Mr Guy Evans
Urbanco
PO Box 546
Pyrmont NSW 2009

17/09/2021

Dear Mr Evans

St Marys Intermodal (SSD 7308)
Rail Noise and Air Quality Technology

I refer to your correspondence dated 22 June and 24 July in relation to Condition D12 of SSD 7308. I also acknowledge your responses to the Department's requests for additional information.

Condition D12 requires that you submit a report that justifies the rail noise and air quality technology proposed and how it meets the objectives of best practice noise and air quality technologies. The report must be prepared in consultation with Transport for NSW and the Environmental Protection Authority (EPA).

I note that the information provided outlines the rail noise and air quality technology proposed to be utilised by the project. In addition, consultation has occurred with relevant Agencies and all matters have been addressed.

I acknowledge receipt of correspondence for information under condition D12 of SSD 7308. Please ensure this information is published on your project website.

If you wish to discuss this matter further, please contact Amy Porter on 9373 2853.

Yours sincerely

Lee McCourt
Acting Team Leader
Infrastructure Management

As nominee of the Secretary

AECOM Australia Pty Ltd
Level 21, 420 George Street
Sydney NSW 2000
PO Box Q410
QVB Post Office NSW 1230
Australia
www.aecom.com

+61 2 8934 0000 tel
+61 2 8934 0001 fax
ABN 20 093 846 925

12 August 2021

Pacific National
C/o Urbanco
PO Box 546
PYRMONT NSW 2009

Dear Guy,

St Marys Freight Hub - Development Consent Conditions Prior to Commencement of Operations

1.0 Introduction

This letter has been prepared to satisfy part of Condition D12 in the Development Consent SSD 7308 for construction and operation of Pacific National's St Marys Freight Hub.

Condition D12 states:

> *Prior to the commencement of operation, the Applicant must prepare a report that justifies the rail noise and air quality technology proposed and how it meets the objectives of best practice noise and air quality technologies. The report must be prepared in consultation with TfNSW and the EPA and address the following:*
>
> *Port shuttle operations must use:*
>
> *(a) locomotives that incorporate available best practice noise and emission technologies; and*
>
> *(b) wagons that incorporate available best practice noise technologies.*

This letter report relates to the noise requirements listed in Condition D12. The Air Quality requirements are provided in a separate report.

2.0 Curve squeal

2.1 Incidence

Curve squeal is a highly tonal noise that sometimes occurs when rolling stock navigates sharp curves. The likelihood of curve squeal occurring increases with smaller curve radii and longer wheelbases. Studies have concluded that curve squeal does not normally occur for typical one-piece bogies or three-piece bogies with good steering characteristics, for curve radii of around 200 m or more (1). Another study notes that curve squeal may occur on larger curve radii, where the bogies have poor steering characteristics.

The railway line accessing the St Mary's Freight Hub includes a curve with a radius of around 250 m, therefore curve squeal may occur where wagons have poor steering.

2.2 Causes

Transport for NSW (TfNSW) completed a comprehensive study which examined the cause of squeal noise on small radius curves (2). The study found that in Sydney severe squeal is associated with only around 5% of wagons. For good steering bogies, the leading wheelset typically presents an Angle-of-Attack (AoA) to the rail proportional to the wheelcase and curvature, whereas the trailing wheelset aligns to the curve centre. In great contrast, for poor steering bogies both the leading and trail wheelsets can have large AoAs up to 40 – 50 mrad. Analysis of AoA data by TfNSW has shown that a high AoA is a pre-requisite for squeal. The analysis has also shown that the cause of squeal from freight wagons is typically associated with warping of three-piece bogies due to an inability of the bogie bolster to rotate to negotiate the curve. Basic three-piece bogies with poor steering were found to be exclusively responsible for wheel squeal on curves with moderate curve radius (from 300 m to 500 m) (3). Recent results from a very tight curve show that only basic three-piece bogies squeal on that curve too (160 m radius) (4).

Rotation can be improved by reducing friction at the centre plate, either through lubrication or a wear liner (4). However, a more effective strategy is to eliminate warping of three-piece bogies altogether through the use of cross bracing or steering arms (2).

This adverse curving behaviour is typically associated with classes of wagons, rather than individual wagons within a class and is therefore likely to be associated with the design of these particular wagons and bogies (3).

3.0 Best practice noise technologies

This section relates to available best practice noise technologies for wagons and outlines how best practice is proposed to be implemented at the St Marys Freight Hub.

