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Tackling barriers will bolster integration

New research makes sweeping recommendations for improving the integration of land use and transport planning. National goal and priority setting, legislative changes, revamped organisational structures and a commitment to collaboration are among the measures proposed to foster integration.

Both within New Zealand and internationally, concerns continue to mount about the environmental, economic and social costs of burgeoning road networks and the escalating use of motor vehicles.

Lack of integration between land use and transport planning has been identified as a major factor feeding into the problem – if land uses are planned without meaningful reference to their effects on transport, and vice versa, then efforts to address the problem fall flat.

Making the connection

According to Land Transport New Zealand-funded research carried out in 2006 and 2007, the connections between land use and transport are well documented.

Dispersed land use patterns typically lead to higher levels of dependence on private cars, while concentrated land use is more likely to encourage public transport use, provided supporting transport policies are in place. Likewise, decisions about transport can affect how land is used, both directly (eg in providing for more roads and car parks) and indirectly (eg by encouraging or discouraging urban sprawl).

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Your views

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It follows that ensuring that land use and transport planning are integrated is an important prerequisite to creating more sustainable cities and urban environments.

Theories about making smarter, more compact cities abound. Typical transport elements of these theories include maximising public transport use, encouraging green modes of transport such as cycling and walking, and managing private car use. Potential benefits include minimised urban sprawl, increased accessibility, reduced noise pollution and improved air quality.

The road to integration

In New Zealand, the road to integration has been paved by recent developments in policy and legislation. Both the New Zealand Transport Strategy 2002 and the Land Transport Management Act 2003 sought to improve transport planning, while the Ministry of Transport identified the integration of land use and transport planning as one of four strategic priorities for the sector in its Transport Sector Strategic Directions 2005.

Yet while the principle of integration has gained rapid acceptance, its implementation remains problematic. The traditional separation between the two schools of land use and transport planning continues to make itself felt, with a lack of organisational and legislative processes in place to encourage an integrative approach.

Barriers to integration

Knowing what stands in the way of integration is a crucial first step if the two planning processes are to work effectively together.

The research reviewed New Zealand's current planning arrangements and identified several barriers.

The recent history of permissiveness in planning approaches is still influential and fails to encourage the extra rigour that integration requires.

Land use planning and transport planning may often be carried out as totally distinct activities, even when they occur within the same organisation. This mirrors legislative arrangements, which set out the requirements for the two fields in separate pieces of legislation with little common ground between them.

A lack of national guidance on the common goals and objectives that land use and transport planning should be pursuing also undermines attempts to bring the two disciplines together.

At a regional level, political and professional tensions between local authorities can prevent collaborative approaches to problems that span territorial boundaries. Typically, both transport and land use issues require a bigger picture approach, particularly in heavily urbanised areas such as Auckland, where regional planning for development and transport has in fact begun.

In respect of transport, aspects of a predict-and-provide model of planning, which aimed to forecast and accommodate traffic growth, are still being used, even though the model is generally recognised as being no longer appropriate. Funding arrangements, which remain focused on road building and maintenance, are also influential.

Business and commercial interests tend to dominate public consultation about transport decisions, with consultation processes making it difficult for communities and individuals to have a meaningful say.

Looking abroad for the answers

Having identified the barriers, the research looked at examples overseas where land use and transport planning had been successfully integrated.

Four planning systems used in Australia, Canada and the United Kingdom were identified as being particularly relevant to New Zealand. The research analysed them in respect of their underlying policy and governance arrangements, how well they worked in practice and the challenges they faced.

From this analysis, several factors were identified that, if present, could foster integration. These included a national policy framework that supported integration, and a legal and regulatory framework to back this up. Better coordination and cooperation between organisations with land use and transport planning responsibilities was also important, as were steps to improve the skills and knowledge of the planners involved. In addition, facilitating effective public participation in decision making was necessary if integrated planning was to be effective.

Using the insight gained into the current New Zealand situation, and drawing on the learning from the overseas models, the research team was able to recommend practical steps that could be taken to improve the integration of land use and transport planning in New Zealand.

New Zealand's main barriers to integration

- Planning functions are allocated across a range of different organisations.
- There are limited links between land use and transport plans.
- There is a lack of common goals and policies at a national level to guide planning outcomes.
- The public has limited opportunities to genuinely influence transport decisions.
- Funding and assessment processes do not support land use and transport integration.

