

ALLOWING TRUCK TRAILERS AT PBS MASS LIMITS

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Abstract

The National Transport Commission recently completed a project that investigated whether certain truck and trailer combinations that meet specific requirements could enjoy the productivity benefits of the Performance Based Standards (PBS) scheme, without having to endure the costs and time delays associated with the formal PBS assessment and approval process. Popular truck and trailer combinations, such as the six and seven axle combinations, account for approximately 60 percent of all PBS applications approved between 2008 and 2013. Based on the available data, it is clear that these vehicle combinations are safe to operate at increased mass limits on specific freight routes and a popular choice of combination with heavy vehicle operators. Migrating approved PBS designs into regulations is in line with the original policy of the PBS scheme which envisaged allowing innovative heavy vehicle combinations to operate in a controlled environment before including them as part of prescriptive access arrangements. This paper outlines the recommended approach to be followed by relevant authorities to allow specific PBS style specification envelopes to be included in regulations.

Keywords: Truck, trailer, dog, PBS, Performance Based Standards, productivity, safety, envelope, specifications, regulations

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1. Introduction

The National Transport Commission (NTC) is an inter-governmental agency charged with improving the productivity, safety and environmental performance of Australia's road, rail and intermodal transport system. As an independent statutory body, the NTC develops and submits reform recommendations for approval to the Transport and Infrastructure Council, (the Council) which comprises federal, state and territory transport, infrastructure and planning ministers. The NTC also plays an important role in implementation planning to ensure reform outcomes are realised on the ground.

This paper will describe the outcomes of a recent project undertaken by the NTC that assessed the feasibility of allowing six and seven axle truck and trailer combinations to operate at Performance Based Standards (PBS) mass limits without the need for a PBS approval. These combinations form the majority of PBS vehicles and account for about 60% of all PBS applications from 2008 to 2013. The NTC developed Vehicle Specification Envelopes (VSE) for the truck and trailer combinations, which listed technical and operational requirements for vehicles built to these envelopes. While practical envelopes for six axle combinations could not be developed at this time, all Australian states and territories agreed to grant network access to complying seven axle truck and trailer combinations via notices. This will allow up to 20% extra payload to be safely carried in these vehicles.

While the existing PBS scheme provides a formal approach for approval of innovative heavy vehicle designs, this project proposed an alternative and less costly procedure for granting similar high productivity heavy vehicles access on specific routes without the need for a formal PBS approval process.

2. Heavy Vehicles in Australia

There are over 500,000 heavy vehicles in Australia travelling along a freight network of 817,000 kilometres. A large portion of the freight network, about 657,000 kilometres, is owned and managed by local government authorities. Australia carries about 70% of its national domestic freight by road (National Heavy Vehicle Regulator (NHVR), 2015).

2.1 Vehicle Standards

Heavy vehicles in Australia are built to existing Australian and international standards, rules and regulations. Key standards are laid out in the following documents:

- Australian Design Rules (ADR)
- Heavy Vehicle (Vehicle Standards) National Regulation
- Heavy Vehicle National Law (HVNL).

The ADRs are national standards for vehicle safety, anti-theft and emissions. They cover a range of issues such as occupant protection, structures, lighting, noise, engine exhaust emissions and braking. The Heavy Vehicle (Vehicle Standards) National Regulation prescribes the standards with which heavy vehicles must comply. The ADRs and the Heavy Vehicle (Vehicle Standards) National Regulation set out key dimension limits for the design and construction of heavy vehicles. The HVNL establishes a national scheme for facilitating and regulating the use of heavy vehicles on roads. The HVNL applies in all Australian states

and territories except Western Australia and the Northern Territory. The regulatory framework under the HVNL prescribes requirements including:

- standards heavy vehicles must meet before they can use roads
- maximum permissible dimensions of heavy vehicles
- securing and restraining loads on heavy vehicles
- ensuring parties in the chain of responsibility are held responsible for drivers of heavy vehicles exceeding speed limits
- preventing drivers of heavy vehicles from driving while impaired by fatigue
- nationally consistent penalties.

2.2 Access Arrangements

The HVNL provides three main ways in which a heavy vehicle can obtain access to the road network:

- ‘as of right’ access
- Restricted access managed by notices
- Restricted access managed by permits.

