

Implementation of NSW Rail and Road traffic Noise Guidelines on Light Rail Projects

Samaneh Fard, Megan Haberley and Poppy Coleman

Safety, Environment and Regulation Division, Transport for NSW, Sydney, Australia

ABSTRACT

The mode of public transport known as light rail has been prioritised by the NSW Government, funding three (3) infrastructure projects since 2010 to serve and revitalise the growing Sydney and Newcastle communities. Light rail connects communities and helps both locals and visitors move around more freely and explore what regions have to offer. Transport for NSW's light rail portfolio includes Newcastle Light Rail, Sydney Light Rail (Inner West Light Rail, and CBD & South East Light Rail) and Parramatta Light Rail. This paper demonstrates how these three case studies have implemented the Rail Infrastructure Noise Guideline (RING) and Road Noise Policy (RNP) criteria to comply with the planning approval requirements, while outlining the challenges encountered that are not addressed in these guidelines. The impact of noise and community response to at-property treatments due to light rail operations is also discussed.

1 INTRODUCTION

Light rail is a frequent, reliable mode of transport featuring modern, air-conditioned, driver-operated vehicles which run along a dedicated track, bypassing traffic congestion. It is a safe way to explore the city and connect to major train, bus and ferry hubs. Light rail, historically known as a 'tram', is operated by a driver and runs within existing streets, often sharing roads with pedestrians, cyclists and cars. Light rail often runs in a dedicated corridor and can be powered by electricity from overhead wires, batteries recharged at light rail stops ('wire free') or a combination of the two. Light rail is able to quickly move a high volume of passengers. For example, a 45-metre light rail vehicle (LRV) can carry up to 300 passengers, equivalent to around six buses. Some of the advantages of light rail systems over metro systems and buses are that they can operate on steeper gradients and tighter curves than heavy rail systems, and they can run at lower capital costs in rolling stock and infrastructure compared to underground metros and are also more reliable than buses (Knowles and Ferbrache, 2016; Fageda 2021 and Hass-Klau et al., 2003).

In recent years, many cities in Australia have invested in light rail systems, including Adelaide, Newcastle, Canberra and Sydney. Today's LRVs have less noise impacts and are considered more streamlined and efficient than those of the past, where the noise levels for light rail pass-by depends on the type of vehicle, frequency of light rail service and speed profiles. This study investigates the developments that recent light rail projects in New South Wales (NSW) have encountered to ensure compliance with planning approvals, in particular air-borne noise limits are achieved during operations.

2 TRANSPORT FOR NSW LIGHT RAIL PROJECTS

2.1 Newcastle Light Rail

The Newcastle Urban Transformation and Transport Program (NUTTP) was established to deliver the NSW Government's commitment to revitalise the city of Newcastle. The program aimed to bring people back to the city centre by strengthening connections between the city and the waterfront, creating employment opportunities, providing more public space and amenity, and delivering better transport.

Construction of Newcastle Light Rail (NLR) was an integral part of the NUTTP. The light rail extends in an east/west direction across the city centre, within the former heavy rail corridor (brownfield section) and road reserves (predominantly along the main Newcastle CBD thoroughfare of Hunter Street, the greenfield section) and became operational in early 2019. It is bounded to the west by the Newcastle Interchange in Wickham and terminates in the east at Pacific Park in Newcastle East. Newcastle Light Rail comprises:

- About 2.7 kilometres of wire free light rail track, consisting of about 2.5 kilometres of dual track and 180 metres of single track
- Six light rail stops and associated infrastructure such as platforms, shelters, lighting and charging infrastructure for LRV batteries (Figure 1)



- A light rail stabling and maintenance facility at the location of the former heavy rail Wickham Station.
- Terminus facilities at the Newcastle Beach stop
- Ancillary infrastructure, including two new substations, power supply, wiring and utilities
- A fleet of six battery-powered (wire free) LRVs, approximately 33-metres long, featuring air conditioning and accessible low-floor design, with a capacity to carry 1200 passengers per hour.



