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Research suggests tools to make integration a success

One size does not fit all when it comes to integrating land use and transport in New Zealand. With so much variety between regions, no single integration approach is likely to fit the bill. In the interests of sustainability, an NZ Transport Agency (NZTA) research project has tackled the issue, fleshing out the idea of a regional toolbox, with tools to enable better integration in ways that suit individual regions.

The Land Transport Management Act 2003, as amended in 2008, signals a desire for better integration of land use and transport in New Zealand, and gives regional councils more responsibility to ensure that it happens. Likewise, the Resource Management Act 1991 and Local Government Act 2002 provide for integration opportunities.

At ground level too, practitioners are supporting the concept, with better integration of land use and transport in New Zealand now widely seen as

crucial if we are to achieve a sustainable transport system and sustainable communities.

The practicalities of the matter are different though.

Research team leader Paula Hunter of MWH New Zealand Ltd says that, 'Despite good intentions across organisations towards integration and despite the signals we're receiving from central government, the current business-as-usual approach isn't working. To get the required shift,



PAGE **4** Understanding national travel profiles



PAGE **7** Australasian Transport Research Forum



PAGE **8** Building the connection between lifelines and roads

Your views

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we need to see change happening at a professional and organisational level, supported by a suite of tools and approaches that practitioners can use to improve integration policy and practice.'

Current barriers to better integration include responsibility for planning resting with a range of different organisations, a lack of links between the plans developed by these organisations, a lack of common goals and outcomes to guide planning and funding decisions, and procedures for making planning and funding decisions that do not focus on or support integration.

Mix and match for integration success

Early on in the project it became apparent that a one-size-fits-all guideline to integration (the original focus of the research) would not be appropriate. Instead a toolbox approach was adopted, with the focus of the research shifting to scoping and making recommendations about the contents of this toolbox.

An integrated approach to planning

The Integrated Approach to Planning Project is a collaborative endeavour between transport sector agencies and the Ministry for the Environment, led by the NZTA. A key priority of the *Transport sector strategic directions* document, the project aims to further central government's objectives for a sustainable New Zealand transport system, consistent with the *New Zealand transport strategy*.

The project had previously looked at the issues and barriers associated with integrating land use and transport, identifying six action areas to be addressed if practice was to shift:

- Legislation.
- Policy (non-legislative).
- Institutional frameworks.
- Funding.
- Planning practice (implementation).
- Capacity and capability.

The current research feeds into the Integrated Approach to Planning Project by making recommendations about the contents of a toolbox specifically designed to help regions better integrate land use and transport, and suggesting how that toolbox should be developed.



Paula says, 'The shift from guidelines to tools was in recognition of the hugely different integration issues that the regions of New Zealand face. Not only do the regions vary greatly in size and complexity, but we have regions where the focus of land use and transport integration is on promoting desirable future changes, while in others it's about managing real and rapid changes that are already happening. We've got regions where the desired transport networks look set to cost billions of dollars, while in others we're only talking about a few million.

'It became apparent quite quickly that a guideline approach was unlikely to be flexible enough to cut across these rural/provincial/metropolitan differences, and remain an effective instrument for change. A toolbox on the other hand, with a range of tools that can be mixed and matched to fit a range of circumstances, should be much more useful for the regions.'

Using the six recommended areas of action from the Integrated Approach to Planning Project as a framework, the project went on to scope a wide range of potential tools.

First steps first

At present, there is no explicit legislative requirement for land use and transport to be integrated. Rather the requirement is

inferred from the complex web of legislation governing the two areas.

Land use and transport are managed under separate legislation - land use under the Resource Management Act 1991 and transport under the Land Transport Management Act 2003.

Paula says, 'Both legislative frameworks are complex, with each supported by specialist institutions and strategic and operational frameworks. Add to this mix, for local government at least, the need to operate within the overarching framework of the Local Government Act 2002, and you get a complex matrix of requirements and approaches. It's hardly surprising in the circumstances that integration doesn't always gel.

'For this reason, although it was outside the regional scope of the project, we made some recommendations in the report about things that needed to happen first, at a national level, before the toolbox was developed.

'The first key issue was that the principles for land use and transport need to be clearly articulated, and the issues that integration is trying to address need to be clearly identified. Basically we need to understand the whys of integration, before we turn to the how. Practitioners must be able to visualise and articulate what integrated land use and transport looks like "on the ground" and in various spatial forms.

'The second key issue is that there needs to be guidance developed for implementing the Land Transport Management Act 2003. This should include explaining the implications of the new legislation and what it means for current practice. There's a lack of clarity around this at the moment and organisations don't necessarily understand the mandate it gives them with respect to integration.

