

# Beyond Industry vs Government: A Partnership Approach to Managing Freight Rail Noise in NSW

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## ABSTRACT

The NSW Government manages the shared passenger / freight rail network around Sydney, stretching from Newcastle in the North to Nowra in the South and Lithgow to the west. As well as carrying one million passengers every day this network supports freight rail operations delivering billions of dollars to the state and national economies. The NSW Government, under its Long Term Transport Master Plan, has committed to doubling the rail freight task over the next decade. Noise from freight trains is the primary environmental issue associated with the network, and a major challenge in delivering this objective. This paper provides an overview of how rail freight noise is managed in NSW to protect the health and amenity of the community and support growth in the freight rail business. Key Government agencies are working in partnership with the freight industry, to design and implement appropriate management structures that are focussed on identifying and fixing key noise issues, mitigating legacy noise impacts through a targeted noise attenuation program and ensuring that new dwellings have noise controls built in. This paper outlines the development of these structures and describes how they are applied to manage both current rail freight noise impacts, including wheel squeal and noise emissions from locomotives, and future rail freight noise impacts, including from new rail infrastructure.

## 1 INTRODUCTION

The NSW Government manages the rail network around Sydney, stretching from Newcastle in the north to Nowra in the South and Lithgow to the west. The majority of these lines carry both freight and passenger services and, for most of the daytime period, passenger services are given priority.

Freight trains using this network play a critical role in transporting bulk commodities to the major ports of Botany, Newcastle and Port Kembla as well as import, export and interstate container traffic. This freight task provides billions of dollars to the state and national economies. The NSW Government, under its Long Term Transport Master Plan, has committed to doubling the rail freight task over the next decade and the Government is currently investing in rail infrastructure to both expand Sydney's rail network and separate the passenger and freight rail networks. However, the majority of the rail network will remain a shared passenger / freight rail network for the foreseeable future.

While the growth of the NSW rail freight and passenger networks brings benefits to the environment and wider community, there is a risk of adverse local impacts associated with this growth. One of the key challenges for the NSW Government is that the networks traverse the key and densely populated cities of Sydney, Newcastle and Wollongong resulting in the exposure of a significant number of people to noise and air emissions from freight trains. Additionally, as the rail freight task grows an increasing number of services will occur during the evening and night time periods with attendant challenges from increased noise exposure and sleep disturbance.

These challenges need to be appropriately managed to ensure that the community's acceptance of rail operations does not become an issue for the growth of freight transport by rail.

## 2 THE IMPACT OF FREIGHT RAIL NOISE ON THE COMMUNITY

Noise from freight trains can be annoying, result in speech interference, affect concentration and disturb sleep. Its impacts depend on the noise level, its characteristics and how it is perceived by the person affected. When communities are impacted by freight rail noise, local complaints have the potential to escalate to become a broader issue especially if the noise and relationship between the railway and the community is not managed well.

In general terms, the key sources of noise from freight trains can be split between the wheel-rail interface and engine and exhaust noise sources (Transport for NSW, NSW Rail Noise Database Stage III Measurements and Analysis 2015). Examples include:

- Rolling noise which is influenced by speed, wheel roughness, rail pad stiffness and the roughness of the rail;
- Wheel squeal and flanging which occurs on the many tight radius curves on the network; and
- Noise from locomotives generated by the engine, exhaust, brake and radiator fans, air intake grills and, where relevant, turbochargers and ancillary equipment. Engine idling and low frequency noise from diesel locomotives can be particularly annoying.

Other specific sources of noise that can affect communities alongside a railway include brake squeal, noise from freight wagons 'booming' when empty, and noise from bunching and stretching of wagons. In some instances, vibration or regenerated noise can also occur. Noise from horns and safety systems (e.g. level crossings) can also be a noise nuisance; however these noise sources are regarded as a safety issue and managed under the network rules.

A report commissioned by Transport for NSW in 2013 estimated that over 12,000 residences were affected by rail noise exceeding 60 dB LAeq,24hour in the Sydney metropolitan region. Approximately 80% of the 12,000 were exposed to noise from freight operations or a mixture of freight operations and passenger services (SLR Consulting 2013).

