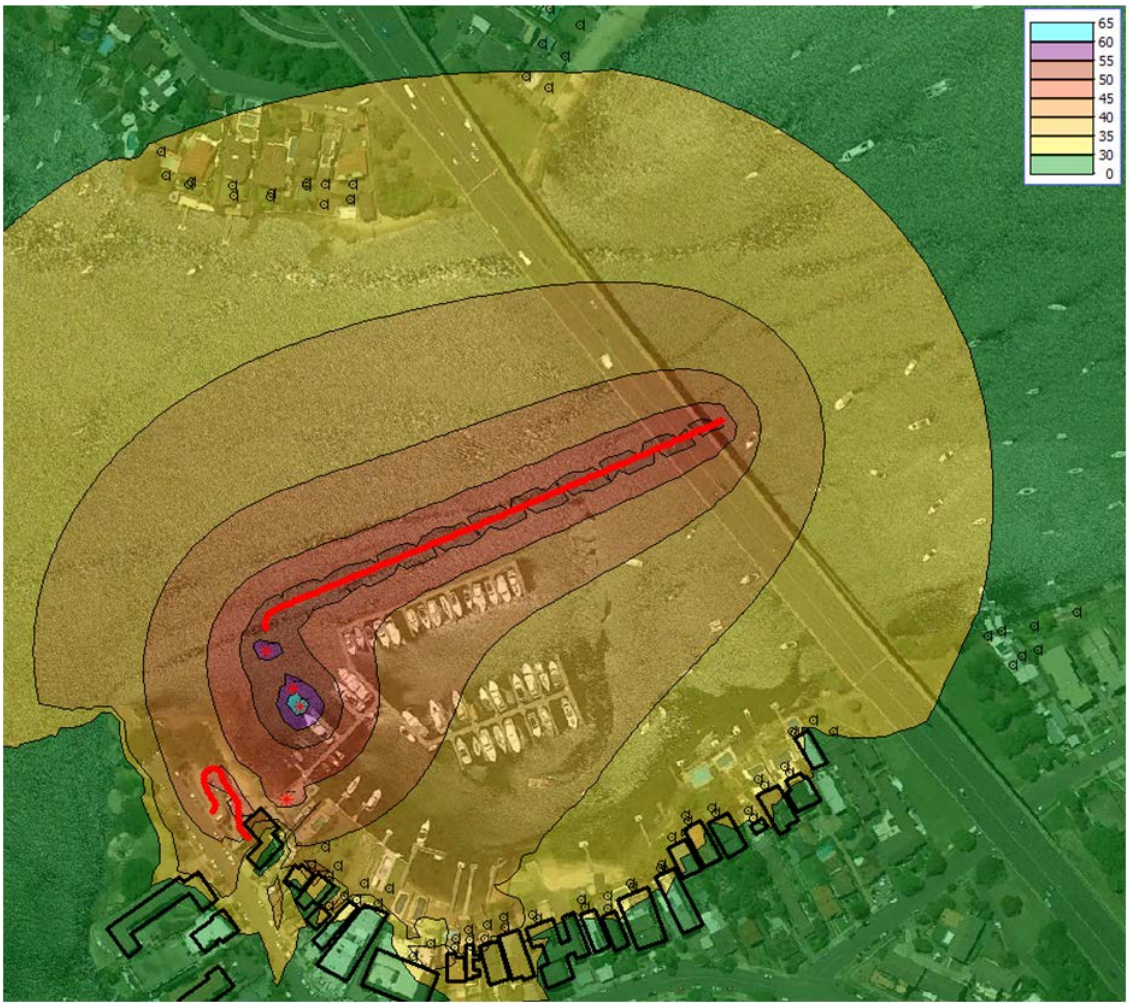


Figure 11 Operational Scenario - Marina Use Berth A7

Figure 12 Operational Scenario - Marina Use Berth E28

Figure 13 Operational Scenario - Marina Use Berth E49

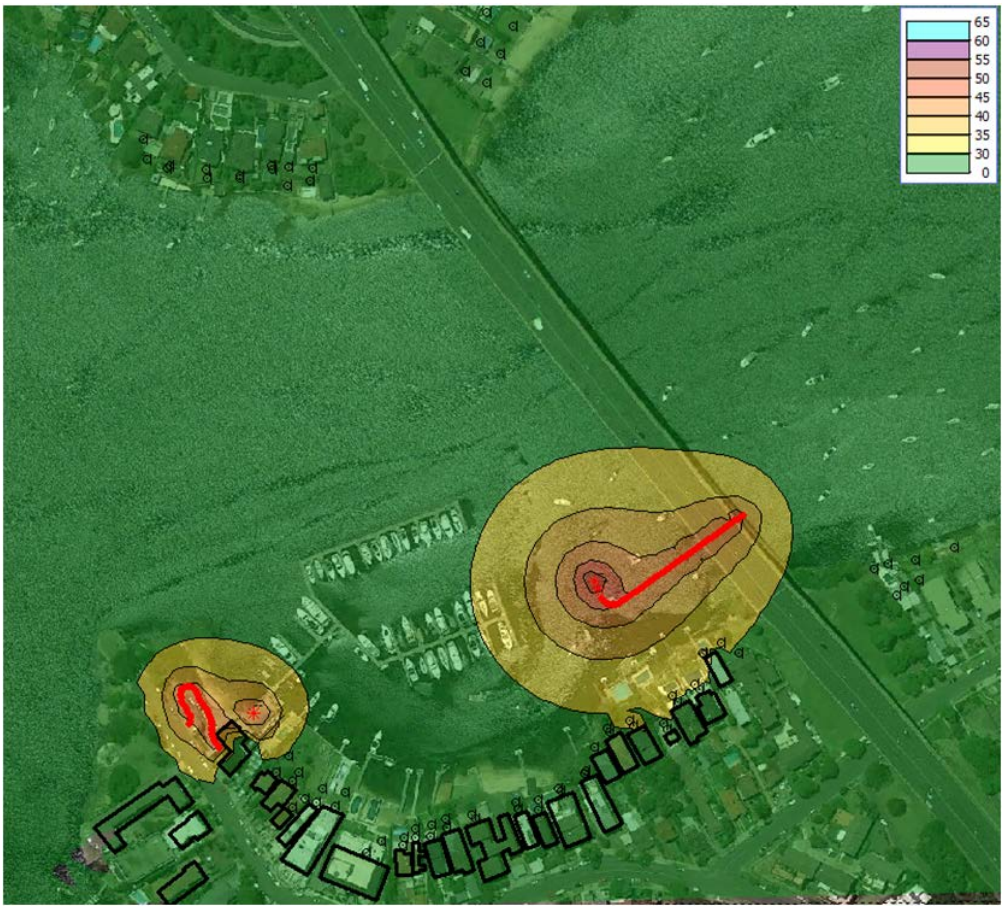
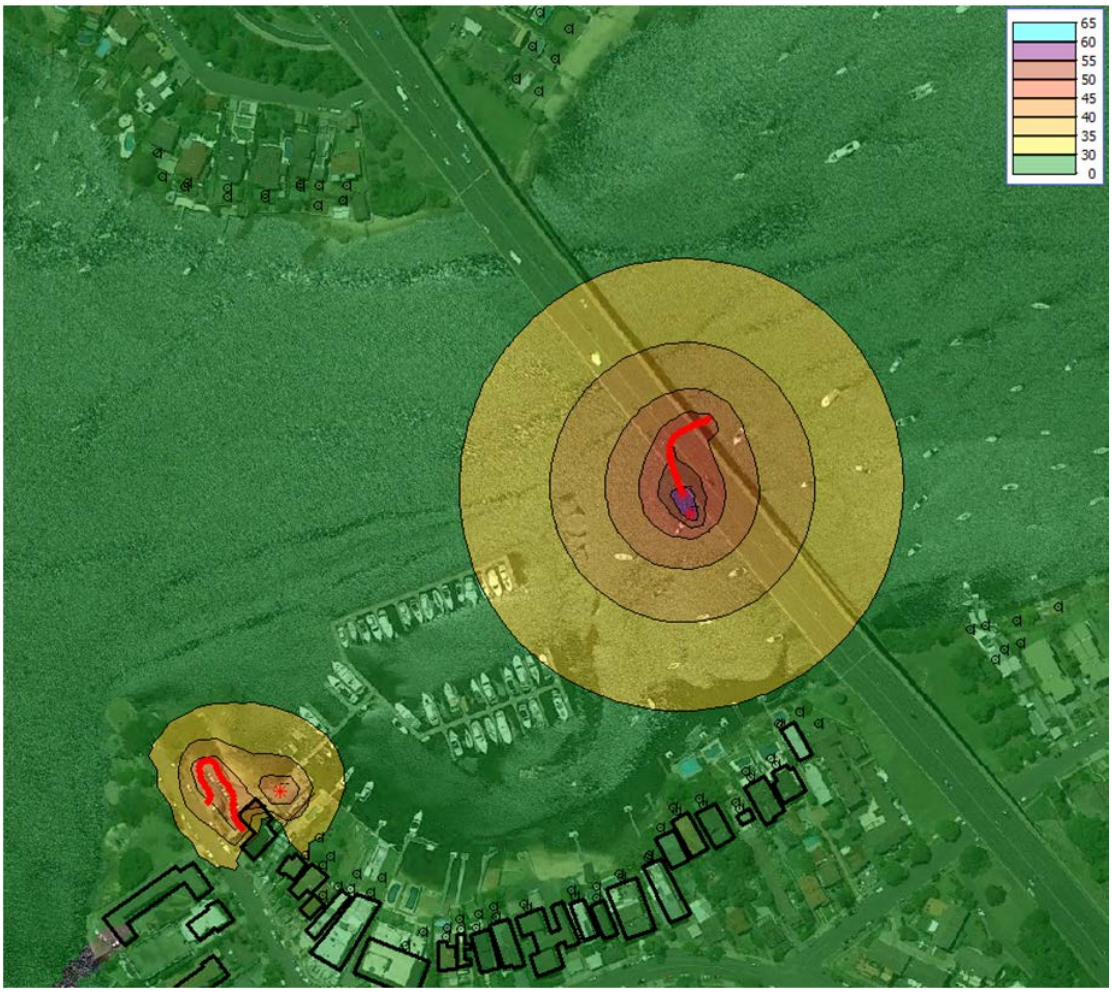


Figure 14 Operational Scenario - Marina Use Berth D29



Results from Table 12 and Figure 10 to Figure 14 show that the noise levels are predicted to comply with the noise criteria at all surrounding receptors and all scenarios.

6.3.2 L_{AMax} Results

The L_{AMax} results of the modelled operational scenarios are presented below in Table 13.