Figure 1: Newcastle Light Rail stops and its connection with other transport modes.

2.2 Sydney Light Rail - Inner West Light Rail, and CBD & South East Light Rail

Sydney Light Rail (SLR) network (Figure 2) is comprised of three lines including Line 1 - Inner West Light Rail or L1, Line 2 - CBD & South East Light Rail between Circular Quay and Randwick or L2, and Line 3 - CBD & South East Light Rail between Circular Quay and Juniors Kingsford or L3.

2.2.1 Inner West Light Rail

The Inner West Light Rail (IWLR) is a 12.8 km light rail line and with a fleet of 12 light rail vehicles running from Central railway station through the Inner West to Dulwich Hill and serving 23 stops (Line 1). The first section of light rail became operational in 1997, and the line was extended in 2000 and 2014. Figure 2 shows the Inner West Light Rail route and stops.

2.2.2 CBD & South East Light Rail

The Central Business District (CBD) and South East Light Rail Project (CSELR) comprised the construction and operation of a new light rail service in Sydney, including approximately 12 kilometres of new light rail track from Circular Quay to Central, Kingsford and Randwick via Surry Hills and Moore Park (Lines 2 and 3). The CSELR opened to the public in 2020, and includes 20 light rail stops, a pedestrian zone on George Street, 11 substations to provide power for the LRVs, an LRV stabling facility in Randwick and a maintenance depot in Rozelle. Some of the key operational features include:

- Interchange with heavy rail at major rail stations (Circular Quay, Wynyard, Town Hall and Central), ferry interchange at Circular Quay, and bus interchanges at the Town Hall, Queen Victoria Building, Rawson Place, Central Station, Randwick and Kingsford stops
- A fleet of 60 electric-powered LRVs, approximately 67-metres long, featuring air conditioning and accessible low-floor design and can carry up to 450 passengers per service equivalent to nine standard buses
- A highly reliable service with the capability to carry up to 9,000 passengers per hour in each direction.





Figure 2: Sydney Light Rail (Inner West Light Rail, and CBD & South East Light Rail) route.

2.3 Parramatta Light Rail

2.3.1 Stage 1

Stage 1 of the Parramatta Light Rail (PLR) will connect Westmead to Carlingford via the Parramatta CBD and Camellia. Construction commenced in 2019 and is expected to be operational in 2023. The route will link Parramatta's CBD and train station to a number of key locations, including the restaurants and cafés on 'Eat Street'; the health and medical research facilities at Westmead Health Precinct; CommBank Stadium; the new science, technology and innovation museum Powerhouse Parramatta; Rosehill Gardens Racecourse; and three Western Sydney University campuses.

Key features of Stage 1 include:

- A new dual track light rail network (except for a single track arrangement under Pennant Hills Road, Carlingford) of approximately twelve (12) kilometres in length, including approximately seven (7) kilometres within the existing road corridor (greenfield section) and approximately five (5) kilometres within the existing Carlingford Line and Sandown Line, replacing current heavy rail services (brownfield section).
- Embedded track is used for greenfield section while ballasted track is used for the brownfield section.
- High frequency 'turn up and go' services operating seven days a week from 5am to 1am, departing approximately every 7.5 minutes from 7am to 7pm weekdays
- A fleet of 13 modern, comfortable, driver-operated, air-conditioned vehicles, 45-metres long, carrying up to 300 passengers in each vehicle
- Conversion of the single-track heavy rail to dual-track light rail from Carlingford to Camellia
- Connections to existing rail, bus and ferry interchanges at Westmead, Parramatta CBD and Carlingford
- New shared walking and bike-riding paths along the light rail route.
- A Stabling and Maintenance (SaM) Facility located in Camellia for light rail vehicles to be stabled, cleaned and maintained.