### 3 FREIGHT RAIL NOISE MANAGEMENT FRAMEWORK

The framework for managing freight rail noise impacts from the NSW Government managed rail network consists of four central and complementary components (Figure 1).

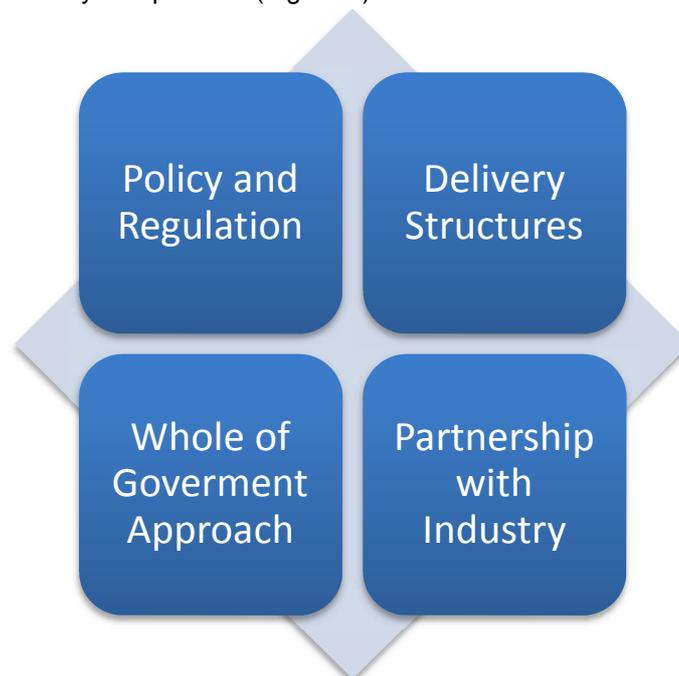


Figure 1 The framework for managing noise impacts from the NSW Government managed rail network

Underpinning this framework is policy and regulation, which sets the minimum standards for protecting the health, safety and amenity of the community, and ensures the safe and efficient planning and operation of the railway. The policy and regulation foundation for managing freight noise is built on the Protection of the Environment Operations Act 1997 (NSW Government 1997) and its associated Regulations and instruments, the NSW State Environment Planning Policy (Infrastructure) 2007 (NSW Government 2007) and the Rail Infrastructure Noise Guideline (NSW EPA 2013). Rail noise policy and regulation is discussed in more detail in Section 4.

Delivery structures such as the Strategic Noise Action Plan, described in Section 5, outlines how the gains achieved from long term implementation of the regulatory framework can be built on to deliver on Government commitments such as those contained in NSW Government Long Term Transport Master Plan (Transport for NSW 2012) and the NSW Government Freight and Ports Strategy (Transport for NSW 2013).

A whole of government approach is applied by Government agencies, including the NSW Environment Protection Authority (EPA), Transport for NSW and the Department of Planning and Environment working collaboratively, and delivering change. This approach, discussed in Section 6, aims to:

- Continuously improve rail noise regulation to protect the amenity of the community and maintain freight rail's social licence to operate;
- Implement policy and regulation efficiently and consistently;
- Prevent (or minimise) future land use conflict; and
- Engage with our industry partners.

#### 4 POLICY AND REGULATION

The EPA is the State's environmental regulator. The EPA protects the community and the environment in three ways: as a leader in protecting our air, waterways, land and the health of the community for the future; as a partner, working with communities, government and business to reduce impacts on the environment; and as a protector, holding people and businesses to account through licensing, monitoring, regulation and enforcement. In addition to the instruments described in Section 3, the EPA issues Environment Protection Licences to rail network operators that include rail noise provisions.

##### 4.1 Environment Protection Licences

The noise impacts of the rail network have been managed by the EPA and its predecessor agencies since 1970. Currently, Sydney Trains, as the operator and maintainer of the NSW Government managed rail network under contract to Transport for NSW, is regulated by the EPA through an Environment Protection Licence (licence) issued under the Protection of the Environment Operations Act 1997 (NSW Government 1997).

From a noise perspective the objective of the licence is:

- To minimise noise levels, to the extent practicable, of railway operations and their impact on communities surrounding the railway network; and
- Through the use of Pollution Reduction Programs, to progressively reduce noise impacts towards façade based noise criteria.

