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DA Acoustic Assessment

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1 EXECUTIVE SUMMARY

This *SSDA Acoustic Assessment* has been prepared by Acoustic Logic (**AL**) to accompany State Significant Development Application (SSD-84416958) for a mixed use, residential development at 253-265 Pacific Highway, North Sydney.

This report has been prepared to address the Secretary's Environmental Assessment Requirements (SEARs) issued for the project (SSD-84416958). This report concludes that the proposed development is suitable and warrants approval subject to the implementation of the following mitigation measures.

- Complying façade constructions as described in Section 9.
- Indicative ground floor communal area management controls as noted in Section 9.
- Noise emissions criteria from mechanical plant to be designed to the requirements as outlined in Section 7.
- Construction noise and vibration management as outlined in Sections 11-15.

Following the implementation of the above mitigation measures, the remaining impacts are appropriate.

2 INTRODUCTION

The SSDA (SSD – 84416958) seeks approval for: the demolition of existing buildings at 253-265 Pacific Highway, North Sydney, and the retention and reuse of the existing local heritage item building at 265 Pacific Highway; the construction of a part 10, part 13 storey, mixed use, shop top housing development including: a 2 storey podium consisting of ground and first storey commercial tenancies, ground level communal open space and deep soil landscaping at 265 Pacific Highway; a tower above consisting of 35 residential apartments and communal roof garden; excavation of four levels of basement level car parking and servicing; and the stratum and strata subdivision of the building.

As part of the proposed residential component, 10 affordable housing apartments are proposed to be provided under Chapter 2 – Infill Affordable Housing under the State Environmental Planning Policy (Housing) 2021 (Housing SEPP).

This report has been prepared in response to the requirements contained within the Secretary's Environmental Assessment Requirements (SEARs) dated 29/05/2025 and issued for the SSDA (SSD-84416958). Specifically, this report has been prepared to respond to the SEARs requirement issued below.

Table 2-1 – SEARs Requirements

Item	Description of Requirement	Section Reference (this Report)
10. Noise and Vibration	Provide a noise and vibration assessment prepared in accordance with the relevant NSW Environment Protection Authority (EPA) guidelines. The assessment must detail construction and operational noise and vibration impacts on nearby sensitive receivers and structures and outline the proposed management and mitigation measures that would be implemented	Sections 9, 11-15.
SEARs Industry Specific Cover Letter item 3.	Provide an assessment of:… • the appropriateness of the communal open space located at the ground floor level in terms of…noise impacts to the surrounding residents.	Sections 8.2
SEARs Industry Specific Cover Letter item 5.	Consider noise and vibration impacts from the Western Harbour Tunnel corridor and Pacific Highway in the Noise Impact Assessment Report.	Section 6.5

Impacts assessed include:

- Noise intrusion from traffic on nearby public roads.
- Noise emissions from usage of the ground floor communal space.
- Noise emissions criteria for mechanical plant.

The subject site and local context are indicated in Figure 1.

The report has been prepared for the sole purpose of a development application assessment and should not be used or relied on for any other purpose.

3 REFERENCED DOCUMENTS

3.1 BACKGROUND INFORMATION USED

This assessment has been conducting using the following documents:

- Nettletontribe architectural drawings for SSDA submission (Project No.: 14344, dated 27th June 2025).
- Western Harbour Tunnel and Warringah Freeway Upgrade Environmental Impact Statement (**EIS**) (dated January 2020).

3.2 GUIDELINES

The following planning instruments and guidelines have been used in the assessment:

- State Environmental Planning Policy (Transport and Infrastructure) (**TI SEPP**) 2021
- NSW Department of Planning Development near Rail Corridors and Busy Roads (**DNRCBR**) (Interim Guideline) 2008, and
- NSW EPA *Noise Policy for Industry* (**NPfI**) October 2017.

4 ABBREVIATIONS AND DEFINITIONS

The following abbreviations and definitions are used in this noise impact assessment.

dB	Decibels – unit for the measurement of sound
dB(A)	A-weighted decibels. Unit of measurement for broadband sound with the A-frequency weighting applied to approximate human loudness perception to sounds of different pitch.
L_{eq}	Energy, time averaged sound level
L_{max}	Maximum sound pressure level, fast response
L_{90}	Sound level exceeded for 90% of the measurement period
R_w	Frequency weighted sound reduction index.
NRC	Average absorption co-efficient for the octave bands with centre frequencies of 250Hz to 2 kHz inclusive.
Day*	The period from 7am to 6pm (Monday to Saturday) and 8am to 6pm (Sundays and public holidays).
Evening*	Refers to the period from 6pm to 10pm.
Night*	The period from 10 pm to 7 am (Monday to Saturday), and 10pm to 8am (Sundays and public holidays).
Project Trigger Level	Target noise levels for a particular noise-generating facility.
Assessment Background Level (ABL)	Background noise level representative of a single period.
Rating Background Level (RBL)	The overall, single-figure background level representing each assessment period (day/evening/night) over the whole monitoring period. (Calculated in accordance with NPfI unless noted otherwise)

* Unless nominated otherwise.

5 SITE DESCRIPTION AND THE PROPOSAL

5.1 SENSITIVE RECEIVERS

Onsite acoustic investigation has been carried out by this office regarding the surrounding acoustic environment. These have been detailed below:

- Residential properties located along the western boundary (across Pacific Highway).
- Residential properties located along the southern and eastern boundaries.
- Commercial properties along the northern boundary.
- Educational, place of worship and further commercial properties surrounding the site.

The following table lists the nearest/potentially most impacted sensitive receivers surrounding the site. An aerial photo of the site indicating nearby noise sensitive receivers and measurement locations is presented in Figure 1.

Table 5-1 – Sensitive Receivers

Receiver (Refer Figure 1)	Receiver Type	Comment
R1	Residential	Residential receivers to the west across Pacific Highway
R2	Residential	Residential receiver to the east across Church Lane
R3	Residential	Residential receivers to the south on McLaren Street
C1	Commercial	Commercial receiver to the north
C2	Commercial	Commercial receiver to the southeast (medical practice)
E1	Educational	North Sydney Public School to the west
E2	Educational	St Thomas' North Sydney Preschool further east
P1	Place of Worship	St Thomas' Anglican Church further east
Road	Road	Pacific Highway to the west of the site
Road	Road	Church Lane to the east of the site

Figure 1 – Site Plan Showing Local Context (Source: NSW SDT Explorer)

Project Site
Residential Receivers
Commercial Receivers
Educational Receivers
Place of Worship Receivers
Unattended Noise Monitoring
Attended Noise Measurements

6 TRAFFIC NOISE INTRUSION AND VIBRATION ASSESSMENT

The noise sources assessed as potentially impacting the proposed development are traffic noise from Pacific Highway and the future Western Harbour Tunnel corridor.

6.1 GUIDELINES AND ASSESSMENT CRITERIA

6.1.1 State Environmental Planning Policy (Transport and Infrastructure) 2021

Sensitive development adjacent to major roadways and railway infrastructure must have regard to TI SEPP Clause 2.120.

Section 2.120 Impact of Road Noise or Vibration on Non-Road Development

(1) This section applies to development for any of the following purposes that is on land in or adjacent to the road corridor for a freeway, a tollway or a transitway or any other road with an annual average daily traffic volume of more than 20,000 vehicles (based on the traffic volume data published on the website of TfNSW) and that the consent authority considers is likely to be adversely affected by road noise or vibration—

(a) residential accommodation,

(b) a place of public worship,

(c) a hospital,

(d) an educational establishment or centre-based child care facility.

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

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

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

6.1.2 Development Near Rail Corridors and Busy Roads – Interim Guideline

This guideline provides general and specific advice for the planning and assessment of noise sensitive development impacted by roads and railways, and in particular those uses required to be addressed under the TI SEPP. The assessment criteria broadly mirror those in the TI SEPP.

6.1.2.1 Internal Noise Criteria – Airborne Noise

Table 3.1 of the guideline (repeated below) summarises the internal noise levels that should be achieved in noise sensitive developments. The $L_{eq,15hr}$ descriptor is recommended to assess noise levels in habitable rooms of non-residential development.

Table 6-1 – DNRCBR Airborne Noise Criteria

Building Use	Room	Noise Level dB(A) L_{eq}
Residential	Sleeping Area (Bedroom)	35 (10pm to 7am)
	Other habitable rooms (excl. garages, kitchens, bathrooms & hallways)	40 (7am to10pm)

6.1.2.2 Ventilation

The DNRCBR recommends that when "windows open" noise levels are excessive, that is when that "windows open" noise level exceeds the "windows closed" criterion by more than 10 dB(A), the occupants should be able to *"leave their windows closed, if they so desire, and also meet the ventilation requirements of the Building Code of Australia (BCA)."*

6.2 PROJECT SPECIFIC NOISE AND VIBRATION CRITERIA

The site is impacted by a road having an average daily traffic volume of greater than 20,000 vehicles per day. Therefore, the TISEPP requirements apply to the site.

The following criteria have been adopted following a review of the applicable guidelines.

Table 6-2 – Airborne Noise Criteria

Building Use	Room	Noise Level dB(A) L_{eq}
Residential	Sleeping Area (Bedroom)	35 (10pm to 7am)
	Other habitable rooms (excl. garages, kitchens, bathrooms & hallways)	40 (7am to10pm)

6.3 SITE AMBIENT NOISE LEVELS

A survey of ambient noise and vibration has been undertaken to characterise the existing environment. Representative noise levels have been determined from the data using the methodology outlined in Appendix B3 of the RNP. The survey data and the calculated noise descriptors are described in detail in Appendix A.

A summary of the site data used in the assessment is provided below.

Table 6-3 – Noise Measurement Summary

Location	Ambient Noise Level (dB(A) $L_{eq,period}$)	
	Day (7am to 10pm)	Night (10pm to 7am)
Noise monitor facing Pacific Highway, 365 Pacific Highway, North Sydney	69.9*	67.1*
Noise monitor facing Church Lane, 365 Pacific Highway, North Sydney	57	52.8

*-2.5dB(A) for façade reflections based on reflections at noise monitoring position.

6.3.1 Predicted Façade Noise Levels

Predicted façade noise levels based on the collected site data are provided below.

Table 6-4 – Noise Measurement Summary

Location*	Ambient Noise Level (dB(A) $L_{eq,period}$)	
	Day (7am to 10pm)	Night (10pm to 7am)
Western Façade (Pacific Highway)	69	66
Northern/ Southern Façade near Pacific Highway	65	62
Northern/ Southern Façade near Church Lane	63	60
Eastern Façade (Church Lane)	57	53

** At 1.5m off local ground level.*

6.4 AIRBORNE NOISE ASSESSMENT

An assessment of noise impact has been undertaken using the following methodology:

- Windows Closed Noise Levels

  Windows closed noise levels were calculated to the centre of the room using the predicted octave band façade incident external noise levels and, for each façade element, correcting for the exposed area, octave band sound transmission loss and room sound power to pressure correction. The room noise level was calculated by accumulating all significant noise paths.

  Envelope performance requirements to comply with the noise criteria stipulated in Section 6.2 have been assessed.

- Windows Open Noise Levels

  "Windows open" noise levels have been calculated by subtracting 10 dB(A) from the façade incident noise level, as promulgated by the RNP (Table 7). The noise reduction assumes the open area of window is equivalent to 5% of the room floor area. Where openable windows to the room are located on different facades, the façade opening(s) with the lowest noise levels have been assessed first.

6.4.1 External Noise Levels

The measured noise levels have been used as a basis for predicting façade-incident noise levels around the development by:

- Correcting for different distances between the noise source compared to the monitoring location.
- Barrier effects, where applicable.
- Reflections off adjacent structures, where significant.

The CoRTN traffic noise prediction model has been used to calculate the above adjustments indicated above.

6.4.2 Discussion

The modelling indicates that mitigation of noise impacts is needed to achieve compliance with the nominated assessment criteria. Complying mitigation is provided in Section 9.

6.5 WESTERN HARBOUR TUNNEL NOISE AND VIBRATION IMPACTS

6.5.1 Operational Noise and Vibration Impacts from the Western Harbour Tunnel

Chapter 11, Section 11.5.2 of the Western Harbour Tunnel and Warringah Freeway Upgrade *Environmental Impact Statement* (**EIS**) states the following:

> *Noise from traffic travelling through the tunnels would be contained within the tunnels and would not impact noise sensitive receivers or heritage structures. Refer to Section 11.6 for a discussion on ground-borne noise and vibration impacts from traffic travelling through tunnels and portals.*

Section 11.6 provides further clarification on predicted ground-borne noise and vibration as conducted for the EIS:

> *The potential for operational ground-borne noise and tactile vibration impacts on nearby sensitive receivers from traffic on project surface roads and tunnels has been reviewed.*
>
> *Vibration emissions from traffic travelling on roads typically occur where there are irregularities in the road surface (eg pot holes).*
>
> *As the new and upgraded roads on the surface and in the tunnels associated with the project would be designed and constructed to avoid road irregularities, operational ground-borne noise and tactile vibration impacts from operation traffic are not expected.*
>
> *Vibration impacts from traffic travelling on the proposed surface roads, through tunnels and portals are considered negligible and are unlikely to result in ground-borne noise or tactile vibration impacts to sensitive receivers directly adjacent to surface roads, tunnels and portals.*
>
> *Similarly, vibration from operational fixed facilities is not anticipated to exceed objectives given the distance between these facilities and the nearest sensitive receiver.*

In this regard, the EIS for the Western Harbour Tunnel has already assessed operational impacts on the site and is not anticipated to result in any ground-borne noise or vibration.

6.5.2 Construction Noise and Vibration Impacts from Mainline Tunnelling

Appendix G, Section 5.11.1 of the EIS provides two tables summarising the estimated number of potentially ground-borne noise affected receivers from road header tunnelling and rock hammer tunnelling. The EIS does not predict any ground-borne noise issues from road header tunnelling, however rock hammering within the tunnels has been predicted to be within a 45-50dB(A) range. This level of ground-borne noise is likely to affect residents in the evening and night time period, noting however that the residents within the site are located from Level 2 and above, therefore providing some noise reduction from the predicted values. As such, residents at the development site will be no more noise affected compared to existing residents surrounding the site, therefore no additional measures are required above and beyond what the EIS already reviewed.

Appendix G, Section 5.11.2 of the EIS provides a table summarising the estimated number of potentially vibration impacted receivers from road header tunnelling and rock hammer tunnelling. The EIS does not predict any vibration impacted receivers from road header tunnelling, however rock hammering within the tunnels has been predicted to be within the minimum working distance for human response for rock hammer tunnelling with respect to the site development location. Given that residents to the east (**R2**) are also within the minimum working distance per the EIS predictions, residents at the development site will be no more vibration impacted compared to existing residents surrounding the site, therefore no additional measures are required above and beyond what the EIS already reviewed.

7 NOISE EMISSION CRITERIA

The noise emission from the project site shall comply with the requirements of the NSW Environment Protection Authority (**EPA**) *Noise Policy for Industry* **(NPfI)** 2017.

7.1 NSW EPA NOISE POLICY FOR INDUSTRY (NPFI) 2017

The NSW EPA Noise Policy for Industry (NPfI) 2017, has two criteria which need to be satisfied: namely the Intrusiveness noise level criteria and the Project Amenity noise level criteria. The Project Noise Trigger Levels are then established based on the lower of the intrusiveness and project amenity levels.

Noise levels are to be assessed at the property boundary or nearby dwelling, or at the balcony or façade of an apartment.

7.1.1 Intrusiveness Noise Level Criteria

The guideline is intended to limit the audibility of noise emissions at residential receivers and requires that noise emissions measured using the L_{eq} descriptor do not exceed the background noise level by more than 5dB(A). Where applicable, the intrusive noise level should be penalised (increased) to account for any annoying characteristics such as tonality.

Background noise levels adopted are presented in Section 4. Noise emissions from the site should comply with the noise levels presented below when measured at nearby property boundary.

Table 7-1 – Project Intrusiveness Noise Levels

Receiver	Period/Time	Project Intrusiveness Noise Levels dB(A)$L_{Aeq(15min)}$
R1-R3	Day (7am-6pm)	55
	Evening (6pm-10pm)	51
	Night (10pm-7am)	44

7.1.2 Project Amenity Noise Level Criteria

The guideline is intended to limit the absolute noise level from all noise sources to a level that is consistent with the general environment.

The NSW EPA Noise Policy for Industry sets out acceptable noise levels for various localities. Table 2.2 on page 11 of the policy indicates 3 categories to distinguish different residential areas. They are rural, suburban, urban. This site is categorised by urban receivers.

For the purposes of this condition:

- Day is defined as the period from 7am to 6pm Monday to Saturday and 8am to 6pm Sundays and Public Holidays.
- Evening is defined as the period from 6pm to 10pm.
- Night is defined as the period from 10pm to 7am Monday to Saturday and 10pm to 8am Sunday and public holidays.

The project amenity noise level is calculated by taking the recommended amenity noise level (as presented in table 2.2 of the policy), subtracting 5dB(A) and then adding 3dB(A) to convert from $L_{Aeq,\ period}$ to a $L_{Aeq,\ 15\text{-}minute}$ descriptor. The project amenity noise level criteria are presented in the table below.

Table 7-2 – Project Amenity Noise Levels

Location	Period/Time	Project Amenity Noise Levels dB(A)$L_{Aeq(15min)}$
Nearby residences – Urban Receivers (**R1-R3**)	Day (7am-6pm)	58
	Evening (6pm-10pm)	48
	Night (10pm-7am)	43
Educational Receiver (**E1-E2**)	When in use	35 (internal noisiest 1 hour)
Place of Worship (**P1**)	When in use	40 (internal)
Commercial Receivers (**C1-C2**)	When in use	63

7.1.2.1 Sleep Disturbance Criteria

The Noise Policy for Industry recommends the following noise limits to mitigate sleeping disturbance:

> *Where the subject development / premises night -time noise levels at a residential location exceed:*
>
> - *$L_{eq,15min}$ 40 dB(A) or the prevailing RBL plus 5 dB, whichever is the greater, and/or*
> - *L_{Fmax} 52 dB(A) or the prevailing RBL plus 15 dB, whichever is the greater, a detailed maximum noise level event assessment should be undertaken.*

Table 7-3 – Sleep Arousal Criteria for Residential Receivers

Receiver	Rating Background Noise Level (Night) dB(A)L_{90}	Emergence Level
R1-R3 Night (10pm – 7am)	39 dB(A) L_{90}	44 dB(A)$L_{eq,\ 15min}$; 54 dB(A)L_{Fmax}

7.1.2.2 Project Noise Trigger Levels

The project noise trigger level (as outlined in section 2.1 of the policy) is the lower of the intrusiveness and project amenity noise levels. The project noise trigger levels are presented in the table below.

Table 7-4 – Project Noise Trigger Levels (NPfI)

Receiver(s)	Time Period	Assessment Background Noise Level dB(A) L_{90}	Intrusiveness Criteria dB(A) $L_{eq(15min)}$	Project Amenity Criteria dB(A) $L_{eq(15min)}$	NPfI Criteria for Sleep Disturbance
Residential Receiver **(R1-R3)**	Day (7am – 6pm)	50[1]	**55**	58	N/A
	Evening (6pm-10pm)	46[1]	51	**48**	N/A
	Night (10pm-7am)	39[1]	44	**43**	**44 L_{eq}** **54 L_{max}**
Educational Receivers (**E1-E2**)	When in use	N/A	N/A	**35 (internal noisiest 1 hr)**	N/A
Place of Worship (**P1**)		N/A	N/A	**40 (internal)**	N/A
Commercial Receivers **(C1-C2)**		N/A	N/A	**63**	N/A

1 Based on noise monitoring facing Church Lane instead of Pacific Highway for conservative assessment.

The project noise trigger levels are indicated by the bolded values in the table above.

8 NOISE EMISSIONS ASSESSMENT

8.1 NOISE FROM MECHANICAL PLANT (IN PRINCIPLE)

Detailed plant selection and location has not been undertaken at this stage. Satisfactory levels will be achievable through appropriate plant selection, location and if necessary, standard acoustic treatments such as duct lining, acoustic silencers and enclosures.

Noise emissions from all mechanical services to the closest residential receiver should comply with the requirements of Section 7. Detailed acoustic review should be undertaken at CC stage to determine acoustic treatments to control noise emissions to satisfactory levels.

Notwithstanding the above, an assessment of preliminary plant layouts and locations is presented below, noting that it is likely for layouts or equipment types to vary during the detailed design phase of the project.

- Roof top plant:
    - All rooftop plant is proposed to be maintained within enclosure plantrooms, as nominated by the architectural documentation.
    - Major fans (typically with a sound power level over 80db(A) – such as kitchen exhaust, major toilet exhaust and major relief air fans) will require acoustic treatment if located externally. Wherever possible for major fans it is recommended that axial (as opposed to roof mounted fans) are to be used as this will enable acoustic treatment to be incorporated within ductwork running to atmosphere.
- Basement:
    - Indicatively, fans may require attenuation treatment to meet NPfI requirements are surrounding sensitive receivers.
    - To ensure compliance with NPfI requirements during the day, evening and night time, additional review is recommended following final plant selection and review.
- Level 2 Residential condenser plant: Condensers and a centralised hot water system heat pump servicing the Level 2 & 3 residential units are located on the southern podium of Level 2. Indicative calculations using a typical condenser selection (Mitsubishi PUMPY-SP140, 56dB(A) at 1m anechoic) running in quiet mode for the night time period (super silent 1) with 10x located on Level 2 as well as a heat pump with a theoretical 72dB(A) sound power level are predicted to be within the project noise trigger levels of the night time period. Typical condenser operation (without night mode active) are predicted to be compliant with day and evening period project noise trigger levels.
- Level 2 & 3 Commercial condenser plant: Condensers servicing the commercial tenancies are located in small condenser rooms facing Church Lane on Level 2 & 3. Indicative calculations using a typical condenser selection (Mitsubishi PUMPY-SP140, 56dB(A) at 1m anechoic) with 2x located on Level 2 and 2x located on Level 3 are predicted to be within the project noise trigger levels of the day and evening time periods, noting that commercial tenancies typically do not operate in the evening time and that the condensers will not operate during the night time period.

