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Darlington Road Terraces Mixed Use Building Additions and Alterations to the Darlington Road Terraces and Public Domain Improvements

Noise Impact Assessment

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1 INTRODUCTION

Acoustic Logic Consultancy have been engaged to conduct an acoustic assessment of noise impacts associated with the proposed University of Sydney Darlington Road Mixed Use development, Darlington.

This assessment discusses potential noise impacts associated with development, which will typically include:

- Outdoor communal terraces;
- Mechanical plant operation; and
- Noise and vibration associated with the demolition and construction phases of the proposed development.

This assessment has been undertaken using the architectural drawing set provided by Allen Jack and Cottier architects.

Noise impacts have been addressed in accordance with the following standards and regulations as detailed in the Secretary's Environmental Assessment Requirements (SEARs) noted below:

- New South Wales Environmental Protection Authority –
  - *Industrial Noise Policy.*
  - *Interim Construction Noise Guideline.*
  - *Assessing Vibration: A Technical Guideline 2006*
  - State Environment Planning Policy (Infrastructure) 2007

This assessment indicates that the construction and ongoing operation of the proposed building can comply with the aforementioned requirements.

2 SECRETARY'S ENVIRONMENTAL ASSESSMENT REQUIREMENTS

Noise impacts associated with the development have been assessed for the following in accordance with the SEARs for this project:

1. Statutory and Strategic Context – including:

Address the statutory provisions contained in all relevant environmental planning instruments, including:

- *State Environmental Planning Policy (State & Regional Development) 2011;*
- *State Environmental Planning Policy (Infrastructure) 2007;*
- *State Environmental Planning Policy No. 33 – Hazardous and Offensive Development;*
- *State Environmental Planning Policy No. 55 – Remediation of Land; and*
- *Sydney Local Environmental Plan 2012.*

7. Noise and Vibration

Identify and provide a quantitative assessment of the main noise and vibration generating sources during construction and operation. Outline measures to minimise and mitigate the potential noise impacts on surrounding occupiers of land.

- *Address State Environmental Planning Policy (Infrastructure) 2007 where applicable*
- *Relevant Policies and Guidelines:*
    - *NSW Industrial Noise Policy (EPA)*
    - *Interim Construction Noise Guideline (DECC)*
    - *Assessing Vibration: A Technical Guideline 2006*

3 DEVELOPMENT PROPOSAL

The development site is located along Darlington Road, Darlington NSW 2008. The site is bounded by Darlington Road to the north, Golden Grove Street to the west, Darlington Lane to the south (the lane is also included in the project works), and Codrington Street to the east. The site consists of a row of thirty-eight (38) late Victorian Terraces with rear gardens backing onto Darlington Lane.

The terraces that are privately owned include 88-93, 97 &120 Darlington Road.

3.1 PROPOSED STRUCTURES

The University of Sydney is proposing building additions and alterations to the existing Darlington Road Terraces and H66 Darlington House for mixed uses integrating affordable student accommodation and other educational establishments.

The development will also include adaptive reuse of the existing Terraces and construction of four (4) separate mixed use buildings within the rear yards for use by residents and the wider University community.

Once completed the mixed use development will provide:

- Approximately, 337 student accommodation beds;
- Other educational establishment facilities including:
    - Bookable meeting / tutorial rooms;
    - Computer labs/E Learning;
    - Lecture/theatre;
    - Multi-function learning spaces;
    - Study areas;
    - Maker Spaces; and
    - Meeting rooms and informal spaces.
- Communal areas including:
    - Self-catered kitchen;
    - Main dining hall;
    - Lounge;
    - Breakout spaces;
    - Laundry facilities; and
    - Music Rooms.
- Central courtyards
- Roof top terraces with courtyard views,
- Ground level waste and bike storage,
- Basement level with plant rooms,
- External areas – soft and hard, and
- Operator administration office.

3.2 SURROUNDING USES AND NOISE SENSITIVE RECEIVERS

The site is bounded by the following uses:

- Residential terraces, located at:
    - 88-93 Darlington Road;
    - 97 Darlington Road;
    - 120 Darlington Road.
- Residential buildings to the West along Golden Grove Street;
- University buildings to the North, West and East;
- Darlington Public School to the South;

The nearest most affected noise sensitive receivers will include the existing terraces not owned by the University of Sydney as per above and the school to the South.

Residences across Golden Grove Street are typically screened via structures along Golden Grove Street to the site and will not be affected by the general operation of the site.

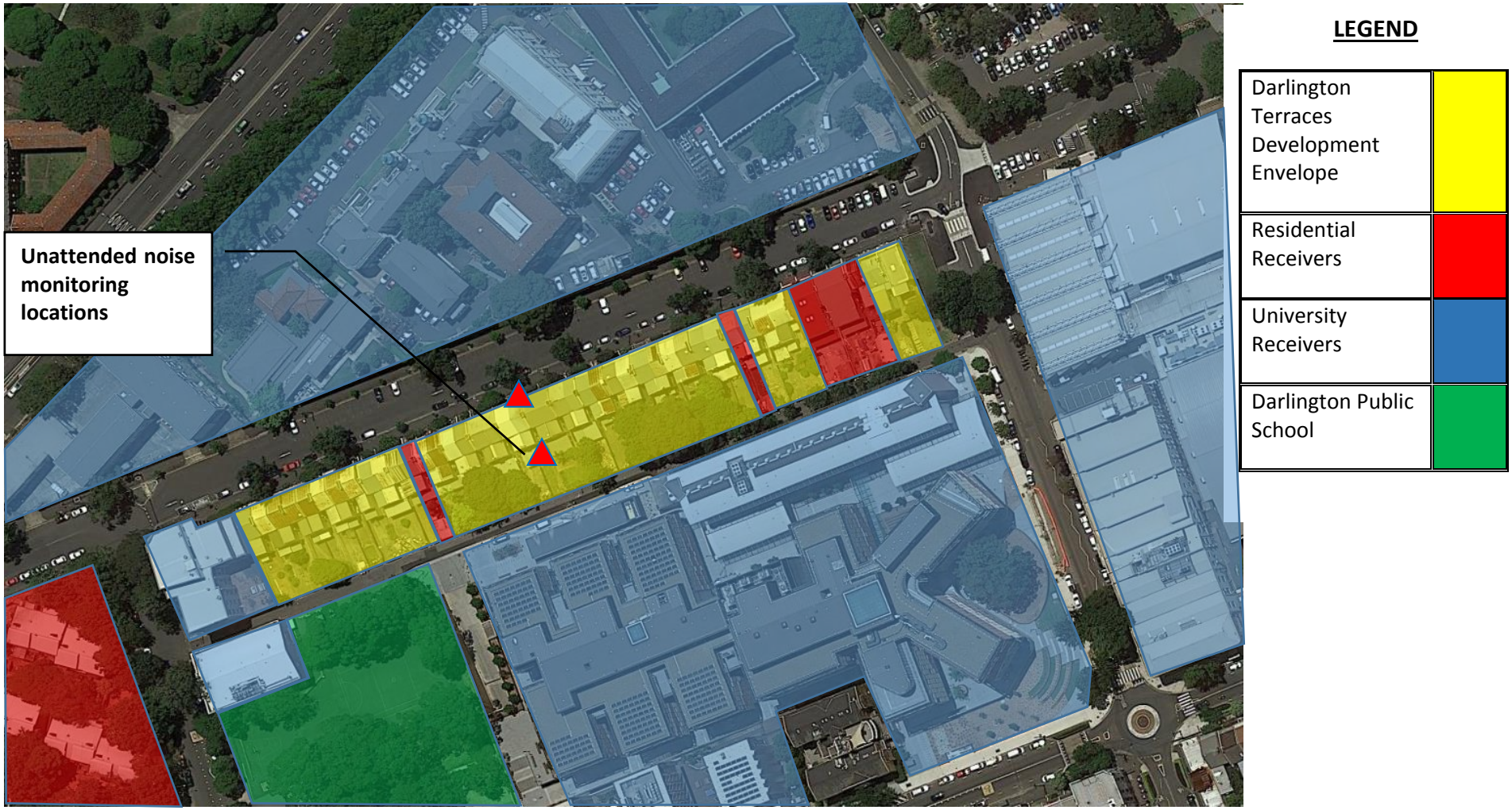


Figure 1: Site Survey and Monitoring Positions

4 EXISTING ACOUSTIC ENVIRONMENT

The existing acoustic environment is categorised by latent traffic noise from City Road which carries significant traffic volumes, intermittent car pass-bys on Darlington Road and the public using the footpaths around the site.

The site is a highly trafficable area for students using the Business School to the South of the site and transiting from nearby train stations through to the University of Sydney North of City Road.

4.1 ENVIRONMENTAL NOISE DESCRIPTORS

Environmental noise constantly varies. Accordingly, it is not possible to accurately determine prevailing environmental noise conditions by measuring a single, instantaneous noise level.

To accurately determine the environmental noise a 15-20 minute measurement interval is utilised. Over this period, noise levels are monitored on a continuous basis and statistical and integrating techniques are used to determine noise description parameters.

In analysing environmental noise, three-principle measurement parameters are used, namely L_{10}, L_{90} and L_{eq}.

The L_{10} and L_{90} measurement parameters are statistical levels that represent the average maximum and average minimum noise levels respectively, over the measurement intervals.

The L_{10} parameter is commonly used to measure noise produced by a particular intrusive noise source since it represents the average of the loudest noise levels produced by the source.

Conversely, the L_{90} level (which is commonly referred to as the background noise level) represents the noise level heard in the quieter periods during a measurement interval. The L_{90} parameter is used to set the allowable noise level for new, potentially intrusive noise sources since the disturbance caused by the new 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.

The L_{eq} parameter represents the average noise energy during a measurement period. This parameter is derived by integrating the noise levels measured over the 15 minute period. L_{eq} is important in the assessment of environmental noise impact as it closely corresponds with human perception of a changing noise environment; such is the character of environmental noise.

4.2 BACKGROUND NOISE LEVELS

Background noise levels which will be used as a basis for this assessment are detailed in the following sections.

4.2.1 Measurement Equipment

Unattended noise monitoring was conducting using Acoustic Research Laboratories Pty Ltd noise logger. The logger was programmed to store 15-minute statistical noise levels throughout the monitoring period. The equipment was calibrated at the beginning and the end of the measurement using a Rion NC-73 calibrator; no significant drift was detected. All measurements were taken on A-weighted fast response mode.

4.2.2 Measurement Location

Noise monitoring was conducted at the front and rear of 110 Darlington Road to record typical background noise levels and the level of noise impact associated with City Road. Refer to Figure 1.

4.2.3 Measurement Period

The logger was on site from 16 May to 24 May, 2016. Refer to Appendix 1 for unattended long term noise monitoring data.

4.2.4 Ambient Noise Levels

The ambient noise levels established from the unattended noise monitoring are detailed in the Table below.

Table 1 – Rating Background Noise Level

Logger Location	Time of Day	Rating Background Noise Level dB(A) L_{90}	Existing Noise Level dB(A) L_{eq}
Front of 110 Darlington Road	Day (7am to 6pm)	47	56
	Evening (6pm to 10pm)	46	54
	Night (10pm to 7am)	42	49
Rear of 110 Darlington Road	Day (7am to 6pm)	49	54
	Evening (6pm to 10pm)	48	52
	Night (10pm to 7am)	44	49

4.2.5 Weather Affected Noise Data

Weather affected noise data (as determined by Sydney Observatory – Observatory Hill) has been used to determine potentially affected weather data. Rain affected noise data has been removed from the data set.

For the most part, there is negligible difference between the recorded background noise levels during winds exceeding 5m/s and winds less than 5m/s. This is due to the fact that the monitor was shielded from the majority of wind.

On this basis, ALC would deem the background noise data acceptable.

5 NOISE CRITERIA

Noise emissions from the construction and operation of the development have been addressed in accordance with the following:

- NSW Industrial Noise Policy (EPA)
- Interim Construction Noise Guideline (DECC)
- Assessing Vibration: A Technical Guideline 2006

Construction noise and vibration objectives are discussed in Section 8.

Intrusive noise sources into the development have assessed against the State Environment Planning Policy (Infrastructure) 2007 in accordance with the SEAR requirements.

5.1 EPA - INDUSTRIAL NOISE POLICY

The INP provides guidelines for assessing noise impacts from industrial developments. The recommended assessment objectives vary depending on the potentially affected receivers, the time of day, and the type of noise source. The INP has two requirements which both have to be complied with, namely an amenity criterion and an intrusiveness criterion.

Intrusiveness Criterion

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 not exceed the background noise level by more than 5 dB(A).

Rating background noise levels for the area have been established from long term unattended noise monitoring as detailed in Section 4.2. Intrusive criteria based on the noise monitoring conducted at the site are detailed in Table 2.

Table 2 – INP Intrusiveness Criteria

Time of day	Background Noise Level dB(A)L_{90}	Intrusiveness Criteria (Background+5dB(A)) dB(A)L_{eq}
Day	49	52
Evening	48	51
Night (10pm to 7am)	44	47

Amenity Criterion

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 Industrial Noise Policy sets out acceptable noise levels for various land uses. Table 2.1 on Page 16 of the policy has four categories to distinguish different residential areas. They are rural, suburban, urban and urban/industrial interface.

Pursuant to Section 2.2.1 of the INP, 'Suburban' and 'Urban' are defined as areas which have acoustical environments which incorporate the following characteristics.

Suburban - An area that has local traffic with characteristically intermittent traffic flows or with some limited commerce or industry. This area often has the following characteristics:

- Decreasing noise levels in the evening period (1800-2200); and/or
- Evening ambient noise levels defined by the natural environment and infrequent human activity.

