CONSTRUCTION NOISE AND VIBRATION MANAGEMENT PLAN (PRELIMINARY)

6-18 Gosford Gateway, Watt Street, Gosford

ID: 11778 R01 vB

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1.0 INTRODUCTION

PKA Acoustic Consulting have been commissioned by Jarre P/L to submit a Construction Noise & Vibration Management Plan to assess the potential noise and vibration impact from the proposed construction work for the development at 6-18 Watt Street, Gosford. The proposed development consists of three mixed use towers and a public plaza.

This report has been prepared as part of a feasibility study to ensure compliance with Construction Noise and Vibration guidlelines.

To analyse and minimise construction noise and vibration impact the EPA's *Interim Guidelines on Construction Noise* will be applied. References will also be made to AS 2436 Guide to noise and vibration control on construction, demolition and maintenance sites.

The goal of this assessment is to:

- Present the noise criteria for the construction stages of the development.

- Undertake a general noise and vibration analysis of the impacts to the affected receivers and to provide recommendations to reduce such impacts.

Noise levels of the plant items have been taken from Australian Standard AS2436:2010.

2.0 SUMMARY

Indicative plant and machinery noise emissions using published sound power levels were used to assess the noise levels at the nearest and most affected receivers and to determine compliance with the nominated noise criteria. It was found that for some processes the adjacent buildings will be exposed to noise levels below or equal to the EPA "*Noise Affected Level*" and "*Highly Noise Affected Level*" and in some cases, exceed the limits. Details on noise impact mitigation strategies have been presented.

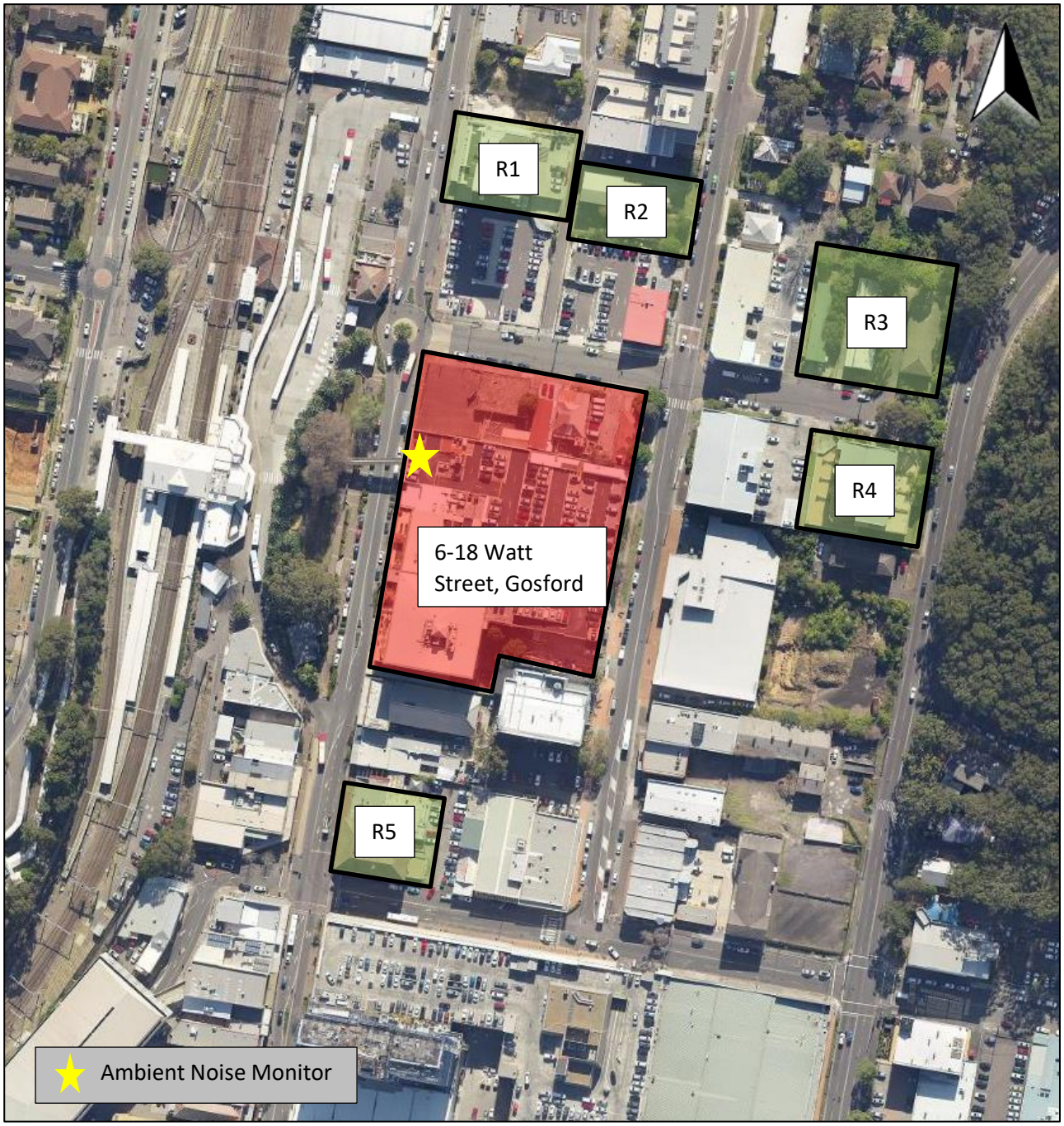
Induced ground vibrations from typical construction machinery have been estimated at the nearest and most affected receivers to determine compliance with the nominated vibration criteria. The assessment results are presented in the report. To reduce the vibration impacts, a series of mitigation measure are recommended. Details on vibration impact mitigation strategies have also been presented.

3.0 SITE DESCRIPTION

3.1 Site Overview

The proposed development is located at 6-18 Watt Street, Gosford. The site is bounded by Fuance Street to the north, Mann Street to the west, Watt Street to the east and other commercial buildings to the south. The site location is shown in Figure 3-1.

Figure 3-1 Site Location



3.2 Site Plan

Figure 3-2 Proposed Development

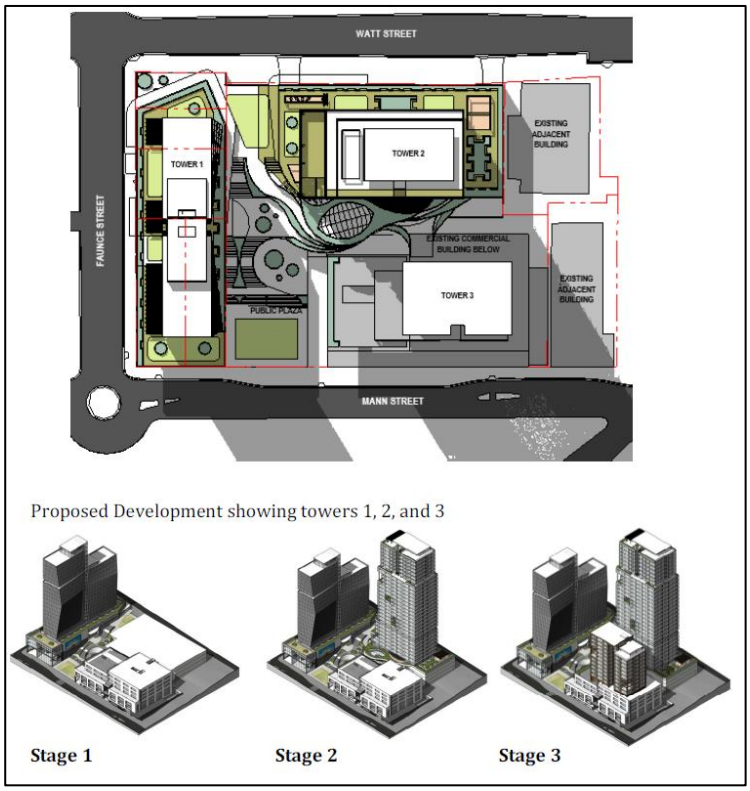
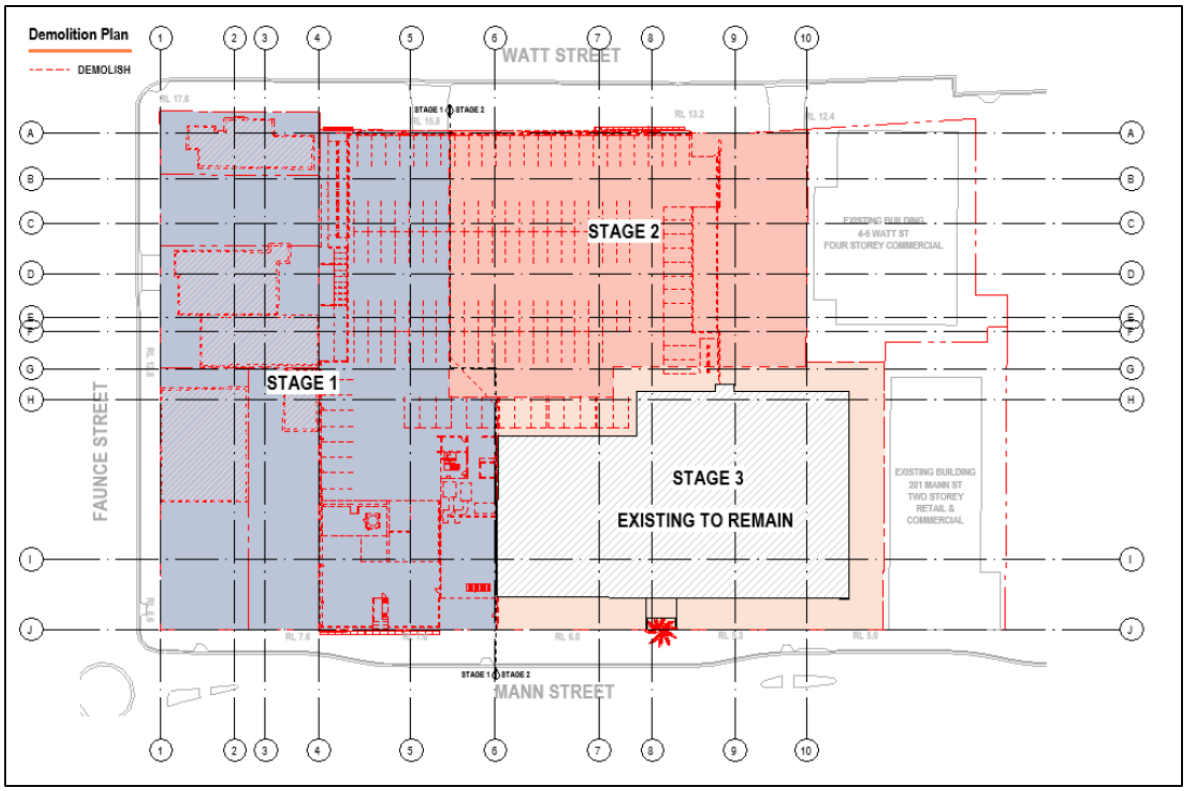


Figure 3-3 Demolition Plan



3.3 Residential Receivers

Residential Receiver 1 (R1) – 273 Mann Street, Gosford is located to the north of the proposed development. The multistorey residential building is approximately 70 metres from the site. R1 will have direct line of sight of the stage 1 demolition process.