The licence specifies criteria for noise emissions from locomotives being introduced to the rail network for the first time or that have been substantially modified since operating on the rail network (Table 1).

Table 1 EPA Locomotive Noise Emission Criteria

Operating condition	Speed and external location	External noise limit
Low idle with compressor radiator fans and air conditioning operating at maximum load occurring at low idle	Stationary, 15 metre contour, except end positions (front and rear)	70 dB(A) L <sub>Amax</sub> , F, 30s
All other throttle settings under self-load with compressor, radiator fans and air conditioners operating	Stationary, 15 metre contour, except end positions (front and rear)	87 dB L <sub>Amax</sub> , F, 30s 95 dB L <sub>ZMax</sub> , F, 30s

Tonality requirements are included on the basis of third octave band analysis.

- No third octave band below 160 Hz to exceed 15 dB(A) above both adjacent bands
- No third octave band 160 Hz to 400 Hz to exceed 8 dB(A) above both adjacent bands
- No third octave band above 400 Hz to exceed 5 dB(A) above both adjacent bands.

In addition (and unless otherwise stated) the overall linear noise level is not to exceed the overall A-weighted noise level by more than 15 dB.

The licence also allows the EPA to approve a locomotive that does not meet all of the noise limits, provided that: the noise emission performance of the locomotive is consistent with best practice, all feasible and reasonable mitigation measures have been implemented and the non-compliances will not result in unacceptable environmental impacts. All approvals are undertaken on a type or class approval basis rather than licensing individual locomotives.

Approximately 70% of the locomotives operating on the network meet the licence requirements.

The locomotive noise emissions limits have been an effective way of reducing rail noise. A Freight Locomotive Wayside Noise Survey, conducted by Transport for NSW (ETTT Alliance 2015), analysed 607 freight passby events across five locations around the network and found that 'all the locomotives identified as having high LCmax levels or subjective noise impacts were introduced to NSW prior to the EPA approval process'.

The extension of the requirement to 'substantially modified' locomotives has been less successful. It was presumed that locomotives would require a major overhaul every eight to ten years and therefore every locomotive operating within NSW would have been substantially modified and assessed against the noise criteria within a decade. However, this has not been the case, either because many locomotives have not been substantially modified or because the EPA/railway operator has not been notified when rolling stock operators have done so. The term "substantially modified" has been interpreted by the industry to exclude major overhauls.

Transport for NSW has incorporated the licence noise limits for rolling stock into the minimum operating standard for rolling stock, which must be met for vehicles to be allowed to operate on the network. Each time a freight operator seeks approval to bring a new class of freight vehicle into service on the network, they must provide evidence to Transport for NSW that it meets these minimum operating standards, typically through type testing.

Aside from the locomotive noise emission criteria, the principal mechanism under the licence for reducing the noise impacts of the operational rail network has been through the use of Pollution Reduction Programs (PRPs).

The EPA can require licensees to develop and implement PRPs to improve their environmental performance and reduce pollution. PRPs are legally binding and may require licensees to undertake studies before implementing steps to address environmental problems. There have been a range of PRPs placed on the rail industry in relation to noise.

The PRPs over the last decade have focussed on:

1. Establishing a baseline for noise performance of the rail network to inform a strategic approach to address long-term rail noise issues. This included monitoring the passby noise performance of freight locomotives on the rail network and monitoring locomotive and wagon axle alignment to identify rolling stock with the capacity to cause wheel squeal from misaligned axles; and
2. Implementing works to address more immediate and discrete noise issues. This included the installation of Top of Rail Friction Modifier Applicators at known squeal hot spots and a review of safety related practices that cause a noise nuisance.

These programs resulted in some noise improvements across the network with repairs made to defective wagons and some localised noise improvements due to reduced squeal and changes in horn usage. However, the real benefit has been the requirement under a PRP for RailCorp (Sydney Train's predecessor) to install an angle-of-attack monitoring system on a curve at Beecroft, and the collection of over ten years of monitoring data by this system. The data collected has formed the basis of the Transport for NSW research into the mechanics of how wheel squeal is generated as discussed in more detail below.

## 4.2 Rail Infrastructure Noise Guideline

The underlying policy that guides the assessment process for new rail infrastructure is the Rail Infrastructure Noise Guideline – RING (Environment Protection Authority 2013). RING sets out noise trigger levels, which if likely to be exceeded, feasible and reasonable mitigation must be identified to reduce noise from the project.