8.2 NOISE FROM THE GROUND FLOOR COMMUNAL AREA

In regard to the proposed ground floor communal area, we note the following:

- Towards the east are currently residential dwellings where the top level is on a similar plane (or higher) than the proposed communal area.
- Landscaping/ planting is being used to visually screen the communal area to the surrounding receivers.
- The communal area is for the use of residents (rather than retail & commercial tenants) and would accommodate the use by the 35 apartments included in the development. General activities to be associated with its use is anticipated to be mainly passive activities.
- No lighting is designed for the area, therefore naturally limiting usage to daylight hours.
- The designed residential entry and canopy provide shielding and act as an acoustic barrier to the communal area and residents to the rear of the site.
- Additionally, use of the area would also be part of the strata management plan, and be subject to ongoing controls or restrictions to how it is used, for example:
    - Limits on the times of use.
    - Limits on the types of activities which can be undertaken (for example, the playing of amplified music).
    - Restrictions on the numbers of people which can use the space at given times.

9 COMPLYING MITIGATION AND CONTROLS

The assessment indicates that the building envelope is required to be upgraded beyond what is considered to be a "standard" form of construction to comply with the internal noise criteria. The following complying mitigation has been determined to comply with the required internal noise levels.

9.1 GLAZED WINDOWS AND DOORS

Acoustically rated external windows and doors are required. Aluminium framed/sliding glass doors and windows will be satisfactory provided they meet the following criteria.

All external windows and doors listed are required to be fitted with Q-lon type (or equal) acoustic seals. (**Mohair Seals are unacceptable**). The suitability of alternative seal types should be determined to an appropriately qualified acoustic expert.

The complying constructions are listed below.

Table 9-1 – Complying Glazing Constructions

Façade	Level	Space	Glazing Construction	Acoustic Seals
Western	Levels 2-3	Bedrooms outside wintergardens	12.38mm Laminated	**Yes**
		Living rooms outside wintergardens	12.38mm Laminated	**Yes**
		Wintergardens (including internal glazing to bedrooms and living rooms	6mm Float or Toughened	**Yes**
	Levels 4-12	Bedrooms with two glazed façades	10.38mm Laminated, 90mm airgap, 5mm Float or Toughened	**Yes**
		Bedrooms with one glazed façade	12.38mm Laminated	**Yes**
		Living rooms	12.38mm Laminated	**Yes**
	All Levels	All Other Glazing	6.38mm Laminated	**Yes**
Northern & Southern	All Levels	Bedrooms outside wintergardens	6.38mm Laminated	**Yes**
		Living rooms outside wintergardens	6.38mm Laminated	**Yes**
		Wintergardens (including internal glazing to bedrooms and living rooms	6mm Float or Toughened	**Yes**
		All Other Glazing	6.38mm Laminated	**Yes**
Eastern	All Levels	Bedrooms outside wintergardens	6.38mm Laminated	**Yes**
		Living rooms outside wintergardens	6mm Float or Toughened	**Yes**
		Wintergardens (including internal glazing to bedrooms and living rooms	6mm Float or Toughened	**Yes**

Thicker glazing may be required for structural, safety or other purposes. Where it is required to use thicker glazing than scheduled, this will also be acoustically acceptable.

It is recommended that only window systems having test results indicating compliance with the required ratings obtained in a certified laboratory be used where windows with acoustic seals have been recommended.

In addition to complying with the minimum complying glazing construction, the R_w rating of the glazing fitted into open-able frames and fixed into the building opening should not be lower than the values listed in the following table. This will require the use of acoustic seals around the full perimeter of open-able frames and the frame will need to be sealed into the building opening using a flexible sealant.

Table 9-2 – Minimum Rw of Glazing (with Acoustic Seals)

Glazing Assembly	Minimum R_w/Rw+C_{tr} of Installed Window
6.38mm Laminated	31
10.38mm Laminated	35
12.38mm Laminated	37

9.1.1 Use of Insulated Glass Units (Double Glazing)

Where single glazing has been recommended in Table 9-1, the following IGU's can be used in place of the tabled single glazing.

Table 9-3 – Equivalent IGU Systems

Single Glazing Assembly	Equivalent IGU	Minimum R_w/R_w+C_{tr} of Installed Window
6.38mm Laminated	8/16AG/8 OR 6/12/6.38	35/31
10.38mm laminated	6/12AG/10.38 or 8/12/8.38	40/35
12.38mm laminated	8/12AG/11.52	42/38
10.38mm Laminated, 90mm airgap, 5mm Float or Toughened		44/39

9.2 EXTERNAL ROOF/CEILING CONSTRUCTION DETAILS

Roof constructions of brick, concrete or masonry will not require acoustic upgrading. Where other systems are proposed they should be reviewed and approved by a suitably qualified acoustic consultant.

9.3 EXTERNAL WALL CONSTRUCTION

External walls constructed from concrete/masonry elements will not require any acoustic upgrading to achieve the acoustic requirements. For light-weight materials, the following complying constructions are provided.

Table 9-4 – Complying External Light Weight Wall Construction

Space	Internal Lining	Stud System	External Lining
Bedrooms Facing Pacific Highway	1x16mm high density plasterboard	Minimum of 92mm stud with 75mm thick 14kg/m^3 glasswool insulation in cavity	12mm Dekton porcelain cladding
All other spaces	1x13mm standard plasterboard		

9.4 NON-GLAZED ENTRY DOORS

Doors to be minimum 44mm thick solid core timber (minimum 32 kg/m^2 surface density), fitted with full perimeter acoustic seals equal to Raven RP10 to the top and sides and Raven RP38 to the underside of a hinged door.

For glazed external doors refer Section 9.1.

9.5 ALTERNATIVE VENTILATION

With respect to natural ventilation of a dwelling, the NSW Department of Planning document '*Development near Busy Roads and Rail Corridors - Interim Guideline*' dictates that:

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

With windows open, the allowable internal noise goal is permitted to be 10dB(A) higher than when the windows are closed (i.e. – allowable level in bedrooms becomes 45dB(A) $L_{eq(9hr)}$ and 50dB(A) $L_{eq(anytime)}$for living rooms).

- All SOU's with an eastern aspect façade can rely on open windows or doors on this façade for natural ventilation and achieve internal noise requirements. This includes rooms which are dual aspect with openings on the eastern façade.

- All northern, southern and western aspect façades cannot be relied upon for open windows or doors for natural ventilation and achieve internal noise requirements.

10 CONSTRUCTION NOISE AND VIBRATION IMPACTS

A preliminary assessment of construction noise and vibration impacts during the main building works of the development has been undertaken. The assessment includes:

- Identification of the noise and vibration guidelines which will be applicable to this project.
- Identification of potentially affected nearby sensitive receivers.
- Identification of likely noise sources and vibration generating activities.
- Formulation of a strategy to address the guidelines identified including mitigation treatments.

A detailed construction staging program is yet to be finalised, however we have assumed there will be excavation and piling. Construction work (and the associated typical loudest plant/equipment) would be expected to comprise of:

- Bulk excavation.
- Bored or CFA piling of foundations.
- Erection of building structure (powered hand tools for formwork, concrete pump, vibrators).
- Façade Installation (powered hand tools).
- Landscaping (front end loaders etc).

The following work hours are the recommended standard working hours stipulated in the NSW Interim Construction Noise Guideline:

- Monday to Friday: 7am to 6pm
- Saturday: 8am to 1pm
- Sundays and/or Public Holidays: No work

10.1 NOISE MANAGEMENT LEVELS

Noise associated with construction activities on the site will be assessed in accordance with the NSW EPA Interim Construction Noise Guideline.

10.1.1 NSW EPA *Interim Construction Noise Guideline* (ICNG) July 2009

The "quantitative" assessment procedure, as outlined in the Interim Construction Noise Guideline (ICNG) will be used. The quantitative assessment method requires: Determination of noise generation goals (based on ambient noise monitoring); Prediction of operational noise levels at nearby development; and if necessary, recommendation of noise controls strategies in the event that compliance with noise emission goals is not possible.

EPA guidelines adopt differing strategies for noise control depending on the predicted noise level at the nearest residences:

- *"Noise affected" level*. Where construction noise is predicted to exceed the "noise affected" level at a nearby residence, the proponent should take reasonable/feasible work practices to ensure compliance with the "noise affected level". For residential properties, the "noise affected" level occurs when construction noise exceeds ambient levels by more than 10dB(A)$L_{eq(15min)}$.
- "*Highly noise affected level*". Where noise emissions are such that nearby properties are "highly noise affected", noise controls such as respite periods should be considered. For residential properties, the "highly noise affected" level occurs when construction noise exceeds 75dB(A)$L_{eq(15min)}$ at nearby residences.

In addition to the above management levels for residential receivers, the ICNG nominates a Management Level of 70dB(A) $L_{eq(15min)}$ at commercial receiver facades (typical office, retail). And a Management Level of RBL + 5 dB(A) for any work done outside of standard hours.

A summary of the above recommended noise levels from the ICNG is presented below.

Table 10-1 – Noise Emission Goal at Residential Property Boundaries

Location	**"Noise Affected" Level - dB(A)$L_{eq(15min)}$ Standard Hours**	**"Highly Noise Affected" Level - dB(A)$L_{eq(15min)}$**
Residential Receiver **R1, R3**	70 externally at façade for residents facing Pacific Highway	75
Residential Receiver **R1-R3**	60 externally at façade for all other residents	75

Where noise from the construction works is above the "noise affected" level, the proponent should apply any feasible and reasonable work practices to minimise noise. The "noise affected level is representative of a level where there may be some community reaction to noise.

If noise emissions are likely to exceed 75 dB(A)$L_{eq(15min)\ \text{"highly noise affected"}}$ at the boundary of surrounding affected residential receivers, the receiver is deemed to be "highly noise affected". The "highly noise affected" level is representative of a level where strong community reaction to noise is expected. Introduction of management controls such as scheduling of noisy periods, or respite periods is then recommended. Refer to Section 11 for specific recommendations.

Section 4.1.2 and 4.1.3 of the EPA Interim Construction Noise Guideline also nominates management levels for other sensitive land uses (other than residences). Criteria relevant to this assessment is detailed below.

Table 10-2 – Noise Emission Goal at Commercial/ Sensitive Property Boundaries

Location	Management Level $dB(A)L_{eq(15min)}$
Educational Receivers **E1-E2**	45 internally
Place of Worship Receiver **P1**	45 internally
Commercial Receivers **C1-C2**	70 externally at facade

10.1.2 Australian Standard AS2436:2010 "*Guide to Noise Control on Construction, Maintenance and Demolition Sites*"

The Australian Standard AS2436 states that where all reasonable and available measures have been taken to reduce construction noise, mitigation strategies may be put in place to reduce levels noise levels to within a reasonable and acceptable level.

For the control and regulation of noise from construction sites, AS2436:1981 nominates the following:

a. That reasonable suitable noise criterion is established,

b. That all practicable measures be taken on the building site to regulate noise emissions, including the siting of noisy static processes to locations of the site where they can be shielded, selecting less noisy processes, and if required regulating construction hours, and

c. The undertaking of noise monitoring where non-compliance occurs to assist in the management and control of noise emission from the construction site.

The guideline reflects on feasible and reasonable mitigation strategies, management controls and public liaising in the effort to reach realistic comprises between construction sites and potential noise affected receivers.

Based on these criteria the following procedure will be used to assess noise emissions:

- Predict noise levels produced by typical construction activities at the sensitive receivers.
- Adopt management conditions as per AS2436 in the event of a non-compliance.

10.2 VIBRATION OBJECTIVES

Vibration caused by construction at any residence or structure outside the subject site will be assessed with reference to:

- For structural damage vibration, German Standard DIN 4150-3 *Structural Vibration: Effects of Vibration on Structures*; and
- For human exposure to vibration, Department of Environment and Conservation NSW "Assessing Vibration: A Technical Guideline" (Feb 2006) is based on the guidelines contained in BS 6472:1992 *Guide to Evaluate Human Exposure to Vibration in Buildings (1Hz to 80Hz)* for low probability of adverse comment.

The criteria and the application of this standard are discussed in separate sections below.

10.2.1 Structure Borne Vibrations (Building Damage Criteria)

German Standard DIN 4150-3 (2016-12) provides a guideline for acceptable levels of vibration velocity in building foundations, to assess the effects of vibration on structures. The table give guidance on the maximum accepted values of velocity at the foundation and in the plane of the highest floor of various types of buildings, to prevent any structural damage.

The table below lists the peak particle velocity, which is the maximum absolute value of the velocity signals for the three orthogonal components. This is measured as a maximum value of any of the three orthogonal component particle velocities when measured at the foundation, and the maximum levels measured in the x- and y-horizontal directions in the plane of the floor of the uppermost storey.

Table 10-3 – DIN 4150-3 (2016-12) Safe Limits for Building Vibration

TYPE OF STRUCTURE		PEAK PARTICLE VELOCITY (mms^{-1})			
		At Foundation at a Frequency of			Plane of Floor of Uppermost Storey
		< 10Hz	10Hz to 50Hz	50Hz to 100Hz	All Frequencies
1	Buildings used in commercial purposes, industrial buildings and buildings of similar design	20	20 to 40	40 to 50	40
2	Dwellings and buildings of similar design and/or use	5	5 to 15	15 to 20	15
3	Structures that because of their particular 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	3 to 8	8 to 10	8

10.2.2 Assessing Amenity

The NSW EPA's *Assessing Vibration – a technical guideline* is based on the guidelines contained in British Standard BS 6472-1992 '*Guide to Evaluate Human Exposure to Vibration Buildings (1Hz to 80Hz*'. This guideline provides procedures for assessing tactile vibration and regenerated noise within potentially affected buildings.

The recommendations of this guideline should be adopted to assess and manage vibration from the site. Where vibration exceeds, or is likely to exceed, the recommended levels then an assessment of reasonable and feasible methods for the management of vibration should be undertaken.

Table 10-4 – BS 6472 Vibration Criteria

		RMS acceleration (m/s^2)		RMS velocity (mm/s)		Peak velocity (mm/s)	
Place	**Time**	**Preferred**	**Maximum**	**Preferred**	**Maximum**	**Preferred**	**Maximum**
Continuous Vibration							
Residences	Daytime	0.01	0.02	0.2	0.4	0.28	0.56
Offices	Day or night-time	0.02	0.04	0.4	0.8	0.56	1.1
Workshops		0.04	0.08	0.8	1.6	1.1	2.2
Impulsive Vibration							
Residences	Daytime	0.3	0.6	6.0	12.0	8.6	17.0
Offices	Day or night-time	0.64	1.28	13	26	18	36
Workshops		0.64	1.23	13	26	18	36

Note 1: Continuous vibration relates to vibration that continues uninterrupted for a defined period (usually throughout the daytime or night-time), e.g., continuous construction or maintenance activity. (DECC, 2006).

Note 2: Impulsive vibration relate to vibration that builds up rapidly to a peak followed by a damped decay and that may or may not involve several cycles of vibration (depending on frequency and damping), with up to three occurrences in an assessment period, e.g., occasional loading and unloading, or dropping of heavy equipment. (DECC, 2006).

10.3 CONSTRUCTION NOISE EMISSIONS ASSESSMENT

10.3.1 Noise Levels of Typical Construction Activities

Typically, the most significant sources of noise or vibration generated during a construction project will be demolition, excavation, structural works and piling.

A summary of the equipment/processes which typically generate the highest noise levels during demolition, excavation and construction are summarised below.

Table 10-5 – Sound Power Levels of Typical Equipment

Equipment/ Process	Sound Power Level dB(A)	Duty*
Excavator with hydraulic hammer (10t)	118	75%
Jackhammer	113	75%
Tower Crane	113	50%
Piling Rig – Bored	112	100%
Pump – Concrete	109	100%
Truck – Concrete	109	100%
Trucks – Medium Rigid	103	10%
Powered Hand Tools	102	50%

*Typical amount of time operational within any given 15-minute period.

The noise levels presented in the above table are derived from the following sources, namely:

1. On-site measurements
2. Table A1 of Australian Standard 2436-2010, and
3. Data held by this office from other similar studies

Noise levels take into account correction factors (for tonality, intermittency where necessary).

10.3.2 Predicted Noise Levels

The predicted noise levels during demolition, excavation and construction will depend on:

- The activity undertaken.
- The distance between the work site and the receiver. For many of the work areas, the distance between the noise source and the receiver will vary depending on which end of the site the work is undertaken. For this reason, the predicted noise levels will be presented as a range.

Predicted noise levels are presented in the following tables. Predictions take into account noise reduction as a result of distance, and barrier effects where applicable.

Table 10-6 – Predicted Noise Generation to R1

Activity	Predicted Level dB(A)	Comment
Excavator with hydraulic hammer	72-79	Exceeds 75 dB(A) Highly Noise Affected Level when working near receiver (Refer to Recommendations Section 11).
Piling Rig – Bored	56-62*	Under 60/70 dB(A) Noise Management Level.
Trucks – Medium Rigid	54-61*	
Pump – Concrete	56-63	Exceeds 60 dB(A) Noise Management Level but under 75 dB(A) Highly Noise Affected Level (Refer to Recommendations Section 11).
Truck – Concrete	53-60	Under 60/70 dB(A) Noise Management Level.
Tower Crane	53-60	
Powered Hand Tools	37-44	

*1-2dB(A) exceedance is considered negligible

Table 10-7 – Predicted Noise Generation to R2 & R3

Activity	Predicted Level dB(A)	Comment
Excavator with hydraulic hammer	75-95	Exceeds 75 dB(A) Highly Noise Affected Level (Refer to Recommendations Section 11).
Piling Rig – Bored	58-78	Exceeds 75 dB(A) Highly Noise Affected Level when working near receiver (Refer to Recommendations Section 11).
Trucks – Medium Rigid	56-76*	Exceeds 60 dB(A) Noise Management Level but under 75 dB(A) Highly Noise Affected Level (Refer to Recommendations Section 11).
Pump – Concrete	58-78	Exceeds 75 dB(A) Highly Noise Affected Level when working near receiver (Refer to Recommendations Section 11).
Truck – Concrete	55-75	Exceeds 60 dB(A) Noise Management Level but under 75 dB(A) Highly Noise Affected Level (Refer to Recommendations Section 11).
Tower Crane	55-75	
Powered Hand Tools	39-59	Under 60 dB(A) Noise Management Level.

*1-2dB(A) exceedance is considered negligible

Table 10-8 – Predicted Noise Generation to C1

Activity	Predicted Level dB(A)	Comment
Excavator with hydraulic hammer	75-95	Exceeds 70 dB(A) Noise Management Level (Refer to Recommendations Section 11).
Piling Rig – Bored	58-78	Exceeds 70 dB(A) Noise Management Level when working near receiver (Refer to Recommendations Section 11).
Trucks – Medium Rigid	56-76	
Pump – Concrete	58-78	
Truck – Concrete	55-75	
Tower Crane	55-75	
Powered Hand Tools	39-59	Under 70 dB(A) Noise Management Level.

Table 10-9 – Predicted Noise Generation to C2

Activity	Predicted Level dB(A)	Comment
Excavator with hydraulic hammer	63-75	Exceeds 70 dB(A) Noise Management Level when working near receiver (Refer to Recommendations Section 11).
Piling Rig – Bored	46-58	Under 70 dB(A) Noise Management Level.
Trucks – Medium Rigid	45-57	
Pump – Concrete	47-59	
Truck – Concrete	44-56	
Tower Crane	44-56	
Powered Hand Tools	28-40	

Table 10-10 – Predicted Noise Generation to P1

Activity	Predicted Level dB(A) (Internal)	Comment
Excavator with hydraulic hammer	51-57	Exceeds 45 dB(A) Internal Noise Management Level (Refer to Recommendations Section 11).
Piling Rig – Bored	34-40	Under 45 dB(A) Internal Noise Management Level.
Trucks – Medium Rigid	33-38	
Pump – Concrete	35-40	
Truck – Concrete	32-37	
Tower Crane	32-37	
Powered Hand Tools	16-21	

Table 10-11 – Predicted Noise Generation to E1

Activity	Predicted Level dB(A) (Internal)	Comment
Excavator with hydraulic hammer	59-63	Exceeds 45 dB(A) Internal Noise Management Level (Refer to Recommendations Section 11).
Piling Rig – Bored	42-46*	Under 45 dB(A) Internal Noise Management Level.
Trucks – Medium Rigid	41-45	
Pump – Concrete	43-47*	
Truck – Concrete	40-44	
Tower Crane	40-44	
Powered Hand Tools	24-28	

*1-2dB(A) exceedance is considered negligible

Table 10-12 – Predicted Noise Generation to E2

Activity	Predicted Level dB(A) (Internal)	Comment
Excavator with hydraulic hammer	49-54	Exceeds 45 dB(A) Internal Noise Management Level (Refer to Recommendations Section 11).
Piling Rig – Bored	32-37	Under 45 dB(A) Internal Noise Management Level.
Trucks – Medium Rigid	31-35	
Pump – Concrete	33-37	
Truck – Concrete	30-34	
Tower Crane	30-34	
Powered Hand Tools	14-18	

10.4 DISCUSSION

Noise

The demolition stage utilises the loudest equipment in any stage of construction.

Primarily, the use of the excavator with hydraulic hammer is predicted to be the highest noise generating equipment. It is also noted that the excavator with hydraulic hammer is only expected to be used in during specific portions of the demolition and excavation stages and will not be continuous throughout these stages.

External noise level predictions to all receivers have been presented as worst-case scenarios where the closest receiver has direct line of sight to construction plant operating at the closest point of the site with respect to each individual receiver where not obviously shielded by other buildings. It is noted that many residents are shielded by other developments, which would lead to lower noise levels than those predicted in the previous section. It is likely that the demolition staging will allow for much more screening of local receivers than predicted. This will be dependent on the demolition staging process that is to be detailed by the Client.

It is also noted that ground level receivers will also receive lower noise levels than predicted due to hoarding around the perimeter of the site, likely to reduce the construction noise level by 10 dB(A).

Treatment processes are recommended as per Section 11 with further recommendations in Sections 12, 13 & 14. With the implementation of the aforementioned sections, the Client demonstrates that all reasonable and feasible vibration and noise mitigation measures have been taken.

Vibration

Given the distance and Type 1 vibration limits (from DIN-4150), vibration impacts to surrounding developments are not expected to require specific mitigation unless conducting high vibration generating activities to the building at **C1** and **R3** directly adjacent to the site boundary with potential vibration concerns for high impact equipment at **R2**. Where a complaint is received, attended measurements of vibration may be undertaken to determine the cause and any further investigation or monitoring which should be undertaken.

11 PROJECT SPECIFIC CONSTRUCTION MANAGEMENT CONTROLS

In light of the above, we recommend:

1. **Community Consultation/Notification:** Notification (leaflet or similar) of all receivers identified in Section 5.1 is recommended prior to commencement of works. Notification should advise of anticipate date and duration of demolition. Consultation has already been conducted as part of this proposal.