Table 13 Predicted Noise Levels, Operational Scenarios, L_{AMax}

Receiver	L_{AMax} Criteria	Predicted Noise Levels, Scenario				
	Night	1	2	3	4	5
R1	60	52	47	51	41	42
R2	60	49	41	46	36	38
R3	60	48	42	46	38	40
R4	60	48	41	46	40	41
R5	60	49	42	47	44	44

R6	60	47	42	47	46	44
R7	60	44	37	42	41	42
R8	60	44	32	36	33	41
R9	60	47	34	38	34	40
R10	60	46	34	37	33	37

The maximum noise levels comply with the sleep disturbance criteria at all considered receivers. Therefore additional impacts from sleep disturbance are considered unlikely and further noise controls are not recommended.

7 CONSTRUCTION NOISE ASSESSMENT

7.1 Noise Generating Scenarios

Information on the noise generating construction activities was provided by SMC Marine and by Gladesville Bridge Marina. It is understood that construction works to be undertaken will involve the following activities

- Installing new piers and floating dock for the increased storage space of vessels;
- Decommissioning of the slipway; and
- Improvements to marina amenities.

It is understood that the pile driving will require the screwing of piles, with hammering to achieve embedment. The pile driver will most likely be modelled on a barge. Full details are available in the navigation report, but it is understood that barring poor weather or ferry requirements, pile driving will be able to be conducted during standard construction hours.

The existing slipway will be decommissioned, with the rails removed by hand tools, and taken from the site by truck. The slipway area will be used to allow for eight additional car spaces.

Based on the potential activities above, the following worst case scenarios will be assessed in this report

- Pile driving of new piers; and
- Decommissioning of the slipway.

It is assumed that the construction activities are able to take place during standard construction hours.

Table 14 Construction scenarios and associated noise sources

Construction scenario	Equipment Type	Number	Height (m)	Duration per 15 minute period	Sound power level $L_{Aeq(15min)}$ dBA
1. Pile Driving of New Piers	Piling Rig[1]	1	3	5 minutes	116
	Barge Motor	1	1	15 minutes	95
2. Decommissioning of the Slipway	Truck	1	2	5 minutes	102
	Hand Tools	1	1	15 minutes	100

Note 1: As per section 4.5 of the Interim Construction Noise Guideline, the characteristics of piling activities are recommended to be factored in by adding 5 dB to the predicted noise levels.

Noise sources are positioned in the following locations for the two noise generating construction scenarios

Figure 15 Scenario 1 – Pile Driving of New Piers

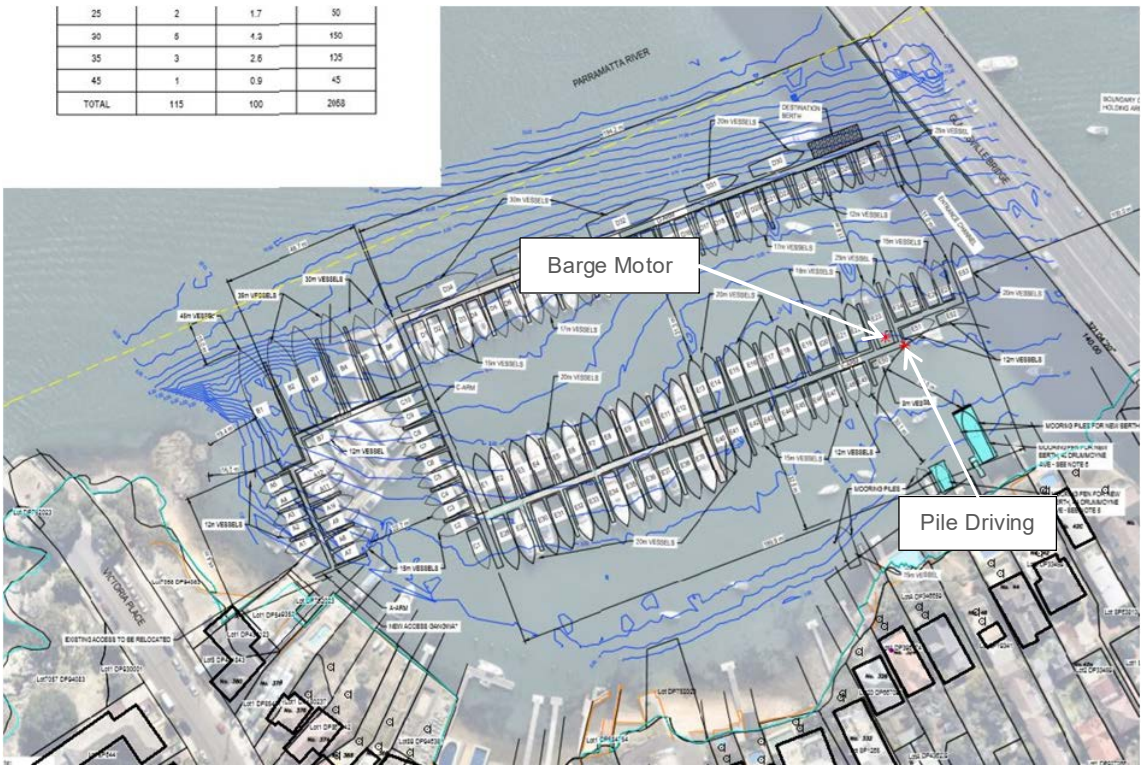
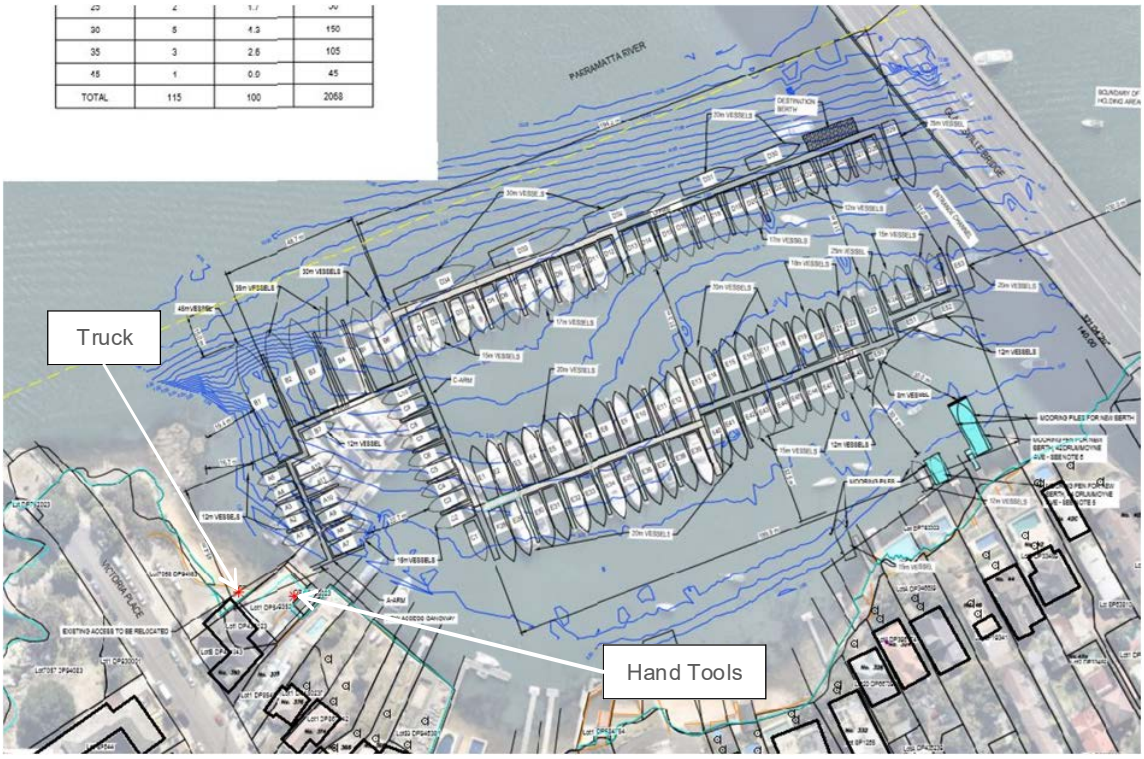


Figure 16 Scenario 2 – Decommissioning of the Slipway



7.2 Noise Modelling Methodology

Construction noise modelling was conducted utilising the ISO 9613 algorithm within the iNoise 2020.0 computational package. The iNoise software enables a 3D computational model of the site and surrounding area to be created. Inputs into the noise model included terrain, ground absorption, surrounding buildings, receiver locations and construction noise sources.

The following modelling assumptions are utilised in the construction noise assessment:

- Noise generating scenarios are modelled for the worst case 15 minute period;
- Terrain has been sourced from the NSW Land and Property Information database Sixmaps;
- Ground Absorption has been included in the model with water having an absorption factor of 0 (hard) and surrounding land having an absorption factor of 0.25;
- All residents include a receiver modelled at the property boundary or within 30m of the residence, 1.5m above the ground;
- All multi-storey buildings also include a receiver modelled for each level. The receivers are located on the balconies/upper stories with adjustments for free field results;
- Off-site structures such as buildings have been included in the model;
- The included noise sources, sound power levels, heights and durations have been modelled as per the information presented in Table 14;

7.3 Predicted Noise Levels

The modelled results of the noise generating scenarios are presented below in Table 15. Noise contours of the two construction scenarios are shown below in Figure 17 and Figure 18.

Table 15 Predicted Noise Levels, Construction Scenarios

Receiver	Criteria (Standard Hours)	Predicted Noise Levels, Scenario	
		1	2
R1	55	54	60
R2	55	54	42
R3	55	56	44
R4	55	59	45
R5	55	64	41
R6	55	64	39
R7	55	57	36
R8	55	51	38
R9	55	51	41
R10	55	49	41

