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NZ TRANSPORT AGENCY
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On your bike

Encouraging students to cycle to school

Turning back the clock is not an option, but faced with an ongoing decline in the number of children who cycle to school, a recent research project has found that there are things we can do to encourage kids to get back on their bikes.

In the 1980s, it was common to see school bike racks crammed to bursting with bikes of every size, shape, colour and age. These days, a more common sight is the lone cycle, propped dejectedly among rows and rows of empty spaces.

Ministry of Transport data shows that in 1989/1990 young people aged between 13 and 17 cycled just over 8km per person per week. By 2003/04–2005/06, this had dropped to 2.5km. In Auckland alone, between 1978 and 1980, approximately 20 percent of all intermediate students cycled to school each day. In 2008, this figure was 4 percent.

Yet this is at a time when, along with the rest of the western world, New Zealand is facing an epidemic of childhood obesity, which already imposes a significant health cost burden on New Zealand. Sedentary lifestyles and an excess of energy-rich foods are being blamed, and while cycling cannot correct the latter, it can certainly contribute to children being more physically active and enjoying a healthier lifestyle.

Other benefits of cycling include:

- economic benefits from reduced congestion
- improved safety and personal security (cycling is still safer than many other childhood activities, and there is safety in numbers – the more people who cycle, the less risk there is of crashing)
- improved liveability of communities
- improved community accessibility and cohesion (increased independent child mobility helps restore and build social capital)
- important contributions to any climate change solution.

That cycling has been abandoned in favour of other means of getting to school is obvious. These days, cars clog the roads outside the school gates at home time, and even though in recent years there has been a resurgence in the numbers of children walking to school, this trend has yet to spread to cycling.

The reasons that children no longer cycle are many, including parental fears for their safety, school board concerns, a decrease in young cyclists' abilities and widespread community preference for a transport system that favours cars.

Hamish Mackie of TERNZ explains how the research project was driven by the fact that, while cycling has many potential benefits, it is not currently provided for adequately and the numbers of cyclists are low. 'A quick look at the road environment around many New Zealand schools at 8am or 3.30pm helps to explain why students don't cycle to school,' says Hamish. 'Even if many of our road environments aren't actually dangerous for cyclists (in terms of crash statistics), they certainly look it, and understandably many parents are reluctant to expose their children to such environments.

'Through the project, we were trying to firstly look in more depth at what the barriers are that prevent students cycling to and from school, and secondly put forward some recommendations for how those barriers might be overcome.'

The study worked with six intermediate schools, three within Auckland and three outside, gathering information from teachers, students and parents about perceived barriers and possible solutions. A package of proposed cycling initiatives (such as secure bike storage, cycle training, bike buddies, a school cycling officer and low-speed zones) were put together for each school, with a particular focus on developing a school cycle network.

The findings for all the schools were then compared to extract themes and recommendations that were relevant at a national level.

'What we found is that, for all the schools except one, the number of students who were cycling to school was considerably lower than the number who said they would like to,' says Hamish. 'So the demand is definitely there. The most significant barriers were issues with the route to school, the amount and speed of traffic, the need to cross busy roads, and personal and bike security. In general, the students (and their parents) preferred to use quiet residential streets, footpaths, shortcuts and reserves to get to school, but a well-connected route to school using these environments is not always available.'

Key recommendations from the research included the need for genuinely safe and attractive cycle networks to be developed around schools. These would make use of the types of routes favoured by children, and engineer safe passages through or across arterial 'trouble spots' nearer to school.

The need for cycle training, secure bike storage and more slow-speed environments were also key recommendations. 'It is encouraging that both slow zones and, more recently, cycle training are becoming established in New Zealand,' says Hamish. 'In this regard, we can make good use of experiences overseas where initiatives of this type have been in place for longer with a good degree of success.'

The need to more carefully consider the benefits that cycling to school (and active transport in general) delivers was the third major recommendation made by the report, on the grounds that giving a higher priority to school active transport and cycle network projects would help to 'future proof' New Zealand's transport system, and improve social and environmental wellbeing.

'Cycling infrastructure is increasingly emerging as a cost-effective option,' says Hamish, 'especially when the wider benefits are taken into account and when it makes use of existing road corridors. We're seeing hard evidence for this, especially in countries like the UK, where the preference for cycling has not traditionally been high. They are now taking active steps to encourage cycling, including cycling to school.'