2. **Respite Periods:** To protect the amenity of nearby residential receivers, it is proposed to introduce respite periods where construction activities exceed the 'highly noise affected level (75 dB(A) $L_{eq(15min)}$) based on the predicted noise levels presented in Section 10.3.2. In the event that respite periods are to be imposed, it is recommended to consider respite hours as follows:

    a. Monday to Friday: 7:00am-8:00am

    b. Monday to Friday: 12:00pm-1:00pm

    c. It is noted that the construction plant which is predicted to exceed the 'highly noise affected level' would only be in use intermittently during the demolition stage.

    d. It is noted that respite periods will extend the length of demolition works and may provide heavier loss of amenity compared to non-imposed demolition.

3. **Vibration monitoring**: In the event of a complaint, we recommend vibration monitoring is to be implemented along the property boundary closest to the vibration receiver who issued the complaint.

4. **Noise monitoring**: In the event of a complaint, noise monitoring can be implemented along the property boundary closest to the noise receiver who issued the complaint.

5. **Quiet Work Methods/Technologies:**

    a. The primary noise generating activity at the site will be the demolition and excavation periods. As much as practicable, use of quieter methods is to be adopted.

    b. It is recommended to use rock/ concrete saws near all boundaries to reduce vibration and noise levels if required.

    c. Materials handling/vehicles:

        i. Trucks and bobcats to use a non-tonal reversing beacon (subject to OH&S requirements) to minimise potential disturbance of neighbours.

        ii. Avoid careless dropping of construction materials into empty trucks.

        iii. Trucks, trailers and concrete trucks (if feasible) should turn off their engines during idling to reduce noise impacts (unless truck ignition needs to remain on during concrete pumping).

6. **Complaints Handling:** In the event of complaint, the procedures outlined in Section 14 should be adopted.

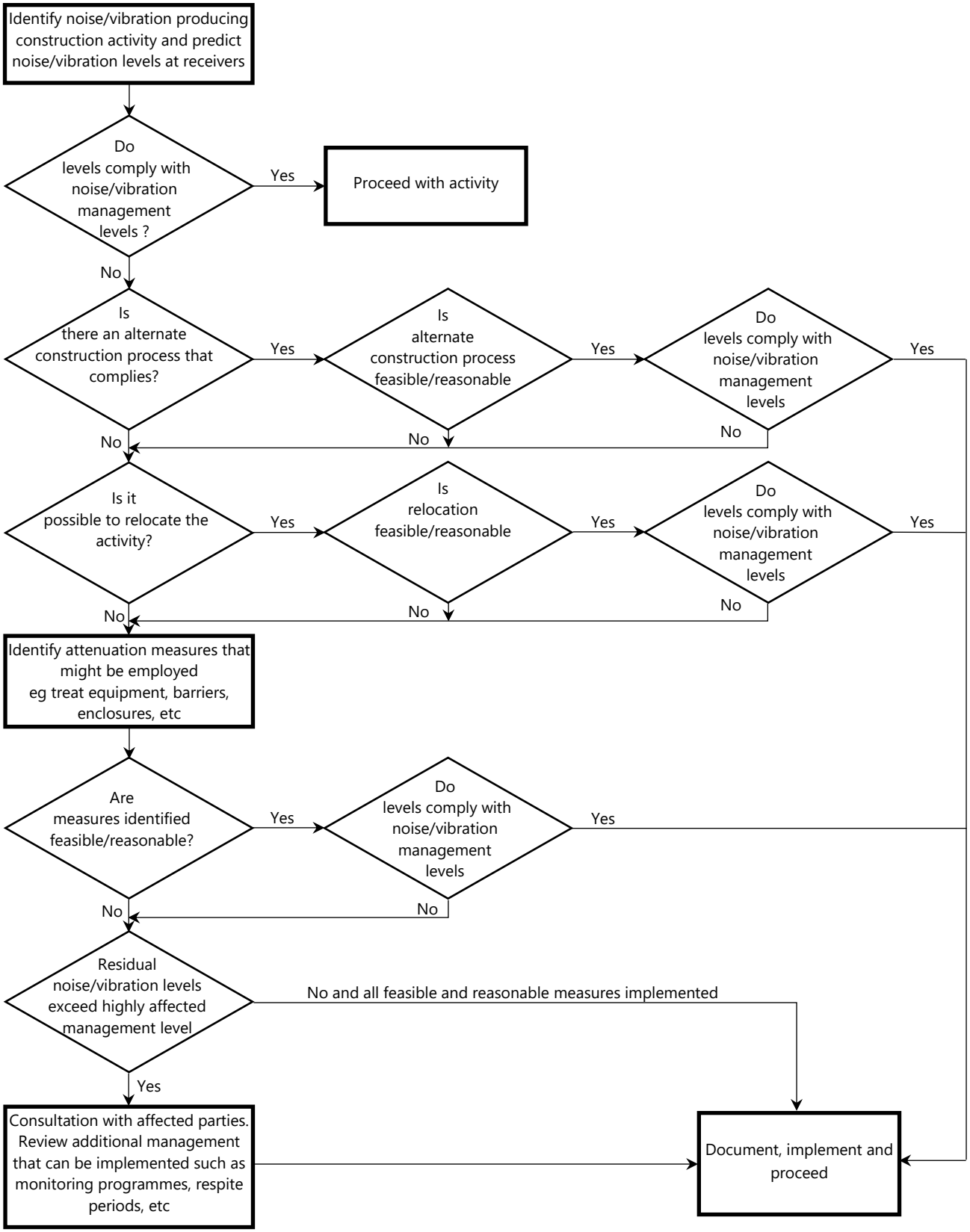
7. **Site Induction:**

    a. A copy of these recommendations is to be available to contractors. The location of this should be advised in any site induction.

    b. Site induction should also detail the site contact in the event of noise complaint.

12 CONTROL OF CONSTRUCTION NOISE AND VIBRATION – PROCEDURAL STEPS

The flow chart presented below illustrates the process that will be followed in assessing construction activities.



13 ADDITIONAL NOISE AND VIBRATION CONTROL METHODS

In the event of complaints, there are a number of noise mitigation strategies available which can be considered.

The determination of appropriate noise control measures will be dependent on the particular activities and construction appliances. This section provides an outline of available methods.

13.1 SELECTION OF ALTERNATE APPLIANCE OR PROCESS

Where a particular activity or construction appliance is found to generate excessive noise levels, it may be possible to select an alternative approach or appliance. For example, the use of a hydraulic hammer on certain areas of the site may potentially generate high levels of noise. Undertaking this activity using bulldozers, ripping and/or milling machines will result in lower noise levels.

13.2 ACOUSTIC BARRIER

Given the position of adjacent development, it is unlikely that noise screens will provide significant acoustic benefit for residential receivers but will provide noticeable improvement for those on ground level.

The placement of barriers at the source is generally only effective for static plant. Equipment which is on the move or working in rough or undulating terrain cannot be effectively attenuated by placing barriers at the source.

Barriers can also be placed between the source and the receiver.

The degree of noise reduction provided by barriers is dependent on the amount by which line of sight can be blocked by the barrier. If the receiver is totally shielded from the noise source reductions of up to 15dB(A) can be affected. Where only partial obstruction of line of sight occurs, noise reductions of 5 to 8dB(A) may be achieved. Where no line of sight is obstructed by the barrier, generally no noise reduction will occur.

As barriers are used to provide shielding and do not act as an enclosure, the material they are constructed from should have a noise reduction performance that is approximately 10dB(A) greater than the maximum reduction provided by the barrier. In this case the use of a material such as 10mm or 15mm thick plywood (radiata plywood) would be acceptable for the barriers.

13.3 MATERIAL HANDLING

The installation of rubber matting over material handling areas can reduce the sound of impacts due to material being dropped by up to 20dB(A).

13.4 TREATMENT OF SPECIFIC EQUIPMENT

In certain cases, it may be possible to specially treat a piece of equipment to dramatically reduce the sound levels emitted.

13.5 ESTABLISHMENT OF SITE PRACTICES

This involves the formulation of work practices to reduce noise generation. A more detailed management plan will be developed for this project in accordance with the construction methodology outlining work procedures and methods for minimising noise.

13.6 COMBINATION OF METHODS

In some cases, it may be necessary that two or more control measures be implemented to minimise noise.

14 COMMUNITY INTERACTION AND COMPLAINTS HANDLING

14.1 ESTABLISHMENT OF DIRECT COMMUNICATION WITH AFFECTED PARTIES

In order for any construction noise management programme to work effectively, continuous communication is required between all parties, which may be potentially impacted upon, the builder and the regulatory authority. This establishes a dynamic response process which allows for the adjustment of control methods and criteria for the benefit of all parties.

The objective in undertaking a consultation process is to:

- Inform and educate the groups about the project and the noise controls being implemented
- Increase understanding of all acoustic issues related to the project and options available
- Identify group concerns generated by the project, so that they can be addressed, and
- Ensure that concerned individuals or groups are aware of and have access to a Constructions Complaints Register which will be used to address any construction noise related problems should they arise.

Community consultation is recommended prior to any works commencing on site, with letterbox notifications to all identified surrounding sensitive receivers (refer Section 5.1). This will include a construction management plan detailing the proposed works on site and duration of each stage.

14.2 DEALING WITH COMPLAINTS

Should ongoing complaints of excessive noise or vibration criteria occur immediate measures shall be undertaken to investigate the complaint, the cause of the exceedances and identify the required changes to work practices. In the case of exceedances of the vibration limits all work potentially producing vibration shall cease until the exceedance is investigated.

The effectiveness of any changes shall be verified before continuing. Documentation and training of site staff shall occur to ensure the practices that produced the exceedances are not repeated.

If a noise complaint is received the complaint should be recorded on a Noise Complaint Form. The complaint form should list:

- The name and address of the complainant (if provided)
- The time and date the complaint was received
- The nature of the complaint and the time and date the noise was heard
- The name of the employee who received the complaint
- Actions taken to investigate the complaint, and a summary of the results of the investigation
- Required remedial action, if required
- Validation of the remedial action, and
- Summary of feedback to the complainant.

A permanent register of complaints should be held. All complaints received should be fully investigated and reported to management. The complainant should also be notified of the results and actions arising from the investigation.

The investigation of a complaint shall involve where applicable:

- Noise measurements at the affected receiver
- An investigation of the activities occurring at the time of the incident
- Inspection of the activity to determine whether any undue noise is being emitted by equipment, and
- Whether work practices were being carried out either within established guidelines or outside these guidelines.

Where an item of plant is found to be emitting excessive noise, the cause is to be rectified as soon as possible. Where work practices within established guidelines are found to result in excessive noise being generated then the guidelines should be modified so as to reduce noise emissions to acceptable levels. Where guidelines are not being followed, the additional training and counselling of employees should be carried out.

Measurement or other methods shall validate the results of any corrective actions arising from a complaint where applicable.

14.3 REPORTING REQUIREMENTS

The following shall be kept on site:

1. A register of complaints received/communication with the local community shall be maintained and kept on site with information as detailed in this report.
2. Where noise/vibration complaints require noise/vibration monitoring, results from monitoring shall be retained on site at all times.
3. Any noise exceedances occurring including the actions taken and results of follow up monitoring.
4. A report detailing complaints received and actions taken shall be presented to the construction liaison committee.

14.4 CONTINGENCY PLANS

Where non-compliances or noise complaints are raised the following methodology will be implemented.

1. Determine the offending plant/equipment/process.
2. Locate the plant/equipment/process further away from the affected receiver(s) if possible.
3. Implement additional acoustic treatment in the form of localised barriers, silencers etc where practical.
4. Selecting alternative equipment/processes where practical.

15 SUMMARY OF COMPLYING MITIGATION

Modelling indicated that additional mitigation is needed to achieve compliance with each respective criterion. This additional mitigation is described below, along with other measures to minimise impacts.

15.1 INTERNAL NOISE CONTROL

Minimum façade requirements including glazing, external roof/ceilings, external wall constructions are provided in detail within Section 9.

Façade constructions are to be reviewed at CC stage based on construction drawings pending final façade design.

15.2 CONSTRUCTION NOISE

15.2.1 Management Controls

Recommendations within Sections 11 to 15 have been provided to reduce noise levels resulting from the construction of the development.

16 CONCLUSION

This report summarises the noise impact assessment undertaken for the proposed development at 253-265 Pacific Highway, North Sydney. The outcomes are:

- Ambient noise has been measured at the site. The data obtained have been used to predict exposure around the envelope of the proposed development, and the impacts assessed using relevant project specific criteria.
- The assessment indicates that treatment of the building envelope will be required to mitigate impacts from the environmental noise sources impacting the site, as identified in the assessment. Complying mitigation is provided in in Section 7 of this report.
- With the implementation of adequate mitigation, the proposed development will achieve an acceptable level of acoustic amenity for the future occupants.
- It is recommended that a condition for obtaining a Construction Certificate should be a detailed assessment of the measures needed to comply with the performance objectives adopted in this assessment. The completed development should incorporate those recommendations.

Yours faithfully,

Acoustic Logic Pty Ltd
Weber Yeh

APPENDIX A AMBIENT NOISE MONITORING

This appendix summarises the ambient noise data measured near the subject site, and the calculated noise level descriptors adopted to characterise the existing noise environment.

Monitoring has been undertaken to provide the following ambient data:

- Background noise levels at the surrounding residential properties.
- Traffic noise levels.
- Noise generated by adjacent land uses.

A.1 NOISE DESCRIPTORS

Ambient noise constantly varies in level from moment to moment, so it is not possible to accurately determine prevailing noise conditions by measuring a single, instantaneous noise level.

To quantify ambient noise, a 15-minute measurement interval is typically utilised. Noise levels are monitored on a continuous basis over this period, and statistical and integrating techniques are used to characterise the noise being measured.

The principal measurement parameters are:

L_{eq} - represents the average noise energy during a measurement period. This parameter is derived by integrating the noise levels measured over the measurement period. L_{eq} is important in the assessment of noise impact as it closely corresponds with how humans perceive the loudness of steady state and quasi-steady state noise sources (such as traffic noise).

L_{90} – This is commonly used as a measure of the background noise level as it represents the noise level heard in the quieter periods during the measurement interval. The L_{90} parameter is used to set noise emission criteria for potentially intrusive noise sources since the disturbance caused by a noise source will depend on how audible it is above the pre-existing noise environment, particularly during quiet periods, as represented by the L_{90} level.

L_{10} is used in some guidelines to measure noise produced by an intrusive noise source since it represents the average of the loudest noise levels produced at the source. Typically, this is used to assess noise from licenced venues.

L_{max} is the highest noise level produced during a noise event and is typically used to assess sleep arousal impacts from short term noise events during the night. It is also used to assess internal noise levels resulting from aircraft noise and ground vibration induced noise from railways.

L_1 is sometimes used in place of L_{max} to represent a typical noise level from a number of high-level, short-term noise events.

A.2 UNATTENDED LONG TERM NOISE MONITORING

A.2.1 Equipment Used

Unattended noise monitoring was conducted using the following equipment:

- Rion NL-42 (Type 2)
- Svan calibrator SV 338

Monitoring was continuous, with statistical noise levels recorded at 15-minute intervals throughout the monitoring period. Measurements were taken on "A" frequency weighting and fast time response, unless noted otherwise.

All monitoring equipment used retains current calibration - either manufacturers' calibration or NATA certified calibration. The monitors were field calibrated at the beginning and the end of the measurement with no significant drift in calibration noted.

A.2.2 Location Monitored

The location monitored is indicated in Figure 2. Photographs of the monitoring locations are provided below.

A.2.3 Weather Affected and Extraneous/ Outlying Data

Periods affected by adverse weather conditions (as defined by Fact Sheet B) are indicated on the following data graphs and have been excluded from the assessment. Weather data was obtained from records provided by the Bureau of Meteorology for the following station:

As the Bureau of Meteorology wind data is typically obtained at an exposed location at 10m above ground level, and the monitoring locations were at approximately 1.5m above ground in more sheltered locations a wind multiplying factor of 0.33 has been applied to the BOM data to estimate the wind speed at the microphone location based on monitoring being done in a suburban/ urban area.

Wind speed was obtained from Fort Denison AWS.

Rain fall data was obtained from Observatory Hill AWS.

Multiple time periods were identified as likely to contain significant periods of non-representative data and have been excluded from the assessment.

Figure 2 – Noise Monitoring Locations (Source: NSW SDT Explorer)

Project Site

Residential Receivers

Commercial Receivers

Educational Receivers

Place of Worship Receivers

Unattended Noise Monitoring

Attended Noise Measurements

Figure 3 – Monitor Placed at 265 Pacific Highway Facing Pacific Highway (Traffic)

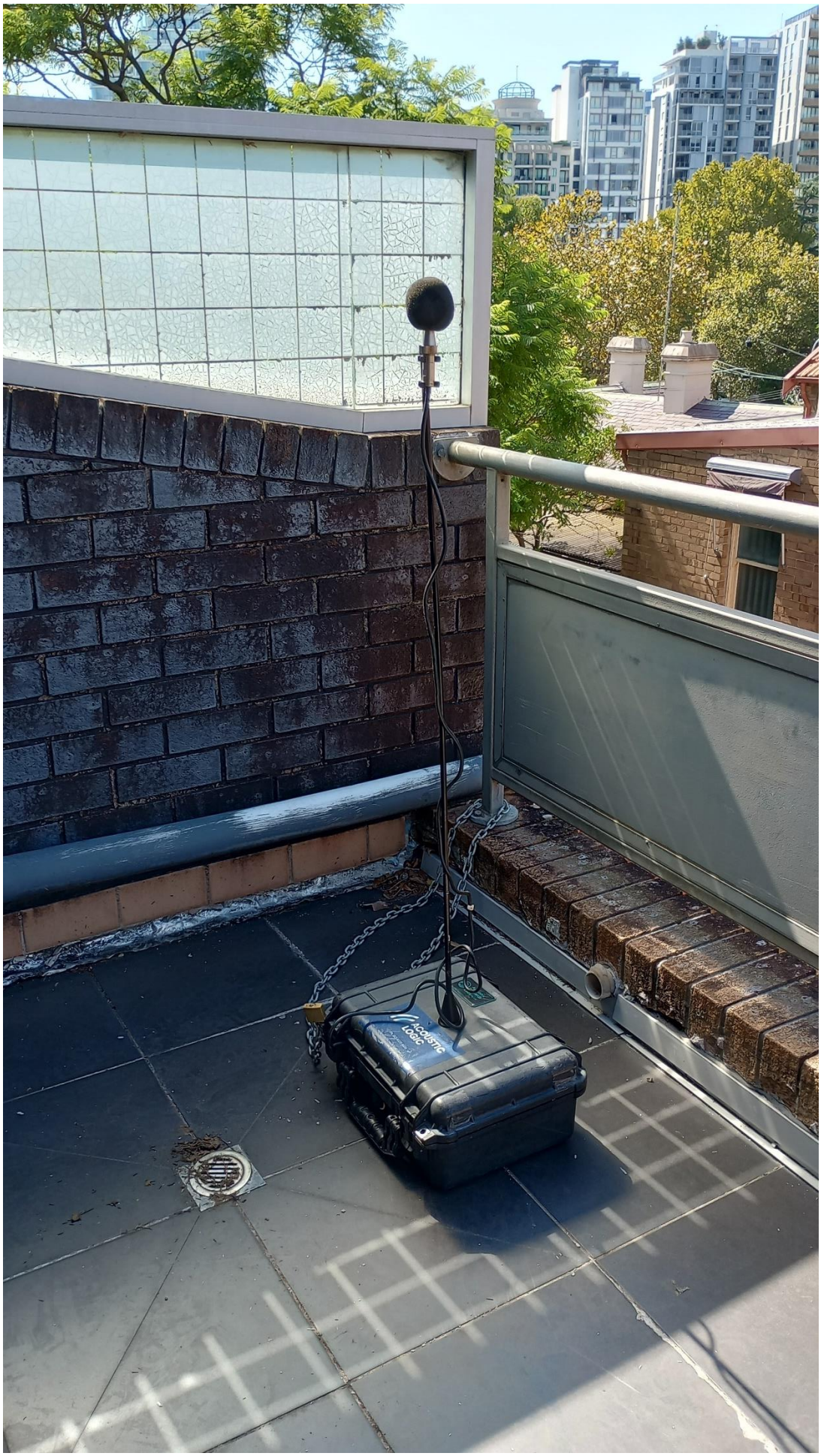


Figure 4 – Monitor Placed on Balcony at 265 Pacific Highway Facing Church Lane (Background)

A.3 CALCULATION OF REPRESENTATIVE AMBIENT NOISE LEVELS

The ambient, assessment and rating background levels have been determined from the unattended, long-term noise monitoring data based on the methodology in the Noise Policy for Industry Fact Sheet B.

A.4 RATING BACKGROUND NOISE LEVELS

The following table summarises the assessment background noise levels (ABL) for each location. Note that where no ABL is indicated, this is because that period was significantly affected by adverse weather or other extraneous noise.

In accordance with the NPfI:

- If the calculated evening rating background noise level is higher than the day level, the day rating background noise level has been adopted for the evening period.
- If the calculated night rating background noise level is higher than the evening level, the evening rating background noise level has been adopted for the evening period.
- If the calculated day rating background noise level was less than 35 dB(A), a "default" background of 35 dB(A) has been adopted.
- If the calculated evening or night rating background noise level was less than 30 dB(A), a "default" background of 30 dB(A) has been adopted.
- Where monitoring was conducted within 3m of a significant sound reflecting surface, 2.5 dB(A) has been subtracted from the calculated rating background to account for an increase in noise from reflections.

Table A-1 – Assessment Background Noise Levels – Facing Pacific Highway

Location	Date		ABL		
			Day	Evening	Night
Facing Pacific Highway, 365 Pacific Highway (**R1, R3**)	Wednesday	5/02/2025	0	53.9	41.5
	Thursday	6/02/2025	61	55.2	42
	Friday	7/02/2025	60	56.8	41.4
	Saturday	8/02/2025	56.7	54.8*	41.8*
	Sunday	9/02/2025	54.4	52.2	39.6
	Monday	10/02/2025	61*	53.3	41.5
	Tuesday	11/02/2025	59.9	55.2	40.4
	Wednesday	12/02/2025	59.9	55.1	42.2
	Thursday	13/02/2025	59.8	56.9	41.7
	Friday	14/02/2025	61.8	57.5	43
	Saturday	15/02/2025	57.2	54.8	41.7
	Sunday	16/02/2025	53.4	49.8	41.3
	Monday	17/02/2025	0	0	0
	Calculated RBL		**60**	**55**	**42**
	Adopted RBL		**60**	**55**	**42**

*Weather affected data removed from calculation.

