ROAD CONTROLLING
AUTHORITIES FORUM (NZ) INC

LAND TRANSPORT RULE : VEHICLE DIMENSIONS AND MASS 2016

SUBMISSION on DRAFT RULE

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Confidentiality:

We note that this submission may be requested under the Official Information Act 1982 and confirm that all of this submission may be released by the Ministry of Transport in that event.

INTRODUCTION

This submission on the proposed Land Transport Rule: Vehicle Dimensions and Mass 2016 is made by the Special Interest Group on Low Volume Roads of the Road Controlling Authorities Forum (New Zealand) Incorporated (RCA Forum) on behalf of the RCA Forum members.

The Road Controlling Authorities Forum (New Zealand) Incorporated is a closed, non-political incorporated society of road asset managers and roading professionals from all territorial local authorities (except the Chatham Islands Council), the Department of Conservation and the New Zealand Transport Agency. The membership of the Special Interest Group on Low Volume Roads is listed at Appendix 1.

Transit New Zealand and representatives from territorial local authorities, the Department of Conservation, Land Transport New Zealand and Local Government New Zealand established the RCA Forum in1996 to address common issues relating to road assets.

The RCA Forum's vision is to assist road-controlling authorities to make informed decisions. It supports sector working groups on common issues and meets to exchange information and provide updates on sector activities, proposed legislation, new standards and guidelines, highway and procurement strategies and other issues relevant to the other member organisations.

Proposed Rule and Regulation changes

The proposed Land Transport Rule: Vehicle Dimensions and Mass 2016 is designed to deliver productivity improvements, greater regulatory efficiency and reduced compliance costs without compromising the road transport system and road user safety outcomes. The goals of the main changes are described as being to:

- Allow operators to carry more freight and passengers per trip, by better utilising the existing capabilities of heavy vehicles (within manufacturers' specifications), and capacity of the road network.
- Encourage fleet renewal by allowing industry to access a wider range of suppliers of vehicles built to international dimensions and mass limits with modern safety, emissions, and performance technologies.
- Provide for more effective planning in the movement of the largest over-dimension loads.
- Allow local authorities greater flexibility in permitting, and clarify the categories under permit.
- Decrease non-compliant operators' levels of accepted overloading by reducing weighing tolerance thresholds.

The review of the 2002 Rule noted that the transport task is estimated to increase by 58 percent over the next 30 years and that any productivity gains in road transport have an effect across the entire economy. The member authorities of the RCA Forum support initiatives that will increase productivity in New Zealand. Every authority is keen to support any initiative that boosts economic performance. Regional economies in particular remain built on export production of dairy, meat, logs and wool, and increasingly on tourism. To thrive, each of these industries requires an efficient transport network. However, one of the major drawbacks of transporting heavier loads on the road network is the potential for a substantial increase in pavement deterioration.

The performance of pavements depends on the interaction of the thickness of the pavement layers, quality of pavement materials and construction, maintenance practices, the number and weights of axle loads to which the pavements are subjected, the width and area of tyre contact and the ratio of inflation pressure of those tyre to the recommended pressure for the load on them. Pavement deterioration increases sharply with increases in axle load, on steering axles in particular, reduced tyre contact area and higher inflation pressures. Several proposals have a direct bearing on these factors.

Comment on Proposals

PROPOSAL 1
1A. Increase the gross mass limit for 7-axle combinations with a minimum wheelbase of 16.8m from 44,000kg to 45,000kg
1B. Increase the gross mass limit for 8-axle combinations with a minimum wheelbase of 17.4m from 44,000kg to 46,000kg
(Schedule 1 Table 3B and 3.1)

1.1 These increases would be phased in; until 1 November 2017 the proposed limits would apply only to HPMV and 50MAX routes as published by the Transport Agency. The changes are described as:

- providing additional payload benefits of 1,000kg (7 axle) and 2,000kg (8 axle) for operators who comply with the mass limits; and
- reducing the payload disadvantage that the more pavement-friendly 8-axle combinations currently have, compared to 7-axle combinations, due to the lower tare weight of 7-axle combinations.

1.2 The longer axle spacing requirements (the current 44 tonne limit requires an axle base of 16 metres) is considered appropriate to mitigate bridge risks.

Operator benefits

1.3 The benefit:cost ratio for these changes has been calculated to be 2.34 over a project period of seven years, based on extra costs of $8.54M and benefits of $20M. The additional costs fall 2:1 on local roads. Stimpson & Co has calculated the benefits.[1] The Executive Summary of their report notes that benefits largely relate to the value of the reduced crash exposure from heavy vehicle kilometres travelled (HVKT) avoided as a result of efficiency gains from the increased limits. A 40-year NPV of $12 million is assumed from the reduced crash exposure, assumed from a fixed freight task and an increase of 1,000kg for 7-axle units and 2,000kg for 8-axle units.

1.4 Stimpson & Co has calculated significant additional benefits from these changes. For 7-axle units, an increase of 1000kg in Gross Mass limit for general access is calculated to give an immediate benefit of $5 million in the first year declining to $2 million in year 7 as the fleet moves to 50Max. The 40-year NPV of these benefits is calculated at $44.8 million. For 8-axle units, an increase of 2000kg is calculated to give an initial benefit of $15 million in year 4 declining to $10.3 million in year 7 as this fleet is converted to 50Max. This change is calculated to have a 40-year NPV of almost $152 million.

1.5 These benefits appear to be based on the existing weighing tolerance of 1500kg, however. At the end of the Executive Summary and in Paragraph 40 and Table 14 of the report, Stimpson & Co clearly state that reducing the weighing tolerance from 1500kg to 500kg would nullify any benefits from increasing GVM limits for 7-axle units and would halve the benefits for 8-axle units. As the reduction in weighing tolerances was included in the proposals being assessed, as shown in Table 1 of the report, it would have been helpful for all of the calculated benefits to reflect this.

1.6 As one example, the lower tolerance on 7-axle R12T22 combinations alone would nullify 90.25 percent (1,965,954 of 2,178,410) of the HVKT assumed to be avoided in the safety benefit calculation for all 7-axle units.

[1] Stimpson & Co, *Vehicle Dimension and Mass rule amendment proposal 2016*, 23 June 2016

[2] IDS, *Pavement Impact Assessment from Increased Gross Vehicle Mass on 7 & 8-axle Combination Vehicles* (2016)

Pavement Impact Assessment

1.7 The assessment of potential increased pavement wear and damage from the proposed increase in GVM on 7 and 8-axle combinations has been undertaken by Infrastructure Decision Support (IDS).[2] To assess the impact on the local roads network, IDS has extrapolated the pavement class data from Southland District. The methodology adopted for this project, as set out in Appendix B of the IDS report, initially determined the remaining pavement life for each treatment length by the pavement structural number (SNP). The SNP was originally developed in the USA as a means to determine the required pavement thickness for a new pavement for a given loading and over time has been adapted to assign a strength/capacity value to existing pavements.

1.8 This approach is recognised to have many short-comings, as no consideration of material quality or layer thicknesses are used in the calculation. During the project the project team was authorised to use the data from the Regional Precedent Performance (RPP) Study of Pavements project that has been recently completed by Geosolve Ltd. This data provided a breakdown of estimated remaining pavement life in terms of equivalent standard axles (ESA) for each treatment length and is based on a rigorous analysis of historical deflection measurements.

1.9 The RPP data was available for the state highway network and some local authority networks. The remaining life data was split into six categories based on the estimated remaining life in terms of ESA, with the length of pavement reported for each category. IDS assumed the pavement strength distribution on the Southland District Council road network for all roads outside of the state highway network, as this was deemed to be the best available dataset.

1.10 Thus, Table 1-0-3 indicates that Southland District has 0.4 percent in pavement class 1 (Extremely Weak) and Table A-1 adopts 366km (0.44 percent) of the local road network for pavement class 1. Similarly, Table 1-0-3 indicates that Southland District has 1.3 percent in pavement class 2 (Very Weak) and Table A-1 adopts 1079km (1.3 percent) of the local road network for pavement class 2.

1.11 IDS has calculated the predicted pavement damage cost using four alternative models: 100% uptake of the increased GVM limits and a lower potential uptake of the increased GVM limits; a damage exponent of 4 and a variable damage exponent.

1.12 The calculated potential uptake of the increased GVM limits indicates a surprisingly low operator demand for these increased limits. Tables 4-3 and 4-5 indicate a potential uptake of 42 percent by R12T22 units, 8.3 percent by B1222 units and 22.5 percent by A223 units, for 7-axle combinations. For 8-axle combinations, Tables 4-3 and 4-5 indicate a potential uptake of 20 percent by R22T22 units, 3.7 percent by B1232 units and 7.8 percent by A224 units. This relatively low uptake is especially surprising given the assumption in the report by Stimpson & Co that 25 percent of both 7 and 8-axle combinations are already loading above the current limits and would obtain no benefit from the changes (Table 13).

1.13 IDS notes that an exponential damage model was used for determining pavement wear. The model was run with two scenarios: firstly with the traditional exponent value of 4 and secondly using a variable power exponent model that used material test data and pavement rutting information from the Transport Agency Accelerated Pavement Testing facility (CAPTIF) to determine the rate of pavement wear for different pavement and loading scenarios. The output from this model was a variable load damage exponent that was found to calculate a higher rate of pavement wear than the fourth power approach. In particular, the rate of wear was greater for the weaker pavements. The LDE range was from 1 to 9.

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[2] IDS, *Pavement Impact Assessment from Increased Gross Vehicle Mass on 7 & 8-axle Combination Vehicles* (2016)

1.14 The load damage exponent (LDE) of 4 used by IDS is the traditional exponent used in pavement design. The AASHO road tests undertaken in 1956-61 established a fourth power relationship between pavement wear and axle loads that became the basis for pavement design and asset management. The fourth power relationship is the basis for pavement design, pavement management and Road User Changes in New Zealand, and for current design practice specified in the Austroads Guide to Structural Design of Road Pavements (Austroads 2004), the earlier Transit NZ State Highway Pavement Design and Rehabilitation Manual (1989) and various design methods adopted by local authorities, such as NZS 4404.

1.15 The anticipated pavement damage caused by different axle configurations and axle weights has been determined in the design of New Zealand roads by converting the axle loading to an equivalent number of passes of the standard axle using the fourth power relationship.[3] This measure is referred to as the number of Standard Axle Repetitions (SARs) in Austroads; it is also referred to as Equivalent Standard Axles (ESA).