Urban - an area with an acoustical environment that:

- Is dominated by 'urban hum' or industrial source noise
- Has through traffic characteristically heavy and continuous traffic flows during peak periods
- Is near commercial districts or industrial districts
- Has any combination of the above,

Where 'urban hum' means the aggregate sound of many unidentifiable, mostly traffic-related sound sources.

ALC would determine the site an 'Urban' noise environment given that:

- The receiver site is within 70m to City Road, which carries heavy and continuous traffic flows during peak periods, and
- Whilst there is a minor decrease in the evening background noise level (drops 1dB(A) from the day) the evening ambient noise levels would not be defined by the natural environment and infrequent human activity.

The corresponding Amenity Criteria noise emission goals are presented below.

Table 3 – INP Amenity Acceptable Noise Levels

Type of Receiver	Indicative Noise Amenity Area	Time of day	Recommended Acceptable Noise Level dB(A) L_{eq}
Residence	Urban	Day	60
		Evening	50
		Night	45
Commercial premises	All	When in use	65
Active recreation area	All	When in use	55

The aforementioned acceptable levels are to be adjusted in accordance with Section 2.2 of the INP. The existing L_{eq} noise levels (including industrial sources and localised noise sources) recorded at the site are as follows:

- Day – 54dB(A) L_{eq}
- Evening – 52dB(A) L_{eq}
- Night – 49dB(A) L_{eq}

In relation to the aforementioned noise levels, ALC notes the following:

- The contribution from industrial noise sources, that being mechanical plant associated with the adjoining commercial uses (i.e. university buildings) was predicted to be in the order of:
  - 51dB(A) L_{eq} during the day;
  - 50dB(A) L_{eq} during the evening; and
  - 47dB(A) $L_{eq.}$ during the night.
- The resultant L_{eq} noise level in the vicinity of the site is largely controlled by latent traffic noise from City Road and sporadic car movements along Fisher Road.

Utilising the modification factors in Table 2.2 of the INP, the amenity criteria becomes the following:

Table 4 – INP Adjusted Amenity Noise Criteria

Time of Day	Acceptable noise level, dB(A) L_{eq} (period)	Existing L_{eq} noise level from industrial noise sources, dB(A)	Modification factor	Adjusted Amenity criterion, dB(A) $L_{eq\ (period)}$
Day	60	46	N/A	60
Evening	50	45	Acceptable noise level minus 2	45
Night	45	41	Acceptable noise level minus 2	43

6 TRAFFIC NOISE INTRUSION ASSESSMENT

SEAR 1 states that an assessment of the development should be conducted in accordance with the State Environment Planning Policy (Infrastructure) 2007.

6.1 STATE ENVIRONMENT PLANNING POLICY (INFRASTRUCTURE) 2007

The SEPP (Infrastructure) details specific acoustic requirements for traffic noise intrusion into residential uses as part of a development.

The SEPP Infrastructure defines busy roads that are subject to an acoustic assessment as:

> *"Roads specified in Clause 102 of the Infrastructure SEPP: a freeway, tollway or a transit way or any other road with an average annual traffic (AADT) volume of more than 40,000 vehicles (based on the traffic volume data provided on the website of the RTA).*
>
> *Any other road – with an average annual daily traffic (AADT) volume of more than 20,000 vehicles (based on the traffic volume data published on the website of the RTA).*
>
> *Any other road – with a high level of truck movements or bus traffic."*

The Infrastructure SEPP sets out the following criteria for internal noise levels from airborne traffic noise:

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

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

- *(a) a building for residential use,*
- *(b) a place of public worship,*
- *(c) a hospital,*
- *(d) an educational establishment or child care centre.*

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

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

- *(a) in any bedroom in the building—35 dB(A) at any time between 10 pm and 7 am,*
- *(b) anywhere else in the building (other than a garage, kitchen, bathroom or hallway)—40 dB(A) at any time.*

ALC notes that the development is within 70m of City Road which carries in excess of 40,000 vehicles per day. An assessment of traffic noise impact on the development is provided in the following Section.

6.2 ASSESSMENT OF TRAFFIC NOISE

The SEPP (Infrastructure) 2007 does not provide specific direction as to which developments should or should not be assessed when in close proximity to a road corridor. However, the Department of Planning document 'Development Near Rail Corridors and Busy Roads – Interim Guideline' provides guidance for the assessment of traffic noise intrusion in fulfilling the purpose of the SEPP (Infrastructure).

Section 3.3 of the Interim Guideline states that:

Under this Guideline only those new residential and noise sensitive building developments with a clear line-of-sight to the road traffic need to be assessed for noise mitigation measures.

Given that the development is screened from City Road by the buildings between Darlington Road and City Road, traffic noise levels would not be sufficient to warrant additional acoustic treatment and as such do not need further assessment.

7 OPERATIONAL NOISE ASSESSMENT

Noise emissions from the general operation of the proposed student accommodation building have been addressed for the following noise sources:

- Noise associated with rooftop terraces; and
- A preliminary assessment of noise from mechanical plant.

ALC notes that there is no car parking associated with the proposal and as such traffic generation and noise associated with on-site movements have not been assessed.

A preliminary assessment of construction noise has also been included in Section 8.

7.1 OUTDOOR TERRACES

The outdoor terraces may be used by the occupants for recreational uses during the day and evening period. Noise emissions from this use have been assessed for students using the space during the evening period.

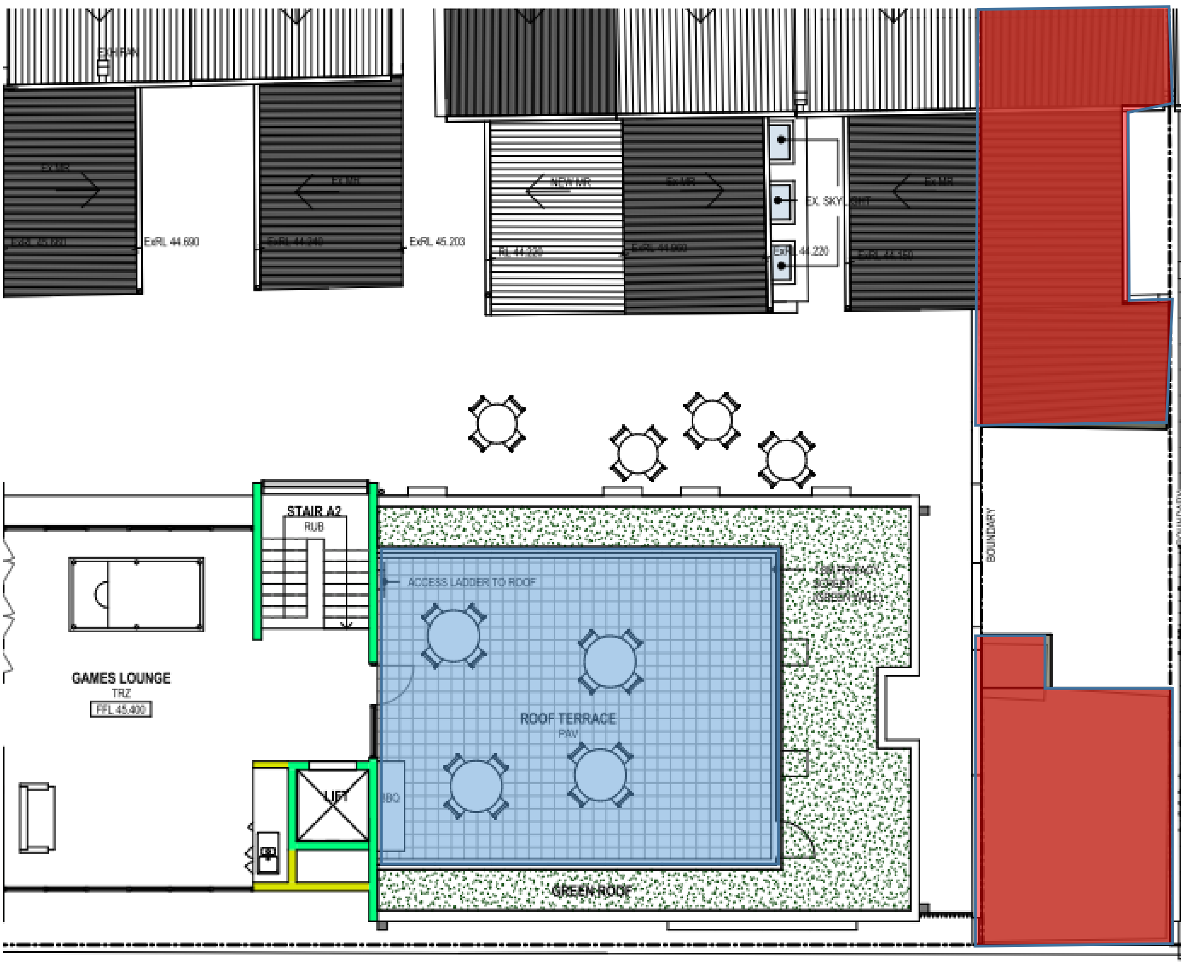


Figure 2: Rooftop Terrace – Building A

The Building A roof terrace has been assessed to the private residential dwelling located at 120 Darlington Road which is not included as part of the proposal. Noise associated with the terrace has been assessed as per the following:

- Up to 50 students using the terrace;
- A sound power level of 72dB(A) L_{eq} with 1 in 3 students talking at any one time;
- No music is to be played on the external terrace; and
- The terrace should not be utilised after 10pm.
- The proposed 1800mm high privacy screen around the top of the Building A terrace has been incorporated. The screen is to be solid with no gaps at the base or between panels (i.e. glass panels, fibre cement etc).

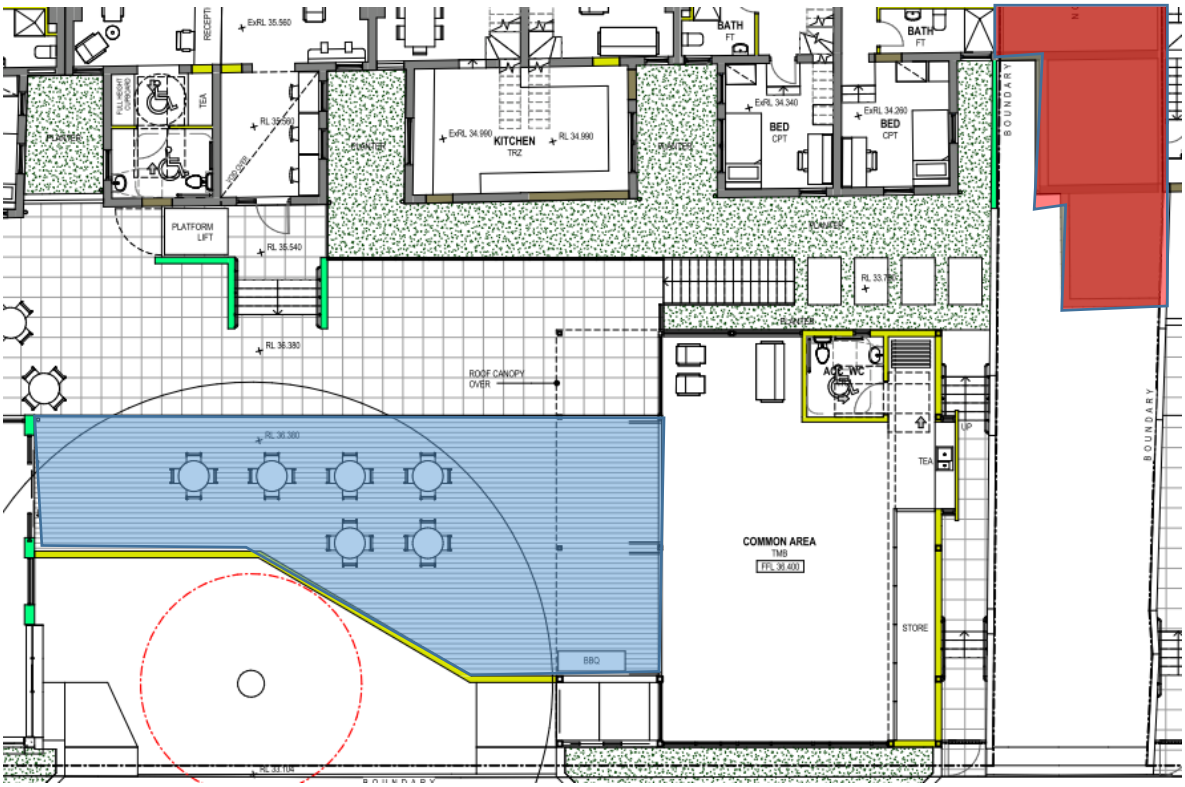


Figure 3: Ground Level Terrace – Building B/C

The courtyard terrace between Buildings B and C has been assessed to the private residential dwelling located at 97 Darlington Road which is not included as part of the proposal. Noise associated with the terrace has been assessed as per the following:

- Up to 50 students using the common room terrace;
- A sound power level of 72dB(A) L_{eq} with 1 in 3 students talking at any one time;
- No music is to be played on the external terrace; and
- The terrace should not be utilised after 10pm.

7.1.1 Predicted Noise Levels

The predicted noise level from the operation of the terraces are detailed in the Table below.