Table A-2 – Assessment Background Noise Levels – Facing Church Lane

Location	Date		ABL		
			Day	Evening	Night
Facing Church Lane, 365 Pacific Highway (**R2**)	Wednesday	5/02/2025	0	45.6	39.4
	Thursday	6/02/2025	50.6	45.5	39.6
	Friday	7/02/2025	51.5	49.3	39.3
	Saturday	8/02/2025	48	45.2*	39.2*
	Sunday	9/02/2025	45.3	44.6	38.9
	Monday	10/02/2025	51.6*	44.3	38.1
	Tuesday	11/02/2025	50.2	45.5	39.3
	Wednesday	12/02/2025	50.6	46.2	40.3
	Thursday	13/02/2025	52.9	48.9	39.6
	Friday	14/02/2025	51	46.8	40.1
	Saturday	15/02/2025	47	45.9	38.6
	Sunday	16/02/2025	46	44.2	38.4
	Monday	17/02/2025	0	0	0
	Calculated RBL		**50**	**46**	**39**
	Adopted RBL		**50**	**46**	**39**

*Weather affected data removed from calculation.

As the noise monitoring facing Pacific Highway is heavily traffic noise dominated, RBL's shall be adopted from noise monitoring facing Church Lane for conservative assessment of residential façades that are not directly facing Pacific Highway

A.5 AMBIENT NOISE LEVELS

The data for the day, evening and night periods have been processed to determine the ambient noise levels at the monitoring locations for each period.

The $L_{eq,15hr}$ (day period, 7am to 10pm) and $L_{eq,9hr}$ (night period, 10pm to 7am) ambient noise level descriptors adopted in the NSW *Road Noise Policy* 2011 guideline have been calculated from the data and are summarised in the following table.

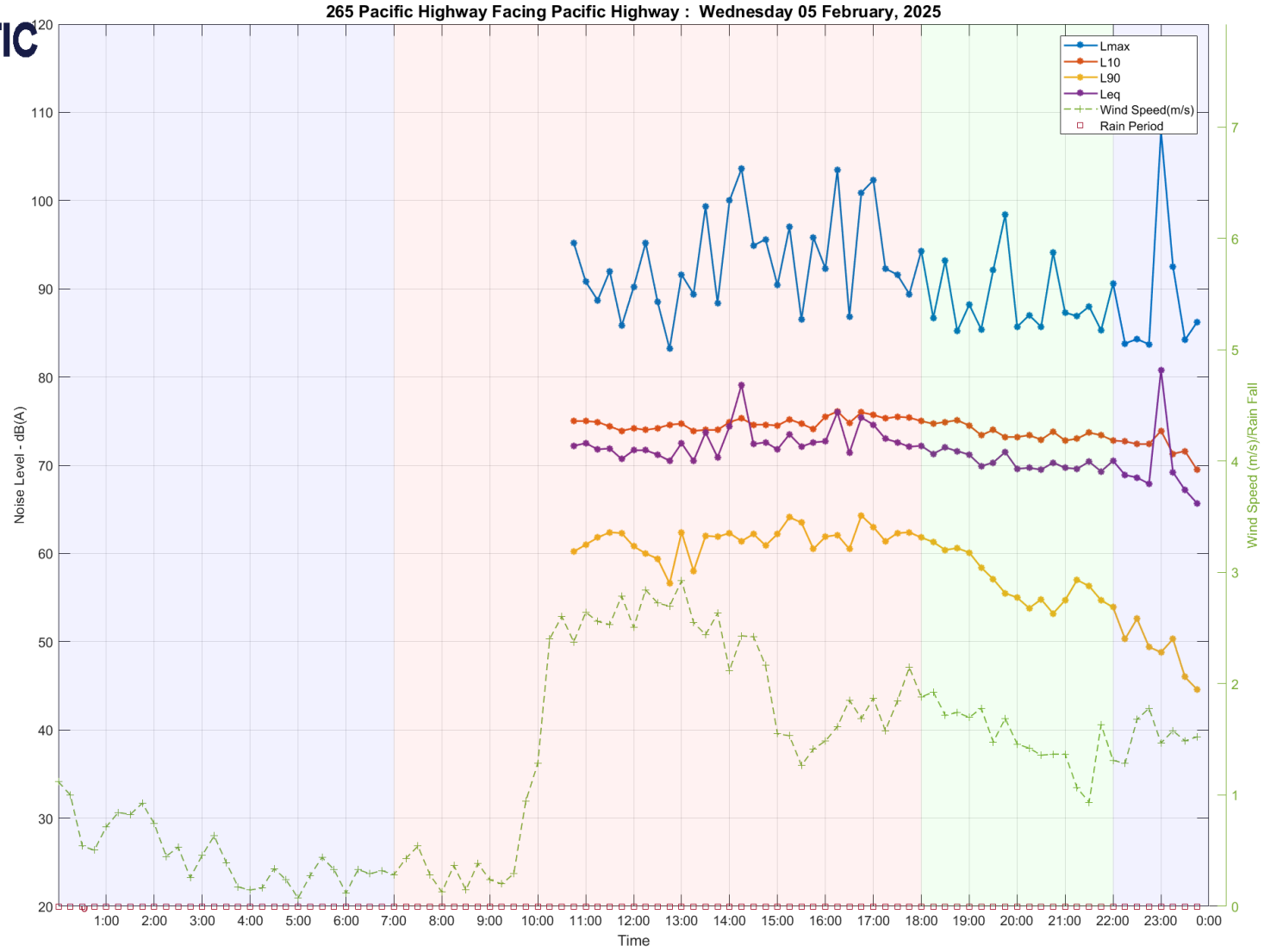
Table A-3 – RNP Ambient Noise

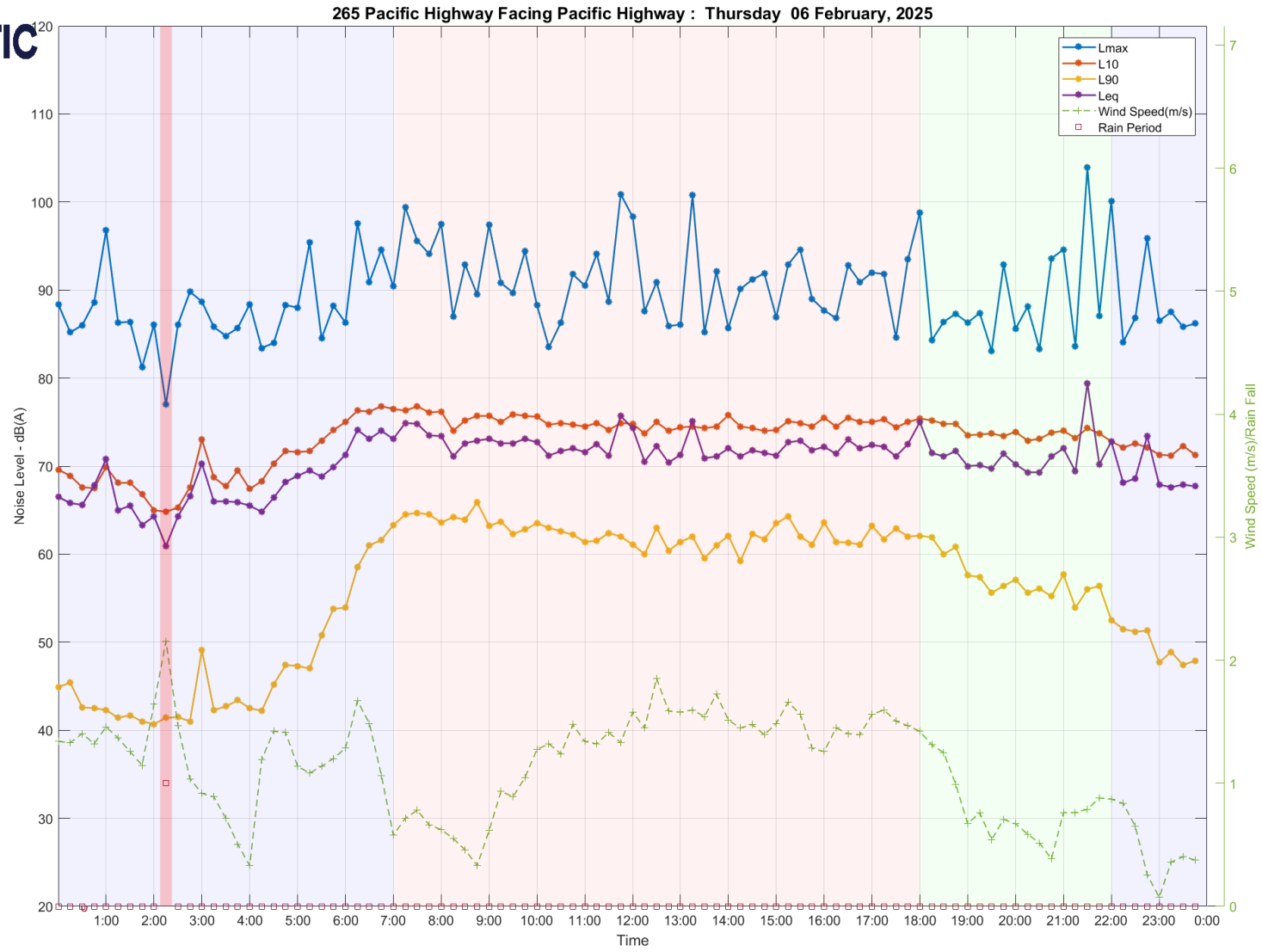
Location	Ambient Noise Level (dB(A) $L_{eq,period}$)	
	Day (7am to 10pm)	Night (10pm to 7am)
Noise monitor facing Pacific Highway, 365 Pacific Highway, North Sydney	69.9*	67.1*
Noise monitor facing Church Lane, 365 Pacific Highway, North Sydney	57	52.8

*-2.5dB(A) for façade reflections based on reflections at noise monitoring position.

