ALLOWABLE GROSS COMBINATION MASS FOR TWIN-STEER PRIME MOVER AND SEMI-TRAILER COMBINATIONS

PROPOSAL AND REGULATORY IMPACT STATEMENT

November 2007

National Transport Commission

Prepared by
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Abstract:

The proposal and regulatory impact statement considers whether seven-axle articulated vehicles, incorporating twin-steer axle group and a tri-axle semi-trailer, should be permitted to operate at a general mass limit of 46.5 tonnes and on approved routes at higher mass limits, of 49.5 tonnes.

The impact analysis shows that the regulatory proposal would be economically viable. The net present value is $34 million and the benefit cost ratio is 2.5. The regulatory proposal has a positive economic benefit and complies with Performance Based Standards safety and infrastructure criteria.

Purpose:	For consideration by the Australian Transport Council (approved June 2008).
Key words:	Prime mover, twin-steer, road safety.

FOREWORD

The National Transport Commission is an independent, statutory body, established by the *National Transport Commission Act 2003*. The Commission has a continuing responsibility to develop and maintain uniform, or nationally consistent, road, rail and intermodal transport reforms, to improve safety, productivity and environmental outcomes.

This proposal and regulatory impact statement has been prepared to support a proposal to members of the Australian Transport Council to allow twin-steer prime mover and semi-trailer combinations to operate at a gross mass limit of 46.5 tonnes. An amendment to the *Road Transport Reform (Mass and Loading) Regulations 1995* is required to apply this policy.

Four rounds of consultations have been undertaken. The first, in 1998, sought road agency comments on a general proposal circulated by VicRoads. It proposed increases in the gross mass for seven-axle, articulated, combinations with a twin-steer axle group. It also considered a report prepared by Roaduser Research relating to the operation of twin-steer articulated combinations.

Further comments were sought from government and industry, by means of the wide circulation of the *Twin-Steer Axle Mass Limits Project: Discussion Paper July 2004* (Pearson et al 2004). The discussion paper canvassed a range of technical and policy issues including the possibility that a road friendly twin-steer axle group be permitted an increased load (not part of this regulatory proposal). There was little opposition to the concept of summing the axle group masses, either from industry or road agencies.

Further input into the project was obtained at a workshop held at VicRoads on 27 July 2004, with participants from government and industry. The main focus of the workshop was the discussion paper. However, other relevant issues included industry take-up, the ability to achieve the load on the twin-steer axle group, interchangeability of semi-trailers and a methodology for calculating impacts. Further consultation took place with the circulation of a draft proposal and regulatory impact statement in October 2006 and the final draft proposal and regulatory impact statement to Transport Agency Chief Executives in February 2007.

The National Transport Commission would like to sincerely thank all those parties who have contributed to the many phases in developing this proposal. Special thanks are due to VicRoads, as lead agency for the project, and those who participated in workshops or responded to the discussion paper.

I wish to acknowledge the significant contributions made by: Mr Don Hogben and Mr John O'Regan of VicRoads, Mr Bob Pearson (Pearsons Transport Research Centre Pty Ltd), Mr Damian Yeo (Economic Associates Pty Ltd) and Dr Hans Prem (Mechanical System Dynamics Pty Ltd). I thank them for their work in the preparation of the discussion papers and this regulatory impact statement, and commend former National Transport Commission officers, John Edgar and Barry Hendry, for their enthusiasm and commitment to this project.

Michael Deegan
Chairman

SUMMARY

The national *Road Transport Reform (Mass and Loading) Regulations 1995* limit all articulated truck combinations with general access to 42.5 tonnes gross combination mass, irrespective of the number of axles fitted to the combination. Consequently, a twin-steer combination, for which the individual axle group mass limits add to 47.5 tonnes, gains no productivity benefit from having a seventh axle. In fact, it loses productivity because it must carry the tare mass of the additional steer axle. Some specialist applications that need very high steer axle masses, for example vehicles fitted with truck mounted cranes, are presently the most common combinations using a twin-steer prime mover and tri-axle trailer.

Basing the permitted gross mass for twin-steer prime mover and semi-trailer combinations on the sum of axle weights would allow operators to make efficient choices about the use of these vehicles relative to other vehicle types, such as 19 metre B-doubles and truck-trailers. More operators would also be able to accommodate vehicle mounted cranes for loading and unloading, an advantage from an occupational health and safety perspective.

Vehicles operating under the Higher Mass Limits regime are restricted to operating on approved routes and may have a gross combination mass less than the sum of the individual axle group limits.

The regulatory proposal is to enable gross mass for twin-steer combinations up to 46.5 tonnes at general mass limits and 49.5 tonnes at higher mass limits. This position has been refined from an original proposal submitted to Transport Agency Chief Executives in February 2007 to reflect feedback received from industry and jurisdictions.

Where jurisdictions consider it appropriate, vehicles can be permitted to operate in excess of 46.5 tonnes at general mass limits. The NTC encourages jurisdictions to apply Performance Based Standards safety criteria to permit applications above the regulated maximum.

Economic analysis reveals positive net present values for regulation at the gross combination mass of 46.5 tonnes and marginally higher at 47.5 tonnes ($33 million to $51 million and benefit cost ratios of 2.5 and 3.4 respectively). This analysis excludes the effect of access to a ‘general access’ network which is expected to tip the benefits in the favour of the smaller gross mass whilst complying with the Performance Based Standards safety and infrastructure standards.

The regulatory proposal is that:

Seven-axle articulated vehicles, incorporating a twin-steer axle group and a tri-axle semi-trailer, should be permitted to operate:

a) under the general mass limits regime (legislation equivalent to the *Road Transport Reform (Mass and Loading) Regulations 1995)* at a gross mass not exceeding 46.5 tonnes (and the twin-steer axle limited to 10.5 tonnes);

b) under the Higher Mass Limits regime (in the States and Territories that allow increased mass limits for vehicles fitted with road friendly suspension systems) at a gross mass not exceeding 49.5 tonnes (and the twin-steer axle limited to 10.5 tonnes); and

c) the limits on mass with axle spacing under the General Mass Limits regime would be extended beyond the present limit of 42.5 tonnes in accordance with the Austroads formula M = L + 32.5, where M is the allowable mass in tonnes and L is the distance between the extreme axles of axle groups more than 10 metres apart, together with the

higher mass limits of an additional mass allowance of 0.5 tonnes per tandem axle and 2.5 tonnes per tri-axle.

In the national *Road Transport Reform (Mass and Loading) Regulations 1995*, the capacity of a twin-steer axle group with a load sharing suspension is 11.0 tonnes. To limit overall combination wear on infrastructure, this regulatory proposal limits the capacity on the twin-steer axle group with a load sharing suspension to 10.5 tonnes. Non-load share suspensions for twin-steer axle groups will still be limited to 10.0 tonnes.

Other regulatory options were considered and rejected. A 'do-nothing' option failed to deliver national consistency and productivity gains for industry. A proposal to set the gross combination mass at the sum of the axle masses was rejected due to increased bridge wear in excess of the maximum stress for certain types of bridges and for bridges built before the 1960s. This would limit the available network and restrict the reform from being 'general access' to being limited to specific approved routes. Jurisdictions retain the right to allow access under permit to higher mass combinations beyond the proposed regulatory limit, including Concessional Mass Limits in line with previously agreed reforms.

As the gross mass is presently regulated, non regulatory options are not available. For the purpose of this regulatory impact statement, the base case is a 'no change' option.

The current twin-steer fleet is estimated to be around 500 vehicles, of which it is assumed 50% will take up the regulatory proposal. The regulatory impact statement estimates total take-up to be approximately 950 vehicles in the regulatory proposal. The balance of 700 vehicles represents migration from the existing six-axle articulated vehicle fleet to twin-steer vehicles in response to the regulatory proposal.

Total vehicle related capital costs, representing the incremental costs of manufacturing a seven-axle twin-steer vehicle relative to a conventional six-axle articulated vehicle, are estimated to be $25,000 per vehicle. Initial vehicle related capital costs over a three year take-up period would be $17.1 million in the regulatory proposal, as existing six-axle semi-trailer combinations are replaced with seven-axle twin-steer combinations (no additional capital costs would be incurred for existing seven-axle twin-steer combinations that take up the regulatory proposal). In addition, each jurisdiction is estimated to incur costs totalling $30,000 (equal to $240,000 nationally) over three years, in changing present legislative requirements and in associated tasks.

The larger part of the benefits is estimated to comprise reductions in vehicle operating costs, as fewer vehicle kilometres of travel are needed to deliver the same transport task. In addition, estimated capital cost savings of approximately $2 million per year would accrue in avoided replacement costs for six-axle semi-trailer combinations, displaced by take-up of the regulatory proposal.