Key recommendations

Working within the existing legal and institutional framework

- Set national goals, priorities and targets for land transport to foster sustainable transport outcomes.
- Introduce a national policy statement on sustainable urban form and design.
- Establish clear responsibility for and resource the development of guidance on integration.
- Introduce effective content auditing standards for transport strategies and programmes.
- Actively promote collaboration between transport agencies and the Ministry for the Environment and the Ministry of Health.
- Provide for more effective public participation.
- Amend Land Transport NZ's funding allocation process to foster integration.

Strengthening the existing legal and institutional framework

- Make regional planning a statutory requirement.
- Encourage the integration of strategic and spatial planning by:
 - requiring demonstration of land use and transport planning integration in transport funding procedures
 - requiring demonstration of land use and transport planning integration in the preparation of regional land transport strategies
 - amending relevant statutes to require formal links between policy instruments

- making a single agency responsible for monitoring regional councils to ensure the strategic integration of land use and infrastructure.

Examining new legal or institutional arrangements

- Review the effectiveness of the Auckland Regional Transport Authority model and consider its application elsewhere.
- Look at the possibility of establishing special transport administrative areas, based on overseas models.
- Provide for direct election of regional land transport committees to ensure public interests are represented.
- Establish new combined central government transport agencies.

Enhancing professional and organisational capacity

- Facilitate integration by encouraging commitment to and identifying best practice for collaboration between organisations.
- Identify internal organisational arrangements that enhance collaboration across disciplines.
- Strengthen organisations internally by adopting coherent and consistent policies, and committing sufficient resources to achieve strategic and operational integration.
- Build capacity through professional development programmes that review how different disciplinary cultures operate, promote new ways of working together and build relevant skills.
- Encourage tertiary educators to incorporate opportunities for interdisciplinary activities in professional programmes.

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Integrating land use and transport planning,
 Land Transport NZ research report 333
 Freely available online at
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2008/09 Land Transport NZ research programme

Land Transport NZ has recently announced its 2008/09 National Land Transport Programme, which incorporates the research programme for the coming year.

This year, we will be funding 48 research projects across the seven key topic areas. These projects are outlined below.

Environmental effects

PROJECT | Determination of personal exposure to traffic pollution while travelling by different modes

RESEARCH ORGANISATION | University of Canterbury

OBJECTIVES | This project will assess the comparative risk associated with exposure to traffic pollution from travelling on various transport modes. By investigating the pollution exposure implications of travel choices, and ways to plan and design bus, cycle and pedestrian routes to minimise pollution exposure, the research will provide:

- accurate and New Zealand-specific data on personal pollution exposure by mode
- information to inform transport decision making at personal and societal levels
- a stronger base for advocating consumer change in behaviour.

PROJECT | Environmental and financial costs and benefits of warm asphalts

RESEARCH ORGANISATION | Opus Central Laboratories

OBJECTIVES | The purpose of this research is to evaluate and compare the environmental and financial costs and benefits of producing and laying warm asphalts with those for standard hot mixes. Warm mixes are claimed to use significantly less energy than hot-mix asphalt, create lower emissions and have benefits regarding worker health and product longevity.

This project will investigate overseas research and trials of various methods of producing asphalt mixes to establish whether they would be cost-effective and appropriate for use in New Zealand.

Sustainable land transport

PROJECT | Health effects of intervening in the trip to work

RESEARCH ORGANISATIONS | University of Otago, University of Auckland, Massey University and Synergia

OBJECTIVES | This project aims to develop a system dynamics model of the complex relationships between commuting patterns and human well-being.

The research will use a participatory process that will:

- allow all the groups involved to identify the issues that are important to their community
- lead to improved understanding of the effects of transport patterns on community well-being, and the potential health and environmental impacts of changes to transport patterns.

Initially, the model will be used to inform policy around workplace travel planning. It will then be available, nationally and internationally, with training on the use of the model provided.



PROJECT | Tools for assessing exposure to land transport emissions

RESEARCH ORGANISATION | National Institute of Water and Atmospheric Science (NIWA)

OBJECTIVES | The purpose of this project is to develop and demonstrate methods for the improved integrated impact analysis of the effects of transport emissions on public health at local scales, and to identify ways to cost-effectively reduce adverse impacts.