3.1 Wagon steering

Transport for NSW has identified that poor wagon steering is the root cause of wheel squeal. Bogies that steer properly do not squeal (6). As discussed in section 2.2 curve squeal is caused by the rotational resistance of the bogie bolster being too high and the warp stiffness of the bogie being too low. Each of these factors can be controlled.

- The rotational rail resistance is caused by friction between the wagon body and the bolster, specifically the centre plate and the constant contract side bearers. If the resistance is too high, the wagons cannot steer properly, leading to noise, wheel wear and higher risk of wheel climb derailment. The rotational resistance can be controlled by ensuring the level of centre plate friction is maintained at suitable levels. The friction at this interface can be controlled by using lubrication or a polymer liner. TfNSW conducted a trial in 2014 with eight intermodal wagons which exhibited poor steering and squealed. The steel centre plates were upgraded to include a polymer liner and no severe squeals were recorded by the time the trial was reported. However there were still several instances of wheelsets with AoA greater than the ideal 7 mrad magnitude. This indicates that although the polymer lining has addressed the rotational resistance issue the bogies do not have high warp stiffness and so can still lozenge under curving to produce high AoA towards the high rail (6). This indicates that additional bogie modification eg. increasing the bogie warp stiffness is required to eliminate the large AoAs.
- Low bogie warp stiffness can be avoided by the use of steering arms, fabricated, rigid bogie frames and cross bracing. The simplest solution is cross bracing. This involves installing structural members that connect the side frames and physically prevent the bogie warping. Generally, wagons with cross bracing, steering arms or rigid frames do not generate curve squeal. As a result of proper steering, these bogies also have much lower rates of wheel and rail wear (estimated at half the wear rate from three-piece bogies) and lower train resistance leading to lower fuel usage (6). TfNSW completed an analysis of wayside condition monitoring data from a curve of 300 m radius in Sydney over a three-year period. The analysis showed the generation of severe wheel squeal is strongly determined by the steering performance, or AoA, which is primarily a function of the bogie design (4).

Section 2.7.1 of Asset Standards Authority (ASA) Standard T HR RS 00400 ST specifies a limit of 15 mrad for acceptable AoA (7). Any wagon that exceeds the AoA limit at any wayside detection system on the TfNSW network would be held in breach of the requirement and notification would be issued to the operator to rectify the wagon performance or submit a plan to rectify the performance.

As noted above the steering performance of bogies has been identified as potentially the most important factor in rail squeal. Bogies with poor steering performance present the wheels at a high angle of attack to the track, which is a pre-requisite for rail squeal. Therefore, the use of bogies with good steering performance is expected to minimise the likelihood of the occurrence of rail squeal.

Pacific National has advised that the following wagon and bogie types would be used:

- CQBY – three-piece bogies with cross bracing and non-metallic liner centre plate
- CQGY – 70T ride control bogie
- PQGY – 70T ride control (super service) bogie

Pacific National are well advanced with a testing and service validation program for wheel squeal bogie modifications. One of the modifications can be applied to the 70t Ride Control bogie and the

Ride Control (Super Service) bogie. The modification has shown full compliance with the AoA limits implemented by TfNSW to reduce squeal. The modification includes the use of a friction wedge which acts between the bogie bolster and the bogie side frames via control springs. TfNSW has demonstrated the efficacy of these modifications (8).

It is noted that all of these wagons include either three-piece bogies with cross-bracing or can be fitted with modifications to comply with the TfNSW AoA limits. On this basis, they are considered to represent best practice and are expected to have good steering characteristic around curved track sections with a low risk of curve squeal.

3.2 Track design

Pacific National have undertaken to implement engineering design changes as part of refurbishment works to widen the gauge along the rail curve. This will alleviate the wheel flange pushing outwards on the rail when the wagons on the curve.

The rail refurbishment works will therefore result in reduced wheel squeal as the gauge of the tracks is to be adjusted at the curve to reduce noise impacts on nearby residential receivers.

3.3 Rail lubrication

Maintaining low friction levels on the gauge face and gauge corner of the rail can also mitigate some types of wheel squeal. A long-term trial of gauge face lubrication and top of rail friction modification was completed at a curve in Sydney. The trial showed that application of gauge face lubrication on both the low and high rails all but eliminated wheel squeal at the test site (9). Gauge face lubrication (GFL) can be applied through wayside or on-train applicators.

Effective lubrication can also reduce the energy (fuel) consumption associated with wheel/rail interaction and reducing the flanging wear noise associated with wheel/rail interaction.

Pacific National are installing wayside RTE-25 Track lubricators in accordance with ARTC RC 2411 (10) at the beginning of the curves at the following locations:

- MC01 CH63.000
- MC01 CH290.000
- MC02 CH51.000
- MC02 CH290.000.