Pavement cost impacts would decrease by approximately $1.1 million annually under the regulatory proposal but would increase by $0.3 million annually if vehicles were allowed to operate at combined axle masses under the alternative option. Transport Agency Chief Executives (TACE) members raised concerns about the impact of these combinations at maximum axle group masses on existing bridge infrastructure. The regulatory impact statement identifies that there would be some increased wear on a small number of bridges, mainly in older bridges and some continuous span bridges. The overall increase in stress on bridges built in the 1960s or to the MS18 design standard is approximately 5% above the generally accepted limit, with a slightly higher effect on older bridges. The revised Performance Based Standards bridge assessment criteria, whereby bridges are assessed

against a three-tier approach, allows jurisdictions and industry to negotiate the level of access for the operation of vehicles under this regulatory proposal.

These impacts do not include any consideration of costs recovered for road wear, which are included in registration charges, and the allocated portion of fuel excise. These are considered transfer payments. Under the current Heavy Vehicle Charges regime, the registration charge for a four-axle prime mover is nearly 30% higher at $5,201, compared to the registration charge for a three-axle prime mover, which is $4,019. A twin-steer articulated combination already contributes payment for the road wear it creates.

The impact analysis shows that both the regulatory proposal and the opportunity to operate at combined axle masses would be economically viable, with net present values of between $34 million and $51 million and a benefit cost ratios of 2.5 and 3.4. The regulatory proposal is the preferred option, based on the combined economic benefit, and compliance with the Performance Based Standards safety and infrastructure performance criteria wallowing wider network access.

Sensitivity testing of the input parameters of discount rate and vehicle-related capital cost has shown the results of the impact analysis to be robust.

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1. INTRODUCTION

1.1 The regulatory issue

All articulated truck combinations with general (that is, unrestricted) access to the road network are limited to 42.5 tonnes gross combination mass under the national *Road Transport Reform (Mass and Loading) Regulations 1995*, irrespective of the number of axles fitted to the combination. The maximum of 42.5 tonnes gross combination mass is achieved with a standard six-axle combination, comprising a single-steer axle (allowed 6 tonnes), a tandem axle drive group (allowed 16.5 tonnes) and a tri-axle trailing group (allowed 20 tonnes).

Consequently, a twin-steer (with an allowable group mass of up to 11 tonnes) articulated combination towing a tri-axle trailer gains no benefit from a productivity perspective. In fact, it loses productivity because it must carry the tare mass of the additional steer axle. Some specialist applications that need very high steer axle masses, for example vehicles fitted with truck mounted cranes, are presently the main combinations using a twin-steer prime mover and tri-axle trailers.

Basing the gross mass for twin-steer prime mover and semi-trailer combinations on the sum of the allowable group axle masses would allow operators to make efficient choices about the use of these vehicles relative to other vehicle types (such as 19 metre B-doubles and truck-trailers that are permitted a gross combination mass in excess of 42.5 tonnes). More operators would also be able to accommodate vehicle mounted cranes for loading and unloading; an advantage from an occupational health and safety perspective. Operators would also be able to mount larger fuel tanks, for more cost effective travel in areas with higher fuel costs.

In addition, the Mass Limits Review (National Road Transport Commission, 1996a) recommended higher mass limits for tandem and tri-axle groups fitted with road friendly suspension systems. These vehicles operate under the Higher Mass Limits regime and may travel on approved routes only. Under this regime, six-axle articulated combinations are permitted 45.5 tonnes.

Consequently, two different mass issues arise:

- allowable gross mass limits for twin-steer articulated combinations at general mass limits specified in the *Road Transport Reform (Mass and Loading) Regulations 1995*; and
- allowable gross mass limits for twin-steer articulated combinations under the Higher Mass Limits[1] regime.

Concessional Mass Limits[2] are not considered here, as present twin-steer tri-axle trailer combinations are eligible for concessional mass limits under previously agreed reforms and that would not change.

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[1] Vehicles operating under the Higher Mass Limits regime are required to have road friendly suspensions and, on approved routes, may operate at mass limits allowing an additional 2.5 tonnes for tri-axles and 0.5 tonnes for tandem axles.

[2] Concessional Mass Limits allow for increased loading, provided the operator has an auditable Mass Management System in place to guarantee the mass on the vehicle prior to the commencement of a trip.

1.2 Background

In the past, twin-steer vehicles have not been favoured by industry because of their poorer tyre wear performance and limited manoeuvrability. This is due to low wheel cut associated with the needs of two steering axles. Accordingly, there had been little industry demand for an increase in the maximum gross combination mass above 42.5 tonnes. However, modern twin-steer trucks have significantly improved steering systems and concern about the manoeuvrability and maintenance of twin-steer vehicles has all but dissipated with demand expected to build.

In November 1998, the Victorian Road Freight Advisory Council requested VicRoads to approach the National Road Transport Commission [now the National Transport Commission (NTC)], to seek a national position on a proposal to increase the maximum gross mass limit for a twin-steer prime mover and semi-trailer combination. The project is part of the NTC's Third Heavy Vehicle Reform Package, with its purpose: '*To establish a national mass limit for a twin-steer prime mover and single semi-trailer vehicle combination*'. VicRoads was the lead agency for this national project.

Twin-steer rigid trucks are being used successfully in the waste, quarry, premix concrete and recycling industries; benefiting from the additional load capacity. These vehicles, all with less than six axles, are able to operate at the sum of axle weights (including 11 tonnes on the steering group), as the gross mass remains below 42.5 tonnes. However, twin-steer prime movers are not currently viable in many industries. The additional tare mass of the second steer axle is not compensated for by additional payload because both six-axle and seven-axle articulated vehicles are limited to 42.5 tonnes under the General Mass Limits regime.

If twin-steer single articulated vehicles were permitted to operate at the sum of their allowable axle group mass limits, the resultant gross mass will increase, as shown in Table 1.

Table 1: Allowable loads for twin-steer articulated vehicles, if allowed the sum of axle group limits

Mass regime (note 1)	Twin-steer axle group (note 2)	Tandem drive axle group	Tri-axle trailing group	Gross mass
General Mass Limits	11 tonnes	16.5 tonnes	20.0 tonnes	47.5 tonnes
Higher Mass Limits	11 tonnes	17.0 tonnes	22.5 tonnes	50.5 tonnes

Notes:

1. Present regulations restrict the gross mass to 42.5 tonnes for general mass limit vehicles and 45.5 tonnes for higher mass limit vehicles.
2. 11 tonnes permitted for a load sharing, twin-steer group, the limit drops to 10 tonnes if a load sharing suspension is not fitted.

Twin-steer vehicles, typically rigid trucks, are presently used for carrying high density loads, such as concrete, waste and similar bulk products. Twin-steer semi-trailer configurations were popular in Western Australia for many years as they are able to operate under permit at a gross combination mass of 47.5 tonnes. Their popularity has declined in recent years as other larger and more productive combinations were permitted. Use of twin-steer configurations in general freight semi-trailer configurations in other states is low because of the 42.5 tonnes gross combination mass limit. In Tasmania, twin-steer combinations are permitted in logging operations at a gross mass of 47.5 tonnes, with some vehicles also being able to access the higher mass limits maximum of 50.5 tonnes.

This regulatory impact statement does not deal with combinations other than a four-axle prime mover incorporating a twin-steer axle group towing a tri-axle semi-trailer. In particular, B-doubles fitted with twin-steer axles are not considered.

1.3 Objective of the regulatory proposal

The objective of the regulatory proposal is to increase economic efficiency without reducing road safety by increasing the permitted gross combination mass of seven-axle single articulated vehicles with twin-steer axle groups.

1.4 Road safety aspects

As part of the project examining the mass of twin-steer vehicles, the safety performance of alternative twin-steer articulated combinations were investigated using a Performance Based Standards approach. Performance Based Standards, endorsed by Council Of Australian Governments (COAG) and approved by Australian Transport Council (ATC), offers a nationally agreed process to demonstrate the safety and infrastructure sensitivity of vehicles operating at higher than regulated masses. More details of the Performance Based Standards approach can be obtained from the website of the NTC at www.ntc.gov.au.

The investigations in this project used computer modelling to simulate the response of five different twin-steer combinations that were considered the most likely users of seven-axle articulated combinations:

- a flat top as used in the construction industry;
- a general freight curtain-sided van;
- a logging jinker;
- a petrol tanker; and
- a skel trailer carrying containers.

The results of the simulations are given in NTC (2005a).