1.16 Although pavement engineers have continued to use ESA factors estimated from the AASHO Road Test as the basis for designing pavements, the use of ESA factors to relate axle loading to pavement deterioration was abandoned in pavement distress models used in the Federal HCA Studies (HCAS) in 1982 and 1997.

1.17 Research undertaken in New Zealand has shown that, while the fourth power has been used for empirical pavement design, for fatigue cracking of chipseal on thin flexible pavements caused by heavier axle weights the fifth power is appropriate, and for rutting of chipseal on thin flexible pavements the seventh power is more appropriate.[4] This research is particularly relevant, because it too was done on Southland District roads.

1.18 Local research using the accelerated testing facility concluded that higher powers than those recognised in the Austroads Guide may apply for weak pavements and lower powers for strong pavements. These trials used: (i) an artificial environment; (ii) only one measure of distress (vertical surface deformation); and (iii) deformation was extrapolated rather than taken to a terminal condition. Although LDE values of 4 to 7 are indicated by Austroads for unbound granular pavements, the accelerated pavement testing trials reported load damage exponents in the range of 1.1 to 3.4 for local materials.[5]

1.19 Because such low results were not consistent with internationally recognised LDE ranges, and were not consistent with findings for in-service pavements, detailed re-analyses of the data from the trials were carried out to correctly account for non-linearity of layer moduli and recognise modular ratios between successive unbound granular layers, and a non-linear projection to a terminal rutting condition. This re-analysis resulted in a range of load damage exponents with an average of about 8, from the same data.[6] Independent reviewers have expressed similar reservations that the CAPTIF findings involving the load damage exponent cannot be relied upon.[7] [8] [9]

1.20 Nevertheless, IDS has employed the LDE values derived from the CAPTIF tests in its pavement impact assessment. The values adopted for local roads are shown in Tables A-1 to A-4 as:

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[3] A standard axle is defined as a twin-tyred single axle loaded to 80kN or approximately 8.2 tonnes.

[4] Laskewitz J, Hudson K, Wanty D, *The damaging effect of overweight vehicles on Southland roads*. (2014)

[5] Arnold G, Steven B, Alabaster D, and Fussell A, *Effect on pavement wear of Increasing Mass Limits for Heavy Vehicles*. Land Transport New Zealand Research Report 281. (2005)

[6] Tonkin & Taylor, *LTPP Study Section 6: Re-analyses of Permanent Deformation at CAPTIF*. (2006)

[7] TERNZ, *Methodology for Calculating the Exponent in a Pavement Wear Model*. (2008)

[8] Opus, *Relationship between design and predicted performance of New Zealand pavements.* Land Transport New Zealand Research Report 259. (2006)

[9] GeoSolve, *Discussion document on load damage exponents nationally.* (2016)

- Class 1 – extremely weak LDE 9.0 (0.44%)
- Class 2 - very weak LDE 5.6 (1.3%)
- Class 3 – weak LDE 3.5 (3.37%)
- Class 4 – average LDE 1.9 (59.9%)
- Class 5 – strong LDE 1.9 (17.9%)
- Class 6 – very strong LDE 1.1 (17.1%)

1.21 The LDE spread for basecourses for local roads in Southland District (left chart) and Auckland Motorway (right chart) is shown in Figure 1. It is copied from Figure 9 of the GeoSolve report on Pavement Structural Damage from Single versus Twin Tyres appended as Appendix 2 to this submission.

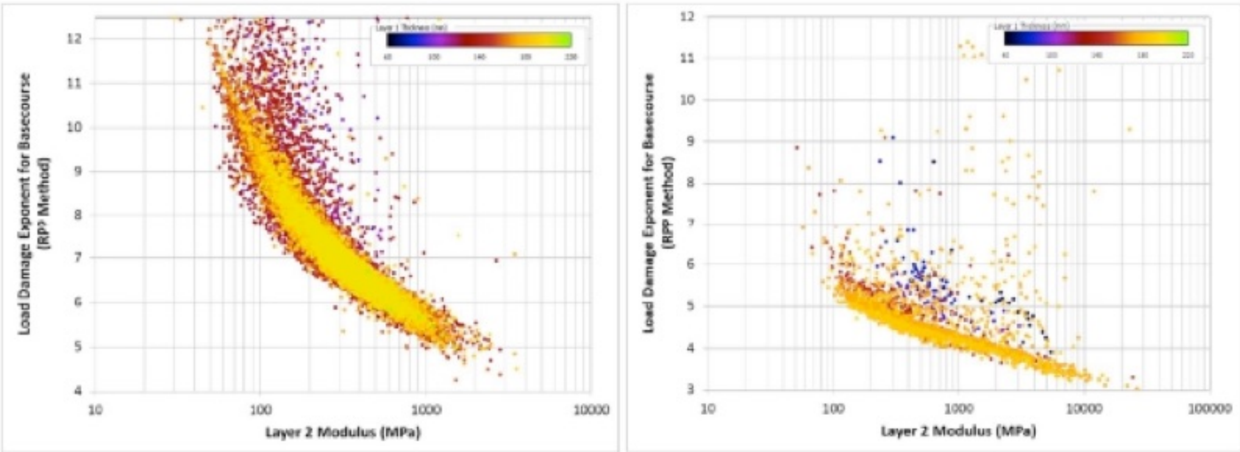

Figure 1: Comparison of LDE distribution for Southland District and Auckland Motorways

1.22 In contrast with the LDE values adopted by IDS for the local roads network, the LDE values for Southland District pavement basecourses shown in Figure 1 extend from 5 to 11. Fewer than 10 percent of the tested samples for Southland District roads had a LDE of <6, whereas 50 percent had an LDE of 7. The LDE values adopted by IDS yield a cumulative distribution of damage exponents for local roads with 94.9 percent having an LDE between 1 and 2. These values differ significantly from LDE values obtained in the RPP study, which produced well-defined fatigue parameters and associated load damage exponents for each pavement layer. The RPP study collated the historic structural analyses carried out throughout New Zealand (with some regions, including Southland having close to 100,000 structural analyses).

1.23 An alternative approach is to compare the composite cumulative distribution curve of LDE values used by IDS for the local roads network with composite cumulative distribution curves for known segments of the national network. Figure 2 shows a comparison of the LDE composite cumulative distribution curves for Auckland Motorways, Wellington City and Southland District. As noted above, the LDE values adopted by IDS yield a cumulative distribution of damage exponents for local roads with 94.9 percent having an LDE between 1 and 2.

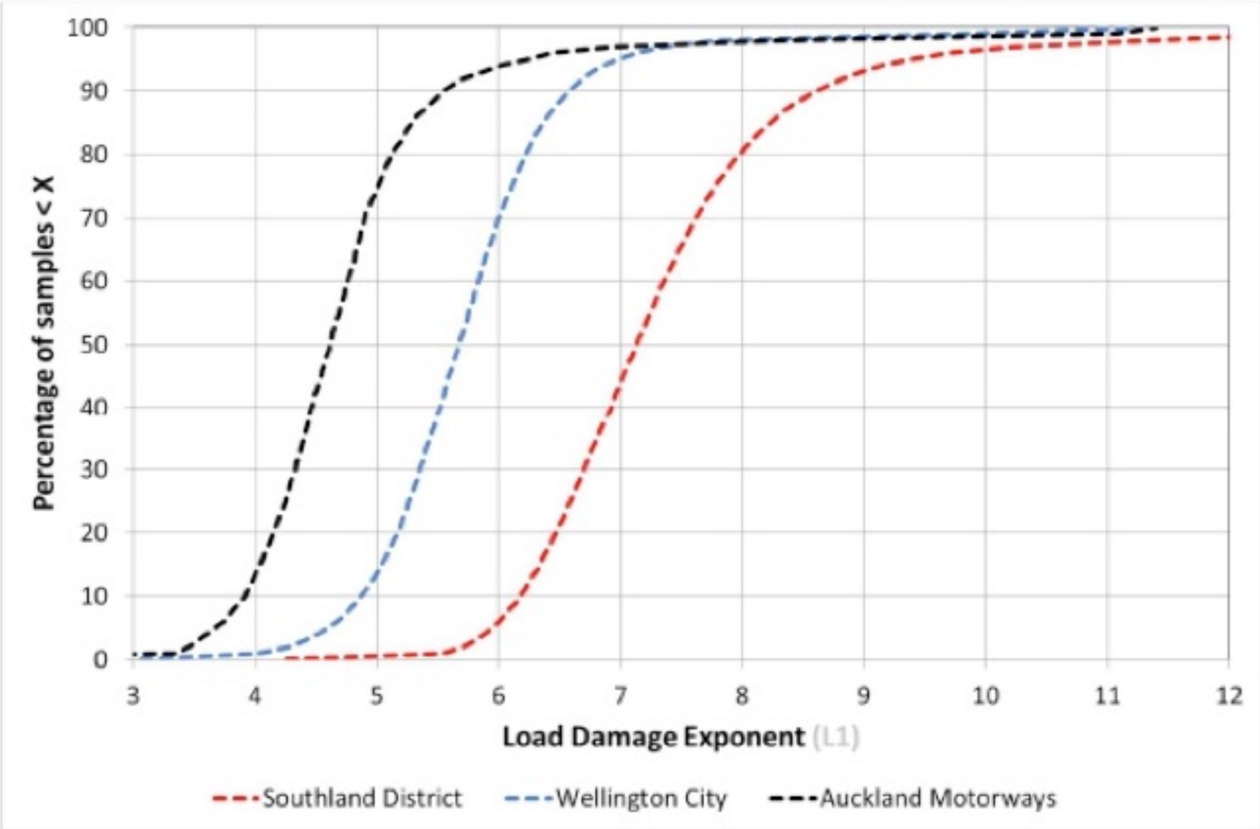

Figure 2: Comparison of composite cumulative distribution of LDE values

1.24 The LDE values used by IDS in Tables A-1 to A-4 would place over 90 percent of the LDE curve adopted for local roads to the left of the starting value on this chart and imply that substantially lower LDE values apply to the local roads network than to Auckland Motorways.