'The third issue is the need for guidance for regions on how the three pieces of legislation (the Resource Management Act, the Local Government Act and the Land Transport Management Act), inter-relate with respect to land use and transport management.

'Finally, we need to see a commitment from central government to appropriately fund implementation of the Land Transport Management Act 2003 and its integration requirements.'

A flexible set of tools

The toolbox suggested in the report is structured around the process regions will need to follow when integrating land use and transport. This process is essentially four-tiered, and elements of the toolbox feed into each tier or stage:

- Understanding the legislative context that guides land use and transport integration.
- Determining the relevant regional context for land use and transport integration.
- Developing policy and strategy at the regional level.
- Implementing policy and strategy, which includes 'feeding down' to district and local levels, as well as supporting the regional strategy.

Paula says, 'Developing and implementing regional policy or strategy to do with land use and transport integration is the key element for regions. The most likely approach is something like a growth management or urban development strategy

and in this regard we can look to Auckland, Wellington, Christchurch and the Bay of Plenty for examples. These regions have already prepared strategies and lessons can be learnt from the different approaches.'

Toolbox elements are suggested for each stage, with a particular focus on building organisational capacity and capability, as many of the tools, mechanisms and approaches listed in this regard are relevant to more than one stage of the process.

Among the many tools recommended are:

- training for practitioners and politicians
- case studies of best practice collaborative strategy development and implementation
- guidance on collaborative processes
- model partnership agreements
- a central enabling team to work with regions to align policies, plans and practice
- funding incentives to support integration of land use and transport
- guidance on political risk assessment and management
- guidance on building integrated teams
- development of a shared understanding of land use transport integration
- a mentoring programme
- secondment programmes.

Following the report, the next step would be to develop and apply the toolbox.

Paula says, 'The research team and its steering group strongly believe this needs to happen on a region-by-region basis. It would involve visiting the regions to look at issues and contexts, discussing the tools available and working with them to prioritise a toolbox specific to the region.'

'Although potentially costly, in terms of resources and time, we feel this degree of input would be necessary if we were going to achieve the shift in practice necessary to make effective integration a reality.'

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Better integration of land use and transport at a regional level: scoping of regional guidelines, NZ Transport Agency research report 354

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Why, where and how we travel: drawing a national profile from the data

Using the extensive information collected by the New Zealand Household Travel Survey, researchers have drawn a comprehensive picture of New Zealanders' travel behaviour, including how, when and why they choose to travel.

Since 2003, the Ministry of Transport's New Zealand Household Travel Survey has been carried out on a continuous basis, providing (to date) data about the travel behaviour of 13,000 people from 6000 households.

Used primarily to formulate national travel policies, and improve the safety and efficiency of New Zealand's transport system, the survey's database is also intended as a resource for use by transport researchers and practitioners.

A Land Transport New Zealand (now NZ Transport Agency) funded research project analysed the data to provide detailed travel profiles for urban and rural New Zealand. Covering such things as trip length, duration and purpose, travel profiles are particularly valuable for planning sustainable transport for the future.

The approach

Started in 2007, the research project was undertaken as a joint consultant exercise by the Trips Database Bureau, and was an opportunity to describe the travel profile of the whole of New Zealand on a typical weekday or weekend. With this end in mind, the Ministry of Transport's national survey results were analysed with respect to:

- personal travel
- travel mode
- travel purpose
- travel by trip purpose and mode of travel
- social inclusion and accessibility
- travel by time of day.

Findings were summarised for travel within major urban areas (with populations of over 30,000 people), secondary urban areas (populations between 10,000 and 30,000) and rural areas (those areas with lesser populations).

Primarily providing a descriptive snapshot of typical daily travel, the research did not attempt to analyse or comment on trends over time, or make detailed regional comparisons. However, such work is proposed in the future, as up-to-date data from the ongoing Ministry of Transport travel surveys continues to become available. This will be of even greater use for planners, transport practitioners and council staff seeking to predict future travel patterns and needs.

Focus on trips

The New Zealand Household Travel Survey breaks journeys up into 'trip legs', with each leg having its own origin and destination, and relating to the particular type of transport used for that part of the overall journey.

The Ministry of Transport defines it as:

A trip leg is a section of travel by a single mode with no stops. Thus if one walks to the bus stop, catches the bus to town and walks to his/her workplace, he/she has completed three trip legs (home to bus stop, bus stop 1 to bus stop 2, bus stop 2 to work).