Figure 17 Construction Scenario 1 – Pile Driving of New Piers

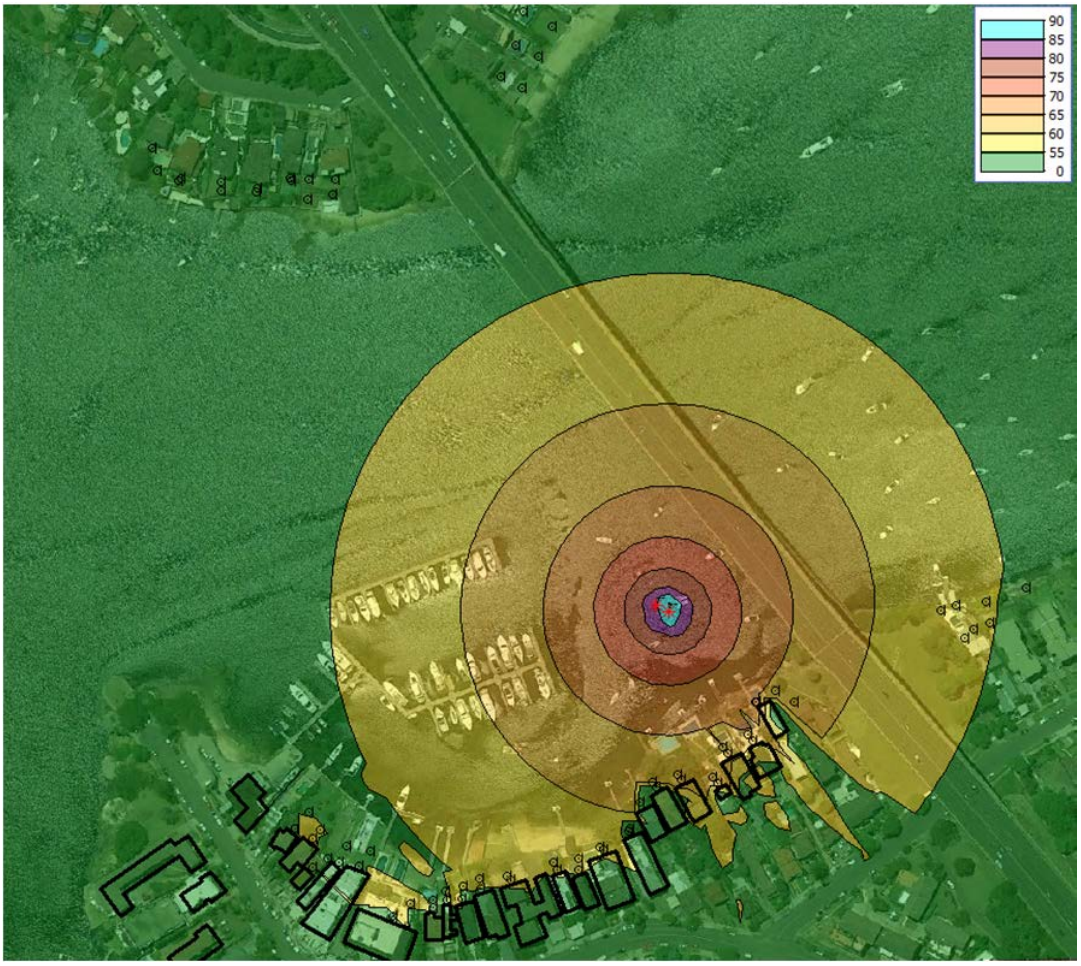


Figure 18 Construction Scenario 2 – Decommissioning of the Slipway

The modelling shows that noise levels are predicted to comply with all receivers except for R1 during the decommissioning of the slipway. Exceedances of the construction noise criteria are predicted during pile driving, with R5 and R6 predicted to be 9 dB above the Noise Management Levels. While some exceedances of the Noise Management Levels are predicted, all construction activities are expected to be below the "highly noise affected" level presented in Table 7.

7.4 Construction Noise and Vibration Management Procedures

Due to the predicted exceedances of the Noise Management Levels in section 7.3, noise and vibration mitigation measures are recommended in this section.

7.4.1 General Mitigation Measures (Australia Standard 2436-2010)

The contractor will, where reasonable and feasible, apply best practice noise mitigation measures during the construction phase. These measures shall include the following:

- Maximising the offset distance between plant items and nearby noise sensitive receivers.
- Preventing noisy plant working simultaneously and adjacent to sensitive receivers.
- Minimising consecutive works in the same location.

- Orienting equipment away from noise sensitive areas.
- Carrying out loading and unloading away from noise sensitive areas.

In order to minimise noise impacts during the works, the contractor will take all reasonable and feasible measures to mitigate noise effects. The contractor will also take reasonable steps to control noise from all plant and equipment. Examples of appropriate noise control include keeping sharp tipped tools and utilising low noise mufflers.

The contractor should apply all feasible and reasonable work practices to meet the NMLs and inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels, duration of noise generating construction works, and the contact details for the site foreman.

As well as the above project specific noise mitigation controls, AS 2436-2010 "*Guide to Noise and Vibration Control on Construction, Demolition and Maintenance Sites*" sets out numerous practical recommendations to assist in mitigating construction noise emissions. Examples of strategies that could be implemented on the subject project are listed below, including the typical noise reduction achieved, where applicable.

7.4.2 Adoption of Universal Work Practices

- Regular reinforcement (such as at toolbox talks) of the need to minimise noise and vibration.
- Regular identification of noisy activities and adoption of improvement techniques.
- Avoiding the use of portable radios, public address systems or other methods of site communication that may unnecessarily impact upon nearby sensitive receivers.
- Where possible, avoiding the use of equipment that generates impulsive noise.
- Minimising the need for vehicle reversing for example, by arranging for one-way site traffic routes.
- Use of broadband audible alarms on vehicles regularly used on site.
- Minimising the movement of materials and plant and unnecessary metal-on-metal contact.
- Minimising truck movements.

7.4.3 Plant and Equipment

- Choosing quieter plant and equipment based on the optimal power and size to most efficiently perform the required tasks.
- Selecting plant and equipment with low vibration generation characteristics.
- Operating plant and equipment in the quietest and most efficient manner.

7.4.4 On Site Noise Mitigation

- Maximising the distance between noise activities and noise sensitive land uses.

7.4.5 Work Scheduling

- Restricting noisy activities to time periods that least affect the nearby noise sensitive locations.
- Scheduling work to coincide with non-sensitive periods, i.e. standard construction hours.
- Providing respite periods during the loudest activities, i.e. pile driving
- Planning deliveries and access to the site to occur quietly and efficiently and organising parking only within designated areas located away from the sensitive receivers.
- Including contract conditions that include penalties for non-compliance with reasonable instructions by the principal to minimise noise or arrange suitable scheduling.

7.4.6 Source Noise Control Strategies

Some ways of controlling noise at the source are:

- Where reasonably practical, noisy plant or processes should be replaced by less noisy alternatives.
- Modify existing equipment: Engines and exhausts are typically the dominant noise sources on mobile plant such as excavators, trucks, etc. In order to minimise noise emissions, residential grade mufflers should be fitted on mobile plant utilised on site.
- Siting of equipment: locating noisy equipment behind structures that act as barriers, or at the greatest distance from the noise-sensitive area; or orienting the equipment so that noise emissions are directed away from any sensitive areas, to achieve the maximum attenuation of noise.
- Regular and effective maintenance.

7.4.7 Miscellaneous Comments

- Deliveries should be undertaken only through the approved construction hours in the Notice of Determination.
- Maximise hammer penetration (and reduce blows) by using sharp hammer tips. Keep stocks of sharp profiles at site, and monitor the profiles in use
- It is advised that mobile plant and trucks operating on site for a significant portion of the project are to have reversing alarm noise emissions minimised. This is to be implemented subject to recognising the need to maintain occupational safety standards
- No public address system should be used on site.

7.5 Vibration Mitigation Measures

The following vibration mitigation measures should be implemented during the construction works:

- Any vibration generating plant and equipment is to be located in areas within the site in order to lower the vibration impacts at nearby receivers.
- Investigate the feasibility of rescheduling the hours of operation of major vibration generating plant and equipment.
- Identify other vibration sensitive structures such as tunnels, gas pipelines, fibre optic cables, Sydney Water retention basins. Specific vibration goals should be determined on a case-by-case basis by an acoustic consultant which is to be engaged by the construction contractor.
- Identify heritage structures as well as vibration sensitive premises (such as those containing scientific and surgery equipment).
- Use lower vibration generating items of construction plant and equipment, that is, smaller capacity plant.
- Minimise conducting vibration generating works consecutively in the same area (if applicable).

7.6 Additional Management Measures

Table 16 below summarises the additional management procedures recommended for airborne noise during the construction phase. These procedures are also further discussed in the report. Hence, where applicable, links to further references are provided in Table 16.

Table 16 Summary of excavation phase mitigation procedures

Procedure	Abbreviation	Description	Further Reference
Periodic Notification	PN	Issue a notification of upcoming construction works to nearby neighbours by letterbox drop. The length of the letter should be an A4 page and contain at least an overview of the works, the predicted length of the works, construction times and a hotline number for nearby residents to contact.	Refer to Section 7.7
Verification Monitoring	V	Verification monitoring to comprise attended or unattended acoustic surveys. The purpose of the monitoring is to confirm measured levels are consistent with the predictions in the acoustic assessment, and to verify that the mitigation procedures are appropriate for the affected receivers Monitoring should generally occur if requested by during the works. If the measured levels are higher than those predicted, then the mitigation measures will need to be reviewed	Refer to Section 7.7
Specific Notification	SN	Specific notifications are in the form of a personalised letter or phone call to identified stakeholders no later than seven calendar days ahead of construction activities that are likely to exceed the noise objectives. Alternatively (or in addition to), communications representatives from the contractor would visit identified stakeholders at least 48 hours ahead of potentially disturbing construction activities and provide an individual briefing.	-

The application of these procedures is in relation to the exceedances over the relevant criteria. In this document, the additional mitigation measures are recommended to be applied as per the *"Construction Noise and Vibration Strategy"* issued by Transport for NSW.

For residences during the construction phase, the management procedures have been allocated based on noise level exceedances at the affected properties, which occur over the designated NMLs. The allocation of procedures is summarised in Table 17 below with the recommended area for notifications and monitoring shown in Table 17.

Table 17 Allocation of noise management procedures – construction phase

Construction Hours	Exceedance over NML (dB)	Management Procedures	Relevant Receivers
Mon – Fri: 7:00 am to 5:00 pm plus Sat 8:00 am to 1:00 am	< 10	-	See Figure 19
	> 10 to 20	PN, V	See Figure 19
	> 20	PN, V	-
	75 dBA or greater	PN, V, SN	-
Notes: Verification monitoring to be undertaken upon complaints received from affected receivers			

Figure 19 Recommended Notifications and Monitoring Area

Please note the following regarding the allocation of these procedures:

- The exceedances have been estimated as part of the acoustic assessment, and these are summarised in Table 15.
- The allocation of procedures is based on exceedances over NMLs. This approach has been adopted since it is our opinion that the L_{Aeq} index provides a better description of the construction noise impact than the $L_{A\,av\,max}$ descriptor. Furthermore, current guidelines for construction noise assessment based their mitigation strategies on exceedances over NMLs (such as the *"Construction Noise and Vibration Strategy"* issued by Transport for NSW).

7.7 Community Consultation

Active community consultation and the maintenance of positive relations with local residents assist in alleviating concerns and thereby minimising complaints. It is common for construction projects to provide community consultation if exceedance of the noise goals has been predicted. As with the Periodic Notifications recommended in section 7.6, this communication is commonly conducted in the form of a letter box drop or more active engagement with more highly impacted receivers.

This form of notification should provide specific notification of the duration and timing of the construction activities, so that residents are informed about the proposed works ahead of time. The letter should also provide the community with a hotline number. Ideally the hotline number should provide concerned locals an opportunity to raise any concerns with the project proponent and provide an opportunity to determine the best method to satisfy all requirements.