Table 5 – Terrace Predicted Noise Levels

Time of Day	Receiver Location	Predicted Noise Level, dB(A) $L_{eq\ 15min}$	Noise Emission Criteria, dB(A) $L_{eq\ 15min}$	Complies
Evening	120 Darlington Road	41	45	Yes
	97 Darlington Road	41	45	Yes

7.2 NOISE FROM MECHANICAL PLANT

Detailed acoustic design of mechanical plant cannot be undertaken at approval stage, as plant selections and locations are not finalised. However, an indicative assessment of primary plant items is presented below.

Primary plant items may include:

- Large VRV condenser units to be located within the sub-level plant room of Building A.
- Smaller condenser units at various locations around the development.

No large mechanical such as cooling towers, air handling units, chiller or carpark exhaust are proposed on this project.

- Large Condenser Units (Plant Room)
    - The plant room is to incorporate a discharge louvre into the development courtyard. The discharge from the condensers are ducted which will be acoustically treated.
    - The intake from the plant room will face onto Darlington Lane. No additional acoustic treatment is expected; however acoustically lined duct work may be fitted to the back of the intake louvre to reduce noise levels into Darlington Lane.
    - Detailed acoustic review of all plant rooms to be undertaken following equipment selection, in particular if there are louvres facing North. Ideally, fans/air handling units will be ducted to the external louvre (with the remainder of the louvre blanked off to prevent noise escape) as opposed to the being large louvre areas open directly into the plant room (which may necessitate acoustic louvres).
- Small Condenser Units
    - Smaller condenser units may be located around the site. Locations for these items of plant will be selected to ensure compliance at the residential terraces which break up the development.

In any case, compliance with INP acoustic criteria as set out in Section 5.1 will be achievable, provided that detailed acoustic review of plant items is undertaken once plant is selected, and acoustic treatments similar to those outlined above are adopted.

7.3 OPERATIONAL VIBRATION IMPACTS

There are no significant sources of vibration associated with the development which may cause impact on sensitive receivers in the vicinity of the site.

On this basis, the development will be fully compliant with the criteria detailed in the EPA document *'Assessing Vibration: A Technical Guideline 2006'*.

8 CONSTRUCTION NOISE AND VIBRATION ASSESSMENT

This section presents processes to manage noise and vibration impacts associated with the proposed construction activities for the facility and the potential for noise and vibration impact to surrounding receivers.

The principal objective of this study is to undertake an evaluation of works to be performed during the operation of the various activities during construction and develop a management plan to ensure noise and vibration:

1. Does not excessively impact on the sensitive receivers.
2. Is minimised to all surrounding receivers.
3. Does not exceed OH&S standards at surrounding receivers.
4. Is monitored when potentially high noise and vibration generating activities are being used.

This assessment will formulate/present the relevant noise and vibration objectives for which construction activities should be managed to comply with. Additionally, effective mitigation measures have been recommended where possible to ensure noise and vibration objectives are achieved and impacts are minimised.

The principal issues to be addressed in this Section are:

- Identification of the noise and vibration standards which will be applicable to this project.
- Formulation of a strategy for construction activities to comply with the standards identified in the above point.
- Development of demolition and excavation methods which will minimise the impact on surrounding uses.

The expected activities can be expected to include:

1. Light internal demolition within the existing terraces.
2. Excavation of soil and soft sand stone.
3. Construction of new student accommodation structure.
4. Fitout works of existing terraces.

8.1 CONSTRUCTION NOISE MANAGEMENT LEVELS

Noise emanating from the construction site has been assessed in accordance with the recommendations of the EPA *Interim Construction Noise Guideline*.

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

Residential dwellings are discussed in Section 4.1.1 of the ICNG.

Table 6 – Construction Noise Management Levels

Management level, L_{Aeq} (15min)	**How to apply**
Noise affected RBL + 10dB	The noise affected level represents the point above which there may be some community reaction to noise. • Where the predicted or measured LAeq (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(A)	• The highly noise affected level represents the point above which there may be strong community reaction to noise. • Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account: 1. times identified by the community when they are less sensitive to noise (such as before and after school for works near schools, or mid-morning or mid-afternoon for works near residences 2. if the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.

Section 4.1.2 of the ICNG provides guidance on construction noise management levels for sensitive uses other than residential dwellings. These uses as detailed in the following Table.

Table 7 – Construction Noise Management Levels

Land Use	Management level,dB(A) $L_{Aeq\ (15min)}$ (applies when properties are being used)
Active recreation areas	65
Classrooms (Darlington Public School)	45 internally

A summary of noise emission goals for both standard hours of construction and outside standard hours are presented.

Table 8 – Construction Noise Emission Objectives

Location	"Noise Affected" Level dB(A) $L_{eq\ (15min)}$	"Highly Noise Affected" Level dB(A)$L_{eq(15min)}$
Residences	59	75
Commercial Development	70	N/A
Active recreation areas	65	
Classrooms (Darlington Public School)	45 internally	

8.2 CONSTRUCTION VIBRATION

Vibration goals for the amenity of nearby land users are those recommended by the EPA document *Assessing Vibration: A technical guideline.* These levels are presented below:

Table 9 – Construction Vibration Objectives

Location	Time	Peak velocity (mm/s)	
		Preferred	Maximum
Continuous Vibration			
Residences	Daytime	0.28	0.56
Commercial	When in use	0.56	1.12
Impulsive Vibration			
Residences	Daytime	8.6	17
Commercial	When in use	18	36

8.3 ASSESSMENT OF CONSTRUCTION NOISE

With respect to general construction noise, the impacts on nearby development will be dependent on the activity in question and where on the site the activity is undertaken. Excavation and piling works tend to be the loudest typical construction activity. Works close to terraces not owned by the University will have greatest potential for noise impact from the construction works.

Noise has been provided in principle to these receivers and also to the Darlington Public school to the South of the site.

The following discussion assumes that no screening has been provided as hoarding documentation will not be prepared prior to the development consent. Notwithstanding, the commentary is provided to assist in the preparation of the documentation and planning of plant locations.

8.3.1 Demolition Works

Demolition works will typically include:

- any light weight structures external to the existing terraces;
- trees on the sites;
- light weight rear portions of the terraces;
- internal demolition of stairs, partition walls and cabinetry.

Demolition of the existing external structures is not expected to be undertaken for a large portion of time. Noise exposure to residences and the childcare centre is expected to be limited to bobcats and small machinery.

Notwithstanding, in relation to noise impact ALC provide the following commentary:

- During the demolition periods, small excavators and bobcats are expected to be the loudest sources of noise to surrounding receiver locations.
    - Noise levels exceeding EPA “Noise Effected”/”Background+10dB(A)” are likely to occur at the residential receivers. Given its proximity some exceedances of the “Highly Noise Effected” level of 75dB(A) may occur when in close proximity to the receiver locations (i.e. demolition at No. 121, 119, 98, 97, 94 and 87).
    - Noise levels at Darlington Public School are summarised as follows:
        - Exceedances of the 65dB(A) noise level for active play areas is unlikely;
        - Exceedances of the 45dB(A) noise level internally is also unlikely with windows open or closed.

8.3.2 Excavation Works

No bulk excavation works are proposed for the development given there is no sub-level basements. The extent of excavation will entail the cut of existing land topography to allow for the bottom floor to be on grade with Darlington Lane. This will typically entail:

- The use of excavators; and
- Dump trucks to remove waste from the site.

In relation to noise impact ALC provide the following commentary:

- During the detailed excavation periods, large excavators and bobcats are expected to be the loudest sources of noise to surrounding receiver locations.
    - Noise levels exceeding EPA "Noise Effected"/"Background+10dB(A)" are likely to occur at the residential receivers. Given its proximity some exceedances of the "Highly Noise Effected" level of 75dB(A) may occur when in close proximity to the receiver locations.
    - Noise levels at Darlington Public School are summarised as follows:
        - Exceedances of the 65dB(A) noise level for active play areas may occur within close range to the outdoor play areas;
        - Slight exceedances of the 45dB(A) noise level may occur internally with windows closed.

8.3.3 General Construction Works

- During erection of structure, it is the use of hand tools (angle grinders etc.) and concrete pumps which are the loudest typical activity (sound power levels of approximately 105dB(A)$L_{eq(15min)}$).
    - Noise levels exceeding EPA "Noise Effected"/"Background+10dB(A)" are likely to occur at the residential receivers. Given its proximity some exceedances of the "Highly Noise Effected" level of 75dB(A) are unlikely to occur, even with the pump directly outside residents on Darlington Lane.
    - Noise levels at Darlington Public School are summarised as follows:
        - Exceedances of the 65dB(A) noise level for active play areas are only likely to occur with the pump close to outdoor play areas and in any event only in slight exceedance of the management level;
        - Exceedances of the 45dB(A) noise level may occur internally with windows open but will be unlikely to occur with windows closed.
- Noise from construction vehicles and material handling may slightly exceed the EPA "Noise Effected"/"Background+10dB(A)" noise level if trucks and the like are left to idle for extended periods. Exceedances of the "Highly Noise Effected" noise level are unlikely to occur.
- Slab finishing works (use of helicopter floats or similar) may potentially extend into the evening depending on the size of the slab and weather conditions. Noise levels exceeding the "Highly Noise Effected" level of 75dB(A) at the residences are likely to occur when in close proximity to residents.

- Once construction of the building shell is complete, noise from hand tools will be relatively low, as the new building façade will provide considerable noise attenuation. Once the building shell is largely complete, use of hand tools in internal areas is unlikely to exceed EPA recommended levels at any sensitive receiver locations.

8.4 DISCUSSION

In light of the above, we recommend:

- Use of augured rather than driven or vibratory piling will be considered if feasible.
- Location of the crane toward the centre of the site, around 110 Darlington Road to maximise proximity to residential terraces.
- Location of the concrete pump away from residential terraces if practical. If this is not possible, in the event of complaint, temporary screening of the pump should be considered (plywood hoarding, or plywood sheet fixed to temporary fencing).

  Given that the terraces are two storeys; screens or hoarding may not have a significant acoustic benefit for the upper levels of the terrace. In this case, noise levels should be reduced as practically possible for the lower levers of the terraces particularly during noisy works.
- Concrete agitator trucks should not arrive at the site outside of the approved construction hours.
- For activities where acoustic controls and management techniques still cannot achieve the “Noise Management”/”Background+10dB(A)” noise levels, implement a notification process whereby nearby development is made aware of the time and duration of noise intensive construction processes. This may include days of heavy demolition and excavation works.
- Implementation of a noise monitoring program (attended noise measurements during key stages of construction) during construction to provide feedback back to the Builder to ascertain whether construction noise goals are being exceeded and determine additional management strategies. This would be expected at commencement of demolition works.
- In any case, close consultation with the privately owned terrace stakeholders should be undertaken to ensure that noise associated with concrete pours and intense demolition works is managed accordingly.

Through adoption of the above, noise impacts on nearby development can be suitably managed to prevent unreasonable impact. Management processes for dealing with construction noise complaints and response procedures are addressed in Section 8.6.

8.5 CONSTRUCTION VIBRATION

For the most part, construction vibration will be limited to the internal soft demolition works and the rear portions of the existing terraces.

Demolition of the internal stairs, partitions and cabinetry will be highly unlikely to cause significant construction vibration to receivers within adjoining terraces.

Detailed demolition of the rear external components of the existing terraces may result in some vibration impact given the connection between joined terraces. Construction processes should be determined to ensure that vibration is minimised and limit the potential for cosmetic damage to adjoining terraces.

Construction works are not expected to result in significant vibration to receiver structures given that no heavy hammering is proposed at this stage.

8.6 NOISE AND VIBRATION MONITORING, REPORTING AND RESPONSE PROCEDURES

Noise and vibration monitoring may either consist of manned and/or unmanned measurements. Active monitoring may be undertaken during the construction work phase of the project if required in the event complaints are received from neighbours. In the event complaint are received from neighbours the following process will be followed:

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

Where monitoring is required and indicates exceedances of the noise limits immediate action should be taken to identify any further controls as required to reduce noise emissions so that the noise limits are complied with. Monitoring of the activities following the implementation of these additional controls will be undertaken to confirm compliance.

8.6.1 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 below.
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.
5. All monitoring and reporting shall be conducted in conjunction with the conditions of consent.

8.6.2 Response procedures

Complaints associated with noise and vibration generated by site activities shall be recorded on a Noise Complaint Form. The person(s) responsible for complaint handling and contact details for receiving of complaints shall be established on site prior to construction works commencing. A sign shall be displayed at the site indicating the Site Manager and the general public and their contact telephone number

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.
- Indicate what operations were occurring on site at the time of the complaint.
- Required remedial action, if required
- Validation of the remedial action.
- Summary of feedback to the complainant.

8.6.3 Control of Construction Noise

The flow charts that follow illustrate the process followed to assess construction activities prior to the start of work on site and well as the ongoing investigation into noise during the construction period.