Apart from a minor non-conformance against a dimensional standard, the only standard that some of the twin-steer single articulated vehicles did not initially meet was the Static Roll Threshold. The Static Roll Threshold is an important safety standard indicating the propensity of a vehicle to roll over during cornering. The report concluded that, given the range of assumptions necessary to assess the vehicle and with the minor design changes necessary to meet the standard, this non-conformance was not considered a cause for concern.

Nevertheless, because of the importance of the Static Roll Threshold standard for safety, further refinement was undertaken in NTC (2005b). Further assessment found that twin-steer prime movers towing a tri-axle trailer loaded to the sum of allowable axle loads met the Performance Based Standards static roll threshold by a narrow margin. This would be so irrespective of whether the vehicle was loaded to general mass limits or higher mass limits.

This revised regulatory proposal recommends twin-steer combination vehicles operate at 46.5 tonnes general mass limits and 49.5 tonnes higher mass limits, with modelling indicating likely compliance with the Static Roll Threshold limit. However, tanker vehicles were not able to meet the more stringent Static Roll Threshold value stipulated for vehicles carrying dangerous goods in bulk. Vehicles carrying dangerous goods will be required to achieve a Performance Based Standards Static Roll Threshold of 0.40g.

Therefore, the requirements for a vehicle carrying bulk dangerous goods will increase the roll stability for tankers assessed under the Performance Based Standards regime, while this regulatory proposal simply maintains the present level of roll stability of the existing fleet.

Given these issues, together with the reduced road travel associated with greater payloads (as noted in Section 3.2.6), road safety does not appear to be a barrier to allowing twin-steer truck and tri-axle trailer combinations to operate at the masses proposed in this regulatory proposal. It is not intended to restrict the uptake of the regulatory proposal to particular freight applications as the regulations would be made under prescriptive regulations.

2. THE REGULATORY PROPOSAL AND ALTERNATIVES

2.1 Submission to Transport Agency Chief Executives February 2007

This regulatory impact statement has been refined from the original proposal submitted to Transport Agency Chief Executives (TACE) in February 2007, to reflect feedback received from industry and jurisdictions. The document contained two options, the regulatory proposal to allow a seven-axle articulated vehicle with twin-steer and tri-axle semi-trailer to operate at the sum of allowable axle group loads, that is at 47.5 tonnes under general mass limits and 50.5 tonnes under higher mass limits; and Alternative 1 which set the limits at 46.5 tonnes for general mass limits and 49.5 tonnes for higher mass limits. Both options provided positive net present values and benefit cost ratios (see section 3.3) when compared with the base case (current regulatory arrangements).

TACE, in general, endorsed the regulatory impact statement. Concerns were expressed relating to the combinations complying with the Performance Based Standards safety and infrastructure standards, in particular static roll threshold criteria and the pavement and bridge standards.

Modelling undertaken by the NTC shows that for the two regulatory options put forward in February 2007, the combinations meet the safety criteria assessed under Performance Based Standards (see section 1.4). The revised Pavement Vertical Loading Standard, approved by ATC in October 2007, ensures the vehicle combinations meet pavement wear performance parameters.

TACE concern for the impact of these combinations on bridge infrastructure relates specifically to MS18 bridges, bridges built prior to the 1960s, and some continuous span bridges. There are a number of these bridges located throughout the south east coast of Australia. The impact of combinations on bridge infrastructure can be addressed by the revised Performance Based Standards Bridge Standard. At 47.5 tonnes, the combination produces stresses greater than the maximum desired by road agencies on these particular bridges. At 46.5 tonnes, the combinations generally meet the requirements of induced stresses in the bridges, however in some situations, the increase in stress can be up to 4% above the accepted limit (see section 3.2.5).

Adopting a gross combination mass of 47.5 tonnes for the regulatory proposal would restrict the available network due to bridge capacity limitations. Reducing the gross combination mass to 46.5 tonnes, with the axle limits detailed in section 2.2, would limit the impact on bridges and provide wider ‘general’ network access. This is a practical solution to a regulatory matter and allows jurisdictions to use local processes to sanction increased mass limits under permit schemes.

2.2 The regulatory proposal

The regulatory proposal is that:

Seven-axle articulated vehicles, incorporating a twin-steer axle group and a tri-axle semi-trailer, should be permitted to operate as follows:

a) under the General Mass Limits regime (legislation equivalent to the *Road Transport Reform (Mass and Loading) Regulations 1995)* at a gross mass not exceeding 46.5 tonnes (and the twin-steer axle limited to 10.5 tonnes);

b) under the Higher Mass Limits regime (in the States and Territories that allow increased mass limits for vehicles fitted with road friendly suspension systems) at a gross mass not exceeding 49.5 tonnes (and the twin-steer axle limited to 10.5 tonnes); and

c) the limits on mass with axle spacing under the General Mass Limits regime would be extended beyond the present limit of 42.5 tonnes in accordance with the Austroads formula M = L + 32.5, where M is the allowable mass in tonnes and L is the distance between the extreme axles of axle groups more than 10 metres apart, together with the higher mass limits of an additional mass allowance of 0.5 tonnes per tandem axle and 2.5 tonnes per tri-axle.

In the national *Road Transport Reform (Mass and Loading) Regulations 1995*, the capacity of a twin-steer axle group with a load sharing suspension is 11.0 tonnes. To limit overall combination wear on infrastructure, this regulatory proposal limits the capacity on the twin-steer axle group with a load sharing suspension to 10.5 tonnes. Non-load share suspensions for twin-steer axle groups will still be limited to 10.0 tonnes.

Under the present Higher Mass Limits regime, an operator with a vehicle incorporating a tri-axle trailer is required to be accredited under the National Heavy Vehicle Accreditation Scheme (Mass Management Module). It is proposed that this policy remain unchanged, meaning that an operator of a seven-axle articulated vehicle with twin-steer and tri-axle semi-trailer, would require accreditation to operate at higher mass limits.

2.3 Alternatives to the regulatory proposal

Other regulatory options were considered and rejected. A 'do-nothing' option failed to deliver national consistency and productivity gains for industry. A proposal to set the gross combination mass at the sum of the axle masses was rejected because there would be increased bridge wear in excess of the maximum stress for certain bridge types. This would limit the available network and restrict the reform from being 'general access' to being limited to specific approved routes.

The regulatory proposal put to TACE in February 2007 was to allow a seven-axle articulated vehicle with twin-steer and tri-axle semi-trailer to operate at the sum of allowable axle group loads, that is, at 47.5 tonnes under general mass limits and 50.5 tonnes under higher mass limits. Twin-steer axle groups operating at masses approaching the maximum allowable of 11 tonnes are relatively more damaging for road pavements than present single-steer axles. A twin-steer axle load greater than 10.1 tonnes will theoretically cause more road wear than a single-steer axle load at 6 tonnes. Restricting the gross mass and the twin-steer mass to levels below the maximum axle capacities will result in pavement wear lower than the equivalent value of the reference vehicle – a six-axle semi trailer combination operating at 42.5 tonnes (see Section 3.2.4).

The issue of the impact of these combinations at maximum axle group masses on existing bridge infrastructure was also raised during the TACE consultation process. As discussed in Section 3.2.5, there would be some increased wear on bridges, with this being restricted to MS18, pre 1960s bridges and some continuous span bridges.

The ATC approved an increase in allowable mass on a single-steer axle to 6.5 tonnes for vehicles fitted with the latest Euro 4 engines, Front Underrun Protection Systems and stronger cabs. The approval relates to single steer vehicles only to ensure the effective introduction of the above safety and environmental features. There is no intention at this stage by jurisdictions to consider implementing a revised steer axle mass for twin-steer vehicles,

accordingly this regulatory impact statement does not incorporate operating the vehicle at increased masses.

In addition, achieving the full payload advantages with twin-steer prime movers could be difficult. The fifth wheel needs to be positioned up to one metre ahead of the drive axle group to transfer sufficient load on to the steer axle group. This compares to normal six-axle articulated vehicles, which typically will have the fifth wheel positioned 100 millimetres to 250 millimetres ahead of the centre of the drive axle group. This would lead to a need for semi-trailers specifically designed for towing behind a twin-steer prime mover. Restricting the allowable mass on the twin-steer for pavement wear reasons may therefore not have the productivity disadvantages for some applications that might be initially apparent. The impact analysis takes this effect into account.

The main alternatives to the regulatory proposal would be to retain the present gross mass limits (the base case), or to allow the vehicles to operate at increased mass under a permit arrangement (the combined axle mass limits in this scenario). A variety of combinations of axle group and gross mass limits could have been adopted as alternatives, however, it was determined that this option represented the next best balance of economic opportunity and access of the cases considered.

As the gross mass of seven-axle articulated vehicles is limited by regulation, non-regulatory options are not available.