Residential Receiver 2 (R2) – 24 Watt Street, Gosford is located to the north of the proposed development. The single story residential building is approximately 90 metres from the site. R2 will have direct line of sight of the stage 1 demolition process.

Residential Receiver 3 (R3) – 140-144 Faunce Street, Gosford is located to the north-east of the proposed development. These residential buildings are approximately 80 metres from the site. R3 will have direct line of sight of the stage 1 demolition process.

Residential Receiver 4 (R4) – 145 Faunce Street, Gosford is located to the east of the proposed development. The multi-storey residential building is approximately 55 metres from the site. R4 will have direct line of sight of the stage 1 demolition process.

Residential Receiver 5 (R5) – Gosford Hotel, Mann St &, Erina St E, Gosford is located to the south of the proposed development. The two-storey Hotel is approximately 55 metres from the site.

4.0 NOISE CRITERIA

4.1 SEAR's Requirements

The Planning Secretary's Environmental Assessment Requirements (Application No: SSD-10414) dated 17/01/2020 requires the following assessment prior to the commencement of the construction works.

15 Noise and Vibration

- *Prepare a noise and vibration assessment in accordance with the relevant EPA guidelines. This assessment must detail construction and operational noise impacts on nearby sensitive receivers and outline the proposed management and outline how construction impacts would be appropriately managed and mitigated.*
- *Demonstrate how public safety will be maintained during construction and operation, including any public safety measures that will be implemented.*

4.2 Road Noise Policy

To assess the vehicular noise impact of the construction activities upon the surrounding environment, we refer to the criterion defined by the *NSW Road Noise Policy* (RNP).

Table 4-1 presents the noise assessment criteria by the RNP for land use developments with potential to create additional traffic on existing roads.

Table 4-1: Road Traffic Criteria for Residential Land Use

Road category	Type of project/land use	Assessment criteria, dB(A)	
		Day: 7am-10 pm	Night: 10pm – 7 am
Local roads	Existing residences affected by additional traffic on existing local roads generated by land use development	$L_{eq\ (1\ hr)}$ 55 (external)	$L_{eq\ (1\ hr)}$ 50 (external)

In cases noise exceeds the above criteria:

- The RNP recommends that "where feasible, existing noise levels should be mitigated to meet the noise criteria. In this regard, the RNP states that for existing roads there is limited potential for noise control as the development is not linked to road improvements. It does however advise that applicable strategies include appropriate location of private access roads, regulating times of use, using clustering, using quiet vehicles, and using barriers and acoustic treatments".

- For existing residences and other sensitive land uses affected by additional traffic on existing roads generated by land use development, any increase in total traffic noise level should be limited to 2 dB exceedance.

4.3 EPA NSW Interim Construction Noise Guidelines (ICNG)

NSW EPA Interim Construction Noise Guideline (ICNG) is used for the assessment.

The document aims at managing noise from construction works regulated by the EPA. Details of noise limits are presented in the following Table 4-2.

Table 4-2: Noise Levels Residential Receivers (Extract from EPA ICNG)

Time of day	Management level $L_{Aeq\ (15\ min)}$	Application
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 $L_{Aeq\ (15\ min)}$ is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level. The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.
	Highly noise affected 75 dB	The highly noise affected level represents the point above which there may be strong community reaction to noise. Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account times identified by the community when they are less sensitive to noise (such as before and after school for works near schools, or mid-morning or mid-afternoon for works near residences if the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
Outside recommended standard hours	Noise affected RBL + 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.

4.4 General vibration criteria

During demolition and excavation there is the potential for vibration impact on the neighbouring buildings' amenity and on structures. The EPA ICNG states that human comfort (amenity) vibration is to be measured and assessed in accordance with *Assessing Vibration – a technical guideline* (DECC 2006).

In general, structural damage due to vibration can be of concern when hammering, blasting, vibration rolling, crushing, piling and other vibration inducing construction works are carried out.

The EPA ICNG does not have specific structural vibration damage criteria however the RTA *Environmental Noise Management Manual* (2001) recommends the use of the following Standards:

- British Standard BS 7385: Part 2: *Evaluation and Measurement for Vibrations in Buildings – Part 2 Guide to Damage Levels from Ground-Borne Vibration*
- AS 2187.2 *Explosives-Storage, transport and use, Part 2: Use of Explosives*
- German Standard DIN 4150, Part 3: *Structural Vibration in Buildings: Effects on Structures*

Structural Damage Vibration Criteria

Guidance for the vibration structural damage are adopted from the German Standard *DIN 4150, Part 3: Structural Vibration in Buildings: Effects on Structures.* The main criteria are based on the absolute value or magnitude of the peak body (X, Y or Z) component velocity at the foundation or on the planar axes (X, Y) for the top floor and are presented in Table 4-3. All tabulated vibration levels for structural considerations are given in terms of the Peak Particle Velocity (PPV).

Table 4-3: DIN 4150-3 Vibration Criteria

Building Type		Vibration at Foundation Level (PPV)				Top Floor Horizontal Vibration
		<10 Hz	10-50 Hz	50-100 Hz	>100 Hz	All Freq
1	Buildings used in commercial purposes, industrial buildings and buildings of similar design	20 mm/s	20-40 mm/s	40-50 mm/s	50 mm/s	40 mm/s
2	Dwellings and buildings of similar design and/or use	5 mm/s	5-15 mm/s	15-20 mm/s	20 mm/s	15 mm/s
3	Structures that because of their sensitivity to vibration, do not correspond to those listed in Lines 1 or 2 and have intrinsic value (e.g. buildings that are under a preservation order)	3 mm/s	3-8 mm/s	8-10 mm/s	10 mm/s	8 mm/s

Table 4-4 presents the vibration criteria for pipelines in "good" condition which are buried and restrained from vibrating freely by the surrounding back fill.

Table 4-4: DIN 4150-3 Short Term Peak Component Buried Pipe Vibration Criteria

Pipe Material Type	PPV Vibration on Pipe
Steel	100 mm/s
Clay, Cement or Metal	80 mm/s
Masonry or Plastic	50 mm/s

Although not specified in the EPA ICNG, guidance will be sought from BS 5228-2:2009 Code of practice for noise and vibration control on construction and open sites for items not covered by the recommended standards. The following tables present relevant criteria for items that are in "good" condition. For underground services, the item is restrained from vibrating freely by the surrounding backfill.

Table 4-5: BS 5228-2 Peak Component Retaining Wall PPV Vibration Criteria

Wall Material and Type	Vibration Type	Vibration on toe of Wall	Vibration on crest of Wall (horizontal)
Masonry	Transient	10 mm/s	40 mm/s
Propped, Tied, Mass Gravity	Transient	15-20 mm/s	60-80 mm/s
Well supported Steel Pile, Reinforced Concrete	Transient	15-20 mm/s	60-80 mm/s
Masonry	Continuous	4-6 mm/s	16-26 mm/s
Propped, Tied, Mass Gravity	Continuous	6-13 mm/s	24-53 mm/s
Well supported Steel Pile, Reinforced Concrete	Continuous	6-13 mm/s	24-53 mm/s

Table 4-6: BS 5228-2 Peak Component Underground Services PPV Vibration Criteria

Wall Material	Vibration Type	Vibration on wall
Reinforced concrete	Intermittent/Transient	30 mm/s
Reinforced concrete	Continuous	15 mm/s

Project Vibration Criteria

In the absence of any other site-specific criteria, the following generic vibration criteria is recommended for guidance in setting construction vibration limits. Vibration level criteria from the nominated standards has been presented in this section.

The target vibration levels of the Amenity criteria are typically not achieved on the ground and lower floors in buildings near works such as hammering and other construction processes such as piling and compaction. The possible disturbance from the works is temporary and typically the effect is removed once the process is complete, thus it is unlikely to have a permanent effect, so these criteria are considered as ideal target levels but not as mandatory limits.

The structural damage criteria relevant to this project have also been presented in the previous section and are considered as mandatory vibration limits. Generic criteria are presented for structures in “good” condition and compliance with the listed levels will minimise the likelihood of structural damage. For structures in diminished or poor condition the vibration level limits should be appropriately reduced. Note the standards presented do not cover structural damage due to subsidence, compaction/settling, soil liquefaction, etc. resulting from vibration. Vibration criteria to cover these and other vibration related effects are typically documented in the geotechnical and structural engineer’s reports for the site and adjacent buildings. Vibration level requirements from these two specialists shall precede any generic criteria presented in the standards.

Although the specified vibration levels given for buildings are frequency dependent, for vibration monitoring, the criteria levels for buildings may be set to the lowest limit being the level for frequencies less than 10 Hz for each respective building type. Alternatively, each vibration source or process can be site measured and the respective criteria level selected based on the dominant frequency of the excitation. Typically, this will relax vibration limit levels to permit a higher level of vibration.

5.0 NOISE SURVEY

Unattended noise monitoring was conducted on site between 13th and 20th March 2020 to record the existing background noise levels. Attended ambient noise measurements were conducted on the 13th of March 2020 to record the daytime background noise level at the rear of the proposed development in Watt Street. PKA observed that existing construction was present around the surrounding locations which may have affected the overall background noise levels. The results of this monitoring can be used as part of the Construction Management Plan but any future acoustic design for mechanical plant may require additional noise monitoring post construction as there may be a reduction in the background noise levels.

The noise monitor was programmed to store the L_n percentile noise levels for each 15-minute sampling period. Measurements were made of L_{min}, L_{max}, L_{90}, and L_{eq} and were later retrieved for analysis. The position of the noise monitor is shown in Figure 3-1. The results and summary of the noise monitoring are listed in graphical form in Appendix B of this report.

5.1 Instrumentation

Noise measurements were conducted using the following equipment:

- Sound analyser NTi XL2 Type Approved, Serial No. A2A-06988-E0.
- Sound analyser NTi XL2 Type Approved, Serial No. A2A-09467-E0.
- Sound calibrator B&K 4230, Serial number 830447.

The instruments were calibrated before and after the noise measurements and there were no adverse deviations between the two. The analysers are type 1 and comply with AS IEC 61672.2-2004. The instruments carry traceable calibration certificates.

5.2 Project Noise Criteria

Table 5-1 and Table 5-2 below presents the results of ambient, background noise levels and the noise affected level (criterion). The following is considering that the project management intends to do the construction during normal daytime working hours 7am to 6 pm.