1.25 Further work is required to establish the potential cost to members of general access for the increased limits. A further aspect of infrastructure wear to be considered is geometric effect of the increased lengths. The proposal increases the general access minimum wheelbase for a 7-axle combination by 0.8m and for an 8-axle combination by 1.2m. Many local authority roads, particularly those built before the introduction of recent subdivision design standards such as NZ4404:1982, have not been designed to accommodate the space requirements of large combination vehicles. A typical intersection on a local authority road is based on road widths of 10 m to 12 m with corner radii of 9 m to 13.5 m. Large vehicles such as semi-trailer vehicles currently have difficulty negotiating the corners of these roads and remaining on their side of the road. This creates a significant safety risk on roads where local topography obscures the view of what might be approaching at a corner. At intersections and entrances heavy vehicles cause damage to kerbs and channeling, because they are unable to negotiate the turns, and they present a safety risk to other vehicles in opposing traffic lanes, or parked nearby. Large vehicles also have difficulty negotiating roundabouts and right-turn bays at intersections and often drive over and damage medians and traffic islands. Many rural local authorities have already incurred significant expense in repairs to safety rails on narrower bridges, because longer vehicles cannot negotiate the approaches.

1.26 Large changes in axle loading will have a significant impact on weaker pavements that have been constructed in shallow pavements and with marginal aggregates, and may even result in rapid failure on some sections of road especially on the local authority network.

1.27 The experience of RCA Forum members is that, far from reducing the number of heavy vehicle trips, as offered as a significant benefit for the introduction of HPMV and increased general access GVM, these larger vehicles are being used for regular deliveries that were previously undertaken by much lower mass vehicles. The frequency and HVKT is the same, but the loading and associated impact on the pavements is increased. The greater presence of much larger vehicles on minor urban streets also brings increased safety risks and damage to infrastructure such as signs and traffic islands. Local urban roads are much more susceptible to increases in vehicle dimension (whether in length, width or height) due to the physical constraints of on-street parking, street furniture (traffic signals, street lights, signage) and street trees.

1.28 Larger, heavier vehicles accelerate and brake more slowly, leading to slower travel times and congestion. Careless or inexperienced drivers, operating larger, heavier and faster vehicles exacerbate the damage to pavements with visible degradation at braking, accelerating and gear-change points near intersections and on gradients. If the heavier GVM vehicles are restricted to the routes with stronger pavements the risk of significant cost increase from an incremental increase in loading on a network basis will be lower as these routes would have been constructed and maintained to sustain a higher number of heavy vehicles.

Submission

1.29 For the reasons set out in the comments above, the RCA Forum members are not satisfied that the potential benefits and potential costs of Proposal 1 are known adequately to allow general access for the proposed GVM limits. The proposed limits should apply only to HPMV and 50MAX routes as published by the Transport Agency until a far better understanding of the potential benefits and probable costs of the increased GVM and lengths is available and a discussion of how those costs should be met has been had.

PROPOSAL 2

Rationalise general access axle mass limits
(Schedule 1 Table 2)

2.1 The explanation for the changes to Table 2 is that the existing axle mass tables contain a number of distinctions between axle types and the maximum mass allowed by the Rule that, in some instances, do not reflect real-life effects (such as increased pavement wear). The draft Rule proposes minor adjustments (all are increases). These adjustments include:

- Single standard tyres in a twin-steer axle set, or in a tandem axle set with a twin or single large-tyred axle: increase from 5,400kg to 5,500kg.

2.2 RCA Forum members cannot support the increase of the allowable total mass for front steer axles, as these axles already cause a disproportionate amount of pavement damage due to the loads being carried on single standard-tyred axles. Experience with Southland District 50MAX approvals has shown that these loads can be reduced to 5,000kg without a diminution of productivity. The reduced load can be carried elsewhere on the unit, causing significantly less damage. Increasing these axle mass limits even higher will generate increased costs on the road network for very little benefit.

2.3 Using the Austroads methodology, and depending on the pavement failure mechanism considered, increasing front axle loads by 1.85 percent from 10.8 tonnes to 11 tonnes results in an increase in pavement damage due to the front axles of 14 percent at a LDE of 7. Also it should be noted that the effect of increasing the front axle loads from 10 tonnes (as per Southland District) to 11 tonnes is that pavement damage caused by the front axles increases 95 percent. The front axle loads do not need to be increased and, in fact, should be reduced to reduce pavement damage.

2.4 These effects are shown in Table 1, which compares pavement damage due to a range of weights using both the traditional fourth power exponent and the LDE of 7 identified by the findings of the RPP study as the median LDE, on the basis that 50 percent of Southland District roads (used as an exemplar for the national local roads network) have a LDE of 7.

TABLE 1: COMPARISON OF LOAD DAMAGE EXPONENTS FOR FRONT TANDEM STEER AXLES		
	LDE at 90kN for axle pair	
Weight of each axle (kg)	**4**	**7**
4500	0.93	0.87
5000	1.41	1.83
5400	1.92	3.13
5500 (proposed)	2.07	3.56
Comparison of Load Damage Exponents for Two Individual Front Steer Axles		
	LDE at 53kN for each axle	
Weight of each axle (kg)	**4**	**7**
4500	0.96	0.56
5000	1.47	1.16
5400	2.00	1.99
5500 (proposed)	2.15	2.27

Single Large Tyres

2.5 The proposed increases relate to both twin and single large-tyred axles. Continuing to allow single wide tyres at their current weights and actually increasing the allowable load on some of these axles is particularly detrimental to pavements, particularly those weaker pavements on lower volume roads. New Zealand already allows higher loads on single wide-tyred axles than Australia. Table 2 provides a comparison showing the effects of different loads and tyre widths.

TABLE 2: COMPARISON OF ALLOWABLE SINGLE AXLE LOADS, TYRE WIDTHS AND LOAD DAMAGE EXPONENTS					
Tyre width (mm)	kN	Max kg	Authority	LDE 4	LDE 7
<355	53	6000	All	1.52	2.08
355 - 374	53	6000	Australia	1.52	2.08
		7200	New Zealand	3.15	7.47
375 - 449	58	6700	Australia	1.65	2.40
		7200	New Zealand	2.20	3.97
>450	71	7000	Australia	0.87	0.79
		7200	New Zealand	0.98	0.96

2.6 Table 2 demonstrates that the maximum limits for different tyre sizes should be reviewed against their respective effect on pavements. In particular, the current 7200kg limit for single large-tyred axles causes substantially more pavement damage than the Australian 6000kg limit. The replacement of twin standard tyres with large single tyres increases the stress on the pavement and hence the ESA. For example the relative damaging effect of single axle fitted with large tyres as compared with dual tyres is $(8.2t)^4/(7.2t)^4$ = 1.68, an increase of 68 percent[10].

2.7 More extensive use of single tyres on load-bearing axles precipitated efforts in both the USA and Europe to examine the effect on pavement deterioration of substituting single for dual tyres. Research in the USA during 1989 to 1993 by Smith (1989), Sebaaly and Tabataee (1992), Bonaquist (1992), and Gillespie (1993) found rutting damage ratios between single large-tyre and dual tyre assemblies varying between 1.4 and over 1.6. A steering axle carrying 12,000 pounds with single tyres was found to be more damaging to flexible pavements than a 20,000-pound axle with conventional dual tyres.

2.8 A major European study (COST 334) was published in 1998 comparing wide single tyres and dual tyres subject to the same load. For European pavements the average thickness of structural asphalt is 119 and 218 mm for design traffic loadings of 1 million and 10 million ESA respectively. The study found a range of results for the relative damage of single to twin tyres under the same load, for which the median was a factor of about 2.5 for structural asphaltic pavements.

2.9 The benefits of wide-base tyres for operators are reduced tyre weights and operating costs, but the consensus of international and local research is that wide-base tyres have substantially more adverse effects on pavements than dual tyres, because they produce a smaller overall tyre-road contact.

2.10 For unbound granular pavements, Austroads determines the equivalency of various axle types from the relative deflection induced under the respective loads and inflation pressures, assuming each footprint will exert uniform stress, and using a load damage exponent of 4. The load equivalency factors apply only to axles supported at each end by dual tyres, however.

2.11 Using Weigh-in-Motion data located on Auckland's southern motorway and applying standard Austroads power laws, Hudson and Wanty (2014) concluded that heavy commercial vehicles with six or more axles using single large tyres could cause up to 60 percent greater pavement damage at a LDE of 4 and up to 180 percent more damage using a LDE of 7, compared to the same load on dual tyres.

2.12 However, these damage exponents apply only for specific forms of pavement. A more detailed assessment of damage caused by single tyres using in-situ testing from the Southland District network has been prepared by GeoSolve and is appended as Appendix 2. Detailed analysis of local roads was carried out to establish a reliable pavement life model for unbound granular pavements, using regional precedent performance (RPP) of the entire network. This calibrated mechanistic model enabled comparison of the damage from alternative axle configurations, and one road, nominated as a representative case for local low volume unbound granular pavements, was examined in greater detail.

2.13 The calculations confirmed that for roads where there is thick structural asphalt and where the subgrade governs the life of the road, it can be reliably established that for the same axle load, the number of passes before structural rehabilitation will be required changes minimally when using single large tyres compared to standard twins with similar axle loads. The damage ratio is about 1. In a flexible granular

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[10] Sinclair Knight Merz, Road Users Charges Review Group: Engineering Advice (2009), section 9.2

pavement where the subgrade is deep and an unbound basecourse with thin surfacing forms the top layer (and governs the life of the pavement), however, the damage ratio can easily reach 4 or more.

2.14 Structural analysis of a road where the basecourse was found to be of only moderate quality and forms the critical layer governing pavement life, as it has the capacity for lesser load repetitions than the subgrade, indicates a tenfold decrease in pavement life when changing to a single large-tyred axle from dual tyres. This is shown in Figure 3 (copied from the GeoSolve report, Appendix 2).