No change is proposed to the present requirement that the mass of any twin-steer axle group without a load sharing suspension system must not exceed 10 tonnes.

3. IMPACTS OF THE REGULATORY PROPOSAL

3.1 Fleet estimates

3.1.1 Present fleet of seven-axle combinations

Data from the Australian Bureau of Statistics' Survey of Motor Vehicle Use for 2004 shows that there are between 375 and 625 (that is, 500 plus or minus 25%) twin-steer prime movers hauling tri-axle semi-trailers, travelling on average 115,500 km per year. This compares to 96,600 km per year on average for all articulated trucks and 91,000 for the 34,000 six-axle articulated trucks. Twin-steer prime movers hauling tri-axle semi-trailers perform less than 1% of total articulated truck travel. However, there is a relatively large error associated with the data on twin-steer prime movers (due to the very small numbers in total). Consequently, there can be no certainty that their present average travel is any different to that of other articulated trucks, or that of six-axle articulated trucks.

For the purpose of comparing different vehicle combination types, twin-steer prime movers hauling tri-axle semi-trailers are referred to hereafter as A223, this coding using a standard vehicle notation.

3.1.2 Estimated take-up by existing seven-axle combinations

It is most unlikely that all existing vehicles would be able to take advantage of increased payload. Vehicles in the construction industry, believed to be the most common present user of A223 vehicles, are often below allowable gross mass due to restrictions on order sizes. Many existing vehicles use a twin-steer to support a large crane for long reach at the point of delivery, and loads are often not of sufficient size to utilise the additional payload. Therefore, of the existing twin-steer vehicles, it is estimated that only 50%, or 250, would take advantage of the increased payload made possible by the regulatory proposal.

The numbers of A223 vehicles operating under the Higher Mass Limits regime are low because of the mainly urban nature of A223 vehicles and associated restrictions on local access. The estimated numbers in future vehicles are also expected to be too small to generate appreciable effect on road wear. Analysis of operational performance at general mass limits and higher mass limits indicates that there will be no appreciable difference in safety risk or pavement wear.

Twin-steer higher mass limits combinations are therefore not considered in this analysis; although, under the regulatory proposal, higher mass limits A223 vehicles would be permitted where higher mass limits routes are available.

3.1.3 Estimated transfer from six-axle to seven-axle articulated vehicles

The numbers of six-axle combinations transferring to seven-axle combinations is likely to be influenced by the payload advantage of twin-steer combinations, purchase cost and operating cost increments of these combinations and their suitability for different tasks (for example, bricks versus general freight).

It is assumed that only operators of six-axle articulated vehicles will take up the option of migrating to seven-axle articulated vehicles. It is possible that some operators of twin-steer prime movers may operate tandem axle semi-trailers to accommodate the mass of a crane.

Take-up estimates for different industries are given in Table 2. Again, higher mass limits vehicles are excluded, due to limits to access. All of these vehicles are assumed to operate at general mass limits.

Table 2: Estimated take-up percentage by industry segment

Industry segment	percent	Industry segment	percent
Agriculture	2	Grain	2
Mining	10	Petrol	2
Manufacturing	2	Bulk liquid	2
Construction	2	Logs	2
Wholesale/retail	2	Food	2
Livestock	0	Waste	0
Mineral	10	General freight	2
Car	0	Parcels	0
Quarry	2	Containers	10

These estimates would result in a new fleet of 700 seven-axle articulated vehicles in addition to 250 existing twin-steer vehicles that are estimated to take up the regulatory proposal. Lowest take-up would be in Western Australia, which already permits the sum of axle masses, and the traditional road train areas, including the Northern Territory and large parts of Queensland and South Australia.

Factors that influence these take-up estimates include:

- the high penetration into the traditional mass sensitive markets (e.g. petrol and bulk liquid) of 'pocket' B-doubles at 19 metres, which are permitted a gross mass of 50 tonnes and are allowed general access;
- the use of truck and trailer combinations of a similar gross mass in the quarry, grain and fertiliser industries;
- the need to purchase both a new prime mover and a specially designed trailer for complete utilisation of the benefits of a twin-steer prime mover; and
- the difficulty with the inter-changeability of twin-steer prime movers and traditional semi-trailers.

It is unlikely that all operators of seven-axle vehicles transferring from six-axle articulated combinations would be able to take advantage of the full payload advantages under the regulatory proposal. Some will utilise part of the increase in available gross combination mass to fit a crane and utilise some additional payload.

In these circumstances, the assumptions for these twin-steer vehicles operating under general mass limits are:

- 50% will utilise the full potential payload advantages;
- 25% will utilise half the potential payload advantages, due to partial loading; and
- 25% will take advantage of some increased gross mass to fit a crane to reduce the time (and therefore cost) of loading and unloading of freight, and reduce the need to relocate goods after being unloaded, again reducing overall costs.

3.1.4 Estimated future fleet of seven-axle articulated vehicles

It is expected that the operators transferring from six-axle to seven-axle articulated vehicles will take three years to fully transfer. This is a typical period over which investment in new equipment may occur.

Given the take-up assumptions and the present fleet of seven-axle articulated vehicles, the estimates of vehicle numbers are given in Table 3.

Table 3: Estimated fleet composition for the impact analysis

	Base Case		Regulatory Proposal			Combined Axle Mass Limits		
Configuration	A123	A223	A223	A223	A223	A223	A223	A223
Description (see note 1)	General Mass Limits	General Mass Limits	General Mass Limits (Full)	General Mass Limits (Half)	General Mass Limits (Crane)	General Mass Limits (Full)	General Mass Limits (Half)	General Mass Limits (Crane)
Estimated future fleet (see note 2)	813	250	494	240	240	470	240	240
Gross mass (t)	42.5	42.5	46.5	44.5	46.5	47.5	44.5	47.5
Tare mass (t)	16.0	19.0	17.5	17.5	19.0	17.5	17.5	19.0
Payload (t)	26.5	23.5	29.0	27.0	27.5	30.0	27.0	28.5

Notes: 1. The notations of the vehicles in the regulatory proposal relate to the loading assumptions in Section 3.1.3, with General Mass Limits (Full) being full to gross mass limits loads, General Mass Limits (Half) being half loaded to General Mass Limits loads and General Mass Limits (Crane) being a vehicle with a crane.

2. The numbers of A123 vehicles in the Base Case (813) were calculated based on the same freight task (in tonne kilometres) for each of the three optional loading scenarios.

3. A123 represents a single steer prime mover towing a 3 axle semi-trailer. A223 represents a twin-steer prime mover towing a tri-axle semi-trailer.

Average travel by the future fleet of seven-axle articulated combinations is difficult to estimate. As noted in Section 3.1, the Survey of Motor Vehicle Use (2004) shows that present vehicles travel, on average, 115,000 km per year (but with a large relative standard error). However, nearly two thirds of the new fleet are likely to be from industries characterised by shorter distance travel, such as quarry, construction, container and even general freight. Few twin-steer vehicles are likely to be interstate vehicles, which have the largest travel distances. Therefore, an average distance of 80,000 km per year has been assigned to the future fleet.

3.2 Estimation of impacts

3.2.1 General

The regulatory proposal is likely to have benefits and costs in a number of categories. Benefits and costs are calculated as the difference between the impacts of the current regulatory requirements (the base case) and those in the regulatory proposal. Vehicles that would take advantage of the regulatory proposal would be either:

- existing seven-axle articulated vehicles that are presently limited to 42.5 tonnes gross combination mass; or
- current six-axle articulated vehicles that would become seven-axle articulated vehicles by replacing the prime mover with a twin-steer prime mover.

The benefits and costs for these two groups of vehicles will be different, although some commonality will exist. A general description of the benefits is given in Table 4.

Table 4: General description of benefits of the regulatory proposal

Description of benefit	For existing seven-axle combinations	For six-axle combinations transferring to seven-axle combinations
Reduced operational costs due to reduced vehicle kilometres facilitated by higher vehicle payload	Significant, greater for the regulatory proposal	Some, greater for the regulatory proposal
Reduced road safety risk associated with a reduced number of vehicle trips for the same freight task	Similar for each group	
Reduced pavement wear for the amount of freight carried	Some vehicles only (see detail later)	
Greater flexibility for operators in the choice of vehicles	Not applicable	Significant
Greater flexibility in loading and unloading arrangements, in that the use of a truck mounted crane is more commercially viable	Applies only if a crane is fitted, and applies mainly to present six-axle combinations transferring to seven-axle combinations	
Reduced injury and fatality costs, including indirect employer and community costs, as driver and/or loader safety is improved by the use of vehicle mounted cranes for loading and unloading	Applies only if a crane is fitted where there was none before and applies mainly to present six-axle combinations transferring to seven-axle combinations	
Savings in capital costs of replacing six-axle semi-trailers displaced by the higher productivity of the regulatory proposal	Not relevant	Significant capital cost saving

It can be seen from Table 4 that the benefits will vary according to whether the vehicle is an existing seven-axle combination and whether it is already fitted with, or the operator chooses to fit, a crane. The benefits for existing seven-axle combinations are likely to be higher than for current six-axle combinations transferring to seven-axle combinations.

