

LITTLE MINDIL DEVELOPMENT

Noise Impact Assessment

Prepared for:

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SLR 

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BASIS OF REPORT

This report has been prepared by SLR Consulting Australia Pty Ltd (SLR) with all reasonable skill, care and diligence, and taking account of the timescale and resources allocated to it by agreement with KTT Investment Pty Ltd (the Client). Information reported herein is based on the interpretation of data collected, which has been accepted in good faith as being accurate and valid.

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1 Introduction

SLR Consulting Australia Pty Ltd (SLR) has been commissioned by Urbanscope (Australia) Pty Ltd on behalf of KTT Investment Pty Ltd to undertake a noise impact assessment for the proposed hotel development at 25 Gilruth Avenue, The Gardens in Darwin (Little Mindil).

This noise impact assessment has been conducted with reference to Australian Standard AS 1055:2018 *Description and Measurement of Environmental Noise* and in accordance with the *Northern Territory Planning Scheme*. This report details the results of the calculations of potential noise emissions and the assessment of noise effects from the proposed development on surrounding noise sensitive sites.

A description of acoustic terminology is provided in **Appendix A**.

2 Project Description and Site Location

The proposed development at Little Mindil will consist of a luxury hotel resort, serviced apartments and villas, all housed within significant landscaped gardens. The development will also provide for new and existing public walkways and active spaces to maintain community access to the site itself, the beach and the creek.

Little Mindil is situated two kilometres from Darwin's central business district in a mixed-use area that includes tourist, entertainment and recreation attractions. To the immediate north-east is the Mindil Beach Casino and Resort, which features restaurants, bars, pools and business amenities. To the immediate south-west is the National Trust-listed Myilly Point heritage precinct.

The nearest identified noise sensitive receptors (NSRs) are as follows:

- Mindil Beach Casino Resort located to the north-east of the site adjacent Gilruth Avenue;
- Multiple storey residential dwelling located to the south-west adjacent Burnett Place; and
- Mylilly serviced apartments located to the south-west adjacent Mylilly Terrace.

Figure 1 shows the site location in the context of surrounding land uses and nearest identified off-site noise sensitive receptors (NSRs).

Figure 1 Little Mindil Location (in yellow) and Nearest NSR's



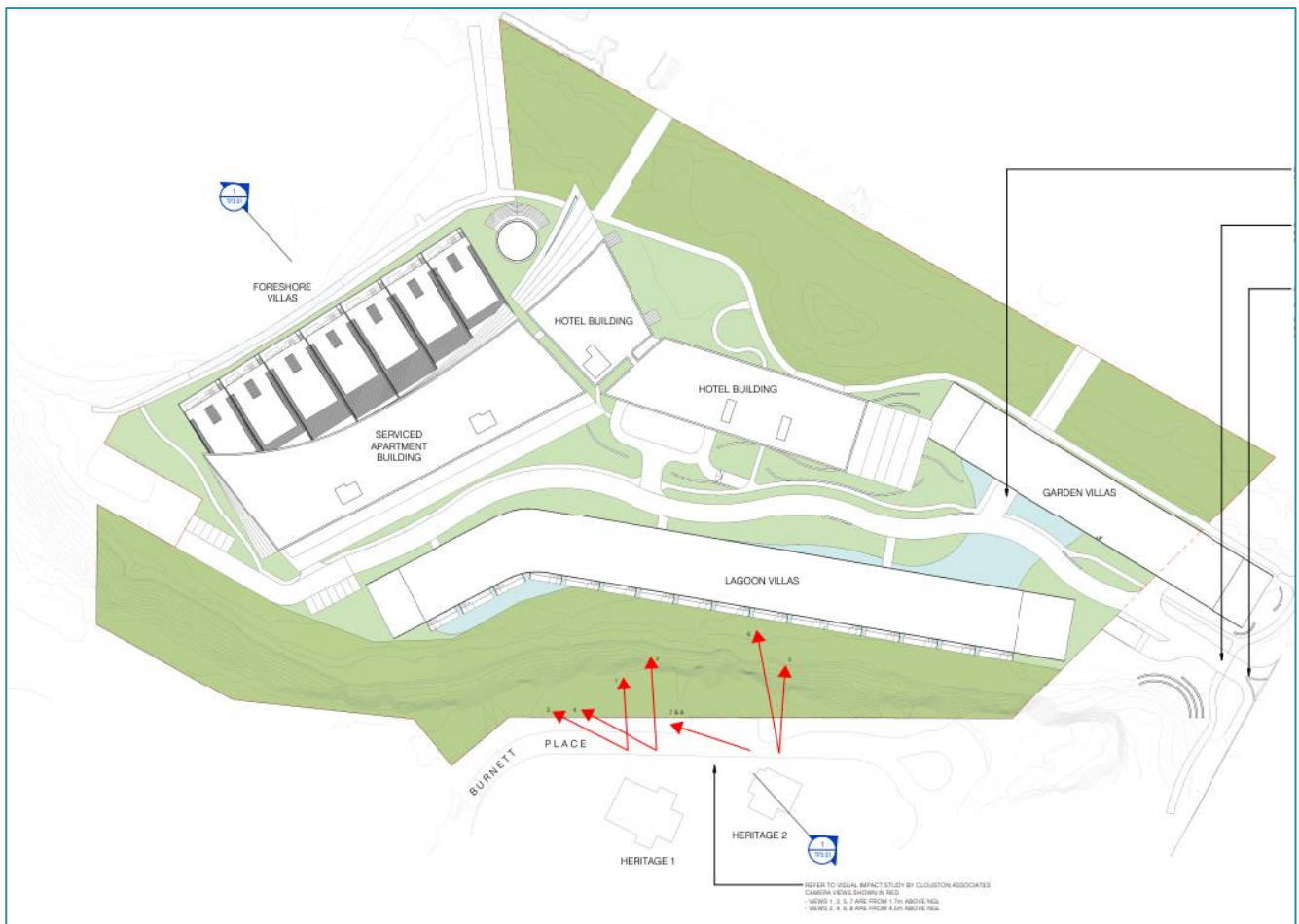
The proposed development will consist of four (4) buildings comprising of the following:

- 149 hotel rooms
- 46 serviced apartments
- 6 retail spaces
- 277 car parks

All buildings will be served by mechanical plant, with the major air conditioning equipment expected to be positioned on the rooftop.

Figure 2 shows the site plan of the proposed development.

Figure 2 Proposed Site Plan



For the purposes of this assessment, the proposed hours of operation for the retail activities are as follows:

- Level 1 All Day Dining Restaurant and Bar - 6:00 am to 10:00 pm
- Level 1 Poolside Bar - 07:00 am to 3:00 am
- Ground Level Food and Beverage Bar - 7:00 am to 1:00 pm
- Ground Level Communal Market Area - 9:00 am to 6:00 pm

The noise emissions associated with the proposed development are expected to include:

- Mechanical plant (roof top air-conditioning/ventilation units).
- Vehicle movements on the premises including car parking activities.
- Vehicles servicing the development such as delivery trucks.
- Unloading and loading delivery trucks.
- Amplified music and patron noise.

3 Existing Acoustic Environment

Noise measurements were conducted by SLR to identify and quantify the existing noise environment at the site and surrounding land. The noise monitoring methodology and the measured ambient noise levels are detailed below with the daily noise charts in **Appendix B**.

3.1 Noise Monitoring Methodology

The noise measurements were undertaken as per the *Northern Territory Noise Management Framework Guideline* and the *NSW EPA Noise Policy from Industry 2017*.

3.2 Ambient Noise Level Survey

Continuous unattended noise logging was undertaken at the two locations shown in **Figure 3** between 8th February 2021 and 15th February 2021. The objective of the unattended noise monitoring was to quantify the existing noise levels in the area surrounding the subject site and to assist in determining appropriate noise level goals for the subject site.

Figure 3 Noise Monitoring Locations



Unattended noise monitoring was carried out using two (2) SVAN 957 environmental noise loggers. The noise loggers were configured to record a range of A-weighted fast-response statistical noise levels, including the rated background noise levels (RBL) over consecutive 15-minute periods. The noise loggers were checked for calibration before and after the monitoring, using a sound level calibrator and no significant drift in calibration was detected. The noise loggers were located in the free field with a microphone height of 1.5 m above the existing ground level.

A summary of rated background noise levels (RBL) is presented in **Table 1**.

Table 1 Summary of Measured Rated Background Noise Levels (RBL)

Parameter	Period	Location 1	Location 2
		Average of 15-minute Measured Noise Levels (dBA)	
Rated Background Noise Level (RBL)	Daytime (7 am-6 pm)	49	48
	Evening (6 pm-10 pm)	47	48
	Night (10 pm-7 am)	47	47

3.3 Octave Band Noise Logging

Octave band noise data was extracted from the noise monitoring results obtained between 8th February 2021 and 15th February 2021 for the purposes of establishing the recommended project specific assigned noise levels for indoor entertainment venues. The representative minimum baseline LA90 noise spectrum during the noise monitoring is shown in **Table 2**.

Table 2 Background Noise Spectrum, dB

Background noise (L ₉₀)	Octave-band levels, dB re 20 µPa at octave band centre frequency (Hz)							OVERALL, dBA
	63	125	250	500	1000	2000	4000	
Location 1 background noise level at 4:00 am to 4:15 am on Tuesday, 9 February 2021	37	38	38	38	39	36	40	46
Location 2 background noise level at 12:30 am to 12:45 am on Sunday, 14 February 2021	39	31	30	30	31	30	36	41

4 Noise Assessment Criteria

The relevant zoning legislation is the *Northern Territory Planning Scheme*. According to the scheme:

- The proposed site is located within a Multi-zone (MZ) area.
- The nearest identified noise sensitive residential receivers are as follows:
 - Mindil Beach Casino Resort located to the north in a Tourist Commercial (TC) zone.
 - Multiple storey residential dwelling located to the south in a Low-Medium Density Residential (LMR) zone.
 - Mylilly serviced apartments located to the south in a Tourist Commercial (TC) zone.

The *Northern Territory Noise Management Framework Guideline* details the relevant noise emission criteria for different types of noise assessments. For the purposes of this assessment, the following types of noise assessments are relevant to the proposed development:

- Commercial and Industrial Noise (for mechanical plant, vehicle movement, loading activities etc); and
- Entertainment Venue Noise (for the restaurant, bars and communal market area etc).

The relevant noise emission criteria for the proposed development is detailed in the sub-sections below.

4.1 Commercial and Industrial Noise

The relevant noise emission criteria for commercial and industrial noise sources is summarized in **Table 3** for the adjacent zones specified above. The rating background level (RBL) was determined from the noise logging conducted as summarised in **Section 3.2**.

Table 3 Commercial and Industrial Noise Criteria

Receiver location	Intrusive Criteria, LAeq, 15 mins (dBA)	Amenity criteria, LAeq, 15 mins (dBA)
Tourist Commercial (TC) zone	Background (RBL) + 5 dBA Day (7:00 am-6:00 pm) = 53 dBA Evening (6:00 pm-10:00 pm) = 52 dBA Night (10:00 pm -7:00 am) = 52 dBA	Day (7:00 am-6:00 pm) = 65 dBA Evening (6:00 pm-10:00 pm) = 55 dBA Night (10:00 pm -7:00 am) = 50 dBA
Low-Medium Density Residential (LMR) zone		Day (7:00 am-6:00 pm) = 60 dBA Evening (6:00 pm-10:00 pm) = 50 dBA Night (10:00 pm -7:00 am) = 45 dBA

The project specific noise criteria are established from the strictest of the criteria for any time period as per the *Northern Territory Noise Management Framework Guideline* Section 3.2.9. The project specific noise criteria are summarised below:

- Day (7:00 am-6:00 pm) = 53 dBA
- Evening (6:00 pm-10:00 pm) = 50 dBA
- Night (10:00 pm -7:00 am) = 45 dBA

4.2 Entertainment Venue Noise

The recommended times for the day/evening and night operating periods from the *Northern Territory Noise Management Framework Guideline's* Section 3.4.8 for indoor and outdoor entertainment venues that are to be used to determine the recommended project specific assigned noise levels (noise criteria) for the time periods are summarised in **Table 4**.