Building a school cycle network

An important part of the research was developing a proposed cycle network for each of the schools that took part. Networks aimed to service clusters of students' homes and to encompass routes that were already favoured by cycling students. They relied heavily on local roads and off-road paths where these existed, also making use of bus and cycle lanes on busier roads if students were already using these.

Almost all of the schools had major arterial roads nearby that students would have to negotiate. 'Share with care' footpaths connecting residential roads to 'bike-friendly' signalised or school crossings over arterial roads were put forward as a way of providing a continuous and user-friendly route to school. Developing these paths and crossings is likely to be where most of the expenditure associated with school cycling networks will arise. Apart from this, all that would be needed is relatively low-cost promotion and education. It would help if the wider community was aware of these cycle routes.

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I want to ride my bike: Overcoming barriers to cycling to intermediate school, NZ Transport Agency research report 380

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HOW PARENTS RANKED THE PROPOSED CYCLING INITIATIVES (1 = most important, 8 = least important)

PROPOSED INITIATIVE	SCHOOL BIKE ROUTE NETWORK	CYCLE SKILLS/ TRAINING	LOW-SPEED ZONE	SECURE BIKE STORAGE	SCHOOL CYCLING MONITOR	BIKE 'BUDDIES'	SCHOOL GATE ENFORCEMENT	CYCLE TRAIN
Parents with children who already bike to school	1	4	2	5	6	3	6	8
Parents with children who do not bike to school	1	4	2	6	5	3	8	7

Finding the best truck for the job

Optimising the performance of New Zealand's heavy vehicle fleet was the aim of recent research that compared our fleet against those used overseas to come up with the ideal truck.

Road user charges (RUC) data from 2006 estimates that New Zealand has 110,400 heavy vehicles, including buses, operating on its roads nationwide.

The types of vehicles favoured for freight and passenger transport in New Zealand have been influenced by operational requirements, current vehicle dimension and mass limits, other regulations and road user charges. One notable result of this is that New Zealand uses more trucks and full trailers for freight transport than other countries, where tractor semi-trailers and B-trains are more popular for similar tasks.

Recent NZTA-funded research compared the performance of New Zealand's heavy vehicle fleet against similar fleets overseas in order to find ways to improve our national fleet's performance.

John de Pont of TERNZ oversaw the research. He says, 'The aim was to improve the performance of our national fleet with respect to protecting road and bridge infrastructure, reducing environmental impacts, improving safety and reducing congestion.

'To achieve this, we took the vehicles typically used for six transport tasks in New Zealand and benchmarked them against vehicles performing similar tasks in Australia, Canada, Southeast Asia and the UK. This enabled us to make recommendations about ways to optimise the vehicle configurations of our fleet in order to get the best performance from it.'

The six transport tasks looked at were transporting bulk liquids, bulk materials, 40 foot ISO inter-modal containers, livestock, refrigerated goods, and people by passenger coach.

The results

One of the most interesting results to come out of the study was that New Zealand vehicles caused the least amount of pavement wear and achieved the best pavement performance in all six of the transport tasks.

John explains, 'We have a unique situation in this country that has come about as a result of how road tax is charged. Road tax on heavy vehicles in New Zealand is collected through road user charges, which include a component for pavement wear based on the fourth power of the axle loads. This encourages operators to fit more axles to carry a given load than is actually necessary to comply with the axle group weight limits, which reduces both pavement wear and bridge wear, particularly for short bridges.'

Compared with the other countries, New Zealand carries out a large proportion of its transport tasks using trucks and full trailers. Trucks and full trailers have good low-speed manoeuvrability and perform well in terms of road space requirements. However, their safety performance can be worse than other vehicle types if they are not designed well.

John says, 'Although New Zealand's size and weight regulations do have some requirements aimed at improving safety, we've argued in our report for more rigorous evaluation of the safety performance of heavy vehicles.

'We face unique safety challenges in New Zealand, as a result of our road geometry, that don't exist to the same extent in the other countries we looked at. Of particular risk is the frequency of high-speed tight radius curves, which can be challenging for both drivers and vehicles. To lessen this risk, we're proposing that higher-productivity heavy vehicles, including motor coaches, should be fitted with crash avoidance technology, such as electronic stability systems and roll stability systems.'