Table 2 Noise trigger levels for heavy rail affecting residential land uses

Type of development	Noise trigger level dB(A) external	
	7 am – 10 pm	10 pm – 7 am
New rail line development	60 LAeq(15h)	55 LAeq(9h)
	or	or
	80 LAFmax	80 LAFmax
Redevelopment of existing rail line	Development increases existing LAeq(period) rail noise by 2 dB or more, or existing LMax rail noise by 3 dB or more and predicted noise level exceed:	
	65 LAeq(15h)	65 LAeq(15h)
	or	or
	85 LAFmax	85 LAFmax

The RING also includes advice on assessing noise from rail traffic-generating developments where land use development other than rail projects are likely to generate additional rail traffic on an existing rail network. Where the LAeq noise levels increases are predicted to be more than 2 dB(A) and exceeds the noise trigger levels for existing rail lines, feasible and reasonable noise mitigation must be considered.

### 4.3 Developments Near Rail Corridors

Planning in NSW is delivered by a range of instruments known as State Environmental Planning Policies, administered by the NSW Department of Planning and Environment.

For new residential developments encroaching on existing rail infrastructure, including renovations of existing properties, the onus lies with the proponent to ensure rail noise impacts are properly managed. The State Environmental Planning Policy (Infrastructure) (ISEPP) defines acceptable noise levels for bedrooms and living spaces in such properties, and applies to all development undertaken since 2009.

Developers of residential dwellings must ensure that the following LAeq levels are not exceeded:

- In any bedroom in the building – 35 dB(A) at any time 10pm – 7am
- Anywhere else in the building (other than a garage, kitchen, bathroom or hallway): 40 dB(A) at any time.

Accompanying the ISEPP is the document Development Near Rail Corridors and Busy Roads – Interim Guideline (NSW Department of Planning 2008) which describes in detail how to ensure the provisions of ISEPP are met. This includes a suite of complying development provisions, guidance on suitable construction methods to achieve the required internal noise levels, and advice on how to conduct an appropriate rail noise assessment.

## 5 THE STRATEGIC NOISE ACTION PLAN

The traditional regulatory model encompassed by the licensing regime has limitations that impact on the outcomes achieved. Private freight operators are not directly licenced. Rather, the network operator Sydney Trains holds the licence but is not equipped to enforce mitigation activities targeting privately owned rolling stock. As the EPA does not have a formal regulator relationship with the private freight operators, its ability to establish partnerships with these companies is impacted. Furthermore, the licence covers all rail service activities, rather than being targeted specifically at freight or passenger rail.

The establishment of Transport for NSW provided an opportunity for an enhanced focus on freight rail noise. This was, in part, driven by heightened community concerns about noise impacts on residents living in proximity to freight rail corridors, as well as recognition that the growing freight task would result in increases in the overall noise burden faced by the community. One of the key responses was the formation of the Freight Access and Performance (FAP) team. The FAP team developed and now implements the Strategic Noise Action Plan in conjunction with key Government and industry partners.

The Strategic Noise Action Plan (SNAP) consists of three streams that work harmoniously to address freight rail noise now and into the future in order to:

- Provide relief from rail noise impacts in the short term through the Freight Noise Attenuation Program (FNAP).
- In partnership with industry, develop solutions that reduce rail noise at-source.
- Ensure that rail noise impacts are addressed through the planning system and the design phases of infrastructure projects to eliminate future noise issues before they eventuate.

#### **5.1.1 Freight Noise Attenuation Program**

The Freight Noise Attenuation Program (FNAP) is a 10 year, \$50 Million dollar initiative of Transport for NSW to provide acoustic treatments to residences exposed to high levels of freight rail noise (Transport for NSW, Freight Noise Attenuation Program 2017). Under the program, eligible homes are fitted with acoustic windows and doors, sources of noise ingress such as vents are sealed, and fresh air ventilation is provided, so that night time noise levels in bedrooms and living spaces are reduced.