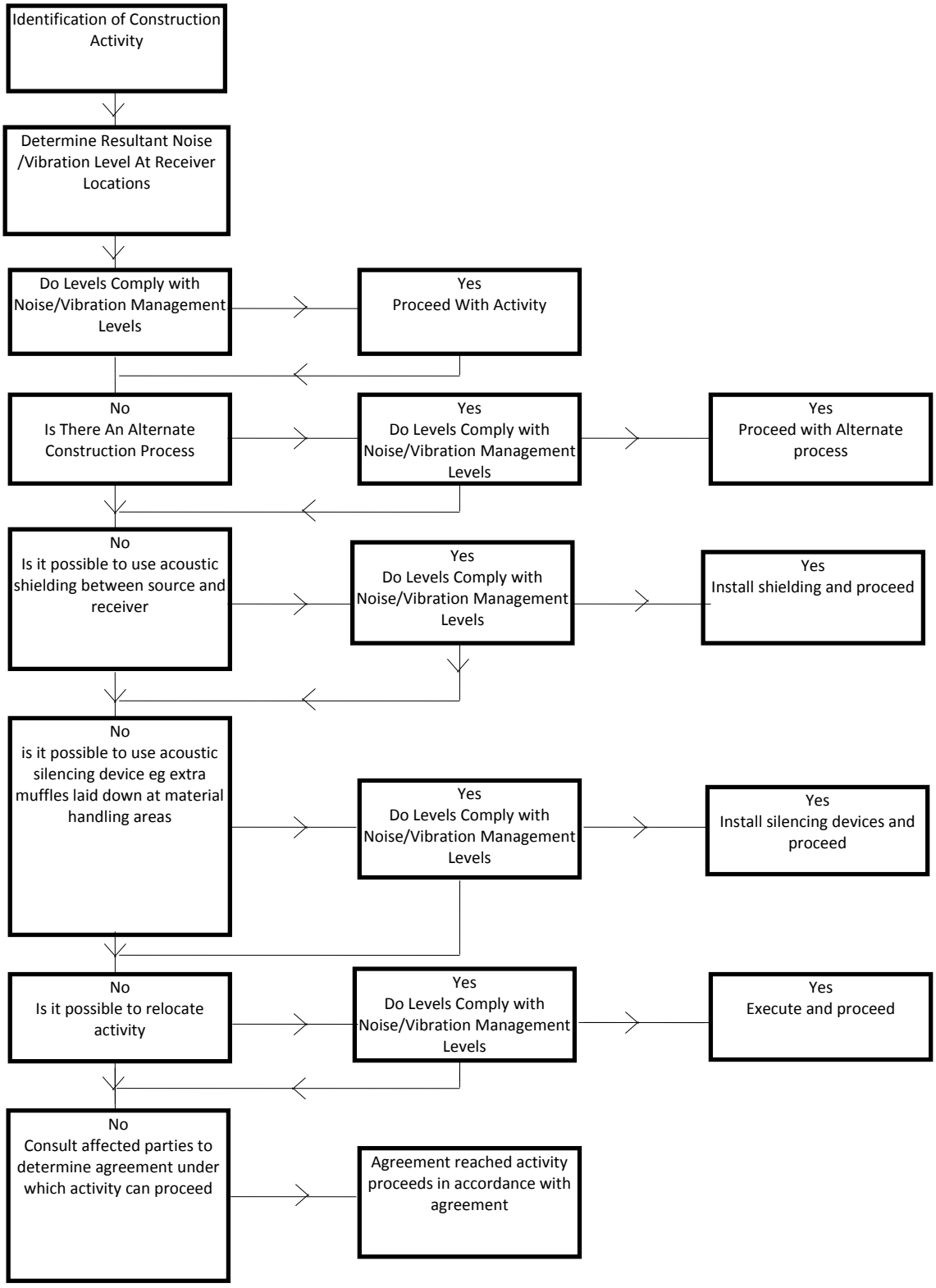


Figure 2 – Process Flowchart

8.7 NOISE CONTROL METHODS

The determination of appropriate additional noise control measures will be dependent on the particular activities and construction appliances identified as requiring future acoustic treatments to those already identified in this report. This section provides an outline of available methods which have previously been used on similar construction sites and may be possible on this site.

8.7.1 Selection of Alternate Appliance or Process

Where a particular activity or construction appliance is found to generate noise levels that exceed the criteria, 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. By carrying this activity by use of pneumatic hammers, bulldozers ripping and/or milling machines lower levels of noise will result.

8.7.2 Acoustic Barriers

The placement of barriers at the source is generally only effective for static plant (tower cranes). Placing barriers at the source cannot effectively attenuate equipment which is on the move or working in rough or undulating terrain.

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 15 dB(A) can be effected. Where only partial obstruction of line of sight occurs, noise reductions of 5 to 8 dB(A) may be achieved. Where the barrier does not obstruct line of sight, 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 which is approximately 10dB(A) greater than the maximum reduction provided by the barrier. In this case the use of a material such as 10 or 15mm plywood would be acceptable for the barriers. A double paled or lapped and capped fencing construction is recommended for such barriers.

8.7.3 Silencing Devices

Where construction process or appliances are noisy, the use of silencing devices may be possible. These may take the form of engine shrouding, or special industrial silencers fitted to exhausts.

8.7.4 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.

8.7.5 Establishment of Site Practices

This involves the formulation of work practices to reduce noise generation. This includes locating fixed plant items as far as possible from residents as well as rotating plant and equipment to provide respite to receivers.

9 RECOMMENDATIONS

We recommend the following acoustic treatments/management controls to ensure compliance with EPA noise emission guidelines.

- An assessment of operational noise associated with outdoor terraces has been provided in Section 7.1. To ensure that noise emissions from these spaces are minimised, the following is recommended:
    - The outdoor terraces are not to be utilised before 7am or after 10pm.
    - No loud music is to be played within the outdoor terrace areas.
    - On-site resident advisors and building management staff are to ensure that loud or boisterous behavior is not permitted on the outdoor terraces.
- The privacy screen around the Building A rooftop terrace is to be 1800mm high and constructed from a solid imperforate material (i.e. glazing panels, fibre cement sheet) with no gaps at the bottom or between panels.
- Detailed acoustic review of all external plant items following equipment selection and duct layout design. Initial analysis (Section 7.2) indicates that with acoustic treatment, all plant items will be capable of meeting noise emission requirements. However, this may require:
    - Acoustic treatment to intake and discharge louvres for the Building A plant room;
    - Consideration for locations of smaller condenser units.
- Construction noise and vibration should be managed using the procedures nominated in Section 8.

10 CONCLUSION

Noise emissions associated with the proposed University of Sydney Darlington Road Mixed Use development has been assessed with reference to relevant EPA acoustic guidelines in order to comply with Secretary of the Environment Requirement 1&7.

A review of the traffic noise impact on the development as per the State Environment Planning Policy (Infrastructure) 2007 and the 'Development Near Rail Corridors and Busy Roads – Interim Guideline' indicates that given the acoustic screening provided by buildings along City Road, no additional acoustic treatment would be required.

An analysis of typical operational noise (terraces, mechanical equipment) indicates that the site is capable of complying with relevant noise emission criteria.

Detailed acoustic review of mechanical plant will be undertaken once the design is further progressed (plant selections finalised etc.). In-principal review indicates that acoustic treatment to major plant items may be required (lined ducting in to intake and discharge louvres) however through appropriate treatment, noise emissions are capable of complying with EPA Industrial Noise Policy and Council requirements.

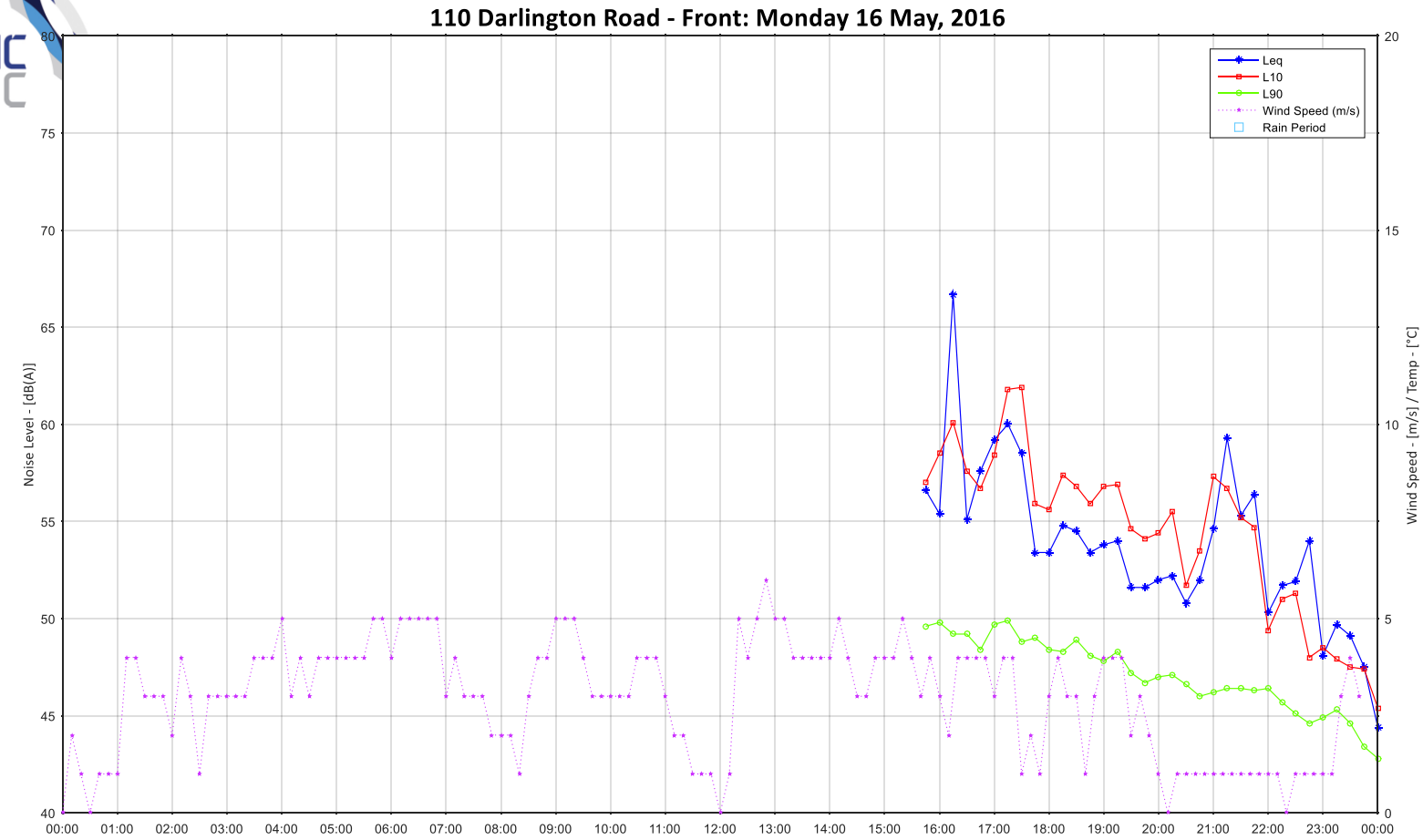
Similarly, detailed noise management practices will be implemented for the control of construction noise and vibration. In principle, the acoustic review indicates that demolition works may have the potential to exceed EPA Interim Construction Noise Policy guidelines, particularly when working in close proximity to the terraces not owned by University of Sydney. Noise mitigation through work scheduling, hoarding/acoustic screening and equipment selection will be considered. This should be implemented via a Noise/Vibration Management Plan, which should be determined once a construction program is complete.

We trust this information is satisfactory. Please contact us should you have any further queries.