A general description of the expected costs is given in Table 5. Again, there are different costs for existing combinations and for six-axle combinations transferring to seven-axle combinations.

Table 5: General description of costs of the regulatory proposal

Description of cost	For existing seven-axle combinations	For six-axle combinations transferring to seven-axle combinations
Vehicle replacement or accelerated replacement (prime movers and trailers) to take advantage of the increased payload	Minor cost	Could be significant cost
Additional vehicle operating costs caused by operation at higher mass	Some	Some, greater for this group of vehicles
Increased pavement wear for the amount of freight carried	Some vehicles only (see detail later)	
Initial cost of cranes to facilitate loading and unloading (where not already fitted)	Similar cost for both groups	
Agency costs in preparing and issuing changes to regulations	Applies to both groups	
Some bridge costs due to higher bridge stresses, depending on the type of bridge	Applies to both groups	

Accreditation costs have not been included, as it is assumed that the same policies will apply to seven-axle combinations at gross mass limits as for six-axle combinations, i.e. no accreditation will be required.

3.2.2 Impact on vehicle operating costs

Two factors will influence the operating cost impacts of the regulatory proposal: firstly, a higher payload will reduce the vehicle kilometres required to achieve the same freight task. Secondly, offsetting this will be increased fuel, tyres, repair and maintenance costs associated with the additional steer axle and increased gross mass. Based on industry advice, it is assumed that the cost of operating seven-axle combinations is between 5% and 8% higher than an equivalent six-axle combination (assumed to be $1.70 per km), depending on the gross mass.

On this basis, the *annual* fleet operating costs for A223 vehicles (and the 813 six-axle articulated vehicles in the base case) are:

Base Case	$146.3 million
Regulatory Proposal	$142.7 million
Combined Axle Mass Limits	$139.8 million

3.2.3 Impact on vehicle capital costs

Twin-steer prime movers cost considerably more than single-steer prime movers. It is expected that specifically designed trailers, required to utilise the forward position of the fifth wheel, would be slightly more expensive than standard trailers – an additional capital cost of $25,000 has been estimated. Owners of existing six-axle articulated vehicles wishing to upgrade to twin-steer vehicles are assumed to do so over a three year take-up period. The additional capital cost would be $18.3 million in the regulatory proposal.

After Year One, the twin-steer fleet is assumed to grow at 3.8% per year in line with the assumed growth in the freight task, and to remain as a fixed percentage of that fleet. Capital costs are incurred in Years Two to Ten for these new vehicles, amounting to about $4.75 million in present value terms in the regulatory proposal. The analysis is conservative as no allowance is made for residual value at the end of the period of analysis.

Savings in the capital costs associated with replacing six-axle semi-trailer combinations are anticipated because the regulatory proposal, with its higher productivity, will displace approximately 90 of these vehicles. The average replacement cost is assumed to be $250,000. This fleet displacement is assumed to occur evenly over the ten years covered by the analysis and to amount to $2 million per year. In present value terms over the ten years, total savings would be $19 million for the regulatory proposal.

3.2.4 Impacts on roadwear

The *Austroads Pavement Design Guide* uses Standard Axle Repetitions (SAR) as the unit of damage to a pavement due to a single pass of an axle[3]. Pavements are assessed under a Load Damage Exponent linked to the performance of different pavement types under load.

Estimations of road wear are made on the following basis:

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[3] $$SAR = \sum_{i=1}^{i=m} (L_i / SL_i)^{LDE}$$

Where:

Li	= load carried by axle group type i (kN)
SLi	= Standard Load for axle group type i
LDE	= load damage exponent, varies from 4 to 12 depending on the pavement distress type.
m	= number of axle groups for the vehicle

- the national road proportions given in Table 6 are taken from Jameson (2002);

Table 6: Assumed proportions of road types

Roads where the 4th power is appropriate	84.2%
Roads where the 5th power is appropriate	13.3%
Roads where the 12th power is appropriate	2.5%

- the Standard Axle Repetitions per vehicle for the different road types are given in Table 7;

Table 7: Standard Axle Repetitions per vehicle for different road types

	A123	A223			
Gross mass (t)	42.5	42.5	44.5	46.5	47.5
Axle group masses (see note 1)	6, 16.5, 20	9, 15.5, 18	10, 15.5, 19	10.5, 16, 20	11, 16.5, 20
Standard Axle Repetitions 4th power	4.9	3.4	4.1	4.9	5.5
Standard Axle Repetitions 5th power	5.6	3.6	4.5	5.5	6.4
Standard Axle Repetitions 12th power	14.6	5.5	8.2	13.5	19.8

Note 1: the loads are the mass in tonnes on the steer axle(s), the tandem drive and the tri-axle semi-trailer

- pavement costs are based on 4.22 cents per Standard Axle Repetitions per km (Equivalent Standard Axle km in NTC 2004).

On this basis, the likely impacts on road wear are illustrated in Table 8.

Table 8: Likely impacts on road wear

	Base Case		Regulatory Proposal			Combined Axle Mass Limits		
	A123	A223	A223	A223	A223	A223	A223	A223
	General Mass Limits		General Mass Limits (Full)	General Mass Limits (Half)	General Mass Limits (Crane)	General Mass Limits (Full)	General Mass Limits (Half)	General Mass Limits (Crane)
Total Standard Axle Repetition kms (4th)	270,200	57,451	162,695	66,479	78,965	173,215	66,479	88,450
Total Standard Axle Repetition kms (5th)	48,562	9,484	29,092	11,399	14,120	31,958	11,399	16,319
Total Standard Axle Repetition kms (12th)	23,781	2,770	13,314	3,936	6,462	18,656	3,936	9,526
Total each vehicle	342,543	69,704	205,101	81,815	99,547	223,829	81,815	114,295
Total Standard Axle Repetitions	412,247		386,463			419,939		
cf Base Case	100%		93.7%			101.9%		
Pavement costs	$17.4 million		$16.3 million			$17.7 million		

Notes: 1. Road friendly, road wear reduction factors, were not applied in this analysis.

These impacts do not include any consideration of costs recovered for road wear, which are included in registration charges, nor the allocated portion of fuel excise, as these are considered transfer payments. Nevertheless, it should be noted that the registration charge for a four axle prime mover is nearly 30% higher at $5,201, compared to the registration charge for a three axle prime mover, which is $4,019. Therefore, a twin-steer articulated combination is already contributing to the cost of the road wear it creates.

3.2.5 Impacts on bridges

VicRoads undertook a study of the effects of the various twin-steer vehicles on bridges. The vehicles in the investigation were in some respects non-typical as it was assumed that the twin-steer axles were only 1.2 metres apart, whereas in practice the axle spread will be between 1.7 metres and 2.0 metres.

In general, the effect of the regulatory proposal on bridges is no worse than for current vehicles under the base case. Only a small number of bridges exhibit effects under the regulatory proposal that is worse than for the base case. The number of affected bridges is not known with the majority located in Victoria, New South Wales and Queensland. The effects are limited to the general access network and do not apply to the higher mass limit network.

The bridges that the study indicated could be affected are:

- those that are continuous for live load and with spans in the range from 10.5 metres to 13.5 metres; and
- built in the 1960s to the MS18 bridge design standard or built prior to the 1960s.

In the case of bridges built to the MS18 design standard, the maximum effect of the twin-steer combination at maximum axle capacities is a 5% increase in loading above the generally accepted limit for spans of 12 metres. Considering the small numbers of vehicles likely to operate under the regulatory proposal at 46.5 tonnes (where the effect is up to 4% above the accepted limit), the effects on these bridges will be minimal. The effect on the older bridges is slightly greater. The revised Performance Based Standards bridge assessment criteria, whereby bridges are assessed against a three-tier approach, allows jurisdictions and industry to negotiate the level of access for the operation of vehicles under this regulatory proposal. Bridges can be specifically assessed and access determined as is the current practice for under strength bridges.

As noted above, the spacing of the twin-steer axles in the study was non-typical but the VicRoads study indicated the difficulties could be overcome if the overall axle spacing of the prime mover was in the region of 5.5 metres. This overall axle spacing is typical of vehicles on the market. In addition, there is a requirement for the overall axle spacing to be at least 15 metres for a gross mass of 47.5 tonnes (under the Austroads formula $M = L + 32.5$). This is the same formula used for truck trailer combinations and short general access B-doubles and should obviate any bridge concerns.