Table 4 Operating Periods for Indoor and Outdoor Entertainment Venues

Day	Operating Period	
	Day/Evening	Night
Monday – Friday	7:00am – 11:30 pm	11:30 pm – 7:00 am
Saturday	8:00am – 11:30 pm	11:30 pm – 8:00 am
Sunday	9:00am – 11:30 pm	11:30 pm – 9:00 am
Days preceding public holidays	8:00 am – 12:00 am (midnight)	12:00 am (midnight) – 8:00 am
New Year's Day	8:00 am – 12:00 am (midnight)	12:30 am – 8:00 am

4.2.1 Indoor Entertainment Venue Noise

The recommended project specific assigned noise levels for indoor entertainment venues are as follows:

- Day/Evening – the adjusted maximum sound pressure level L_{Aeq} , plus adjustments for tonal and impulse components, must not exceed the background level L_{A90} by more than 5 dBA when measured at any affected premises.
- Night – the sound pressure level LO_{CT10} , in full octave band with centre frequencies from 63 Hz to 4000 Hz must not exceed the background level, LO_{CT90} , by more than 8 dB in any octave band when measured at any affected premises.

Other points to note:

- The measurement shall be made of at least 15 cumulative minutes of music audible at the measurement point.
- Significant extraneous noise shall be excluded.
- The measurement shall be made at a time when the greatest intrusion of music noise into the sensitive noise receptor is likely to occur

Based on the above criteria and SLR's background noise readings (refer to **Table 1** and **Table 2**) two criteria have been listed in **Table 5**, depending on the latest operational time of the proposed use:

- An overall dBA limit for operational noise during the day and evening periods.
- An octave band limit for night-time operation.

Table 5 Recommended Project Specific Assigned Noise Levels for Indoor Entertainment Venues

Amplified Music and Live Entertainment Noise Criterion	Octave-band levels, dB re 20 µPa at octave band centre frequency (Hz)							Overall, dBA
	63	125	250	500	1000	2000	4000	
L _{Aeq} criteria for operation during the day/evening: Evening background level + 5 dBA	-	-	-	-	-	-	-	52
L _{10, oct} criteria for operation at night: Night-time background level + 8dB	47	39	38	38	39	38	44	-

The above criterion is applicable to the following proposed uses:

- Level 1 All Day Dining Restaurant and Bar (6:00 am to 10:00 pm); and
- Ground level Food and Beverage Bar (7:00 am to 1:00 pm).

Based on the recommended operating periods in **Table 4**, the above premises are expected to operate during the daytime, evening and night-time periods.

4.2.2 Outdoor Entertainment Venue Noise

The recommended project specific assigned noise levels for outdoor entertainment venues are presented in **Table 6**.

Table 6 Recommended Project Specific Assigned Noise Levels for Outdoor Entertainment Venues

Time	Recommended project specific assigned noise levels
Day/Evening period	55 dBA when located indoors with doors closed and windows open only if it is the only means of ventilation.
Night-time	The noise from the outdoor venue premises shall not be audible within any habitable room in any residential premises for the night period. ¹

Note 1 – For the purposes of this assessment, inaudible will be assessed as 10 dB lower than the current background noise.

The above criteria is applicable to the following proposed uses:

- Level 1 Poolside Bar (7:00 am to 3:00 am); and
- Ground Level Communal Market Area (9:00 am to 6:00 pm).

Based on the recommended operating periods in **Table 4**, the Level 1 Poolside Bar is expected to operate during the daytime, evening and night-time periods and the Ground Level Communal Market Area during the daytime period only.

5 Noise Assessment Methodology

5.1 Noise Modelling

Topographical information for the study area was sourced from the client as well as SLR's database comprising of light detection and ranging (LiDAR) data and digital elevation data used to create a detailed terrain map of the proposed site and surrounding areas.

With this terrain survey as a base, SLR developed a 3D SoundPLAN noise model of the study area to predict noise emissions for nearby sensitive receptors. SoundPLAN is a software package which enables compilation of a sophisticated computer model to develop a 3D ground map containing ground contours, road contours (including gradients) and existing building locations.

The Industry Noise (ISO 9613-2) 1996 algorithm was utilised in SoundPLAN to calculate and predict future noise emission levels at nearby noise sensitive receptors influenced by the proposed development.

5.2 Noise Source Overview

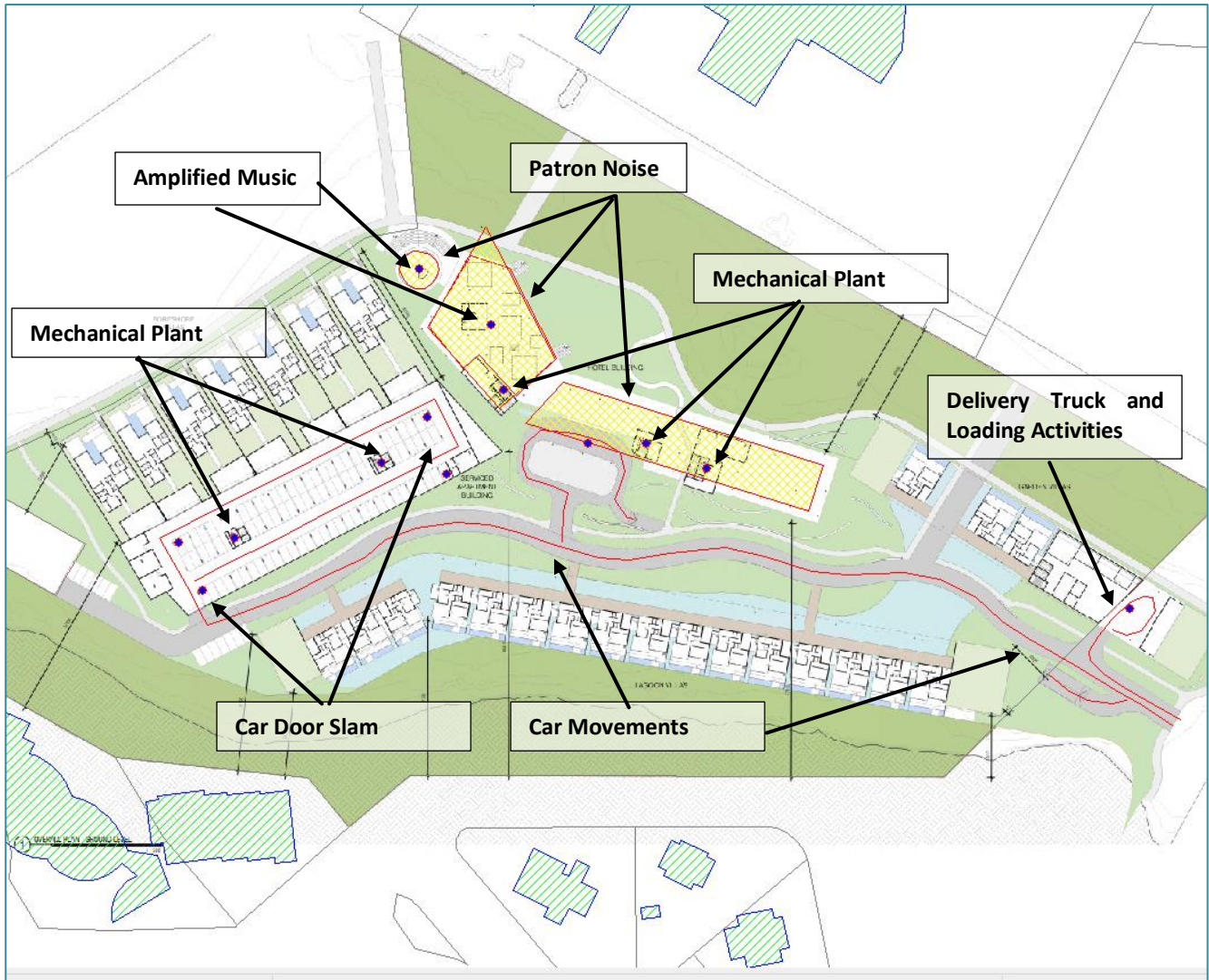
The noise sources to be assessed as part of this development are as follows:

Non-steady noise sources include:

- Noise emissions from the mechanical plant (roof top air-conditioning/ventilation units).
- Noise emissions from vehicle movements on the premises.
- Noise emission from vehicles servicing the development such as delivery trucks.
- Noise emissions from unloading and loading delivery trucks.
- Noise emissions from amplified music.
- Noise emissions from patrons.

Figure 4 shows the various noise sources modelled which are associated with the proposed development.

Figure 4 Noise sources modelled



The number of, duration and expected sound power levels for these events are listed in the report sub-sections.

5.2.1 Mechanical Plant Noise Emissions

Continuous noise emissions from items such as mechanical plant have the potential to affect surrounding noise sensitive receptors if not adequately attenuated. SLR understand that the location of the external mechanical plant for the new buildings has not been finalised. In lieu of any detailed mechanical plant information SLR expect the majority of external noise emitting mechanical plant items will be positioned on rooftop areas. **Table 7** lists the plant sound powers used for this assessment.

Table 7 Mechanical Plant Sound Power Levels

Plant	Modelled Location	Number of Units	Assumed Maximum SWL, dBA LAeq
Rooftop Mechanical Plant	1 m above the roof of each building	5	80 dBA

For the purposes of this assessment the noise sources are assumed to be continuous in operation. Any plant items not listed above are expected to be either 10 dBA quieter than the above or well attenuated by the building structure (e.g. located inside the building) and therefore of minimal risk of noise impact.

5.2.2 Car Noise Emissions

Vehicles are expected to enter and exit off the single access point on Gilruth Avenue. Noise will be generated by activities associated with cars arriving and leaving the site (opening and closing of doors, starting, manoeuvring and accelerating). For the purposes of this assessment, SLR have assumed car movements would occur for no more than 30-minutes during a 1-hour period.

Sound power levels for these activities occurring on the proposed development are shown in **Table 8**. Noise data was either obtained from the SLR in-house source noise measurement database or from manufacturer’s data obtained for similar projects with a 1-hour period time correction applied to car movements.

Table 8 Noise Sources – Passenger Vehicles

Noise Source	Car movements LAeq	Car Doors Closing at carpark LAeq
Sound power level	62 dBA, Lw/m, m ²	89 dBA
Source Height (m)	0.5	0.5
Penalty, dBA	Nil	+5 impulsive penalty
Duration (minutes) within 1-hour period.	30	1.1 Assumed 2 car door closures (exiting and entering car) for each carpark in a 1-hour period.
Time Correction for a 1-hour operation period (dBA)	-3 dBA	17
Resultant SWL to be modelled, dBA	59 dBA, Lw/m, m ²	77 dBA

5.2.3 Delivery Truck Movements

Noise will be generated by the delivery trucks manoeuvring on site and truck passbys on entry and exit ramp. It has been assumed that a maximum of one delivery truck per hour would enter the site and would manoeuvre within a 10-minute period. Trucks will be entering and exiting the premises from Gilruth Avenue to access the refuse and loading dock located to the east of the Garden Villas and the overall site.

The delivery trucks and its associated sound power levels (SWL) are described in **Table 9**. Noise data was obtained from the SLR in-house source measurement database with a time period correction applied to delivery truck movements.

For the purposes of this assessment, it has been assumed that up to ten deliveries during the day/evening period (7am to 10pm) and two deliveries during the night-time (10pm to 7am) can be expected to occur.

Table 9 Noise Source – Delivery Truck

Noise Source	Delivery truck LAeq
Sound power level	93 dBA
Source Height (m)	2.0
Penalty, dBA	Nil
Time weighting correction for duration of event within each time period Day (11hrs), Evening (4hrs) & Night (9hrs)	Day: 8 x 10 mins in 11 hour day period = -9 dBA Evening: 2 x 10 min duration within 4 hour evening period = -10 dBA Night: 2 x 10 mins duration in 9 hour night period = -14 dBA
Resultant SWL to be modelled, dBA	Day: LAeq 84 dBA Evening: LAeq 83 dBA Night: LAeq 79 dBA

5.2.4 Unloading and Loading Delivery Trucks

All unloading and loading of the delivery trucks is expected to take place in the refuse and loading dock with events including manual pallet jack uses. The loading activities can be expected to occur during the day, evening and night time periods, with the duration based on the assumed number of deliveries specified in **Section 5.2.3**.

Sound power levels for manual or electric pallet jack internal uses are described in **Table 10**. Noise data was obtained from the SLR in-house source measurement database with a time period correction applied to loading activities.

Table 10 Noise Source – Pallet Jack

Noise Source	Unloading truck with pallet jack LAeq
Sound power level	96 dBA
Source height, m	0.5
Penalty, dBA	+5 impulsive penalty
Time weighting correction for duration of event within each time period Day (11hrs), Evening (4hrs) & Night (9hrs)	Day: 6 hours in 11 hour day period = -3 dBA Evening: 2 hour duration within 4 hour evening period = -3 dBA Night: 2 hour duration in 9 hour night period = -6 dBA
Resultant SWL to be modelled, dBA	Day: LAeq 98 dBA Evening: LAeq 98 dBA Night: LAeq 95 dBA

5.2.5 Amplified Music Emissions

The Ground Level Food and Beverage Bar and Level 1 Poolside Bar are expected to have amplified music emanating from their premises. The Ground Level Food and Beverage Bar is an indoor venue with façades comprised of primarily large areas of glazing and the Level Poolside Bar is an outdoor venue as shown in **Figure 5**.