- Sixteen (16) stops that are fully accessible and integrated into the urban environment including a terminus stop at each end of Westmead and Carlingford.
- New bridge structures along the alignment including over James Ruse Drive and Clay Cliff Creek, Parramatta River (near the Cumberland Hospital), Kissing Point Road and Vineyard Creek, Rydalmere

An estimated 130,000 people will be living within walking distance of Stage 1 Parramatta Light Rail stops by 2026. An overview of PLR Stage 1 route is shown in Figure 3.

2.3.2 Stage 2

Stage 2 of the PLR will connect Stage 1 and Parramatta CBD to Ermington, Melrose Park, Wentworth Point and Sydney Olympic Park. An option for extending east through Camellia before crossing the Parramatta River to Rydalmere is also being considered. Stage 2 will connect to the future Sydney Metro West, heavy rail in Parramatta and Sydney Olympic Park, as well as ferry services at Rydalmere and Sydney Olympic Park. In June 2021, the NSW Government committed \$50 million to planning and development works for Stage 2 of the PLR as part of the 2021-22 NSW Budget. The project is currently progressing the development of its Environmental Impact Statement (EIS). An overview of PLR Stage 2 route is shown in **Figure 3**.

Key features of Stage 2 of the PLR include:

- Approximately 10 to 12 stops over a 10-kilometre two-way track
- Travel times of around 25 minutes from Sydney Olympic Park to Camellia, and a further eight minutes to Parramatta CBD
- Supports the vision for Greater Parramatta to the Olympic Peninsula (GPOP) to become a true city at the geographic and demographic heart of Greater Sydney
- Currently being further developed and informed by consultation with the community and stakeholders.



Figure 3: Parramatta Light Rail Stage 1 and 2 routes

3 ENVIRONMENTAL PLANNING AND ASSESSMENT ACT 1979 (EP&A ACT) FOR LIGHT RAIL PROJECTS

3.1 Review of Environmental Factors - Newcastle Light Rail

Unlike SLR and PLR, the potential environmental impacts of NLR were assessed under a Review of Environmental Factors (REF) in accordance with the provisions of Part 5 of the *Environmental Planning and Assessment Act* 1979 (NSW) (the EP&A Act). Section 111 of the EP&A Act imposes a duty on TfNSW to 'examine and take into



account to the fullest extent possible all matters affecting or likely to affect the environment' by reason of the proposal. The Project was approved by TfNSW and was carried out in accordance with the REF subject to compliance with Conditions of Approval. The Conditions of Approval relevant to operational noise and vibration impacts for this project is listed below (TfNSW, 2017):

<u>Condition of Approval 17:</u> Prior to commencement of laying of light rail track, construction of the stabling and maintenance facility at Wickham or the construction of physical noise mitigation structures, an operational noise and vibration management plan (ONVMP) shall be prepared to confirm the final mitigation measures for operational noise and vibration that would be implemented. The ONVMP shall be prepared in consultation with relevant stakeholders. The ONVMP shall:

(b) examine all reasonable and feasible noise and vibration mitigation measures consistent with Rail Infrastructure Noise Guideline (EPA, 2013) and the Industrial Noise Policy (EPA, 2000)

The ONVMP shall be submitted to the PMEM (or nominated delegate) for approval, at least one month prior to commencement of laying of light rail track or the construction of physical noise mitigation structures (or such time as is otherwise agreed to by the PMEM). The approved physical mitigation measures are to be installed prior to the commencement of operations, unless otherwise agreed by the PMEM.

3.2 Critical State Significant Infrastructure (CSSI) Projects

SLR and Stage 1 of the PLR were both declared a critical 'State significant infrastructure' project by the NSW Minister for Planning and Infrastructure. Part 5.1 of the NSW Environmental Planning and Assessment Act 1979 (EP&A Act) establishes an assessment and approval regime for 'State significant infrastructure' (SSI). Detailed environmental impact assessments have been carried out and approved by the Minister for Planning and Public Spaces.