7.8 Noise Monitoring

As per section 7.6, noise monitoring, if required, will be performed by an acoustical consultant directly engaged by the contractor.

Noise monitoring for the pile driving should be undertaken using statistical noise loggers. The statistical parameters to be measured should include the following noise descriptors: L_{Amin}, L_{A90}, L_{A10}, L_{A1}, L_{Amax} and L_{Aeq}. Unattended noise measurements should be conducted over consecutive 15 minute periods.

This monitoring should also be complemented by undertaking attended noise measurements in order to:

- Differentiate between construction noise sources and other extraneous noise events (such as road traffic and aircraft noise)
- Note and identify any excessive noise emitting machinery or operation.

If required, at the commencement of the noise monitoring, unattended noise measurements will be performed at the adjacent receivers for a period of one week in order to determine the noise impact from the subject works. This unattended monitoring will be supplemented with operator-attended noise measurements in order to determine the noise contribution from construction and demolition events. Following this initial monitoring period, recommendations on subsequent locations for unattended measurements and monitoring periods (such as weekly reporting) will be advised by the acoustic consultant. These recommendations will depend upon the degree of impact on surrounding sensitive locations and frequency of received complaints.

In the event of any complaints, the noise impact at the affected location should be confirmed by conducting attended noise measurements. The survey methodology and any equipment should comply with the requirements discussed in standard AS 1055.1-1997.

7.9 Complaints Management System

It is noted that Gladesville Bridge Marina already has a complaints procedure in place. This procedure should continue to be carried out throughout construction works. As part of the procedure, information to be gathered should include location of complainant, time/s of occurrence of alleged noise or vibration impacts (including nature of impact particularly with respect to vibration), perceived source, prevailing weather conditions and similar details that could be utilised to assist in the investigation of the complaint. All resident complaints will be responded to in the required timeframe and action taken recorded.

8 ROAD NOISE ASSESSMENT

As part of the assessment, Colston Budd Rodgers and Kafes (CBRK) Pty Ltd undertook a traffic and transport report. Utilising information from the CBRK report, the following movements are estimated along Victoria Place during the worst case daytime one hour period

- Under the current day scenario, 100 vehicles two way take place, of which 14 movements are associated with the Marina
- Under the proposed day scenario, 105 vehicles two way take place, of which 19 movements are associated with the Marina

8.1.1 Predicted Noise Results

The receivers closest to the Marina entrance along Victoria Place will have a greater percentage of traffic passing by their property as traffic associated with the Marina. Thus as a worst case scenario, the receiver at 359 Victoria Place Drummoyne is analysed.

The road traffic noise was modelled using iNoise V2020.0. Given the proposed traffic volumes of 105 vehicles two way per hour, the noise limits are expected to be well below the day local road criteria of 55 dB $L_{Aeq\ 1\ hour}$.

Furthermore, the increase of the existing traffic noise from 100 two way vehicles per hour to 105 two way vehicles per hour corresponds to an increase of 0.2 dB. Under section 3.4.1 of the Road Noise Policy “for existing residences and other sensitive land uses affected by additional traffic on existing roads generated by land use developments, any increase in the total traffic noise level should be limited to 2 dB above that of the corresponding ‘no build option’”.

As build and no-build noise levels are below the local road criteria, and the predicted increase in noise levels is below 2 dB, the proposed road movements are predicted to comply with the Road Noise Policy. Therefore, no further noise mitigation measures are recommended.

9 VIBRATION

The operational noise sources within Table 11 do not contain any significant sources of vibration. The construction noise sources in Table 14 include the hammering from the piling rig. Of the pile rig works proposed to take place, the closest residential receiver is located 35m away. From BS 7385 within the Transport for NSW Construction Noise and Vibration Strategy, the minimum recommended distance to avoid cosmetic damage from a hammering piling rig is 15m, as shown in Table 18.

Table 18 Recommended minimum working distances from vibration intensive plant (as taken from TfNSW Construction Noise and Vibration Strategy)

Plant Item	Approx. Size/ Weight/ Model	Minimum Distance – Cosmetic Damage (BS 7385)	Minimum Distance – Human Response (OE&H Vibration Guideline)
Vibratory Roller	1-2 tonne	5 m	15 m to 20 m
	2-4 tonne	6 m	20 m
	4-6 tonne	12 m	40 m
	7-13 tonne	15 m	100 m
	13-18 tonne	20 m	100 m
	> 18 tonne	25 m	100 m
Small Hydraulic Hammer	300 kg (5 to 12t excavator)	2 m	7 m
Medium Hydraulic Hammer	900 kg (12 to 18t excavator)	7 m	23 m
Large Hydraulic Hammer	1600 kg (18 to 34t excavator)	22 m	73 m
Pile Driver – Vibratory	Sheet piles	2 m to 20 m	20 m
Piling Rig – Bored	≤ 800 mm	2 m (nominal)	N/A
Piling Rig – Hammer	12 t down force	15 m	50 m
Jackhammer	Hand held	1 m (nominal)	Avoid contact with structure

Therefore given the considered distances to the closest receivers during the proposed piling works, further mitigation measures against potential vibration impacts are not warranted.

10 CONCLUSION

Pulse Acoustics has been engaged by Gladesville Bridge Marina to prepare a Noise and Vibration Impact Assessment for the proposed alterations and additions of the Marina Dock. Gladesville Bridge Marina currently consists of 50 floating berths, 44 swing moorings and approval for 5 boat cradles. It is proposed to increase the amount of floating berths to 115, with 15 moorings. It is also proposed to decommission the slipway and provide an additional eight car spaces in this location.

This Noise Impact Assessment outlines the proposed noise generating activities, identifies the surrounding receivers and details the undertaken noise measurements. Noise criteria for the operational, road traffic and construction scenarios are given by the Noise Policy for Industry, Road Noise Policy and Interim Construction Noise Guideline respectively.

Operational, Road Traffic and Construction noise scenarios were modelled in iNoise V2020.0 modelling software. Assuming that a single boat is arriving or leaving during a 15 minute period, compliance is predicted with the operational criteria during the day, evening and night periods.

Construction noise impacts were predicted to exceed the noise management levels at a number of surrounding receptors during the piling activities. Construction noise and vibration mitigation measures are recommended in section 7 of this report.

Road traffic impacts were predicted to comply with the Road Noise Policy at all receivers. Cosmetic damage from vibration is not predicted during construction or operational activities.

APPENDIX A

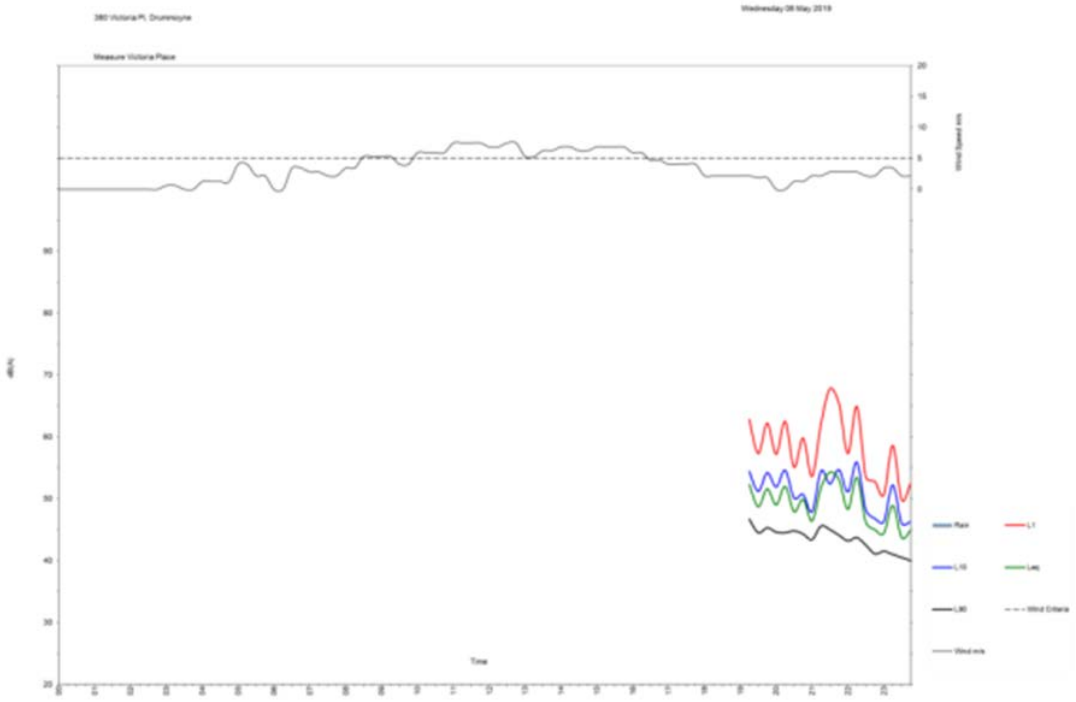
The following is a brief description of the acoustic terminology used in this report.

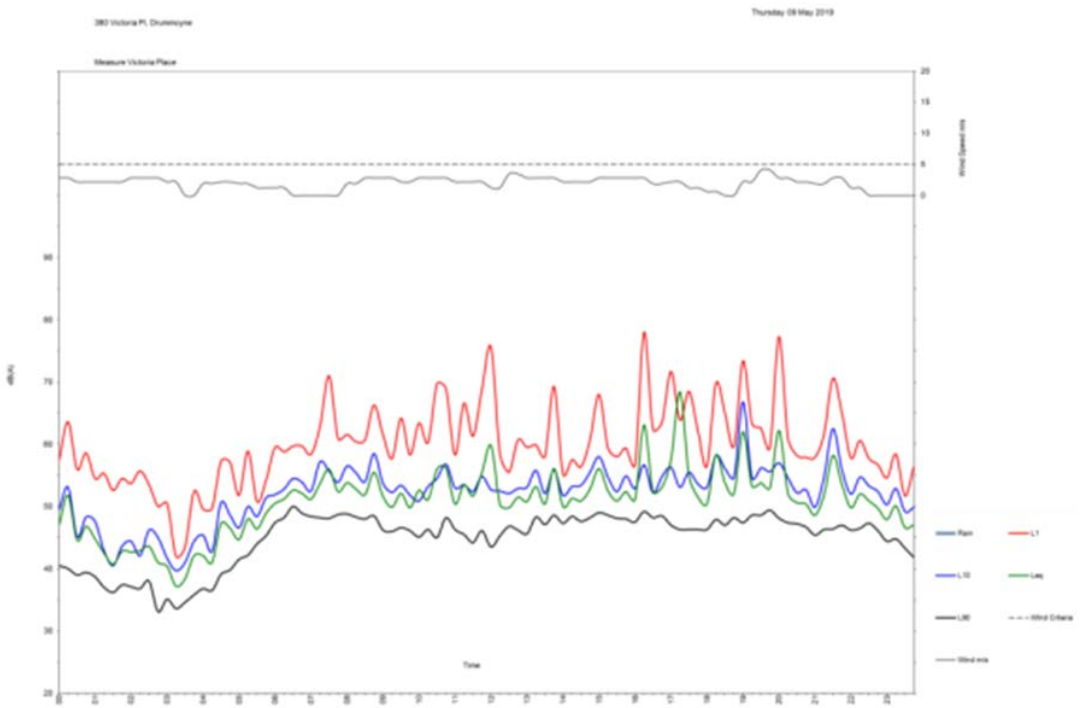
Ambient Sound	The totally encompassing sound in a given situation at a given time, usually composed of sound from all sources near and far.
Audible Range	The limits of frequency which are audible or heard as sound. The normal ear in young adults detects sound having frequencies in the region 20 Hz to 20 kHz, although it is possible for some people to detect frequencies outside these limits.
Character, acoustic	The total of the qualities making up the individuality of the noise. The pitch or shape of a sound's frequency content (spectrum) dictate a sound's character.
Decibel [dB]	The level of noise is measured objectively using a Sound Level Meter. 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 Martin Place 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 ear is not as effective in hearing low frequency sounds as it is 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. The sound pressure level in dB(A) gives a close indication of the subjective loudness of the noise.
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.
Loudness	A rise of 10 dB in sound level corresponds approximately to a doubling of subjective loudness. That is, a sound of 85 dB is twice as loud as a sound of 75 dB which is twice as loud as a sound of 65 dB and so on
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 L_{90} 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.
Background Sound Low	The average of the lowest levels of the sound levels measured in an affected area in the absence of noise from occupants and from unwanted, external ambient noise sources. Usually taken to mean the L_{A90} value
Ctr	A frequency adaptation term applied in accordance with the procedures described in ISO