Yours faithfully,

Acoustic Logic Consultancy Pty Ltd
James Small

APPENDIX ONE – UNATTENDED NOISE MONITORING DATA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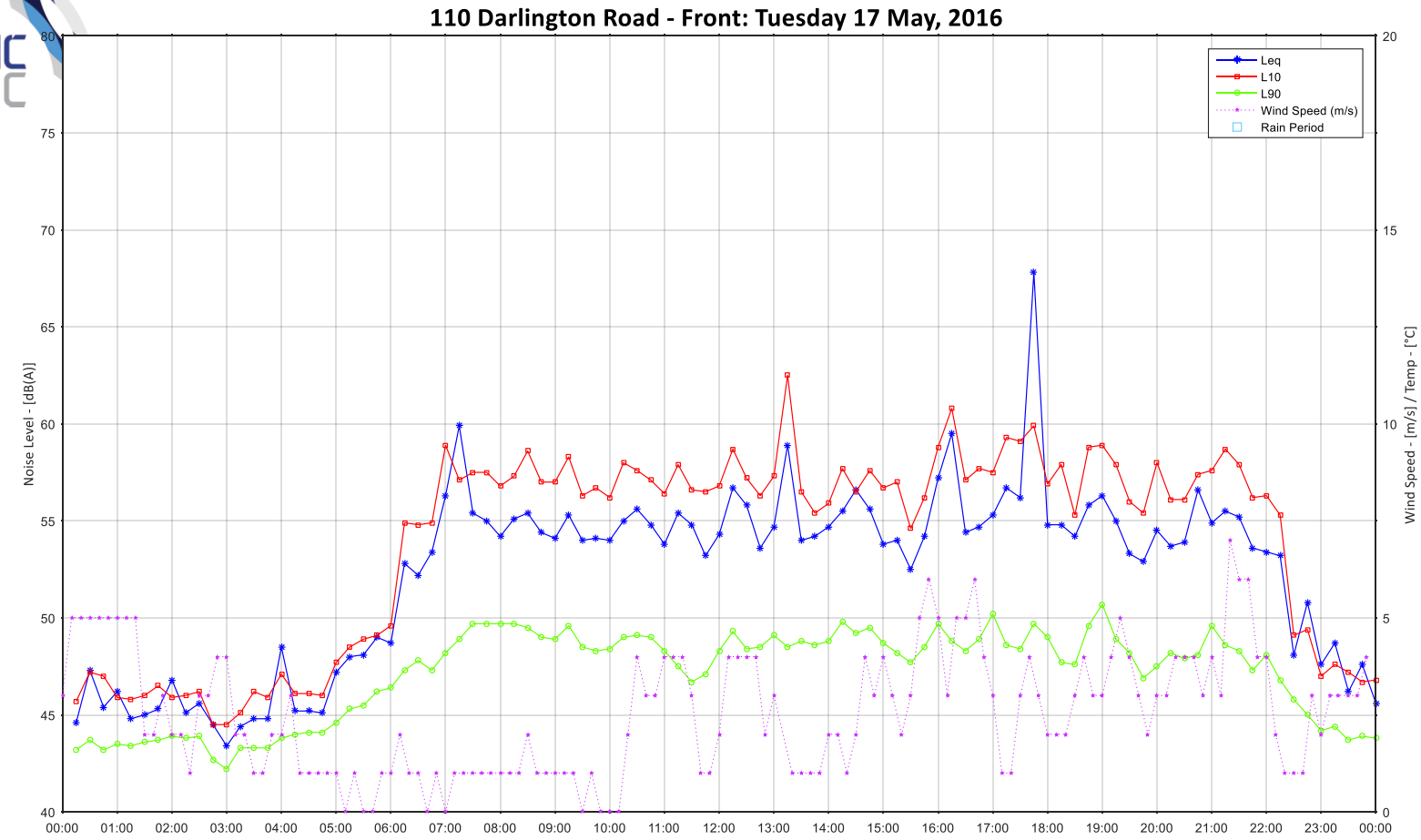
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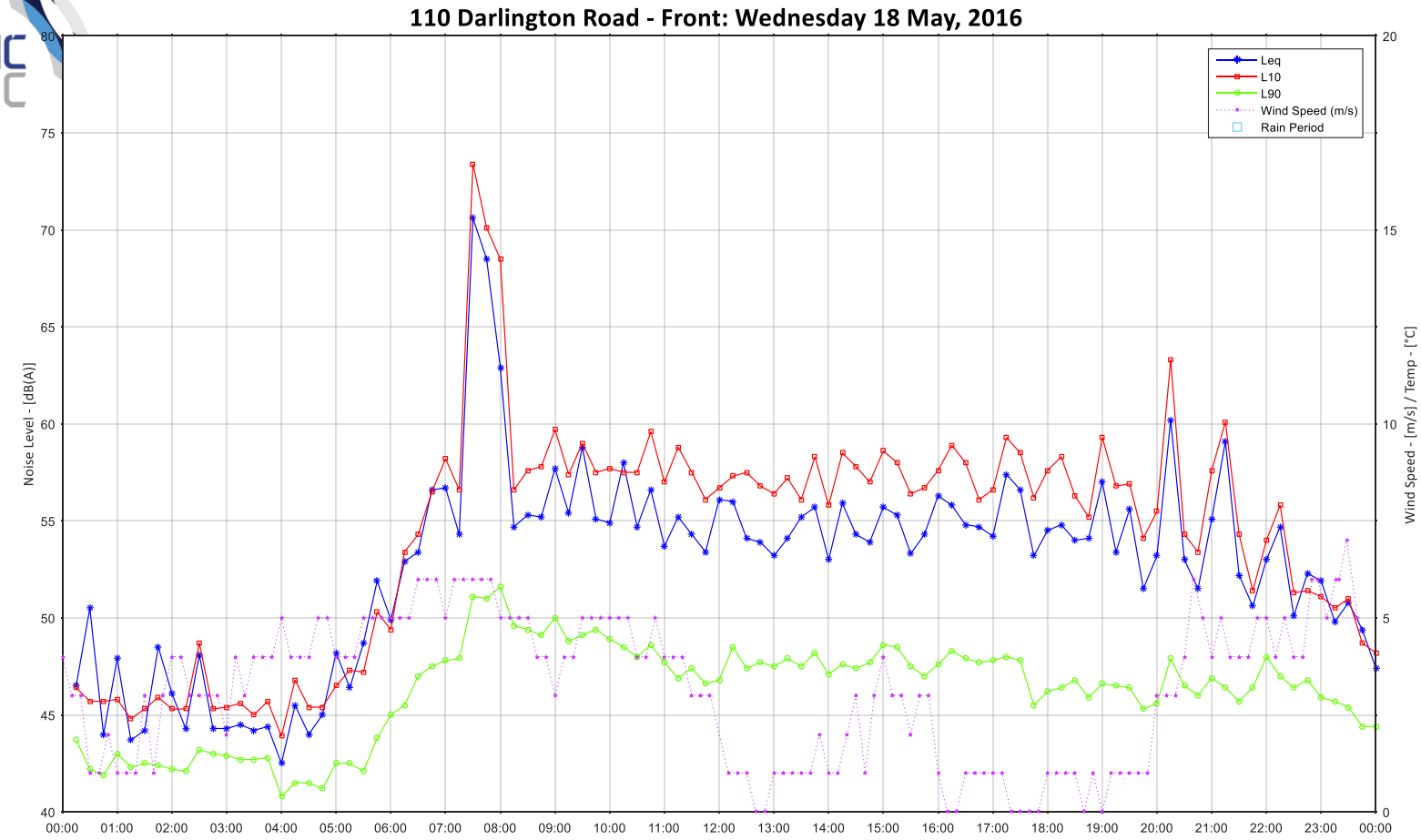
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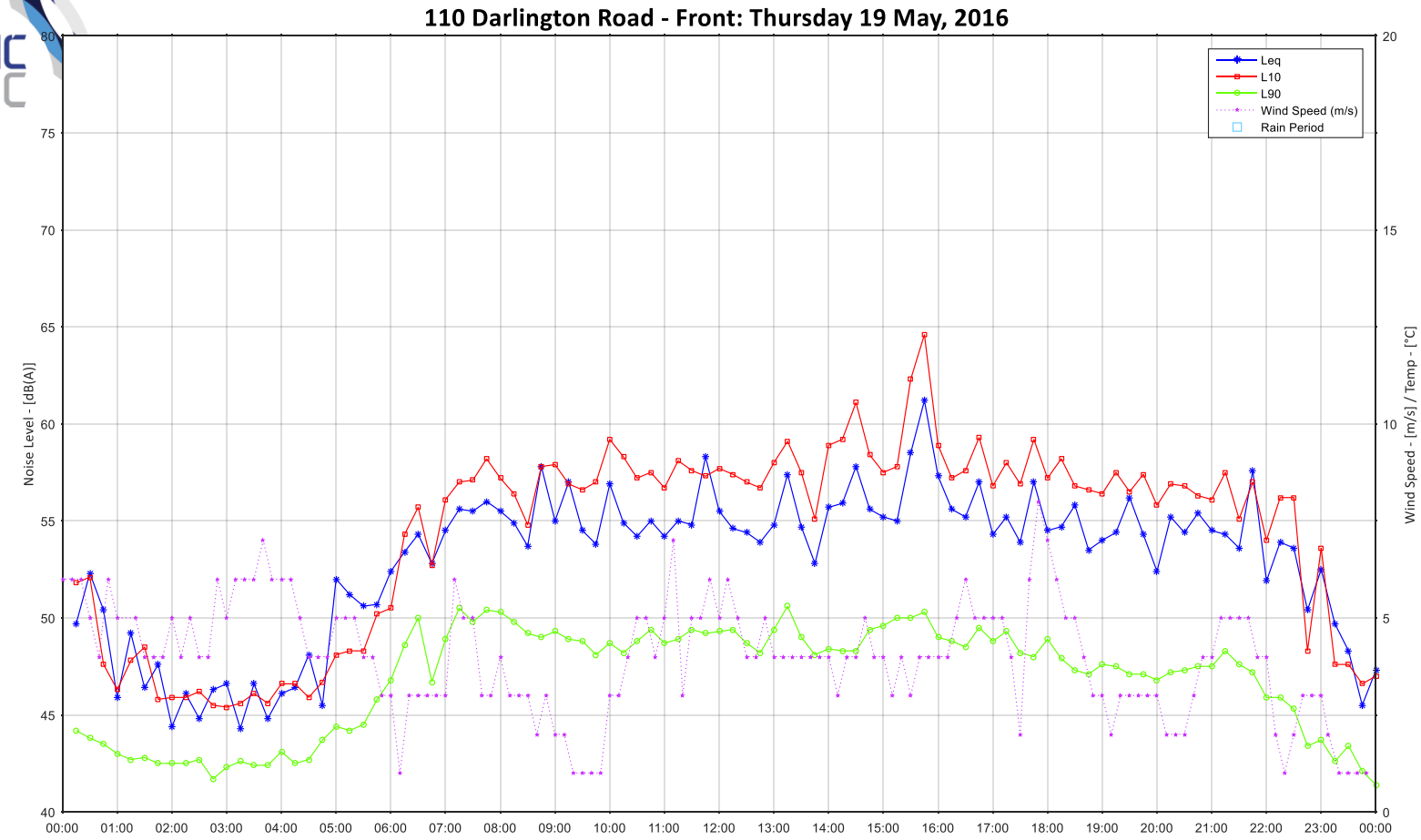
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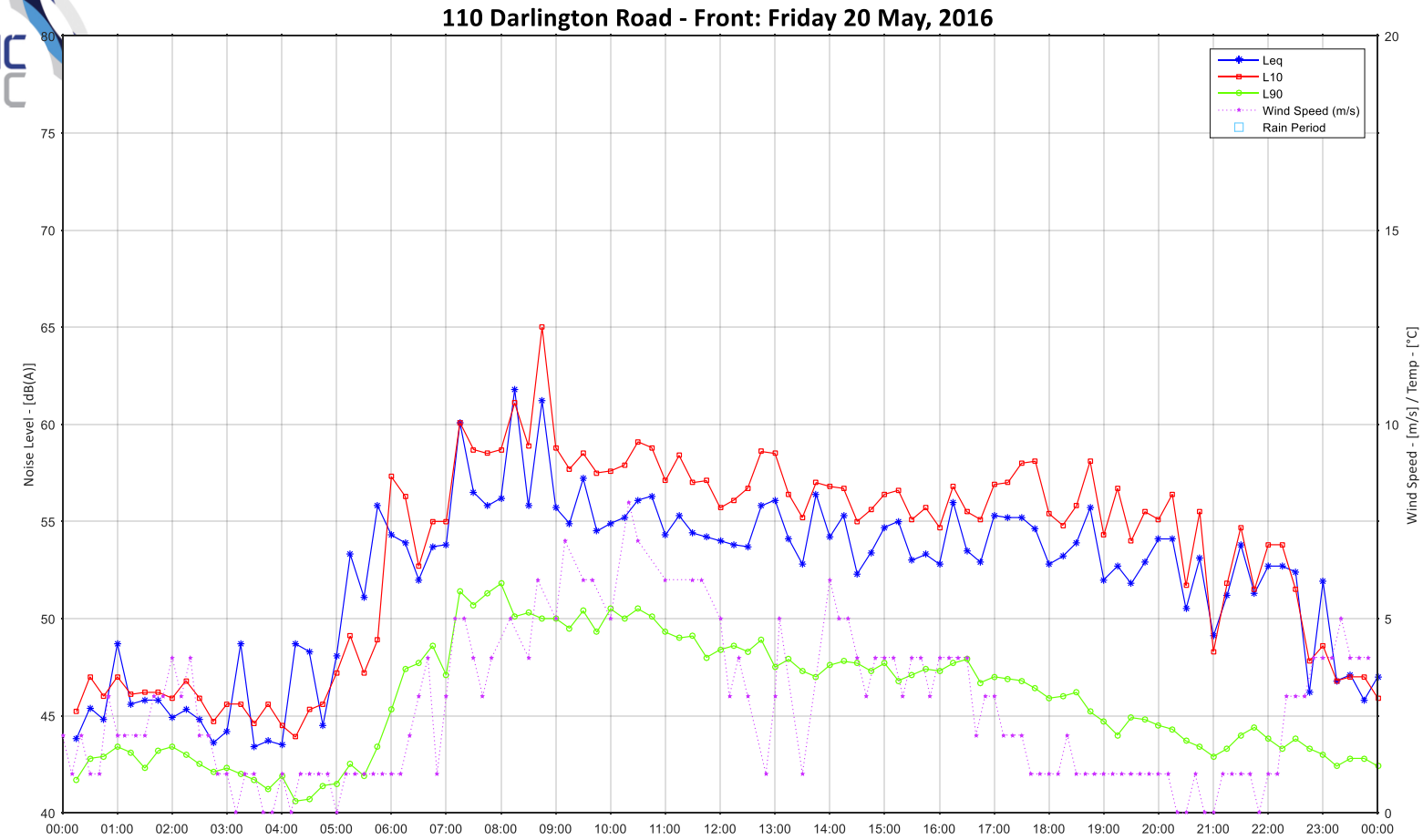