A.6 UNATTENDED MONITORING DATA GRAPHS

A.6.1 Facing Pacific Highway




265 Pacific Highway Facing Pacific Highway : Thursday 06 February, 2025
Lmax
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L90
Leq
Wind Speed(m/s)
Rain Period
Noise Level - dB(A)
Wind Speed (m/s)/Rain Fall
Time
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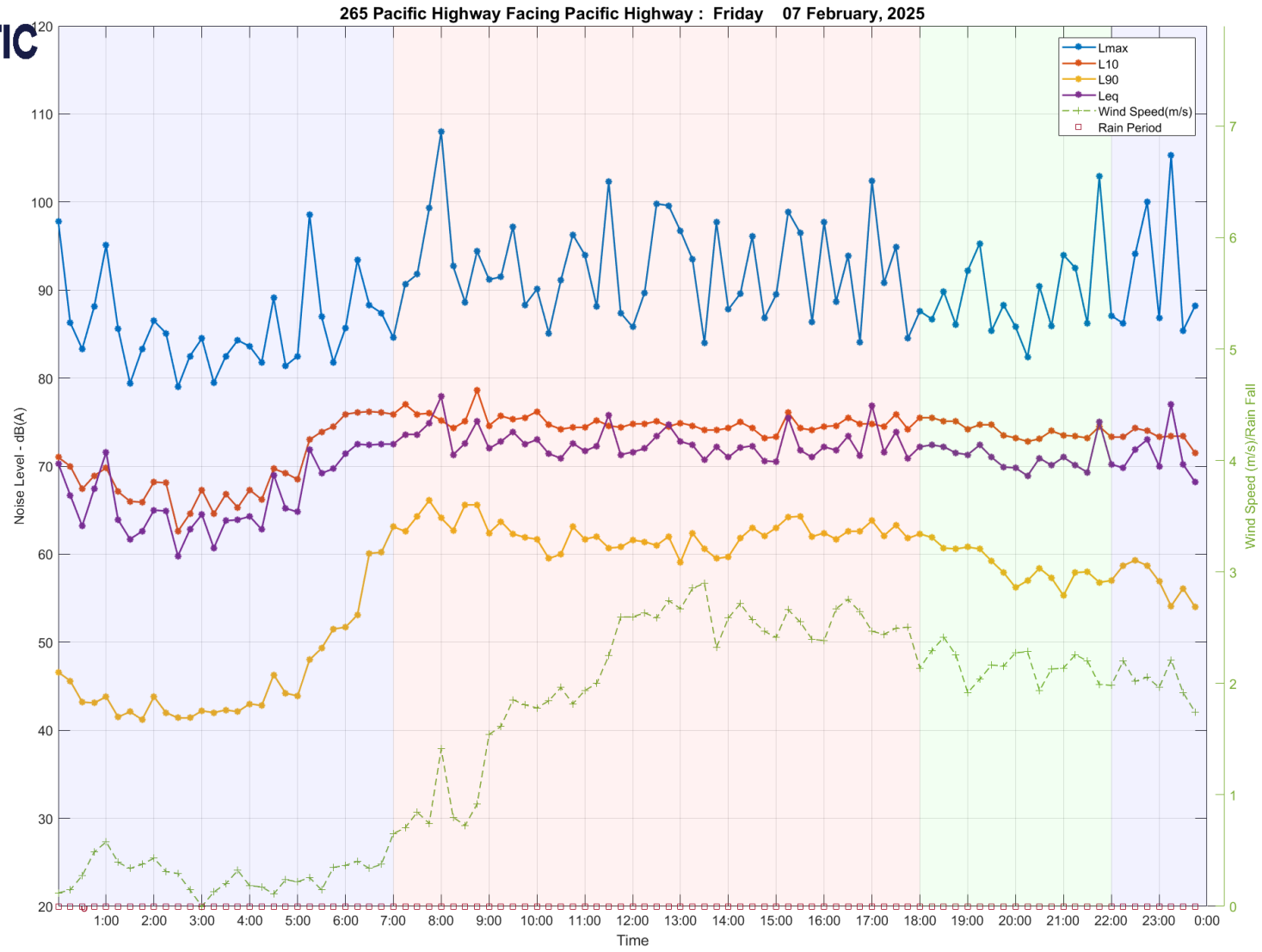
265 Pacific Highway Facing Pacific Highway : Friday 07 February, 2025
Lmax
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L90
Leq
Wind Speed(m/s)
Rain Period
Noise Level - dB(A)
Wind Speed (m/s)/Rain Fall
Time
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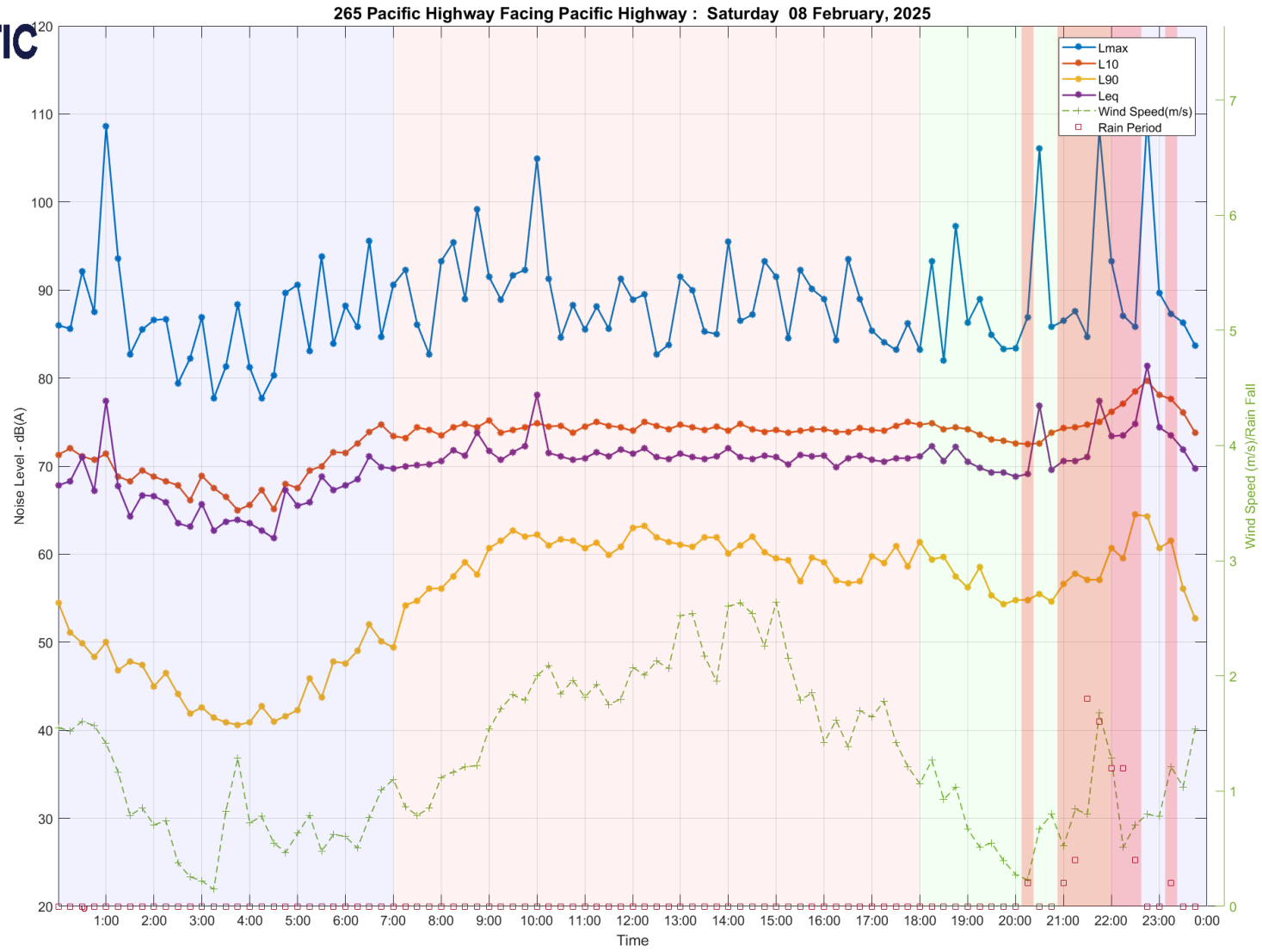
265 Pacific Highway Facing Pacific Highway : Saturday 08 February, 2025
Lmax
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Leq
Wind Speed(m/s)
Rain Period
Noise Level - dB(A)
Wind Speed (m/s)/Rain Fall
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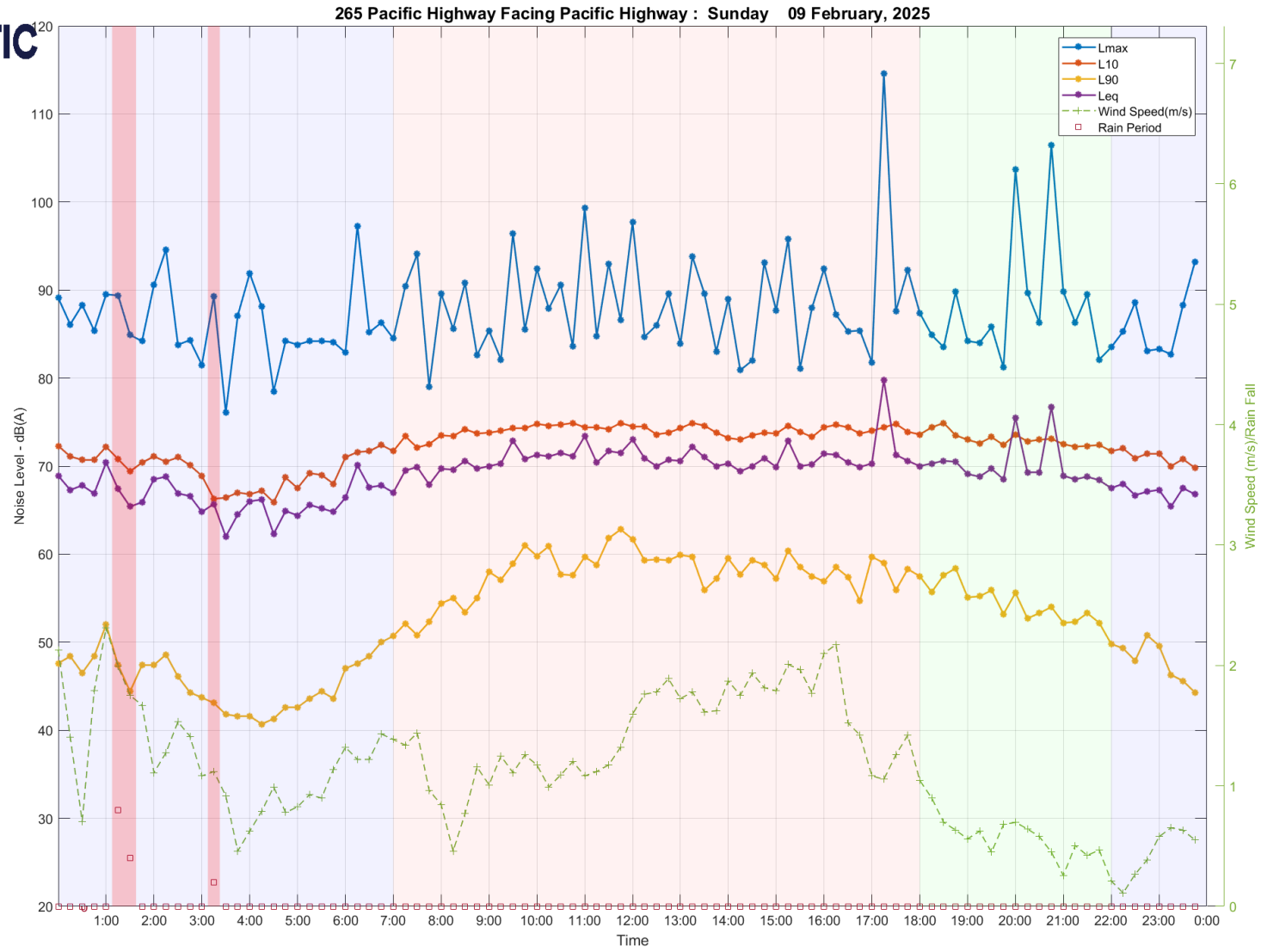
265 Pacific Highway Facing Pacific Highway : Sunday 09 February, 2025
Lmax
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Leq
Wind Speed(m/s)
Rain Period
Noise Level - dB(A)
Wind Speed (m/s)/Rain Fall
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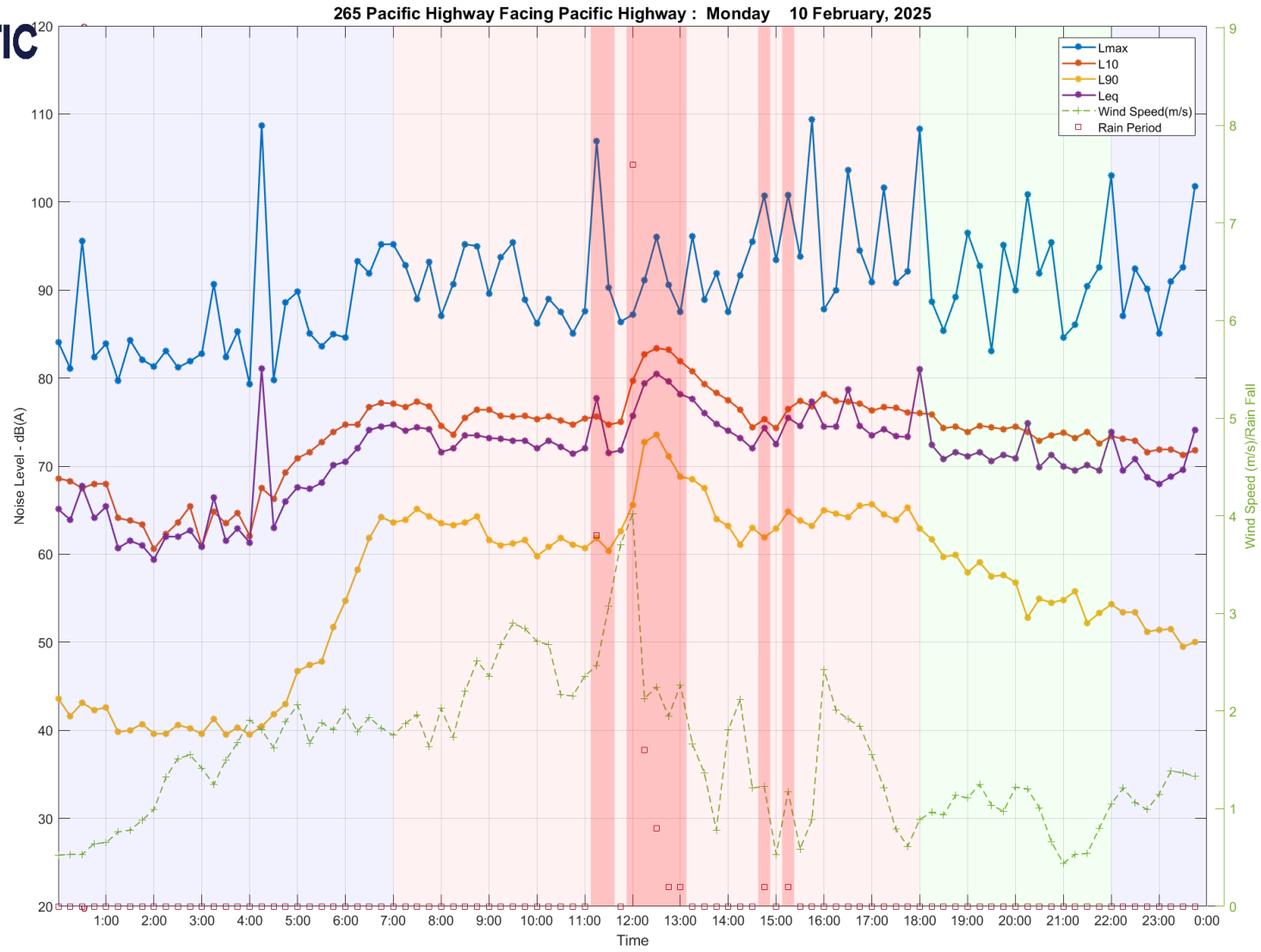
265 Pacific Highway Facing Pacific Highway : Monday 10 February, 2025
Lmax
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Leq
Wind Speed(m/s)
Rain Period
Noise Level - dB(A)
Wind Speed (m/s)/Rain Fall
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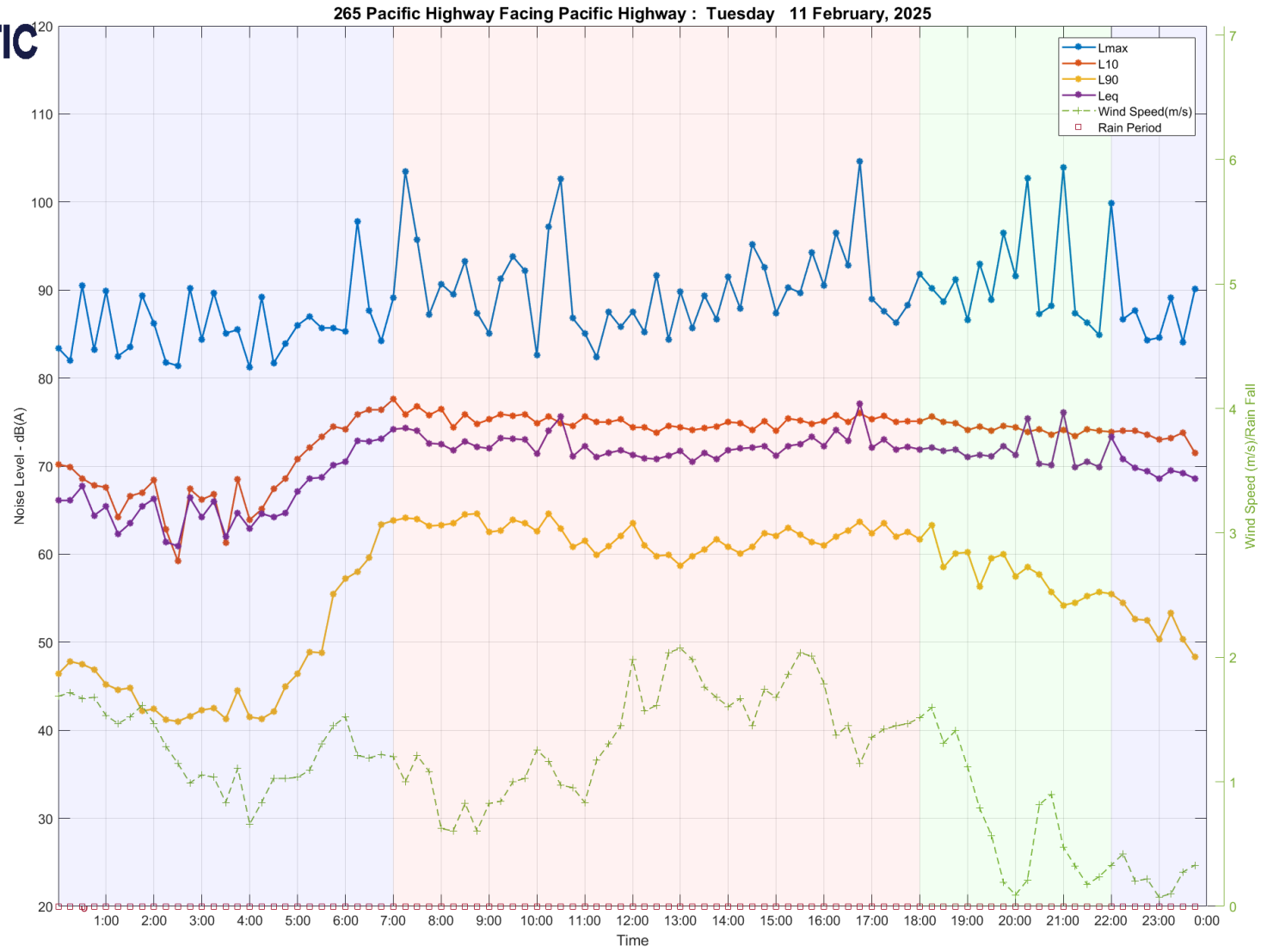
265 Pacific Highway Facing Pacific Highway : Tuesday 11 February, 2025
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Leq