The survey identifies 15 different purposes for trip legs; home, work (split into main job, other job, and going about an employer's business), education, shopping, social welfare,

Figure 4.1 Mean Trip Legs/Person/Day Categorised by Area

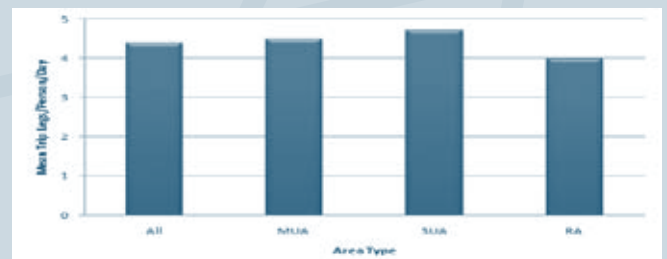


Figure 4.2 Mean Trip Leg Distance Categorised by Area

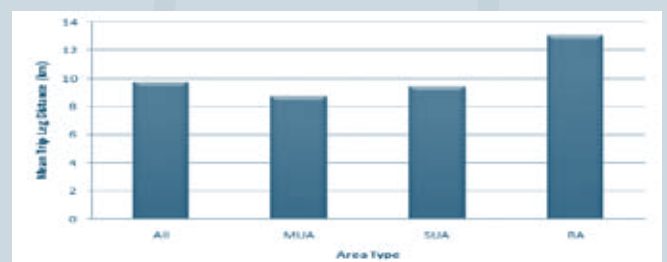
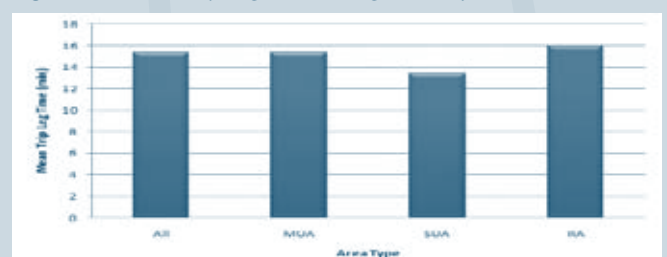


Figure 4.3 Mean Trip Leg Time Categorised by Area



personal business and services, medical and dental, social, recreation, accompanying someone else, changing travel modes, leaving the country, and other.

On average, respondents to the survey took 4.4 trip legs per person per day.

In the research project, trip leg profiles were drawn up according to the trip's purpose, mode of travel, and type of household that the traveller lived in (defined according to vehicle ownership). Profiles were then summarised within regions, and for rural, and major and secondary urban areas.

Major findings

The New Zealand Household Travel Survey provides a vast array of information and the research project and report brought together some of the most important data, marshalling it into a useful format.

Sample findings are:

- nationwide, the most common travel mode for respondents was as a vehicle driver. On average, people driving vehicles represented 55 percent of all trip legs taken, with more trips taken by this mode on weekdays than at weekends
- when vehicle passengers are added in, the percentage of trip legs taken per person per day by motor vehicle rises to 80 percent
- the main purpose for trip legs was to return home, followed closely by trips to people's main place of work
- people whose main means of travel is as a vehicle driver make more trip legs and travel longer distances each year, compared to people who mainly travel by other means
- people with lower incomes (between \$10,000 and \$15,000) make fewer trips than those with larger incomes
- more trip legs are taken by bus, on foot or by cycle on weekdays than at weekends
- the average cycling trip to work in a major urban area takes only 14 minutes
- at the weekend, trip legs with recreation as their purpose have the longest duration (22 minutes on average), while during weekday trips for work (employer's business) last the longest.

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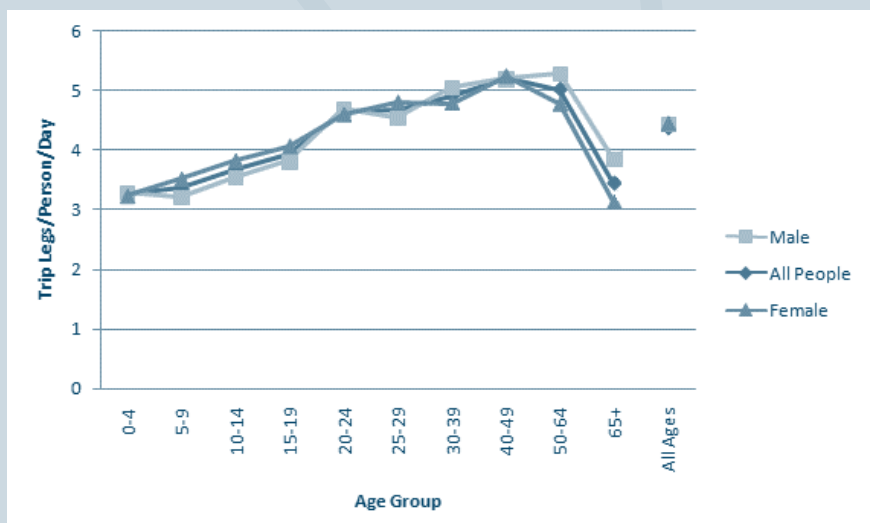
Table 6.1 Number of Trip Legs and Distance/Person/Day Categorised by Trip Purpose¹