The research aims to:

- develop analytical tools to quantify the geographical and social distribution of exposure to transport emissions at a local scale
- develop generic guidelines to inform optimal transport and land-use design to show how transport can support sustainable settlements
- demonstrate and promote best practice in integrated environmental and health impact analysis.

PROJECT | Applying health impact assessment to land transport planning: How, when and why?

RESEARCH ORGANISATIONS | Quigley and Watts Ltd and Martin Ward

OBJECTIVES | Health impact assessment (HIA) is thought to have potential for improving integrated development processes. The purpose of this research is to draw on overseas experience to understand the best application of HIA to the transport sector in New Zealand, and to produce recommendations for undertaking HIA in a systematic way.

This project aims to:

- evaluate the role of HIA in land transport planning in New Zealand, and explore barriers to its use
- understand the best point for application of HIA within the New Zealand transport sector
- produce recommendations for better integration of HIA with other development processes in a transport context.

PROJECT | Public transport network planning: An Australasian guide to best practice

RESEARCH ORGANISATION | Massey University

OBJECTIVES | The purpose of this research is the development, in collaboration with international academics, of a 'best practice guide' for public transport network planning for Australasian cities.

Because of their relatively small population base and urban settlement patterns, small- to medium-sized cities face challenges in developing viable, high-quality public transport systems that can compete with the speed and convenience of using cars. International research shows that network planning is critical to the success of public transport in these cities.

This project will analyse appropriate concepts and principles, and some practical examples of their implementation in comparable cities of the world, and make recommendations for network planning in Australasia.

PROJECT | The social impacts of poor access to transport in rural New Zealand communities

RESEARCH ORGANISATION | Fitzgerald Applied Sociology

OBJECTIVES | Because of the dispersed nature of rural populations, rural residents mainly rely on private cars for transport. Lack of access to private and public transport can lead to isolation and disadvantage in terms of employment, services and social participation opportunities.

This research aims to inform and enhance planning for sustainable rural communities by:

- identifying and mapping the rural communities and subpopulations that are comparatively disadvantaged in terms of access to land transport, and the causes and socio-economic impacts of this
- identifying possible immediate and strategic interventions and policies for improving access.

PROJECT | Low-emission, fuel-efficient vehicles

RESEARCH ORGANISATION | TERNZ Ltd

OBJECTIVES | The purpose of this research is to encourage the adoption of low-emission, fuel-efficient vehicles in New Zealand. International concern about global warming has resulted in renewed efforts to develop new vehicle technologies such as hybrids, plug-in hybrids, mini and micro cars, small diesels, and electric vehicles powered by batteries, hydrogen or capacitive energy storage devices.

This research will:

- review the literature on these technologies
- examine the social, technical, economic, legislative and infrastructural barriers to the use of such vehicles in New Zealand
- prepare recommendations that could encourage a change to a more sustainable national vehicle fleet.



PROJECT | Demand-responsive passenger transport in low-demand situations

RESEARCH ORGANISATION | Booz & Company

OBJECTIVES | In low-density urban areas, small towns and rural areas, traditional public transport (PT) services are typically of low frequency and coverage, and inadequate to meet people's needs. They are sometimes heavily subsidised.

Current demographic and environmental trends are likely to increase the demand for PT services.

Through literature review, workshops with stakeholders and case studies, this research will assess the role and potential of demand-responsive transport and other flexible forms of PT in cost-effectively meeting these accessibility needs. It will focus particularly on the access needs of PT-dependent groups, and low-demand situations.

PROJECT | Attitudes and behaviour in relation to public transport: A study of trends in passenger transport usage in New Zealand's non-metropolitan regions

RESEARCH ORGANISATION | Massey University

OBJECTIVES | The purpose of this project is to build understanding of the take-up of public transport by different groups within non-metropolitan settlements.

Focusing on New Plymouth, Napier/Hastings and Palmerston North/Wanganui, the research will examine the demographic characteristics of selected settlements in these regions, and the census data on the main means of travel to work for these settlements. Survey and interview data will also be gathered to build a more comprehensive understanding of the modal choices of residents, and to identify priority areas for enhancing use of passenger transport especially by commuters and the transport disadvantaged.