3.4 Speed

TfNSW found that severe squeal occurrence was found to increase linearly with increasing speed. However TfNSW considers the relationship to be weak and speed restrictions are not considered a primary mitigation method. Nonetheless the speed restriction of 15 km/h within St Marys Freight Hub (implemented for safety reasons) will further reduce the likelihood of squeal occurrence (4).

3.5 Electronically controlled pneumatic (ECP) braking

Electronically Controlled Pneumatic (ECP) braking systems simultaneously apply and release freight wagon brakes, through a hard-wired electronic pathway down the length of a train. This results in a no delay, no run-on of slack from the rear of the train. This allows the trains to operate at higher average speeds and carry heavier loads whilst operating within safety limits. It also reduces wagon bunching noise.

It is understood that Pacific National's existing container wagons in NSW do not utilise ECP braking systems (11). Pacific National has advised that fitting ECP brakes to their existing fleet would be cost prohibitive. Wagons would need to be stripped of all their existing brake componentry and fitted with the ECP system, wiring and fixtures. The capital cost of equipment is not considered reasonable.

3.6 Rail grinding

Rail grinding is often undertaken to restore the rail profile, remove surface cracks, defects and rail corrugation. Rail grinding was undertaken twice during the TfNSW wayside condition monitoring study and the data showed that the incidence of wheel squeal increased sharply after rail grinding. It was concluded that this was caused by excessive grinding of the high rail gauge corner which prevented

conformal rail/wheel contact and restricted the distribution of lubrication to the gauge corner areas. Therefore care must be taken to achieve satisfactory grinding (4).

3.7 Monitoring and maintenance

In accordance with Condition D13 in the Development Consent SSD 7308 a rail noise monitoring system will be installed within the Freight hub at the commencement of operations to continuously monitor the noise from rail operations. The system will capture the noise from each individual train passby. If the noise monitoring system identifies wagons with squeal or high noise emissions, these wagons will be removed from service and any issues addressed. In addition, all wagons would be subject to a rigorous maintenance program.

4.0 Conclusion

This letter has been prepared to satisfy part of Condition D12 in the Development Consent SSD 7308 for construction and operation of Pacific National's St Marys intermodal terminal and container park.

The study provides a review of curve squeal noise and the key design parameters that influence whether bogies are likely to squeal or not when negotiating small radius curves. Investigations by TfNSW and others conclude that squeal noise is primarily related to bogies which have a low warp stiffness and/or high rotation resistance. At locations with small curve radii, bogies with a low warp stiffness and/or high rotation resistance have high angles of attack (AoA) and this can cause squeal.

Asset Standards Authority Standard T HR RS 00400 ST provides details relating to the mandatory requirements for bogie AoA and steering performance. If a wagon exceeds the AoA limit, operators are notified and are required to rectify non-compliances within specified timeframes.

Whilst the use of ECP braking systems can reduce wagon bunching noise Pacific National current container wagon fleet do not utilise ECP braking systems. Pacific National has advised that fitting ECP brakes to their existing fleet would be cost prohibitive. It is noted that ECP braking systems are currently only installed on coal wagons in NSW.

Other measures that Pacific National will implement to minimise the risk of curve squeal include the installation of a permanent noise monitoring system. This will monitor the noise from all trains accessing the Freight Hub. Pacific National will deal with any non-compliances with the established noise limits. Pacific National are also installing rail lubricators and have widened the rail gauge along the rail curve to minimise squeal.

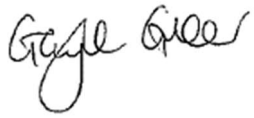
It is concluded that Pacific National are incorporating the best practice noise technologies at the St Mary's Freight Hub to minimise noise.

5.0 References

1. Thompson D, (2009) *Railway Noise and Vibration: Mechanisms, Modelling and Means of Control,* Elsevier, Oxford.
2. Hanson D, Jiang J, Dowdell B and Dwight R (2014) C*urve squeal: Causes, Treatments and Results,* Internoise 2014.
3. Jiang J, Anderson D, Dowdell B, Wang, C (2013) *The Impact of Angle of Attack on Curve Noise*. World Congress on Rail Research, Sydney Australia.
4. Jiang J, Hanson D and Dowdell B (2018) *Wheel Squeal: Insights from Wayside Condition Monitoring.* In Anderson D et al (eds) Noise and Vibration Mitigation for Rail Transportation Systems. Notes on Numerical Fluid Mechanics and Multidisciplinary Design, vol 139, Springer.
5. Association of American Railroads (2011) *Manual of Standards and Recommended Practices Section H-III-Lubrication Manual,* The Association of American Railroads, 2011, S S-730 3.
6. Jiang J, Hanson D, Dowdell B (2015) *At-source Control of Freight Rail Noise: A Case Study*, Acoustics Australia 43:233-243.
7. Transport for NSW Asset Standards Authority (2017) *TH HR RS 00400 ST RSU 400 Series – Minimum Operating Standards for Rolling Stock – Freight Vehicle Specific Interface Requirements* Version 2.0 dated 24 August 2017.