The FNAP was developed in response to noise being identified as a barrier to the growth in rail freight in NSW and to address of the impacts of noise on people's health and amenity. It was designed to provide relief to residents in the short term, while at-source noise controls are developed and implemented and to address legacy noise issues that will remain once at-source controls are in place. The program is implemented under a policy developed in consultation with other government agencies including the EPA, Department of Planning and Environment, Sydney Trains and NSW Health, and based on the already successful Noise Abatement Program delivered by Roads and Maritime Services.

In 2014 a pilot of the FNAP was delivered to a small number of houses and units of varying construction styles and materials, including both heavy masonry and lightweight weatherboard constructions. The Pilot demonstrated the treatments were effective with pre and post noise measurements showing noise reductions of up to 20dB and internal noise levels in accordance with the requirements for bedrooms and living areas in the Infrastructure SEPP. The full FNAP was launched in late 2015 and is now in its second year of implementation with more than 150 properties treated so far.

One of the issues that has arisen in delivering the FNAP is the treatment of homes on bushfire prone land. Much of the rail network passes through such land, in areas including the Illawarra and Blue Mountains, where special bushfire regulations apply. In response, and in consultation with bushfire experts and local councils, Transport for NSW has developed a technical specification that includes specific window and door requirements to improve the bushfire resistance of the dwellings.

The FNAP is delivered in partnership with a range of service providers, including builders and on-the-ground project managers, private certifiers, bushfire experts, and planning consultants. Post-treatment quality audits are conducted and feedback from residents has been positive. The processes that underpin the FNAP are periodically reviewed and updated in accordance with the feedback from the public and these service providers as part of a continuous improvement process.



Figure 2 The FNAP delivers acoustically rated windows and doors for residences impacted by high levels of rail noise

### 5.1.2 At-Source Noise Control

The most effective and efficient means of mitigating rail noise is usually to address the noise at-source, i.e. to prevent the noise from being generated in the first place. In most cases, extraneous noise indicates inefficiency or other “error state” in the operation of the railway. In other words, rail noise is often a symptom of an underlying problem, and fixing this problem can yield cost savings and operational improvements.

Transport for NSW conducts a range of research into the mechanisms by which rail noise is generated in order to devise the most effective at-source noise controls. This has included:

- Leading one of the largest studies conducted into rail lubrication and friction modification (Curley, et al. 2015), which culminated in the development of a new rail lubrication standard (Asset Standards Authority 2015).
- Research and development into the causes of wheel squeal which have, for the first time, identified that freight wagon steering performance is the controlling factor (Jiang, Hanson and Dowdell 2016) and has led to the development of solutions,
- Developing programs focused on solutions for locomotive noise and brake noise.

This program has created a template for how government can successfully work with private freight operators to devise solutions that benefit the operators, the community and the Government.

### 5.1.3 Addressing Rail Noise at the Planning / Development Stage

The most effective way to manage noise impacts is to ensure they do not occur in the first place. In NSW, rail noise is addressed at the planning stage by including consideration of rail noise impacts at the outset. An example is identifying corridors for future rail lines. As part of this corridor preservation exercise, high-level rail noise impacts are considered as part of multi-criteria assessments to select the most appropriate route and reduce the potential for future land use conflict. At each subsequent stage of the planning process, the noise impact assessment is refined and developed to consider the noise impacts in more detail.

Under the SNAP, the rail noise expertise and knowledge developed by Transport for NSW is applied throughout the planning stage of rail infrastructure projects. This includes providing subject matter expert advice to corridor preservation, environmental impact assessments and working with project teams to deliver new rail lines. In addition, the FAP team has identified opportunities for improving rail noise regulations and is working with colleagues in other Government agencies to update these regulations.

## 6 WHOLE OF GOVERNMENT APPROACH

As outlined above, the noise impacts of the NSW Government rail network have been regulated by the EPA and its predecessor agencies since 1970. By the late 1980s, noise criteria applicable at property facades and noise limits for individual locomotives had been developed to manage rail noise in NSW (Hanemann and Maddock 2016). However, as rail freight traffic continued to grow and was actively encouraged by the NSW Government, it was recognised that a whole of government approach was required to manage existing and future rail noise. This led the establishment of a Rail Noise Working Group comprising of government agencies equivalent to the current EPA, Department of Planning and Environment, NSW Health and Transport for NSW. This group oversaw the development of the core government agreed policies for managing freight rail noise including the Development Near Rail Corridors and Busy Roads – Interim Guideline and the Interim Guideline for the Assessment of Noise from Rail Infrastructure Projects (later revised and published as Rail Infrastructure Noise Guidelines - RING).