UNWEIGHTED SAMPLE SIZE (PEOPLE) = 12698				
TRIP LEG PURPOSE	TRIP LEGS/ PERSON/ DAY	TRIP LEGS/ PERSON/ DAY (%)	KILOMETRES/ PERSON/ DAY	KILOMETRES/ PERSON/ DAY (%)
Home	1.4	35%	11.7	37%
Work – Main Job	0.6	15%	5.2	16%
Work – Other Job	0.02	0.5%	0.2	0.5%
Work – Employers Business	0.1	2%	1.0	3%
Education	0.2	4%	0.8	2%
Shopping	0.5	14%	3.3	10%
Personal Business/services	0.01	0%	0.0	0%
Medical/Dental	0.2	6%	1.6	5%
Social visits	0.03	1%	0.2	1%
Recreational	0.5	12%	4.6	14%
Change Mode	0.2	6%	2.6	8%
Accompany Someone Else	0.2	5%	0.8	3%
Total	3%	100%	32.0	100%

¹ Only includes vehicle passenger, vehicle passenger, bicycle, bus and taxi trip leg distances.



Figure 5.4 The number of trip legs per person per day categorised by age groups and gender



Malcolm Douglass of the Trips Database Bureau says, 'The research report was published in August and already is being well used for establishing issues such as travel to school, shopping catchments, bicycle trips, bus use and bus patron characteristics. More research is required to enable the information to be used to establish trip prediction models, and this is proposed as an extension of the present work.'

'Additional analysis of matters such as the type of trips taken by vehicle, and the distance, time, locations and land uses that people visit by active modes of transport (such as walking or cycling), combined with having to hand a full five years of data (which we will have when reporting on the 2007 survey is complete), will also enable more meaningful comparisons to be made and trends to be established during part B of the research.'

Contact for more information

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*National travel profiles part A:
Description of daily travel patterns,
NZ Transport Agency research report 353*

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Hard copy \$30.00
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Figure 5.5 Distance travelled per person per day categorised by age groups and gender

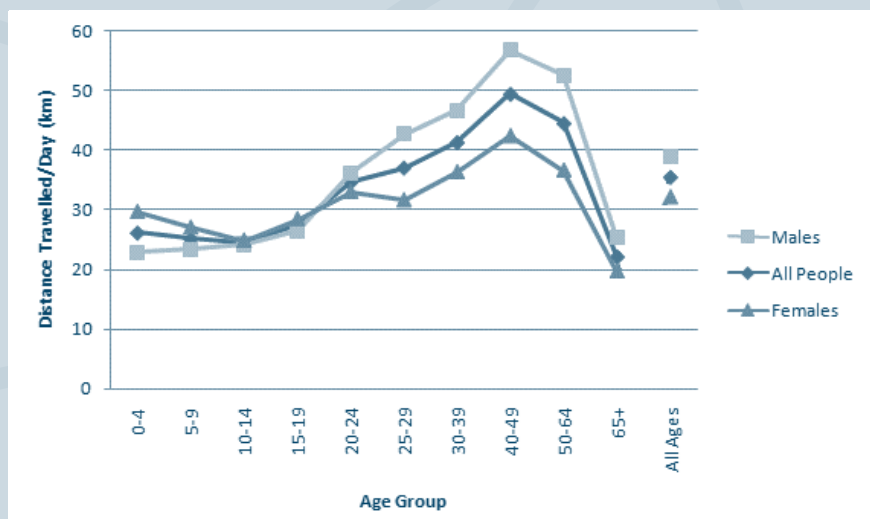
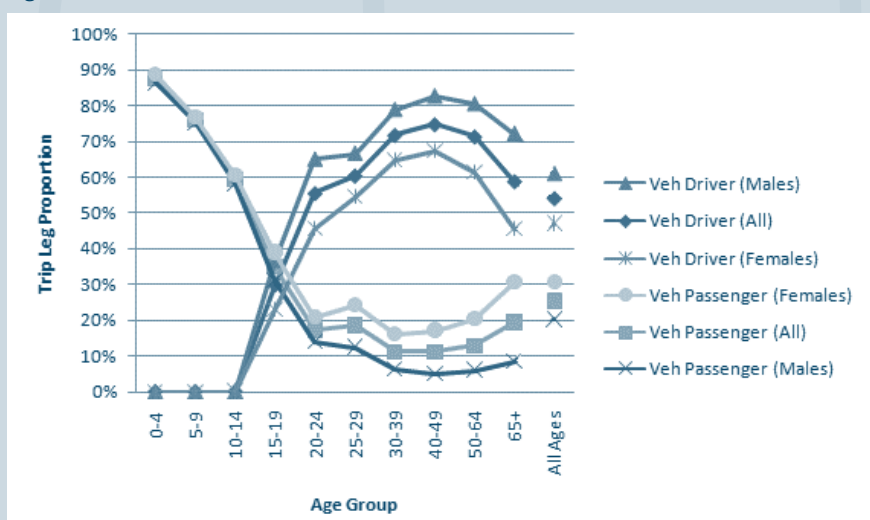