Figure 5 Ground Level Food and Beverage Bar and Level 1 Poolside Bar



For the purposes of this assessment, noise emissions from the two premises have been undertaken based on sound spectrum inputs to the noise model outlined in **Table 11**. Amplified music inputs were scaled from the ‘normalised moderator’ found in the Queensland Government’s *Guideline 51 – Preparing an Acoustic Report* document.

Table 11 Noise Sources – Amplified Music at 3m from the Speaker

Source	Speaker sound power 1/1 octave spectrum dB							Overall SPL, dB	Overall SPL, dBA
	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz		
Ground Level Food and Beverage Bar	97	101	92	91	88	87	85	103	94
Level 1 Poolside Bar	84	88	79	78	75	74	72	90	81

5.2.6 Patron Noise Emissions

Patron noise emanating from premises has the potential to affect the surrounding noise sensitive receptors if not adequately attenuated.

Patron noise was determined using the following equation cited from *Prediction of Noise from Small to medium Sized Crowds*¹ dating November 2011, where the A-weighted sound power levels for a crowd size, N, can be approximated by:

$$(1) L_{w_{Aeq}} = 15 \log N + 64 \text{ dB}(A)$$

The following sound power levels (L_w) have been modelled for the preliminary calculation of patron noise emissions emanating from the venue.

- Ground Level Food and Beverage Bar modelled with 115 patrons, $L_{w_{Aeq}}$ of 95 dBA.
- Ground Level Communal Market Area modelled with 150 patrons, $L_{w_{Aeq}}$ of 97 dBA.
- Level 1 All Day Dining Restaurant and Bar modelled with 130 patrons, $L_{w_{Aeq}}$ of 96 dBA.
- Level 1 Poolside Bar modelled with 180 patrons, $L_{w_{Aeq}}$ of 98 dBA.

Based on the above sound power levels for patron noise, the sound spectrum inputs to the noise model are outlined in **Table 12**.

Table 12 Noise Source - Patron Noise

Location	Speaker sound power 1/1 octave spectrum dB							Overall SPL, dB	Overall SPL, dBA
	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz		
Ground Level Food and Beverage Bar	78	84	90	94	90	84	79	98	95
Ground Level Communal Market Area	80	86	92	96	92	86	81	99	97
Level 1 All Day Dining Restaurant and Bar	79	85	91	95	91	85	80	98	96
Level 1 Poolside Bar	81	87	93	97	93	87	82	100	98

The nearest noise sensitive receptors located close to the above listed venues are within and external to the proposed development and also include the following:

- Hotel Building – Levels 2 to 5.
- Foreshore Villas.
- Serviced Apartment Building - Levels 2 to 5.

¹ Source: M.J. Hayne, J.C. Taylor, R.H. Rumble & D.J. Mee, 2011, *Prediction of Noise from Small to medium Sized Crowds*, Paper 133, Proceedings of Acoustics 2011

6 Noise Modelling Results

6.1 Mechanical Plant Noise Emission Predictions

Based on the source items and operational assumptions described in **Section 5.2.1**, a scenario has been modelled comprised of continuous noise sources only. For the purposes of this assessment it was assumed that all plant may operate continuously throughout the day, evening and night-time period.

Table 13 lists the predicted mechanical plant noise emission levels at the worst affected noise sensitive receptor on each street.

Table 13 Mechanical Plant Noise Emission Predictions

Noise source	Noise sensitive receptor	Noise source modelled during period?		
		Day (7:00 am – 6:00 pm)	Evening (6:00 pm – 10:00 pm)	Night (10:00 pm – 7:00 am)
		LAeq, dBA		
Mechanical plant	Mindil Beach Casino Resort (3 floors)	37	37	37
	Mylilly Serviced Apartments (8 floors)	42	42	42
	1 Burnett Place, Larrakeyah (2 floors)	43	43	43
Criteria		53 dBA LAeq	50 dBA LAeq	45 dBA LAeq
Compliant?	Mindil Beach Casino Resort (3 floors)	Yes	Yes	Yes
	Mylilly Serviced Apartments (8 floors)	Yes	Yes	Yes
	1 Burnett Place, Larrakeyah (2 floors)	Yes	Yes	Yes

The above predictions indicate that noise emissions from the standard plant are predicted to be compliant with the project criteria. Acoustic treatment is therefore not required if the overall sound power level of the mechanical plant for each of the new buildings does not exceed 80 dBA with no mitigation.

Mechanical plant will be required to be designed such that the combined noise emissions as measured at noise sensitive receivers do not exceed the project criteria presented in **Table 3** of this report. The following general recommendations are made for mechanical plant located on site:

- Achieve no direct line of sight between major plant items and the nearest noise sensitive receivers.
- If the overall sound power level of the mechanical plant exceeds 80 dBA for each building, acoustic treatment may be required. Acoustic screens would typically need to be at least 800mm taller than the top of the plant and be provided with an internal absorptive face.

- Prior to completion of the project it will be the mechanical contractor’s responsibility to submit confirmation that noise emissions from the installed plant comply with the noise limits listed in **Table 3** of this report. Acoustic testing shall be undertaken over a sufficiently representative period, we expect that 15 minutes during both day and night periods would be sufficient for continuous noises. Testing and reporting shall be undertaken by a suitably qualified acoustic consultant such as a member firm of the Association of Australian Acoustic Consultants or Member of the Australian Acoustical Society.

6.2 Car Noise Emission Predictions

Table 14 lists the predicted car park noise emission levels at the nearest identified noise sensitive receptors, against the noise criteria summarised in **Table 3**.

Table 14 Car Park Noise Emission Predictions

Noise source	Noise sensitive receptor	Noise source modelled during period?		
		Day (7:00 am – 6:00 pm)	Evening (6:00 pm – 10:00 pm)	Night (10:00 pm – 7:00 am)
		LAeq, dBA		
Car movements	Mindil Beach Casino Resort (3 floors)	27	27	27
	Mylilly Serviced Apartments (8 floors)	38	38	38
	1 Burnett Place, Larrakeyah (2 floors)	39	39	39
Car door closing	Mindil Beach Casino Resort (3 floors)	17	17	17
	Mylilly Serviced Apartments (8 floors)	31	31	31
	1 Burnett Place, Larrakeyah (2 floors)	32	32	32
OVERALL Noise level, dBA	Mindil Beach Casino Resort (3 floors)	27	27	27
	Mylilly Serviced Apartments (8 floors)	39	39	39
	1 Burnett Place, Larrakeyah (2 floors)	40	40	40
Criteria		53 dBA LAeq	50 dBA LAeq	45 dBA LAeq
Compliant?	Mindil Beach Casino Resort (3 floors)	Yes	Yes	Yes
	Mylilly Serviced Apartments (8 floors)	Yes	Yes	Yes
	1 Burnett Place, Larrakeyah (2 floors)	Yes	Yes	Yes

The predictions summarised in **Table 14** indicate that compliance with the project noise criteria is expected during the daytime (7:00am to 6:00 pm), evening (6:00 pm to 10:00 pm) and night-time (10:00 pm to 7:00 am) periods. It should be noted that the above predictions are based on car movements occurring for no more than 30-minutes during a 1-hour period. Given that compliance is achieved by 5 dBA or more at the NSRs, an increase in the duration of car movements is expected to still comply with the applicable criteria.

Notwithstanding these findings, SLR recommends the following in relation to patron and vendor car noise sources (excluding deliveries):

- A 10 km/h speed limit is set for on-site traffic.
- The trafficable surface is of a low-squeal compound.
- Metal grates and manhole covers be well fixed to avoid rattling.

6.3 Delivery Truck Noise Emission Predictions

Table 15 lists the predicted noise levels at the nearest noise sensitive receptors for the noise emissions from delivery trucks on site. Contributing sound levels for each component are presented in addition to the overall sum.

Table 15 Delivery Truck Noise Emission Predictions

Noise source	Noise sensitive receptor	Noise source modelled during period?		
		Day (7:00 am – 6:00 pm)	Evening (6:00 pm – 10:00 pm)	Night (10:00 pm – 7:00 am)
		LAeq, dBA		
Delivery Truck	Mindil Beach Casino Resort (3 floors)	28	27	23
	Mylilly Serviced Apartments (8 floors)	29	28	24
	1 Burnett Place, Larrakeyah (2 floors)	31	30	26
Criteria		53 dBA LAeq	50 dBA LAeq	45 dBA LAeq
Compliant?	Mindil Beach Casino Resort (3 floors)	Yes	Yes	Yes
	Mylilly Serviced Apartments (8 floors)	Yes	Yes	Yes
	1 Burnett Place, Larrakeyah (2 floors)	Yes	Yes	Yes

From the predictions summarised in **Table 15**, compliance with the applicable project noise criteria is expected during the daytime (7:00 am to 6:00 pm), evening (6:00 pm to 10:00 pm) and night-time (10:00 pm to 7:00 am) periods for delivery trucks. It should be noted that the above predictions are based on up to ten deliveries during the day/evening period (7am to 10pm) and two deliveries during the night-time (10pm to 7am). Given that compliance is achieved by 19 dBA or more at the NSRs, an increase in the number of delivery trucks is expected to still comply with the applicable criteria.

Notwithstanding these findings, SLR recommends the following in relation to delivery truck noise sources:

- A 10 km/h speed limit is set for on-site traffic.
- The trafficable surface is of a low-squeal compound.
- Metal grates and manhole covers be well fixed to avoid rattling.

6.4 Unloading and Loading Delivery Truck Noise Emission Predictions

Table 16 lists the predicted noise levels at the nearest noise sensitive receptors for the noise emissions from unloading and loading the delivery trucks with a manual pallet jack.

Table 16 Delivery Truck Loading and Unloading Noise Emission Predictions

Noise source	Noise sensitive receptor	Noise source modelled during period?		
		Day (7:00 am – 6:00 pm)	Evening (6:00 pm – 10:00 pm)	Night (10:00 pm – 7:00 am)
		LAeq, dBA		
Pallet jack use	Mindil Beach Casino Resort (3 floors)	39	39	36
	Mylilly Serviced Apartments (8 floors)	38	38	35
	1 Burnett Place, Larrakeyah (2 floors)	37	37	34
Criteria		53 dBA LAeq	50 dBA LAeq	45 dBA LAeq
Compliant?	Mindil Beach Casino Resort (3 floors)	Yes	Yes	Yes
	Mylilly Serviced Apartments (8 floors)	Yes	Yes	Yes
	1 Burnett Place, Larrakeyah (2 floors)	Yes	Yes	Yes

From the predictions summarised in **Table 16**, compliance with the applicable project noise criteria is expected during the daytime (7:00 am to 6:00 pm), evening (6:00 pm to 10:00 pm) and night-time (10:00 pm to 7:00 am) periods for loading activities. It should be noted that the above predictions are based on loading activities occurring for no more than 30 minutes during a 1-hour period in the daytime and evening periods, and no more than 15 minutes during a 1-hour period at night-time. Given that compliance is achieved by 9 dBA or more at the NSRs, an increase in the duration of the loading activities is expected to still comply with the applicable criteria.

6.5 Amplified Music Emissions

Amplified noise emissions have been predicted based on the noise emission items described in **Section 5.2.5**.

6.5.1 Indoor Entertainment Venues

Table 17 and **Table 18** list the predicted noise levels for the indoor entertainment areas at the nearest noise sensitive receptors within the development as these are the driving factor in determining compliance with applicable criteria.

Table 17 Amplified Music Emission Predictions from Indoor Entertainment Venues at Nearest NSRs – Day and Evening Periods

Noise source	Noise sensitive receptor	Noise source modelled during period?	
		Day (7:00 am – 6:00 pm)	Evening (6:00 pm – 10:00 pm)
		LAeq, dBA	
Ground Level Food and Beverage Bar ¹	Internal NSRs		
	Hotel Building (Level 2 – Level 5)	57	
	Foreshore Villas	60	
	Serviced Apartment Buildings (Level 2 – Level 5)	53	
	External NSRs		
	Mindil Beach Casino Resort (3 floors)	40	
	Mylilly Serviced Apartments (8 floors)	20	
	1 Burnett Place, Larrakeyah (2 floors)	17	
Criteria	52 dBA LAeq		

Note 1 – For the purposes of this assessment, a 10 dB noise reduction has been applied to the predictions for the attenuation provided by the building façades.