Wind Speed(m/s)
Rain Period
Noise Level - dB(A)
Wind Speed (m/s)/Rain Fall
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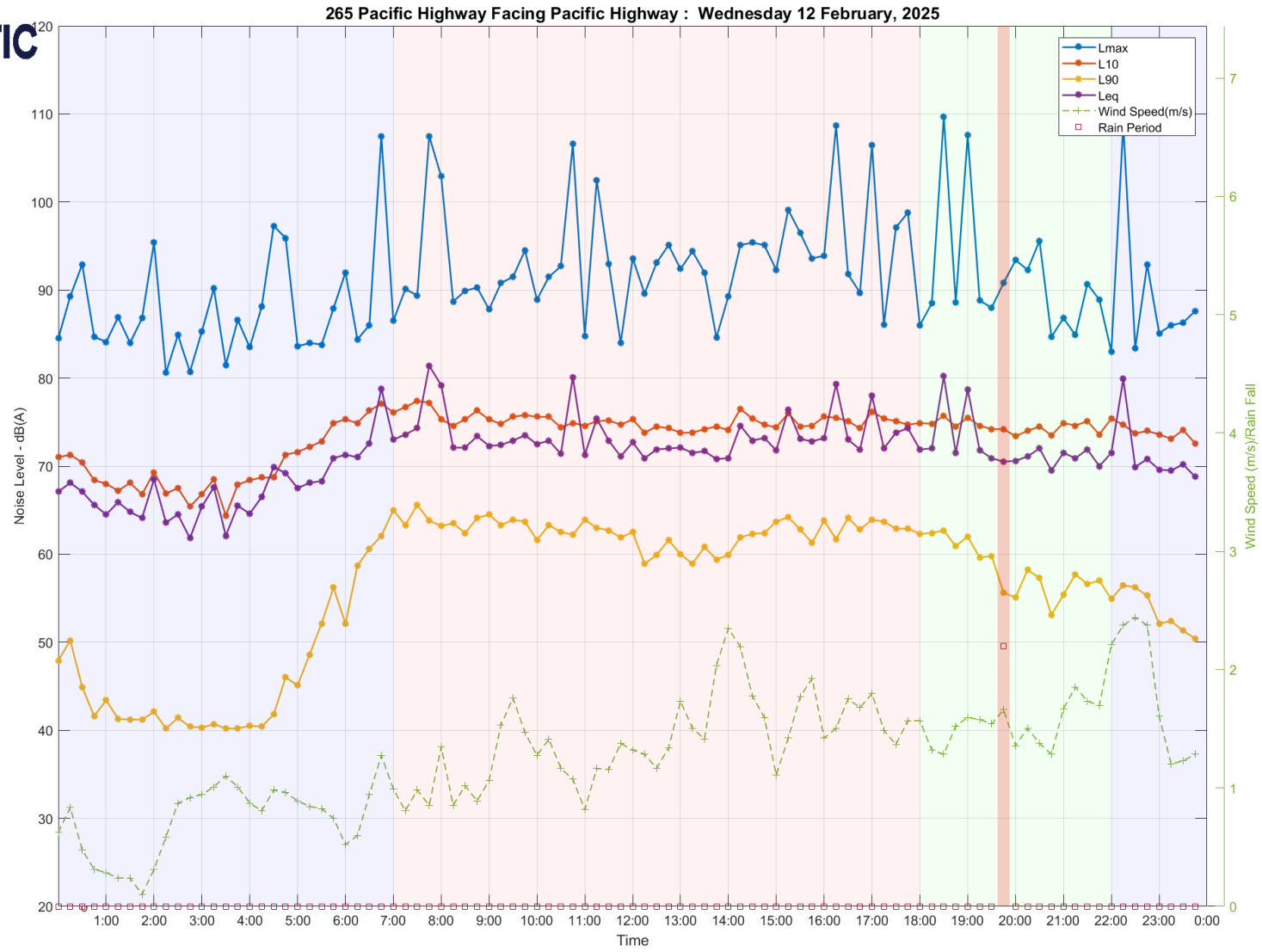
265 Pacific Highway Facing Pacific Highway : Wednesday 12 February, 2025
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Wind Speed(m/s)
Rain Period
Noise Level - dB(A)
Wind Speed (m/s)/Rain Fall
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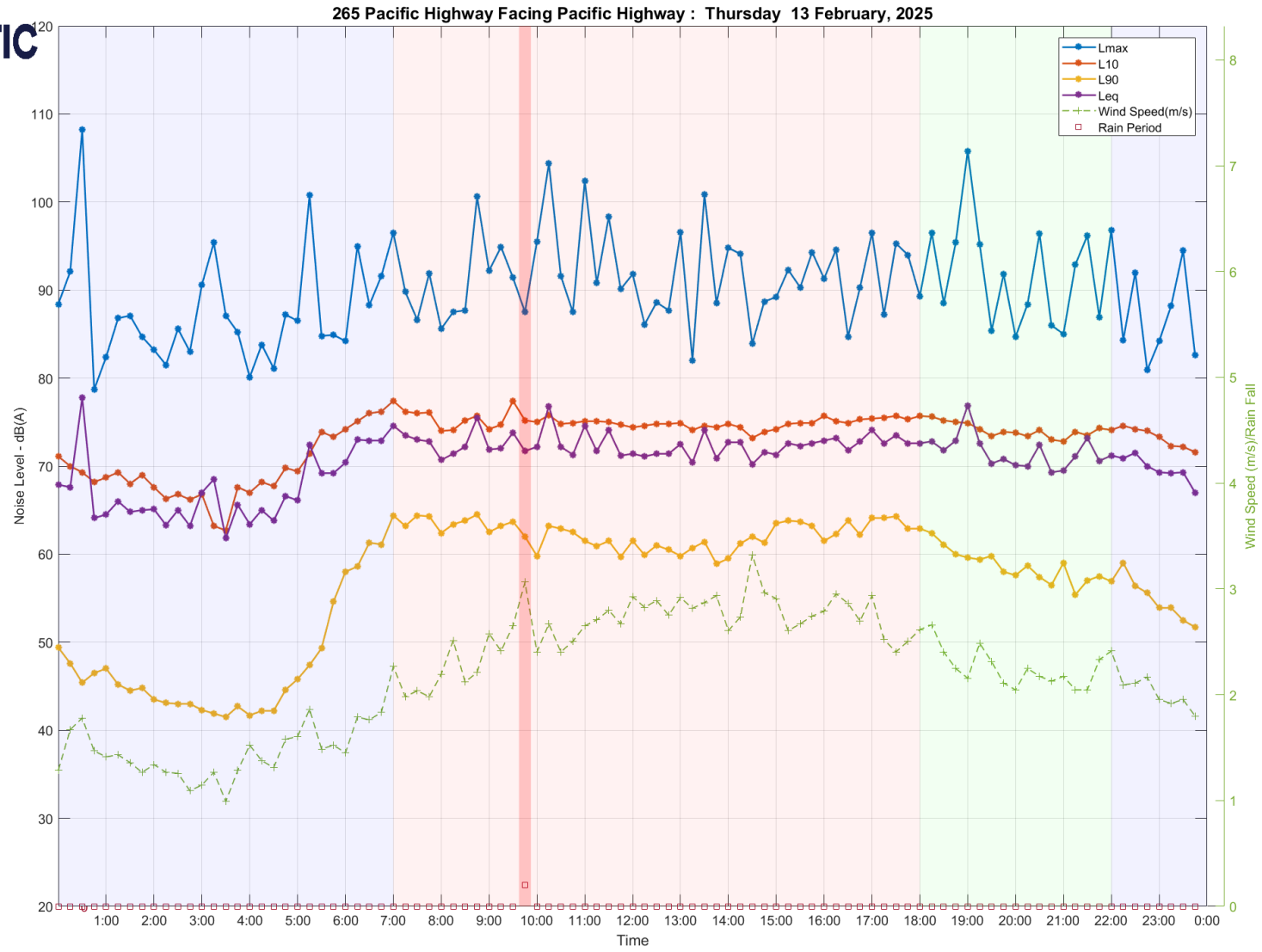
265 Pacific Highway Facing Pacific Highway : Thursday 13 February, 2025
Lmax
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Leq
Wind Speed(m/s)
Rain Period
Noise Level - dB(A)
Wind Speed (m/s)/Rain Fall
Time
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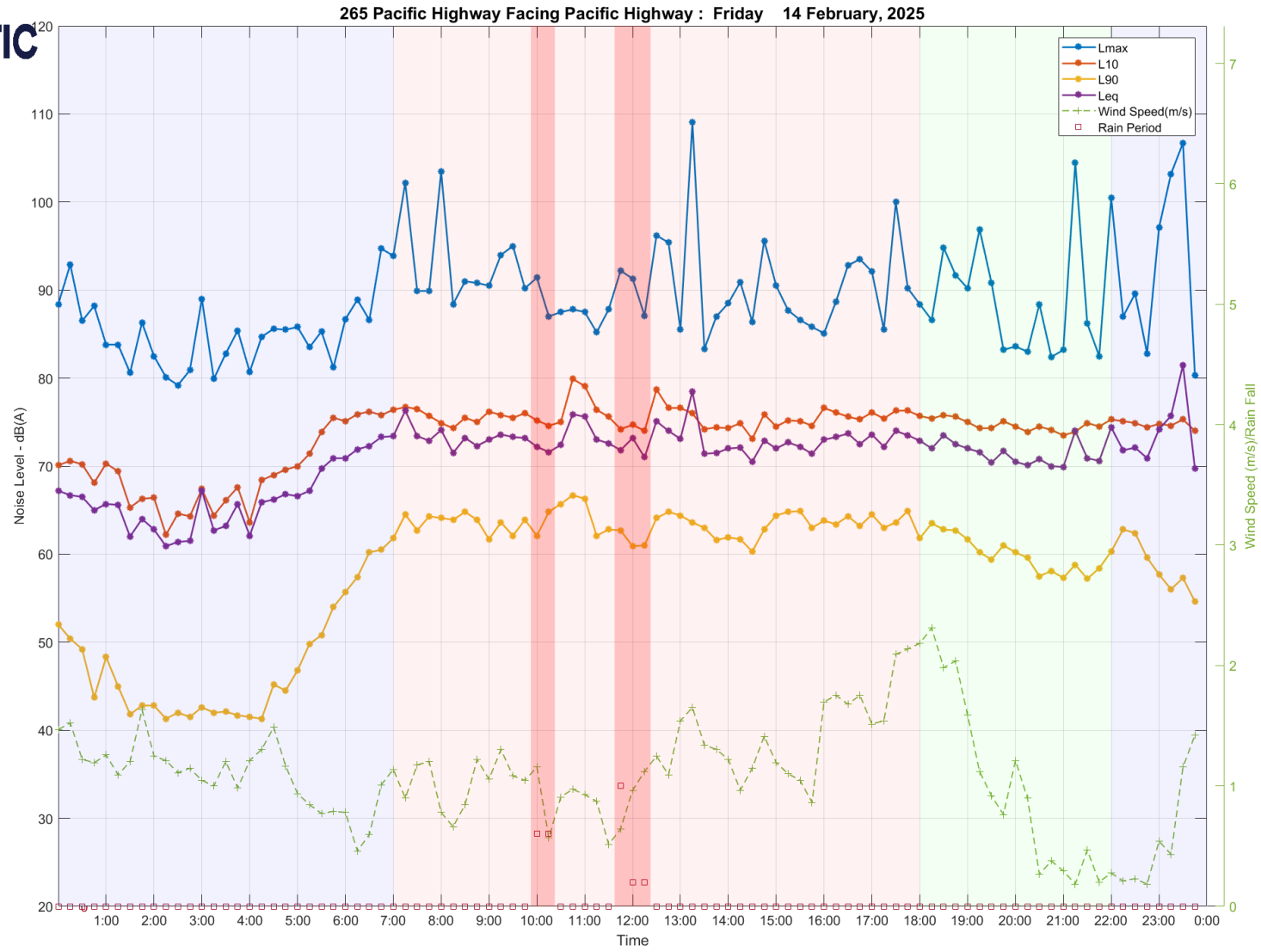
265 Pacific Highway Facing Pacific Highway : Friday 14 February, 2025
Lmax
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Leq
Wind Speed(m/s)
Rain Period
Noise Level - dB(A)
Wind Speed (m/s)/Rain Fall
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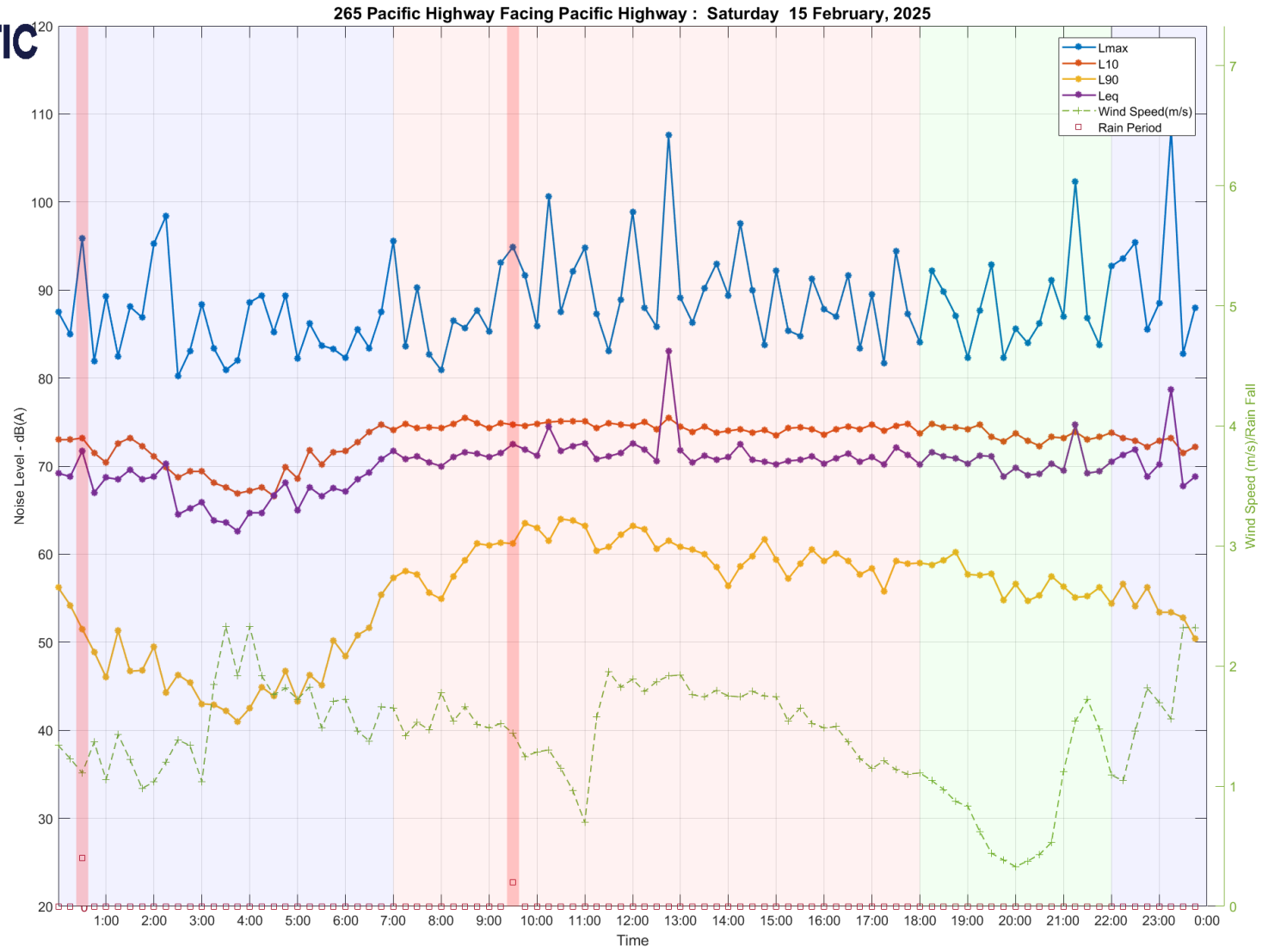
265 Pacific Highway Facing Pacific Highway : Saturday 15 February, 2025
Lmax
L10
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Leq
Wind Speed(m/s)
Rain Period
Noise Level - dB(A)
Wind Speed (m/s)/Rain Fall
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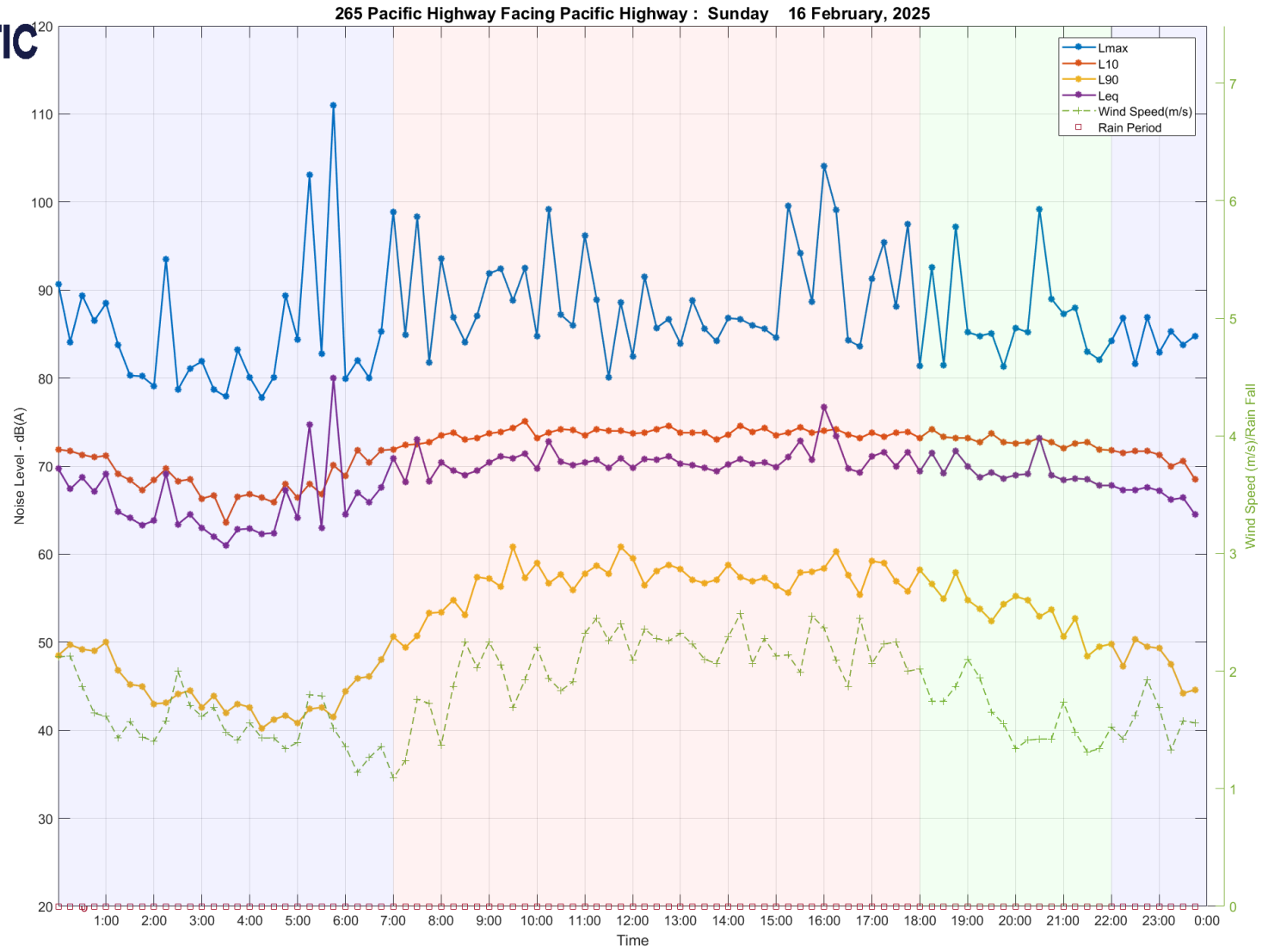
265 Pacific Highway Facing Pacific Highway : Sunday 16 February, 2025
Lmax
L10
L90
Leq
Wind Speed(m/s)
Rain Period
Noise Level - dB(A)
Wind Speed (m/s)/Rain Fall
Time
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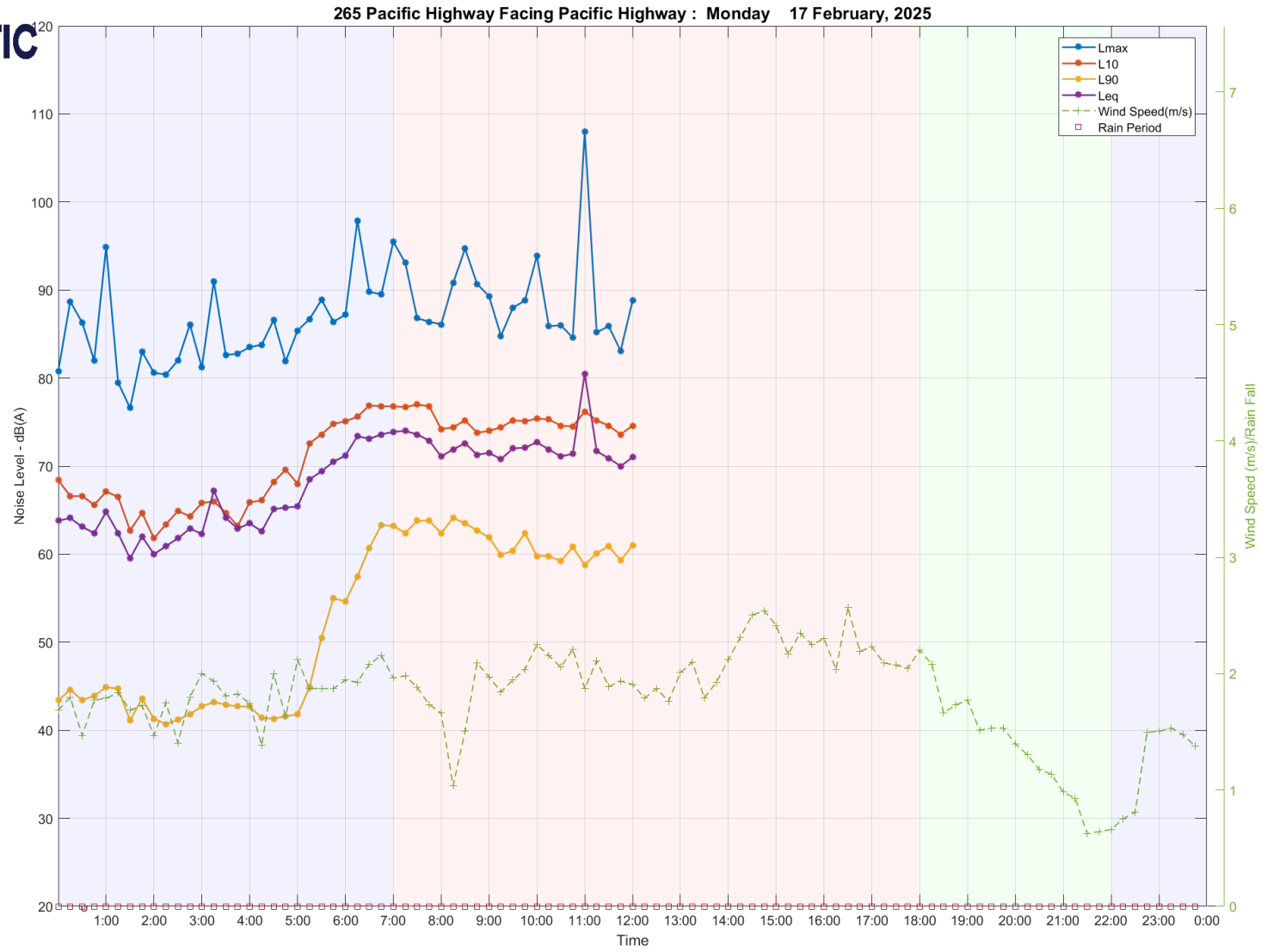
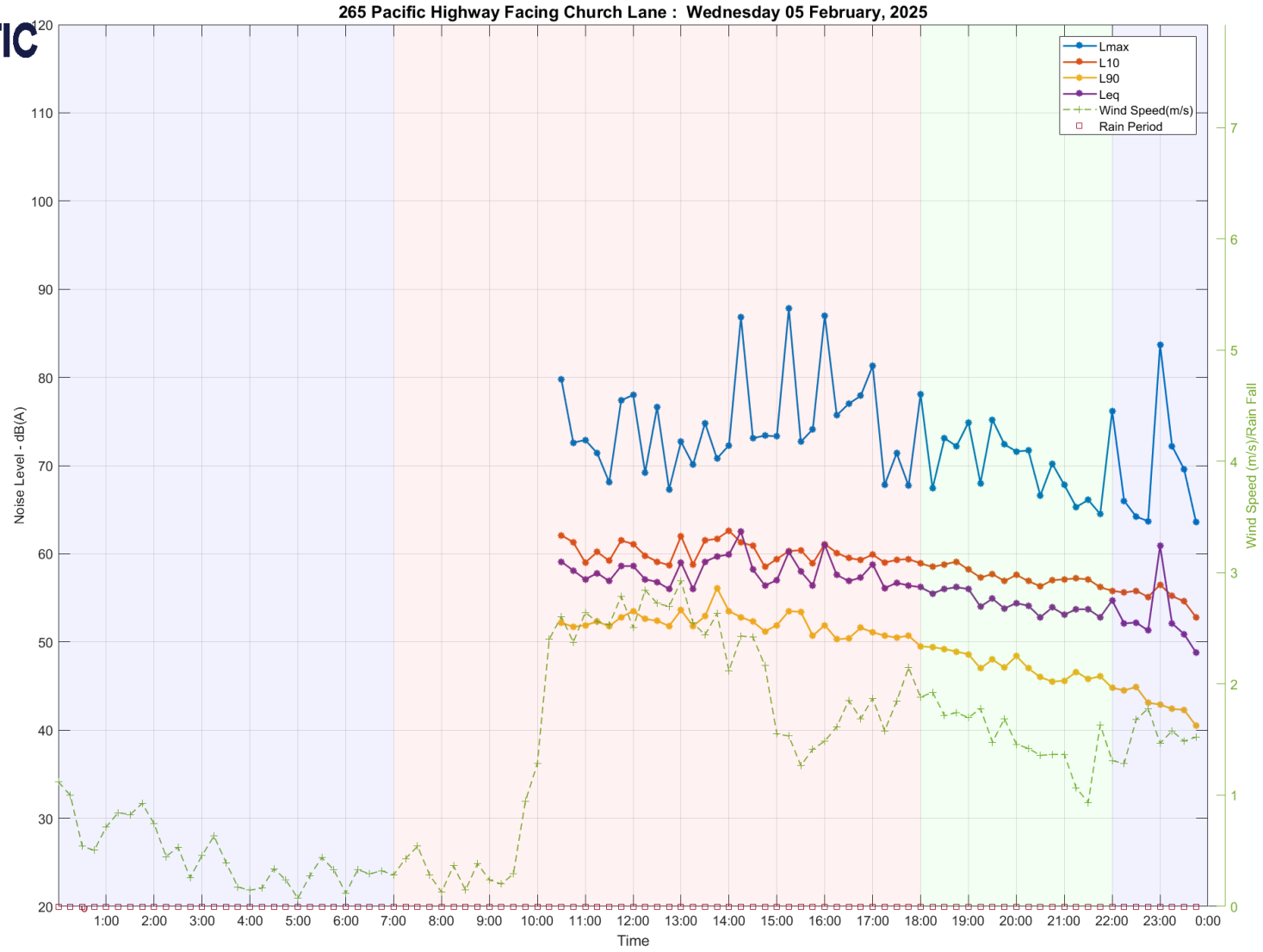
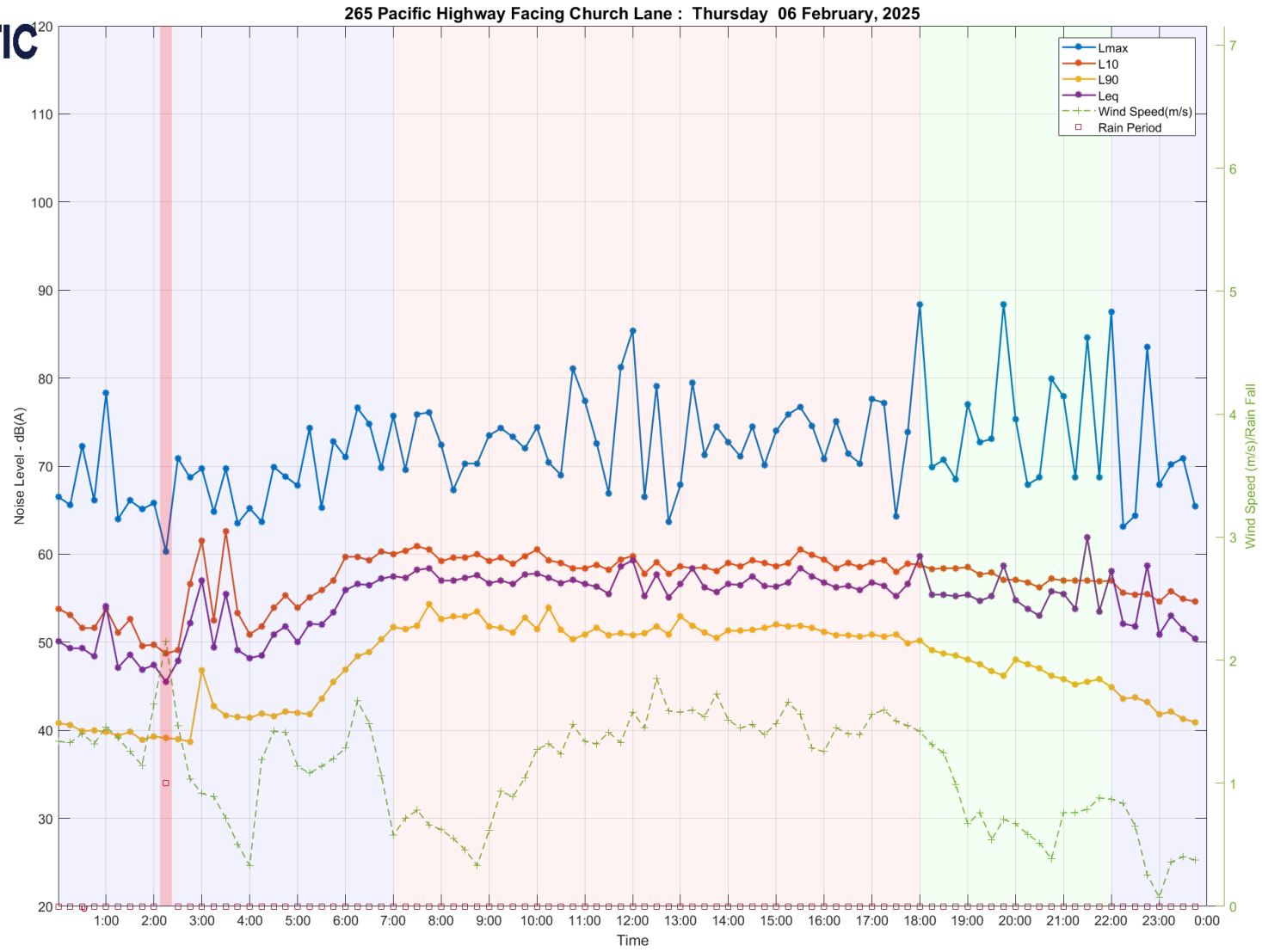