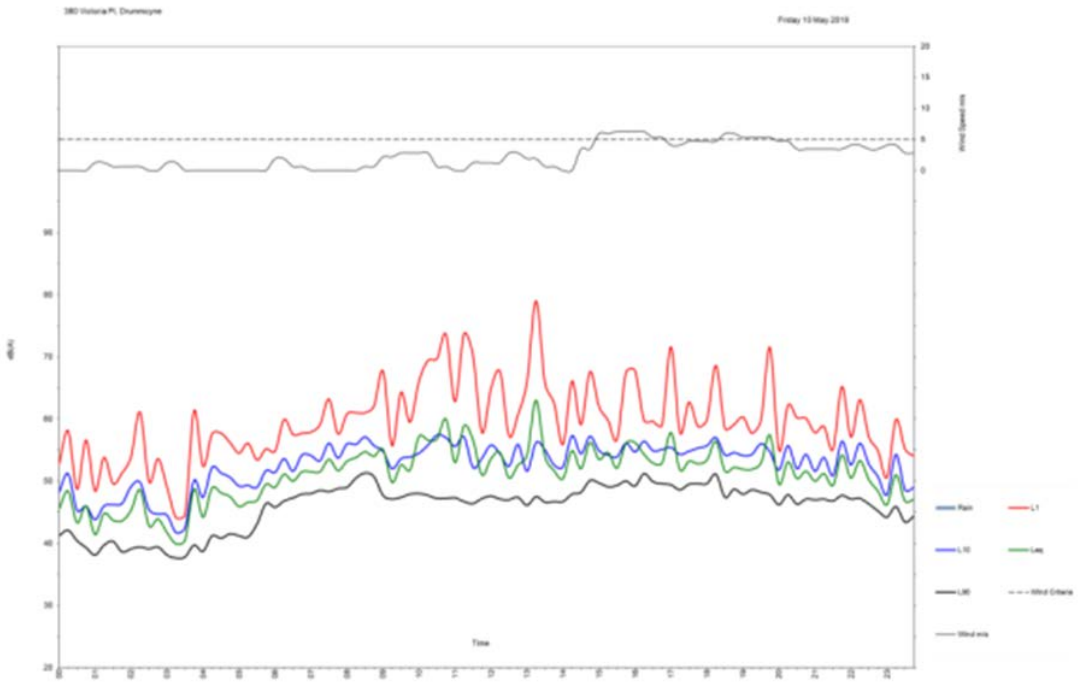
	717.
dB (A)	'A' Weighted overall sound pressure level
Noise Reduction	The difference in sound pressure level between any two areas. The term "noise reduction" does not specify any grade or performance quality unless accompanied by a specification of the units and conditions under which the units shall apply
NR Noise Rating	Single number evaluation of the background noise level. The NR level is normally around 5 to 6 dB below the "A" weighted noise level. The NR curve describes a spectrum of noise levels and is categorised by the level at 1000 Hz ie the NR 50 curve has a value of 50 dB at 1000 Hz. The NR rating is a tangential system where a noise spectrum is classified by the NR curve that just encompasses the entire noise spectrum consideration.
R_w	Weighted Sound Reduction Index - Laboratory test measurement procedure that provides a single number indication of the acoustic performance of a partition or single element. Calculation procedures for Rw are defined in ISO 140-2:1991 "Measurement of Sound Insulation in Buildings and of Building Elements Part 2: Determination, verification and application of precision data".
R'_w	Field obtained Weighted Sound Reduction Index - this figure is generally up to 3-5 lower than the laboratory test determined level data due to flanked sound transmission and imperfect site construction.
Sound Isolation	A reference to the degree of acoustical separation between any two areas. Sound isolation may refer to sound transmission loss of a partition or to noise reduction from any unwanted noise source. The term "sound isolation" does not specify any grade or performance quality and requires the units to be specified for any contractual condition
Sound Pressure Level, L_P dB	A measurement obtained directly using a microphone and sound level meter. Sound pressure level varies with distance from a source and with changes to the measuring environment. Sound pressure level equals 20 times the logarithm to the base 10 of the ratio of the rms sound pressure to the reference sound pressure of 20 micro Pascals.
Sound Power Level, L_W dB	Sound power level is a measure of the sound energy emitted by a source, does not change with distance, and cannot be directly measured. Sound power level of a machine may vary depending on the actual operating load and is calculated from sound pressure level measurements with appropriate corrections for distance and/or environmental conditions. Sound power levels is equal to 10 times the logarithm to the base 10 of the ratio of the sound power of the source to the reference sound power of 1 picoWatt
Speech Privacy	A non-technical term but one of common usage. Speech privacy and speech intelligibility are opposites and a high level of speech privacy means a low level of speech intelligibility. It should be recognised that acceptable levels of speech privacy do not require that speech from an adjacent room is inaudible.
Transmission Loss	Equivalent to Sound Transmission Loss and to Sound Reduction Index in terminology used in countries other than Australia. A formal test rating of sound transmission properties of any construction, by usually a wall, floor, roof etc. The transmission loss of all materials varies with frequency and may be determined by either laboratory or field tests. Australian Standards apply to test methods for both situations.

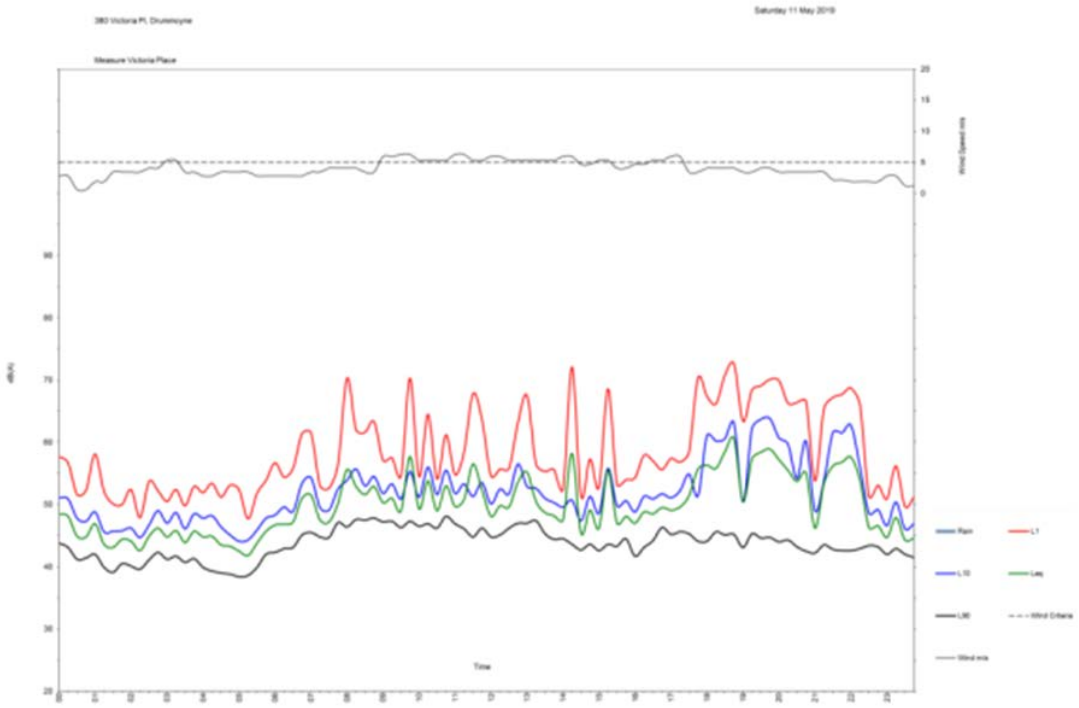
APPENDIX B – UNATTENDED NOISE MEASUREMENTS

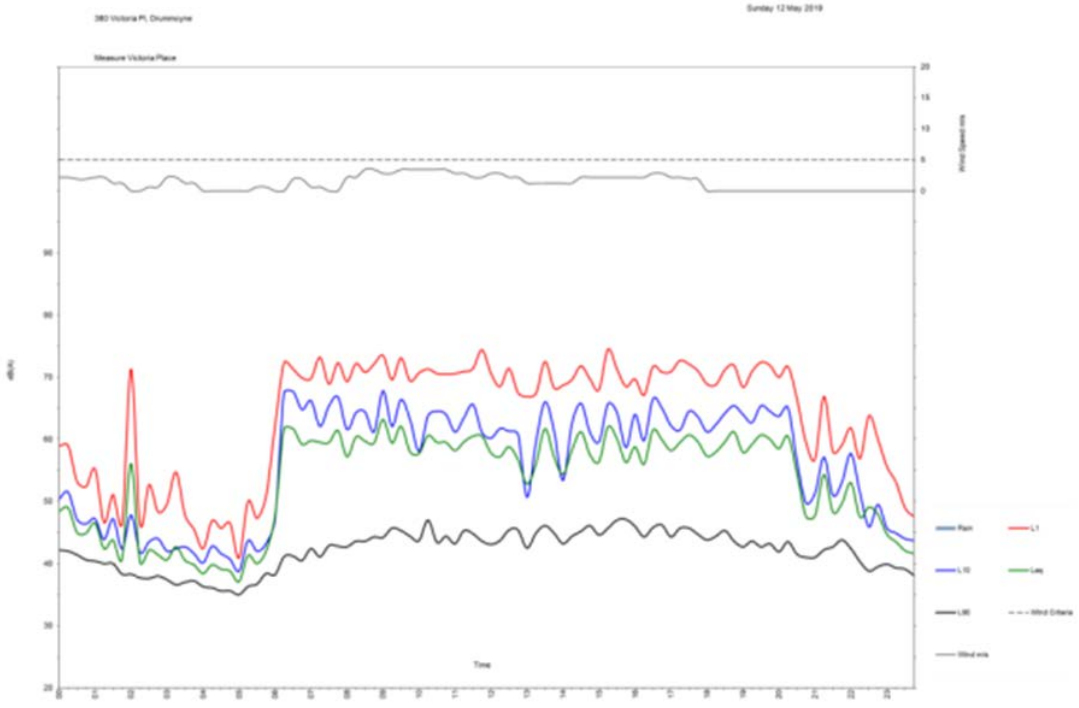
Logger A – 380 Victoria Place, Drummoyne