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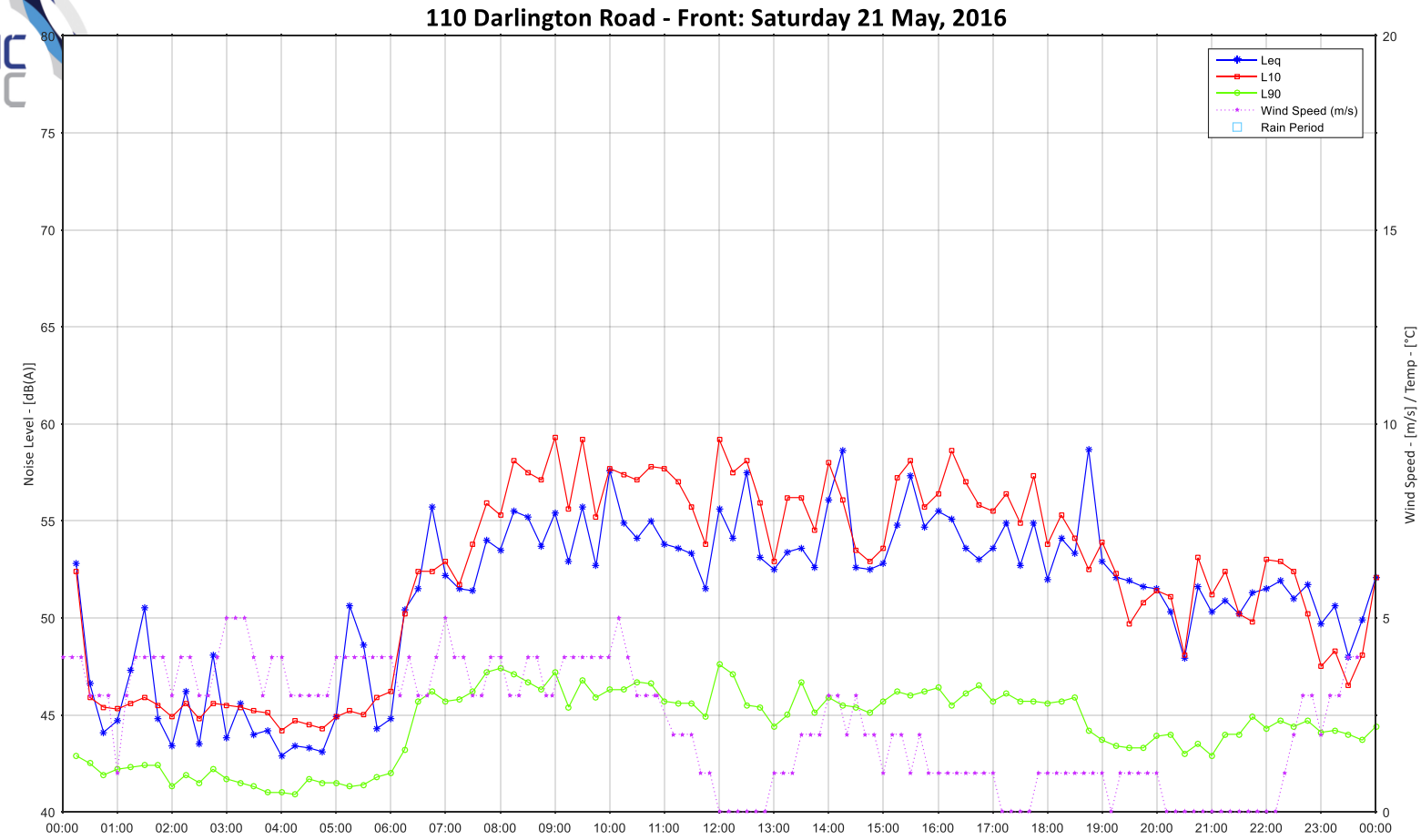
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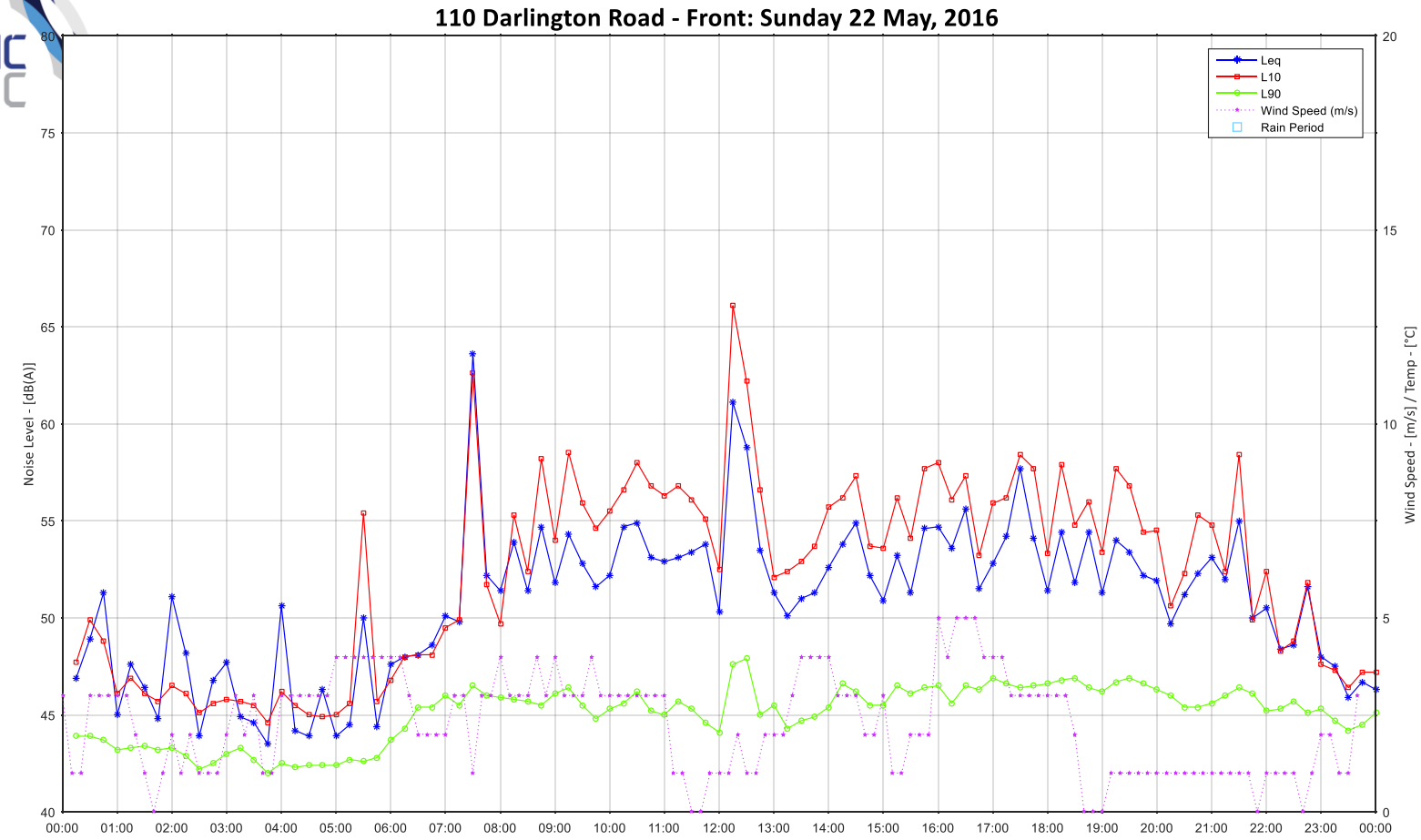
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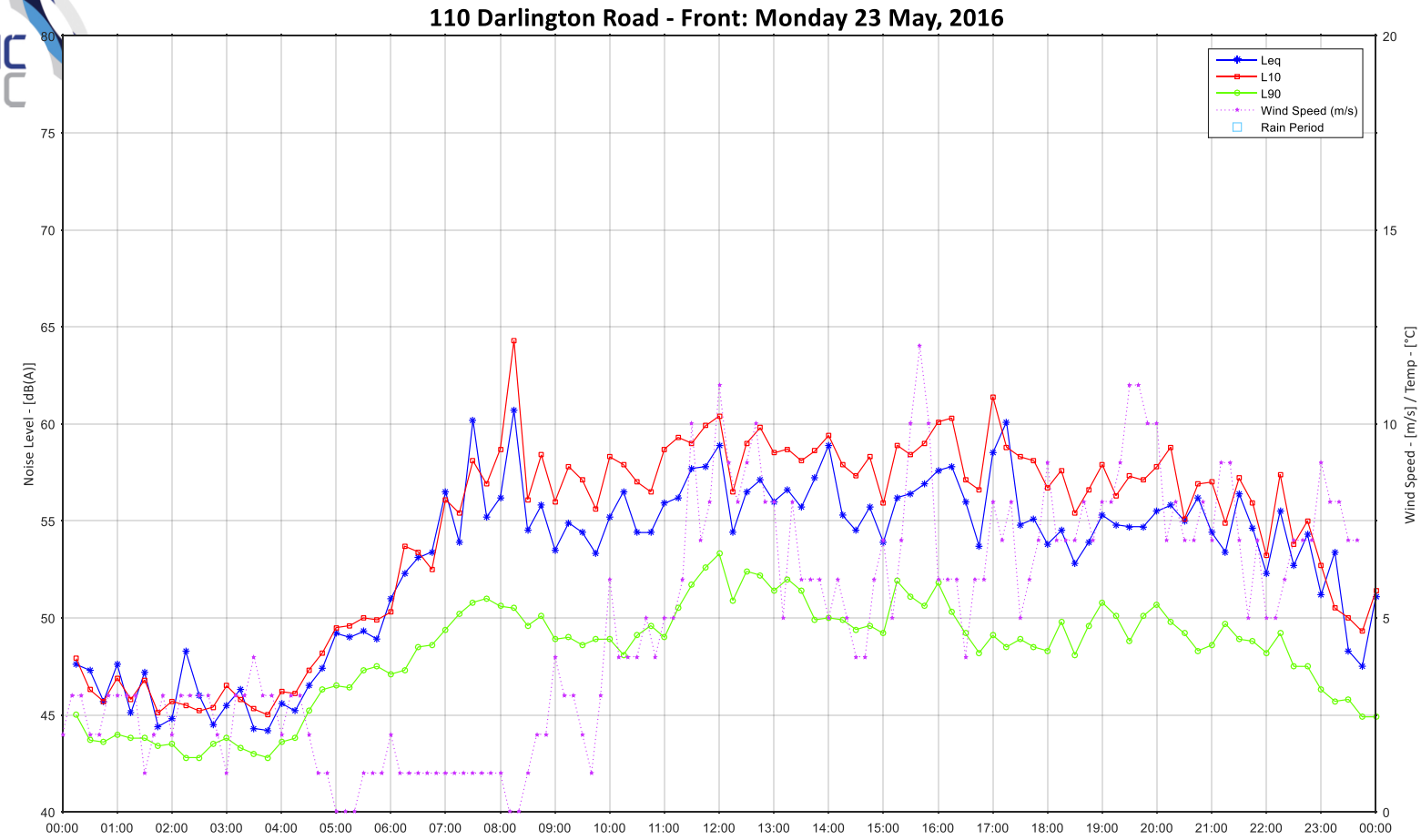
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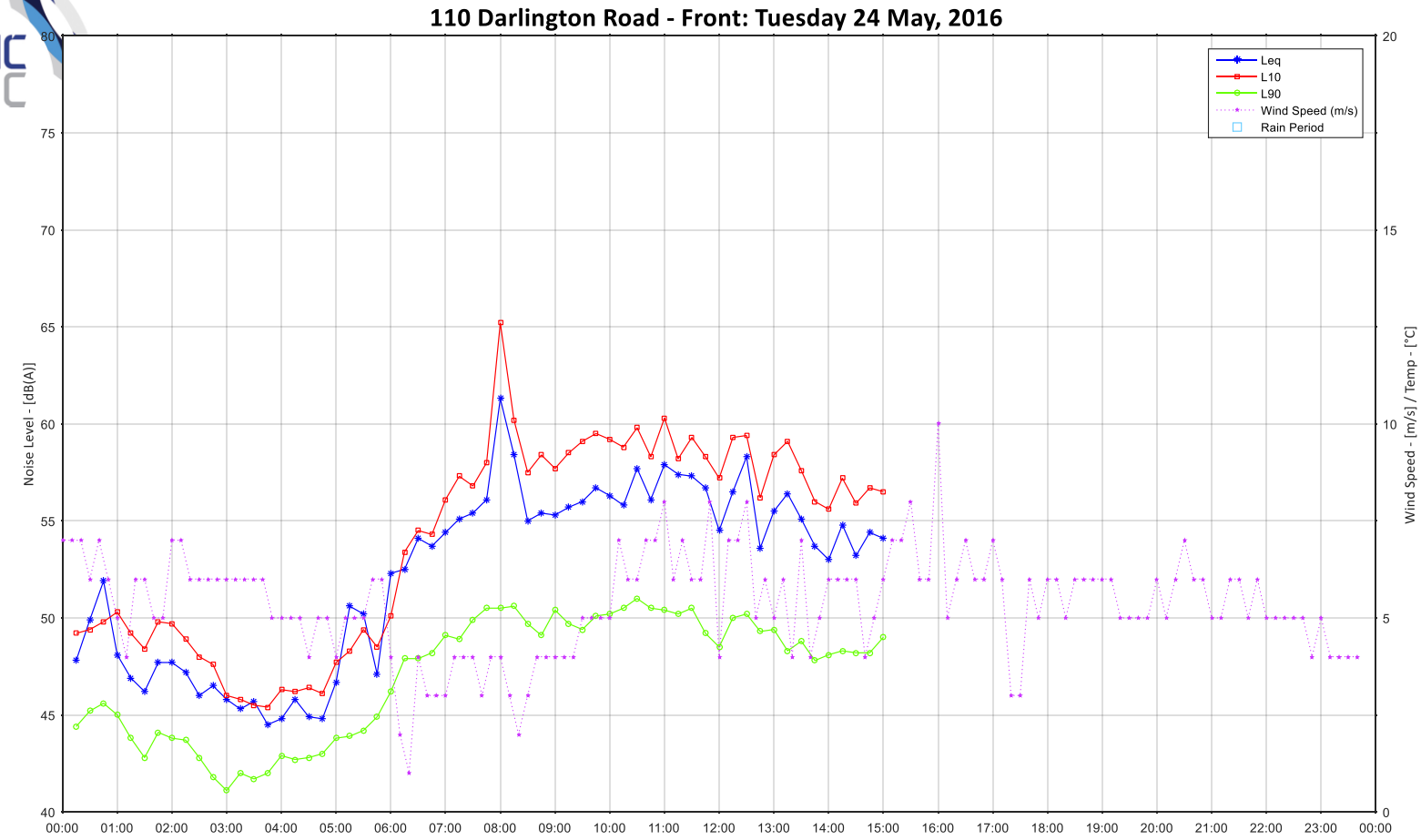
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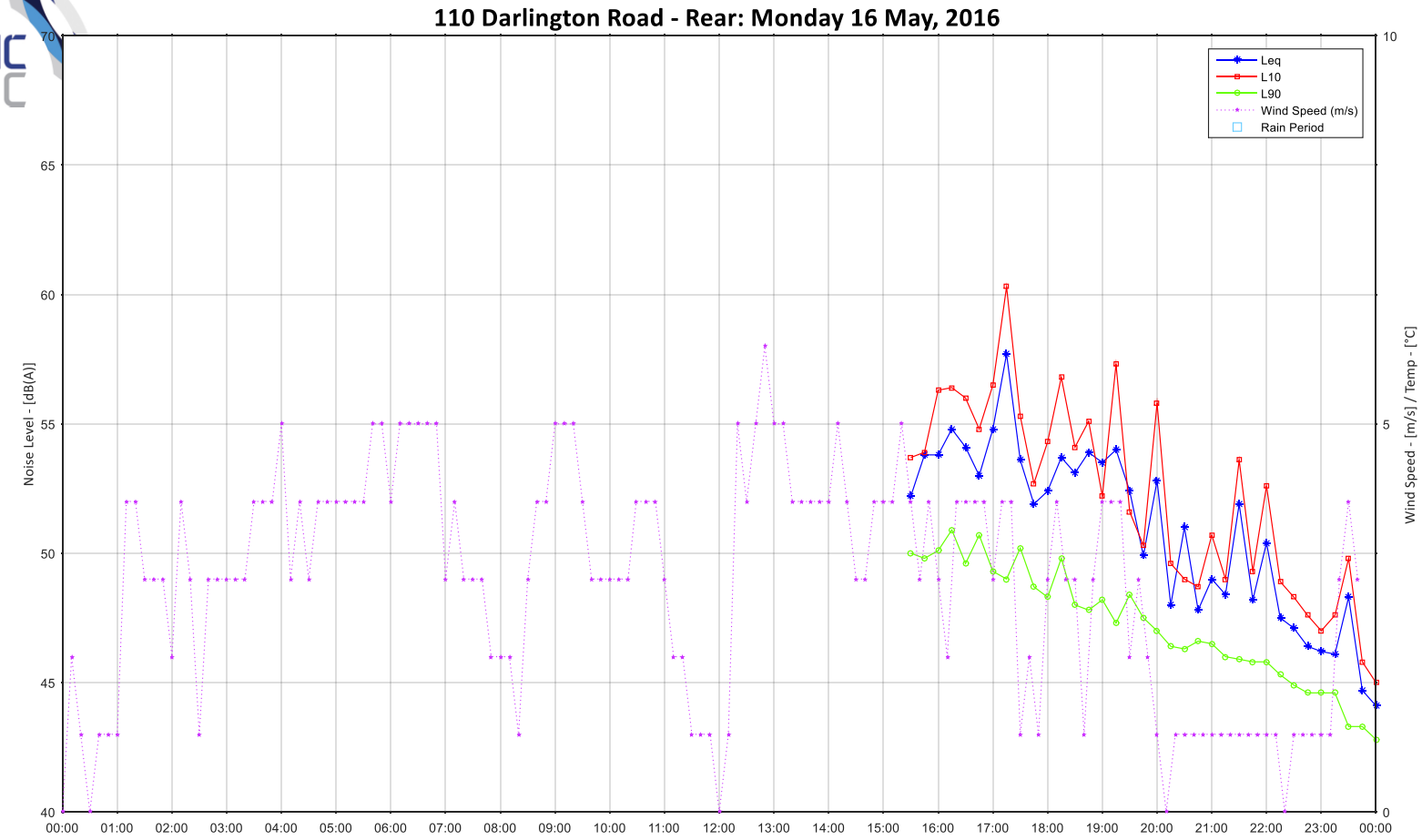