In these circumstances, no costs are assigned to the impacts on bridges.

3.2.6 Road crash costs

Three separate aspects of road safety are relevant:

- crash severity;

- crash exposure; and
- stability and handling effects.

On crash severity, NRTC (1996b) notes that heavy vehicle operations in Australia are already above the threshold limits for occupant survival in impacts at speed with smaller vehicles. An increase in gross mass is unlikely to make any material difference.

For crash exposure, reductions in vehicle kilometres, and hence in trip exposure, associated with higher payload for twin-steer combinations would reduce accident risk. ATSB (2004), Road Safety Working Paper No 2, *Fatal Road Crashes Involving Articulated Trucks*, estimates that there are 2.6 fatal crashes per 100 million kilometres of articulated truck travel. Based on this estimate, the regulatory proposal would save one road death every four to five years.

Fatal crashes are estimated to cost $1.7 million each (BTRE, 2000), resulting in annual fatal crash costs for the relevant fleet being:

Base Case	$3.8 million
Regulatory Proposal	$3.5 million
Combined Axle Mass Limits	$3.4 million

It might be possible to deduce the rate of non-fatal crashes per 100 million kilometres of travel, but the actual rate has not been subject to recent research and therefore no estimates can be made.

Potentially offsetting the safety gains from reduced risk exposure in the regulatory proposal are stability and handling effects. These were investigated for a range of body types in the earlier twin-steer project reports (NTC 2005a and NTC 2005b), as explained in Section 1.4. While the vehicles generally met the Static Roll Threshold values stipulated in Performance Based Standards, an increase in payload will normally raise the height of the centre of gravity of the vehicle. The resultant stability for vehicles built to the regulatory proposal would have a similar, albeit slightly lower, Static Roll Threshold to equivalent six-axle articulated vehicles. For vehicles carrying dangerous goods in bulk (e.g. tankers), the regulations governing dangerous goods vehicles means that the stability of tankers built to the regulatory proposal would have a slightly lower risk than operating at the sum of axle masses (apart from dangerous goods vehicles which would be the same) because of the lower gross mass and a slightly lower centre-of-gravity.

Although there is a slightly lower risk of rollover crashes for the regulatory proposal compared to operating at the sum of axle masses, and a slightly lower risk for the base case compared to the regulatory proposal, the differences would be so small as to be unmeasurable, within the bounds of any assumptions. In the absence of better estimates, therefore, it is assumed that any increase in rollover crashes in the regulatory proposal will be off-set by the reduction in crashes due to the reduced exposure outlined above. In other words, the road crash costs for each of the base case, the regulatory proposal and operating at combined axle masses are assumed to be the same at $3.8 million.

3.2.7 Occupational health and safety costs

An advantage of the regulatory proposal is that the increased prime mover mass would facilitate the installation of vehicle mounted cranes. The use of cranes, such as in loading/unloading pipes, bins, bales or crates, or to assist in the placement of tarps, would

reduce the risk of drivers and other workers falling during these tasks. Transport and storage is a major risk area for falls from heights.

In Victoria, for example, in the fifteen months to March 1998, 51 truck drivers and transport workers made WorkCover claims for injuries sustained in falls from less than one metre, at an average cost per claim of $48,000. The injury severity of those claims was 25% greater than that of the average WorkCover claim (all injury types). A further nine claims were made for falls from heights greater than two metres, at an average cost per claim of $36,000. The injury severity of those claims was over four times that of the average WorkCover claim (Field et al 2000).

In Victoria, injury claims from truck related falls between June 2000 and June 2003 amounted to $10,872,000. However, it is expected that a significant number of injuries from falling from vehicles are not reported. Data collected by the Victorian WorkCover Authority between the years of 2002 and 2004 indicated that:

- each year, one person is killed in a fall from a truck in Victoria;
- each year, 150 truck drivers in Victoria suffer a serious injury in falling from a truck; and
- about 70% of fall injuries occur in falls from, or jumping down from, the cargo area of trucks.

Occupational health and safety benefits associated with any migration to twin-steer vehicles are not estimated here. The estimation of benefits is extremely difficult and, accordingly, the impact results reported in Section 3.3 will be conservative. However, it is most unlikely that the cost of a crane would be incurred by operators unless long term costs were lower, including costs for insurance premiums. Handling times, associated with loading and unloading, can be expected to be significantly better where a crane is installed. It reduces not only injury risks but also dead time for the vehicle, thus allowing better utilisation of the capital investment in the truck itself.

3.2.8 Agency costs

Agency costs to implement the regulatory proposal are expected to be limited to the costs associated with changing present legislative requirements and related publicity. These are estimated to total a one-off cost of around $20,000 for each jurisdiction, or $160,000 nationally, in Year One. In addition, for each of Years Two and Three, a recurrent cost allowance equal to 25% of agency upfront cost is made to cover costs associated with take-up in those years. Total agency costs over three years would therefore be $30,000 per agency, equal to $240,000 nationally.

3.3 Assessment of the regulatory proposal

A summary of the analysis of the regulatory proposal relative to the base case and combined axle mass limits is shown in Table 9 below.

Table 9: Cost comparison of the regulatory proposal

	Base Case	Regulatory Proposal	Combined Axle Mass Limits
Costs/yr			
Pavement cost	$17.4 million	$16.3 million	$17.7 million
Fleet running cost	$146.3 million	$142.7 million	$139.8 million
Crash costs	say $3.8 million	say $3.8 million	say $3.8 million
Total costs	$167.5 million	$162.8 million	$161.4 million
Difference relative to Base Case/yr	$0.00 million	-$4.63 million	-$6.11 million
Capital costs in years 1 to 3	$0.0 million	$17.1 million	$16.5 million
Agency costs (upfront)	$0.0	$0.2 million	$0.2 million

Against initial costs, including vehicle-related capital costs and agency costs of $17.3 million over three years for the regulatory proposal, there would be annual savings at full take-up of $4.6 million in vehicle running costs net of a small decrease in pavement costs. Further capital costs would be incurred after Year One, as additional six-axle semi-trailer combinations are replaced by seven-axle twin-steer combinations. Annual savings in replacement costs of displaced six-axle semi-trailers would be approximately $3 million.

The regulatory proposal would differ from the base case in that:

- operational costs would be lower than for the base case, due to greater vehicle tonne kilometres of travel;
- pavement wear for the amount of freight carried would be lower for each twin-steer combination loading to 46.5 tonnes; and
- take-up among existing operators will be higher, because operating costs per tonne of payload are lower.

Initial costs for the regulatory proposal, including vehicle-related capital costs and agency costs, would be $17.3 million. Annual savings in vehicle running costs and pavement costs would be $4.7 million at full take-up. Additional six-axle semi-trailers would be replaced by seven-axle combinations over the period analysed. Displacement of six-axle semi-trailer combinations would also occur, with capital cost savings of $2 million annually.

Both the regulatory proposal and providing the opportunity to operate at combined axle masses are positive in economic terms, as measured by net present value of $34 million and $52 million. The benefit cost ratio is 2.5 and 3.4. The regulatory proposal would be preferred having a positive net present value and benefit cost ratio, along with complying with the Performance Based Standards safety and infrastructure performance criteria.

Table 10: Results of the impact analysis

	Regulatory Proposal	Combined Axle Mass Limits
Net present value	$33.8 m	$51.7 m
Benefit cost ratio	2.5	3.4

Notes:

1. Based on a freight growth of 3.8% per annum.
2. At a 3% real discount rate over 10 years.
3. The value of wider route access has not been incorporated into the benefit cost ratio.

3.4 Sensitivity tests

Sensitivity tests show the results to be robust. An increase in the discount rate from 3% to 10% leaves the net present values at approximately $20 million and $32 million. With capital costs assumed to be twice those estimated, the net present value would be between $11 million and $30 million for the regulatory proposal and operating at combined axle mass limits respectively. Different take-up rates were not tested, because costs and benefits (other than the relatively small agency costs) are directly proportional to take-up. Results are shown in Table 11.