A heavy vehicle with ‘*as of right*’ access can use any road. A vehicle that does not comply with the ADRs or the Heavy Vehicle (Vehicle Standards) National Regulation, or a vehicle that is prescribed as a Restricted Access Vehicle, can only use roads that have been declared as suitable for that type of vehicle by notice, or for which the operator has obtained permission to use by being issued with a permit.



Image from: www.dpti.sa.gov.au

Figure 1 – The Heavy Vehicle National Law

The HVNL authorises the NHVR to exempt a category of heavy vehicles from compliance with a heavy vehicle standard through a notice defined under Division 2, Chapter 3 of the HVNL. Notices can be national or state based and both are issued by the NHVR. While national notices apply to all states and territories under the HVNL, state based notices only apply to specified states. Notices generally specify the conditions with which an operator must comply in order to access a relevant road network. They are valid for up to five years.

The HVNL also authorises the NHVR to exempt particular heavy vehicles from compliance with a heavy vehicle standard via permits defined under Division 3, Chapter 3 of the HVNL. Permits are issued to an operator listing specific vehicles and are valid for up to three years. A permit includes an exhaustive list of vehicles and operating conditions. Consent must be

obtained from all relevant state, territory and local government authority road managers before the NHVR can issue a notice or a permit.

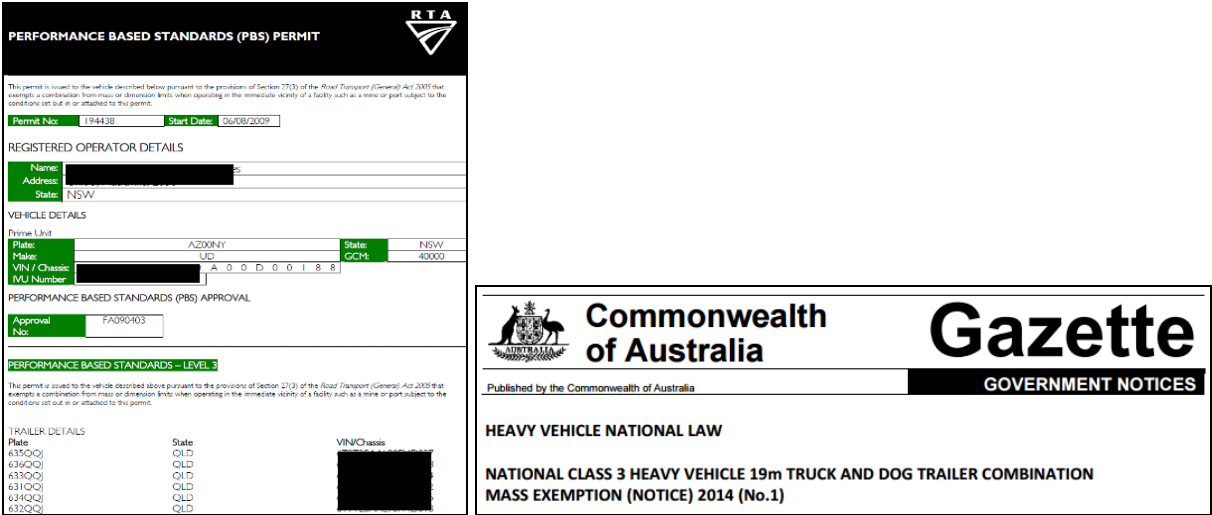


Figure 2 & 3 – Permit and Notice

3. Performance Based Standards in Australia

Improvements to transport productivity reduce the cost of moving people and freight. This in turn reduces the cost of delivering goods and services. However, productivity improvements must not be achieved at the cost of reduced safety for road users. In 2006, Australian transport ministers approved the PBS scheme to meet both needs, by promoting the development and use of more productive and safer heavy vehicles.

The PBS scheme has been operating for nearly a decade. It regulates heavy vehicle access by specifying how well a vehicle behaves on the road, rather than on the basis of its size and dimensions. The PBS scheme was developed to codify acceptable levels of vehicle performance. It provides a means for innovative heavy vehicle designs to be approved without the need to build and demonstrate the performance of a prototype vehicle. This is a cheaper and more reliable way to obtain approvals on new designs, despite the cost of obtaining a PBS assessment for a new vehicle design.