Figure 5.6 The Proportion of the Mean Amount of Vehicle Trip Legs Categorised by Age and Gender



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The ATRF is recognised by both the public and private sectors as the main transport planning and policy forum in Australasia. The ATRF brings together policymakers, advisers, researchers and practitioners from transport disciplines to share and build upon the latest research and initiatives. It is hosted annually by Australian jurisdictions and New Zealand.

The 2009 forum will be hosted by the New Zealand Ministry of Transport at the SkyCity Convention Centre, Auckland. Prospective delegates are now invited to contribute papers relevant to the forum theme. **Abstracts of up to 200 words are requested by 31 March 2009.** Papers may deal with any aspect of transport, including work in progress, and should be research based. Relevant research papers which are directly related to the development of policies or strategies are especially encouraged. Instructions for paper preparation will be sent to authors as soon as their abstracts have been accepted.

Abstracts should include:

- main subject area and keywords
- name(s) and affiliations of author(s)
- a biography of the presenting author.

Please note: names, institutions and contact details of authors should NOT be included on the abstract document.

- Wherever possible the title should be precise so that it conveys a clear message.
- Any conflict of interest should be declared in the email sent with the submission form.

- Abstracts should contain brief but complete statements of Introduction/study.
- Objectives/Methods/Results/Conclusion(s). Please ensure these statements are not under subheadings.
- Only standard abbreviations should be used.
- Only simple tables are acceptable. Abstracts containing graphs, diagrams or complex tables will be rejected.
- References are not to be included.

NB: Abstracts that do not adhere to the guidelines or are received after the closure date will NOT be accepted.

The organising committee may decide to limit the number of presentations by any one person, organisation or institution in order to provide as many people as possible with the opportunity of presenting at the conference.

For abstracts with more than one author, only one person should submit the abstract and this person will be the contact for all correspondence.

Abstracts can only be submitted via the electronic submission process that can be accessed from the conference website www.atrf2009.co.nz. Questions should be emailed to the conference organisers, Convention Management Services: atrf2009@cmsl.co.nz.

Authors of accepted abstracts will be asked to prepare the full paper and submit it for inclusion in the conference proceedings by 16 July 2009.

Assessment of papers

Historically, there have been more papers submitted than the organisers have been able to accept. All abstracts and papers submitted will be assessed according to the following criteria:

- Relevance to forum theme.
- Level of innovation and soundness of analysis.
- Contribution to transport knowledge.
- Appropriateness for transport practitioners across a wide range of areas of interest.
- Clarity of written presentation and compliance with the format specifications for the conference.

Prizes

The John H Taplin Prize is awarded for the best paper presented at the Forum.

The David Willis Memorial Student Prize is awarded for the best paper submitted by a student or new professional. Authors will be asked to indicate on the submission form whether any author/co-author qualifies as a student or new professional. To be eligible, authors may be of any age but must have written the paper while studying at a tertiary education institution or have recently joined the profession within two years of leaving a tertiary education institution. The paper can be on any subject relevant to the ATRF. While the paper may be co-authored, it should be principally authored by the student/new professional and should be presented by the candidate for the award.

Building roads' resilience in the face of emergencies

A three-phase research project looked at engineering lifelines in New Zealand in relation to roads and the activities of road controlling authorities.

Engineering lifelines activity refers to 'a collaborative, inter-utility and cross-sector planning process to reduce the pre- and post-emergency impacts of low probability disaster-scale events'.