Optimising the fleet

Having measured performance, the project looked at how changing vehicle weights and dimensions would affect performance and how, from this, performance could be optimised.

Suggested improvements for passenger coaches, trucks and full trailers, and tractor semi-trailers were proposed, including greater allowable gross weight and overall length limits for the various vehicle types.

How the benchmark was done

The benchmark analysis considered four aspects of heavy vehicle performance, looking at how vehicles here performed compared with vehicles overseas.

- Pavement wear performance was determined by the amount of accumulated pavement wear and payload.
- Bridge wear performance was determined by the amount of accumulated bridge wear and payload.
- Road space performance was determined by the amount of road width occupied on low-and high-speed turns and payload.
- Safety performance was based on relating the vehicle's rollover stability and high-speed dynamic stability characteristics to the relative likelihood of being involved in a stability-related crash. The safety performance included payload as a measure of vehicle exposure. Payload was also used as a measure of environmental impact where more productive vehicles result in fuel and emissions savings and in reduced congestion.

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Longer passenger coaches, although generally heavier in tare weight, were also more productive as they could seat more passengers. Any weight increases were unlikely to significantly affect their current good performance in terms of pavement and bridge wear. Increasing length also improved safety, with greater stability for high-speed path changes and evasive manoeuvres, and reduced on-road vehicle exposure due to greater productivity.

For both truck and full trailers and tractor semi-trailers, weight increases were possible without significantly affecting their pavement and bridge wear performance (for tractor semi-trailers, bridge wear performance would actually improve, as most of their impact comes from the tractor units and not the trailers). Increasing the length of trucks and full trailers would also improve their safety (stability and on-road exposure) without significantly affecting their road space performance.

Two variations of a bulk liquid tanker truck and trailer were modelled against the current configuration used (as a baseline) to produce an optimum configuration. The best-performing variant combined an increase in payload capacity of 5 tonnes with an increase in overall length of 3m.

John says, 'Obviously there would be impacts from any changes to current gross combination weight and overall length limits that would have to be managed. Increased weights would mean more pavement wear, but this could be managed through road user charges. Longer vehicles will inevitably occupy more road space and this will have an impact on other road users, for example by increasing overtaking and intersection clearance times. Previous research indicates, though, that this is not likely to significantly affect road safety.'

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Optimisation of heavy vehicle performance, NZ Transport Agency research report 387

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Closing gaps to cou

Three nationwide studies have come out of a two-year project looking at the potential effects of climate change on New Zealand's major land transport networks.

The importance of climate to New Zealand's economy, including the efficient operation of its transport networks, was brought home in 2008 when summer droughts across the North Island rapidly gave way to autumn flooding in the south. The cost to the farming, insurance and related industries totalled billions of dollars.

These, and other, extreme climatic events demonstrate how vulnerable New Zealand's land transport networks are when the weather turns foul, with the risks of disruption and damage likely to grow as the predicted effects of climate change begin to make themselves felt.

Ernie Albuquerque of the NZ Transport Agency explains how the research project into climate change was motivated by the need to better understand which parts of the land transport network were at risk, and how and when disruption and damage were likely to be occur. 'Through the current project, we were seeking to build our understanding of how, where and to what extent climate change will affect the land transport network, and what policy options and adaptation measures should be adopted in response to this risk.'

The outcome was three major studies, carried out in 2009 by MWH New Zealand Ltd, with Laurie Gardiner as lead researcher, which looked in more depth at the risk of:

- heat stress (buckling) affecting the national rail network as a result of more frequent and prolonged periods of very high temperatures
- inundation of low-lying coastal land transport infrastructure (road and rail) as a result of sea-level rises and more frequent and intense storm surges
- future flooding of those sections of the inland state highways and rail networks that are already prone to flooding.

What are the risks and where will they occur?

Stage one of the project identified the climate change effects that were likely to have the most impact on land transport networks. These included increases in mean temperatures and high temperature episodes, increases in mean rainfall in some parts of the country, more frequent extreme rainfall events, greater average windiness and more incidents of strong winds, higher sea levels, more storms, and more heavy swells and storm surges in some areas.

Using a risk matrix approach, the study then went on to identify the main risks to road, rail, ports and coastal shipping networks from these climate change effects, prioritising them as either top or high priority. The results are shown in the table below. The top priority risks became the subject of further study in the project's second stage.