Table 18 Amplified Music Emission Predictions from Indoor Entertainment Venues at Nearest NSRs – Night-time Period

Noise source	Noise sensitive receptor	Night ¹ (10:00 pm – 7:00 am), LOCT10 dB						
		63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz
Ground Level Food and Beverage Bar	Internal NSRs							
	Hotel Building (Level 2 – Level 5)	34	48	46	51	51	51	49
	Foreshore Villas	36	51	49	54	54	54	52
	Serviced Apartment Buildings (Level 2 – Level 5)	29	43	42	46	46	46	44
	External NSRs							
	Mindil Beach Casino Resort (3 floors)	16	29	29	34	34	33	28
	Mylilly Serviced Apartments (8 floors)	4	15	11	13	10	10	5
	1 Burnett Place, Larrakeyah (2 floors)	1	12	6	9	10	10	6
Criteria		47	39	38	38	39	38	44

Note 1 – For the purposes of this assessment, a 10 dB noise reduction has been applied to the predictions for the attenuation provided by the building façades.

The Ground Level Food and Beverage Bar amplified music noise levels are expected to exceed the recommended project specific assigned noise levels for indoor entertainment venues both the day and evening overall LAeq and the night time LOCT10 octave band noise levels at NSRs within the development. Compliance is predicted at the NSRs external to the development for the day, evening and night-time periods.

In order to mitigate the exceedances at the NSRs within the development, acoustic upgrades could be incorporated to the Ground Level Food and Beverage Bar façades to reduce the breakout noise from amplified music noise levels and achieve compliance with the recommended project specific assigned noise levels for indoor entertainment venues.

It should also be noted that this assessment has applied a conservative 10 dB façade noise reduction to the predictions as the details of the proposed construction methods for this space have not been provided at this stage. A reduction of 20 dB would typically be expected from standard glazing systems with the external windows and doors closed, which would result in compliance within and external to the development.

6.5.2 Outdoor Entertainment Venues

Table 19 lists the predicted noise levels for the outdoor entertainment areas at the nearest noise sensitive receptors within the development as these are the driving factor in determining compliance with applicable criteria.

Table 19 Amplified Emission Predictions from Outdoor Entertainment Venues at Nearest NSRs

Noise source	Noise sensitive receptor	Noise source modelled during period?		
		Day (7:00 am – 6:00 pm)	Night ¹ (10:00 pm – 7:00 am)	
		Evening (6:00 pm – 10:00 pm)		
		LAeq, dBA		
Level 1 Poolside Bar	Internal NSRs			
	Hotel Building (Level 2 – Level 5)			57
	Foreshore Villas			29
	Serviced Apartment Buildings (Level 2 – Level 5)			33
	External NSRs			
	Mindil Beach Casino Resort (3 floors)			20
	Mylilly Serviced Apartments (8 floors)			14
	1 Burnett Place, Larrakeyah (2 floors)			15
Criteria		55 dBA LAeq	37 dBA LAeq	

Note 1 – For the purposes of this assessment, inaudible will be assessed as 10 dB lower than the current background noise.

The Level 1 Poolside Bar amplified music noise levels are predicted to exceed the recommended project specific assigned noise levels at the Hotel Building (Level 2 – Level 5) for the day, evening and night-time periods. It is noted that the Hotel Building NSR is located within the proposed development. Compliance is predicted at all other NSRs within and external to the development for the day, evening and night-time periods.

Potential mitigation measures include reducing the noise source emissions (SWL) of the amplified music by 2 dB to comply with the day and evening periods and by 20 dB to comply with the night time criteria. Alternatively, acoustic upgrades to the façades of the Hotel Building (Level 2 – Level 5) should also be considered to reduce the internal noise levels.

6.6 Patron Noise Emissions

Patron noise emissions have been predicted based on the noise emission items described in **Section 5.2.6**.

6.6.1 Indoor Entertainment Venues

Table 20 and **Table 21** list the predicted noise levels for the indoor entertainment areas at the nearest noise sensitive receptors within the development as these are the driving factor in determining compliance with applicable criteria.

Table 20 Patron Emission Predictions from Indoor Entertainment Venues at Nearest NSRs – Day and Evening Periods

Noise source	Noise sensitive receptor	Noise source modelled during period?	
		Day ¹ (7:00 am – 6:00 pm)	Evening ¹ (6:00 pm – 10:00 pm)
		LAeq, dBA	
Ground Level Food and Beverage Bar (115 Patrons)	Internal NSRs		
	Hotel Building (Level 2 – Level 5)	58	
	Foreshore Villas	61	
	Serviced Apartment Buildings (Level 2 – Level 5)	53	
	External NSRs		
	Mindil Beach Casino Resort (3 floors)	41	
	Mylilly Serviced Apartments (8 floors)	18	
	1 Burnett Place, Larrakeyah (2 floors)	14	
Level 1 All Day Dining Restaurant and Bar (130 Patrons)	Internal NSRs		
	Hotel Building (Level 2 – Level 5)	40	
	Foreshore Villas	20	
	Serviced Apartment Buildings (Level 2 – Level 5)	21	
	External NSRs		
	Mindil Beach Casino Resort (3 floors)	23	
	Mylilly Serviced Apartments (8 floors)	19	
	1 Burnett Place, Larrakeyah (2 floors)	19	
Criteria		52 dBA LAeq	

Note 1 – For the purposes of this assessment, a 10 dB noise reduction has been applied to the predictions for the attenuation provided by the building façades.

Table 21 Patron Music Emission Predictions from Indoor Entertainment Venues at Nearest NSRs – Night-time Period

Noise source	Noise sensitive receptor	Night ¹ (10:00 pm – 7:00 am), LOCT10 dB						
		63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz
Ground Level Food and Beverage Bar ¹ (115 Patrons)	Internal NSRs							
	Hotel Building (Level 2 – Level 5)	15	31	45	54	54	49	43
	Foreshore Villas	18	35	48	58	57	52	46
	Serviced Apartment Buildings (Level 2 – Level 5)	11	27	40	50	49	44	38

Noise source	Noise sensitive receptor	Night ¹ (10:00 pm – 7:00 am), LOCT10 dB						
		63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz
	External NSRs							
	Mindil Beach Casino Resort (3 floors)	-3	13	28	38	36	31	23
	Mylilly Serviced Apartments (8 floors)	-16	-2	9	15	12	3	-2
	1 Burnett Place, Larrakeyah (2 floors)	-20	-7	3	10	10	5	-2
Level 1 All Day Dining Restaurant and Bar (130 Patrons)	Internal NSRs							
	Hotel Building (Level 2 – Level 5)	5	19	30	37	33	37	21
	Foreshore Villas	-23	-7	7	16	15	10	3
	Serviced Apartment Buildings (Level 2 – Level 5)	-21	-5	8	17	16	11	5
	External NSRs							
	Mindil Beach Casino Resort (3 floors)	-17	-3	10	20	18	13	6
	Mylilly Serviced Apartments (8 floors)	-21	-6	6	15	15	9	1
	1 Burnett Place, Larrakeyah (2 floors)	-20	-7	6	15	14	9	2
Criteria		47	39	38	38	39	38	44

Note 1 – For the purposes of this assessment, a 10 dB noise reduction has been applied to the predictions for the attenuation provided by the building façades.

The predicted patron noise levels from the Level 1 All Day Dining Restaurant and Bar are expected to be compliant with the recommended project specific assigned noise levels for indoor entertainment venues both the day and evening overall LAeq and the night time LOCT10 octave band noise levels at the nearest sensitive receptors within and external to the development.

The Ground Level Food and Beverage Bar patron noise levels are expected to exceed the recommended project specific noise criteria for indoor entertainment venues during both the day and evening periods (as an overall LAeq noise level) and also the night-time period (as an LOCT10 octave band noise level) within the development. Compliance is predicted at the NSRs external to the development for the day, evening and night-time periods.

In order to mitigate the exceedances at the NSRs within the development, acoustic upgrades could be incorporated to the Ground Level Food and Beverage Bar façades to reduce the patron noise levels and achieve compliance with the recommended project specific assigned noise levels for indoor entertainment venues.

It should also be noted that this assessment has applied a conservative 10 dB façade noise reduction to the predictions as the details of the proposed construction methods for this space have not been provided at this stage. A reduction of 20 dBA would typically be expected from standard glazing systems with the external windows and doors closed.

6.6.2 Outdoor Entertainment Venues

Table 20 lists the predicted noise levels for the outdoor entertainment areas at the nearest noise sensitive receptors within the development.

Table 22 Patron Emission Predictions from Outdoor Entertainment Venues at Nearest NSRs

Noise source	Noise sensitive receptor	Noise source modelled during period?	
		Day (7:00 am – 6:00 pm)	Night ¹ (10:00 pm – 7:00 am)
		Evening (6:00 pm – 10:00 pm)	
		LAeq, dBA	
Ground Level Communal Market Area (150 Patrons)	Internal NSRs		
	Hotel Building (Level 2 – Level 5)	55	-
	Foreshore Villas	36	-
	Serviced Apartment Buildings (Level 2 – Level 5)	46	-
	External NSRs		
	Mindil Beach Casino Resort (3 floors)	27	-
	Mylilly Serviced Apartments (8 floors)	19	-
	1 Burnett Place, Larrakeyah (2 floors)	19	-
Level 1 Poolside Bar (180 Patrons)	Internal NSRs		
	Hotel Building (Level 2 – Level 5)	61	
	Foreshore Villas	51	
	Serviced Apartment Buildings (Level 2 – Level 5)	51	
	External NSRs		
	Mindil Beach Casino Resort (3 floors)	50	
	Mylilly Serviced Apartments (8 floors)	31	
	1 Burnett Place, Larrakeyah (2 floors)	37	
Criteria		55 dBA LAeq	37 dBA LAeq

Note 1 – For the purposes of this assessment, inaudible will be assessed as 10 dB lower than the current background noise.

The predicted patron noise levels from the Ground Level Communal Market Area are expected to be compliant with the recommended project specific noise criteria for outdoor entertainment venues for the day, evening and night-time periods at the nearest sensitive receptors within and external to the development.

The Level 1 Poolside Bar patron noise is predicted to exceed the recommended project specific assigned noise levels for outdoor entertainment venues for the day, evening and night-time periods at the nearest sensitive receptors within the development. For the external NSRs, the Level 1 Poolside Bar predicted patron levels are expected to exceed the night-time limit at Mindil Beach Casino Resort.

Potential mitigation measures include limiting the total number of patrons that can be accommodated during the daytime and evening time to 80 patrons and not operating during the night time period. Alternatively, acoustic upgrades to the façades of the affected NSRs within the development should also be considered to reduce the internal noise levels.

7 Noise Management Plan

A noise management plan has been developed and the following measures are applicable to the overall development:

- Mechanical plant:
 - Achieve no direct line of sight between major plant items and the nearest noise sensitive receivers.
 - If the overall sound power level of the mechanical plant exceeds 80 dBA for each building, acoustic treatment may be required. Acoustic screens would typically need to be at least 800mm taller than the top of the plant and be provided with an internal absorptive face.
 - Prior to completion of the project it will be the mechanical contractor's responsibility to submit confirmation that noise emissions from the installed plant comply with the noise limits listed in **Table 3** of this report. Acoustic testing shall be undertaken over a sufficiently representative period, we expect that 15 minutes during both day and night periods would be sufficient for continuous noises. Testing and reporting shall be undertaken by a suitably qualified acoustic consultant such as a member firm of the Association of Australian Acoustic Consultants or Member of the Australian Acoustical Society.
- Car and delivery truck noise emissions:
 - A 10 km/h speed limit is set for on-site traffic.
 - The trafficable surface is of a low-squeal compound.
 - Metal grates and manhole covers be well fixed to avoid rattling.
- Amplified music emissions:
 - Acoustic upgrades could be incorporated to the Ground Level Food and Beverage Bar façades to reduce the breakout noise.
 - Level 1 Poolside Bar - Reduce the noise source emissions (SWL) of the amplified music in **Table 11** by 2 dB to comply with the day and evening periods and by 20 dB to comply with the night time criteria. Alternatively, acoustic upgrades to the façades of the Hotel Building (Level 2 – Level 5) should also be considered to reduce the internal noise levels.

- Patron noise emissions:
 - Acoustic upgrades could be incorporated to the Ground Level Food and Beverage Bar façades to reduce the breakout noise.
 - Level 1 Poolside Bar - Limit the total number of patrons that can be accommodated during the daytime and evening time to 80 patrons and not operate during the night-time period. Alternatively, acoustic upgrades to the façades of the affected NSRs within the development (Hotel Building (Level 2 – Level 5, Foreshore Apartments and Serviced Apartment Buildings (Level 2 – Level 5)) should also be considered to reduce the internal noise levels.