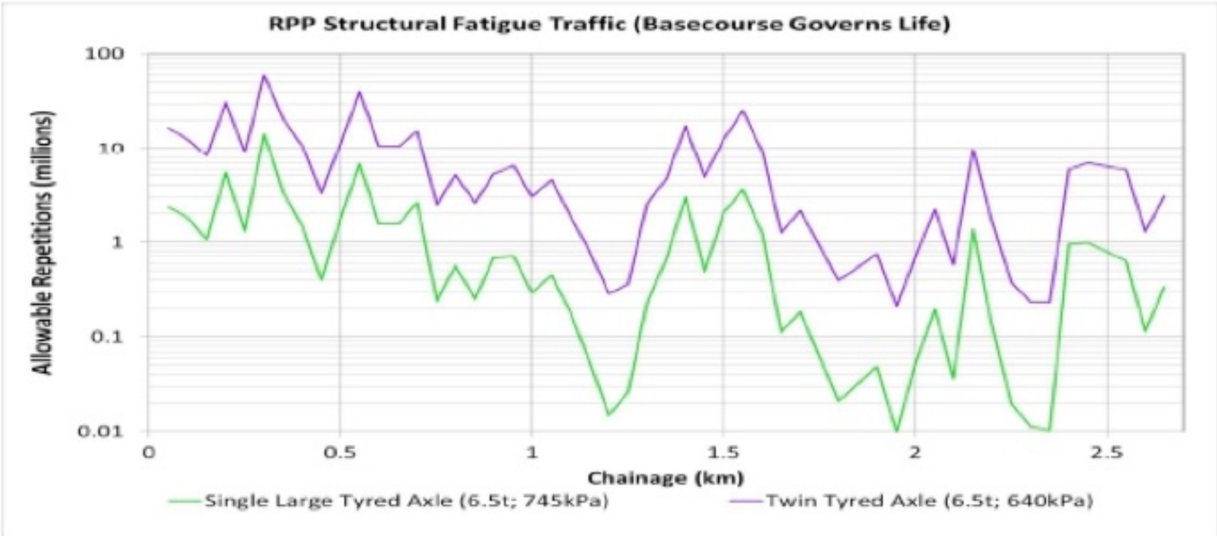

Figure 3: Comparison of Basecourse Structural Fatigue for Single Large Tyred and Dual Tyred Axles

2.15 The following axle set comparisons taken from Tables 2.2, 2.3 and 2.4 of proposed Schedule 1 show that single wide-tyred axles are not pavement friendly and, if they are to be used at all, this should be in limited cases and the tyres should be as wide as possible. If operators are allowed to use these wide tyres, they should pay a RUC that accurately reflects the additional damage they cause.

TABLE 3: DAMAGE COMPARISON OF SINGLE WIDE TYRES AND DUAL TYRES					
	Limit	<375	375-449	>450	Dual
Tandem Axle set	13000	90kN	98kN	120kN	135kN
LDE 7		11.47	6.32	1.53	0.67
Tri-axle set	18000	121kN	132kN	159kN	181kN
LDE 7		14.10	7.67	2.08	0.84
Quad axle set	20000	150kN	164kN	194kN	221kN
		6.55	3.51	1.08	0.43

Dynamic Loading

2.16 Another consideration in evaluating wide-base single versus dual tyres is dynamic loadings that arise from the vertical movement caused by surface roughness, which is more likely to be a feature of weaker pavements. As a heavy vehicle travels along the road, axle loads applied to the pavement surface fluctuate above and below their average values. Peak loads are applied to the pavement that are greater than the average static load.

2.17 The degree of fluctuation depends on factors such as pavement roughness, vehicle speed, radial stiffness of the tyres, mechanical properties of the suspension system, and overall configuration of the vehicle. On the assumption that the pavement deterioration effects of dynamic loads are similar to those of static loads and follow a similar load damage exponent relationship, increases in the degrees of fluctuation increase pavement deterioration.

2.18 Estimates of damage due to the combination of static and dynamic loading conclude that it can be two to four times that due to static loading locally. The combined loading produces a "shock factor" between 1.3 and 1.55, depending upon suspension characteristics. Applying the fourth power law would translate these figures into relative damage estimates ranging from 2.8 to 5.1 times the static loading damage.

2.19 The relative pavement damage caused by the combination of static and dynamic loading at peak damage due to dynamic loads and mean damage due to dynamic loads is shown in Figure 4 (also copied from the full report attached as Appendix 2).

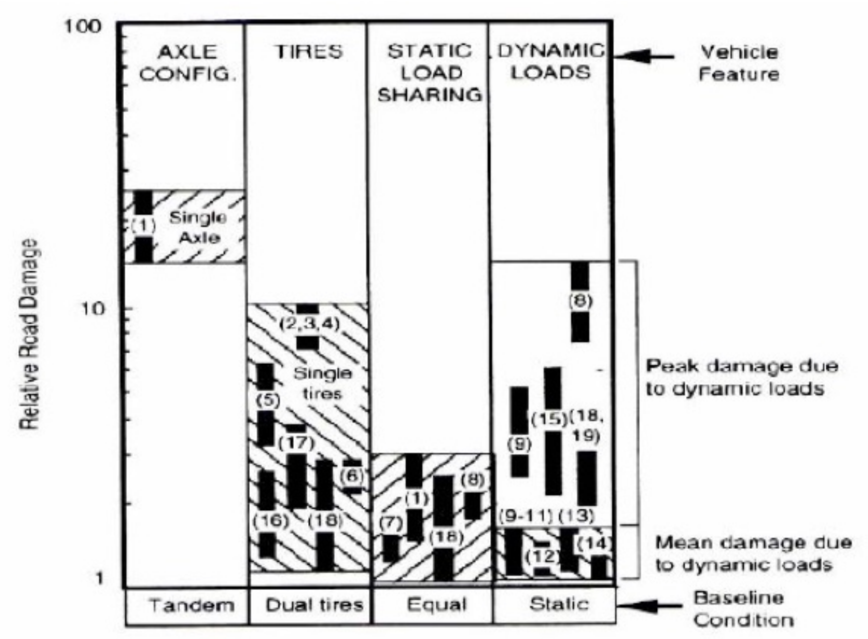

Figure 4: Difference in mean and peak damage due to dynamic loads.

Tyre Pressures

2.20 Tyre pressure needs to be considered in this analysis, too. Tyre pressure is recognised to have a large effect on the fatigue of flexible pavements. Studies on the impact of tyre inflation characteristics on pavement have raised concern over accelerated pavement deterioration, particularly rutting, caused by higher tyre pressures. Higher inflation pressures result in a smaller tyre "footprint" on the pavement and, consequently, a concentration of weight over a smaller area. These changes hasten the wear of pavements, increasing both the rate of rutting and the rate of cracking.

2.21 Tyre pressure is now a specific input for pavement design for US designers using the Mechanistic-Empirical Pavement Design Guide (M-EPDG)[11]. Traditional ESA concepts are convenient, but rely on invalided assumptions. The M-EPDG inputs include the full spectrum of traffic parameters. This more fundamental approach allows a substantially more meaningful quantification of pavement wear. The "one size fits all" ESA approach used in RAMM 4th power calculations is an over-simplification that can give approximate results for a network which has (i) been designed for traffic of at least 10 MESA and (ii) a limited allowable ESA range (less than a factor of 2). Most local roads are poorly suited to ESA methods.

Submission

2.22 For the reasons set out in the comments above, the RCA Forum members are not satisfied that the potential costs of Proposal 2 are known adequately to allow general access for the proposed higher axle limits. Should they proceed, the proposed limits should apply only to HPMV and 50MAX routes as published by the Transport Agency. Further work is required to establish the potential cost to members of general access for the increased limits.

PROPOSAL 3

Provide an indicative list of indivisible loads.
Section 4.1

3.1 The Rule provides a general definition of 'indivisible load'. The Transport Agency Axle Weights and Loading Group has determined that the following loads should be considered as indivisible:

- transformer oil
- platform trailers
- construction equipment
- load dividers
- ballast
- towing of disabled vehicles
- fire-fighting vehicles carrying water
- slurry sealing.

3.2 The reason for wanting to formalise the list is that, while their treatment as indivisible is accepted practice, there remains a legal risk for operators in that the practice does not have formal legal standing.

3.3 Building removals were not added to the proposed Rule because, in theory, buildings may be reduced to individual components and judgement is required in determining what is a disproportionate effort. It has been decided that it would not be appropriate, therefore, to establish a general principle of indivisibility for building removals in the Rule.

3.4 Without further clarification, a general principle of indivisibility for transformer oil, platform trailers, construction equipment, load dividers and ballast appears to fail the same legal test used for building removals, in that each is clearly divisible and judgement would be required to determine what is a disproportionate effort. The terms "construction equipment", "load dividers" and "ballast" are too imprecise to define a test for what makes these loads indivisible.

3.5 While the RCA Forum members are supportive of the intent of this proposal, the terminology used to give formal legal standing to these loads being treated as indivisible must give sufficient clarity around the

[11] NCHRP 2004, Guide for Mechanistic-Empirical Design of New and Rehabilitated Pavement Structures.

test to be applied in determining this to allow enforcement and avoid abuse. The proposal as presented is not supported.

PROPOSAL 4

4.1 This proposal removes current tolerances in VDAM 2002 at 5.1 and 5.2 and replaces the existing weighing tolerances with a weighing tolerance of 500 kg (axles and gross mass) and 1,000 kg (axle sets and groups) for all heavy vehicles that would not be in the Rule. While the Rule sets axle and gross mass limits, tolerances above these limits are applied before enforcement action is taken, reflecting acceptance that some loads may gain weight in transit, for example due to the effects of rain, as well as the difficulty of accurately weighing some loads.

4.2 The current weighing tolerances for axle and gross mass (excepting HPMV) are set out in the Land Transport (Offences and Penalties) Regulations 1999:

- 500kg – for weights up to 11,000kg
- 1,000kg – weights from 11,000kg - 33,000kg
- 1,500kg – weights heavier than 33,000kg
- 300kg – for front steer axles

4.3 It is proposed to set the weighing tolerances to those currently applying to vehicles on permit:

- 500kg for all individual axles, twin steer axles and gross mass limits.
- 1,000 kg for axle sets (e.g. a tri-axle set at the rear of a semi-trailer).

4.4 RCA Forum members regard a reduction in weighing tolerances as critical for the maintenance of the local roads network and a non-negotiable prerequisite to any increase in GVM or axle mass limits. Although supportive of the thrust of the proposal, they retain concerns regarding the proposed limits.

4.5 The principal concern relates to the proposed increase in weighing tolerance for front steer axles from 300kg to 500kg. Austroads research report AP-R505-16 on steer axle loads has concluded that there would be an increase in pavement wear of around 9 percent from a 200kg increase in load on steer axles. There should be no increase in tolerance and, in fact, a reduced tolerance for overloading front steer axles.

4.6 The current weighing tolerances accord the greatest tolerance to the offence causing the greatest damage. The VDAM Review Discussion Document noted that it has become widespread practice for operators to load up to the current tolerance levels, above the legal limits, so that where the prescribed maximum vehicle mass is 44,000kg, the 'tolerated' mass of 45,500kg is the effective limit in practice. The Discussion Document recognised that operators paying road user charges only on 44,000kg, and therefore not paying for the impact the additional 1,500kg on the road network, have a strong economic incentive to overload. A 7-axle vehicle combination loaded to 45,500kg is estimated to cause, on average, 50 percent more pavement damage than an 8-axle combination at the same weight, however.