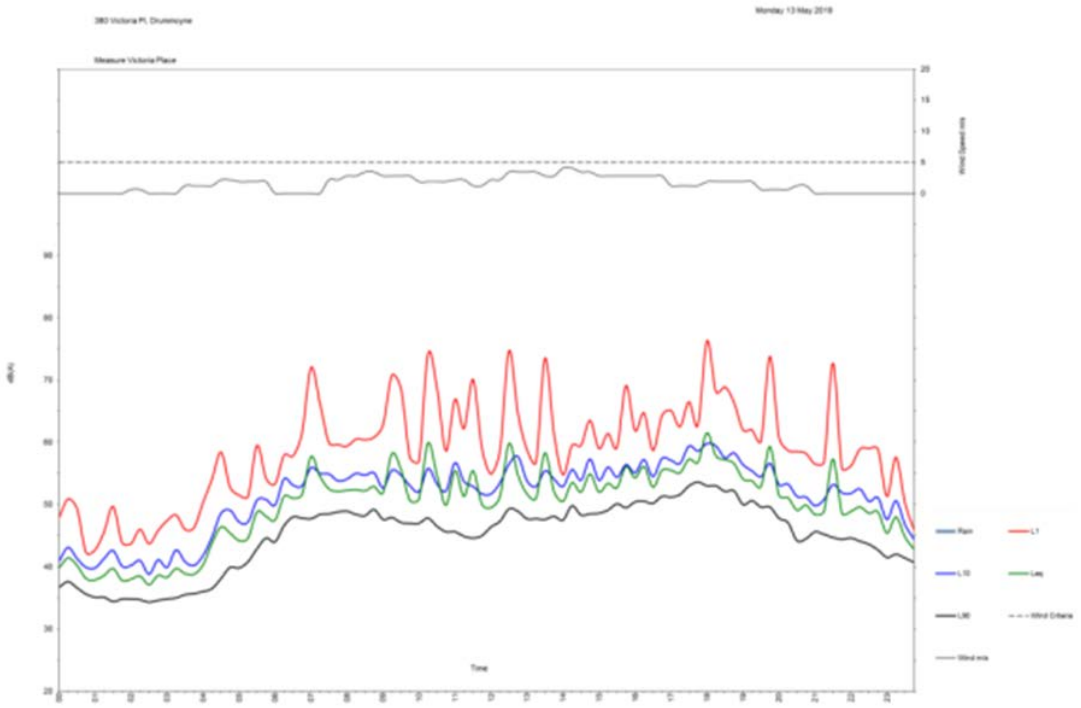


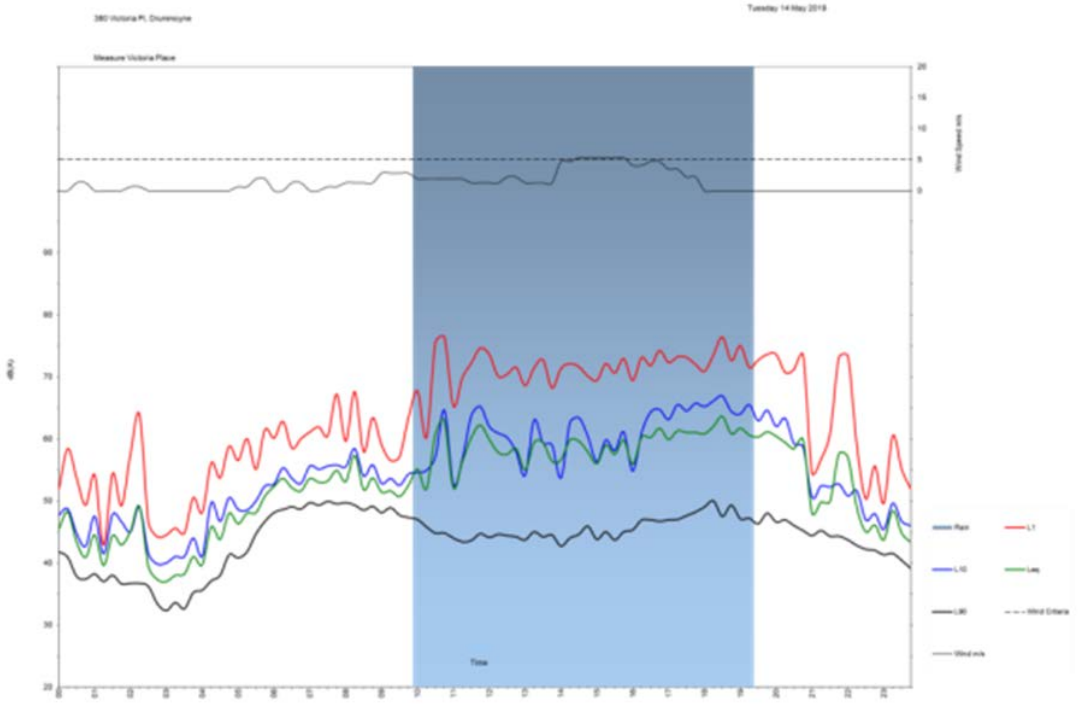


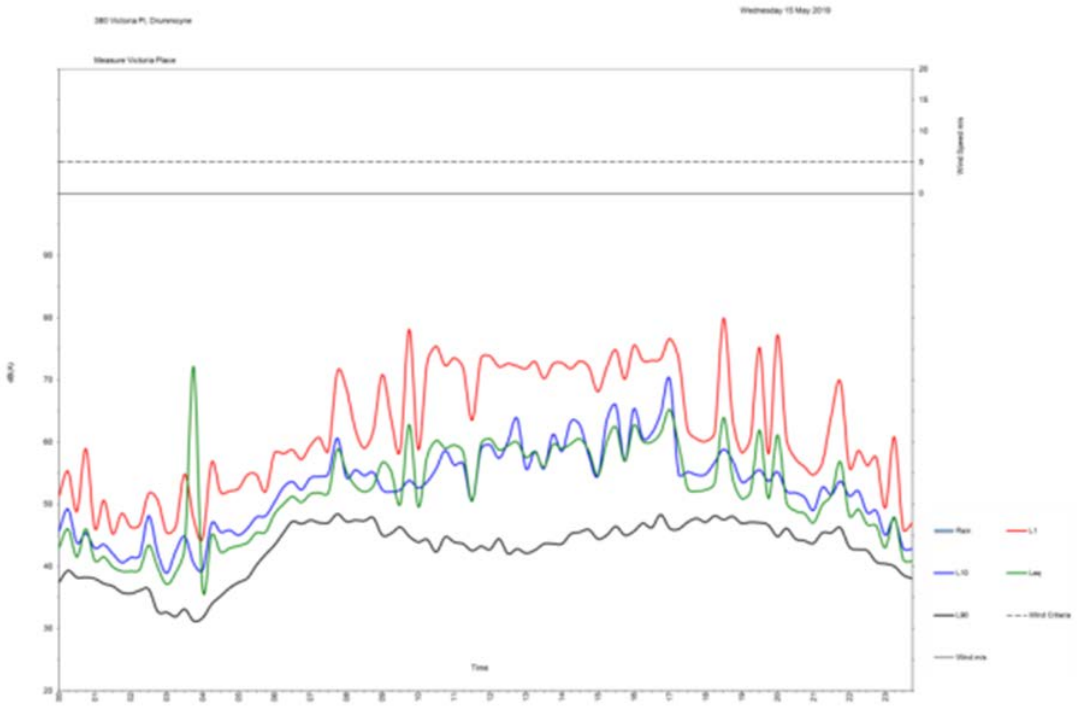


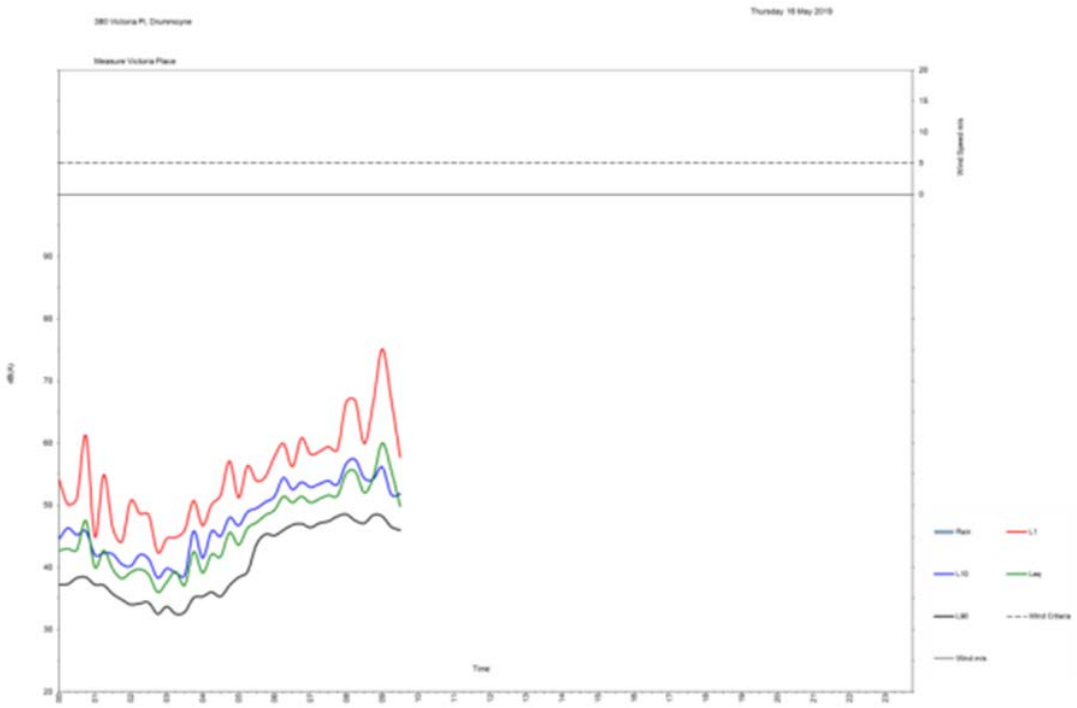












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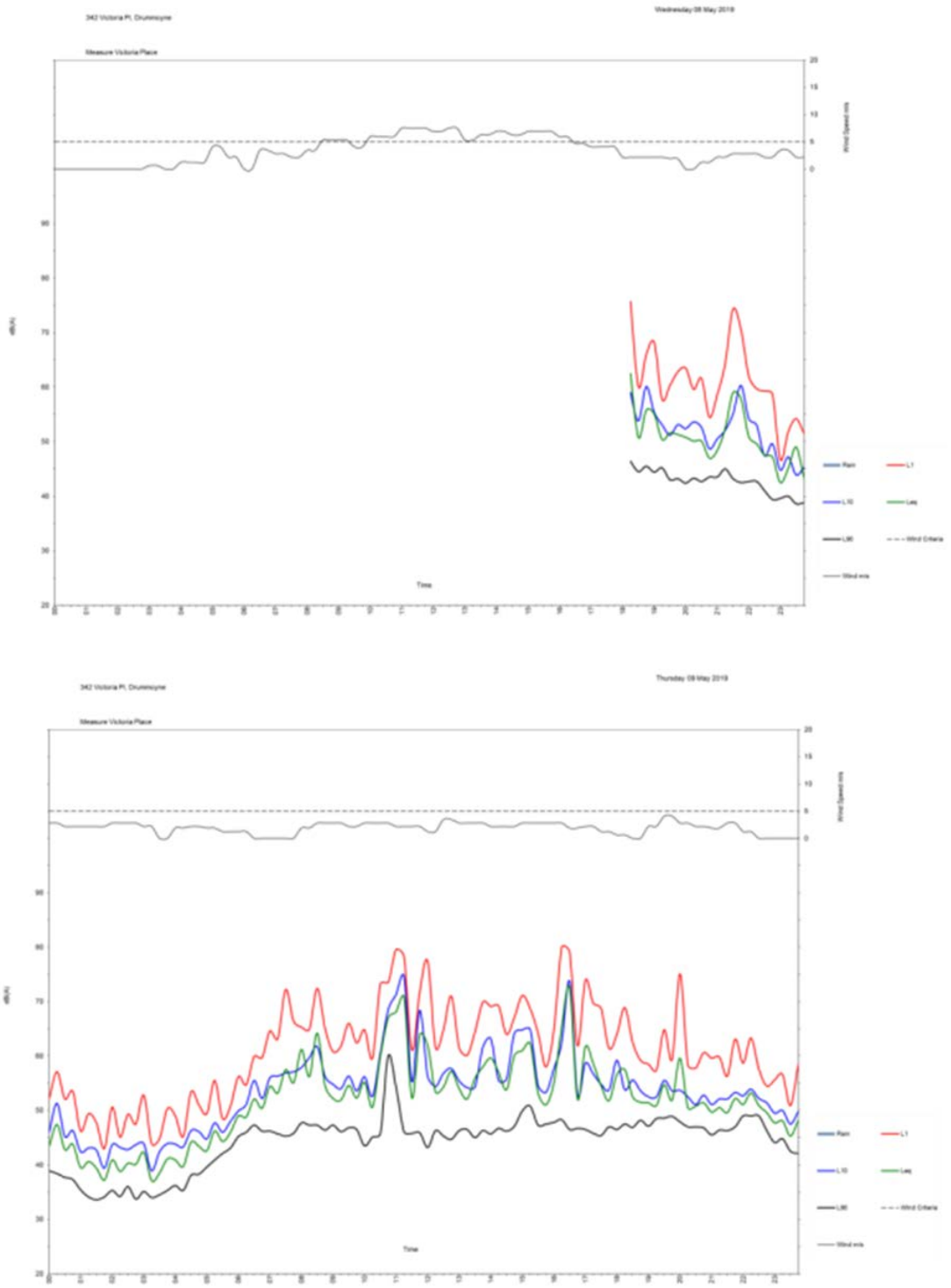