3.2.1 SLR - Inner West Light Rail and CBD & South East Light Rail

The extension of Inner West Light Rail was approved by the NSW Minister for Planning on 16 February 2011 under Part 3A of the EP&A Act. The condition relevant to operational noise and vibration impacts for this project is listed below (DPE, 2011):

<u>Condition of Approval D4</u> The proponent shall within six months of commencing construction, unless otherwise agreed by the Director- General, prepare and submit an Operational Nosie and Vibration Review based on detailed design. The review shall be prepared in consultation with the DECCW and shall:

a) Identify the project specific noise and vibration criteria applicable to each facility.

b) Predict the operational noise and vibration levels at affected receivers.

...Where the noise and vibration criteria cannot be achieved, the assessment shall present an analysis of reasonable and feasible noise and vibration mitigation measures, and the 'best practice' achievable noise and vibration outcome for each facility.

SLR was approved on 4 June 2014, and subsequently been modified three times under Section 5.25 of the EP&A Act, with approvals issued on 17 February 2015, 17 March 2015 and 30 September 2015 respectively. The Condition of Approval relevant to operational noise and vibration impacts for this project is listed below (DPE, 2017):

<u>Condition of Approval C12:</u> The Applicant shall, prior to construction for the Surry Hills precinct and the Randwick stabling facility and within six months of commencing construction for the remainder of the SSI, or as otherwise agreed by the Secretary, prepare and submit an Operational Noise and Vibration Review based on detailed design. The Review shall be prepared in consultation with the EPA and relevant Councils and shall

- a) Identify specific noise and vibration criteria applicable to each component of the SSI;
- b) Predict the operational noise and vibration levels at affected receivers;
- c) Identify the proposed mitigation measures to be used to meet the applicable noise and vibration criteria;

Where the noise and vibration criteria cannot be achieved, the assessment shall present an analysis of reasonable and feasible noise and vibration mitigation measures, and the 'best practice' achievable noise and vibration outcome for each component of the SSI.



3.2.2 PLR

Stage 1 of the PLR was approved by the NSW Minister for Planning on 29 May 2018 and the Infrastructure Approval was subsequently modified twice under Section 5.25 of the EP&A Act, with approvals issued on 21 December 2018 and 25 January 2019 respectively. The Conditions of Approval relevant to operational noise and vibration impacts for this project are listed below (DPE, 2019):

<u>Condition of Approval E48:</u> The Proponent must prepare an Operational Noise and Vibration Review (ONVR) to confirm noise and vibration mitigation measures that would be implemented for the operation of the CSSI. The ONVR must be prepared in consultation with the Department, relevant council(s), other relevant stakeholders and the community and must:

- (a) Identify specific noise and vibration criteria applicable to each component of the CSSI;
- (b) Predict the operational noise and vibration levels at affected receivers;

Where the noise and vibration criteria cannot be achieved, the assessment shall present an analysis of reasonable and feasible noise and vibration mitigation measures, and the 'best practice' achievable noise and vibration outcome for each component of the CSSI.

<u>Condition of Approval E49</u> "Noise mitigation measures as identified in Condition E48 that will not be physically affected by works must be implemented within eighteen (18) months of the commencement of construction in the vicinity of the impacted receiver to minimise construction noise impacts, and detailed in the Construction Noise and Vibration Management Sub-plan for the CSSI.

Furthermore, Conditions of Approval for PLR similar to NLR and SLR requires the proponent to undertake compliance assessment to confirm the predictions of the noise assessment referenced in the operational noise and vibration review report and ensure there is no exceedances of the limits specified in the noise guidelines.

4 CONDITIONS OF APPROVALS AND NOISE GUIDELINES

This section discusses the current gaps between the conditions of approval and the noise guidelines encountered during construction and operation phases of the selected light rail projects in a NSW context.