Stage one of the project (conducted in 2008) had already reviewed the current situation, identified knowledge gaps and prioritised areas needing further research. Rail heat stress, coastal inundation and inland flooding all emerged as priority high-risk areas.

Ernie explains, 'Stage two took what we'd learnt in stage one and went on to develop a national risk profiling approach, which we could use to determine the likely regional effects from climate change in these three risk areas.

'Three separate studies were conducted and within each of these we developed scenarios for current (10 year) and future (50 year and 100 year) timeframes. In each case, we illustrated the likely regional impacts using GIS maps that overlay climate change

nter climate change

predictions and transport infrastructure. We also made recommendations for ways to more effectively manage climate change risks, including suggestions for further research where needed, policy, design and operation.'

Rail heat stress

The rail heat stress study looked at the effect that the higher and more extreme temperatures expected under climate change would have on the national rail network, specifically with respect to causing heat buckling of the rails.

Establishing a critical rail temperature and equivalent threshold air temperature for New Zealand conditions, which would indicate when heat buckling was likely to occur, was an important preliminary step. Predicting which parts of the rail network were likely to experience these or higher temperatures under climate change, and hence be at risk of heat buckling, followed from this.

Ernie says, 'What the predictions showed is that good track maintenance is crucial to reducing the risk of heat buckling and the number of days where speed restrictions become necessary because of this risk. For a well-maintained track in good condition, there should be no need for restrictions, even with increased temperatures from climate change.'

A track that is in poor condition, however, may have restrictions ranging from seven to 49 days, depending on which climate change scenario is applied.

'By optimising the design temperature of the rails and sustaining a high standard of maintenance, climate change will probably play a minimal role in influencing the risk of heat buckling, even in areas subject to the highest temperatures,' says Ernie.

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PRIORITISATION OF CLIMATE CHANGE EFFECTS FOR HIGH RISKS TO LAND TRANSPORT NETWORKS

CLIMATE CHANGE EFFECT CATEGORY	RISK	ADDITIONAL FACTORS	PRIORITY
Coastal flooding (sea level rise and storm surge)	High risk to all three modes	• Top five risk to coastal shipping • Only some coastal locations affected • Significant costs likely for response options • Particularly important for assets with a long design life	✪
Inland flooding	High risk to all three modes	• Top five risk to road • Significant costs likely for reinstatement or rebuilding • Particularly important for assets with a long design life	✪
Rainfall	High risk to road and rail	• Top five risk to road and rail • Significant costs likely for reinstatement or rebuilding	✪
Inland erosion and instability	High risk to road and rail	• Top five risk to road • Significant costs likely for reinstatement or rebuilding	✪
High temperature	High risk to rail	• Top five risk to rail • Rail has a long design life • Forward planning is required to allow staged replacement of at-risk rail, and to ensure new designs are adequate	✪
Storminess	High risk to all three modes	• Aggregate effects (extreme rainfall and high winds) are top risks for all modes and recommended priorities to progress • Potentially widespread distribution of effects	✔
Coastal erosion	High risk to road and coastal shipping	• Not a top five risk • Only some coastal locations affected • Significant costs likely for response options • Particularly important for assets with a long design life	✔
High winds	High risk to road and coastal shipping	• Top five risk to coastal shipping • Most high risks can be mitigated at short notice; however, protecting ports may be difficult	✔

✪ = top priority ✔ = high priority

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Coastal inundation

The coastal inundation study created a national risk profile of the coastal road and rail networks with respect to inundation from sea-level rises and storm surges as a result of climate change.

The elevation of coastal areas was mapped to reveal at-risk areas along coastal transport networks (areas with a less than 5m elevation). Around 3.6 percent (160km) of the national rail network, 1.4 percent (222km) of the state highways and 1.6 percent (2112km) of local roads were found to be at risk of inundation. Also at risk were at least 10 multimodal transport corridors (shared by rail and state highway) nationwide.

Ernie says, 'The actual risk to the network may be less than the figures suggest, as the profiling we used took no account of embankments or other defences to protect networks from inundation. However, if the worst case scenario did pan out, and all of the low-lying areas we've identified required repair or replacement due to inundation, substantial remedial action may be required.

'In our report, we've suggested future work to improve our understanding of the risks that coastal networks face as a result of climate change. This might include quantitative modelling of priority at-risk sections of the network, such as between Blenheim and Kaikoura, and north and south of Dunedin. In both these areas, we've mapped multiple at-risk sections on coastal corridors that contain both major rail trunk lines and state highways.'