The following are also applicable to entertainment noise emissions within the development:

- Adhering to RSA principles thus reducing the likelihood of patrons causing noise and participating in other anti-social activities.
- Not allowing violent, quarrelsome or disruptive conduct on or near the premises.
- Music and entertainment will be appropriate for the venue and manner of trade.
- Acoustic monitoring by the use of a sound level meter to take regular sound measurements from reference points both inside and outside the premises during periods of amplified music or high patronage.
- Following monitoring the applicant will ensure that all reasonable and practicable measures are taken to minimise the overall sound level and low frequency noise at noise-affected premises.
- The applicant will then maintain a record of these measurements in a 'noise diary'.
- All musicians and entertainment providers will be advised regarding sound management practices.
- A communication plan that includes notifying neighbours and authorities for all functions and events that include live music (if any).
- Maintain a complaint register and train staff in the use and handling of complaints.
- Staff closing procedures designed to minimise the risk of noise or disturbance being caused to residents.
- Minimising operational noise in considering local residents when disposing of rubbish and recycled material.
- Appropriate signage requesting patrons be mindful of the neighbourhood in leaving the premises and area quietly.
- Adequate security and lighting in external areas, to discourage loitering when patrons leave the premises.
- Anticipating the need for transport for functions and events at the premises.

8 Conclusion

SLR Consulting Australia Pty Ltd (SLR) has assessed noise impacts associated with the proposed hotel development at 25 Gilruth Avenue, The Gardens in Darwin (Little Mindil).

This noise impact assessment was conducted with reference to Australian Standard AS 1055:2018 *Description and Measurement of Environmental Noise* and in accordance with the *Northern Territory Planning Scheme*.

Potential noise sources that were identified in our assessment were vehicle movements including car park activities, deliveries and the associated loading activities, mechanical plant, patron and entertainment noise.

The findings of the study are that the noise objectives for vehicle movements including car park activities, deliveries and the associated loading activities, mechanical plant are predicted to be achieved during day, evening and night-time periods. Non-compliance is predicted during the day, evening and night-time periods for patron and amplified noise emissions from the Ground Level Food and Beverage Bar and the Level 1 Poolside Bar at the following noise sensitive receptors within the development:

- Hotel Building – Levels 2 to 5.
- Foreshore Villas.
- Serviced Apartment Building - Levels 2 to 5.

For the external NSRs, the Level 1 Poolside Bar predicted patron levels are expected to exceed the night-time limit at Mindil Beach Casino Resort.

Noise mitigation recommendations for consideration include reducing the maximum allowable patrons, acoustic upgrades to the affected NSR and venue façades within the development and limiting the operating hours of the premises in question to day and evening periods, such as the Level 1 Poolside Bar.

Consequently, this noise impact assessment has determined that, with implementation of the noise management and mitigation recommendations in this report, no detrimental impact to the amenity of existing surrounding residential receptors or general amenity of the surrounding area would be expected as a result of the proposed hotel development.

APPENDIX A

Acoustic Terminology

1. Sound Level or Noise Level

The terms ‘sound’ and ‘noise’ are almost interchangeable, except that ‘noise’ often refers to unwanted sound.

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

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

2. ‘A’ Weighted Sound Pressure Level

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

People’s hearing is most sensitive to sounds at mid frequencies (500 Hz to 4,000 Hz), and less sensitive at lower and higher frequencies. Different sources having the same dBA level generally sound about equally loud.

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

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

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

3. Sound Power Level

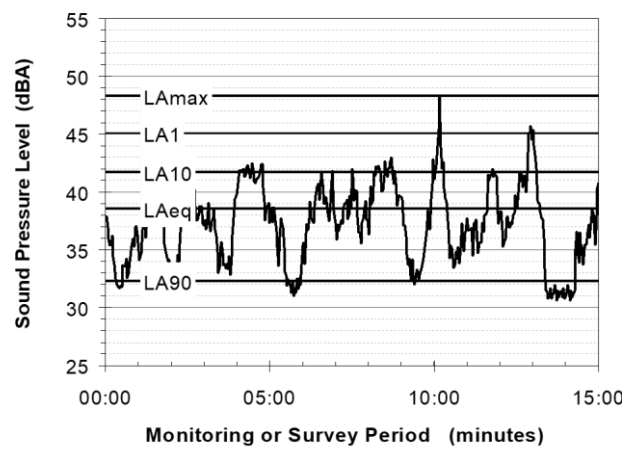
The Sound Power of a source is the rate at which it emits acoustic energy. As with Sound Pressure Levels, Sound Power Levels are expressed in decibel units (dB or dBA), but may be identified by the symbols SWL or LW, or by the reference unit 10^{-12} W.

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

4. Statistical Noise Levels

Sounds that vary in level over time, such as road traffic noise and most community noise, are commonly described in terms of the statistical exceedance levels LAN, where LAN is the A-weighted sound pressure level exceeded for N% of a given measurement period. For example, the LA1 is the noise level exceeded for 1% of the time, LA10 the noise exceeded for 10% of the time, and so on.

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



Of particular relevance, are:

- LA1 The noise level exceeded for 1% of the 15 minute interval.
- LA10 The noise level exceeded for 10% of the 15 minute interval. This is commonly referred to as the average maximum noise level.
- LA90 The noise level exceeded for 90% of the sample period. This noise level is described as the average minimum background sound level (in the absence of the source under consideration), or simply the background level.
- LAeq The A-weighted equivalent noise level (basically, the average noise level). It is defined as the steady sound level that contains the same amount of acoustical energy as the corresponding time-varying sound.

5. Frequency Analysis

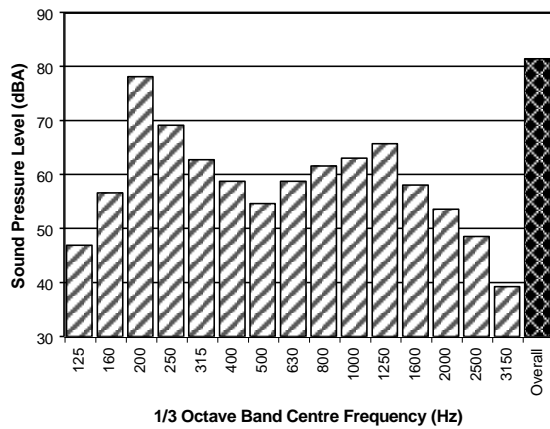
Frequency analysis is the process used to examine the tones (or frequency components) which make up the overall noise or vibration signal.

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

Frequency analysis can be in:

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

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



6. Annoying Noise (Special Audible Characteristics)

A louder noise will generally be more annoying to nearby receivers than a quieter one. However, noise is often also found to be more annoying and result in larger impacts where the following characteristics are apparent:

- **Tonality** - tonal noise contains one or more prominent tones (ie differences in distinct frequency components between adjoining octave or 1/3 octave bands), and is normally regarded as more annoying than 'broad band' noise.
- **Impulsiveness** - an impulsive noise is characterised by one or more short sharp peaks in the time domain, such as occurs during hammering.
- **Intermittency** - intermittent noise varies in level with the change in level being clearly audible. An example would include mechanical plant cycling on and off.
- **Low Frequency Noise** - low frequency noise contains significant energy in the lower frequency bands, which are typically taken to be in the 10 to 160 Hz region.

7. Vibration

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

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

Vibration measurements may be carried out in a single axis or alternatively as triaxial measurements (ie vertical, longitudinal and transverse).

The common units for velocity are millimetres per second (mm/s). As with noise, decibel units can also be used, in which case the reference level should always be stated. A vibration level V , expressed in mm/s can be converted to decibels by the formula $20 \log (V/V_0)$, where V_0 is the reference level (10⁻⁹ m/s). Care is required in this regard, as other reference levels may be used.

8. Human Perception of Vibration

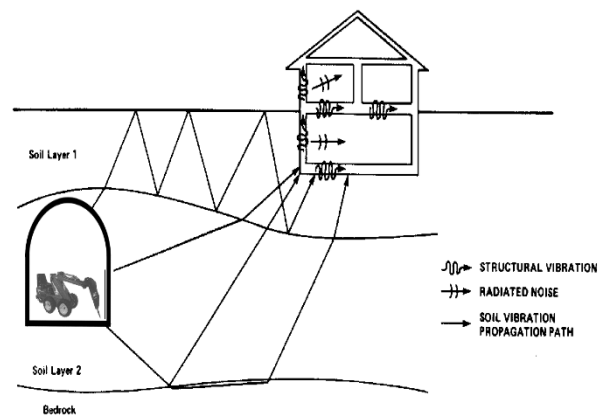
People are able to 'feel' vibration at levels lower than those required to cause even superficial damage to the most susceptible classes of building (even though they may not be disturbed by the motion). An individual's perception of motion or response to vibration depends very strongly on previous experience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

9. Ground-borne Noise, Structure-borne Noise and Regenerated Noise

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

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

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

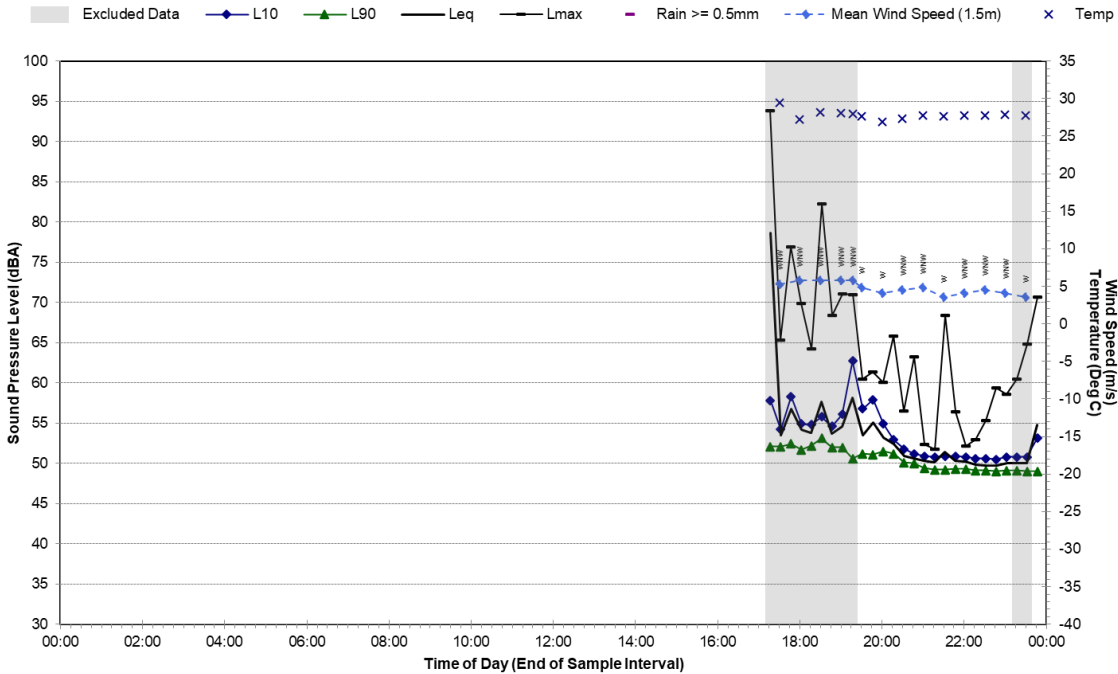


The term 'regenerated noise' is also used in other instances where energy is converted to noise away from the primary source. One example would be a fan blowing air through a discharge grill. The fan is the energy source and primary noise source. Additional noise may be created by the aerodynamic effect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