The PBS scheme uses 20 safety and infrastructure standards to assess new vehicle designs. They can be broadly grouped into powertrain, low speed, high speed and infrastructure requirements. Vehicles that obtain a PBS approval can access the road network via permits, notices or approved PBS networks. Since its inception 2008, the PBS scheme has continued to grow each year and it is expected to grow similarly in the future. Currently over 3.5% of Australian heavy vehicle fleet is PBS approved.

The current PBS scheme is administered by the NHVR under the HVNL as shown in Figure 4. Designing, developing, assessing and constructing new high productivity vehicles to comply with PBS requirements involves significant cost and time. As the PBS scheme has grown, a substantial body of knowledge has developed on the design features necessary for a vehicle combination to meet PBS scheme standards.

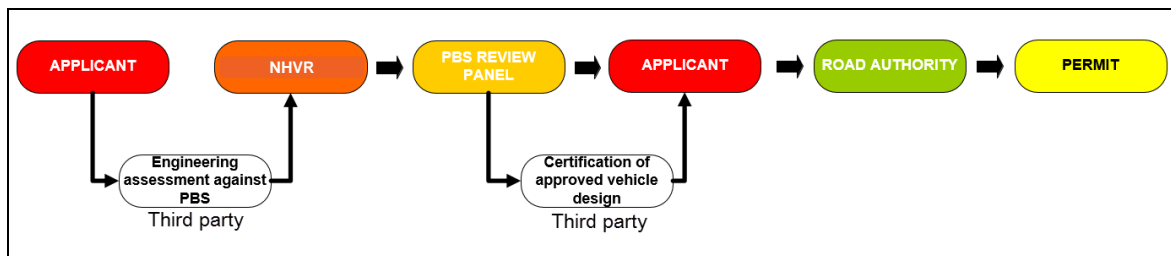


Figure 4 – Current PBS process

When the PBS scheme was originally developed, approved vehicles were expected to be able to access approved PBS networks. However, states and territories have not yet approved any PBS networks, so the current PBS process includes additional steps between the approval of the vehicle and granting of road network access. This involves assessing the road network to ensure right vehicles are matched to the right roads to obtain the consent of the responsible road managers. The NHVR can then issue a permit for access to this road network. This imposes both an administrative burden on governments and delays for vehicle operators.

PBS – Expectations

How it was expected to work

- Vehicle > PBS approval > Access to gazetted networks
- Streamlined PBS approval process

How it works

- Vehicle > PBS approval > (Route assessment) > Permits > Network access
- PBS approval process continues to be streamlined
- Gazetting road networks under progress

Figure 5 – PBS – Expectations

Despite the cost and time involved in obtaining PBS approvals, there has been a year on year increase in the number of PBS approved vehicles each year. Statistics from the NHVR show that PBS vehicle approvals increased by 16 percent in 2013, 25 percent in 2014 and 26 percent in 2015. There has been a further 30 percent increase in the first five months of 2016. One in five trailers registered in 2016 were PBS approved.

Industry and governments introduced improvements to the scheme to streamline the administrative process and facilitate access to the freight network. These include PBS blueprints, simplified PBS process under the HVNL, manufacturer self-certification (still under development) and the recently released [PBS truck and dog trailer notice](#).

3.1 PBS Blueprints

PBS blueprints were introduced in 2007 to facilitate broader adoption of compliant vehicle designs. A PBS blueprint is an approved PBS design that provides specifications for a vehicle combination that will satisfy the PBS requirements for a given level of access. The benefit of blueprints to industry is significant. They remove the time and cost of conducting a PBS assessment of a vehicle design. A vehicle built from a blueprint can move straight to the ‘certification’ stage (see Figure 4).

Both industry and governments developed blueprints for various vehicle types in order to reduce the PBS assessment times. Since the development of industry blueprints there has been a substantial increase in the number of PBS vehicles approved.

