Lower Bound High Productivity Motor Vehicles (LBHPMV): Effects on Existing Pavements in New Zealand

The introduction of Lower Bound High Productivity Motor Vehicles (LBHPMV, also referred to as 50MAX) onto the New Zealand state highway and local road networks will contribute to an increase in freight productivity whilst minimising adverse structural and pavement effects on the existing road infrastructure. In this context, LBHPMV rules[1] enable larger freight carrying vehicles to operate under permit at weights and lengths greater than previously allowed, on approved roads within New Zealand. The LBHPMV pro-forma designs[2] note it is possible to increase the Gross Combination Weight (GCW) to 50 tonne using a longer vehicle without increasing pavement wear.

The New Zealand Transport Agency (NZTA) has studied the effects of these motor vehicles on the highway and road infrastructure, including the existing pavements[3]. The "base case" for these studies of the effects on existing pavements assumes that because the LBHPMV's will be carrying the same overall freight task, the number of trips associated with the expected shift to LBHPMV on approved routes will reduce. Take-up forecasts[4] suggest that most (75%) of the take-up of LBHPMV will be on existing line-haul routes (both rural and urban routes) with the balance being on other routes, including but no limited to rural local roads.

New Zealand state highway and local road pavements are generally considered to be "flexible pavements" incorporating thin chip seal or asphaltic concrete surfacing. More recently, and in particular on urban line haul routes (including state highways and arterial routes in the larger urban areas) thicker asphaltic concrete surfacing has been utilised. It is reasonable to assume that the existing line haul and arterial routes have been built to accommodate the previously projected traffic demand including regulated heavy vehicles with allowance being made for overweight vehicles as appropriate.

The assessment of expected loading effects of the new LBHPMV motor vehicles in terms of equivalent standard axles (ESA) based on the "4^{th} power law" signals a relatively neutral outcome. Whilst the length and weight of the newer vehicles increases, the introduction of new load configurations including rear tridem axle sets spreads the load increase resulting in little net change in the ESA/HCV.

The strength of the existing state highway and local road pavements, when rutting in the subgrade is the governing distress mechanism, can be compared using the

[1] Land Transport Rule: Vehicle Dimensions and Mass Amendment 2010
[2] Lower Bound HPMV's – Vehicle Configurations (Draft Report): *de Pont, J: TERNZ Ltd (June 2012)*
[3] Lower Bound HPMV's, Analysis of Pavement Impacts: *Opus International Consultants (December 2012)*
[4] Stimpson, David. (Nov 2012). Business case for Lower Bound High Productivity Motor Vehicles. Stimpson & Co, Wellington, NZ. 27 November 2012.

Adjusted Structural Number (SNP)[5]. The lower limit 10th percentile SNP for any correctly defined pavement section or treatment length is used as a strength indicator. An SNP less than 2.4 represents a pavement that is more susceptible to adverse loading effects.

For SNP derived from Falling Weight Deflectometer (FWD) deflections, an SNP less than 2.4 is associated with central deflections approaching or greater than 3mm, which for pavements intended as high use on arterial or line-haul routes with non-volcanic subgrade is uncommon. Pavements in New Zealand with volcanic subgrades are known to display higher, mostly recoverable central deflections and to perform adequately provided that the pavement structure and in particular the asphalt bound surfacing is able to adjust to the higher deflections.

SNP pavement strength comparisons from across the national state highway network indicate that approximately 20% of all state highway SNP results are less than 2.4. Individual rural highways characterised as R3 (1,000 – 4,000 Annual Average Daily Traffic (AADT)) and R4 (<1,000 AADT) appear to have the lower 10th percentile SNPs which is to be expected.

SNP pavement strength comparisons from the Long Term Pavement Performance (LTPP) sites on local authority roads show that SNP values are lowest for local roads carrying less than 1,000 vehicles per day. From the limited data available, 30% of these local road sites report indicative SNP less than 2.4.

Any change in heavy commercial vehicle traffic loading, even within the current traffic regulations without the LBHPMV option, can accelerate pavement deterioration. Lower strength pavements that are subjected to an unexpected and rapid change in HCV traffic loading (e.g. the opening of a new processing plant long the route that generates previously unplanned HCV trips) can fail quickly. Road Controlling Authorities (RCA’s) can seek to mitigate the negative funding impacts in such circumstances using effective planning controls and development levies.

The studies into the effects of using LBHPMV on approved state highways and local roads show that most of the predicted take-up will be on existing urban highway or arterial and rural line haul routes, where existing pavement strength (SNP > 2.4) and the comparatively neutral effect on net ESA/HCV and correspondingly fewer trips associated with the LBHPMV will not bring about a significant change in existing pavement performance. Even on pavements with existing SNP < 2.4, the introduction of LBHPMV should not significantly affect pavement performance provided that the introduction of the LBHPMV onto a particular route is not associated with a fundamental change in associated land use and road function.

[5] Cenek, PD, Henderson, R., McIver, I., Patrick, J. (2011) Modelling of Extreme Traffic Loading Effects. DRAFT NZ Transport Agency research report.