Table 5-1: Construction site-specific noise goals for Residential Receivers R1 and R5

Location	Period	L_{eq} dB(A)	Background RBL dB(A)	Noise affected level (Criteria), dB(A)
At residential boundary	Day (7am to 6pm)	65	59	69

Table 5-2: Construction site-specific noise goals for Residential Receivers R2, R3 and R4

Location	Period	L_{eq} dB(A)	Background RBL dB(A)	Noise affected level (Criteria), dB(A)
At residential boundary	Day (7am to 6pm)	59	53	63

The “Highly Noise Affected” criterion has a set level of 75 dB(A).

6.0 CONSTRUCTION NOISE ASSESSMENT

The proposed construction work will consist of demolition of the existing, earthworks / excavation and construction of a mixed-use development consisting of three towers and a public plaza.

PKA reviewed the Preliminary Construction Methodology and Traffic Management Plan provided by ADG Architects and the traffic prepared by SECA Solutions, ref: P1703, dated 27th March 2020 has been provided to PKA to use in the preparation of this report.

The stages of construction and the methodology is yet to be determined. However, the key phases are to involve, site establishment, demolition of existing buildings (including access of heavy vehicles and removal of waste product) and construction of the new buildings.

The proposed hours for the construction works will be as follows:

Type of Construction	Period	
Normal Construction	Monday to Friday	7am to 6pm
	Saturday	8am to 1pm
	No works on Sundays or Public holidays	
Blasting	Monday to Friday	9am to 6pm
	Saturday	9am to 1pm
	No works on Sundays or Public holidays	

Construction during out of standard business hours is not expected to occur.

The construction will require substantial works on site with the majority of the work to be staged as shown in the Figure 3-3. It is expected that there will be a large amount of excavation and demolition to accommodate the removal existing buildings in stage 1 and 2 demolition processes. As per the geotechnical engineer's recommendations and structural engineers' requirements the excavation will accommodate 6 levels of basement car parking and proposed subfloor structures.

As detailed information of proposed demolition, excavation and construction methodologies or plant selections are not known, for the purposes of this assessment, general equipment were considered as follows:

- For demolition: Small excavator, bobcat, sledge or jack hammer, saw, loader & trucks.
- For excavation: Small excavator, jack hammer, saw cutting, bored piling, loader, trucks.
- For construction: Concrete pump, concrete pouring, sawing, tools such as drills & grinders, riveting or welding, trucks loading/unloading.

The selections have been based on the noise equipment at each stage.

Noise impacts due to the construction process will be mostly during the external works. Once the proposed building shells are completed, the noise sources will be mainly inside the building hence limiting noise emissions during the later stages.

6.1 Predicted noise levels

Indicative noise levels from demolition excavation and construction equipment have been calculated at the nearest noise receivers by using the midpoint sound power levels for each machinery item from Australian standard AS2436 and by distance attenuation.

Depending on the work schedule and nature of each task, different equipment may or may not work simultaneously. For example, during demolition, the saw cutting may be used when the hammer is not in operation. Equipment such as the excavator and the hammer will not be working simultaneously. The loader and the truck, however, may work in combination with any other equipment or combination.

Calculations consider a combination for the noisiest equipment in action. Noise levels and noise attenuations at the receivers were calculated based on average distance and directivity.

As the construction area has the same distance to receptors, we have assessed to the northern receiver. A summary of results is presented in Table 6-1.

Table 6-1: Predicted Noise Levels at the nearest receiver (R4,R5) – Most Sensitive

Location	Equipment distance to boundary	Noise Levels, $L_{eq\ 15minute}$ dB(A)		
		Demolition phase	Excavation phase	Construction phase
Nearest Residential Receiver	55 m	49 (Jack hammer)	45 (excavator)	67 (Concrete truck and pump outside)
		68 (Loader & truck)	68 (Loader & truck)	73 (Construction tools inside: Grinder & Plug drill)

The resultant levels in the table allows for the expectation that some items such as the excavator or the saw are likely to operate continuously over the 15-minute assessment period while others such as trucks will contribute to the noise levels for a shorter period such as 3 minutes as the engines will be switched off during loading/unloading.

Noise levels in the summary table above present the highest combined noise levels in each phase. The duration of the highest noise levels above will vary from few minutes to few hours each day depending on the work schedule and work details. The above noise levels will be the maximum levels occurring at any time during each phase of construction. At other times, the noise levels will be lower depending on the type and number of equipment in operation.

The calculations have not allowed for any acoustic screening or shielding from the plant.

6.2 Assessment of equipment noise

The noise levels from the proposed machinery have been assessed against the acceptable noise level criteria for the nearest residential receivers and a summary is presented in Table 6-2.

Table 6-2: Noise Compliance Summary Status for Residential Receivers

Criteria	Location	Complies with criteria (Noise Affected Level)?	Complies with criteria Highly Noise Affected Level, 75 dB(A)?
Noise affected level 69 dB(A) Highly noise affected level 75 dB(A)	R1	**Yes** for demolition (Marginal) **Yes** for excavation (Marginal) **Yes** for construction (Marginal)	**Yes** for demolition **Yes** for excavation **Yes** for construction
	R2	**No** for demolition **No** for excavation **No** for construction	**Yes** for demolition **Yes** for excavation **Yes** for construction
	R3	**No** for demolition **No** for excavation **No** for construction	**Yes** for demolition **Yes** for excavation **Yes** for construction
	R4	**No** for demolition **No** for excavation **No** for construction	**Yes** for demolition **Yes** for excavation **Yes** for construction
	R5	**Yes** for demolition (Marginal) **Yes** for excavation (Marginal) **Yes** for construction (Marginal)	**Yes** for demolition **Yes** for excavation **Yes** for construction

Our comments are as follows:

- The most affected residential buildings will be the R3 and R4. Due to the proximity and direct line of sight to the site the receiver will have a noise impact from most operations, hence mitigation measures will be required.
- Although some individual plant item noise may comply with noise limits, the accumulated noise from simultaneous operation of the equipment including the loader and truck will generally exceed the noise criteria. The exceedance would however be reasonably typical for most construction sites.
- During construction phase, once the building is erected, most noise sources such as drilling or welding will be inside the building, therefore the perceived noise levels will be lower due to shielding.

Typically, construction activities are noisy and are carried out in the open. Australian Standard AS2436 identifies this difficult issue and suggests some leeway in noise criteria by the following extract:

> *Some construction and demolition activities are by their very nature noisy. The authorities responsible for setting noise level criteria for essential works will take note of the constraints imposed by such activities, especially when they are of short duration.*

6.3 Truck noise assessment

The number of movements arising from construction activity are not confirmed at this stage and therefore, detailed assessment the increase in noise generation cannot be determined. However, the SECA report provides the following movement plan for the proposed heavy vehicle routes during construction.

The paths will potentially impact all identified sensitive receivers. In general, with each truck passage, the residences on the street will be briefly subjected to general truck noise. To minimise any noise impact, the management should train and instruct the truck drivers to exercise caution to keep the noise to a minimum. Trucks should be properly maintained and have proper silencers fitted to control the engine and brake noise.

The truck engine should be switched off as soon as trucks arrive on site and drive into position. To minimise any noise impact, the site management should instruct truck drivers to exercise caution to keep the noise to a minimum once they are on the road network and specifically when they are in the vicinity of the site.

7.0 VIBRATION ASSESSMENT

7.1 Assessment approach & analysis

A preliminary analysis of vibration levels at receivers were carried out by using published machinery vibration levels and by distance attenuation corrections.

Assessment of Vibration Levels

A preliminary review of typical construction vibration levels was conducted using published formulae, historical and measured data for major plant equipment expected to be used during the demolition and excavation stages. Actual site vibration levels may vary from those shown in Table 7-1 as there is a dependence on the ground/soil type on site.

Table 7-1: Ground Vibrations vs. Distance for Plant Items

Activity / Plant	Peak Particle Velocity (PPV) mm/s									
	Distance (m)									
	5	10	15	20	25	30	35	40	45	50
Loaded Trucks	3.6	1.3	0.7	0.5	0.3	0.2	0.2	0.2	0.1	0.1
Excavator	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Jack Hammer	1.7	0.6	0.3	0.2	0.1	0.1	0.1	0.1	0.1	0.0
Rock Hammer (1500 Kg)	4.5	3	-	1.5	-	0.4	-	0.3	-	0.3

Based on the vibration levels given in Table 7-1, the predicted vibration levels at the nearest and most affected residential receivers are presented in Table 7-2. The activities which have the highest vibration levels will be the use of excavator and rock hammer in the demolition & excavation phases.

Table 7-2: Assessment of Predicted Vibration Levels at nearest residential receiver (R4,R5)

Plant Item	Distance (m)	Vibration level PPV (mm/s)	Amenity Criterion (mm/s)	Structural Criterion (mm/s)
Loaded Trucks	55	≤ 0.1	0.28 -0.56	5
Small excavator	55	0.0	0.28- 0.56	5
Jack Hammer	55	0.0	0.28 -0.56	5

When on site (or close to the site), the loaded trucks will be moving at a very low speed therefore the actual vibration levels will be much lower than those of a loaded truck shown above.

The above predictions indicate that the vibration levels will be within the structural criteria. When working close to the receiver, items such as jack hammer will result in exceedances above the limit.

The predicted levels are only a guide and it is noted that:

- The dominant frequencies of the vibration producing processes have not been considered.
- The hardness of the ground may be harder than assumed.

- The building foundation/ground coupling properties can also reduce the foundation vibration level.
- The predicted vibrations are for the ground level. Vibration levels on the upper floors of buildings can be different due to structural attenuation losses.

We note that our predictions are based on theoretical assessments rather than measurements on site. As such, actual vibration levels may vary from these predictions. It remains the builder's responsibility to monitor and limit actual vibration levels or substitute processes to lower vibration levels to ensure both amenity and appropriate structural damage risk criteria are maintained.

8.0 MITIGATION STRATEGIES

As the proposal is for concept DA only, subsequent DA's will be lodged for staged construction of the development. The recommendations listed in this report are therefore general in nature to show that the development can comply with noise and vibration criteria; and the recommendations should not form part of any consent conditions for this concept DA. Further detailed assessment and recommendations will be provided for the subsequent DA's.

8.1 Noise mitigation measures

Detailed construction timelines and methodologies are not available at this stage. Typically, detailed construction plans are only prepared once relevant contractors have been appointed and specific details of work for the next stage of works are finalised. Our analysis however indicates at the nearest residences, noise from some activities such as the use of excavator, concrete saw or concrete pouring will not comply with the EPA "Noise Affected Level" and "Highly Noise Affected Level" criteria.

While this may vary based on the actual selected plant, the following comprises a specific and general guide and list of our recommendations for control of such noise and reduction of the noise impact. All feasible and reasonable work practices should be applied to meet the noise affected level. These include: .