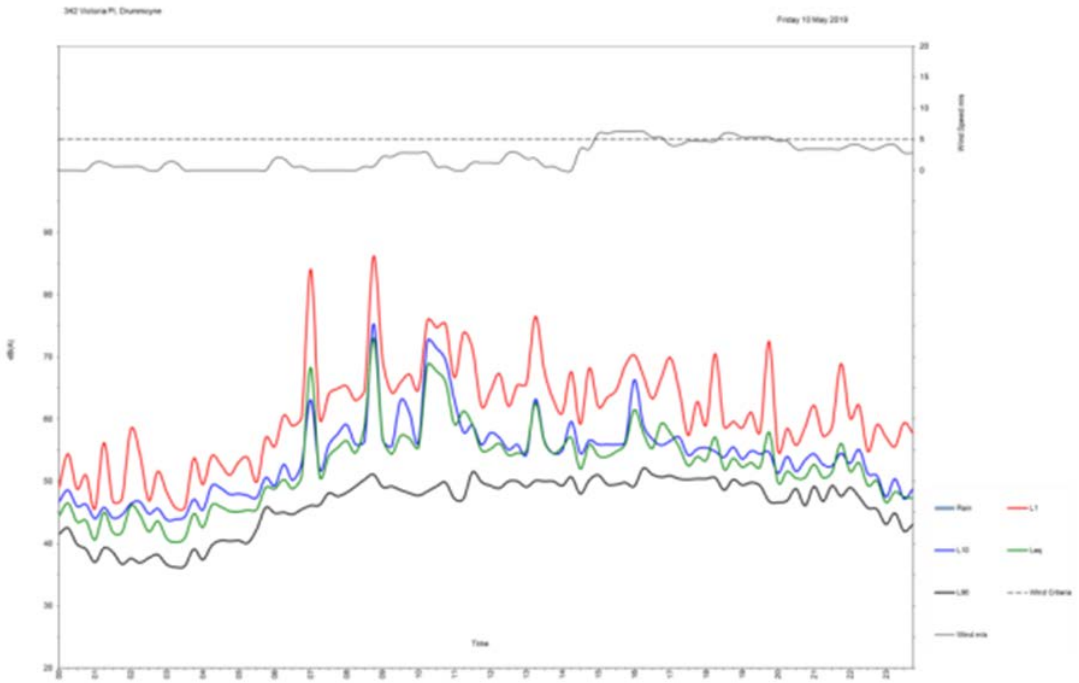

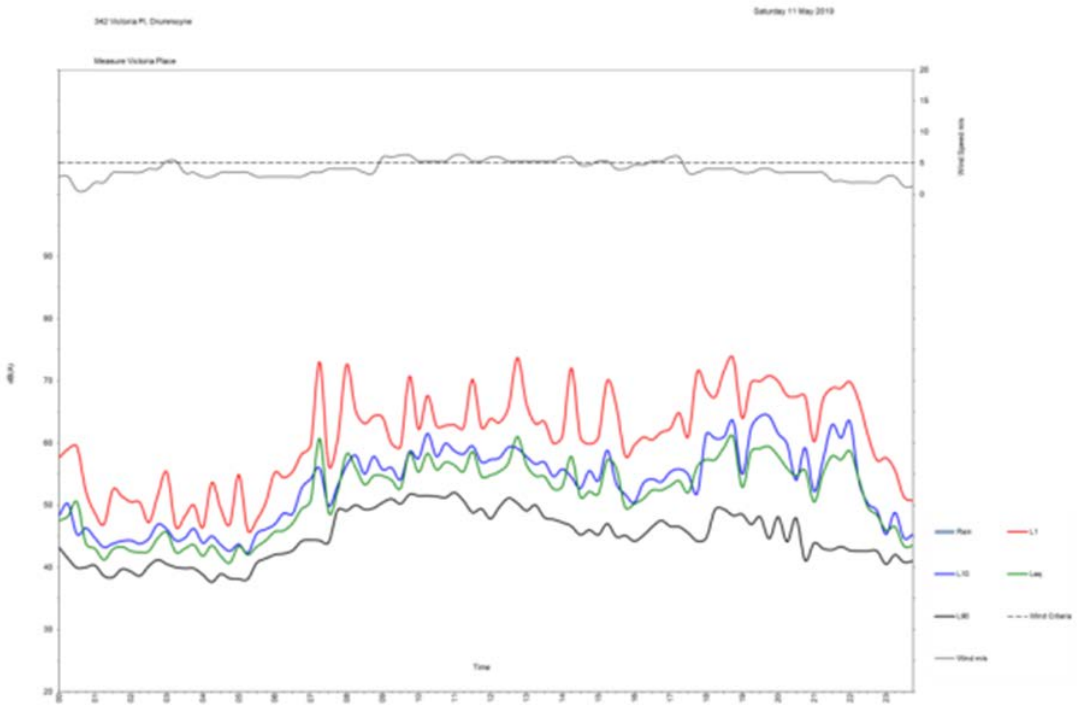

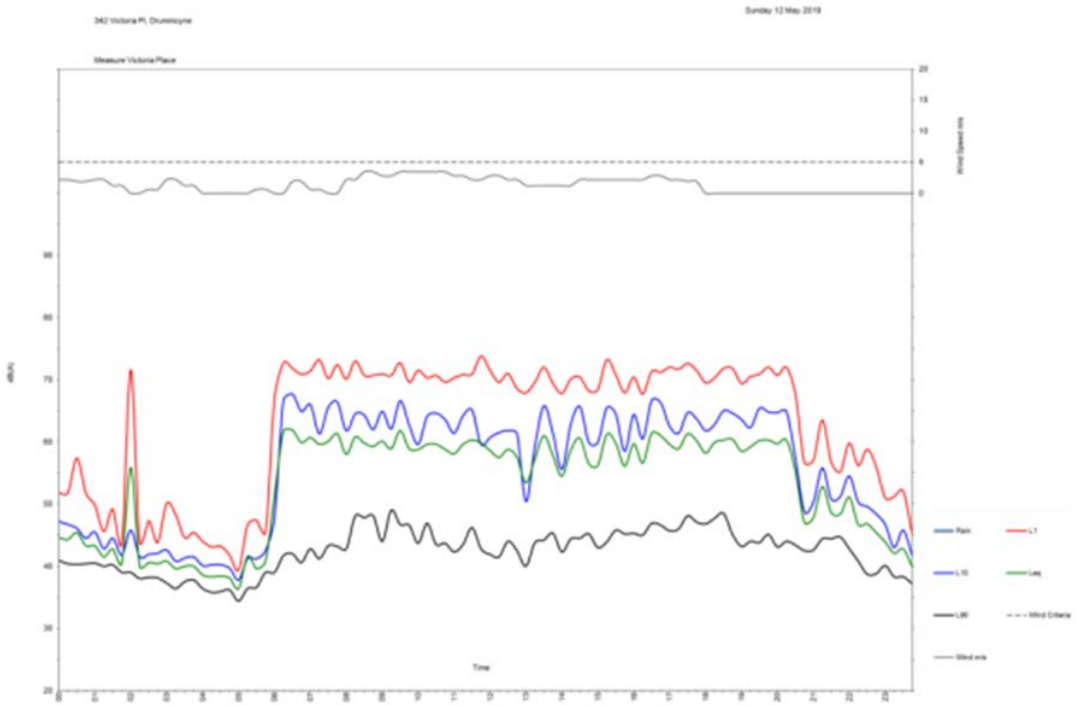

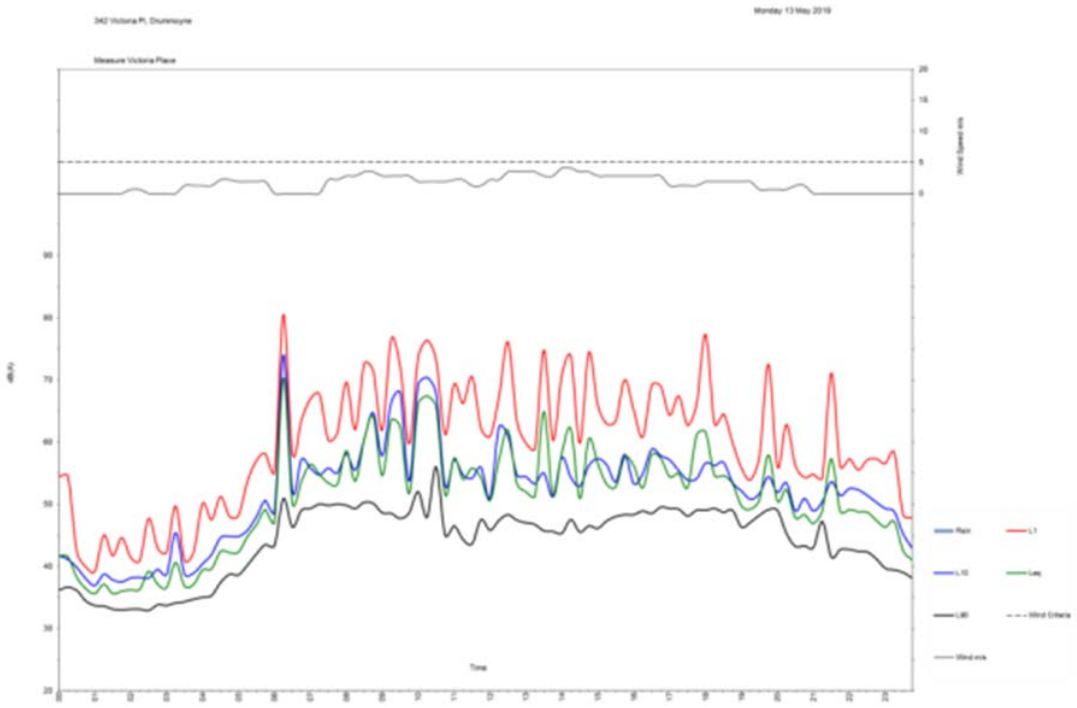