Wind Speed is corrected using factor 0.3300 based on logger location

A.6.2 Facing Church Lane




265 Pacific Highway Facing Church Lane : Thursday 06 February, 2025
Lmax
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Wind Speed(m/s)
Rain Period
Noise Level - dB(A)
Wind Speed (m/s)/Rain Fall
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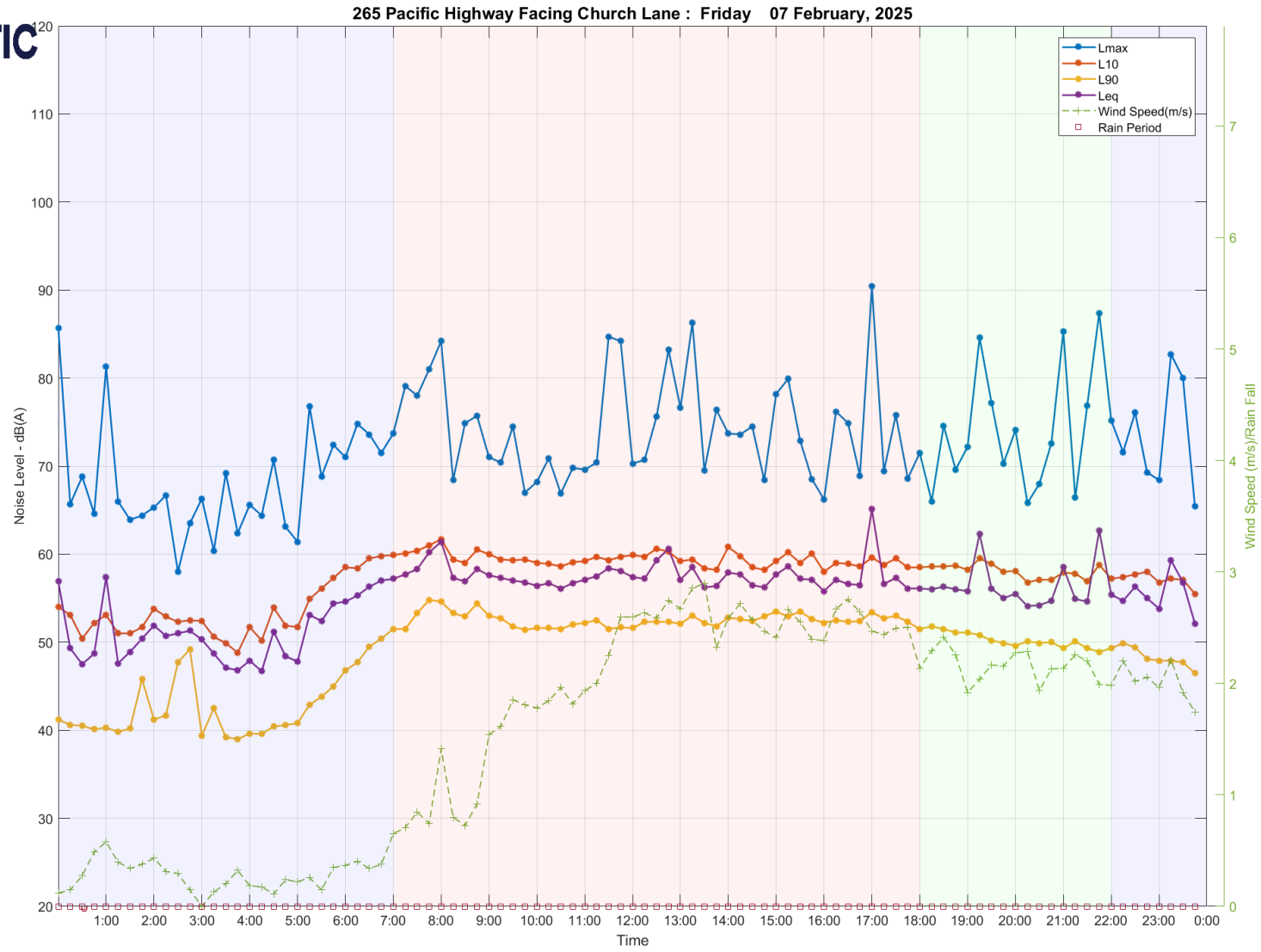
265 Pacific Highway Facing Church Lane : Friday 07 February, 2025
Lmax
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L90
Leq
Wind Speed(m/s)
Rain Period
Noise Level - dB(A)
Wind Speed (m/s)/Rain Fall
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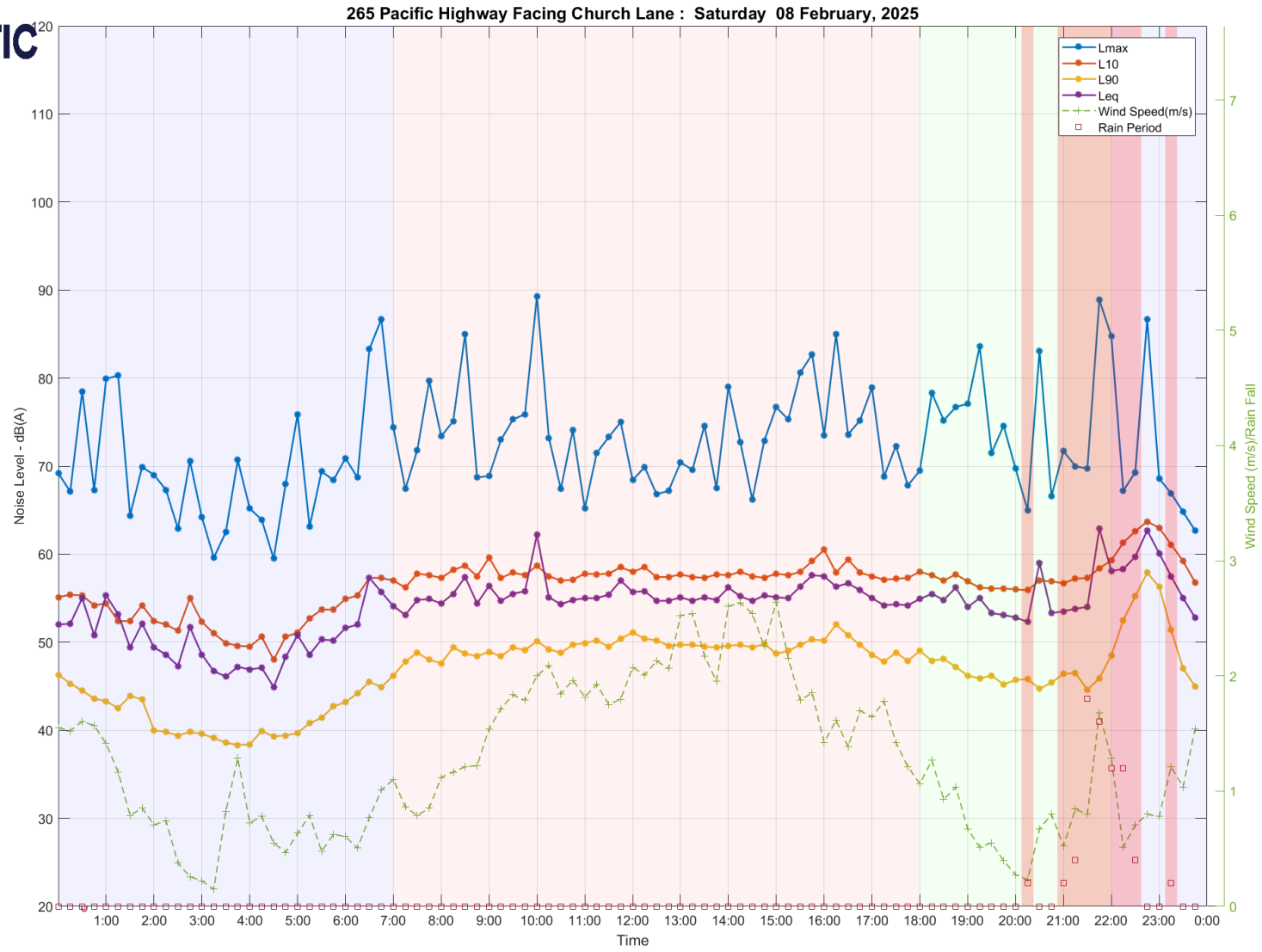
265 Pacific Highway Facing Church Lane : Saturday 08 February, 2025
Lmax
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Leq
Wind Speed(m/s)
Rain Period
Noise Level - dB(A)
Wind Speed (m/s)/Rain Fall
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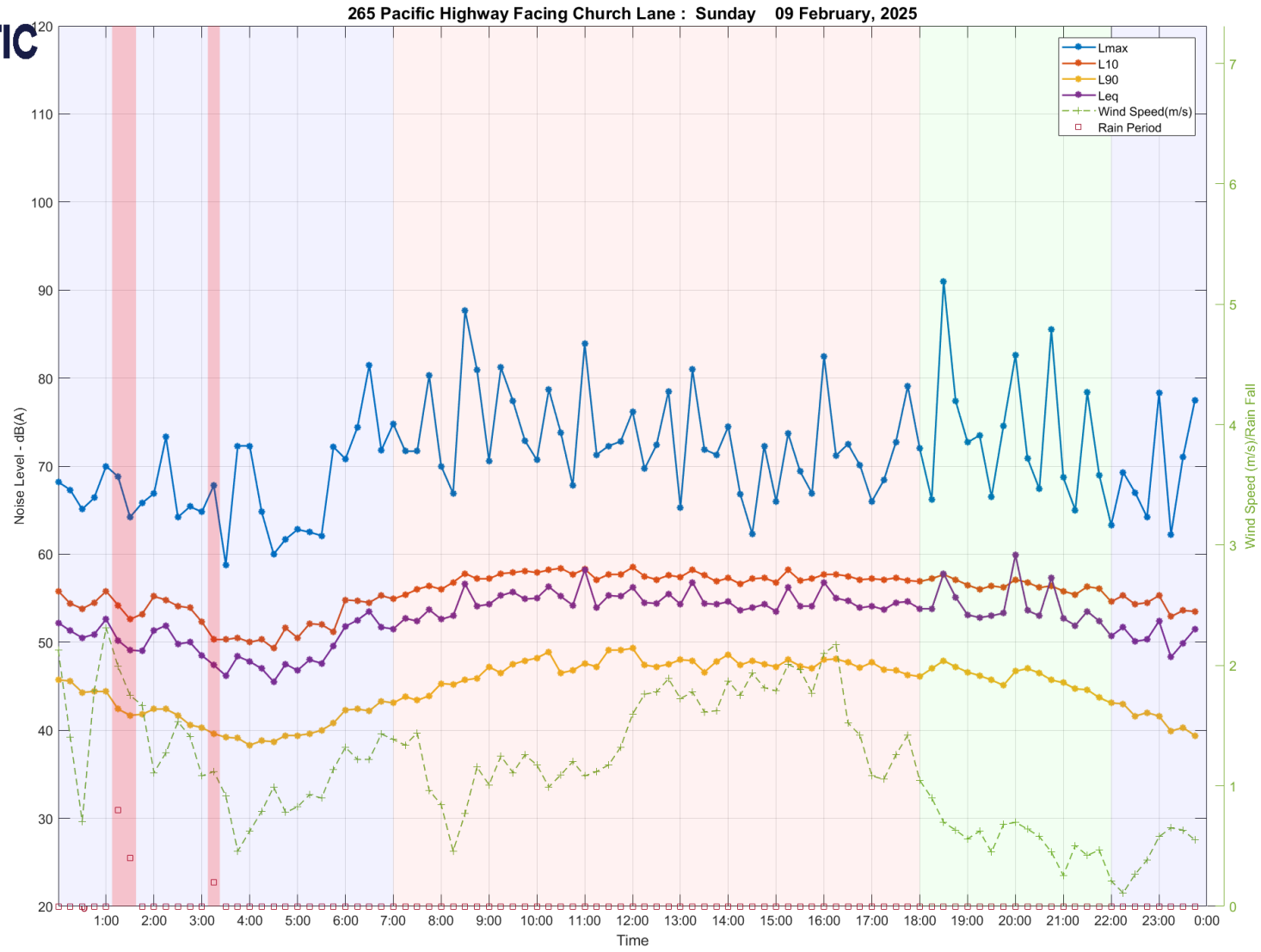
265 Pacific Highway Facing Church Lane : Sunday 09 February, 2025
Lmax
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L90
Leq
Wind Speed(m/s)
Rain Period
Noise Level - dB(A)
Wind Speed (m/s)/Rain Fall
Time
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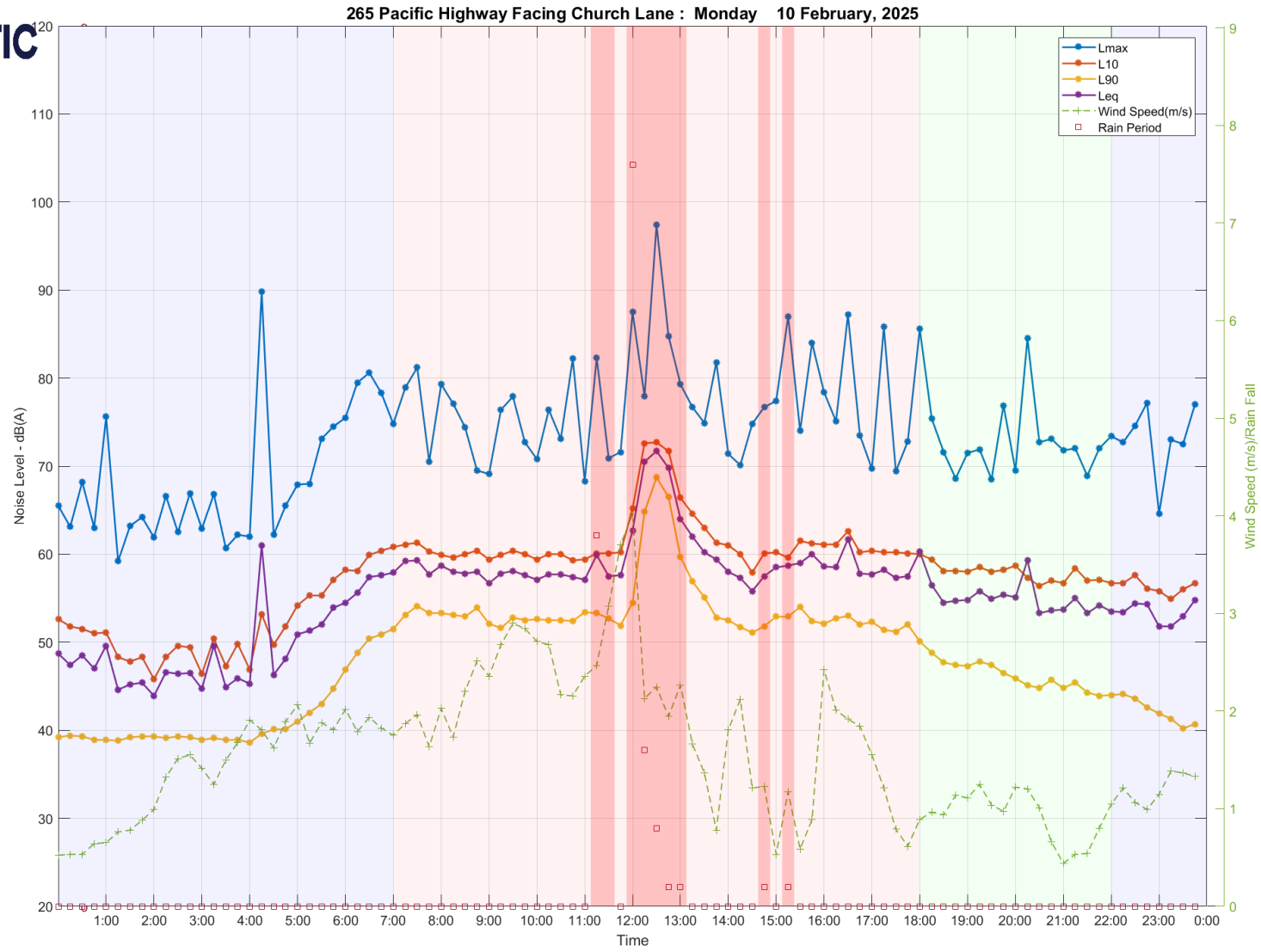
265 Pacific Highway Facing Church Lane : Monday 10 February, 2025
Lmax
L10
L90
Leq
Wind Speed(m/s)
Rain Period
Noise Level - dB(A)
Wind Speed (m/s)/Rain Fall
Time
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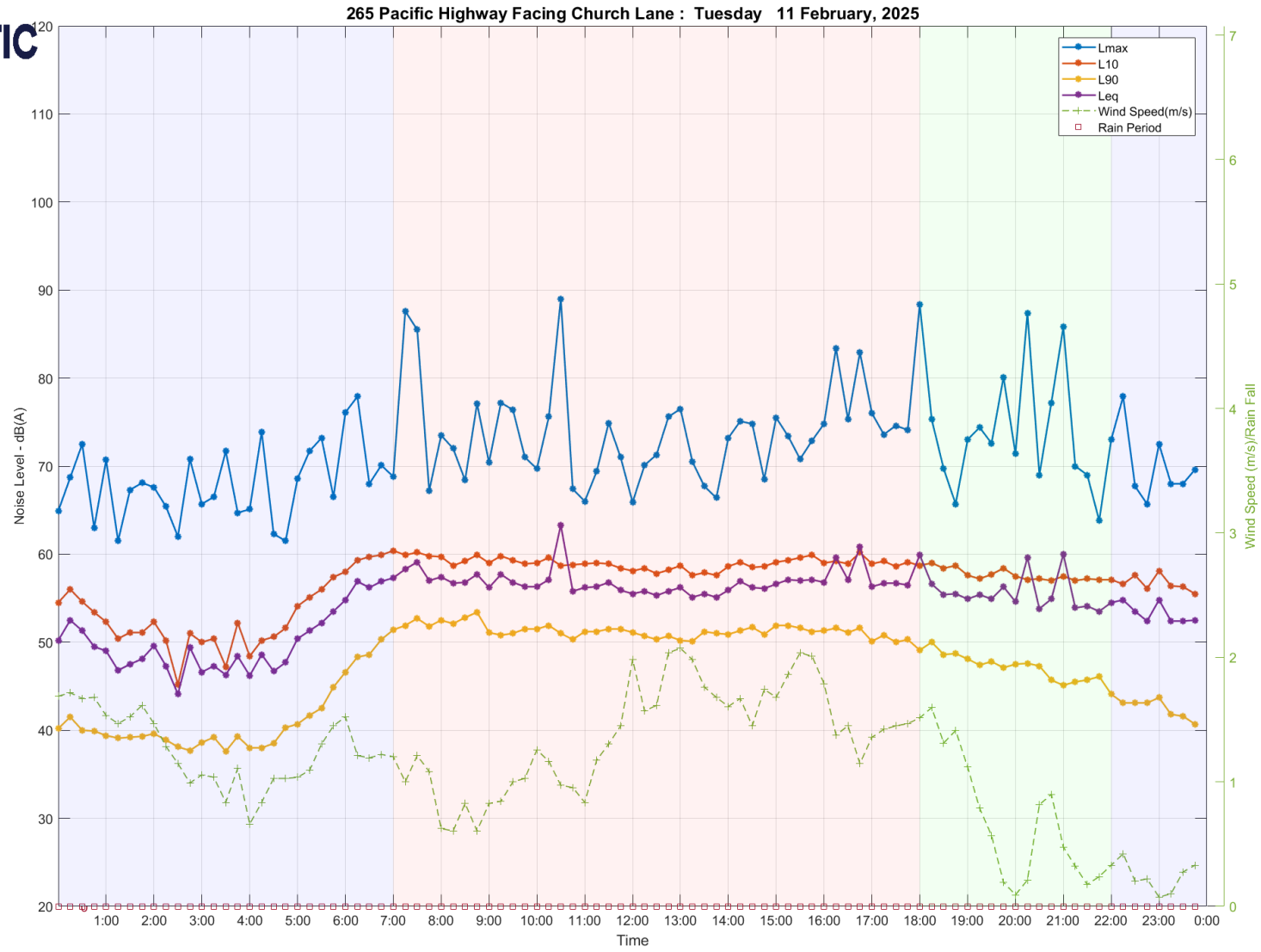
265 Pacific Highway Facing Church Lane : Tuesday 11 February, 2025
Lmax
L10
L90
Leq
Wind Speed(m/s)
Rain Period
Noise Level - dB(A)
Wind Speed (m/s)/Rain Fall
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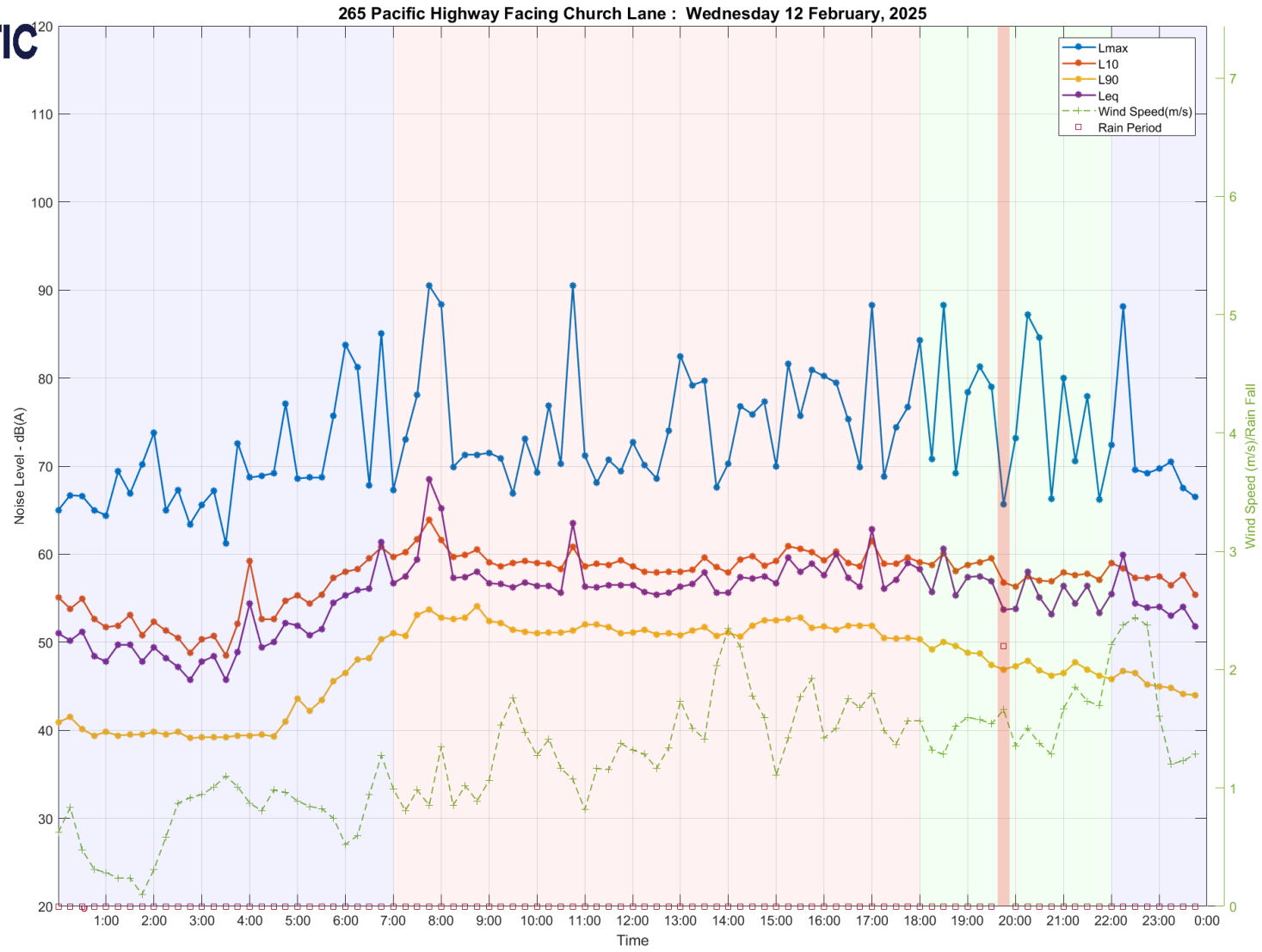
265 Pacific Highway Facing Church Lane : Wednesday 12 February, 2025
Lmax
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L90
Leq
Wind Speed(m/s)
Rain Period
Noise Level - dB(A)
Wind Speed (m/s)/Rain Fall
Time
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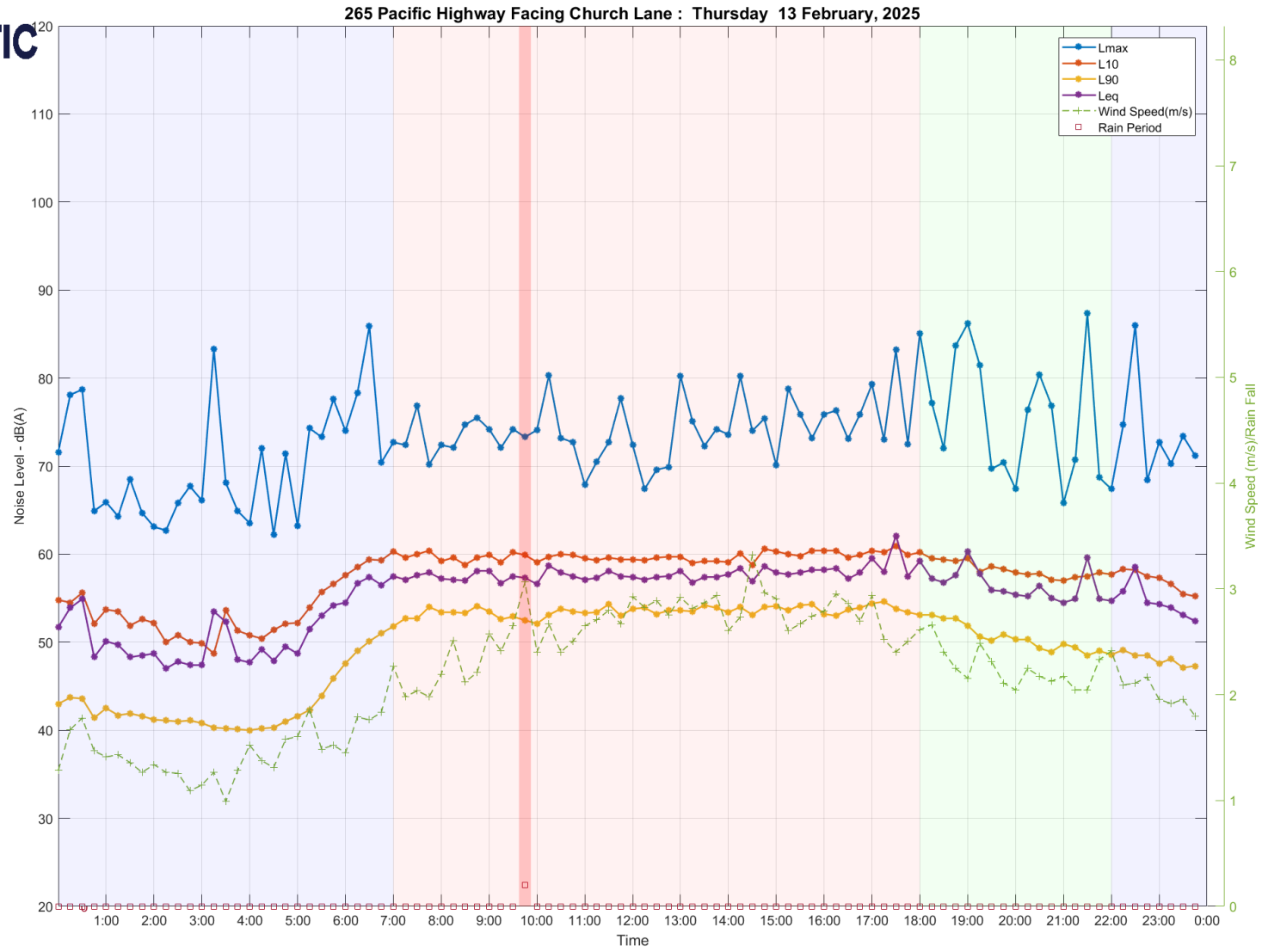
265 Pacific Highway Facing Church Lane : Thursday 13 February, 2025
Lmax
L10
L90
Leq
Wind Speed(m/s)
Rain Period
Noise Level - dB(A)
Wind Speed (m/s)/Rain Fall
Time
120
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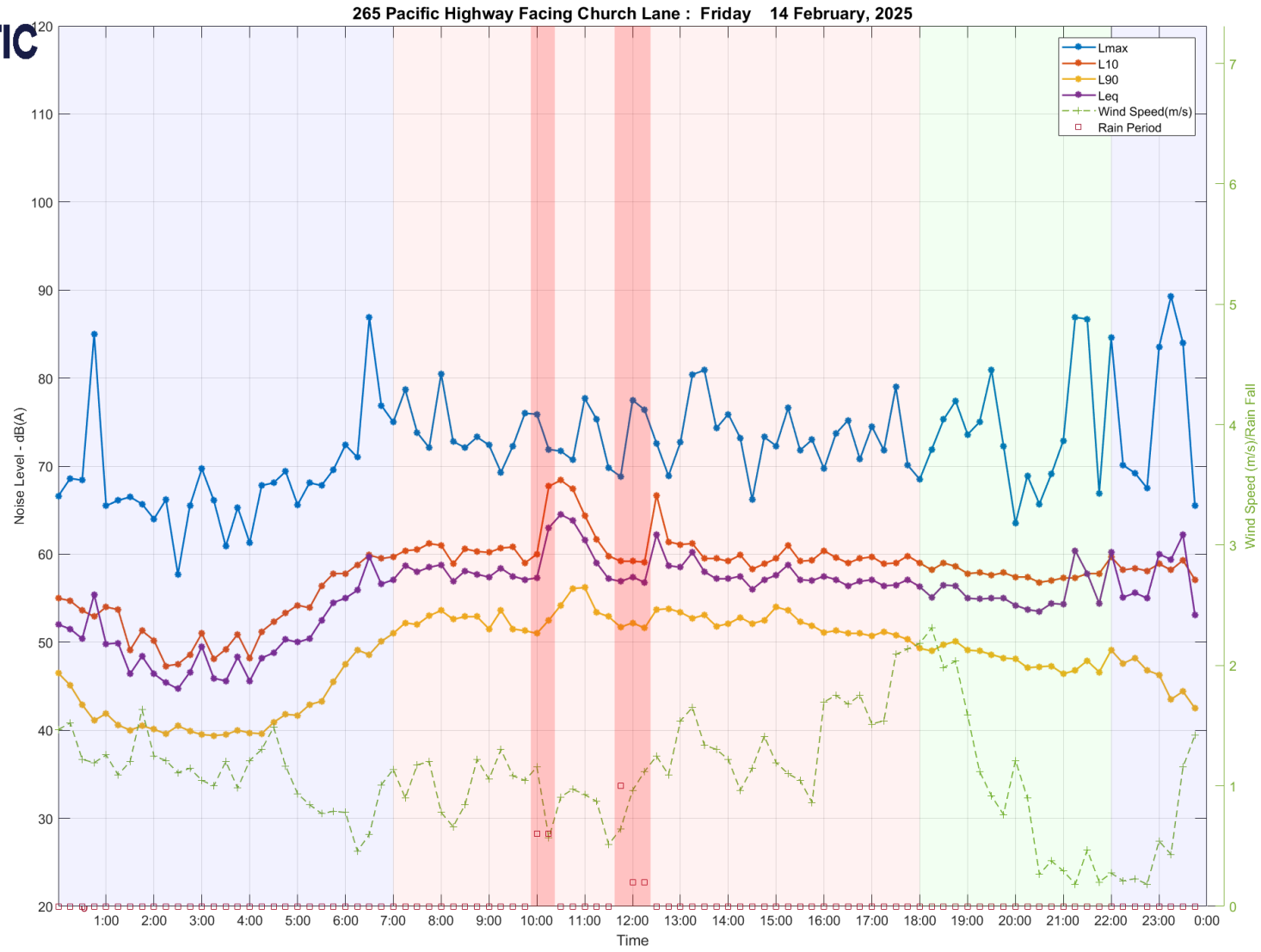
265 Pacific Highway Facing Church Lane : Friday 14 February, 2025
Lmax
L10
L90
Leq
Wind Speed(m/s)
Rain Period
Noise Level - dB(A)
Wind Speed (m/s)/Rain Fall
Time
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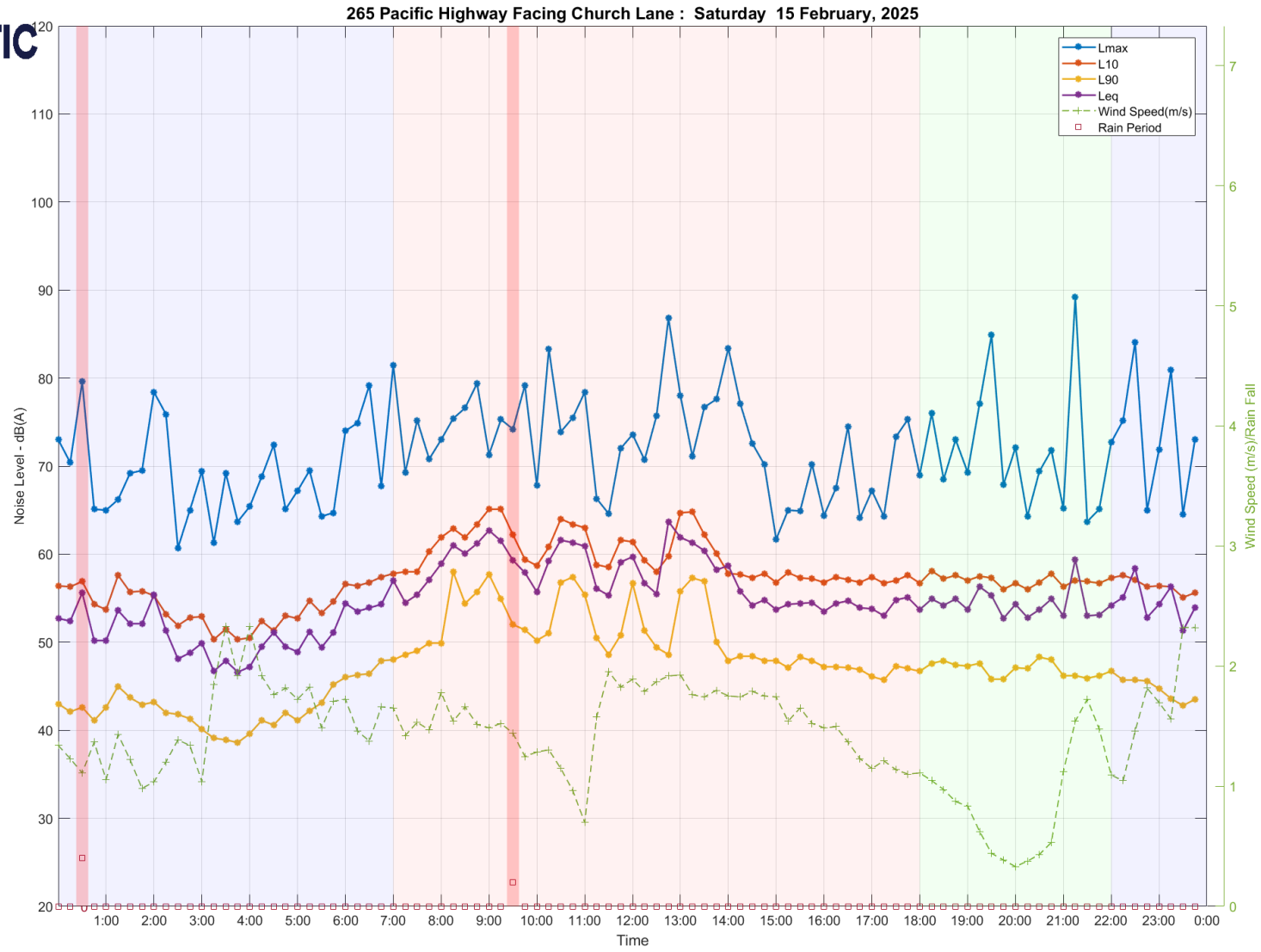
265 Pacific Highway Facing Church Lane : Saturday 15 February, 2025
Lmax
L10
L90
Leq
Wind Speed(m/s)
Rain Period
Noise Level - dB(A)
Wind Speed (m/s)/Rain Fall
Time
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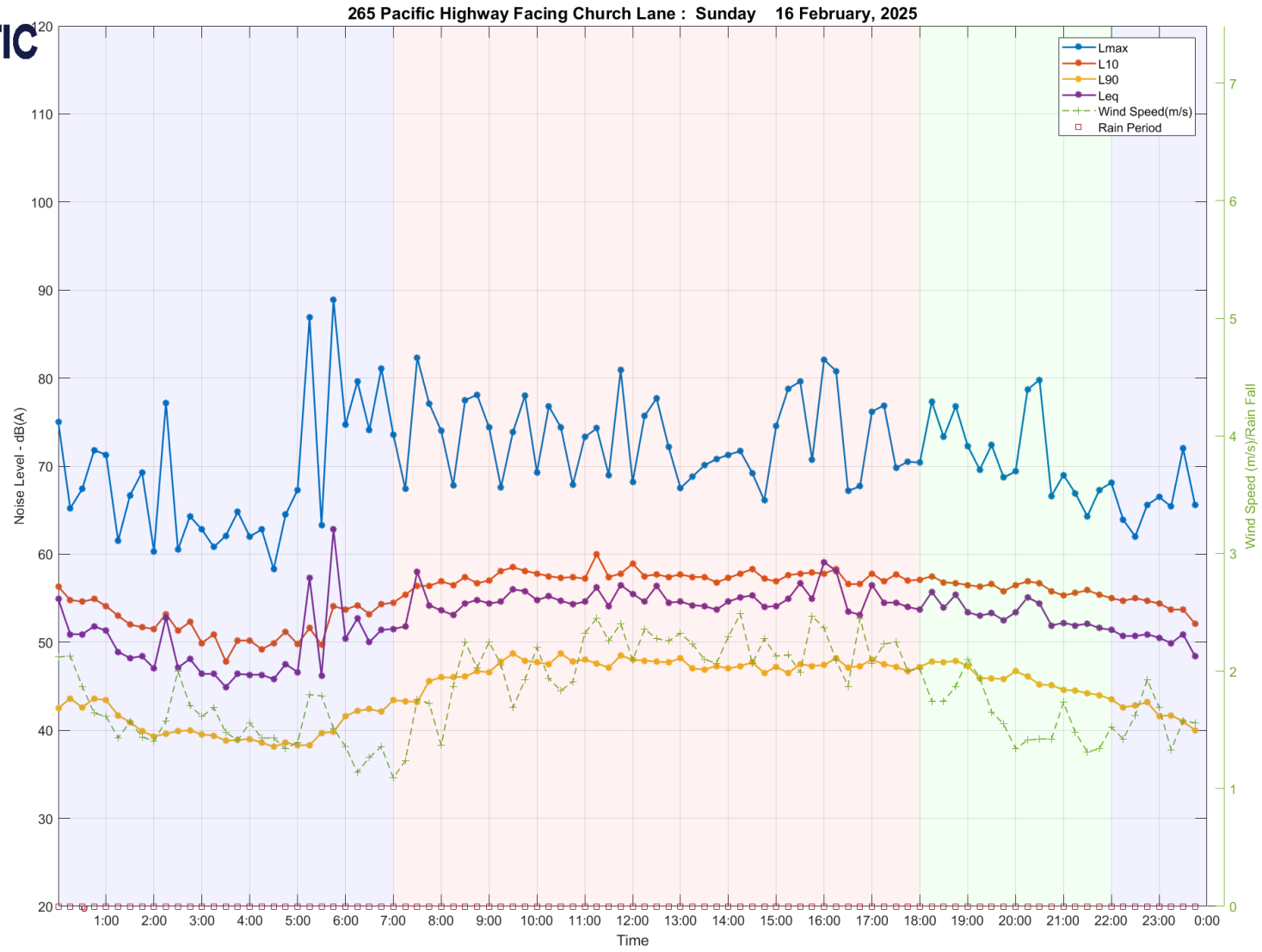
265 Pacific Highway Facing Church Lane : Sunday 16 February, 2025
Lmax
L10
L90
Leq
Wind Speed(m/s)
Rain Period
Noise Level - dB(A)
Wind Speed (m/s)/Rain Fall
Time
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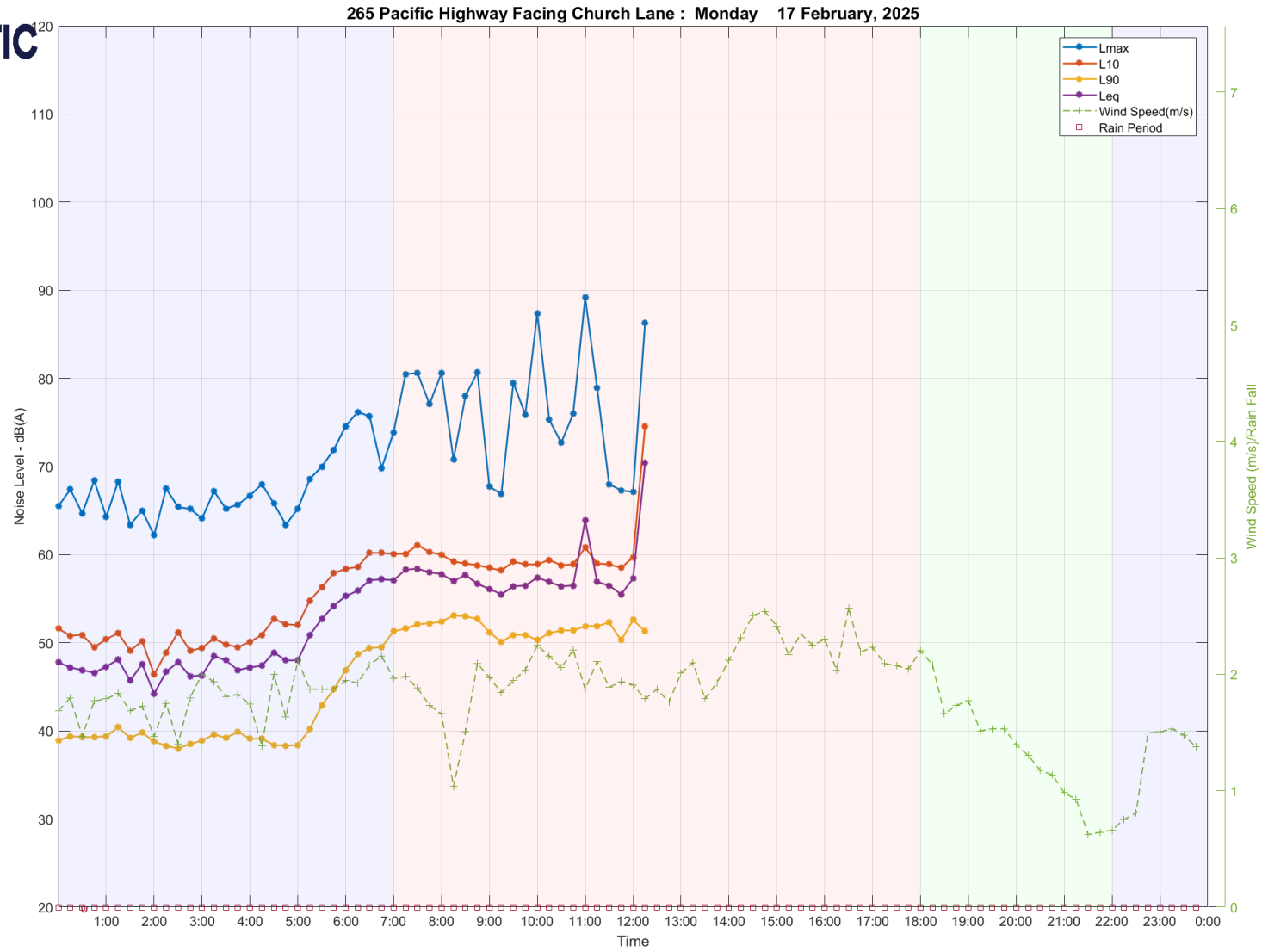