- We recommend installation of hoardings to the appropriate height on the periphery of the site. The hoarding should be constructed of solid panels such as 9 mm plywood or FC sheets. The hoarding panels should have proper overlap, to be free of any gaps or openings.
- The height of the hoarding should be such that there is no line of site between the equipment and the receiver. To have an effective hoarding the height should be in minimum of 3m. However, erection of such tall hoarding may prove impractical. If that is the case, management measures such as the use of "all feasible and reasonable solutions" should be fully considered.
- Where possible, demolishing structures and excavations, should use jaw crushers and saws as an alternative to using rock breakers or dozers. At close distances, hammering should be replaced by ripping.
- using a low noise and vibration generating form of piling, such as bored piling or auger for retaining walls (impact piling not to be used).
- limiting noisy activities such as piling and demolishing, to when community is less sensitive to noise i.e. 9 am to 12 pm Monday to Saturday and 2 pm to 5 pm Monday to Friday respectively to provide respite to surrounding residences.
- selecting low noise equipment, e.g. the engines to have proper exhaust or silencers, or the noise radiating surfaces to be damped.
- the stationary noisy equipment such as generators should be kept as far possible to the residential end. Such equipment to be fitted with a purpose built semi-enclosure.
- liaising with all the affected residences and informing them when noisy work will occur and what is being done to minimize the noise.
- using fewer annoying alternatives (such as broadband "quacker" units) to audible movement alarms that provide a safe system of work or configuring the site to maximize forward movements of mobile plant.

- A proper system for community liaison and consultation to be placed (see below for details)
- All truck movements, loading/unloading should take place with minimum amount of noise emission to the neighbours. The trucks should be selected to have minimal noise and a proper exhaust system. All drivers should be trained to keep the noise to a minimum. To eliminate the reversing beep, the route must be planned to minimize the reversing distance. Trucks should be switched off as soon as they arrive into position.

The *EPA Interim Construction Noise Guideline* provides the operational suggestions to reduce noise impact. The following general procedures based on those in the EPA Guideline can be adopted for this site.

- Community consultation and notification should be carried out. Keep affected receivers informed of upcoming works and construction times.
- A complaint handling procedure should be established. This should include a readily accessible contact point for residents to contact the site staff in charge of noise management, a clear complaint (and reporting) process and establishment of a complaints register.
- Use quiet work methods and lower noise plant and equipment.
- Use quiet equipment where possible. Specified noise levels can be taken into account when selecting individual plant items.
- Operate plant in a quiet and efficient manner. For example, reduce throttle setting and turn off equipment when not being used.
- Maintain equipment to ensure manufacturers design noise levels are achieved.
- Locate noisy plant away from sensitive receivers where possible. This may include locating construction vehicle entrances away from the residential area.
- Maximise noise shielding on site. This may include using site sheds, materials stockpiles or natural landforms to provide acoustic shielding.
- Schedule activities to minimise noise impacts. Consultation should be undertaken with affected neighbours to minimise impacts.
- Organise deliveries and access to minimise noise impacts. This may include nomination of off-site truck parking areas away from residents, provision of on-site parking for trucks and staff and amalgamation of loads to minimise truck movement numbers.

8.2 General Vibration mitigation measures

As general guidelines, the following mitigation should be implemented.

- The equipment especially for excavation should be carefully chosen to have the minimum vibration levels. For example, the work should be limited to using the excavator and saw cutting (avoid using hammer or rock breaker near the north, east & south boundaries).
- Vibration due to piling should be kept to a minimum. Auger method is preferred to compact or other methods.

8.3 Community consultation and complaints handling

The following community consultation and complaints handling procedures should be adopted for the site:

- Contact potentially noise affected neighbours at the earliest possible time before any site work begins.
- Inform potentially noise affected neighbours about the nature of the construction stages and the duration of noisier activities.
- Keep potentially noise affected neighbours up to date on progress.
- Provide contact details (including phone number) on a site board at the front of the site and maintain a complaint register suited to the scale of works.
- Once a complaint is received it should be followed up promptly, acted upon and then the complainant contacted (if amenable) to inform them of progress and check that the solution is satisfactory.
- Ask about any concerns that potentially noise affected neighbours may have and discuss possible solutions.

APPENDIX A DRAWINGS USED TO PREPARE REPORT

This report was prepared using drawings provided by

No.	Rev.	Title	Date

APPENDIX B NOISE MEASUREMENTS (GRAPHICAL)

11778 Gosford Gateway

PKA Acoustic Consulting

Project Address: Watt Street (8-16) , Gosford

Logger Location: At the existing carpark level 3 facing Mann street measuring traffic and ambient noise

		Background Noise Levels L_{A90} dB		
		Daytime 07:00 - 18:00 Measured	**Evening** 18:00 - 22:00 Measured	**Nighttime** 22:00 - 07:00 Measured
Friday	3/13/2020	60.5	54.8	50.1
Saturday	3/14/2020	59.6	54.6	50.0
Sunday	3/15/2020	56.9	53.5	50.2
Monday	3/16/2020	59.6	52.5	50.1
Tuesday	3/17/2020	59.2	52.4	50.0
Wednesday	3/18/2020	59.1	53.7	50.3
Thursday	3/19/2020	59.3	54.0	50.3
Friday	3/20/2020	60.3	54.8	49.9
Saturday	3/21/2020	56.1	52.5	49.8
Sunday	3/22/2020	55.6	52.6	49.7
Monday	3/23/2020	59.1		
Rating Background Level (RBL)		**59**	**54**	**50**

		Existing Noise Levels L_{Aeq} dB		
		Daytime 07:00 - 18:00 Measured	**Evening** 18:00 - 22:00 Measured	**Nighttime** 22:00 - 07:00 Measured
Friday	3/13/2020			58.5
Saturday	3/14/2020	66.0	61.8	60.5
Sunday	3/15/2020	63.2	62.7	60.9
Monday	3/16/2020	65.8	63.4	59.3
Tuesday	3/17/2020	64.9	66.1	59.5
Wednesday	3/18/2020	65.1	62.4	59.1
Thursday	3/19/2020	66.2	61.9	60.1
Friday	3/20/2020	68.2	62.7	58.0
Saturday	3/21/2020	63.2	61.4	57.6
Sunday	3/22/2020	63.3	60.3	60.0
Monday	3/23/2020			
Average Noise Level (L_{Aeq})		**65**	**63**	**59**

11778 Gosford Gateway

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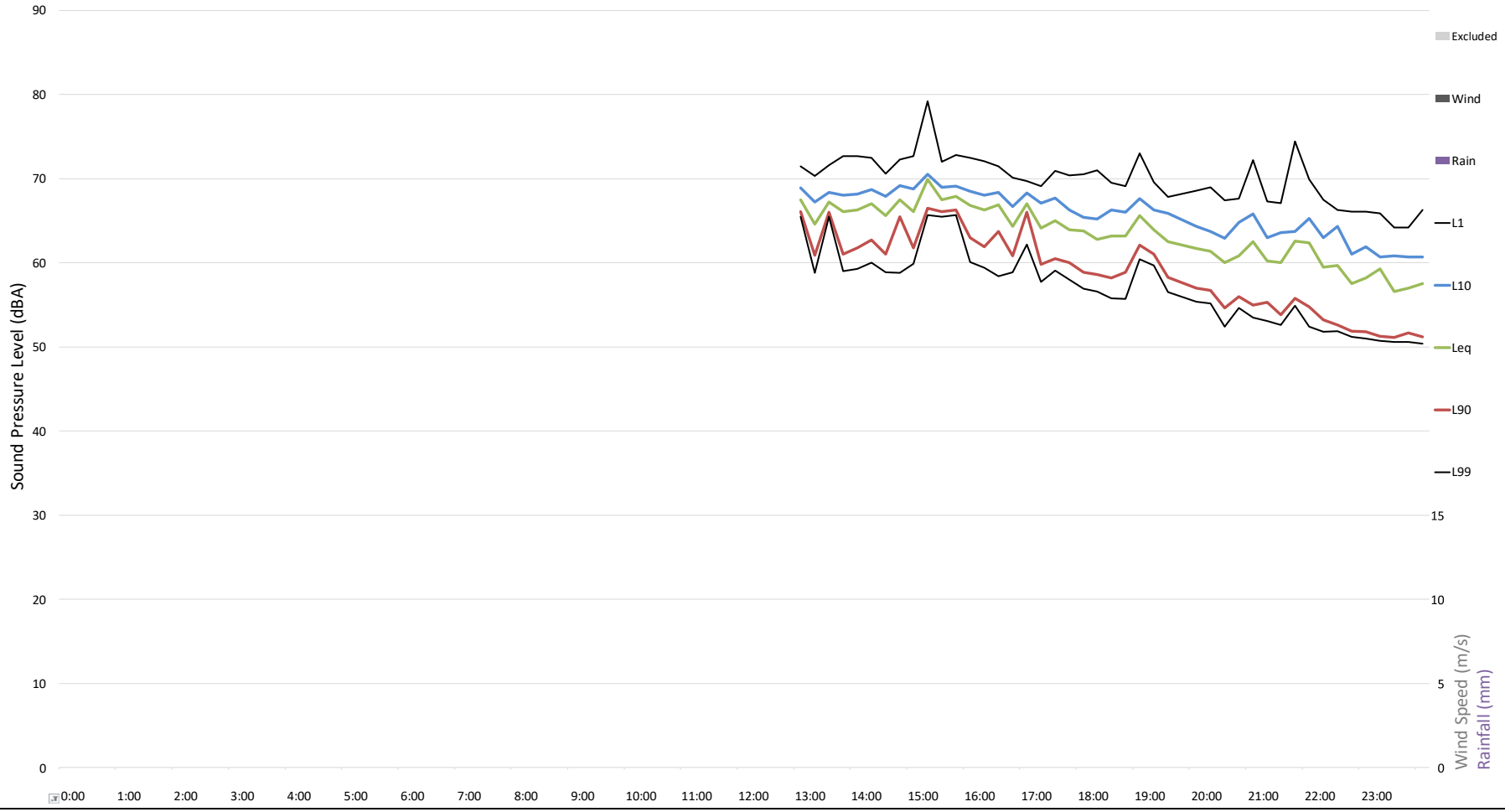
Logger Location: At the existing carpark level 3 facing Mann street measuring traffic and ambient noise

BOM weather data: name[80] history_product[80]

	Daytime 07:00 - 18:00		Evening 18:00 - 22:00		Nighttime 22:00 - 07:00	
	Measured	Corrected	Measured	Corrected	Measured	Corrected
L_{Aeq} dB					58.5	58.5
L_{A90} dB					50.1	50.1

3/13/2020 Friday

Existing Ambient Noise Levels (dBA)