PROJECT | Appraisal of the effectiveness of increased public transport funding

RESEARCH ORGANISATION | Ian Wallis Associates

OBJECTIVES | The aim of this project is to provide a detailed post-evaluation of the New Zealand policy and programme of increasing funding to public transport services, since the year 2000, through the Patronage Funding/Kick Start scheme.

While patronage of public transport services has increased in most regions since that time, it is unclear how much of that has been the result of:

- increased funding levels provided by central government, rather than exogenous factors
- the output-related funding basis applied.

The research will evaluate the impact this policy has had on public transport patronage and car travel, and compare this with the experience in comparable overseas cases.

PROJECT | Experience with the development of off-peak public transport services

RESEARCH ORGANISATION | Ian Wallis Associates

OBJECTIVES | Over recent years, several New Zealand regional councils have substantially improved their evening and weekend public transport, especially bus services. However, the market response to such initiatives has not been clear.

The Australian response to similar initiatives is seen to be very transferable to the New Zealand situation. This research will collate and appraise recent experience in both Australia and New Zealand, particularly addressing the impact of the changes on patronage, mode switching and accessibility. This will provide guidance for future changes to off-peak services and the factors that influence their effectiveness.



PROJECT | The costs of congestion reappraised

RESEARCH ORGANISATION | Ian Wallis Associates

OBJECTIVES | The 'costs of congestion' in Auckland are usually quoted as around \$1 billion per year. This figure is based primarily on a 1997 (Ernst and Young) study, with the figures adjusted and broadly updated for traffic growth and inflation. However, the age of this study and the approach used to estimate the 'costs of congestion' indicate the need for a review of this issue.

The aim of this project is to develop improved approaches to assessing the costs of urban traffic congestion and to make corresponding estimates of the 'costs of congestion' in Auckland. This will provide valuable input to public debate on this problem and to the consideration of policies to address it.

PROJECT | Slow zones: Their impact on mode choice and travel behaviour

RESEARCH ORGANISATIONS | Pinnacle Research & Policy Ltd and Capital Research Ltd

OBJECTIVES | Overseas studies suggest that urban street 'slow zones' lead to substantial increases in safety, and might encourage more people, especially children, to walk and cycle.

As preliminary research, this project will explore:

- the potential benefits of slow zones, beyond safety, on travel behaviour and mode choice, land use and urban form
- difficulties for local authorities in justifying the expense of creating slow zones, and in providing evidence of their benefits
- whether there is a case for New Zealand adopting the overseas 30 km/h speed recommendations.

This information will help identify whether a full evaluation is justified, feasible and likely to provide useful information.

PROJECT | The impact of central city intensification on people's travel behaviour

RESEARCH ORGANISATIONS | Pinnacle Research & Policy Ltd and Ian Wallis Associates

OBJECTIVES | This project focuses on the impact of urban intensification on people's travel behaviour. The research will analyse census data (for journey to work), Auckland and Wellington household interview survey data, and New Zealand Household Travel Survey data, regarding trip-making patterns and mode choice.

This research project will draw on the inner-city experience of urban intensification to ascertain:

- whether they 'reverse commute' to other city centres or suburbs for various activities
- their reasons for locating in the inner city
- how their travel behaviour would differ if they lived in a suburb
- whether living in the central city affects their patterns of car ownership and car use.

PROJECT | A wider look at how travellers value the quality and quantity of travel time

RESEARCH ORGANISATIONS | Pinnacle Research & Policy Ltd and Ian Wallis Associates

OBJECTIVES | Current concerns about environmental sustainability, fuel shortages and public health are prompting consideration of 'slow' modes of transport, such as walking, cycling and using public transport. However, investment decisions continue to focus on travel-time savings, viewing travel time as 'unproductive', which disadvantages any investment seeking to encourage modes other than the passenger car.

As well as examining international literature and experience, this research will conduct face-to-face interviews and/or focus groups to explore people's perception of the 'positive utility' of travel time, particularly for modes other than 'car driver'.