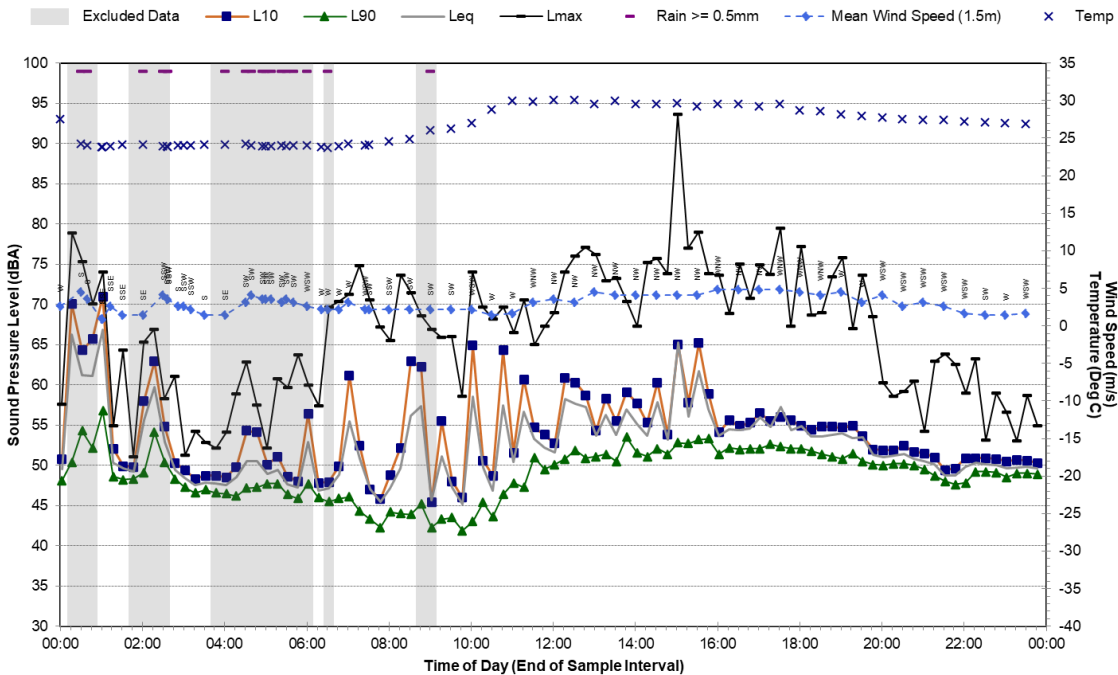
APPENDIX B

Noise Logging Charts

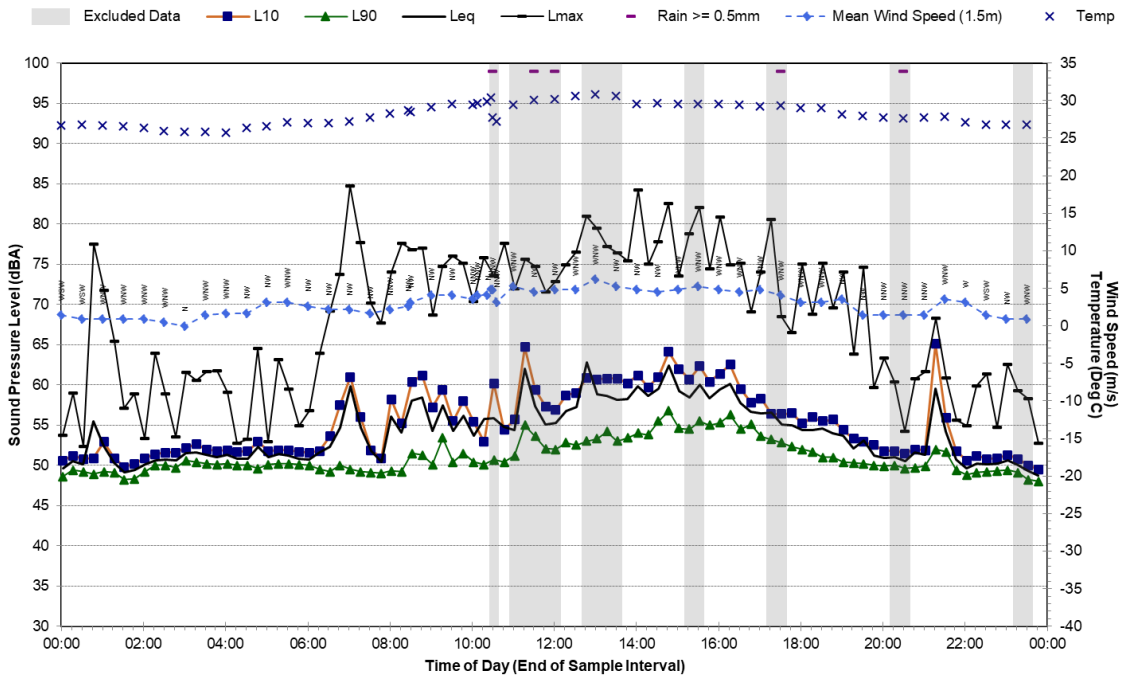
Statistical Ambient Noise Levels Location One - SVAN 957 SN 20644 - Monday, 8 February 2021



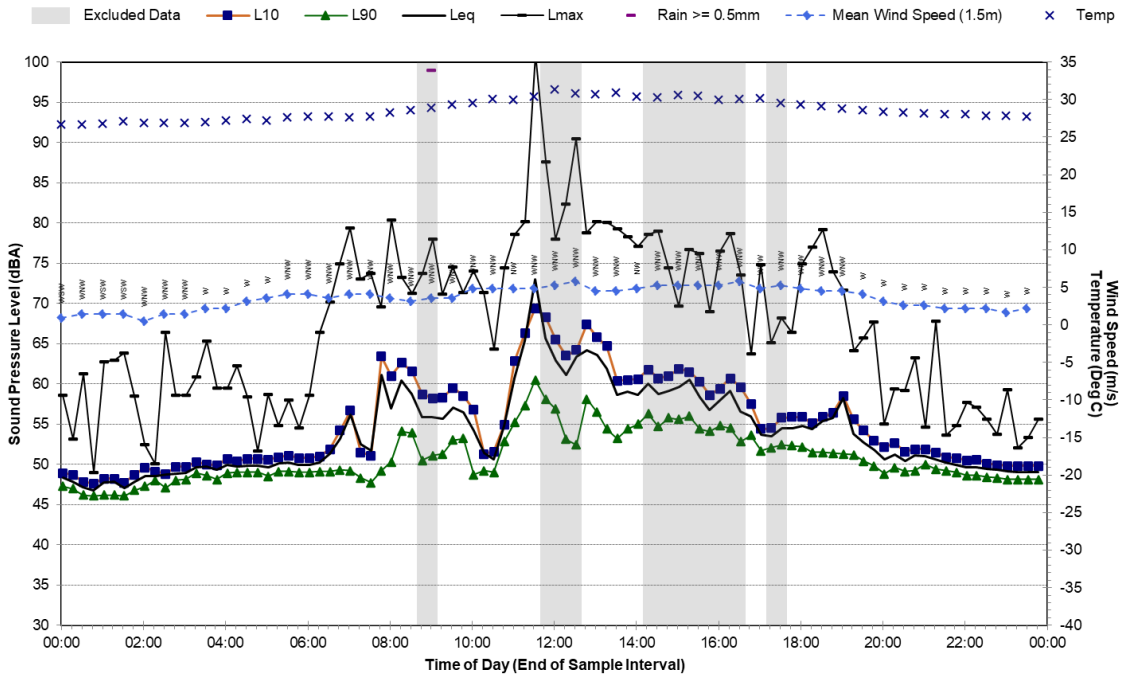
Statistical Ambient Noise Levels Location One - SVAN 957 SN 20644 - Tuesday, 9 February 2021



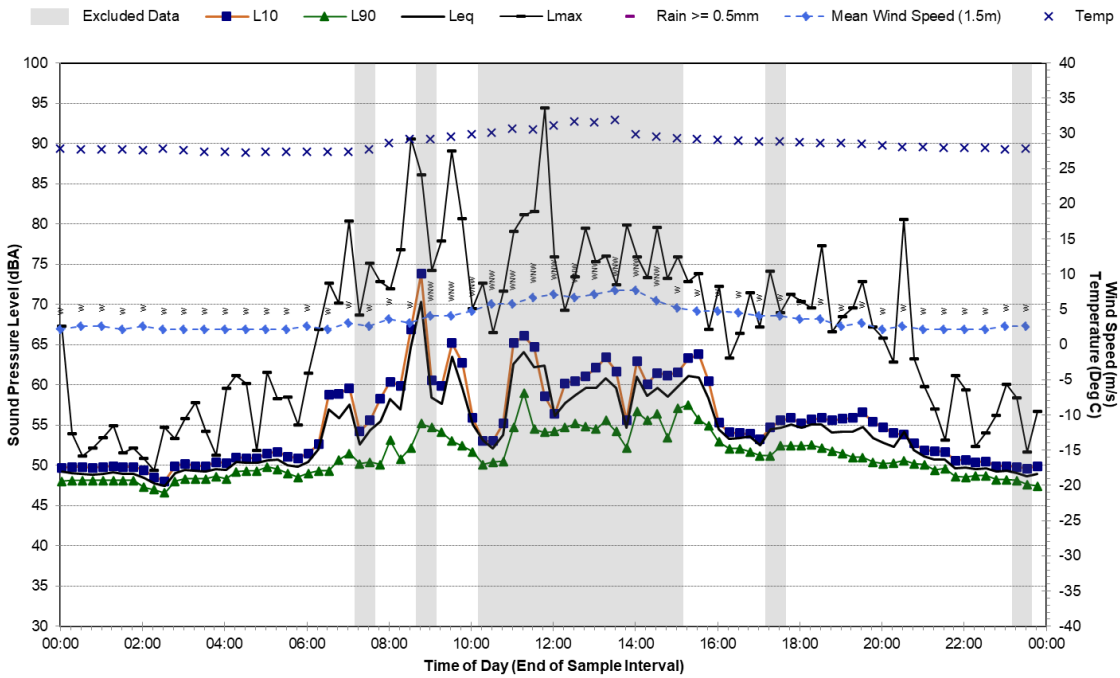
Statistical Ambient Noise Levels Location One - SVAN 957 SN 20644 - Wednesday, 10 February 2021



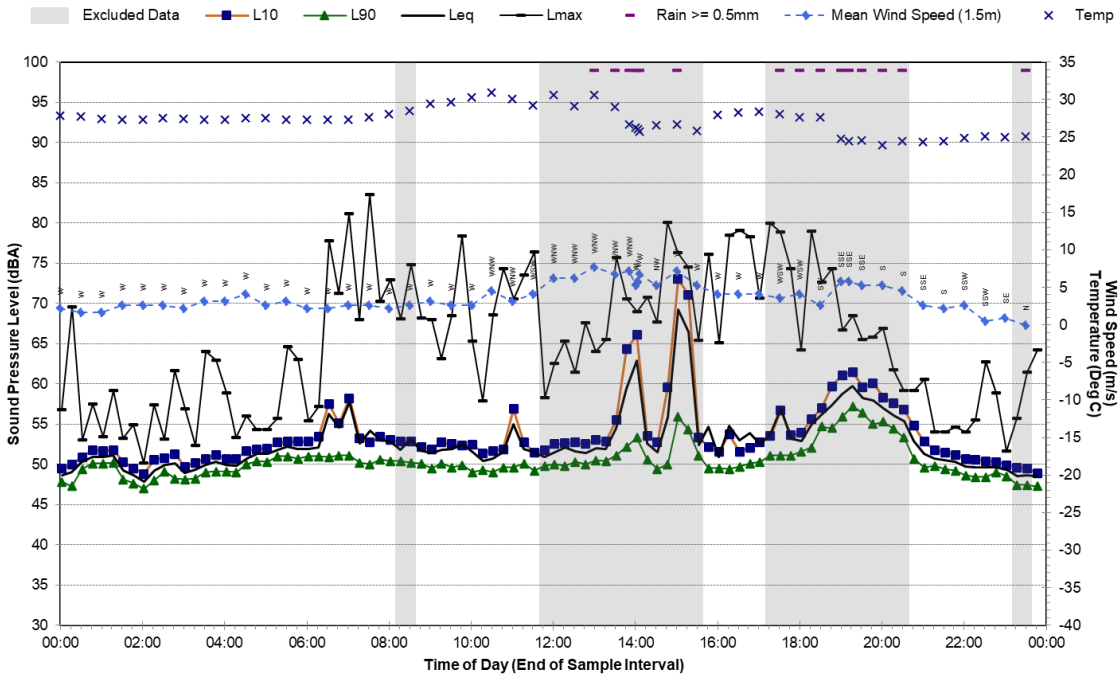
Statistical Ambient Noise Levels Location One - SVAN 957 SN 20644 - Thursday, 11 February 2021