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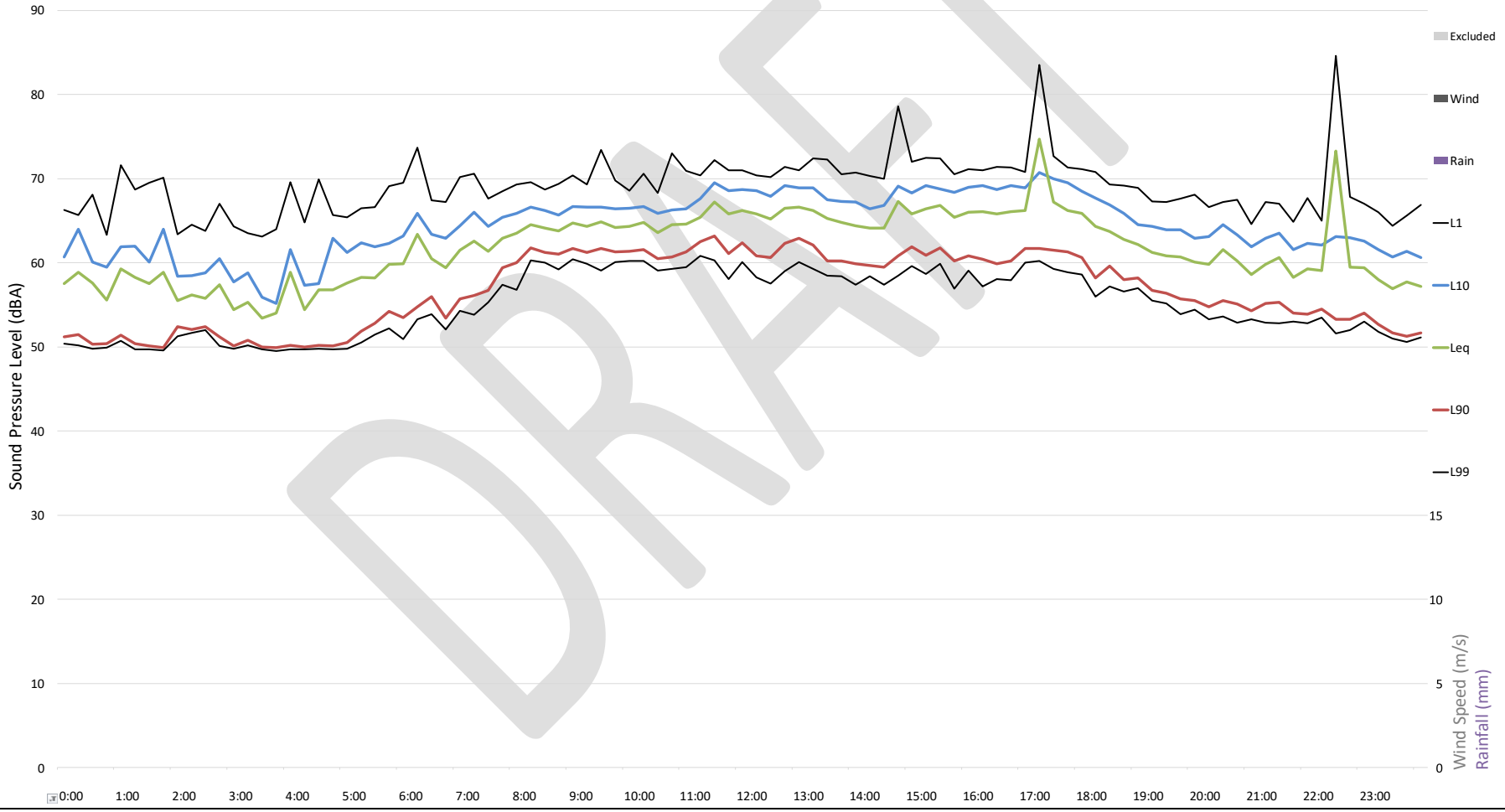
BOM weather data: name[80] history_product[80]

	Daytime 07:00 - 18:00		Evening 18:00 - 22:00		Nighttime 22:00 - 07:00	
	Measured	Corrected	Measured	Corrected	Measured	Corrected
L_{Aeq} dB	66.0	66.0	61.8	61.8	60.5	60.5
L_{A90} dB	59.6	59.6	54.6	54.6	50.0	50.0

3/14/2020 Saturday

Existing Ambient Noise Levels (dBA)



11778 Gosford Gateway

PKA Acoustic Consulting

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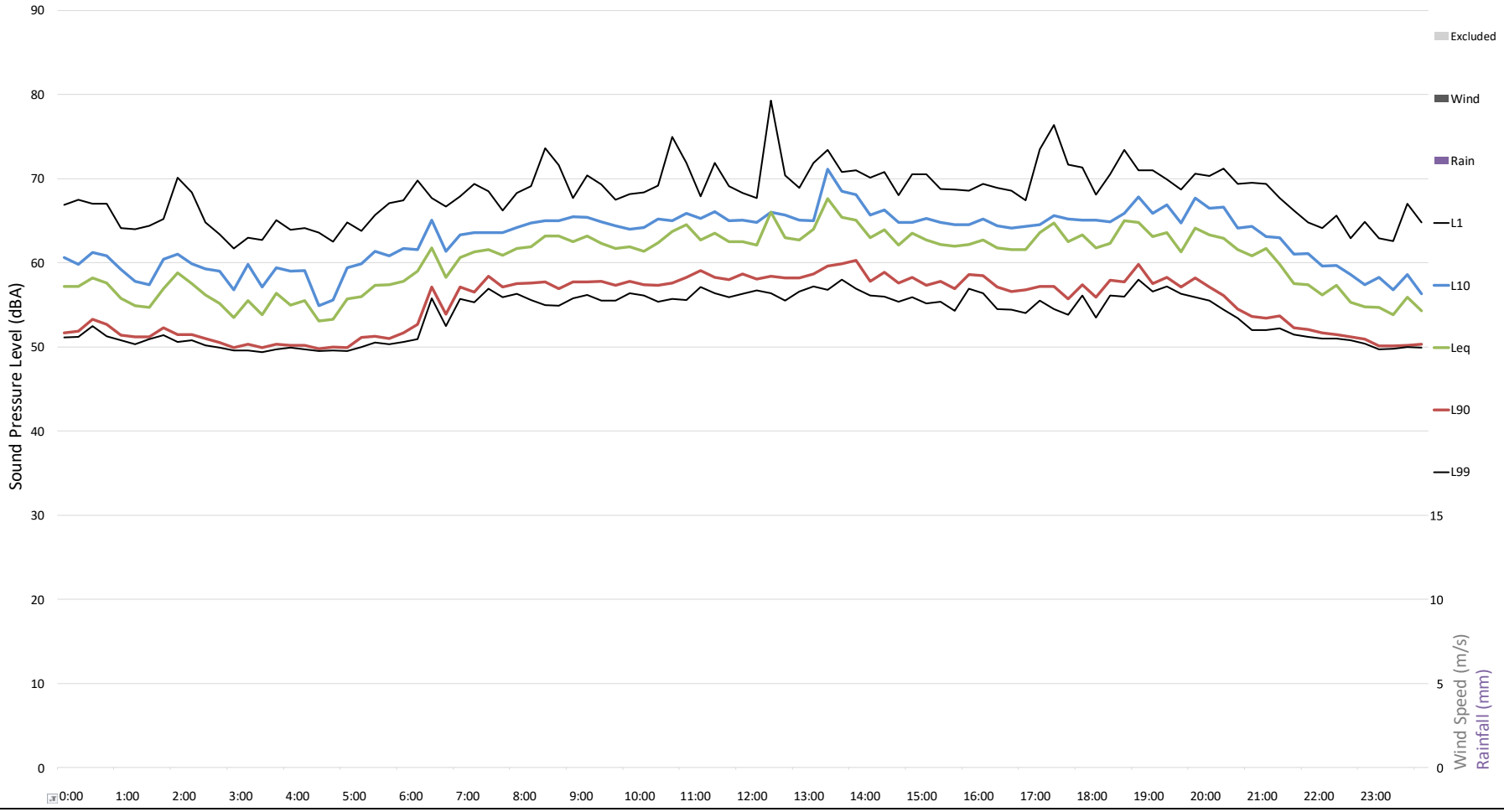
Logger Location: At the existing carpark level 3 facing Mann street measuring traffic and ambient noise

BOM weather data: name[80] history_product[80]

	Daytime 08:00 - 18:00		Evening 18:00 - 22:00		Nighttime 22:00 - 08:00	
	Measured	Corrected	Measured	Corrected	Measured	Corrected
L_{Aeq} dB	63.2	63.2	62.4	62.4	60.9	60.9
L_{A90} dB	56.9	56.9	53.5	53.5	50.2	50.2

3/15/2020 Sunday

Existing Ambient Noise Levels (dBA)



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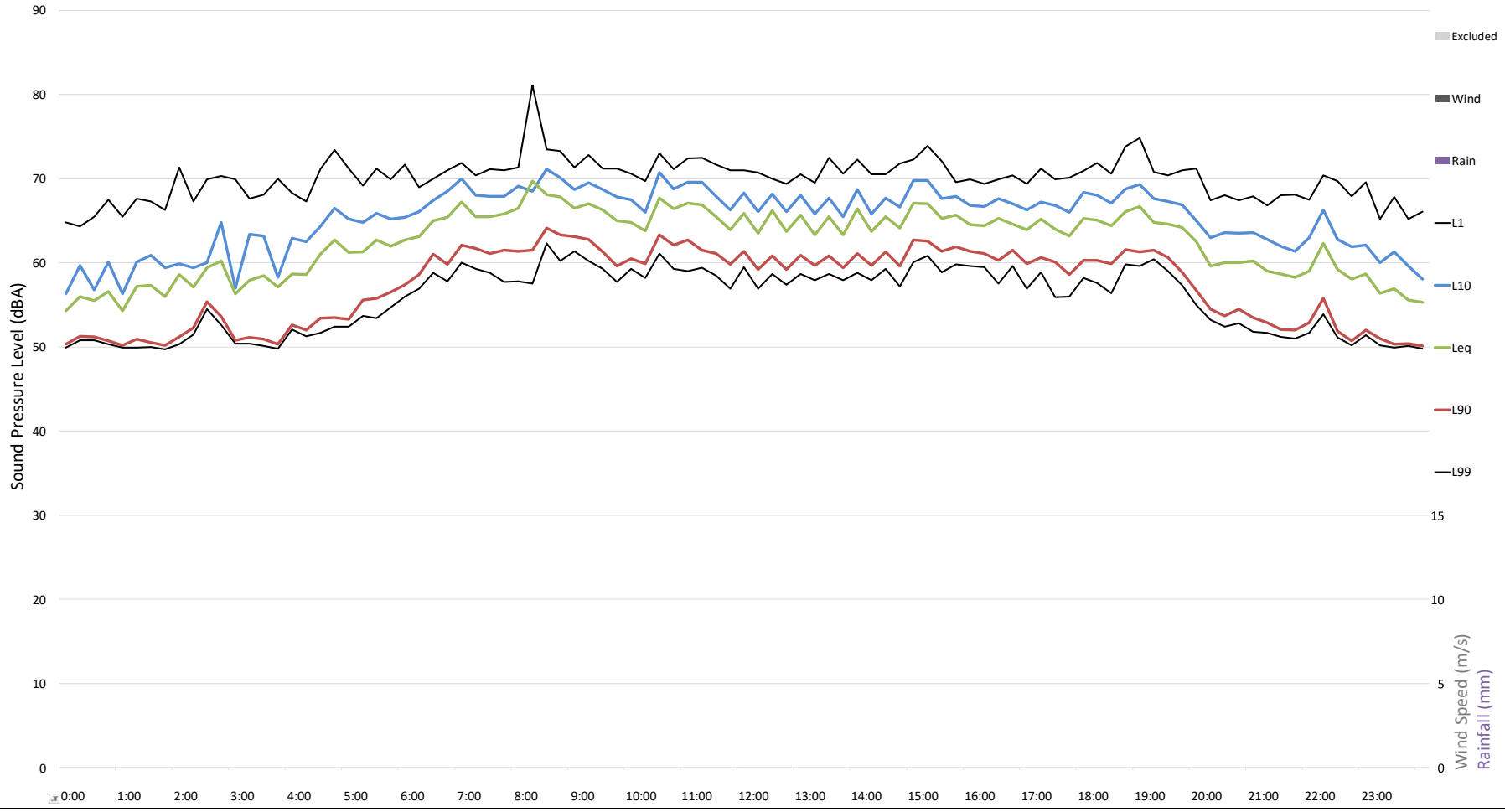
BOM weather data: name[80] history_product[80]