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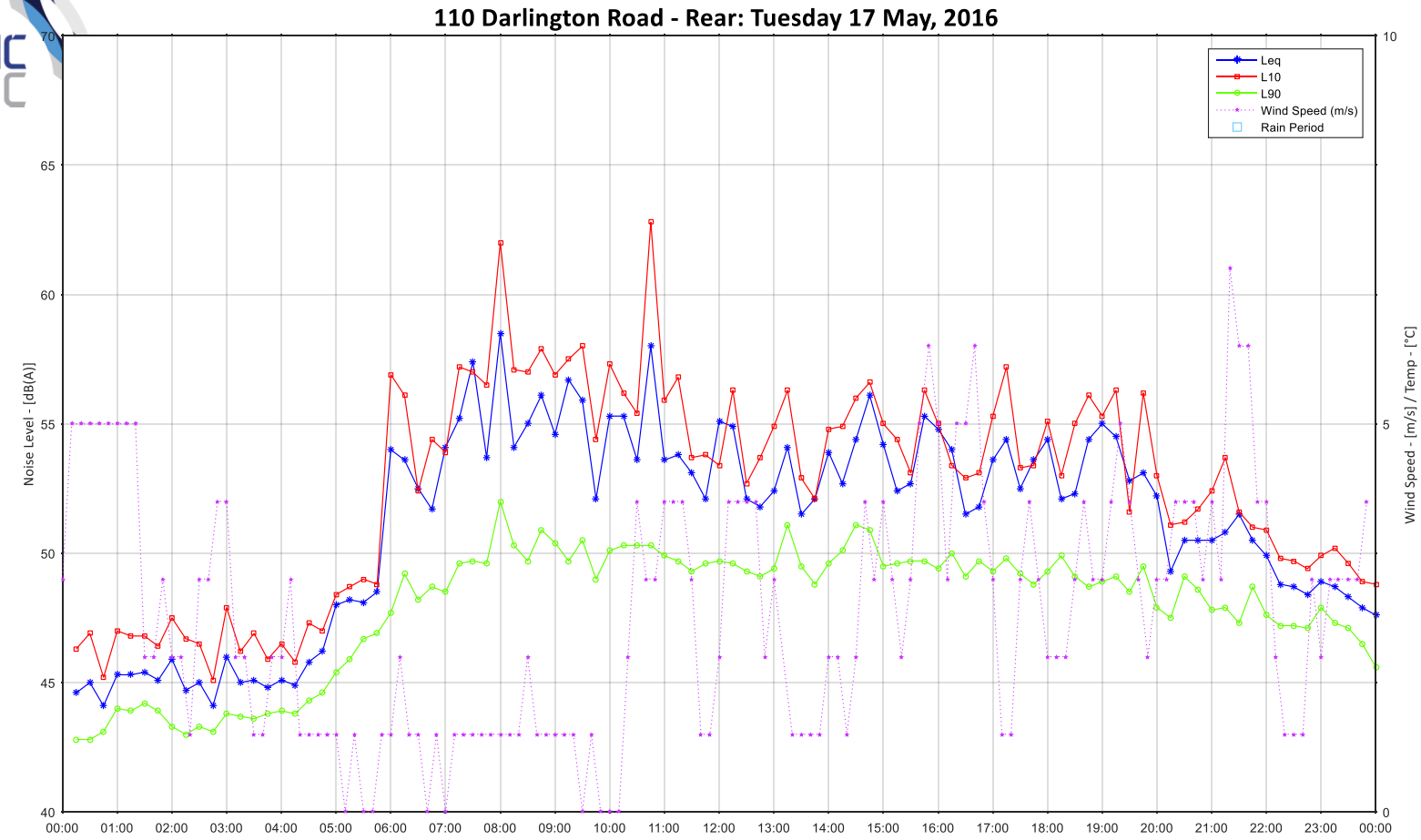
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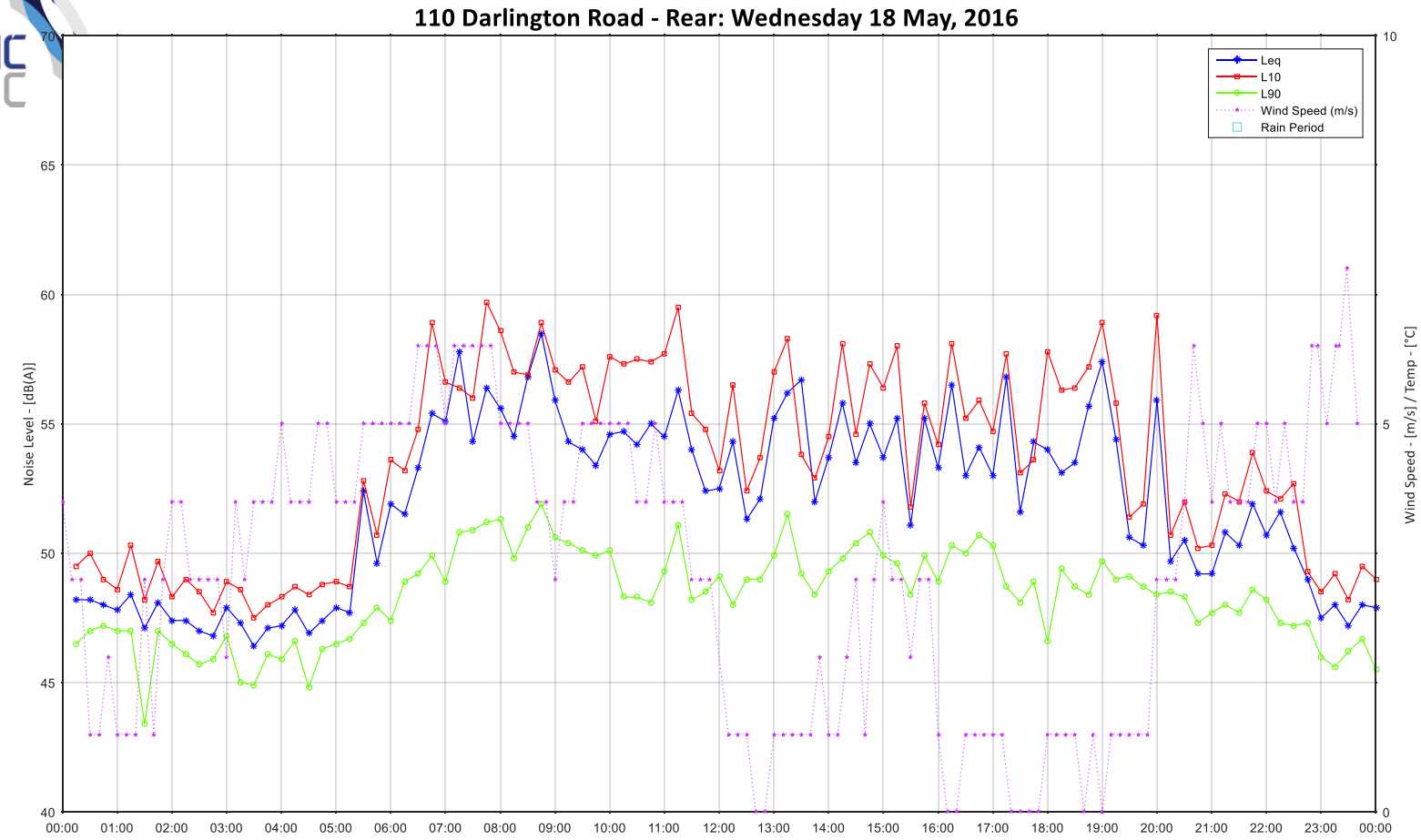
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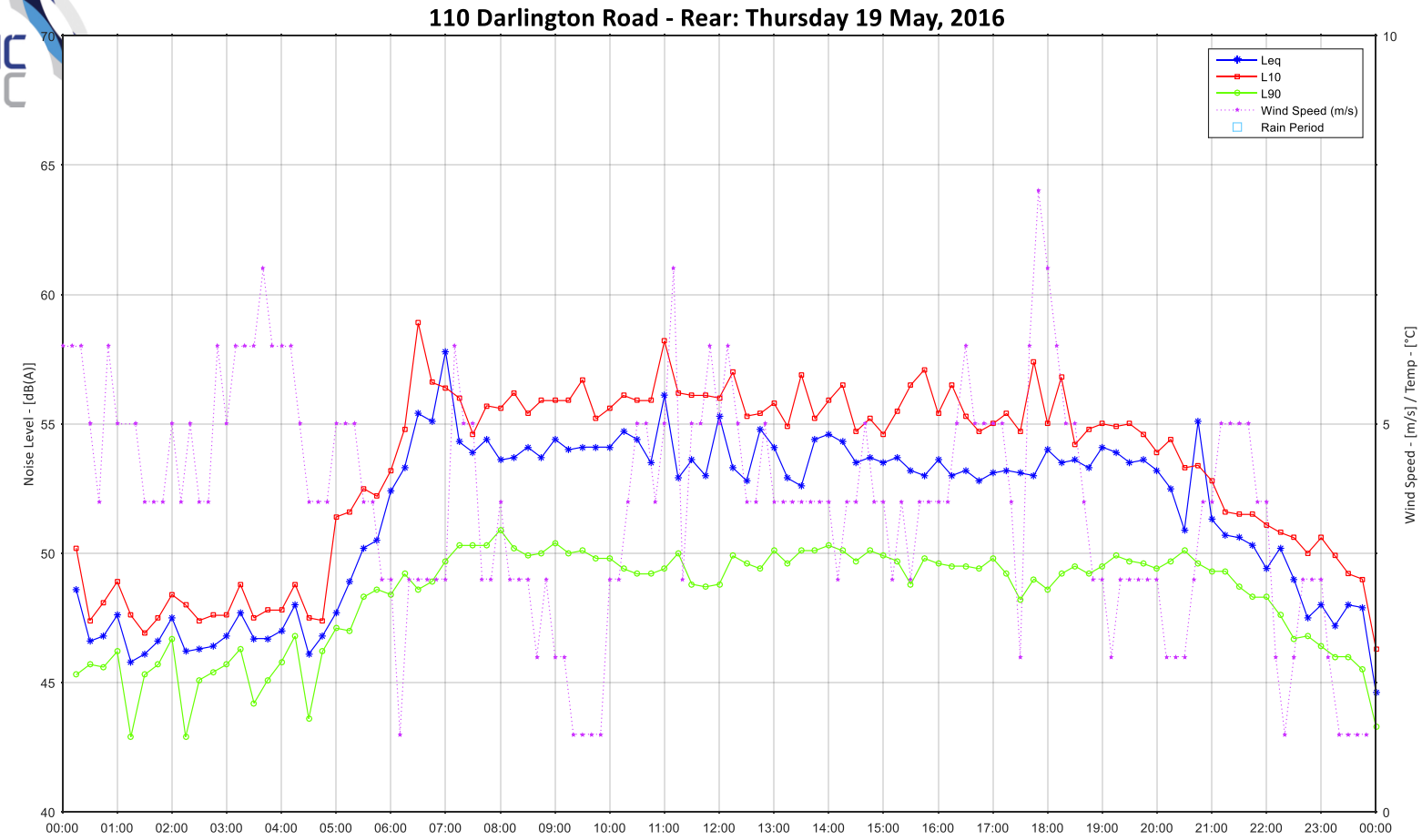
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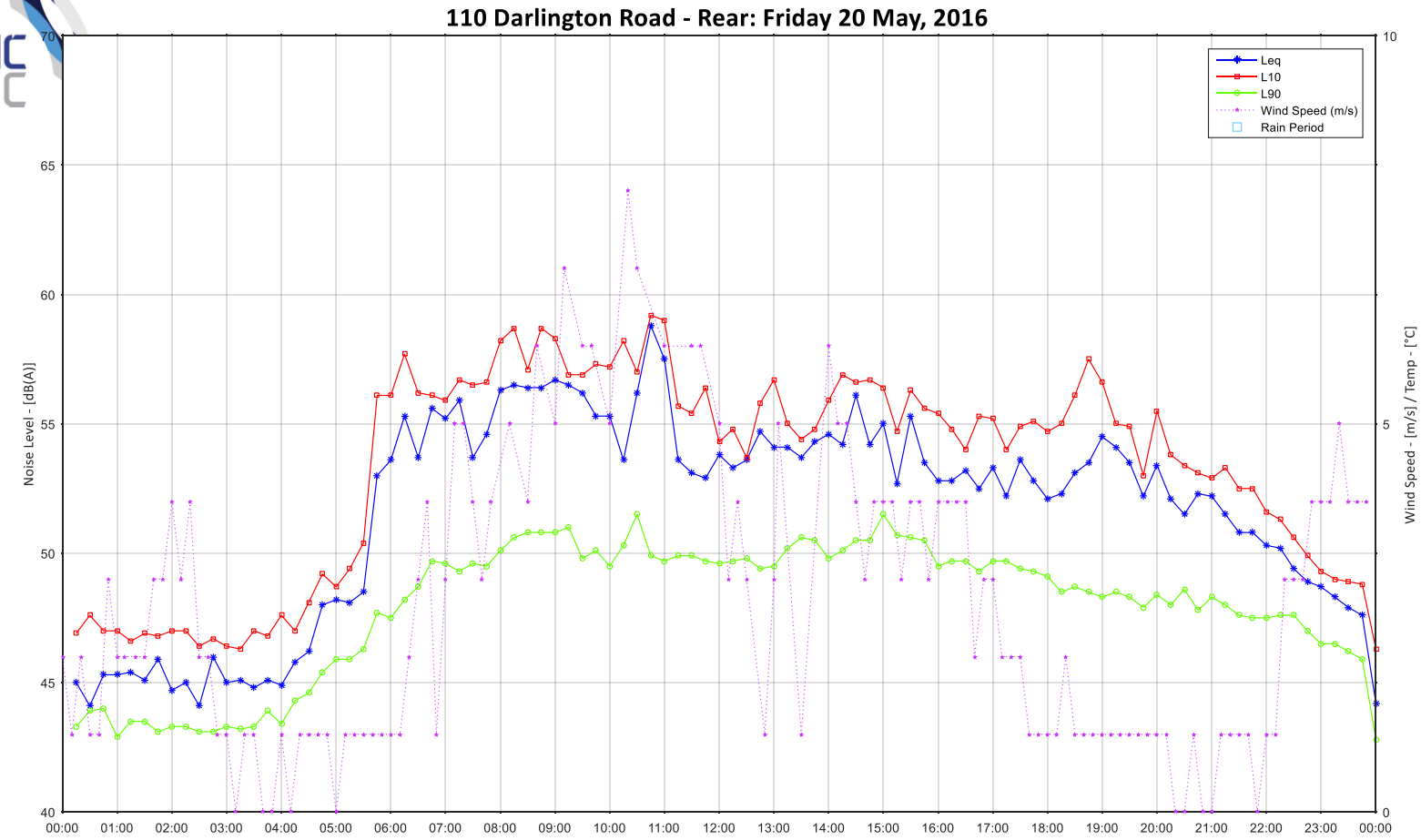
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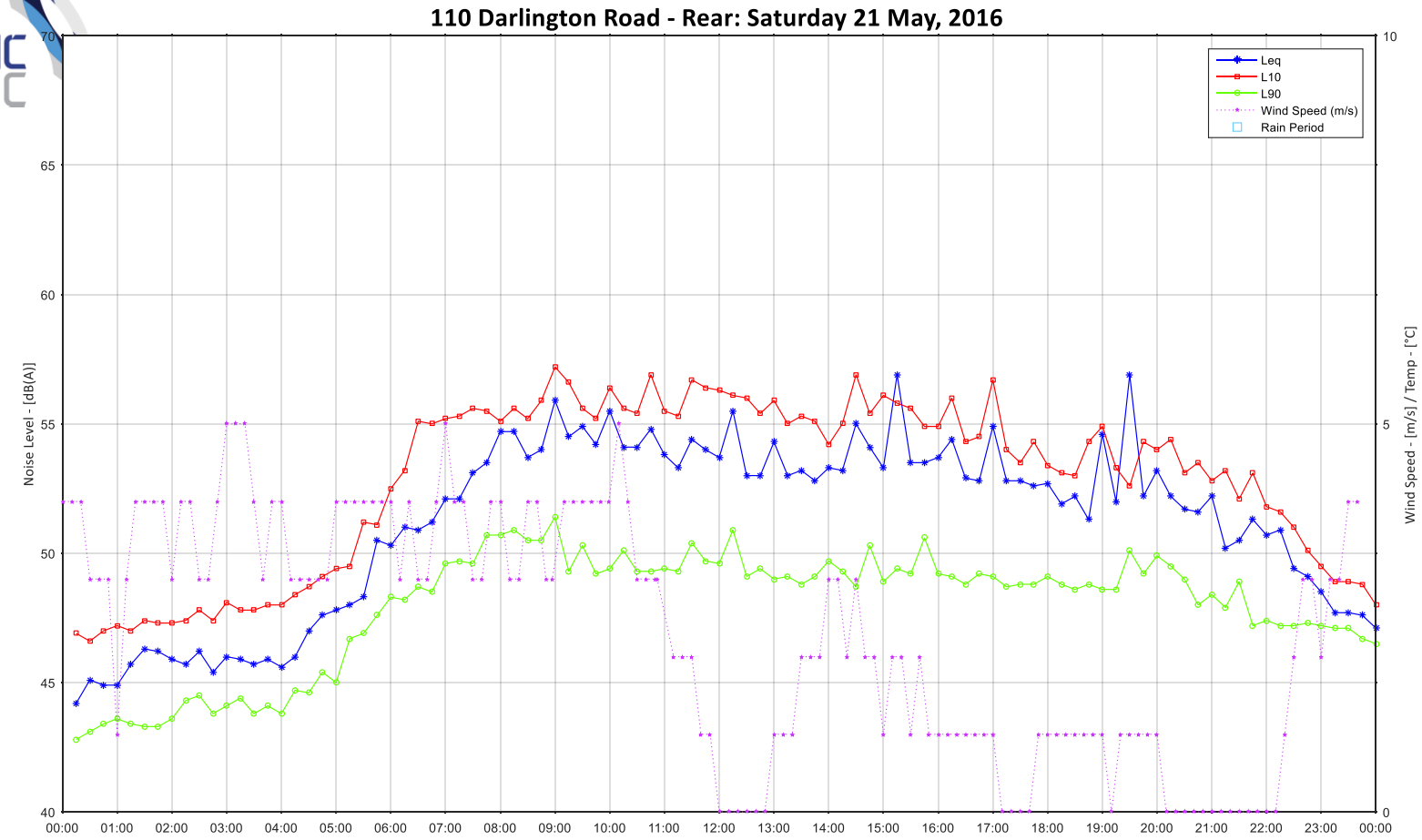