4.7 The proposal reduces the tolerance to 500kg as better reflecting the level of accuracy of modern weighing techniques. The rationale for setting a limit and immediately setting a higher limit below which no action will be taken appears dubious. Modern load cells claim significantly greater accuracy than 500kg and most operators are currently able to load very accurately to 45,500kg.

4.8 The VDAM Review Discussion Document referred to 18 percent non-compliance by truck and trailer combinations, although the 2014 WIM data shows 21.2 percent of such combinations by number and 29.7 percent by GVM were overweight. Stimpson & Co assumed 25 percent non-compliance (Table 13). This indicates very strongly that the current approach is not curbing misuse of the network.

4.9 The RCA Forum members do not accept that the proposed tolerance levels better reflect the accuracy of modern weighing techniques or reinforce the need to load within the legal limits. Tolerances establish additional legal limits above those in the Rule for all practical purposes. These higher loading limits place greater stress on pavements and cause greater wear.

4.10 Competent transport operators recognise that some loads may gain weight in transit and load appropriately to ensure that the GVM does not exceed the current mass limits and weighing tolerances. Retaining an officially specified tolerance for overloading will continue to create an economic incentive to pay for a lesser load and to overload vehicles to that tolerance to maximise the return on the journey. Reducing the tolerance to 250kg would place the onus on the operators to exercise due care and diligence in loading and create a stronger incentive for all operators to comply with the limits.

PROPOSAL 5

5A. Expand the current ability to apply for permits for additional axle limits for passenger service vehicles (buses) to include specified specialist vehicles: concrete mixers; rubbish trucks; and ground-spreader trucks.

5B. Provide increased axle mass limits, on permit only, for these specialist vehicles.
(4.1 and Schedule 1 Table 4B)

5.1 It is proposed that higher axle limits be available, under permit, for vehicles other than buses that typically have heavy rear-axle loads and loads that cannot be easily redistributed. The higher axle limits would be available to rubbish trucks, concrete mixers and ground-spread fertiliser trucks. The decision on whether or not to approve a specific vehicle on a specific route would continue to remain with the relevant RCA. The RCA may also provide for limits below the maximum set by the Rule where access to weaker roads is sought (but could not use the permit process to set axle loadings below general access limits).

5.2 The proposed higher axle limits in Schedule 1 Table 4B of the proposed Rule are compared with the existing (Part C) axle mass limits available for buses on permit:

· twin-tyred axle in any set from 8,800kg to 12,000kg
· twin-tyred axle with a single large-tyred axle in a tandem axle set and a 60/40 load share, from 14,600kg to 16,000kg
· twin-tyred axle with a single large-tyred axle in a tandem axle set and a 55/45 load share, from 16,000kg to 18,000kg.

5.3 The proposal would also add new axle mass limits for two twin-tyred axles in a tandem axle set:

· 17,000kg, for axles spaced less than 1.3m apart
· 18,000kg, for axles spaced 1.3m or more apart.

5.4 The proposal to increase axle mass limits for specific categories of vehicle needs careful consideration. For agricultural vehicles like bulk fertiliser spreaders, harvesters and large tractors, a significant issue for many RCA Forum members is the damage these vehicles do to the sealed surface when entering and exiting paddocks. Larger and heavier vehicles will make this worse. The current overweight permit system allows each case to be considered in terms of the benefits and cost.

5.5 RCA Forum members tentatively support this proposal to give authorities the flexibility to grant permits for vehicles other than buses that typically have heavy rear-axle loads and loads that cannot be easily redistributed. Nevertheless, the weights being proposed are regarded as far too potentially damaging for most of the local roads network.

PROPOSAL 6

Increase the GVM limits for approved over-length simple trailer combinations from 36,000kg to 40,000kg. *(3.1)*

6.1 Car transporters that use a "simple trailer" connection are currently constrained to a combination gross mass of 36,000kg. The draft Rule allows a 40,000kg gross mass if the tow connection includes roll coupling and an HPMV permit is obtained. The increase has been assessed as safe for simple trailer combinations that meet performance and design standards set by the Agency. This would enable the productivity benefits from this proposal to extend from car transporters to other applications of simple trailer combinations.

6.2 While this is a significant increase in gross mass limits, the individual axle mass limits are still within current limits and are not expected to have significant impacts on road infrastructure. For safety purposes, the 36,000kg gross mass limit would still be the default mass limit for simple trailer combinations that do not meet the performance and design standards required to obtain an over-length permit.

6.3 This proposal is not opposed by RCA Forum members.

PROPOSAL 7

Allow a new tyre size category (444mm or wider) and define standard tyres as narrower than 355mm.

(Part 2, Definitions, plus parts of Schedule 1 Table 2)

7.1 The proposed Rule allows for a new tyre size category (444mm or wider) to complement the current single and large size tyres. The new 'mega' tyre would allow a maximum axle mass on a single-tyred axle of 7,600kg. The existing definition for standard tyres would also be changed to remove the reference to rim diameter size; standard tyres would now be defined as all tyres narrower than 355mm.

7.2 The proposed maximum axle mass for single mega-tyred axles are:

(a) in a twin-steer axle set, 5,500kg
(b) in a single-steer axle set, 7,200kg
(c) in any other axle set, 7,600kg

7.3 Single axles with single large tyres, or "super-single" tyres or single "mega-tyres" are used by heavy commercial vehicles as a more economical alternative to standard twin-tyred axles. Concerns over weight limits for such tyres in view of higher rates of pavement deterioration from their use have been fully set out in the comments under Proposal 2.

7.4 RCA Forum members consider the maximum axle masses being proposed for axles with single mega-tyres of 444mm or wider to be excessive. These should be amended to:

(a) in a twin-steer axle set, 5,000kg
(b) in a single-steer axle set, 6,000kg
(c) in any other axle set, 6,700kg

PROPOSAL 8

Extend maximum allowable width to 2.55m, inclusive of load securing devices.
(Schedule 1 Table 1 plus parts of 2.2)

8.1 Under the current Rule, the maximum width of a vehicle for general access is 2.50m. The Rule also specifies a number of items not included in this limit. These include load securing devices, central tyre inflation hoses and collapsible mirrors. In practice the effective width for open body vehicles, such as flat-deck trucks, is 2.55m (i.e. 2.50m width plus the 25mm allowed each side for load securing devices). For enclosed vehicles not using restraining devices the current maximum width is 2.50m.

8.2 Under the proposal, fully enclosed vehicles would be able to make use of an additional width of 50mm. There would be no additional benefit for open-body vehicles. The proposed increased width would allow operators a wider selection of heavy vehicles available for purchase. This should mean better pricing and encourage the uptake of modern vehicles with lower emissions and better safety features.

8.3 The proposal assumes safety outcomes to be unchanged, as many existing heavy vehicles already operate at these widths and the constraint on external fittings (Proposal 9) means that intrusion beyond the lane they occupy should not alter.

8.4 The proposal to alter the maximum legal width to 2.55m for solid sided units to match the width of open loads does not give sufficient consideration to the difference between load securing devices, central tyre inflation hoses and collapsible mirrors on a generally narrower load and a wider unit solid for its full length from corner to corner. Wider solid units will potentially increase existing problems with lane widths on many local authority roads, especially in circumstance where two full width vehicles meet each other. On urban local roads greater separation between the traffic lane and cycle lanes or parking bays is likely to be required by this proposal. As already noted, local urban roads are much more susceptible to increases in vehicle dimension (whether in length, width or height) due to the physical constraints of on-street parking, street furniture (traffic signals, street lights, signage) and street trees.

8.5 Apart from the more obvious safety issues, this proposal would increase pavement degradation through heavy vehicles travelling closer to the edge of the seal as they pass. On many lower volume sealed roads the sealed pavement is less than 6m across and truck (and especially trailer) tyres ride the edge of the seal. This causes edge break. Wider heavy vehicles can only exacerbate this problem, which has obvious maintenance cost implications for local authorities and significant safety implications for all road users forced to travel nearer or over the centreline as a result.

8.6 Damage to the approaches and safety rails of bridges with curved approaches is already a significant cost for member authorities. Wider heavy vehicles will only increase the incidence, severity and cost of this problem.

8.7 The proposal is expected to create productivity gains for refrigerated transport. An assumed benefit of an extra 50mm in width for the cubic capacity a refrigerated heavy vehicle has been calculated by Stimpson & Co as an increase from 26 to 28 pallets on a 15.1m deck of a standard 'quad-semi' and from 27 to 30 pallets on a 15m deck of a current 'super quad'. This is described as a pallet capacity gain of 6.3 percent, which has been calculated to generate a benefit of $10.4 million over 15 years.

8.8 Of 25 pallet sizes used globally, New Zealand is listed as using five:

- 1200 x 1000 x 140 - NZ Standard wooden
- 1219 x 1016 x 144 - NZ Standard plastic
- 1165 x 1165 x150 - Australian Standard wooden
- 1219 x 1016 x 141 - USA Standard wooden
- 1200 x 1000 x 162 - international standard wooden

8.9 Stimpson & Co has not stated whether the New Zealand refrigerated heavy vehicle fleet is designed to carry two NZ Standard wooden 1200mm wide pallets side by side. If it is, a standard 'semi-quad' could load 30 pallets. If not, the most efficient loading would be 1200+1000mm, which would load 27 pallets. An increase from 27 to 30 pallets would be a pallet capacity gain of 11.11 percent.

8.10 More work is required to identify clearly the costs and benefits of this proposal. Further work is needed as well on the rationale for the changes, given the content of proposal 9. These two proposals must be assessed as a single proposal establishing the maximum allowable width. Proposal 8 cannot be supported at present.

PROPOSAL 9

9A. Allow close proximity monitoring devices;
9B. Constrain mirror width to current limits; and
9C. Allow up to 25mm on either side of a vehicle for aerodynamic tabs.
(Exceptions in 2.2)

9.1 Close proximity monitoring systems (CPMS) on heavy vehicles respond to “blind spots” where the driver cannot see vulnerable users, such as a cyclist or pedestrian. These systems can raise a driver’s awareness of the vehicle’s proximity to objects and people. The proposal allows up to 50mm on each side of a vehicle to install a CPMS.