In New Zealand a combined approach has been taken since the early 1990s, supported by the Local Government Act 2002 and Civil Defence Emergency Management Act 2002. The approach involves assessing multiple hazards and multiple lifelines utilities, with a focus on joint planning and mitigation.

Mark Gordon of Maunsell Ltd who led the research project says, 'The approach is fundamentally based on inter-agency communication, understanding and collaboration.

'By overlaying the services of each agency against the hazard event, and understanding the interdependencies between them, we get a clearer picture of the true magnitude of disruption to the community. If each agency deals solely with the impacts from their own point of view, then they are not going

to have much understanding or awareness of the flow-on effects for other utilities.'

New Zealand's collaborative approach is largely un-mirrored internationally. Japan, Australia and the UK, although they all take steps to address the risks posed by potential hazards, do not take a lifelines approach. Only the United States has started developing a collaborative approach to promoting national lifeline efforts, with a focus on harnessing technology and computer applications such as GIS.

Marks says, 'The security of New Zealand's road network is particularly important to all the agencies from a service delivery perspective, and in recent years, efforts have been made nationwide to increase the resilience of the network to natural hazards. What we were interested in was whether the engineering lifelines approach had been successful in this regard, and how well it is integrated with other approaches to managing natural hazards and with road controlling agencies' asset management plans.'

A focus on roads

As part of phase two of the research project, the team looked at developing resilience measures for transport infrastructure, which could be used by road controlling authorities as part of asset management planning.

Resilience relates to the network's ability to continue to support the community and meet its needs, following a major hazard event. Parameters such as how much of the network would be affected by a hazard event, alternative routes, traffic volumes and time required to restore the network following an event, could be assembled into a matrix to be used as part of risk assessment in asset management planning.

Mark says, 'We were looking to identify the parameters that could be used to better understand network resilience and weaknesses, and help prioritise efforts to identify and mitigate risks.'

Phase three of the project assessed the effectiveness of road controlling authorities and their asset management plans with respect to lifelines, natural hazards and risk management. Several recommendations about plan content and the role of asset managers with respect to lifelines (among other things) flowed from the findings.

Marks says, 'Overall, there was insufficient information in the asset management plans about risks and natural hazards. Very few of the plans had any information or maps showing lifelines or key emergency routes, and only one had details of projects for hazard mitigation.

'Funding is another major issue, with funding levels for natural hazard mitigation works for the road network very low in relation to total expenditure and the historical costs of emergency works. Very few local authorities are spending more than nominal amounts on identified forward mitigation works.

What are engineering lifelines?

Engineering lifelines are those essential utility services that support the life of the community. Transport networks are lifelines, as are water, wastewater, stormwater, electricity, gas and telecommunications networks.

Among the lifelines, road networks have a particular significance. All of the other lifelines depend on the road corridor and road structures, such as bridges, to deliver their services.

A failure in part of the road network can lead to consequential failures for other services, and make it harder to repair and restore them in an emergency.

Traditionally, efforts to manage and maintain engineering lifelines in New Zealand have focused on the effects of hazards from external sources (such as volcanic eruptions, floods, earthquakes, snow and landslides). Increasingly though, technological and man-made hazards must also be taken into account.



'The project team felt that an emphasis on integrating risk management and the lifelines engineering approach into asset management practice was needed in order to increase the resilience of New Zealand's

land transport system, and individual road networks.

'We recommended that further work be undertaken on defining and understanding resilience and how this can be managed

through better infrastructure management. We also wanted to see improved asset management plans and risk management processes, so that lifelines planning becomes part of decision-making around funding and investment.

'In addition, there's a need for better knowledge about the natural hazards that threaten the transport and road networks, and also to explore the tools that could be used to assess and manage lifelines risks.'

The New Zealand approach

To varying degrees there are now lifeline activities in most parts of New Zealand. Typically, activities start out with a lifelines project to identify and quantify hazards in a local area or region, and their likely impact on infrastructure assets. The interdependency between assets is assessed, with mitigation actions proposed and put into action by lifelines utilities.

Following the initial project, a lifelines group may be formed for the area to carry out ongoing lifelines activities and maintain awareness and communications across the sectors.

Established in 2000, the National Lifelines Coordinating Committee, encourages the establishment of new lifelines projects, promotes best practice, and coordinates communication and liaison between groups and with national agencies.

The Ministry of Civil Defence and Emergency Management, in association with the national committee, has produced a best practice guide for lifelines and civil defence emergency management planning, aimed at lifelines groups and utilities.