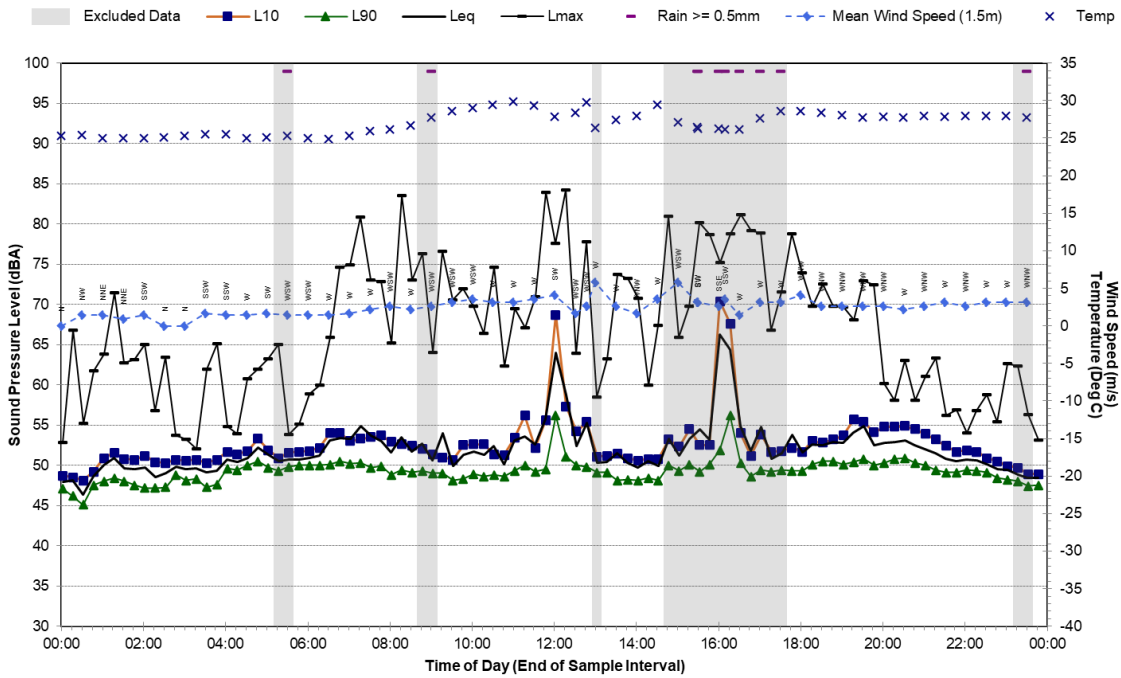
Statistical Ambient Noise Levels Location One - SVAN 957 SN 20644 - Friday, 12 February 2021



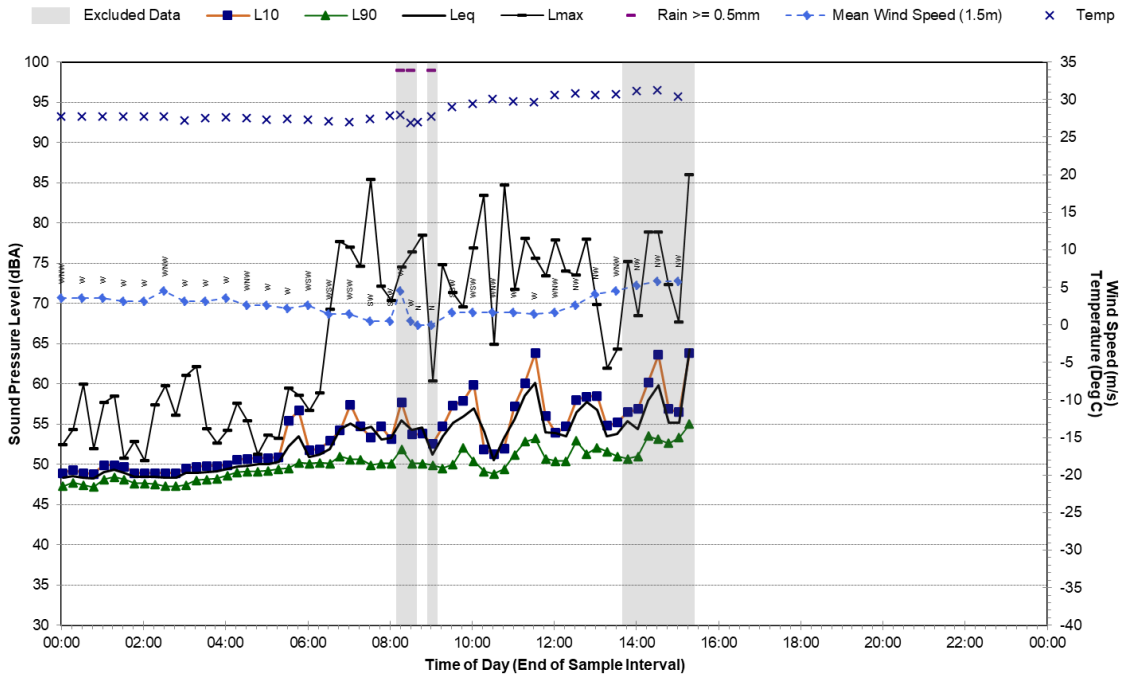
Statistical Ambient Noise Levels Location One - SVAN 957 SN 20644 - Saturday, 13 February 2021



Statistical Ambient Noise Levels Location One - SVAN 957 SN 20644 - Sunday, 14 February 2021

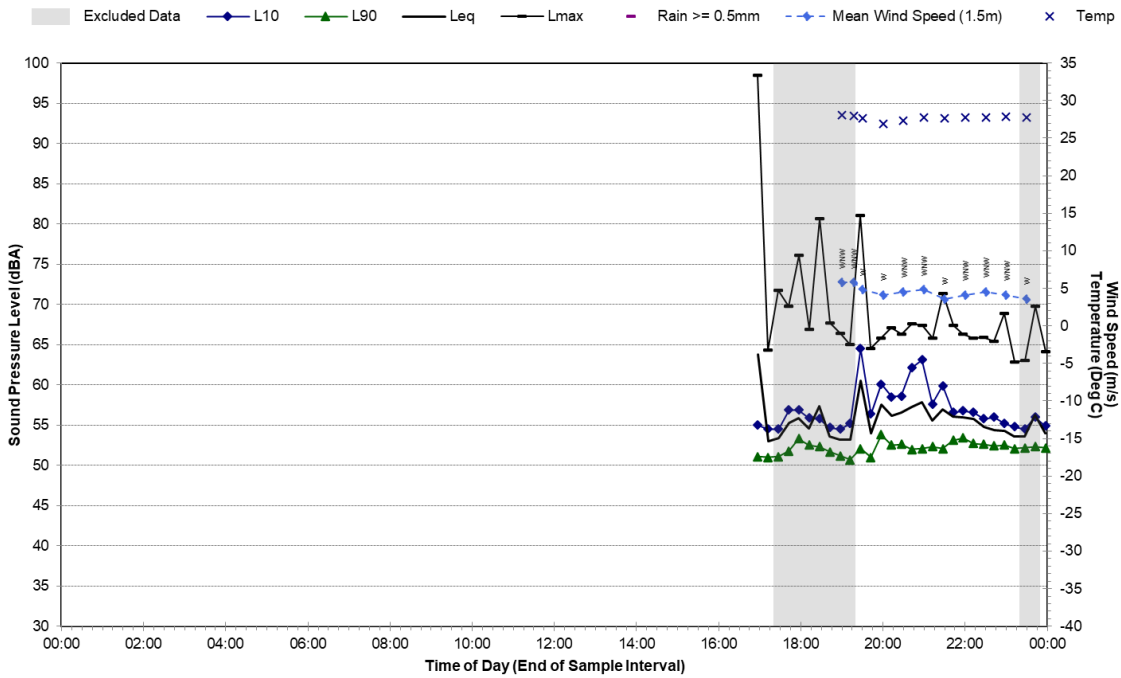


Statistical Ambient Noise Levels Location One - SVAN 957 SN 20644 - Monday, 15 February 2021