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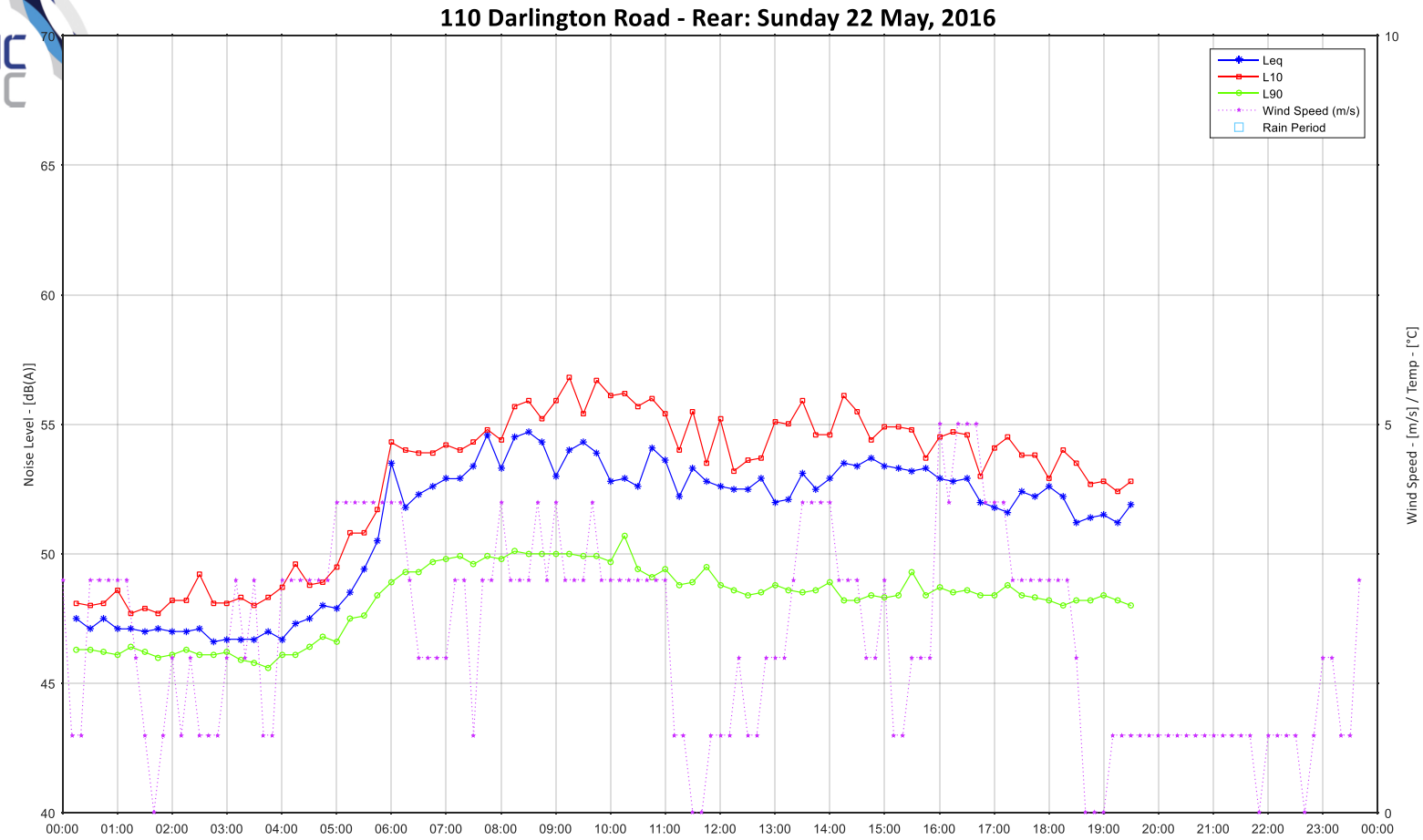
110 Darlington Road - Rear: Sunday 22 May, 2016
Leq
L10
L90
Wind Speed (m/s)
Rain Period
Noise Level - [dB(A)]
Wind Speed - [m/s] / Temp - [°C]
70
65
60
55
50
45
40
10
5
0
00:00
01:00
02:00
03:00
04:00
05:00
06:00
07:00
08:00
09:00
10:00
11:00
12:00
13:00
14:00
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
00:00