9.2 The current exception for collapsible mirrors allows an additional 0.24m either side of the vehicle. Under the 2.50m width limit mirrors do not extend beyond an overall 2.98m maximum. Mirrors would extend to a total of 3.03m with the proposed increased width limit of 2.55m, which would increase the risk of side-swipes.

9.3 Aerodynamic tabs are currently being used under exemptions as a trial, which shows they improve fuel efficiency and vehicle stability. The proposed change provides an exception to allow up to 25mm on each side of a vehicle to attach aerodynamic tabs.

9.4 The rationale given for Proposal 8 is that, in practice, the effective width for open body vehicles, such as flat-deck trucks, is 2.55m (i.e. 2.50m width plus the 25mm allowed each side for load securing devices) while for enclosed vehicles not using restraining devices the current maximum width is 2.50m. Applying the same test of total width to Proposal 9, however, results in the effective width for enclosed vehicles becoming 2.65m (i.e. the new 2.55m width plus the 50mm allowed each side for CPMS) while for open body vehicles, such as flat-deck trucks, the width would remain 2.55m (i.e. 2.50m width plus the 25mm allowed each side for load securing devices).

9.5 Even at the current maximum width the proposed exception for CPMS devices would increase the effective width of heavy vehicles to 2.6m. Similarly, an enclosed vehicle at the proposed increased width of 2.55m with aerodynamic tabs fitted would have an effective width of 2.6m. It should be noted, too, that while load restraining devices will be in use only as the load requires them, aerodynamic tabs and CPMS devices would be permanent fixtures on the vehicle.

9.6 Significantly more work needs to be done on the potential effect of these proposals. As currently proposed they will increase existing problems on a significant portion of the local roads network. These problems include, as already noted:

- Lack of space on many narrow low volume roads when two full width vehicles meet each other;
- Edge break on narrow sealed roads as truck (and especially trailer) tyres ride the edge of the seal;
- Bridge end-strike on narrow bridges with curved approaches.

9.7 Many rural authorities have substantial lengths of sealed roads at 5.4m or less wide and significantly longer lengths between 5.5 and 6.0 m wide. Apart from the maintenance cost implications of this, the increased edge break on narrow roads forces other users of these roads to travel further from the edge and over the centreline in some cases, with obvious safety implications. For local urban roads, increases in vehicle dimension (whether in length, width or height) are no longer readily manageable, due to the physical constraints of on-street parking, street furniture (traffic signals, street lights, signage) and street trees.

9.8 An increase in total or effective HMV width to more than 2.55m is not supported.

PROPOSAL 10

10A. Extend maximum allowable height to 4.30m, inclusive of load securing devices
10B. Allow operators with suitable technology to temporarily exceed the height limit when raising the vehicle to clear obstacles
(Schedule 1 Table 1 and 2.2)

10.1 The current Rule allows 4.25m as the standard height limit, but allows the addition of securing devices at an additional 25mm to give an effective maximum allowable height of 4.275m. The requirement for vehicles to meet the static roll threshold in the Rule would remain unchanged. Under this proposal, fully enclosed vehicles would again receive a slightly greater benefit.

10.2 The Transport Agency has identified some structures on highways that may need to be modified to meet the proposed increase. Additional posting of structures with limited clearance for a standard height vehicle may also be needed.

10.3 Technology that temporarily raises a vehicle is available; this proposal allows vehicles to temporarily raise their height above the height limit in order to clear a ground obstruction, where specified equipment criteria are met. The impact on roll stability is expected to be minimal, as the increase in height is temporary and is automatically retracted when the vehicle gathers speed to about 20 kilometres per hour).

10.4 The VDAM Review Discussion Document explained that transport industry representatives had expressed concerns that the current general access height limit is not adapting to changes in the vehicle fleet. For example, Euro 5 vehicles are fitted with extra environmental technology, which is attached to the chassis of the vehicle. This raises the body of the vehicle and results in a loss of nominal load capacity. Increasing the general access height limit for all vehicles could result in an improvement in volume capacity.

10.5 Another example cited is fitting safety frames without reducing the internal height for animal crates on livestock vehicles, which currently require an over-height exemption in order to install add-ons that improve occupational safety and health (OSH) outcomes and animal welfare. Livestock vehicles are currently exempted and operate at a height of up to 4.3m already, however, so the potential benefit for livestock vehicles is nugatory at best.

10.6 An increase in the height limit would increase the risk of overhead strikes. The proposal notes that some structures may need to be modified to meet the proposed increase. The Review Discussion Document noted, but did not list, five structures on the state highway network that have been identified as susceptible to an increase in the maximum allowable height for general access. It noted that data on the exact number of tunnels, bridges and underpasses on the local road network that would be susceptible to an increase in vehicles' maximum allowable height was not then available. KiwiRail has reported between 15 and 30 rail over-bridge strikes by heavy vehicles each year at the current height limit. Strikes on rail bridges pose a significant safety risk to both rail passengers and road users. Furthermore, they cause disruption to both road and rail services, and can be costly to remedy.

10.7 The proposed change to the vehicle height rule would result in heavy vehicles being forced to use less appropriate alternative local road routes because they cannot use an existing route. One example, in the greater Christchurch network is the Lyttelton Tunnel (SH74). With the current impediment to alternative routes to the Port of Lyttelton being more acute since the earthquakes and a projected significant increase in freight quantities to the Port of Lyttelton from across the South Island, this question of alternatives for higher heavy vehicles needs further consideration.

10.8 An increase in the general access height limit to 4.275m for all vehicles, inclusive of load securing devices, could provide productivity benefits to operators of fully enclosed vehicles without a substantially increased risk of overhead strikes, as no change is being made to the effective current height limit. It does not provide any additional benefits to vehicles with external load restraints.

10.9 Increasing the general access height to 4.3m has the potential to significantly increase the risk of overhead strikes on tunnels, bridges and overpasses, and verandas of roadside premises where the camber causes too great a lean for a vehicle near the kerb. It would also substantially reduce the available margin for reseals under overhead structures and, where the clearance under these structures has been achieved by creating a slight dip in the road beneath them, the combination of both higher and longer vehicles would significantly increase the risk either of overhead strikes or of vehicles becoming stuck under the structures.

10.10 This proposal lacks any proper assessment of the full costs or value of the benefits, and fails to address the issue of funding the necessary modifications to the five structures on the state highway network and the unknown number of tunnels, bridges and underpasses on the local road network that would be susceptible to damage or rendered impassable by an increase in vehicles' maximum allowable height to 4.3m. Such an assessment and a proper discussion of an increased funding co-investment rate for such works must be completed prior to any change. This proposal is not supported.

PROPOSAL 11

11A. Allow bulk permits for HPMV.
11C. [sic] Allow heavy vehicles temporary exceptions from over-dimension permitting for towing or obtaining certification.
(4.1, notes to Schedule 2, and 4.7)

11.1 The proposed Rule would allow identified prime movers (towing vehicles) to be 'mixed and matched' in combination with appropriate pro-forma trailer designs published by the Transport Agency. Other combinations would still require permitting of individual vehicles.

11.2 While the proposed Rule would allow this, the pro-forma designs have yet to be identified and published. The Transport Agency will need to develop systems to identify which trailers can be matched to which prime movers. Options will be considered over the next few months, and operators will be provided with a timeline for progressing this work. Other authorities would also be unable to provide bulk permitting until the systems are in place.

11.3 If this proposed addition is to be made to the Rule, it should be introduced with a clearly defined date for commencement, such as 1 November 2017.

11.4 The proposed Rule change also allows temporary exceptions for HPMV over-length vehicles (up to 23.0m long) to temporarily operate unladen without a permit when moving between the manufacturer and customer and/or vehicle compliance certifier pending registration and permitting. It also allows another heavy vehicle to be temporarily used to move a heavy vehicle (including any trailers) without an over-dimension permit where a heavy vehicle has broken down or crashed.

11.5 The proposed temporary exceptions are supported.

PROPOSAL 12

12A. Allow the Agency to have regard to traffic offending history in considering a permit application.
12B. Create critical conditions for over-dimension permits.
12C. Clarify matters that may be included as conditions.
12D. Clarify the responsibilities of operators and pilots.
12E. Allow crane booms to be disassembled and moved as an over-dimension load.
(4.2, 5.2, and 5.1)

12.1 Over-dimension vehicles pose particular risks to other vehicle users and road infrastructure, such as tunnels, bridges and road signs. The proposed Rule takes a graduated approach to the conditions it imposes on those using such vehicles or carrying these loads. These include requirements to use warning panels and lights, restrictions on when and where loads can travel, and requirements for accompanying pilot vehicles.

12.2 For larger vehicles or loads, permits are required and issued by the Transport Agency. Providing defined roles in the VDAM Rule would require the permit-holder to be responsible for ensuring conditions of a permit are met, and the lead pilot to be responsible for the safe management of the over-dimension load from origin to destination, and in ensuring the vehicle is no wider than allowed for in the permit.

12.3 The key changes proposed are to establish the obligations on the Transport Agency to give due consideration to the capability of the vehicle and the safety of road users when issuing a permit, to align over-dimension permits with considerations that already apply to permit applications for increased mass; and to allow the Transport Agency to have regard to the traffic offending history of the person applying for the permit, including breaches of condition of any permit issued under the Rule, in considering whether a permit should be issued.

12.4 The preference is not to regulate the largest over-dimension loads through establishing specific limits, but to ensure better initial planning is undertaken and, where necessary, require permit conditions specific to the planned trip. This is to be supported by establishing penalties for breaching critical conditions. Breaching a critical condition would create a liability for a greater fine than a standard breach of a permit condition, i.e. $2,000 compared to $350. These changes are modelled on the current overweight permit regime.

12.5 RCA Forum members consider aspects of over-dimension permits that should be regarded as critical should include:

- load and vehicle dimensions;
- piloting requirements;
- specific travel times;
- specific routes;
- axle weights on each axle set;
- number and size of tyres on each axle set;
- tyre pressures and suspension type; and
- strength and capacity of the roads being used.

12.6 It is proposed that crane booms able to be disassembled to be stacked to 3.1m wide and 4.5m high (i.e. within Category 1 over-dimension parameters) may be moved as an over-dimension load. This significantly reduces the number of heavy vehicle trips needed to move the components for the largest cranes. Piloting and other conditions linked to Category 1 over-dimension travel would apply.