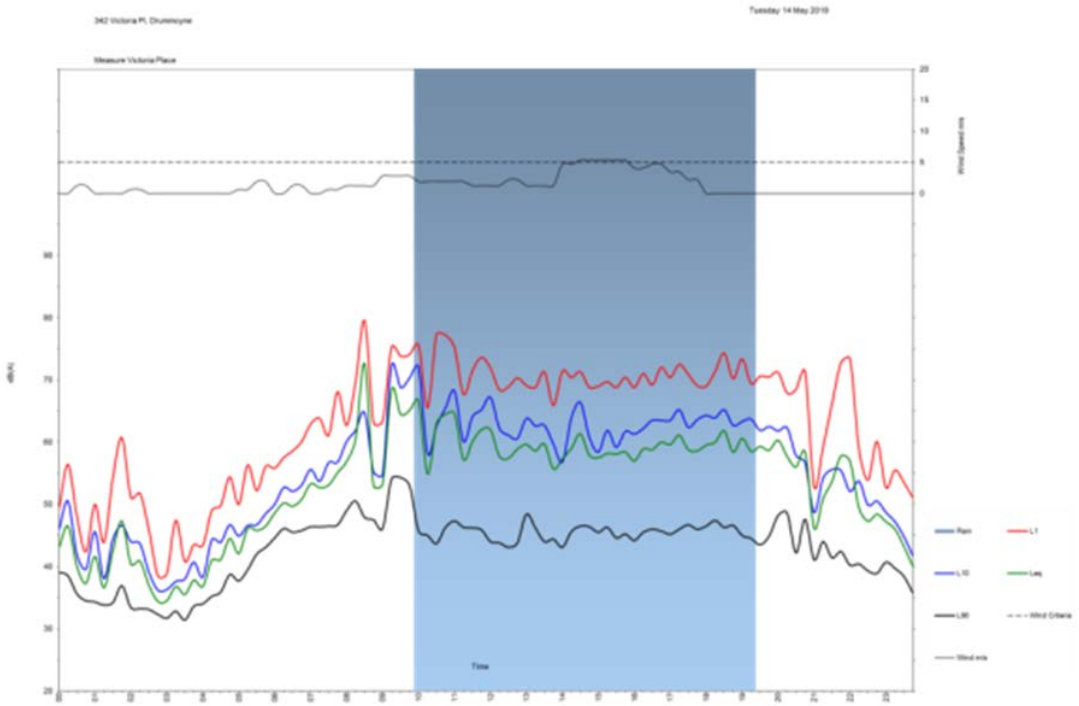

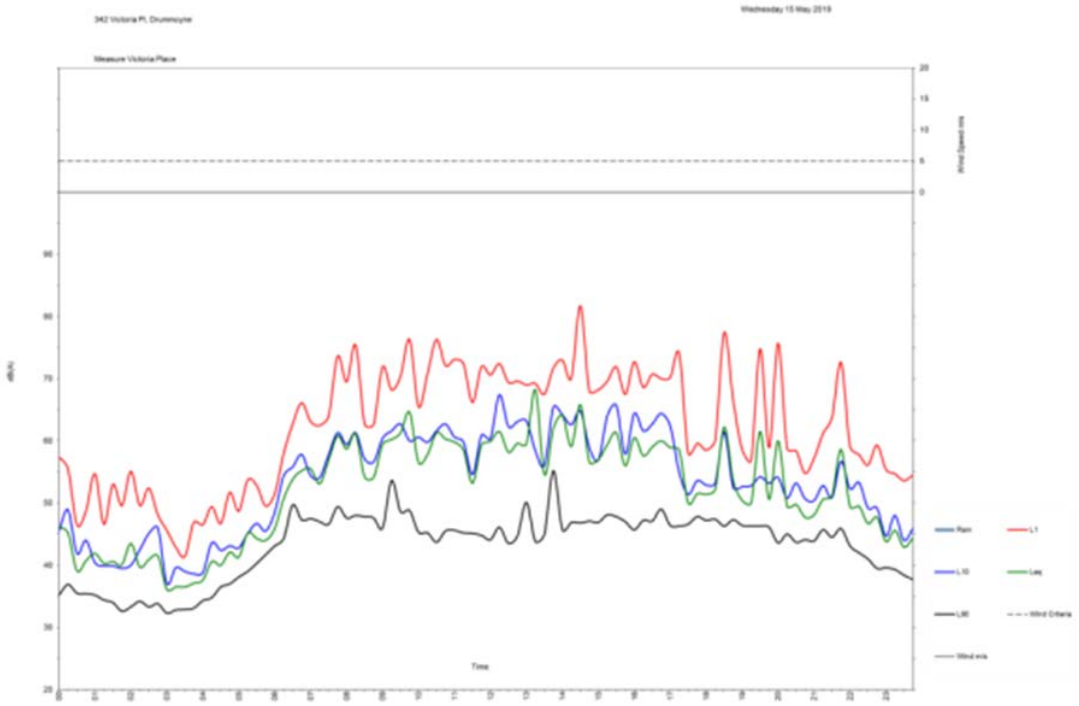

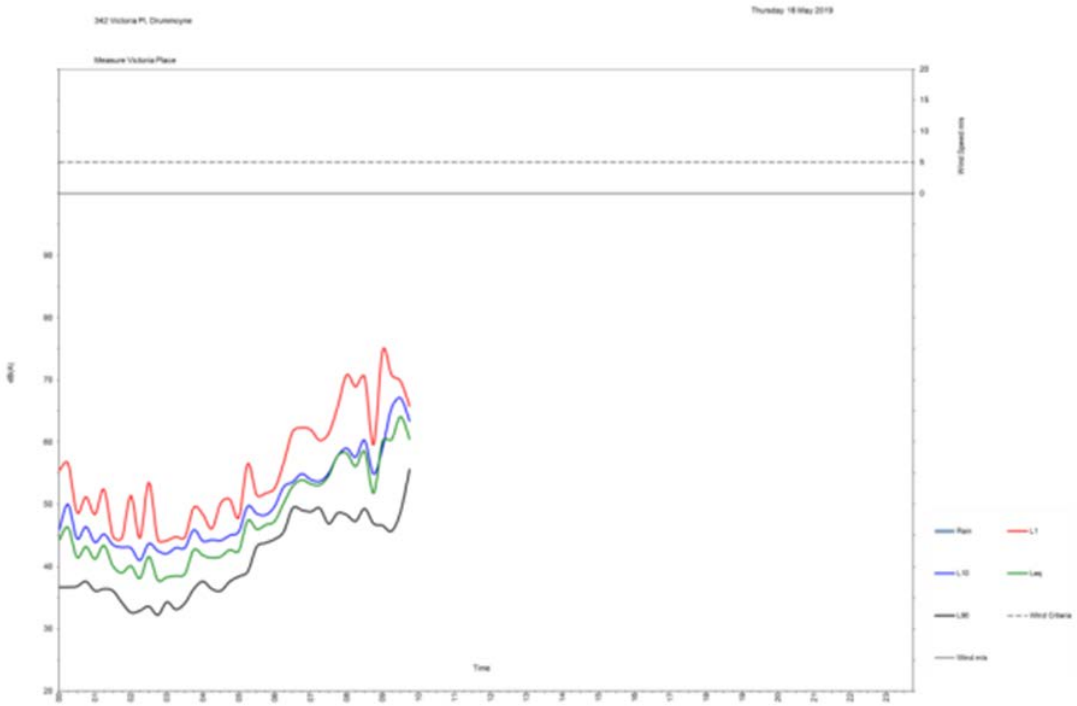

APPENDIX C – SITE PLANS