Travel behaviour

PROJECT | Incorporating travel time reliability in the estimation of assignment models

RESEARCH ORGANISATION | Tau-Squared Ltd

OBJECTIVES | Car assignment models usually consider issues such as mean travel time, travel distance and tolls paid when assigning trips to a network. However, recent experience in modelling Wellington's Western Corridor suggested that travellers were making route choice decisions that also incorporated travel time reliability, which is affected by serious traffic congestion.

The objective of this research is to investigate the feasibility and the statistical validity of incorporating travel time reliability into trip assignment models. This would enable a more robust estimation of potential road user response to, and the economic benefits of, transportation schemes.



PROJECT | Travel demand and behaviour change with increasing fuel price as a function of income for a particular geographic and activity cohort

RESEARCH ORGANISATION | University of Canterbury

OBJECTIVES | The purpose of this research is to:

- establish Travel Demand data (TDD) sets for a large institution in a major urban area, and for a rural area
- set up an experiment to take advantage of the high certainty of petrol price rises over the next 18 months to track the travel demand adaptation behaviour of a cohort of people.

Current knowledge includes anecdotal understanding of this behaviour, and statistical studies of large populations indicate that fuel demand is inelastic to price rise. In contrast, this study aims to provide a behaviour model of distinct income cohorts who are travelling to the same destination.

PROJECT | Assessment of the type of cycle infrastructure required to attract new cyclists

RESEARCH ORGANISATION | University of Canterbury

OBJECTIVES | In spite of increased government spending on infrastructure for cyclists (mostly on-road cycle lanes), there seems to be little growth in cyclist numbers.

The aim of this research is to identify the type of cycle infrastructure that will encourage 'new cyclists' to use cycling as their mode of transport for daily activities. After reviewing the international literature on cycle infrastructure design, the research will:

- assess the demand for different types of cycle route provision, such as cycle lanes and off-road pathways in areas of New Zealand, and their potential influence on the uptake of cycling by current non-utility cyclists
- provide recommendations on the type of cycle route design that is required to encourage the growth of cyclist numbers.

PROJECT | Improving evaluation and monitoring through better understanding of kilometres travelled and vehicle occupancy in urban areas

RESEARCH ORGANISATIONS | Capital Research and Pinnacle Research & Policy Ltd

OBJECTIVES | Evaluating the impact of travel plans and travel behaviour change measures can be difficult because of:

- insufficient understanding of kilometres travelled (KT) in cities and statistical options for analysing KT data collected in travel plan surveys
- lack of appropriate comparison data against which to assess changes measured at schools or workplaces
- lack of detailed analysis of car occupancy.

This project aims to lay the foundations for improved evaluation and monitoring of travel interventions in urban areas through:

- an analysis of urban workplace and school travel, in terms of KT, from the Ongoing Household Travel Survey
- a review of related evidence from overseas research
- a detailed analysis of vehicle occupancy.

PROJECT | 'I'll just take the car.' How can the urban environment and bicycle transportation be improved to discourage automobile use for short trips?

RESEARCH ORGANISATIONS | Massey University and Otago Polytechnic

OBJECTIVES | Although cycling is recognised as a desirable part of a sustainable urban transport system, and many initiatives have promoted cycling to non-cyclists, the uptake of cycling within our urban centres has fallen far short of expectations. This research seeks to find out:

- what factors influence transport mode decisions for short (<6 km) trips

- how to improve the design of products, services and facilities to encourage cycle use for short trips.

The project will measure international research and applications against New Zealand-specific data gathered from case study groups, and identify the features of cycle-based products and services that are essential for the New Zealand context.



PROJECT | Improving bus service reliability

RESEARCH ORGANISATION | Ian Wallis Associates

OBJECTIVES | Market research shows that urban bus service (un)reliability is the most important cause of negative customer perceptions of the services, and hinders improved uptake of services. However, this topic is under-researched, both internationally and in New Zealand.

Through a literature review, discussions with key contacts and a series of case studies with bus operators and service contracting authorities, this project aims to provide urban bus operators and public transport contracting authorities with practical guidance on:

- methods for diagnosis of urban bus service (un)reliability
- the causes of unreliability
- how unreliability is best measured and monitored
- experiences and best practices on methods to improve reliability.