12.7 These proposed changes are supported within the limitations described.

PROPOSAL 13

13A. Remove duty to use flags to mark edges for Category 4 loads.
13B. Allow pilots to use sound warning devices.
13C. All tractors between 2.5m and 3.1m to have the option to use a warning light or hazard panels to signify width.
13D. Provide for the Transport Agency to be able to establish alternative warning signs for vehicles and pilots.
13E. Remove requirement for all warning panels/signs to be frangible.
13F. Define lighting by effect, not watts.
(5.4)

13.1 A number of changes are proposed to improve the operation of the provisions regarding signage and lighting for over-dimension vehicles. These changes are designed to accommodate the uptake of new technologies. The current Rule uses terms that potentially limit the uptake of new technologies. One example is minimum lighting output specified in watts, which irrelevant for energy-efficient LED lighting.

13.2 Another example is the use of variable messaging signs to provide warnings to motorists. At present, only the messages specified in the Rule (such as "Wide Load Follows") can be used. More flexibility, such as providing information about what to do or the nature of the load, could be helpful. Defining which messages can be displayed is necessary to ensure that other drivers are given consistent information.

13.3 At present, the Rule requires flags on the very largest vehicles and loads. This appears to be an error, because these vehicles also have to be piloted, and display signs and hazard panels, but the use of such flags is, nevertheless, a familiar indication of an over-dimension vehicle or load for other road users and should be retained. Recent reports of crashes and near misses with over-dimension loads indicate, as well, that some drivers pay insufficient attention to piloting vehicles. The proposed Rule will, therefore, allow the use of audible alarms to supplement visual warnings.

13.4 Currently the Rule requires all hazard signs to be frangible. Most panels, however, are affixed within the dimensions of a vehicle and this requirement is irrelevant and counter-productive. The proposed Rule will require frangible signs where these project outside the dimensions of the vehicle.

13.5 With the qualification noted, these proposals are supported.

PROPOSAL 14

14A. Allow vehicles to travel in convoy, subject to piloting and traffic flow requirements.
14B. Remove limitation on tyre rim size for Class 2 pilot vehicles.
(5.6 and 5.7)

14.1 The proposal would allow limited travel by over-dimension vehicles in convoy, provided that additional piloting requirements were met. This is similar to the process allowed for specialised agricultural vehicles since 2013.

14.2 The removal of the maximum rim requirement for Class 2 pilot vehicles leading loads will give a greater range of vehicles to choose from and so potentially reduce costs for new and replacement vehicles.

14.3 These proposed changes are supported subject to recognition that traffic flow management would become critical with a long row of slow moving vehicles in a convoy, adding to safety issues to pass this train of continuous vehicles.

PROPOSAL 15

15A. Minor changes to zone descriptions and motorway restrictions for Category 3 and 4 vehicles.
15B. Apply travel restrictions when ANZAC Day falls on a Saturday.
15C. Allow most dedicated fertiliser spreaders to be exempt from the time restrictions currently in Clause 6.6(11) of the 2002 Rule.
(Schedule 5 and 5.5)

15.1 The proposed changes to travel zones and motorways restrictions reflect changes in road layouts and road use patterns. For example, following the Christchurch earthquakes, there has been growth in industrial and commercial sites and traffic to the south of the city. It is also proposed to apply travel restrictions when ANZAC Day falls on a Saturday (consistent with other holiday restrictions). The Rule also needs to align with the practice of "Mondayising" some public holidays.

15.2 Dedicated fertiliser spreaders (with trailers that fit standard width requirements) will no longer require certification that they meet a swept path test before becoming exempt from the time restrictions in the current Rule. This is on the basis that such vehicles have been established to easily meet the swept path test.

15.3 These proposals are supported.

General Comments

Productivity Benefits and Effects on Traffic Volumes

16.1 The substantial economic benefits claimed for the proposal to increase general access GVM limits rely on the conclusion that the heavier trucks will result in reduced traffic, reduced fuel consumption, lower emissions and improved safety.

16.2 The analysis assumes that improved productivity of individual heavy vehicles will produce a proportional reduction in heavy vehicle kilometres travelled. This assumes that freight transport is a derived demand that is inelastic in response to changes in price, and also that the freight transport supply is inelastic. Freight modelling done in Australia found that freight transport demand is price elastic, however.[12] A change in road freight volume was found to correlate with a change in road freight price with a factor of -0.86. This means an increase of 10% in the price of road freight results in a reduction in road freight demand of 8.6%, while a reduction in price by 10% will result in an increase in road freight demand of 8.6%.

16.3 An improvement in productivity would be likely to produce a reduction in freight rates. This in turn would be expected to produce an increase in road freight demand, based on the Australian modelling. Thus the gain in productivity will produce a lesser reduction in heavy vehicle trip numbers than has been predicted by assuming no effect on demand.

16.4 This growth in road freight demand would not be solely the result of increased economic activity, but would include modal shifts of freight from rail and coastal shipping and increased centralisation of storage

[12] BRTE, *Freight Measurement and Modelling in Australia.* Bureau of Transport and Regional Economics: 377 (2006)

and supply, where companies use fewer larger distribution facilities that require more transport instead of more numerous local distribution facilities. There has been no analysis of the cost of a shift of cargo from rail (or coastal shipping) to road, although road has higher safety risks and higher emissions for the same freight task than rail. What is proposed are changes that can be expected to result in a movement of freight both to a distribution pattern and a mode with higher emissions and higher safety risks.

Fuel Consumption and Emissions

16.5 At highway speeds on flat ground approximately 40% of heavy vehicle fuel consumption is proportional to the vehicle's mass while 60% is independent of mass. In stop-start conditions or in hilly environments, a much larger proportion of fuel consumption is mass dependent. Overall about 50% of fuel consumption is mass dependent. For a vehicle combination loaded to a 50T maximum compared with the same vehicle laden to a 44T maximum there is a 14% increase in weight and a 7% increase in fuel consumption.

16.6 Emissions fall into two categories: greenhouse gas emissions that contribute to climate change and regulated emissions that affect air quality and have human health impacts. Greenhouse gas emissions from transport consist primarily of carbon dioxide. The amount of carbon dioxide emitted is directly proportional to fuel consumption and is calculated as 2.7kg of carbon dioxide equivalent emissions per litre of diesel consumed. A heavy vehicle laden to an average gross mass of 41.2T would generate 89.1 tonnes of carbon dioxide over 100,000 km.

16.7 Although it is assumed that reduced truck movements are assumed to lead to reduced emissions, it has also been assumed that newer, heavier, trucks will be used more than those being replaced, so it is far from certain that reduced vehicle emissions will be achieved in this way.

16.8 Regulated emissions, particularly particulate matter from diesel engines, are implicated in about 500 additional deaths per annum in New Zealand.[13] Air quality is a major concern in urban areas. While the Discussion Document states that heavy vehicles emit 21.5% of national carbon dioxide emissions, the ARC Auckland Air Emissions Inventory 2004, found that heavy vehicles made up 7.3 % of the vehicle kilometres on Auckland roads, but generated 43% of the PM10 vehicle emissions.[14] PM10 is considered a surrogate for health impacts from all air pollutants.

16.9 Apart from airborne emissions, heavy vehicles have a number of other adverse environmental impacts on local authority roads that currently result in costs to ratepayers. These include heavy metal and hydrocarbon contaminants from tyres, brakes and fuel contaminating storm water and berms. When accumulated over time the quantities of contaminant on roads carrying high volumes of heavy vehicles are substantial. With increased axle loadings and longer decks the road surface wear will be greater due to increased traction and braking forces on the road pavement and increased scuffing on corners. As a result there will be increased road surface detritus build-up on roads. The typical heavy vehicle tyre loses 7.5kg of weight in its life, which is typically around 100,000 km. An eight-axle combination typically has 28 tyres and typically travels about 100,000 km per annum and thus would leave 210kg of tyre detritus on the network annually.

16.10 Heavier vehicles wear out tyres and brakes faster. If increased general access GVM resulted in a proportionate reduction in traffic the volume of contaminants would remain about the same. If the

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[13] Fisher G, Kjellstrom T, et al., *Health and Air Pollution in New Zealand.* Health Research Council of New Zealand, Ministry for the Environment and Ministry of Transport: 166 (2007)
[14] ARC TP 292

improved productivity of heavier vehicles leads to a reduction in road freight costs and an increase in road freight demand, however, the volume of contaminants would increase.

Safety

16.11 A large safety benefit is assumed from fewer trucks on the road overall. Safety involves a quantity risk and quality risk; reduced numbers of heavy vehicles for same freight task reduces quantity risk, while heavier vehicles increases the quality risk.

16.12 Less frequent encounters with heavy trucks on a road has the potential to increase the risk in every unexpected encounter with a larger and heavier vehicle, relative to a situation where more frequent encounters with heavy vehicles could be expected to produce greater caution in situations of greater potential hazard, such as corners, curves, bridge approaches and some tunnels.

16.13 Increased mass requires a longer stopping distance and yields higher energy in a collision. The proposed changes to the VDAM rule would trade off the potential increases in safety that would naturally accrue from the introduction of improved safety technologies with the normal renewal of the existing heavy vehicle fleet over the coming decades. What has been observed by member authorities is that modern technological improvements in heavy vehicle design, such as stability control and ABS brakes, have allowed these vehicles to travel at higher speeds on all road surfaces. In considering the energy yield in a collision, therefore, the proposals increase both the speed and mass involved.

Road User Charges regime

16.14 The member authorities note two paragraphs in particular from a Cabinet Paper from the Minister of Transport in July 2013:

> *A key principle of the pay-as-you-go system for land transport funding is that road users must make a sufficient contribution toward the costs of operating and developing the network. Therefore, a steady series of regular increases to petrol excise duty, and equivalent increases to road user charges, is recommended so that the NZ Transport Agency is in a position to manage short term expenditure pressures, and to place the National Land Transport Fund into a sustainable position for the future (ie ensuring there is sufficient revenue through pay-as-you-go to meet likely expenditure demands).*
>
> *New Zealand's historic investment in land transport infrastructure has enabled a level of personal road travel among the highest in the world. However, during the 1980s and 1990s, the level of investment in the transport network was significantly lower than in previous decades, while traffic levels continued to grow at unprecedented rates. This has resulted in an infrastructure deficit that we are currently addressing. GPS 2012 outlined the government's priorities for the safe and efficient movement of goods and people, including increased investment in land transport targeted at State highways, the Roads of National Significance, safety, and public transport.*

16.15 An increase in the cost associated with the maintenance of the local road transport network for heavier vehicle use will as a consequence need alignment with local authority Asset Management Plans and Long Term Plans and consideration of the source of funding for this work.