Contact for more information

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Engineering lifelines and transport – should New Zealand be doing it better,
NZ Transport Agency research report
355A and 355B

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New research publications

The affect of adding recycled glass on the performance of basecourse aggregate

Research report 351

Dr Greg Arnold, Pavespec Ltd; Dr Sabine Werkmeister, University of Canterbury; David Alabaster, Transit New Zealand - \$20.00

Glass bottles collected by councils are forming large stockpiles particularly in the South Island as it is uneconomic to transport the glass to the Auckland plant where it is reused for glass bottles. An alternative method of disposal is to crush the glass and mix it into basecourse aggregate. Transit New Zealand currently allows up to 5% by mass of crushed glass to be mixed in the aggregate. This study investigated the effect on aggregate performance of percentages of crushed glass up to 50% by mass of aggregate or a third of the total mass. Performance was measured using the Repeated Load Triaxial apparatus and associated rut depth modelling to determine the number of heavy axles until 10mm of rutting occurs within the aggregate layer. Results found that the performance of the aggregate was not affected for percentages of crushed glass up to 30% by mass of aggregate or 23% of the total.

Developing and trialling a climate based section guideline for chip seal binders

Research report 358

JC Waters, Fulton Hogan Ltd, Christchurch - \$20.00

Standard practice in New Zealand for binder selection for State Highways in recent years has been to use harder penetration grade binders and reduced diluents. This practice was initiated after research showed that the use of harder binders slowed the onset of flushing. However, subsequent research has produced no evidence to support this. The only justification for the continued use of these harder binders is the lower risk of the chipseal bleeding.

The use of harder binders and less diluents increases the risk of early failure of chip seals because the higher viscosity of the binders causes chipseal construction issues, and increased brittleness at low temperatures which can both lead to chip loss.

This report discusses the development and trials of a guideline based on the performance of a binder at the high and low temperatures likely to be encountered at the chipseal construction site. The research follows on from initial work in developing and trialling a Surface Performance Grade (SPG) Specification... by the Texas Transportation Institute (TTI) for the Texas Department of Transportation (TxDOT).

The research work contained in this report involved developing climatic zones for New Zealand and testing binders against the SPG specification and then comparing the actual field performance of the seals with the expected/predicted performance from the binder test results (measured in the laboratory).

Residual binder extraction from emulsions for quality assurance testing

Research report 360

JC Waters, Fulton Hogan Ltd, Christchurch, GM Bosma, Fulton Hogan Ltd, Nelson, PR Herrington, Opus International Consultants, Wellington - \$15.00

Safety and environmental drivers are pushing the New Zealand road construction industry away from hot, cutback binders and towards the use of emulsified bitumen as the delivery medium for chipseal binders. However, there is no agreed standard method for recovery and testing of the emulsified binder. The absence of such a method could potentially lead to dispute over the quality and contractual compliance of emulsified binders due to the effects of differing laboratory techniques for binder extraction and sample preparation.

This research project reviews techniques used worldwide and recommends a method suitable for New Zealand materials and conditions.

Results from the trials of the new test method show that, in spite of completing the extraction of the binder under conditions similar to those encountered in the field, the binder must be reheated to remove water and air from the test sample. This treatment changes the binder rheological properties compared with the same binder prior to emulsification and extraction.

Thus the objective of this research was to develop a simple repeatable method acceptable to suppliers and purchasers to extract the emulsified binder to allow confirmation of the binder properties for quality assurance purposes.

This report outlines the literature review, the method development, the laboratory trials of the method and results from contractor trials of the method.

Vols 1 and 2: Review of Australian standard AS 5100 Bridge design with a view to adoption

Research report 361

DK Kirkcaldie, Opus International Consultants Ltd, Wellington; JH Wood, John Wood Consulting, Lower Hutt - \$45.00

The objective of this project was to investigate the practicality of adopting the AS 5100 bridge design standard for New Zealand. The significant differences and gaps between current design requirements as presented by AS 5100 and the Transit NZ Bridge manual and its supporting standards were identified. The project gave consideration to the New Zealand regulatory environment and identified measures that would need to be taken to enable AS 5100 to be used in New Zealand.

Although many advantages and disadvantages were identified for adopting AS 5100 for bridge design in New Zealand, it was considered that the best option was to retain the Bridge manual and to revise it to incorporate more of the AS 5100 material relevant to bridge design than presently adopted. The overriding consideration in reaching this conclusion was the difficulty of preparing supplementary material for AS 5100.5 and AS 5100.6 to incorporate seismic design requirements consistent with the New Zealand seismic design philosophy. There were also significant differences between the Bridge manual and AS 5100 approaches to traffic loads and loading combinations that have had a major impact on both construction costs and the adequacy of existing bridges, and these would be difficult to resolve and unify.