Safety and personal security

PROJECT | Rural drink-driving enforcement in the Southern Police District

RESEARCH ORGANISATION | New Zealand Police

OBJECTIVES | The deterrence model of drink-driving enforcement used by New Zealand Police is not as successful in rural areas as in urban areas. The purpose of this research is to:

- consider the problem of rural drink-driving as understood by a number of community and police stakeholders
- examine the effectiveness of a pilot enforcement initiative trialled since 2001 in the Southern Police District.

The research will investigate quantitative drink-driving indicators in that region, and conduct qualitative case studies, as a basis for more effective enforcement initiatives and policies that will improve road-user safety.

PROJECT | Effectiveness of transverse road markings on reducing vehicle speeds

RESEARCH ORGANISATION | Opus International Consultants

OBJECTIVES | In many New Zealand driving situations, heavy signage is used to warn drivers of hazards, but research shows that on-road devices, creating 'self-explaining roads', are the most effective method in adverse conditions.

This research aims to understand how transverse road markings:

- affect driver behaviour
- affect driver speed in varying environments
- can be applied to reduce the risk to road users.

The project will review international research to identify transverse road-marking treatments that are relevant to New Zealand use, and conduct trials to determine their effectiveness and any negative aspects of their use. This data will lead to recommendations on best practice for the industry.

PROJECT | Measurement of the road reflection properties of road surfaces to improve the safety and sustainability of road lighting

RESEARCH ORGANISATION | Opus Central Laboratories

OBJECTIVES | The quality and energy-optimisation of road lighting is an important aspect of designing roads for safety and sustainability. The current knowledge of the reflection properties of New Zealand road surfaces is based on research carried out in the early 1980s. Since then, changes in science, measuring equipment and road construction techniques mean the current lighting designs may well be sub-optimal.

This research project will measure a stratified sample of road surfaces to determine the safety and sustainability of road lighting, and update the New Zealand reflectance tables for road surfaces using a sample of modern-day surfaces.

PROJECT | The mechanisms and types of non-motor vehicle injuries to pedestrians in the transport system, and indicated infrastructural implications

RESEARCH ORGANISATION | Opus Central Laboratories

OBJECTIVES | This research aims to assess the mechanisms and types of non-motor vehicle injuries to pedestrians, and use this analysis to evolve cost-effective infrastructural measures to prevent such injuries.

ACC data shows that most pedestrian injuries do not involve motor vehicles, but little further detail about them is known. A home interview survey of injured people will elicit details such as geographical location

of the injury event, the infrastructure involved and its condition, the time of day, lighting and so on. This information will be used to contribute to relevant improvements in the transport environment.

PROJECT | Investigation of passing lane safety benefits, including upstream and downstream areas

RESEARCH ORGANISATION | Opus Central Laboratories

OBJECTIVES | The purpose of this project is to improve the assessment of, and better quantify, the safety benefits of passing lanes. The research will analyse the accident data of crashes that have occurred both before and after passing lanes were constructed at various sites, including the upstream and downstream areas, to assess the crash-reduction factors of various passing lane options.

This will contribute to more reliable assessment of the safety benefits of various passing lane options, so that improvements to road networks achieve the maximum benefits.

PROJECT | Improving transport around schools

RESEARCH ORGANISATION | TERNZ Ltd

OBJECTIVES | The purpose of this research is to develop a process for improving the design of transport systems and infrastructure around schools.

Many school entrances and their associated streets are currently unsafe because of intense transport activity from various modes during peak periods in the morning and afternoon. A comprehensive plan for the entire transport system around schools is needed.

This research will identify the issues and requirements for each transport mode and 'best practice' solutions from New Zealand and overseas. Through case studies with a small number of schools, it will develop a comprehensive Engineering, Enforcement and Education package that will improve the safety and efficiency of all transport modes around schools, and develop guidelines that can be applied to any school.



PROJECT | Gap acceptance accident prediction models

RESEARCH ORGANISATION | Beca Infrastructure

OBJECTIVES | This research aims to build an alternative approach to accident prediction modelling that focuses on the practical causes of accidents, including human factors, to complement the existing approach, which focuses more on variables such as traffic volume, speed, road geometry and so on.

Surveys of intersections in New Zealand's main cities will consider gap acceptance by drivers at intersections with high opposing traffic volumes and develop causative models predicting accident rates in these contexts. This evidence will enable the current prediction models for intersections to be extended to higher-flow intersections so that the timing for intersection upgrades, based on deterioration in crash occurrence, can be predicted.