4.1 Rail Crossing Road Noise

Installation of tracks on the road reserve introduces a new noise source, which is not covered by the rail guidelines (i.e. RING (NSWEPA, 2013)). RNP (NSWEPA, 2011), however, identifies that for existing residences and other sensitive land uses affected by additional traffic on existing roads generated by land use developments, any increase in the total traffic noise level should be limited to 2 dB above that of the corresponding 'no build option'. The experience on SLR has shown that this additional noise source has resulted in a level of annoyance reaction but since RNP was not covered in the conditions of approval, no assessment was undertaken as part of the operational noise and vibration review report (SLR DJV, 2018). For CSSI projects such as SLR and PLR, there are no conditions of approval to assess this additional noise source and reference has only been made to the RING criteria which limits TfNSW ,as the Principal, in directing their Contractors to identify all the impacted receivers and achieve the best outcome for the community. In summary, it would provide greater clarity to the Proponent to provide specific criteria against additional noise sources associated with Light Rail.

4.2 Rail Crossing Road Noise

Widening, provision of additional lanes or diverting traffic to alternative routes on certain sections of light rail alignment can increase traffic numbers and potentially the road traffic noise impacts. The RNP (NSWEPA, 2011) specifies where a development has the potential to result in an increase in road traffic noise levels, the impacts on sensitive receivers are required to be assessed. For example on PLR, a one-way street was converted to a two-way street due to a nearby street being entirely allocated to the light rail route. However, similar to the issue mentioned in Section 4.1, there is no condition of approval to assess the road traffic noise due to the changes made by the light rail project in which can likely result in some complaints during operations.

4.3 CONVERTING FORMER HEAVY RAIL TO LIGHT RAIL ALIGNMENT

Both PLR and NLR were partially located in the former heavy rail corridor, with NLR replacing the CCN Central Coast and Newcastle heavy rail line from the Newcastle Interchange (formerly Wickham Station) into Newcastle Station, closed in December 2014, and Parramatta Light rail replacing the T6 Carlingford heavy rail line, closed in January 2020. Both projects also include the proposed stop locations for the stations in the former rail corridor.



The operational noise and vibration management plan (WSP and Parsons Birkenhoff, 2019) required under condition 17 of NLR compared predicted air-borne noise impacts due to operations with light rail criteria specified in the RING (NSWEPA, 2013) and identified exceedances of the criteria at 38 modelled receivers during the daytime and 78 modelled receivers during the night-time taking into account the proposed feasible and reasonable mitigation measures. Further investigations were undertaken to assess the acceptability of these residual impacts considering the dominant noise source (i.e. road traffic noise) and existing noise levels at the affected receivers. As per the Road Noise Policy, an increase of up to 2 dB is generally taken to represent a minor impact and hence an impact was considered where the change in noise level was more than 2 dBA. The residual impact assessment showed six residential receivers were still expected to be impacted due to light rail operation, consisting of five apartment buildings and one building of two terraces. Properties within these receivers were subsequently inspected for consideration of at-property noise mitigation treatments and eligible properties were offered treatments which included fresh air ventilation systems and the sealing of wall vents, and upgrading windows and doors. The 12-month compliance noise and vibration monitoring report (WSP and Parsons Birkenhoff, 2020) subsequently confirmed that measured noise levels from NLR were within those predicted during development of operational noise and vibration management plan and the relevant RING trigger levels. Despite noise monitoring showing compliance, ongoing complaints have been received which will be discussed in section 5.