	Daytime 07:00 - 18:00		Evening 18:00 - 22:00		Nighttime 22:00 - 07:00	
	Measured	Corrected	Measured	Corrected	Measured	Corrected
L_{Aeq} dB	65.8	65.8	63.4	63.4	59.3	59.3
L_{A90} dB	59.6	59.6	52.5	52.5	50.1	50.1

3/16/2020 Monday

Existing Ambient Noise Levels (dBA)



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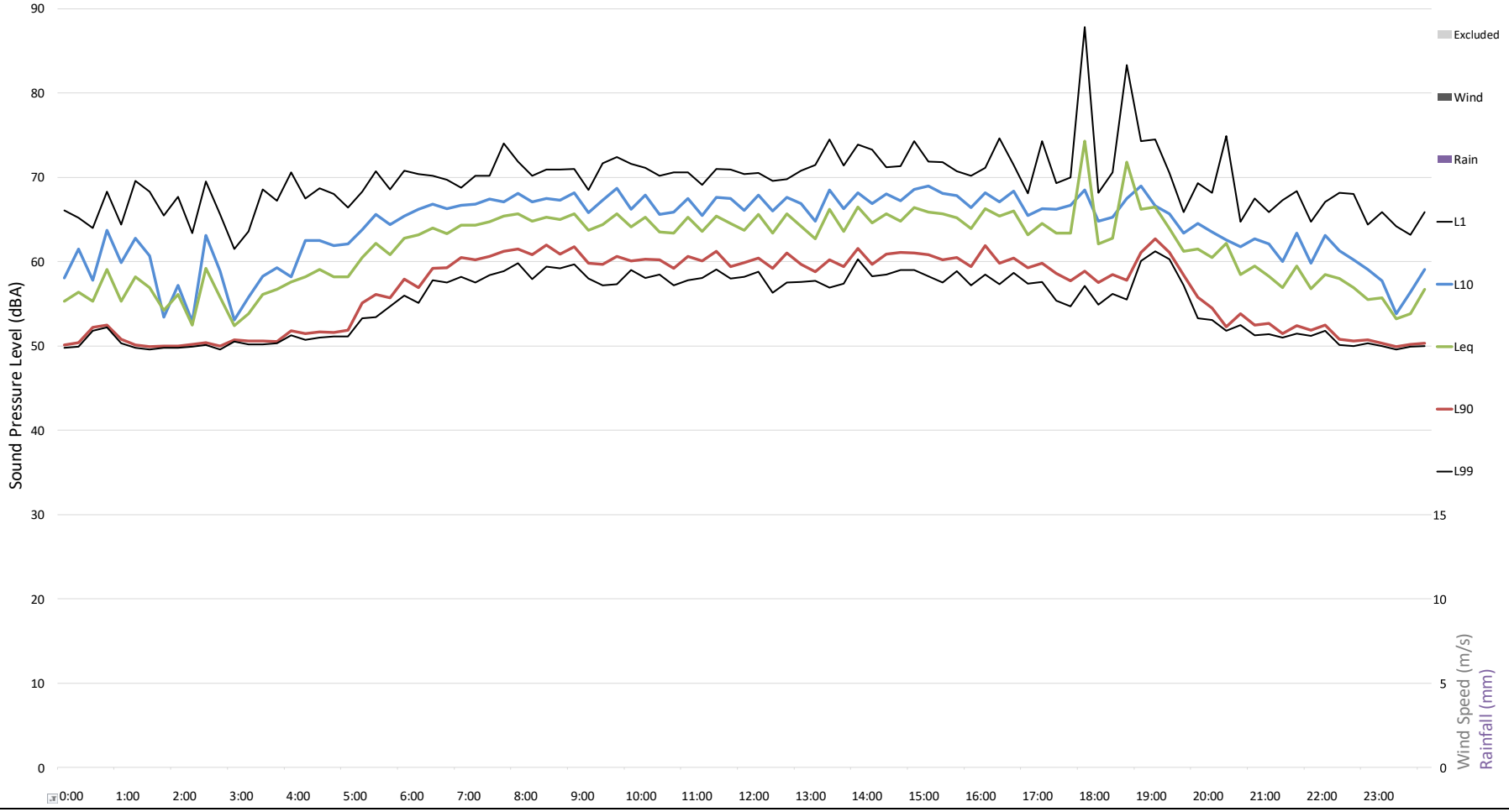
BOM weather data: name[80] history_product[80]

	Daytime 07:00 - 18:00		Evening 18:00 - 22:00		Nighttime 22:00 - 07:00	
	Measured	Corrected	Measured	Corrected	Measured	Corrected
L_{Aeq} dB	64.9	64.9	66.1	66.1	59.5	59.5
L_{A90} dB	59.2	59.2	52.4	52.4	50.0	50.0

3/17/2020 Tuesday

Existing Ambient Noise Levels (dBA)



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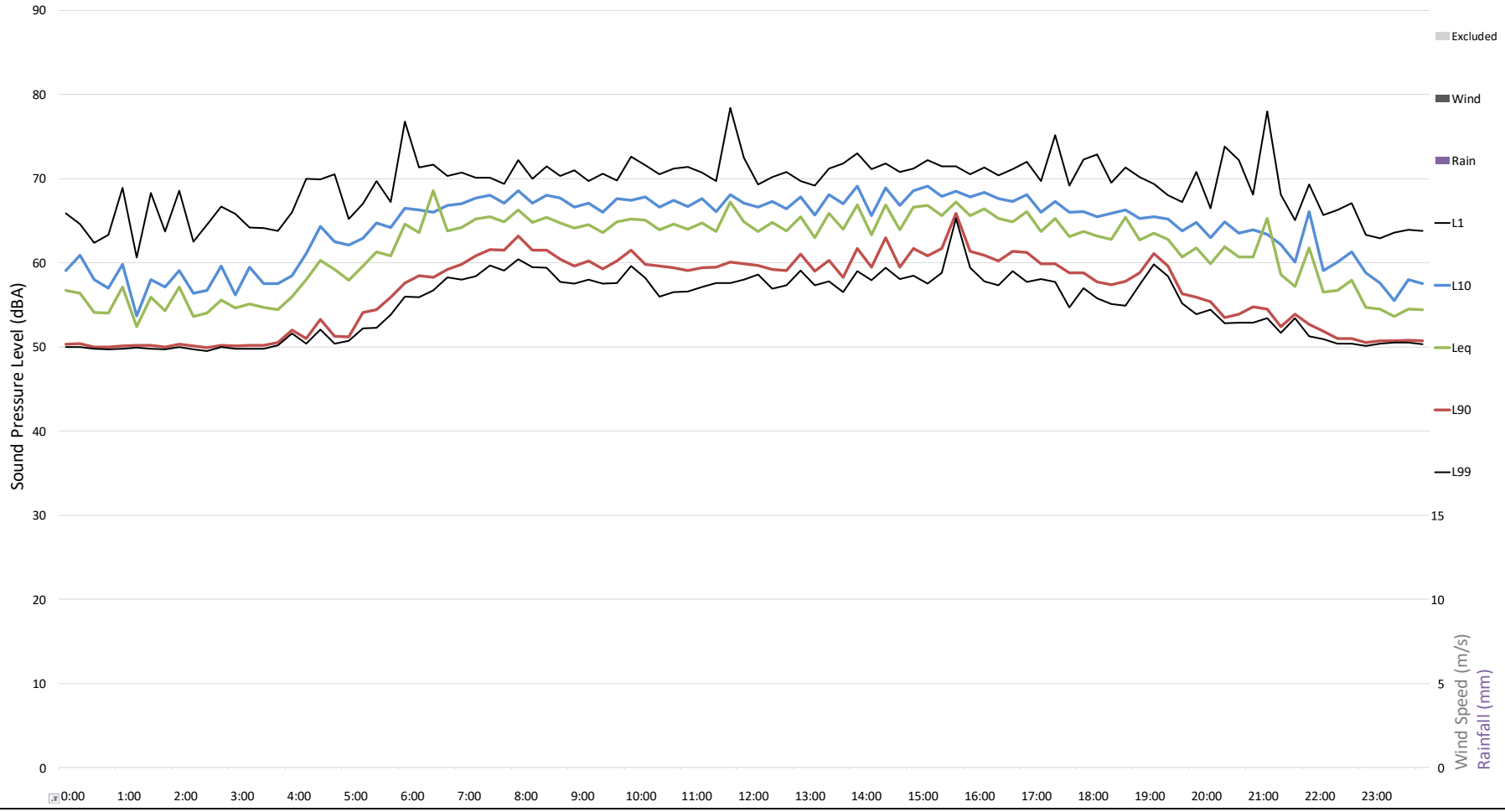
BOM weather data: name[80] history_product[80]

	Daytime 07:00 - 18:00		Evening 18:00 - 22:00		Nighttime 22:00 - 07:00	
	Measured	Corrected	Measured	Corrected	Measured	Corrected
L_{Aeq} dB	65.1	65.1	62.4	62.4	59.1	59.1
L_{A90} dB	59.1	59.1	53.7	53.7	50.3	50.3