Table 11: Results of sensitivity tests

	Regulatory Proposal		Combined Axle Mass Limits	
	Net present values	Benefit cost ratio	Net present values	Benefit cost ratio
Main case analysis	$33.8 million	2.5	$51.7 million	3.4
Sensitivity tests				
Discount rate increased to 10%	$19.6 million	2.0	$31.9million	2.8
Capital costs doubled	$11.2 million	1.2	$29.8 million	1.7

3.5 Conclusion

The impact analysis suggests that:

- take-up from the regulatory proposal would be approximately 974 vehicles in Year One (950 vehicles for operating at combined axle masses);
- at this take-up, there would be a reduction in pavement costs ($1.1 million) under the regulatory proposal and an increase in costs ($0.3 million) if operating at combined axle masses compared to the base case;
- although the opportunity to operate at combined axle masses provided the higher economic return, the regulatory proposal is the preferred option on combined economic, network access, safety and infrastructure grounds; and
- sensitivity tests show the results of the impact analysis to be robust.

4. CONSULTATIONS

Four rounds of consultations have been undertaken. The first, in 1998, sought road agency comments on a general proposal circulated by VicRoads. It proposed increases in the gross mass for seven-axle articulated combinations with a twin-steer axle group. It also considered a report prepared by Roaduser Research relating to the operation of twin-steer articulated combinations. The original proposal was for combinations with road friendly suspensions to be allowed a gross mass of up to 50 tonnes, but was conditional upon meeting Performance Based Standards. As a result of reservations expressed by stakeholders about the need for vehicles operating under prescriptive limits to meet performance standards, that requirement was abandoned.

Discussions between industry and the NTC occurred before the project became part of the Commission's Third Heavy Vehicle Reform Package. Additional consultations took place at forums attended by Chief Executives of road agencies when discussing the reform packages.

Further comments were sought from government and industry by means of the wide circulation and availability of the *Twin-Steer Axle Mass Limits Project: Discussion Paper* (Pearson et al 2004). The discussion paper canvassed a range of technical and policy issues. It also discussed the possibility that a road friendly twin-steer axle group should be permitted an increased load, which is not part of the regulatory proposal. However, there was little opposition to the concept of summing the axle group masses, either from industry or road agencies.

Further input into the project was obtained at a workshop held at VicRoads in July 2004, with participants from both government and industry. The main discussions at the workshop related to the discussion paper, but relevant issues discussed dealt with industry take-up, ability to achieve the load on the twin-steer axle group, interchangeability of semi-trailers and methodology for calculating impacts.

Further consultations took place with the circulation of a draft regulatory impact statement in October 2006. Most jurisdictions supported the proposal, with Queensland Department of Transport preferring Alternative 1 on the grounds of road wear. Some comment also highlighted the fact that mass limits due to axle spacing had been omitted, a situation that has now been rectified. The Australian Trucking Association also supported the proposal.

Attachment A contains a summary of the comments received and responses to those comments.

5. REVIEW / IMPLEMENTATION

The regulatory proposal would be implemented by changing the national *Road Transport Reform (Mass and Loading) Regulations 1995* and changes by the states and territories of legislation equivalent to the Mass and Loading Regulations. It would also require changes to the regulatory arrangements for higher mass limits, in the states and territories that have adopted the Higher Mass Limits regime.

It is normal practice for national land transport reforms to be reviewed on a five to ten year cycle. Five years after implementation an assessment would be made as to whether a detailed review should be initiated immediately or whether it is sufficient for this to occur ten years from implementation.

6. COMPETITION ASSESSMENT

There are a number of ways in which regulations on vehicle mass might potentially restrict competition. The major possibilities are:

- directly restricting the number of operators in the industry;
- advantaging large operators relative to small operators;
- erecting barriers to entry to the industry; and
- limiting the range of individuals or organisations able to supply services related to implementation or operation of the regulatory proposal.

6.1 Directly restricting the number of operators in the industry

The regulatory proposal contains no restriction that would limit the number of operators in the industry and hence is not anti-competitive in this respect.

6.2 Advantaging large operators relative to small operators

The regulatory proposal would apply equally to large and small operators. Small operators may experience more difficulty in funding fleet replacements, but the difficulty is no greater than for other transport tasks. It is therefore not anti-competitive.

6.3 Erecting barriers to entry to the industry

The regulatory proposal would not hinder entry to, or exit from, the industry. The segment of the industry currently using twin-steer articulated combinations is quite small. Access to currently complying, twin-steer combinations, will not be restricted by the regulatory proposal. A resale market for twin-steer trucks should continue to operate and, in fact, strengthen, with wider use of this vehicle type.

Hence the regulatory proposal is not anti-competitive in this respect.

6.4 Limiting the range of individuals able to supply services for implementation or operation of the regulatory proposal

At this time, there are a limited number of suppliers of twin-steer trucks to the market. They serve the existing seven-axle articulated combinations, as well as twin-steer rigid trucks and twin-steer truck and trailer combinations. The increase in total sales will be relatively small. Other manufacturers have not chosen to supply twin-steer trucks to the present market and are not restricted from doing so. Accordingly, the regulatory proposal is not anti-competitive in this respect.

6.5 Conclusion

The regulatory proposal will not restrict competition.

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Attachment A

SUMMARY OF COMMENTS

Below is a summary of comments received from the public consultation round on the twin-steer prime mover and triaxle semi-trailer regulatory impact statement, together with a response to those comments. The paper was circulated in October 2006.

Abbreviations used in the comments column are as follows:

DoTaRS	Department of Transport and Regional Services, Canberra
RTA NSW	Roads and Traffic Authority, New South Wales
MRWA	Department of Main Roads, Western Australia
MR Qld	Department of Main Roads, Queensland
DIER Tas	Department of Infrastructure, Energy and Resources, Tasmania
DUS ACT	Department of Urban Services, Australian Capital Territory
DPI NT	Department of Planning and Infrastructure, Northern Territory
ATA	Australian Trucking Association

Comment	**Response**
Comments from road agencies	
General comments	
Support for the reform (DoTaRS and DIER Tas)	Support noted.
Support the proposal but there appears to be some inconsistency in the regulatory impact statement relating to method of implementation. (MR WA)	Appropriate changes have been made to make it clear that change to the Mass and Loading Regulations (and equivalent State and Territory laws) is the preferred means of implementation. The references to Gazette notices were intended to refer to the implementation of the higher mass limits option. Section 5 is where the main references are.
The policy, which is in line with the current practice in the NT, is supported provided the components in the combination have adequate manufacturers rating (DPI NT)	The regulatory proposal does not obviate the need for every vehicle to have adequate manufacturers rating.
Policy issues	
The proposal should clearly state it only applies to A22 prime movers i.e. no tridem drives. (RTA NSW and MR Qld)	The last paragraph of Section 1.2 states "*This regulatory impact statement does not deal with combinations other than a four-axle prime mover incorporating a twin-steer axle group towing a tri-axle semi-trailer. In particular, B-doubles fitted with twin-steer axles are not considered*." This paragraph precludes a tridem drive as it is only possible to have a four-axle prime mover with a twin-steer and a tandem axle driving group.

Comment	Response
Recommend that assessment of twin-steer prime movers and tandem axle semi-trailers be included in the regulatory impact statement. (MR Qld)	The sum of the allowable loads for a six-axle articulated combination with a twin-steer prime mover and a tandem axle semi-trailer is 44 tonnes. Compared to the regulatory proposal of a 47.5 tonne vehicle, this 44 tonne vehicle has 8% *less* payload but an *increase* in road wear of 11%. In addition, when compared to a 42.5 tonne six-axle articulated vehicle, road wear would *increase* by 25% for a payload increase of 3.5%. Therefore, a 44 tonne six-axle articulated vehicle with a twin-steer is not an efficient vehicle from a road wear perspective and may not have benefits exceeding costs.
Conceptually, the regulatory proposal would not meet the Performance Based Standards Pavement Loading standard whereas Alternative 1 does meet the standard but there is some risk in adopting the standard outside the Performance Based Standards framework as load sharing on the twin-steer may not be enforceable. (RTA NSW)	Agreed.
The regulatory impact statement states that twin-steer axle groups approaching 11 tonnes are relatively more damaging for road pavements and that any twin-steer load greater than 10.1 tonnes is relatively more damaging than a single steer axle. Consequently, MR Qld recommends adoption of Alternative 1.	The regulatory proposal is preferred because it provides greater net benefits even though road wear may be greater. However, since the regulatory impact statement was prepared, the allowable load on a single steer axle has been increased to 6.5 tonnes if the vehicle is fitted with the latest Euro 4 engines, Front Underrun Protection Systems (FUPS) and stronger cabs. A 6.5 tonne single steer axle causes marginally more wear than a twin-steer at 11 tonnes (2.10 compared to 2.06 using SAR4). The regulatory impact statement has been adjusted accordingly.
The proposal should identify the minor design changes that would enable combinations to meet the Performance Based Standards criteria for Static Roll Threshold (SRT) so that they can be incorporated in the regulatory requirements. (RTA NSW)	As shown by the previous proposals in the truck and dog trailer project, jurisdictions object to including requirements such as loading height (the main influence on SRT) in legislation under prescriptive regulations as being impossible to enforce in the field. Therefore, it is not proposed to incorporate any design requirements in this proposal.
The proposal should clarify whether or not, on the basis of the SRT results, it is proposed to exclude tankers. (RTA NSW)	The regulatory impact statement now has some words relating to tankers that indicate that, as the proposal is for prescriptive regulations, it is not proposed to exclude tankers. In addition, it is explained that the performance of tankers will be no worse than present vehicles, even though they do not meet the SRT standard of 0.40g as most present tankers cannot meet that standard anyway.