However, the approach taken as part of the initial PLR Operational Noise and Vibration Review (ONVR) development was different. The air-borne noise predictions were compared against light rail criteria but when considering if at-property noise mitigation is reasonable at residential receivers in the brownfield section, noise treatment thresholds 5 dB(A) higher than the light rail trigger levels specified in Table 1 of RING were considered. Justification for applying the RING for heavy rail redevelopments was due to the existing rail noise with the previous T6 Carlingford heavy rail line EPL noise limits, to be 5 dB(A) higher than the light rail criteria and the octave band frequency content of the noise to be similar to previous heavy rail operations. It was noted that by adopting a noise treatment threshold 5 dB(A) above the light rail trigger levels, they would still be 5 dB(A) less stringent than the heavy-rail trigger levels with a lower risk of the population reporting high annoyance. The potential for annoyance is further reduced as the population in the brownfield area is already exposed to existing heavy-rail noise, with generally higher L_{Amax} noise levels, with greater potential to affect sleep. Eventually, due to some receivers adjacent to the existing heavy rail line being exposed to a higher noise level for future 2033 noise levels compared to the existing heavy rail noise levels, this approach was considered not suitable and hence the locations exceeding the light rail trigger levels where there was predicted noise increase of 2 dB(A) or more above existing rail levels were later identified for at-property treatments. An example of noise exceedances was for an adjacent receiver to existing heavy rail with an airborne noise level (LAeq (15h)) of 55dB(A) and the predicted airborne noise level (LAeg (15h)) due to light rail operations in 2033 to be 64 dB(A). Since the future predicted noise levels were both higher than the existing noise level and the light rail criteria specified in RING (LAeg (15h), 60 dB(A)), additional mitigation measures were considered taking into account the 2 dB increase trigger mentioned above (it is noted that the ONVR for the PLR project is still in progress and is yet to be finalised).

5 COMMON NOISE AND VIBRATION COMPLAINTS DUE TO LIGHT RAIL OPERATIONS

Experience on light rail infrastructure development has shown public perception and attitude to new light rail projects have triggered community reaction and dissatisfaction resulting in several number of complaints. A case study on light rail projects identified that the majority of the complaints due to light rail operations are for noise and vibration. It can be either from pass-by light rails or stationary source. On NLR, the 12 month compliance noise and vibration monitoring report showed all the noise measurements were compliant with the noise trigger levels as per RING and INP, however, ongoing complaints were received due to the various associated noise sources at and nearby stops, such as:

- 1. PA system announcements
- 2. Point machines
- 3. LRVs idling at Newcastle Beach terminus
- 4. Combined Services Cabinets cooling fans.

In contrast, IWLR – the longest operating light rail alignment in NSW – receives very few operational complaints. Ongoing complaints on this network tend to relate to specific operating conditions, such as late night services to the Star Casino needing to turn back to the city at John Street Square stop, which is close to residential recievers, but the services do not stop to pick up or set down passengers at this stop.



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Being the most recent light rail lines in the state to commence operations, SLR has had a number of complaints relating to the introduction of the new noise source to the community. Adjustments continue to be made to both the services and maintenance processes to determine the optimal operating conditions, therefore it is premature to draw definite conclusions from complaints on the network at this stage.

6 CONCLUSION AND CONSIDERATIONS

This paper compares the conditions of approval and corresponding noise guidelines specified in the planning approval for NSW light rail projects. The comparison of projects identified that compliant operational noise trigger levels did not necessarily achieve the best outcome for the affected community near light rail infrastructure. The outcomes of this paper has identified considerations for a revised baseline of operational noise trigger levels that could achieve improved outcomes for affected communities that can be consistently applied across NSW and potentially Australia.

With other light rail projects (such as PLR Stage 2) currently under investigation there is an opportunity for the interface between rail and road to be considered againist relevant criteria and to be applied for both brownfield and greenfield sections for light rail projects. Consideration should also be given to updating the RING criteria with light rail considerations such as road noise and heavy rail redevelopment to light rail thresholds. Some noise monitoring conditions during operation are also required to assess the noise levels and the adequacy of noise mitigation measures to demonstrate compliance with the noise trigger levels specified in RNP.

Furthermore, some complaints are still being recorded during operations despite the fact the measured noise monitoring data showing compliance with the noise trigger levels. There is a view that the affected residents near any new infrastructure projects (e.g. light rail) tend to complain about the new noise sources but that complaints reduce over time as people get used to the new noise source or affected residents giving up complaining because some issues don't get or cannot be resolved. The experience on NLR, however, showed that the noise complaints from the two small groups of neighbours were ongoing and didn't decrease over time. Hence, it seems the existing guidelines and conditions of approval are insufficient to address community concerns and further consideration is required. This is being addressed on future projects.

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