3/18/2020 Wednesday

Existing Ambient Noise Levels (dBA)



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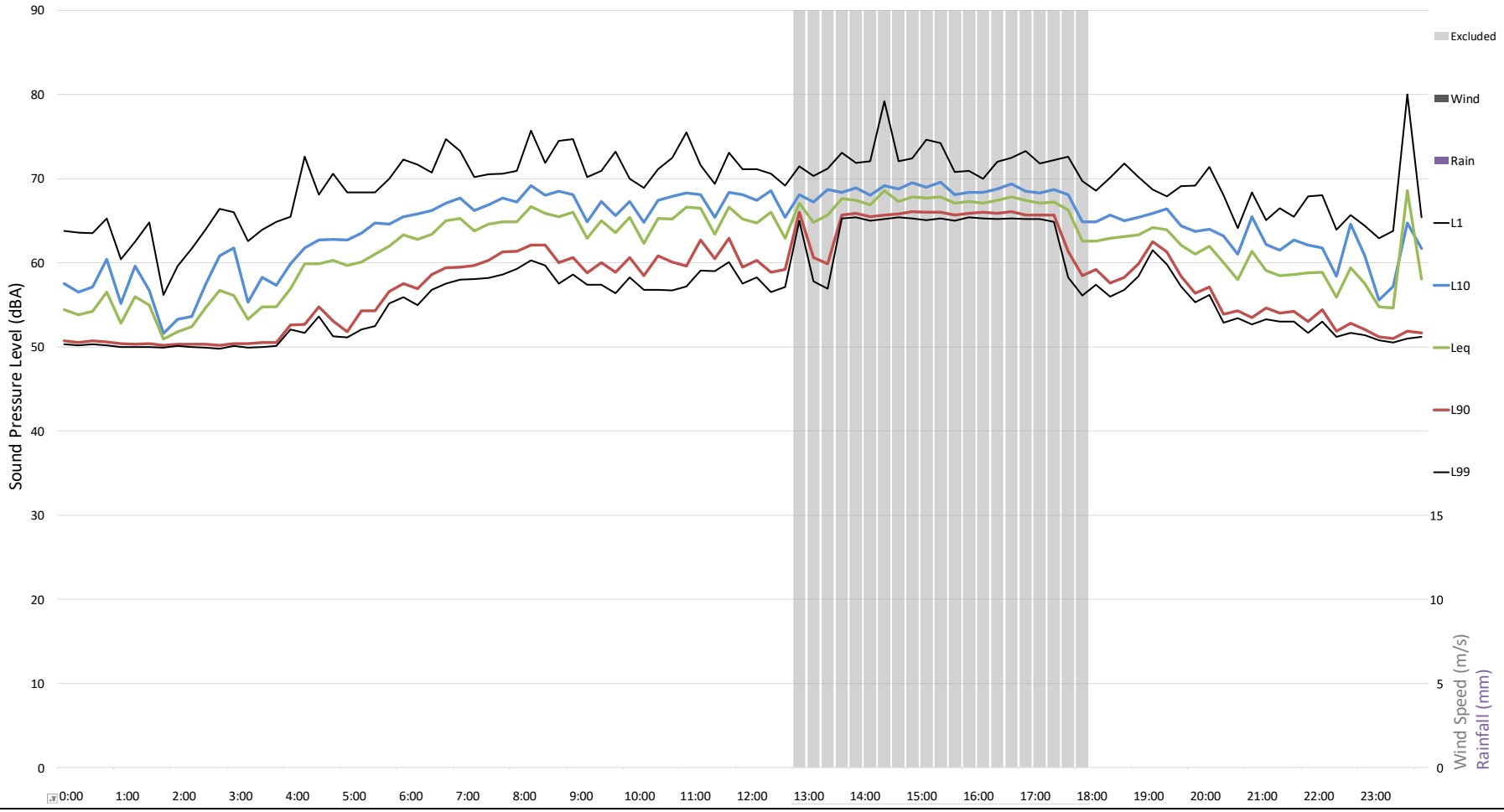
BOM weather data: name[80] history_product[80]

	Daytime 07:00 - 18:00		Evening 18:00 - 22:00		Nighttime 22:00 - 07:00	
	Measured	Corrected	Measured	Corrected	Measured	Corrected
L_{Aeq} dB	66.2	65.1	61.9	61.8	60.1	60.1
L_{A90} dB	59.3	58.9	54.0	53.9	50.3	50.3

3/19/2020 Thursday

Existing Ambient Noise Levels (dBA)



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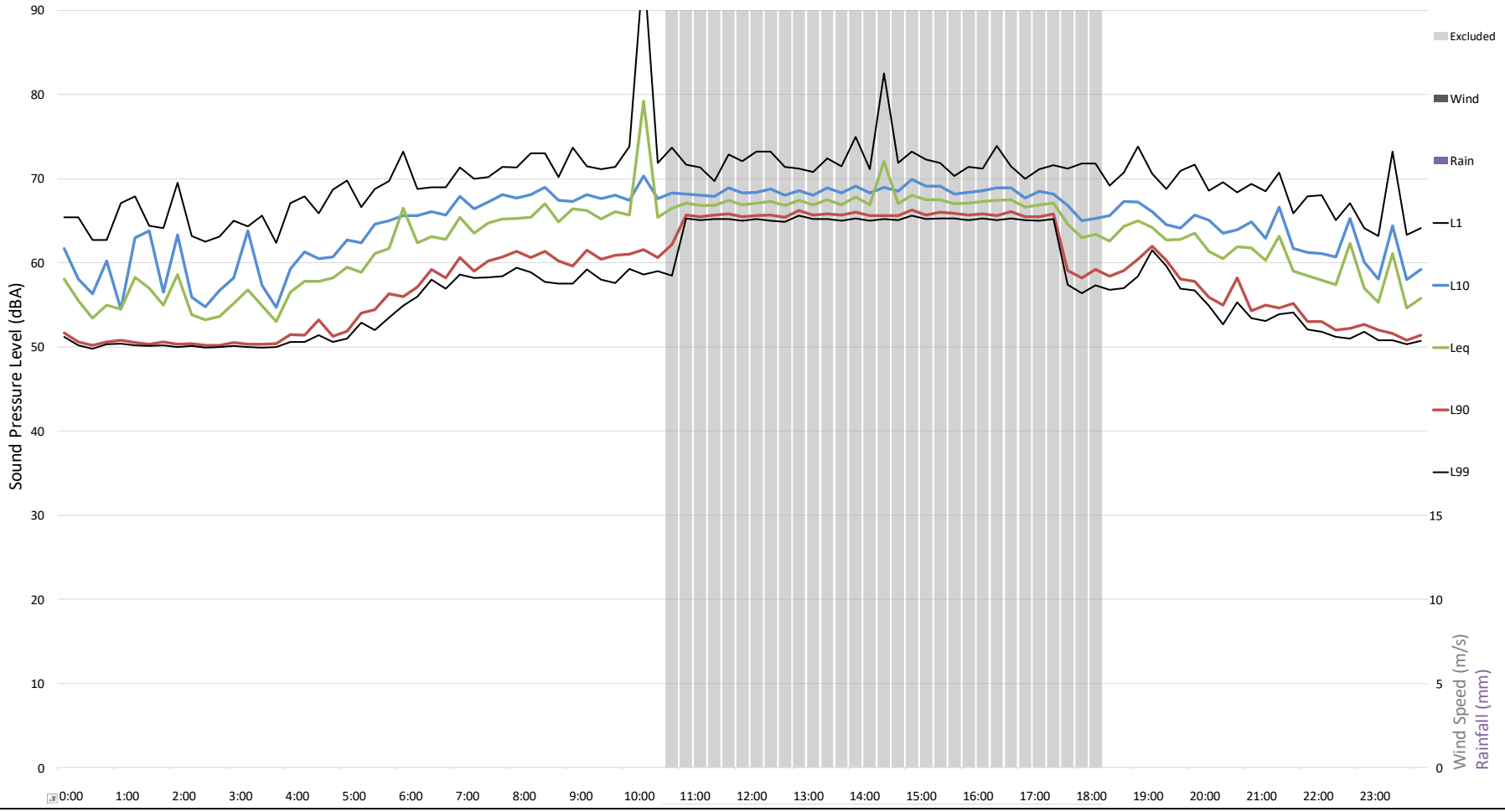
BOM weather data: name[80] history_product[80]

	Daytime 07:00 - 18:00		Evening 18:00 - 22:00		Nighttime 22:00 - 07:00	
	Measured	Corrected	Measured	Corrected	Measured	Corrected
L_{Aeq} dB	68.2	69.5	62.7	62.7	58.0	58.0
L_{A90} dB	60.3	59.8	54.8	54.7	49.9	49.9

3/20/2020 Friday

Existing Ambient Noise Levels (dBA)