## 7 PARTNERSHIPS WITH INDUSTRY

In the past, Government's role in the rail sector has often stopped with a separation between "regulators" and "operators". The current approach in NSW, which emphasises engagement and partnership with the industry is recognition that better outcomes can be achieved by seeking out partnerships with the private freight operators to go beyond the minimum requirements of the regulations where win-win opportunities exist. Transport for NSW has developed a number of partnerships with freight operators to give on the ground effect to the requirements of the regulation to deliver results for the community that also deliver benefits to the freight operators.

A case in point has been the development of a new standard for freight wagon steering to address wheel squeal noise. The biggest single source of rail noise impact arises from wheel squeal, accounting for more than 60% of rail noise complaints received by Transport for NSW.

For nearly two decades, wheel squeal has been an increasing issue that has defied understanding and solution. Building on the PRP instigated by the EPA, and as discussed in Section 5.1.2, Transport for NSW has undertaken substantial research into the causes of wheel squeal and has identified the primary cause as poor wagon steering. Wheel squeal is emitted by freight wagons that have bogies of older, three-piece designs that have poor warp stiffness which leads to them warping out of shape in tight curves. These warped bogies force the wheels to adopt a high angle-of-attack with respect to the wheel, essentially part sliding / part rolling through curves. This metal-on-metal sliding is the cause of wheel squeal.

To address this issue, Transport for NSW has partnered with freight operators to quantify the warp stiffness of different bogie designs. Transport for NSW constructed a test rig in conjunction with a bogie maintainer and developed a test method that built on earlier research in the USA and China. Through this research, clear distinctions in the warp stiffness of bogies that steer well and those that steer poorly were established. This established a clear path for fixing wheel squeal on the network – increase the warp stiffness of poorly performing bogies.

Based on this research, Transport for NSW developed a performance based steering standard that is incorporated into the Minimum Operating Standards for rolling stock on the network. This standard was developed through a consultative approach involving our freight operator partners and built on a substantial evidence base. In this way, freight operators were convinced of the need for the standard from the start, were able to quantify the impact on their businesses, and were partners in incorporating implementation strategies into the wording of the standard. The result is a reasonable and feasible, performance based standard that sets the objectives for the industry rather than prescribing the solution and approach.

The partnerships with industry are now focused on developing inexpensive solutions for the older design bogies. The test rig is integral to this process as it allows detailed investigations into the impacts of specific component modifications to be conducted safely, inexpensively, and much faster than on-track testing. Once solutions have been verified in the rig they can then proceed to the necessary on-track compliance based testing. Transport for NSW currently has testing programs underway to trial solutions for two major freight operators and a major freight leasing company.

This partnership model has now been extended to the issue of brake noise from freight wagons, and further partnerships focused on track-based solutions to wheel squeal, and locomotive noise, are in the planning stages.