Inland flood risk

The inland flood risk study estimated the likely increase of flood risk to vulnerable sections of state highway and rail networks as a result of climate change.

Areas of the networks that were already prone to flooding were identified and recurrence intervals predicted for future flooding in 2040 and 2090.

Ernie says, 'The national rail network is particularly vulnerable to weather extremes, mainly because of inadequate culverts and drainage systems. We found that climate change will increase the flood risk for those track sections that are already flood-prone, in some areas actually doubling it.'

Due to difficulties with the data, the state highway network's vulnerability to weather extremes was less well defined. The report identified short-term actions needed to remedy this situation, including systematic collation of data about extreme weather events causing disruption or damage to the network, and detailed flood risk studies for flood-prone areas.

Building a robust response

Ernie says, 'The three studies represent an initial high-level appraisal of the regional implications that climate change effects will have for the land transport sector.'

Priority actions identified for the future included:

- closing gaps in existing transport data
- building understanding of the network's vulnerability to extreme weather
- linking climate change considerations to network asset management
- analysing the impacts of climate change at a regional and local level
- developing better risk analysis tools
- supporting an integrated transport planning approach
- carrying out a more robust economic evaluation of the potential costs of climate change for the land transport network.

Protecting our ports

An additional study looking at the risks to New Zealand's ports from rising sea levels and increased storm surges found that climate change may not yet be 'on the radar' for many port authorities.

The study explored port authorities' awareness of the risks (and how prepared they were for them) and the vulnerability of key transport networks that serviced the ports. Results indicated that, while many port authorities acknowledged the potential adverse effects that rising sea levels could have, the severity, likelihood and timing of these effects were not well understood. They also showed that (with some exceptions) a concerted effort to assess the risk of climate change and develop a response had not yet been made by the industry.

Ernie says, 'Our hope is that the research will give land transport providers and policy makers some of the information they will need to adapt how they design, operate and maintain their assets in order to better withstand the future effects of climate change.'

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Climate change effects on the land transport network: Volume one: literature review and gap analysis and *Volume two: approach to risk management*, NZ Transport Agency research report 378

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Linking land to transport

An innovative approach to integrating land use and transport planning that aims to improve the outcomes for major urban development projects will require significant changes to how such projects are run in New Zealand.

In recent years, the issue of integrating land use and transport planning has gained increasing importance in New Zealand at a national level. Mounting government concern over the cost-effectiveness of transport expenditure (particularly on roads) and a growing appreciation of how land use planning can improve this cost-effectiveness (eg through compact city strategies) has put integrated planning firmly on the radar.

There is also a desire to make sure that transport investments are not undermined by conflicting decisions about land use and that, vice versa, decisions about transport investment take into account land use needs.

An NZTA-funded research project has looked at the issues surrounding integrated urban development projects and come up with a new approach to their implementation that should help agencies avoid some of the pitfalls they currently face.

Richard Dunbar of CityScope Consultants Ltd was part of the team that carried out the research. 'In the project, we were concerned with larger developments, with transport and land use related expenditures of over $20 million,' says Richard. 'But there's no reasons that the principles and methods we've come up with couldn't also apply to smaller developments.

'We were focused on finding implementation methods for integrated development projects that would improve their chances of success. We weren't weighing up the pros and cons of integration (this has already been covered elsewhere), but were assuming projects where the commitment to integration had already been made.'

The need for the research arose because, although at present transport funding applications for major urban development projects need to demonstrate how the projects will achieve integrated land use and transport planning objectives, the land use aspects of the projects are often not implemented within reasonable timeframes. This means that the intended benefits of the integrated approach are not delivered (at least, not in a timely way) and the justification for the transport expenditure is not fulfilled.

Richard says, 'In our report, we've recommended significant changes to the way that integrated urban development projects are approached, including the way that all levels of government approach their particular responsibilities in this area.'

What are the changes?

The report recommends that independent implementation agencies should be set up for major urban development projects. The agencies would have the mandate and authority to implement the projects, thereby minimising the risk of delay or non-fulfilment.

Richard says, 'The case studies we looked at demonstrated how important commitment and strong leadership are to implementation, and the ability to provide these is one of the major benefits of taking an independent agency approach.