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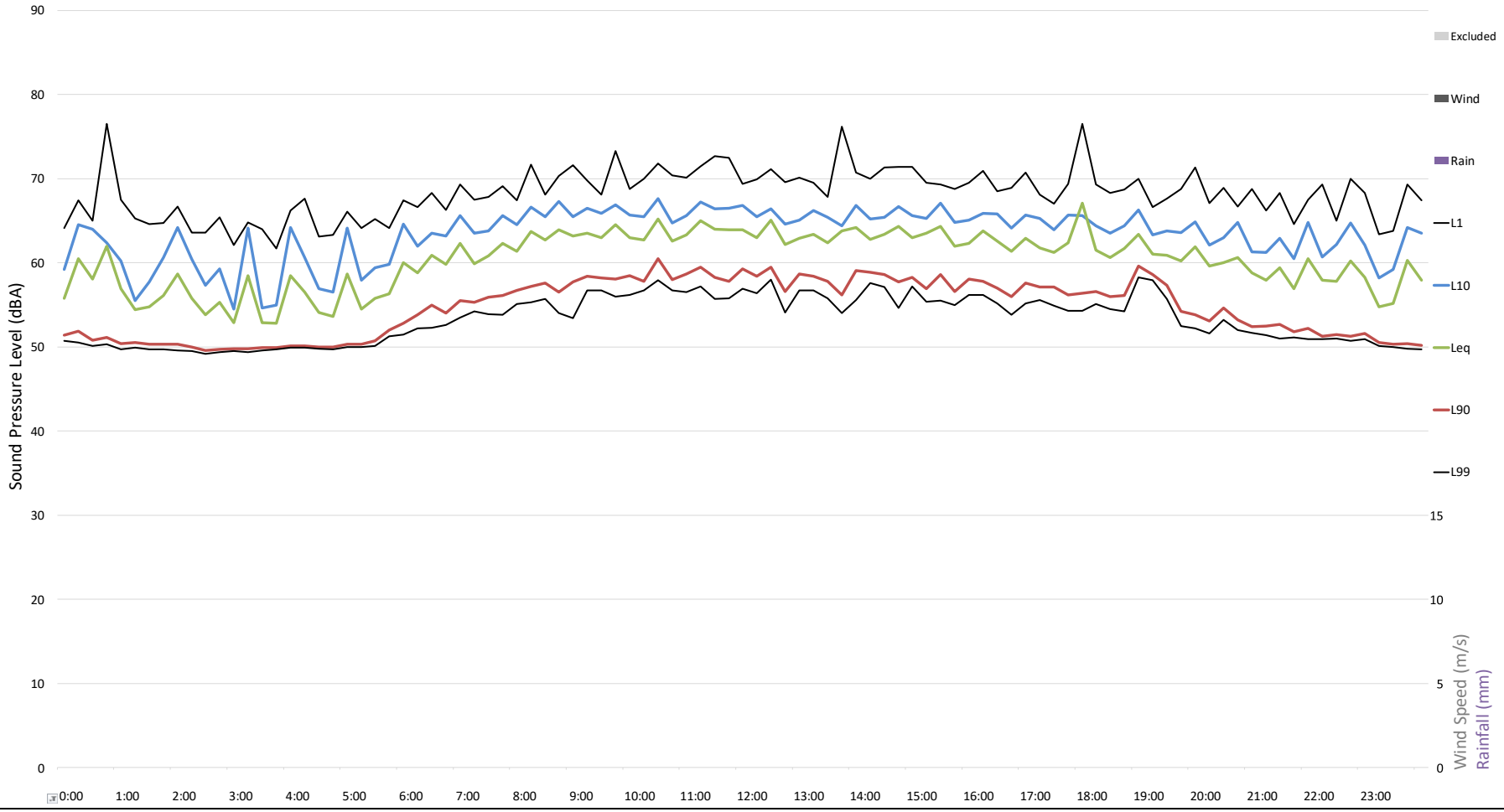
	Daytime 07:00 - 18:00		Evening 18:00 - 22:00		Nighttime 22:00 - 07:00	
	Measured	Corrected	Measured	Corrected	Measured	Corrected
L_{Aeq} dB	63.2	63.2	61.4	61.4	57.6	57.6
L_{A90} dB	56.1	56.1	52.5	52.5	49.8	49.8

3/21/2020 Saturday

Existing Ambient Noise Levels (dBA)



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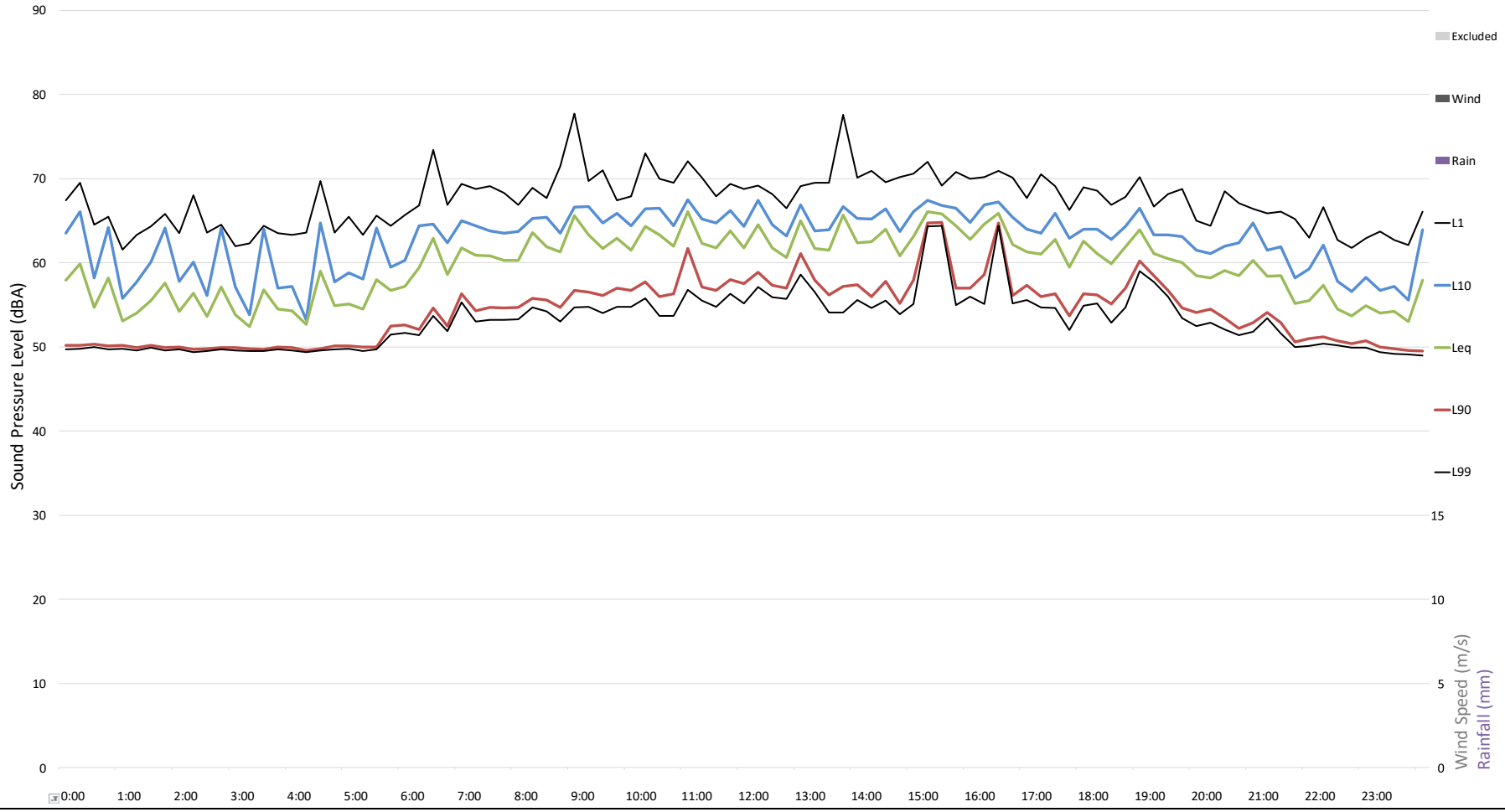
BOM weather data: name[80] history_product[80]

	Daytime 08:00 - 18:00		Evening 18:00 - 22:00		Nighttime 22:00 - 08:00	
	Measured	Corrected	Measured	Corrected	Measured	Corrected
L_{Aeq} dB	63.3	63.3	59.8	59.8	60.0	60.0
L_{A90} dB	55.6	55.6	52.6	52.6	49.7	49.7

3/22/2020 Sunday

Existing Ambient Noise Levels (dBA)



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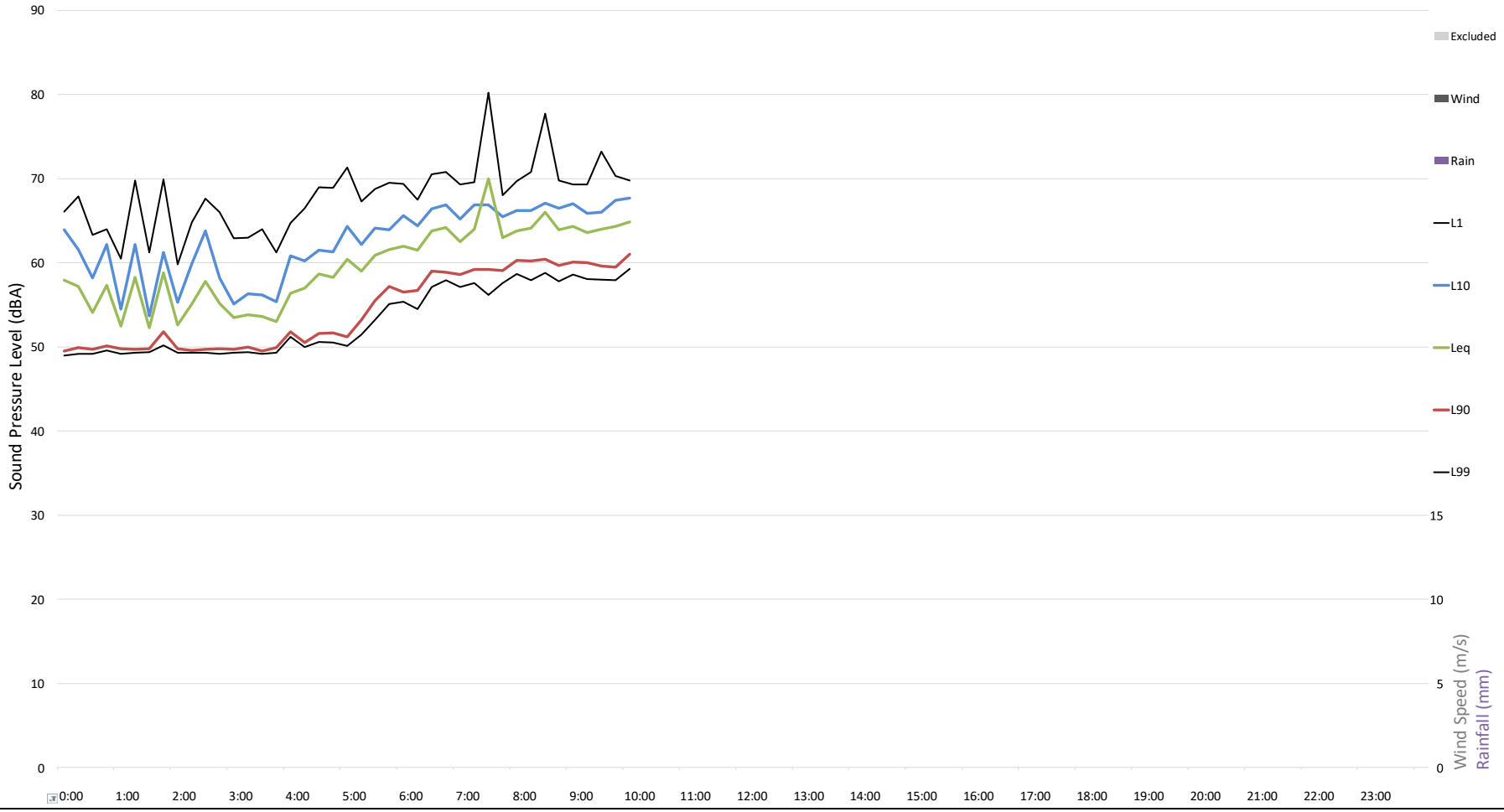
	Daytime 07:00 - 18:00		Evening 18:00 - 22:00		Nighttime 22:00 - 07:00	
	Measured	Corrected	Measured	Corrected	Measured	Corrected
L_{Aeq} dB						
L_{A90} dB						

3/23/2020 Monday

Existing Ambient Noise Levels (dBA)



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