Incorporating sustainable land transport into district plans: discussion document and best practice guidance

Research report 362

Tonkin and Taylor Ltd, Wellington - \$20.00

This report is a discussion document introducing the concept of sustainable land transport, discussing the interaction between land use planning and sustainable transport, and introducing some guidance to incorporating sustainable land transport into district plans. It will assist local authorities when reviewing district plans, and assessing resource consent applications and notices of requirement. The content of the discussion document includes definition of a sustainable land transport system, issues facing sustainable land transport systems in New Zealand, options to address these issues, and provisions that could be included in district plans. Model provisions for best practice are included, along with a checklist of rules that could be included in district plans.

Accessibility planning methods

Research report 363

Susan Chapman and Doug Weir, Booz and Company Ltd, Auckland - \$20.00

This research investigated the applicability of accessibility planning in New Zealand as a tool for assessing and improving personal access to essential services for all New Zealanders. It canvassed international accessibility planning practices in England, the Netherlands and Southern California to understand the various drivers for its introduction and the different approaches taken in its implementation. All three case studies share the goal of improving individuals' access to activity centres and recognise that accessibility planning is best undertaken at the local level with some form of central government guidance and monitoring.

The English comprehensive accessibility planning framework has been adapted to New Zealand's existing social services and local government legislative and institutional environment and the recently legislated changes to the government land transport sector. The resulting recommended framework employed a collaborative approach to assess and improve people's accessibility to employment, food shopping, health, education and social services across New Zealand. All levels of government would participate in the assessment of accessibility, development of priorities, indicators and action plans and monitor progress against outcomes, within government frameworks. Transport actions developed by regional accessibility partnerships to address regional problems would feed directly into their regional land transport programmes for prioritisation for funding.

Standard pre-cast concrete bridge beams

Research report 364

Beca Carter Holling & Ferner Ltd; Opus International Consultants - \$30.00

The standardised designs for pre-cast bridge beams presented in this publication are expected to result in significant economies for bridge projects utilizing these elements in New Zealand.

Earthquake performance of long span arch culverts

Research report 366

Donald Kirkcaldie, Opus International Consultants, Wellington - \$25.00

Dynamic numerical modelling has been carried out in 2005-2007 to investigate the seismic performance of an 11.66 m span, 7.29 m rise, high profile arch culvert. The horizontal components of three earthquakes were used, scaled for Wellington conditions for 1:500 and 1:2500 year recurrence intervals. The effects of a number of parameters were tested by varying their values. These parameters were the soil shear strength, dilation angle and stiffness (measured as the shear wave velocity), the cover over the culvert, the presence and size of concrete stiffening beams and whether or not slipping occurred between the soil and the culvert. Seismic deformation, structural bending moments and axial forces were examined, along with their relationship to earthquake peak ground velocity, peak ground acceleration and the Arias Intensity. It was found that the peak ground velocity and therefore the ovaling of the culvert were not useful in design. Soil shear strength (friction angle and whether it was cohesive or not) affect maximum seismic structural bending moments and thrusts more than soil stiffness. Maximum structural seismic bending moments were usually controlled by maximum construction bending moments.

NZTA research

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NZ TRANSPORT AGENCY
WAKA KOTAHI

Pavement deterioration models for asphalt-surfaced pavements in NZ

Research report 367

Theuns Henning, University of Auckland - \$25.00

This report details findings from the New Zealand Long-Term Pavement Performance (LTPP) programme that aims at the development of deterioration models. Earlier work, completed between 2005 and 2007, resulted in prediction models mostly for thin, flexible chipsealed pavements. This report documents the development of models for dense-graded and porous asphalt surfaces (OGPA).

The research was successful in developing pavement deterioration models for crack initiation of dense-graded asphalt surfaces, and ravelling initiation for OGPA surfaces, and has confirmed the validity of the rutting model that was developed earlier. For both the crack and ravelling initiation models, continuous probabilistic models were developed that predict the probability of the defect to occur. These models use data that is readily available on network level databases, and can therefore be applied on asset management applications such as the New Zealand dTIMS system.

The models were tested on the network data and had a significant success rate (up to 75 percent) in predicting the behaviour of the surfaces. Based on this finding, it is recommended that the models are adopted within the New Zealand dTIMS system. Further work required includes refining the models on the basis of individual sections' LTPP data. In addition, this research has highlighted a number of practical aspects that require further investigation, and the need for the development of maintenance best-practice guidelines.

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