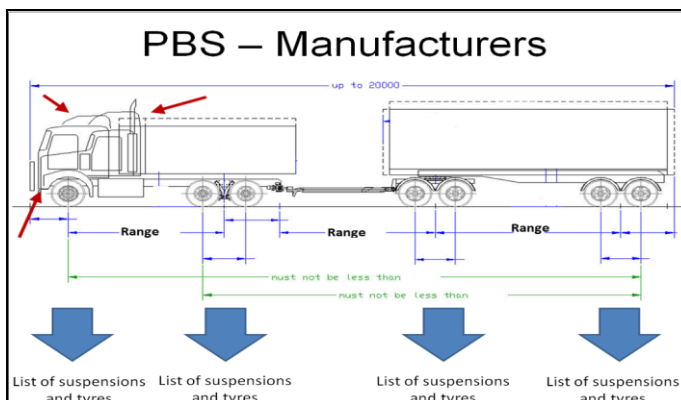
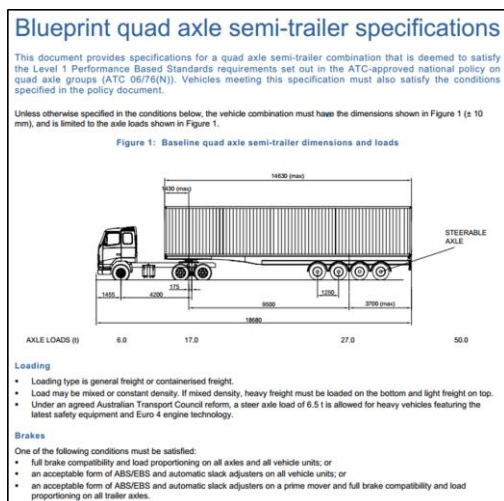


Figure 6 – Government and industry blueprints

3.2 PBS Benefits

Specific benefits of the PBS scheme will vary among operators and vehicle types depending on the purpose of the vehicles and the freight task. However, in general the scheme offers the following benefits:

- Productivity increases of up to 100% compared to prescriptive vehicle types
- Reduction in the number of heavy vehicles needed for a similar freight task by about 37 percent
- Reduction in crashes involving heavy vehicles by up to 85 percent compared to prescriptive heavy vehicles
- Reduction in fuel consumption per tonne of freight, due to the reduced number of heavy vehicles or trips or both
- Reduction in operational kilometres due to the increase in payload
- Increased heavy vehicle safety due to adopting technologies such as Electronic Braking Systems (EBS) to comply with roll stability and braking requirements
- Savings in heavy vehicle insurance claims as a result of fewer accidents
- Significant reductions in CO2 emissions
- Flow on economic benefits from realising the direct operational benefits.

4. NTC Project

Due to delays in states and territories declaring PBS networks, an operator of a PBS approved vehicle combination must apply for an access permit with the NHVR before being able to use the vehicle on approved road networks. The heavy vehicle industry, therefore, requested governments to develop a simplified access framework for popular PBS approved vehicle combinations without having to go through the PBS assessment and the permit system. The NTC was requested to undertake this work.

The NTC project “*Allowing truck and trailer combinations at PBS mass limits*” proposed to supplement the efficiencies delivered by the HVNL by a ‘prescriptive’ design for six and seven axle truck and trailer combinations that meet the safety and infrastructure standards of the PBS scheme. It proposed a more efficient regulatory approach for these combinations

which are presently regulated by the PBS scheme. This approach should allow a number of truck and trailer combinations not currently registered under the PBS scheme, but which may meet PBS standards, to travel with increased mass limits giving access to PBS equivalent productivity benefits without the administrative time and costs currently incurred by industry and governments.

The NTC proposed releasing notices that contain vehicle specifications and access arrangements which will provide access certainty as well as safety and productivity benefits to a larger population of truck and trailer combinations. This project developed Vehicle Specification Envelopes (VSEs) that used PBS standards to standardise these combinations’ dimensional and operational requirements.

4.1 Truck and Trailer Combinations

Over 50 percent of all PBS vehicle approvals are for truck and trailer combinations. Despite this, these types of PBS vehicles only represent about 5 percent of the total truck and trailer fleet currently operating on Australian roads. From January 2013 to June 2014 about two-thirds of all PBS applications were for truck and trailer combinations and over 85 percent of these featured six or seven axle combinations.



Image from: www.trailersales.com.au

Figure 7 – Truck and trailer combination

This presented an opportunity to use the existing knowledge gained from the PBS scheme to consider the feasibility of including these innovative heavy vehicles as part of the prescriptive access arrangements within the HVNL. Freight movement with truck and trailer combinations could achieve significant productivity gains if the mass limits currently only available to PBS approved vehicles via permits are unlocked to the remainder of the truck and trailer fleet. In order to achieve this migration, the NTC sought to develop easy to understand and enforceable vehicle specifications that can be included in a notice or regulation. This could reduce the PBS administrative workload by over 50 percent.