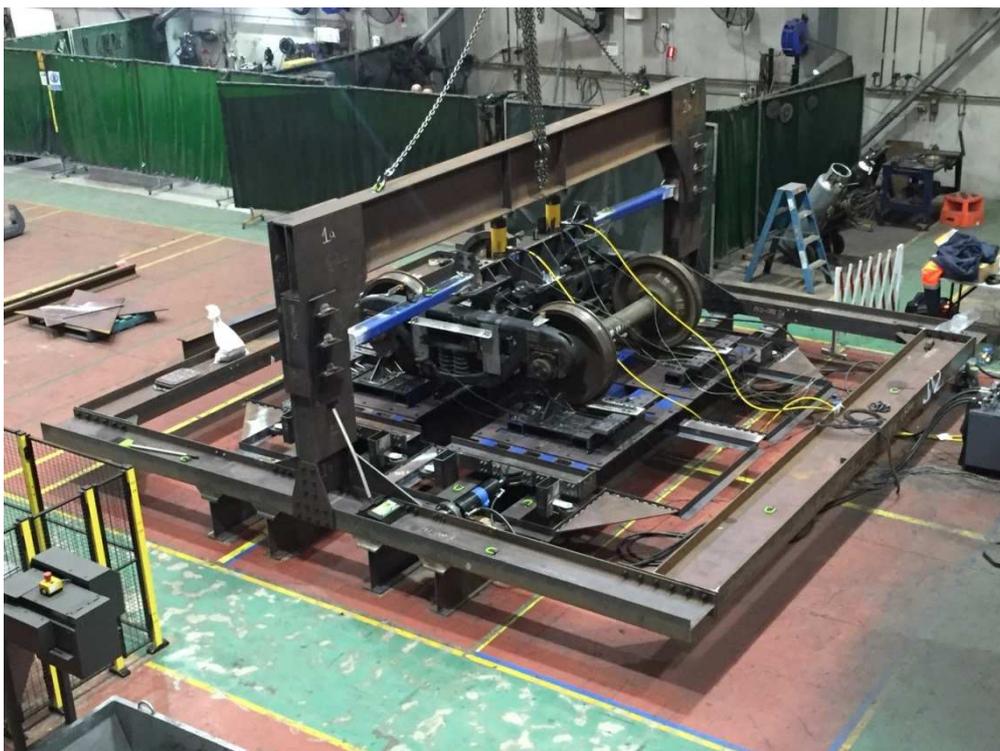


Figure 3 the Transport for NSW bogie warp stiffness test rig

## 8 MANAGING TODAY'S FREIGHT RAIL NOISE IMPACTS

### 8.1 Complaints management

Freight rail noise complaints from the community are managed collaboratively by both the EPA and Transport for NSW. Both organisations maintain 24/7 telephone and internet complaint mechanisms and all complaints are responded to within 5 days of receipt.

The record of complaints provides a snapshot of noise impacts across the network and is used in conjunction with other data sources, such as noise monitoring, to quantify this impact. Transport for NSW combines this complaint data, with the results from noise monitoring at nearly 200 locations across the network, in a GIS system. In addition, Transport for NSW proactively engages with several community stakeholder groups formed around rail noise. This involves public forums where members of the public engage directly with those managing freight rail noise impacts, and often include representatives for the private freight operators.

There are specific protocols established with the Rail Management Centre (RMC) for the management of locomotive idling noise. Rather than complaints about idling locomotives being recorded and channeled to the relevant area for response in due course, idling complaints are directed directly to the RMC to see whether the locomotives can be moved, temporarily shut down, or the noise otherwise managed to provide immediate relief.

### 8.2 Network operation and maintenance

The current licensing regime holds railway system operators legally responsible for the activities of the third party rolling stock operators and assumes that railway system operators can pass on their licensing obligations to the third party rolling stock operators through these access agreements. As discussed in Section 5 however, the railway systems operators have long contended this is not the case. As these obligations have largely not been passed to the rolling stock operators, the rolling stock operators are not directly accountable to the EPA for their environmental performance. This is a concern because many of the noise impacts associated with the rail network arise from issues that are fully or partly the responsibility of rolling stock operators. Using the licensing regime to enforce environmental responsibilities and achieve acceptable environmental performance by the rail industry has therefore had limited success. As a consequence of this, the EPA is proposing regulatory reforms to license rolling stock operators in addition to railway systems operators. This will improve the EPA's role as a protector and strengthen its ability to effect improvements from individual rolling stock operators. In the meantime, Transport for NSW has sought to achieve improved noise outcomes through the engineering standards dictating access to the

rail network and management of the rail asset. The FAP team, in collaboration with the Asset Standards Authority has developed engineering standards for rail lubrication, and freight wagon steering.

## 9 CONCLUSIONS

The way in which rail freight noise is managed in NSW to protect the health and amenity of the community, while supporting growth in the freight rail business, has evolved since the inception of the licensing arrangements by the EPA in 1970. Rather than simply setting limits for the rail industry to achieve, the key Government agencies are working in partnership, both with each other and with industry, to design and implement appropriate regulation and policy, identify and fix key noise issues – as successfully demonstrated with wheel squeal -, and mitigate legacy noise impacts through a targeted freight noise attenuation program. This approach means that, in NSW, progress towards achieving a level of rail noise that is acceptable by the community and supports the growth of freight transport by rail is on track.

## ACKNOWLEDGEMENTS

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