Comment	Response
It is recommended that the NTC qualify or remove the reference to a prime mover carrying a load. (DoTaRS) Freight being carried on the prime mover is not supported as it would be used as a precedent for allowing prime movers of 26 metres to carry a load. (RTA NSW)	Nothing presently in the Mass and Loading Regulations prohibits the carrying of a load on a prime mover, so to introduce a prohibition that would apply only to this combination would seem inequitable. Computer modelling of a prime mover carrying a load did not reveal any problems with dynamic behaviour with such a vehicle. In addition, it is understood that the prohibition on the prime mover of a 26 m B-double carrying a load was to ensure that the increase permitted in dimensions would not be compromised, which does not apply in this case as no dimension increase is proposed. However, the references to load on the prime mover have been removed.
Section 2.2 of the regulatory impact statement indicates that Alternative 1 provides a gross mass limit of 46.5 tonnes with a maximum of 10.5 tonnes on the twin-steer group and the regulatory impact statement should identify from which axle group the other 500 kg has been deducted. (RTA NSW) It is recommended that the regulatory impact statement clearly states all axle group mass limits in Alternative 1. (MR Qld)	The regulatory impact statement assumed that the tandem group was reduced by the additional 500 kg but as the difference at the 4th power level (which is 85% of all roads) is only 2.1% it was decided to increase flexibility by allowing a choice to suit operational requirements about whether the load was reduced from the tandem, the triaxle or some from both.
The regulatory impact statement should identify the comparative performance of the twin-steer and a standard six-axle articulated vehicle. (RTA NSW)	When this work was commenced, it was thought of as a case study for Performance Based Standards and so the performance of the twin-steer combinations was examined against Performance Based Standards, not against six-axle vehicles. Therefore, the comparison has not been undertaken but the following comments are made in Section 3.2.6 of the regulatory impact statement: *While the vehicles generally met the Static Roll Threshold values stipulated in Performance Based Standards, an increase in payload will normally raise the height of the centre of gravity of the vehicle. The resultant stability for vehicles built to the regulatory proposal would have a similar, albeit slightly lower, Static Roll Threshold to equivalent six-axle articulated vehicles.*

Comment	**Response**
Bridge issues	
The proposal to prohibit twin-steer combinations from using the group of bridges that are continuous for live load and in the span range from 10.5 metres to 13.5 metres is not supported as this would require the establishment of separate specific network. To address this matter, it is recommended that for mass limits greater than 42.5 tonnes the L+32.5 formula apply. (RTA NSW and MR Qld) Queensland has in the order of 120 continuous structures in the specified span range, with a reasonable proportion on highly trafficked routes. (MR Qld)	The objection to establishing a separate network is acknowledged and agreed. The wording in the regulatory impact statement relating to bridges and has been improved. The generally accepted limit of overstress is exceeded by about 5% maximum in the span range identified but using non-standard axle spacing. However, the vehicle will be required to meet the Austroads ASMS of M=L+32.5 tonnes and the revised regulatory impact statement makes that clear.
The regulatory impact statement does not indicate the bridge results for Alternative 1. (MR Qld)	Bridges were assessed for the mass identified in Alternative 1 and the comment by VicRoads (who undertook the bridge evaluation for the project) was the Alternative 1 had marginally less effect (between 2% and 5% less) with about 2% less for the worst affected spans.
Technical details	
The RTA's calculations do not coincide with the figures on Standard Axle Repetitions (mainly SAR 12) as there is not enough detail to verify the calculations on road wear impacts (RTA NSW)	The figures in the regulatory impact statement have been checked and are correct. It is likely that the differences occur because the regulatory impact statement did not identify the axle loads assumed when calculating the road wear with the reduced loads for the A223 vehicles. These assumptions have now been included.

Comments from ATA and others	
Support the reform as it has clear productivity advantages and anything less than 47.5 tonnes would be unacceptable. (ATA)	Support noted
The proposal should clearly identify the axle spacing mass schedule to apply. (ATA)	Agreed and the revised regulatory impact statement contains the proposal for the L + 32.5 Austroads formula to 50 tonnes. The usual higher mass limits addition to the formula of 0.5 tonnes for each tandem axle would also apply.
The use of twin-steer vehicles will require a fifth wheel position of about 1260 mm forward of the centre of the axle group with consequent implications for swing clearance, landing legs etc. (ATA)	Agreed. The special needs for semi-trailer design and inter-changeability as outlined were noted in earlier reports and in the regulatory impact statement.

Comment	Response
Twin-steer articulated combinations should be introduced to improve road haulage productivity but in specific industries. Twin-steer articulated combinations are non-optimal for seven-axle combinations. The optimal seven-axle combination is a four-axle single steer prime mover hauling a triaxle semi-trailer. (Mr Arnold McLean of the University of Wollongong)	Operators are in the best position to determine which industries are the most optimal for twin-steer articulated combinations. It was decided early in the project that tri-drive prime movers would not be considered.
Twin-steer prime movers have numerous problems in long haul transport such as: • a higher level of pitching when operating at higher speeds compared to twin-steer rigid dog combination; • higher levels of vibration leading to more rapid onset of driver fatigue • adverse steering alignment and tracking (Mr Arnold McLean of the University of Wollongong)	The original discussion paper in this project noted: *Over the years, various objections have been raised to the use of twin-steer prime movers on long haul operations due to tyre wear considerations. However, no concerns were raised by manufacturers or operators as to the suitability of modern twin-steer prime movers for longer haul transport tasks with their enhanced vehicle and suspension designs.* Comments from industry on the discussion paper indicated agreement with these views.
The modelling undertaken of the vehicles was grossly inadequate (Mr Arnold McLean of the University of Wollongong)	The modelling was undertaken using proven techniques and a widely-used modelling package by a highly qualified researcher.
A significant number of additional comments were submitted by Mr McLean that relate to issues outside the scope of this regulatory impact statement and therefore responses have not been included here. These comments related to, inter alia: • certification of road friendly suspensions; and • dynamic load sharing.	
The Regulatory Issue is not correct as it should be about increased productivity and efficiency from all vehicles capable of exceeding 42.5 tonnes general mass limits or 45.5 tonnes higher mass limits. (Mr Bill Haire, Director of Haire Truck and Bus Repairs and Mr John Lambert, Director of John Lambert and Associates)	The specific regulatory issue that is examined in this regulatory impact statement is a seven-axle combination incorporating a twin-steer prime mover and a triaxle semi-trailer being presently restricted to 42.5 tonnes. The whole focus of the project has been on this combination but that does not preclude examination of alternative combinations in the future.
For reasons that are not explained, road damage is not calculated on the 12^{th} power basis. (Mr Bill Haire, Director of Haire Truck and Bus Repairs and Mr John Lambert, Director of John Lambert and Associates)	The road wear is calculated on the basis of the actual number of kilometres of road that can be attributed to 4^{th}, 5^{th} and 12^{th} power values – see Table 6. Only 2.5% of the road network requires a 12^{th} power calculation.

Comment	Response
In the competition assessment, the proposal would not apply equally to large and small suppliers of transport equipment as large suppliers of twin-steer prime movers would be advantaged over small suppliers who would modify prime movers to convert them to triaxle drive groups. Therefore, the proposal will restrict competition. (Mr Bill Haire, Director of Haire Truck and Bus Repairs and Mr John Lambert, Director of John Lambert and Associates)	The regulatory impact statement is correct for twin-steer prime movers as this proposal does not consider the issue of triaxle drive prime movers.
Extensive additional comments were also provided by Mr Haire and Mr Lambert. Comments were submitted not only on the regulatory impact statement but also the previous documents in the project, namely the original discussion paper and the Final Report of the project. Responses have not been made to matters that do not impinge on this regulatory impact statement and have been dealt with previously. In addition: • many of the comments relied on the incorrect assumption that the twin-steer combination must meet all the Performance Based Standards criteria, and responses have not been made on these issues; and • comparisons were made with a four-axle single steer and tri-drive prime mover that are not relevant to this project.	