16.16 The VDAM Review Discussion Documents and cost assessments have noted that heavier axle mass limits would correlate with higher Road User Charge (RUC) rates, to reflect the increased impact on the roading network and have suggested that, "ideally, the increased revenue from the higher RUC rates would match the increased costs of more regular maintenance of the roading network infrastructure."[15] Road controlling authorities are fully supportive of this ideal, but remain concerned that the proposals put before them contain no mechanism for putting it into effect.

16.17 While additional RUC will be generated by the changes proposed, there is no mechanism available to allocate these additional funds to local authorities to cover accelerated damage to local roads caused by the vehicles for which the RUC was paid. If these RUC fund transfers do not include the local share of the necessary maintenance and improvement costs, these would be an unexpected charge on local authority ratepayers.

16.18 Research undertaken in New Zealand over the past decade and already cited has shown how significantly pavement consumption varies with different load configurations for the same overall load. Currently, the Road User Charges (RUC) regime does not reflect these differences, so there is no economic incentive for operators to seek to load heavy vehicles to minimise pavement damage.

16.19 There is no difference in RUC for any public road that a transport operator chooses to use. This means that operators choose routes solely on what is best for them, rather than what may be best for sustaining an optimal transport network. An example is the use of shortcuts on local roads that may have been designed for only 10% of the ESAs that the alternative state highway was designed for. While the state highway may cost twice as much per kilometre to rehabilitate compared to the local road, it can carry ten times as many ESA before needing rehabilitation, which means the long-term cost to the local authority is five times greater when the transport operator takes the local road shortcut. The local authority ratepayers must meet a significant percentage of that cost.

16.20 Planning needs to begin on full user pays for the roading network, with RUC reflecting the actual pavement consumption for a particular loading configuration on particular roads. This could be achieved with the upgrade of currently available in-truck load-cell technology and GPS location with electronic RUC charging, a pavement damage comparison tool and GIS for route option planning. Charges should be calculated on the actual axle weights on each axle set, number and size of tyres on each axle set (and tyre pressures) and suspension types, and the strength and capacity of the roads being used.

16.21 The 2009 review of the RUC regime concluded that to apply a different LDE over different parts of the network would be complex and administratively difficult to implement. [16] This was accurate for the techniques at the time, when the only way to deduce load damage exponents was by hugely expensive dedicated test track trials built with the specific form of pavement that would be traversed.

16.22 Since 2013, with advances in assessment technology and techniques, there is sufficient evidence to determine the correct power rule for different roads. For state highways the differences are likely to be minor and changes may not be warranted. There is, however, sufficiently robust and clear evidence to review the RUC model for road wear on local authority roads, and the differences are too large to ignore.

16.23 The LDE can now be reliably established from in-situ testing of in-service pavements and these methods are neither "complex nor administratively difficult to implement", while a RUC regime that charges for the axle configuration only and ignores the route, cannot provide the proper incentive to operators. More budget will be required to rehabilitate routes that are required to carry traffic for which they are under-designed.

16.24 By adopting a charging regime reflective of actual loading and actual impact, it would take RUC from being an "average of an average" to providing strong incentives to employ more sustainable configurations

[15] Discussion Document, Page 16

[16] Sinclair Knight Merz, Road Users Charges Review Group: Engineering Advice (2009), section 3.4

on the most cost-effective road for the particular freight task. It would also mean that the operators gaining the benefits of higher loadings would pay for any additional costs imposed on the roading network in obtaining those greater benefits.

16.25 Such a system would also allow a fairer distribution of the RUC income to the roads where the pavement consumption is occurring. The current system does not do this, as it does not account well for the high cost per heavy vehicle using a low volume, low to moderate strength network. This is a particular problem on local authority roading networks where ratepayers rather than the road users are required to fund almost half of the costs.

16.26 It should be possible to achieve significant cost savings across New Zealand's roading network by creating strong economic incentives to reduce the average damage caused by each unit.

16.27 The member authorities retain concerns that the review of the rules governing the principal causes of road maintenance and improvement expenditure by local authorities and the review of the Funding Assistance Rates framework were not better coordinated to ensure that any transfer of funding burden onto ratepayers was avoided. The redistribution of funding assistance applied to local roads across territorial authorities from the latter review, combined with no provisions for inflation and lower level of service expectations expressed in the One Network Road Classification (ONRC) system, transfers the additional burden on to property rates (or other sources of local revenue) to ensure that additional revenue forecast in the NLTF resulting from the increased fuel excise duty (indexed to CPI) is reserved for State highways, the Roads of National Significance, Auckland and Canterbury.

16.28 This does not support the Government's business strategy or growth agenda, which rely heavily on the continued export of primary industry products from rural, and predominantly lower socio-economic, areas of New Zealand. Primary industries and rural communities suffer a proportionately greater impact from reduced funding for local roads. Therefore, any increase in damage to local road infrastructure should be balanced by NLTF revenue increases applied to local road maintenance and renewal activities.

Improving the Heavy Vehicle Fleet

16.29 Similarly to concerns about the disconnect between reviews of the Rule and the FAR, member authorities regret the lack of any direction within the current review process towards a stronger regulatory response to the current safety standards of the heavy vehicle fleet. In making this submission the RCA Forum has had the opportunity to read the submission of The New Zealand Traffic Institute Incorporated (Trafinz) and supports that submission, in particular with regard to the opportunity, need and means to make improvements to the safety of the national heavy vehicle fleet.

16.30 Actions could be taken in parallel with the current review to achieve improvements in heavy vehicle safety at an early date. These would also lead to a more rapid modernisation of the fleet, with higher gains in efficiency and productivity available at an earlier date.

16.31 The Review Discussion Document refered to the 2014 Monash University report *Benefits of Crash Avoidance Technologies in the Heavy Vehicle Fleet,* which concluded that fitting Autonomous Emergency Braking Systems to all heavy vehicles would have the greatest effect on fatal heavy vehicle crashes. Significant reductions were shown for other safety-related systems that could be implemented now by the freight industry.

16.32 Fitting under-run protection systems on trucks, as recommended by the Cycling Safety Panel's 2014 report, could and should be required as a matter of urgency. Such systems are mandatory in most OECD countries and could assist to reduce cyclist and pedestrian fatalities from heavy vehicles.

16.33 Consideration should be given, too, to early introduction of a safety levy when vehicle ownership is changed, or as part of vehicle licensing, to be used to create an economic incentive to scrap older vehicles, as proposed in the Safer Journeys Action Plan 2013-2015 under the heading 'Actions - Accelerate the exit of unsafe vehicles'.

16.34 The member authorities believe the road transport industry must take responsibility by equipping their fleets with GPS and other modern technology to provide them with oversight of their operations. This equipment exists now and can be retrofitted. There should be a requirement placed on the industry to update the fleet accordingly and for the information collected to be available to Police and road controlling authorities.

16.35 Even when such information is available, however, enforcement is inhibited by the available regulatory provisions. Police cannot issue infringement notices under 16A of the Land Transport Act 1998. Every breach of a restriction must be taken to court, which is time consuming and expensive. The provisions in the Local Government Act for heavy vehicle restrictions allow Police to issue infringement notices for a breach of a bylaw, but the infringement fee is limited and would need to be significantly increased to be an effective deterrent to non-compliance. There is a separate need, therefore, for section 16A of the Land Transport Act 1998 to be amended to allow the Police the power to issue infringements for a breach.

16.36 A further barrier to effective enforcement is the lack of clarity on the road as to whether a High Performance Motor Vehicle is working under the provisions of a permit or not when it is observed. HPMV vehicles display an H plate at all times and there is no indication to show when they are operating under an overweight, over-length or 50MAX permit. Police officers cannot be certain whether an offence has occurred without stopping a suspect vehicle and inspecting the permit.

16.37 The RCA Forum records its appreciation of the opportunity to make this submission on the proposed Land Transport Rule: Vehicle Dimensions and Mass 2016.

COMMENT on ISSUES OUTSIDE SUBMISSION on DRAFT RULE

Comment was sought on five issues outside the proposals presented for consultation for the proposed Land Transport Rule: Vehicle Dimensions and Mass 2016.

COMMENTS
Issue 1. The revised Rule has a number of "explanatory" notes that are designed to help the reader understand key distinctions (e.g. the difference between general access and permit mass limits. Do you consider that these and other drafting changes (such as the way tables are set out) assist clarity?

Comment. We consider the explanatory notes do assist clarity and understanding.

Issue 2. The current Rule has 7 tonnes as the cut-off point for class 1 pilot vehicles. This is the only place where this boundary occurs in transport legislation. Is there any reason why this boundary should not be changed to 6 tonnes (aligning with driver licensing)?

Comment. We are aware of no reason to retain 7 tonnes for class 1 pilot vehicles.

Issue 3. On many heavy vehicles, the driver's cab is narrower than the full width across the axles. The current allowance for grab rails (50mm) is too narrow for easy grip with a gloved hand. One option would be to allow a wider grab handle, but only where the extension does not exceed 50mm on either side beyond the axle width (proposed as 2.55m).

Comment. We believe that it would be better practice to specify the maximum vehicle width as inclusive of grab rails, rather than specify an allowance for grab rails.

Issue 4. The current Rule includes 3 methods for calculating Static Roll Threshold and swept path characteristics (Schedules 1, 8 and 9). Should these be removed? The Transport Agency would still be responsible for authorising and publishing any methodology linked to the Rule (Section 6.5 in the revised Rule).

Comment. We believe the continued need for an authorised and published methodology justifies retention of that methodology in the Rule and where alternatives are available, it is appropriate to publish all of the authorised methodologies as schedules to the Rule.

Issue 5. The current definition of Gross Vehicle Mass (GVM) does not create a clear link between design limits and the value recorded on the Motor Vehicle Register. While a change to the Rule definition is anticipated, the ideal solution is to link this to a parallel change in the Land Transport Act 1998 (where it could replace the current gross laden weight definition).

Comment. We would be supportive of a better linkage between the definition of GVM and design limits and recorded values on the Motor Vehicle Register.

APPENDIX 1

Road controlling authority members of the Special Interest Group on Low Volume Roads

Far North District Council

Kaipara District Council

Whangarei District Council

Auckland Transport

Waikato District Council

Whakatane District council

Ruapehu District Council

South Taranaki District Council

Whanganui District Council

Wairoa District Council

Marlborough Roads

Tasman District Council

Waitaki District Council

Dunedin City Council

Southland District Council

New Zealand Transport Agency