Table 1 – Truck and trailer combination mass limits

Access arrangement	Maximum mass limit
HVNL	42.5 tonnes
Current notice	50.5 tonnes
PBS approval and permit	57.5 tonnes

The NTC focussed on the truck and trailer combinations because:

1. Six and seven axle truck and trailer combinations were the most popular vehicle types in the PBS scheme
2. Design applications for these vehicles types had very few variations among them. This presented an opportunity for standardisation
3. There was scope for eligible vehicle combinations to operate at up to 20 percent higher payload (as presented in Table 1)
4. There was an opportunity to extend the increased mass limits to the remaining 95 percent of non-PBS truck and trailer combinations.

5. Vehicle Specification Envelopes

The NTC engaged a technical consultant to develop a list of specifications and boundary conditions for the six and seven axle truck and trailer combinations. Heavy vehicles that complied with these specifications would then be able to access increased mass limits. The NTC prepared Vehicle Specification Envelopes (VSEs) that included critical dimension ranges, boundary conditions, axle spacing and mass schedule, engine and braking requirements and loading conditions. We designed the VSEs so that they could be included in the HVNL. This would allow increased mass limits on the freight network without the need to obtain a PBS approval and a permit. The key steps involved in the preparation of the envelopes are as follows:

Draft VSEs

The NTC consulted with PBS truck and trailer manufacturers and used the technical consultant's experience with truck and trailer PBS approvals to develop suitable ranges of key dimensions such as truck and trailer wheelbase, coupling position, drawbar length and body heights. These key vehicle dimension ranges reflected the vast majority of PBS approvals and wide range of equipment available in the market. Vehicle design and construction practicalities underpinned the development of all design parameters making up the VSEs configuration.

Assessment against PBS standards

The NTC assessed the draft VSEs using PBS standards. We tested the worst-case scenarios against critical PBS standards for the combinations that were possible within the proposed envelopes. The envelopes do not allow all combinations of possible dimensions. They are limited by the overall length limit (20.0m) and by the need to maintain minimum axle spacing to comply with bridge loading requirements.

Public consultation and agreement

The NTC published a discussion paper in August 2014 and accepted comments from stakeholders including industry and governments. The paper included a range of options for stakeholders to consider for migrating popular PBS designs to regulations. All comments were reviewed and suitable recommendations were discussed with all state and territory road transport authorities.

The NTC obtained agreement with all state and territory road transport authorities and developed implementation options (Implementation is covered in Section 6). We prepared a package consisting of the vehicle specifications, inspection and certification requirements and governments' agreed operating conditions. This was then handed over to the NHVR for developing notices under the HVNL.

5.1 Logic and Assumptions

The NTC's original project scope covered both six and seven axle truck and trailer combinations. Draft VSEs were developed for both vehicle types to be tested against the PBS standards. The VSEs can be used to design and build safe and efficient vehicle combinations. Vehicles built from these VSEs will be significantly safer than current non-PBS truck and trailer combinations.

Not all of the dimensions and specifications typically addressed by a PBS application are addressed in the VSEs. This is to ensure a satisfactory safety outcome and a wider coverage of vehicles. For example the VSEs did not consider truck front overhang directly. It is in the operator's interests to minimise truck front overhang so as to achieve the largest possible extreme axle spacing within the overall length limit, and hence the greatest gross combination mass.

The Australian bridge formula requires the combinations to be over 19.0m in overall length in order to access the maximum available mass limits. The Heavy Vehicle (Vehicle Standards) National Regulation requires the overall length of heavy vehicles to be less than 19.0m. These VSEs are designed for a 20.0m maximum length in order to access the maximum available mass limits.

In order to arrive at a safe and practical envelope, the NTC made assumptions on components such as suspensions and tyres during PBS assessment. The VSEs do not impose any suspension or tyre requirement since the risk of adverse outcomes from the use of poor quality components is demonstrated to be insignificant if other controls are in place. These VSEs were developed so that it is not necessary to source commercially sensitive information from component manufacturers.