PROJECT | Evaluation of the C-Roundabout: A new design tool for economically improving safety and capacity at urban road junctions

RESEARCH ORGANISATION | Traffic Engineering Solutions Ltd

OBJECTIVES | The purpose of this research is to practically evaluate the C-Roundabout, a new type of multi-lane roundabout design for major urban road junctions. The C-Roundabout is thought to offer:

- improved safety for all road users by significantly reducing the speeds of vehicular traffic
- cost-effective improvement to the capacity of urban road junctions because of its compact size.

This project will evaluate the safety and operational characteristics of two C-Roundabouts in Auckland. The information will be used to prepare user-friendly guidelines regarding the use of the C-Roundabout.

PROJECT | Improved multi-lane roundabout designs for all road users

RESEARCH ORGANISATION | Traffic Engineering Solutions Ltd

OBJECTIVES | Although New Zealand and overseas evidence shows the safety benefits of multi-lane roundabouts in urban areas, New Zealand road planners have concerns about them for vulnerable road users.

This project will examine aspects of roundabout design that will both clarify and address issues of safety for all road users, particularly cyclists and pedestrians. It includes:

- a comparison of the overall safety statistics for large roundabouts and traffic signals
- an evaluation of options for pedestrian facilities at large roundabouts
- visibility guidelines at roundabouts
- the use of vertical deflection devices at roundabouts
- a review of the Turbo-Roundabout as used in The Netherlands.

Natural hazard risk management

PROJECT | Seismic design of New Zealand highway bridges under non-uniform multiple support ground excitations

RESEARCH ORGANISATION | Department of Civil and Environmental Engineering, University of Auckland

OBJECTIVES | In earthquakes, bridges can experience a non-uniform multiple support excitation (NMSE). The damaging consequences of NMSE have been observed in almost all major earthquakes, but the NMSE effect is not required as part of current New Zealand bridge design procedures.

This research will provide state-of-the-art New Zealand-specific guidelines and design examples, including the NMSE effect, by:

- determining the wave propagation velocity and unique properties of New Zealand soil
- simulating spatially varying ground motions for New Zealand soil conditions
- analysing bridge seismic performance under NMSE
- evaluating the influence factors and their incorporation into new calculation and mitigation approaches
- making recommendations for assessing, retrofitting and design.

PROJECT | Benchmarking the readiness of road controlling authorities to meet their obligations under the CDEM Act 2002

RESEARCH ORGANISATION | University of Canterbury

OBJECTIVES | New Zealand's road controlling authorities have obligations under the Civil Defence and Emergency Management Act 2002. However, they currently do not have an assessment framework that can objectively measure their preparedness for crisis events, or their effectiveness of response and recovery after disastrous events. They also need a clearly defined approach to identify the weaknesses and vulnerabilities of their current practices.

This research aims to develop and test a benchmarking framework that will contribute to the development of tools and training techniques to improve the level and consistency of the response of transport organisations to crisis events.

PROJECT | Case studies and best practice guidelines for risk management on road networks

RESEARCH ORGANISATIONS | RIMS Group and NAMS Group

OBJECTIVES | The purpose of this research is to develop practical examples and guidelines for conducting risk management of road networks.

Recent reviews by both the Auditor General and Land Transport NZ have identified this aspect of local authorities' responsibilities as seriously weak, possibly because guidelines are spread across a number of documents. This research aims to:

- provide well-documented case studies in the various areas of risk management for roads
- make recommendations on business process requirements to identify and manage identified risks
- provide guidance towards any integration considerations for the formulation of an overall risk plan or asset management plan.



Network management

PROJECT | Transit lane or bus lane?

RESEARCH ORGANISATION | GHD Ltd

OBJECTIVES | This project aims to develop a warrant for selecting high-occupancy vehicle (HOV) treatments that will maximise the movement of people along arterial corridors. The research will:

- review the literature on the performance of the various treatment options
- review the performance of existing transit lane installations and bus lane installations to determine compliance and lane utilisation, queuing, etc

- assess the impact of various treatments on traffic in the general traffic lanes
- develop a spreadsheet model to find the optimal solution to efficiency and environmental factors
- investigate the environmental, efficiency and safety effects of including freight/commercial vehicles in HOV lanes.