'An agency would provide clarity of purpose and reduce the scope for political influence. It would also provide a vehicle for accessing the type of project planning and management, and commercial expertise needed to deliver on projects of this kind. One of the obstacles currently faced in New Zealand is finding people with the requisite skills, for both the integrated planning and the implementation stages.

'An agency model would address that. It would also provide a dedicated entity that could apply for consents, advocate for the project, handle funding, engage with stakeholders and third parties, and carry out all the other tasks and functions necessary for successful implementation.'

The proposed agencies would have roles and responsibilities for all levels of government (particularly regional councils) and a significant role for the private sector. They might be formed as council-controlled organisations or entities managing public–private partnerships.

'Whatever the structure, there would need to be sufficient flexibility to accommodate the range of different organisations involved and the way that the projects originate,' says Richard.

The report recommends that development

opportunities should be identified early on when creating regional strategies and plans, with integrated sub-regional plans developed for project areas, followed by structure plans as an essential part of implementation. Detailed implementation plans would also be necessary, and would include economic and financial feasibility assessments, funding plans, details of governance and project management structures, and a clear statement about the project's specifications and outcomes.

The proposed changes would impact on transport funding assessment processes, which would need to be broadened to accommodate and assess the value of the wider objectives that integrated plans would contain. These are likely to be more akin to the diverse objectives currently found in land use plans, than the more narrowly drawn objectives traditionally given importance in transport plans.

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Organising integrated urban development projects, NZ Transport Agency research report 379

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Compliance testing using the Falling Weight Deflectometer for pavement construction, rehabilitation and area wide treatments

NZ Transport Agency research report 381

Pavespec Ltd, Tonkin & Taylor Ltd, University of Canterbury and the NZ Transport Agency

Freely available online at *www.nzta.govt.nz/resources/research/reports/381*
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The Falling Weight Deflectometer (FWD), which measures pavement deflections, was assessed for its ability to predict the life of a newly constructed or rehabilitated pavement. FWD measurements used in the study were from the NZ Transport Agency's test track CAPTIF, roads that have failed and two Performance Specified Maintenance Contracts where the actual life from rutting and roughness measurements could be determined. Three different methods to calculate life from FWD measurements were trialled. The first, a simple Austroads method that uses the central deflection only, was found either to grossly over-predict life by a factor of 1000 times more than the actual life or to grossly under-predict the life. The second method trialled was based on Austroads Mechanistic Pavement Design, where the life is determined from the vertical compressive strain at the top of the subgrade. For the mechanistic approach, the FWD measurements are analysed with specialised software that determines a linear elastic model of the pavement which computes the same surface deflections as those measured by the FWD. From the linear elastic model, the subgrade strain is determined and life calculated using the Austroads equation. It was found when using this approach that predictions of life from individual FWD measured points within a project length can range from nearly 0 to over 100 million ESAs (Equivalent Standard Axles). To cater for this large scatter in results, the 10th percentile value was used as the predicted life of the pavement. In general, the Austroads mechanistic approach under-predicted the life, sometimes by a factor of 10 or more. The third approach trialled was adjusting the Austroads mechanistic approach by applying a factor determined from past performance to calibrate the subgrade strain criterion to local conditions. This third approach greatly improved the predictions but it was found that the multiplying factor was not consistent for a geographical area and thus the factor found from one project may not be suitable for another similar project.

Relative costs and benefits of modal transport solutions

NZ Transport Agency research report 393

GHD Pty Ltd, Russell Kilvington Consulting

Freely available online at *www.nzta.govt.nz/resources/research/reports/393/*
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This report describes the outcomes of a study commissioned by the NZ Transport Agency to inform local authorities about the costs and benefits of transport modes. The aim of the study was to provide general advice on the relative costs and benefits of alternatives, with a focus on passenger transport in urban areas.

The report looks at issues that decision makers face in estimating costs, and sets out an approach to providing estimates. This approach provides parameter values such as cost per vehicle kilometre, which can then be applied to the number of vehicles and the distance they travel, so readers may tailor comparisons to their own situation.

This quantitative exercise is supplemented by contextual discussion of some important issues in urban transport, including drivers of the transport mix, the relationship between land use and transport planning, and road space and traffic management. A selection of case studies drawn from mainly New Zealand urban areas provides some specific illustrations of the issues raised.

NZTA research

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