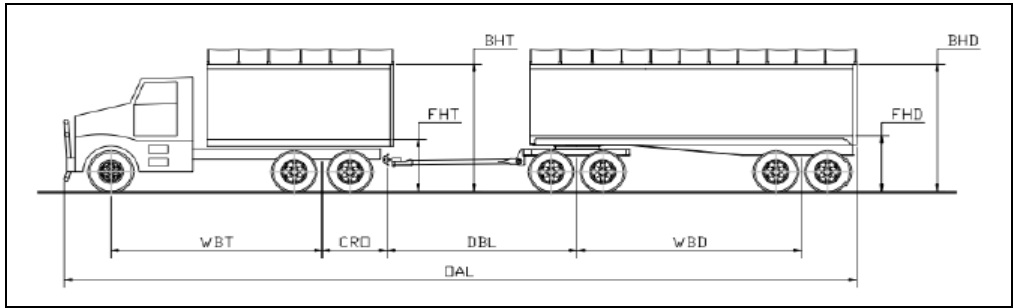
While the NTC consulted on allowing both six and seven axle truck and trailer combinations to run at PBS mass limits, the final recommendations did not include six axle combinations for the following reasons:

- practical envelopes that could cover the majority of six axle combinations could not be easily developed, and
- the envelopes that could be developed for these combinations did not provide significantly higher benefits than are currently provided under existing arrangements.

The NTC considered a range of other assumptions, restrictions and conclusions during the development of the VSEs. The PBS assessment of the VSEs also concluded that more than one VSE was needed to cover a range of product density. These are discussed in detail in the research paper "*Can popular PBS trucks enter mainstream regulations?*" by Rob Di Cristoforo (2013).

5.2 Envelopes

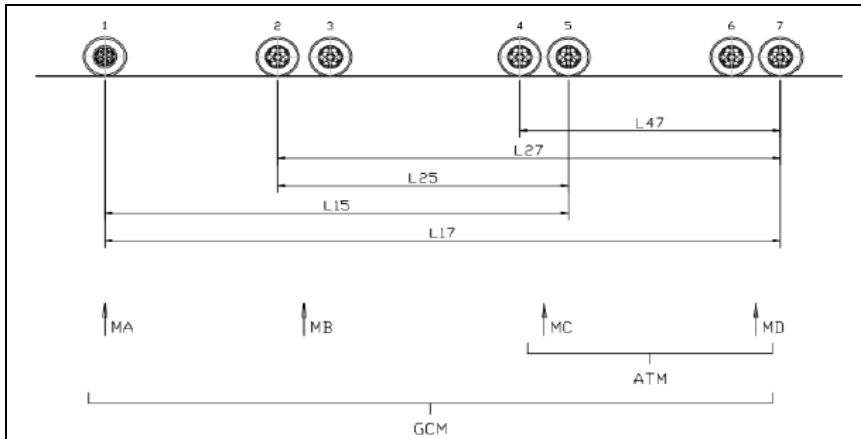
The NTC developed two VSEs for the seven axle truck and trailer combinations. Each VSE had three critical parts. The first part covered key vehicle dimension ranges that assured compliance with PBS standards. The second part detailed minimum axle spacing requirements and corresponding maximum mass limits the vehicles can carry. The final part specified minimum engine requirements. Other conditions such as payload heights, braking, mass distribution and other regulatory requirements are listed in each specification.



PRIMARY DIMENSION LIMITS (METRES)									
	WBT	CRO	DBL	WBD	FHT	FHD	BHT	BHD	OAL
MIN	4.500	1.500	3.300	5.500	-	-	-	-	-
MAX	5.800	1.650	5.000	6.950	1.400	1.450	3.300	3.300	20.000

Figure 8 – VSE – Dimensions

The key difference between the two envelopes is the bin heights. A low bin height vehicle designed to cater high density products allowed greater dimensional flexibility due to lower centre of gravity. On the other hand, a taller vehicle designed to carry higher volumes of low density freight had narrowed dimensional flexibility due to the higher centre of gravity. Figures 8, 9 and 10 show the critical components of the VSE.



AXLE SPACING AND MASS SCHEDULE (METRES & TONNES)										
MA	6.5									
MB/MC/MD	16.5 (GML) 17.0 (CML/HML)									
	GCM			ATM		L47	L27	L25	L15	L17
	GML	CML	HML	GML	CML/HML	MIN	MIN	MIN	MIN	MIN
RESTRICTED ACCESS (B-DOUBLE NETWORK)										
56.0	57.5	57.5	33.0	34.0	6.833	13.333	6.833	8.833	17.333	
55.5	56.5	57.0	32.5	33.5	6.667	13.000	6.750	8.750	17.000	
55.0	56.0	56.5	32.0	33.0	6.500	12.667	6.667	8.667	16.667	
GENERAL ACCESS										
50.5	-	-	27.5	-	5.000	11.500	5.917	7.917	17.500	
50.0	-	-	27.0	-	4.833	11.000	5.833	7.833	17.000	
49.5	-	-	26.5	-	4.667	10.500	5.750	7.750	16.500	