8. RiSSB (2021) *White Paper: Good Practice for the Management of Wheel Squeal, RiSSB.*
9. Jiang J, Hanson D and Anderson D (2013) *Rail Lubrication Trial for Mitigating Curve Squeal*, World Congress on Rail Research, Sydney 2013.
10. ARTC (2006) *Guidelines for Trackside Lubrication*, Engineering Practices Manual – Civil Engineering.
11. Transport Asset Standards Authority (2021) *Train Operating Conditions (TOC) Manual – General Instructions, Report TS TOC.1:2021* issue 1, Version 21.0, issue date 11 May 2021.

Yours faithfully



Gayle Greer
Technical Director/NSW Acoustic Manager
gayle.greer@aecom.com

Mobile: +61 425 274 829
Direct Dial: +61 2 8934 1011
Direct Fax: +61 2 8934 0001

AECOM Imagine it. Delivered.

AECOM Australia Pty Ltd
17 Warabrook Boulevard
Warabrook NSW 2304
PO Box 73
Hunter Region MC NSW 2310
Australia
www.aecom.com

+61 2 4911 4900 tel
+61 2 4911 4999 fax
ABN 20 093 846 925

22 June 2021

Pacific National
C/- Urbanco
PO Box 546
Pyrmont NSW 2009

Dear Guy

St Marys Intermodal Facility - SSD 7308 MOD 4 Air Quality Technology Report

This letter has been prepared to satisfy part of Condition D12 in the Development Consent SSD 7308 for construction and operation of Pacific National's St Marys intermodal terminal and container park. Condition D12 states:

> *Prior to the commencement of operation, the Applicant must prepare a report that justifies the rail noise and air quality technology proposed and how it meets the objectives of best practice noise and air quality technologies. The report must be prepared in consultation with TfNSW and the EPA and address the following:*
>
> *Port shuttle operations must use:*
>
> *(a) locomotives that incorporate available best practice noise and emission technologies; and*
>
> *(b) wagons that incorporate available best practice noise technologies.*

This letter report relates to the air quality requirements listed in Condition D12. The Noise requirements will be provided in a separate report.

Other conditions relevant to air quality listed in the Development Consent Application Number SSD 7308 (Condition ID C18, C19, E15 and E16) are related to non-locomotive air emissions. These conditions are covered under a separate Air Quality Management Plan that has been provided separately to this letter.

Proposed Locomotive Emissions Technology

Emissions from Locomotives in Australia are managed through adherence to the Management of Locomotive Exhaust Emissions Code of Practice (CoP) published by the Rail Industry Safety and Standards Board and through individual State regulatory body regulations.

The purpose of the CoP document is to describe "recommended practices for the management and improvement of exhaust emissions of diesel freight locomotives in the Australian railway industry" and to provide guidance on the improvement of emissions through a range of measures, including the use of Upgrade kits and through fuel / emissions optimisation measures.

Pacific National is committed to meeting the requirements in the CoP and existing locomotives that will be operating through the St Marys Intermodal Facility will be fitted with the Tier 0+ upgrade kit at the next major overhaul, in accordance with the Code of Practice.

Installation of Tier 0+ upgrade kits does not necessarily constitute current best available emission technology as there are higher emission tiers in use in Australia. However, in terms of emission reductions that can be gained for existing locomotives (without replacement), installation of the Tier 0+ upgrade kits can be considered best practice as significant reductions in emission can be realised.

Additionally, Pacific National's commitment to the installation of Tier 0+ upgrade kits for the St Marys terminal is consistent with approval that was granted by EPA during the environmental assessment (EA) stage of the project. It is understood that EPA's concern with locomotive emissions was adequately addressed during the EA process and approval was granted by EPA on the condition Pacific National progressively install Tier 0+ upgrade kits to relevant locomotives servicing the terminal. AECOM does not foresee any justification for changing the agreed stance on Tier 0+ at this stage of the planning process.

Based on the above, Pacific National's commitment to the installation of Tier 0+ upgrade kits should be considered best practice for the St Marys terminal.

Yours faithfully

Julian Ward
Air Quality Scientist