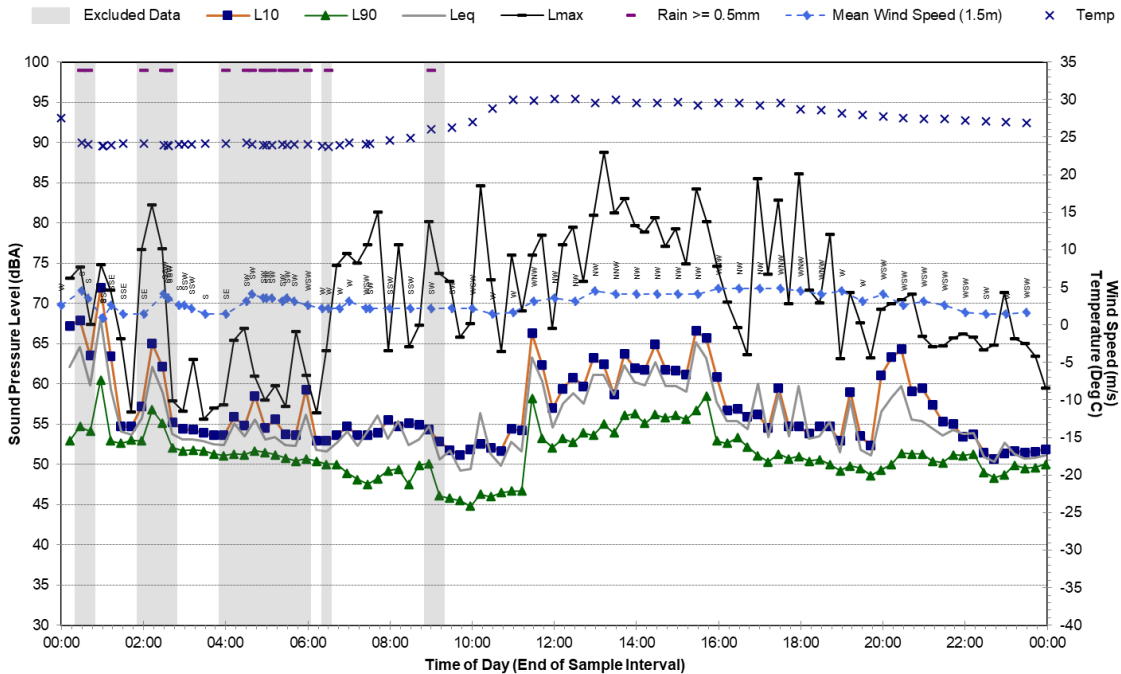
Statistical Ambient Noise Levels

Location Two - SVAN 957 SN 21884 - Monday, 8 February 2021

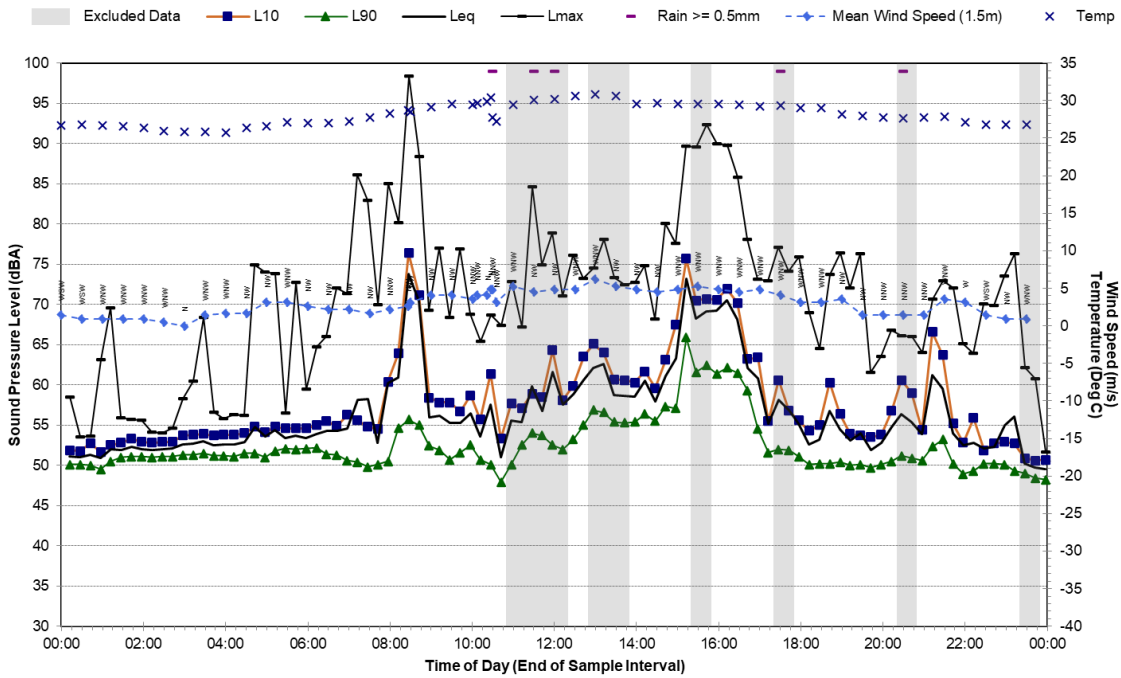


Statistical Ambient Noise Levels

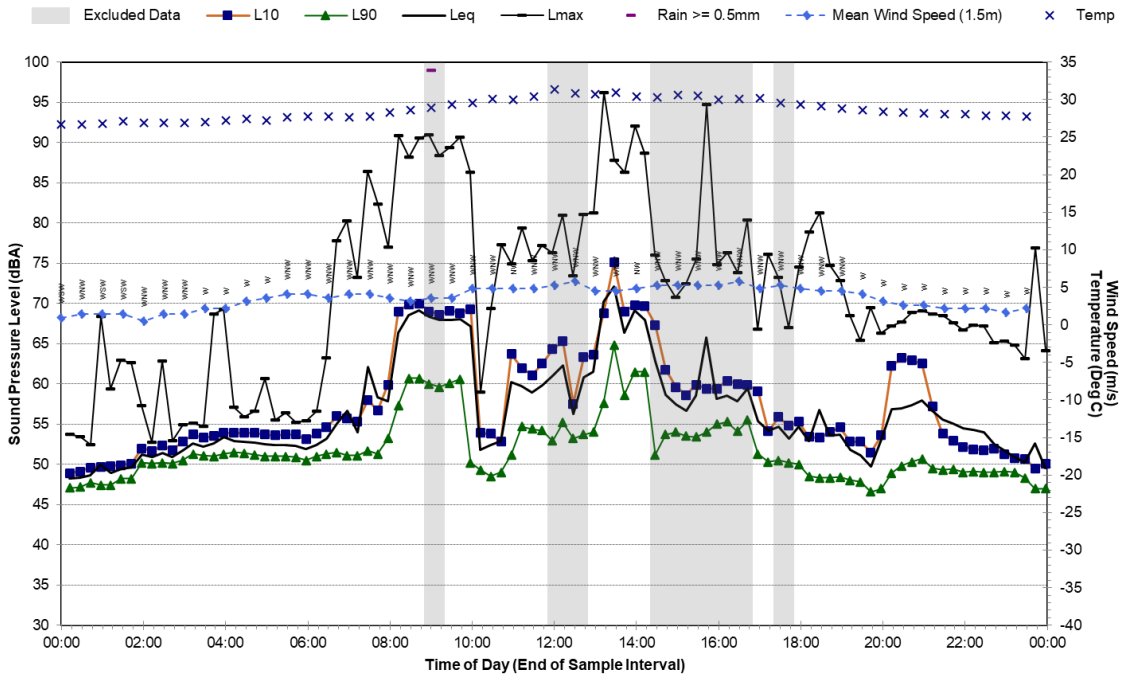
Location Two - SVAN 957 SN 21885 - Tuesday, 9 February 2021



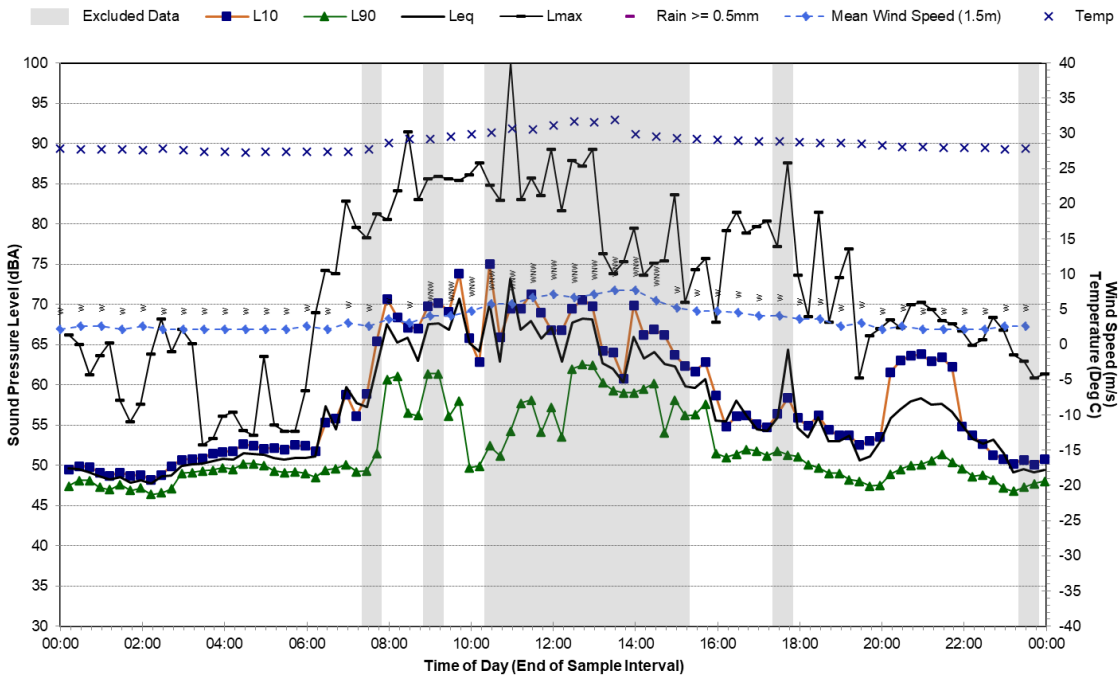
Statistical Ambient Noise Levels Location Two - SVAN 957 SN 21886 - Wednesday, 10 February 2021



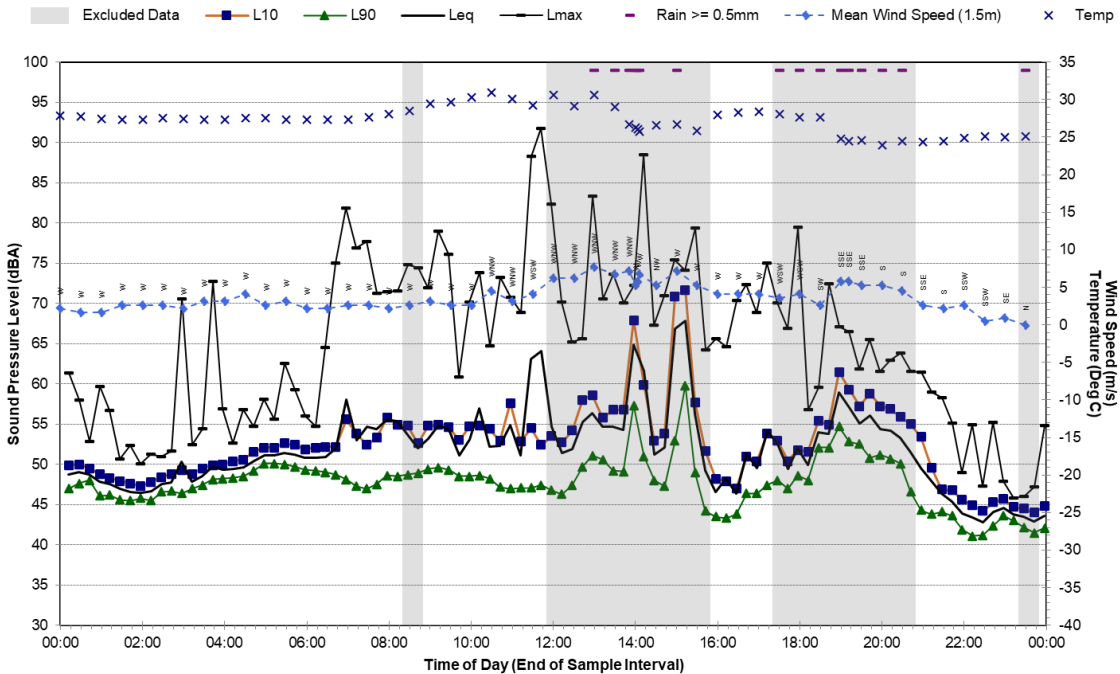
Statistical Ambient Noise Levels Location Two - SVAN 957 SN 21887 - Thursday, 11 February 2021



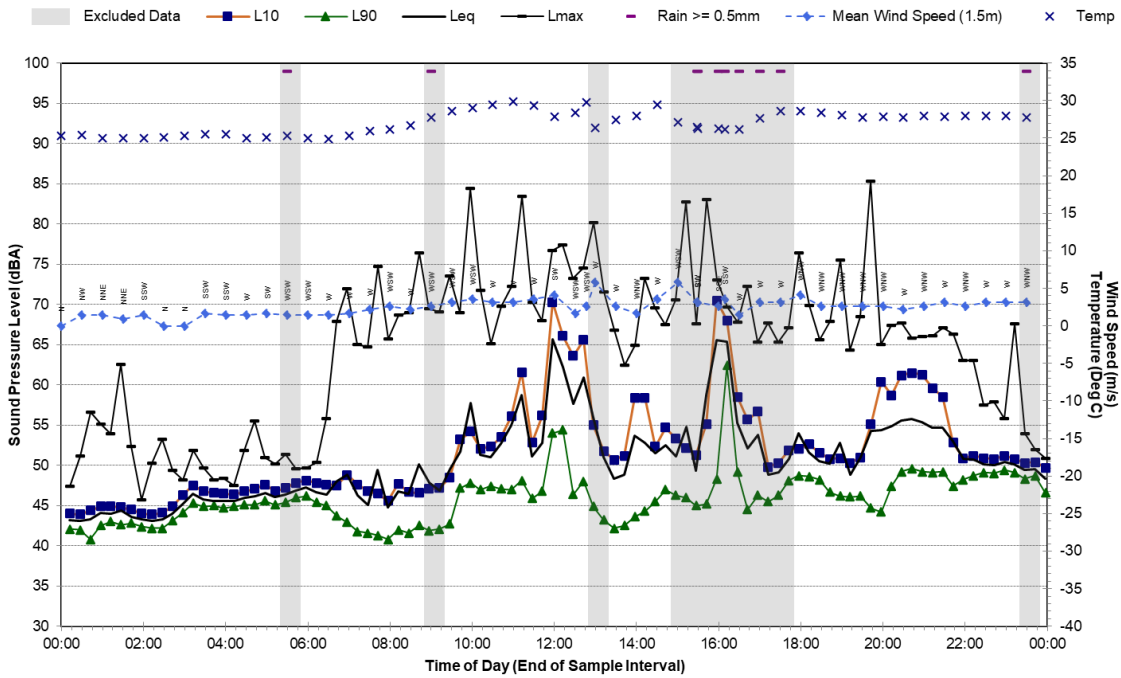
Statistical Ambient Noise Levels Location Two - SVAN 957 SN 21888 - Friday, 12 February 2021



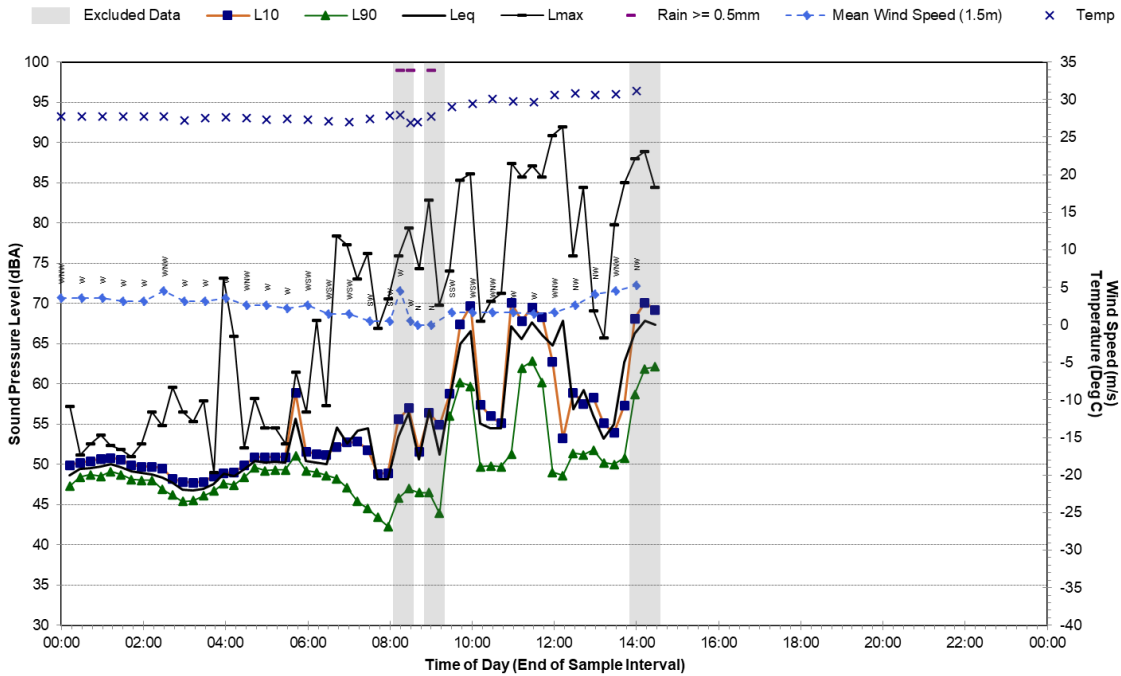
Statistical Ambient Noise Levels Location Two - SVAN 957 SN 21889 - Saturday, 13 February 2021



Statistical Ambient Noise Levels Location Two - SVAN 957 SN 21890 - Sunday, 14 February 2021



Statistical Ambient Noise Levels Location Two - SVAN 957 SN 21891 - Monday, 15 February 2021



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