Figure 9 – VSE – Axle and mass requirements

Peak engine power (in HP) must be not less than 405

Peak engine torque (in Nm) must be not less than 92,000 divided by (LGR x FDR)
where LGR equals Lowest Gear Ratio of gearbox and FDR equals Final Drive Ratio of drive axles.

Truck must satisfy technical requirements for 6.5-tonne regulatory steer axle load
Truck and trailer must have ABS or EBS brakes
Drive and trailer axles must have Certified Road Friendly Suspensions

Figure 10 – VSE – Driveline Specifications

6. Implementation

In order to implement the proposal to allow vehicle combinations that complied with the seven axle truck and trailer VSEs access to the road network at PBS mass limits, approval was required from all state and territory road agencies through the Transport and Infrastructure Senior Officials Committee (TISOC). They agreed that:

- Seven axle truck and trailer combinations that comply with the vehicle specification envelopes can be operated at up to PBS mass limits on the road networks specified by the relevant road managers. Any seven axle truck and trailer combination must be certified as compliant with the vehicle specification envelopes prior to accessing the road network.
- The NTC and the NHVR will develop the notices as part of the implementation of the vehicle specification envelopes as an interim measure, prior to considering allowing access through the HVNL.
- Each state and territory will give access to vehicles operating under notices to the appropriate road networks. Conditions of access are to be similar to existing PBS approved seven axle truck and trailer combinations.

A notice is one of two options to allow eligible seven axle truck and trailer combinations to run at PBS mass limits – the other being to make amendments to the HVNL. Both methods have advantages and disadvantages. While notices are easier to implement, they are subject to limitations such as needing approval from all road managers, including the local government authorities, for access to new road networks. A notice expires after five years unless another period is specified in the notice. Allowing seven axle truck and trailer combinations by making changes to the HVNL is a slower process, but it would provide greater certainty to operators and manufacturers and allow consistent access to the road network.

Implementing the use of VSEs by notice allows for a controlled and monitored introduction of these types of vehicles. The notice would provide details such as dimensional ranges, maximum mass limits, access details, restrictions on the payload heights, essential technical and regulatory power-train requirements, and any other compliance requirements. An operator or builder would assess their vehicle's compliance from the information provided in the notice.

The NTC has agreed to begin a review of the effectiveness of the notice within three years of its commencement, with a view to implement the provisions of the notice under the HVNL. Three years will provide sufficient time and data to assess the effectiveness of the notice.

The NHVR is currently finalising the contents and the inspection requirements in the notice.

7. Conclusion

One of the original policy intents of the PBS scheme was to provide a platform to test heavy vehicle industry innovation in a controlled and efficient manner. Once the safety and performance of the innovation had been proven, the next step was to consider moving access arrangements for these vehicle designs into regulations.

This project has examined an alternative approach to granting access at higher mass limits on specific routes for seven axle truck and trailer combinations that meet PBS scheme vehicle specifications without the need for these vehicle combinations to obtain a formal PBS approval. In addition, the project has achieved agreement from the NHVR and the state and territory road transport authorities that access will be granted via a national notice. This is a major step towards achieving prescribed access arrangements for these types of vehicle combinations under the HVNL.

The NTC intends to assess the effectiveness of the PBS scheme and set the platform for future pathways for the scheme. The NTC is embarking on this journey to determine how the world leading program can operate better. This project is titled “*Assessing the effectiveness of the PBS marketplace and identifying barriers to vehicle design innovation*” or simply “*PBS Marketplace*”. The objects of this program are to:

- Review to identify whether the PBS scheme is meeting its original policy intent.
- Review to identify whether the scheme itself contains barriers to operating as an effective marketplace for the development, sale and commercialisation innovative vehicles.
- Review the productivity, safety and environmental impacts of the PBS scheme by means of promoting innovation.
- Review to assess whether there are modifications which could be made to improve the efficiency of the system (including trying to identify and propose removal of market barriers or administrative costs that are unnecessary) would be valuable.

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9. Acknowledgements

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