Wind Speed is corrected using factor 0.3300 based on logger location

APPENDIX B EPA NOISE POLICY FOR INDUSTRY TRIGGER LEVELS

Project specific assessment trigger levels have been determined for each noise source applying at the identified potentially most impacted receivers.

B.1 NPFI TRIGGER LEVELS

The NPfI requires noise impacts at residential receivers to be assessed in 3 ways:

- Whether the emitted noise is unreasonably loud relative to ambient background noise. (which the EPA calls the "intrusiveness" trigger level).
- Whether the noise emitted is unreasonably loud in an absolute sense, and consistent with surrounding land use and environment. ("amenity" trigger level)
- For night noise emissions, whether discrete noise events are likely to adversely impact sleep ("maximum noise level" trigger levels).

For other receiver types only the amenity trigger level is relevant.

B.1.1 Intrusiveness

The $L_{eq,15min}$ descriptor is used for the intrusiveness trigger level, and is set at a level that is 5dB(A) above the rating background noise level.

B.1.2 Amenity

Table 2.2 of the NPfI (repeated below) sets out acceptable noise levels for various receiver types.

There are 3 categories of residential receivers - rural, suburban, urban. The nearest residential receivers to the subject site are categorised as "urban" receivers. Categories for non-residential uses are also indicated in the table.

The NPfI typically requires project amenity noise levels to be calculated in the following manner:

$$L_{Aeq,15min} = \textit{Recommended Amenity Noise Level} - 5\ dB(A) + 3\ dB(A)$$

NPfI Table 2.2: Amenity Noise Levels			
Receiver	***Noise Amenity Area***	***Time of Day***	***Recommended Amenity Noise Level L_{Aeq}***
Residential	*Rural*	*Day*	*50*
		Evening	*45*
		Night	*40*
	Suburban	*Day*	*55*
		Evening	*45*
		Night	*40*
	Urban	*Day*	*60*
		Evening	*50*
		Night	*45*
Hotels motels caretakers' quarters holiday accommodation permanent resident caravan parks	*See column 4*	*See column 4*	*5 dB(A) above the recommended amenity noise level for a residence for the relevant noise amenity area and time of day*
School classroom – internal	*All*	*Noisiest 1-hour period when in use*	*35 (see notes for table)*
Hospital ward internal external	*All* *All*	*Noisiest 1-hour* *Noisiest 1-hour*	*35* *50*
Place of worship – internal	*All*	*When in use*	*40*
Area specifically reserved for passive recreation (e.g. national park)	*All*	*When in use*	*50*
Active recreation area (e.g. school playground golf course)	*All*	*When in use*	*55*
Commercial premises	*All*	*When in use*	*65*
Industrial premises	*All*	*When in use*	*70*
Industrial interface (applicable only to residential noise amenity areas)	*All*	*All*	*Add 5 dB(A) to recommended noise amenity area*

Notes: The recommended amenity noise levels refer only to noise from industrial sources. However, they refer to noise from all such sources at the receiver location, and not only noise due to a specific project under consideration. The levels represent outdoor levels except where otherwise stated.

Types of receivers are defined as follows:

- rural residential – see Table 2.3
- suburban residential – see Table 2.3
- urban residential – see Table 2.3
- industrial interface – an area that is in close proximity to existing industrial premises and that extends out to a point where the existing industrial noise from the source has fallen by 5 dB or an area defined in a planning instrument. Beyond this region the amenity noise level for the applicable category applies. This category may be used only for existing situations (further explanation on how this category applies is outlined in Section 2.7)
- commercial – commercial activities being undertaken in a planning zone that allows commercial land uses
- industrial – an area defined as an industrial zone on a local environment plan; for isolated residences within an industrial zone the industrial amenity level would usually apply.

Time of day is defined as follows:

- day – the period from 7 am to 6 pm Monday to Saturday or 8 am to 6 pm on Sundays and public holidays
- evening – the period from 6 pm to 10 pm
- night – the remaining periods.

(These periods may be varied where appropriate, for example, see A3 in Fact Sheet A.)

In the case where existing schools are affected by noise from existing industrial noise sources, the acceptable L_{Aeq} noise level may be increased to 40 dB $L_{Aeq(1hr)}$.

B.1.3 Noise Characteristic Modifying Factors

Where applicable, the emitted intrusive noise level should be modified (increased or decreased) to account for characteristics such as tonality, low frequency, duration, etc according to NPfI Fact Sheet C.

B.1.4 Maximum Noise Level Assessment

The purpose of this assessment is to identify whether discrete, night time noise events have the potential to produce adverse sleep impacts.

Section 2.5 of NPfI recommends the following procedure to assess the potential for adverse sleep disturbance.

Where the subject development/ premises night -time noise levels at a residential location exceed:

- $L_{eq(15min)}$ 40 dB(A) or the prevailing RBL (L_{90}) plus 5 dB, whichever is the greater, and/or
- L_{max} 52 dB(A) or the prevailing RBL (L_{90}) plus 15 dB, whichever is the greater,

a detailed maximum noise level event assessment should be undertaken.

The detailed assessment should cover the maximum noise level, the extent to which the maximum noise level exceeds the rating background noise level, and the number of times this happens during the night-time period. Some guidance on possible impact is contained in the review of research results in the NSW Road Noise Policy.

Other factors that may be important in assessing the extent of impacts on sleep include:

- how often high noise events will occur
- the distribution of likely events across the night-time period and the existing ambient maximum events in the absence of the subject development
- whether there are times of day when there is a clear change in the noise environment (such as during early-morning shoulder periods)
- current scientific literature available at the time of the assessment regarding the impact of maximum noise level events at night.

For the research on sleep disturbance to date it can be concluded that:

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

Maximum noise level event assessments should be based on the L_{AFmax} descriptor on an event basis under 'fast' time response. The detailed assessment should consider all feasible and reasonable noise mitigation measures with a goal of achieving the above trigger levels.

B.2 PROJECT SPECIFIC TRIGGER LEVELS

The following table summarises the trigger levels applying at each of the identified "most impacted" receivers. These have been determined based on the NPfI methodology described above and the measured rating background noise levels.

The trigger levels in bold indicate the most stringent trigger level at each location.

Table B-1 – Project Specific Trigger Levels

Location/ Receiver Type	Time	RBL dB(A) L_{90}	Trigger Noise Level (dB(A) $L_{eq,15min}$)		
			Intrusiveness	Amenity	Max Event
Residential **R1**, **R2** & **R3**	Day	50[1]	**55**	58	N/A
	Evening	46[1]	51	**48**	N/A
	Night	39[1]	44	**43**	**44 L_{eq}** **54 L_{max}**

1 Based on noise monitoring facing Church Lane instead of Pacific Highway for conservative assessment.

The project noise trigger levels are bolded above.