PROJECT | Minimising traffic delay during resealing

RESEARCH ORGANISATIONS | Opus Central Laboratories and Fulton Hogan

OBJECTIVES | After an area of road has been resealed, speed restrictions are required to allow the chip seal to bed down and gain strength, and to minimise flying chip damage to paintwork on vehicles. In areas with high traffic volumes, this can result in significant queuing and traffic delay.

Some alternative treatments, such as using hot-mix asphalt, are too expensive, but it is believed that the use of seal types such as 'racked-in' could reduce the length of the traffic restriction.

This project will use controlled trials to develop guidelines on the choice of seal type and traffic control methods that will allow a return to normal operating speeds as quickly as possible.

Asset management

PROJECT | Decision tool for identification and mitigation of prestressing corrosion in concrete bridges

RESEARCH ORGANISATION | Department of Civil and Environmental Engineering, University of Auckland

OBJECTIVES | Transit New Zealand routinely inspects, identifies and rectifies reinforcement corrosion on state highway bridges. However, current inspection systems are challenged by the recent deterioration of prestressed concrete bridge beams.

The purpose of this research is to develop a decision tool that addresses prestressed concrete bridge corrosion, to be used in the assessment and remediation of existing prestressed concrete bridges throughout New Zealand, and in the design of new prestressed concrete bridges. The decision tool will be applicable to both reinforced and prestressed concrete bridges.

PROJECT | Design of prestressed concrete bridges to resist shear

RESEARCH ORGANISATION | Department of Civil and Environmental Engineering, University of Auckland

OBJECTIVES | The aim of this project is to investigate whether improvements can be made to the methods currently used to design prestressed concrete bridges to resist shear. In particular, it will determine whether current limits on allowable shear stresses are

appropriate when high-strength concrete is used.

The research will consist of large-scale laboratory tests of typical concrete bridge sections by constructing a number of bridge sections that are nominally identical except for the concrete strength used during construction. As well, the complete shear design procedure used in New Zealand will be reviewed and compared with recent developments overseas and, if appropriate, an improved design procedure will be recommended for inclusion in the next revision of NZS 3101.

PROJECT | Development of tensile fatigue pavement design criteria for aggregates bound by stabilising agents

RESEARCH ORGANISATION | Pavespec Ltd

OBJECTIVES | The purpose of this research is to develop a methodology from beam fatigue tests to obtain the tensile fatigue design criteria of modified/cemented aggregates for use in pavement design, to guard against cracking within the design life.

The objectives of this project are to:

- undertake tensile fatigue beam tests, using the four-point loading method (currently used in research in Australia) on a range of New Zealand stabilised aggregates, while trialling a simpler method of beam manufacture and associated pavement design criteria for stabilised aggregates
- validate the tensile beam fatigue test method to obtain tensile



fatigue design criteria for stabilised aggregates for use in pavement design.

PROJECT | Earthquake resistant design of bridges: Abutment/backfill influences on response and retrofit decisions

RESEARCH ORGANISATION | University of Auckland

OBJECTIVES | This research is concerned with the earthquake resistance of bridges, and particularly the integrated design of the

complete bridge-abutment-foundation system.

The design of new bridges requires the development of a numerical model of the complete structure and foundation system of a bridge, so it can be considered as a single entity, including the abutments (ie where the bridge ends and the on-ground pavement starts again). This project aims to develop improved methods of modelling bridge-abutment interaction during earthquake shaking, so that design and retrofit procedures are developed for New Zealand practice.

PROJECT | Retrofit assessment of bridge pile foundations

RESEARCH ORGANISATION | University of Auckland

OBJECTIVES | When bridges are assessed against earthquake risk and other natural hazards, and replacement and retrofit decisions are made, one issue is the capacity and stiffness of bridge foundations (usually piled). However, routine site investigation work is based on empirical correlations between penetration resistance and soil properties, which are frequently not verified for New Zealand conditions.

This research will:

- relate the measured stiffness of pile foundations to information gathered during site investigation
- demonstrate the potential of complementary modern geophysical methods
- develop methods for predicting the nonlinear stiffness behaviour of pile foundations from site investigation information.

These improved methods of assessing existing pile foundations will lead to more refined replace or retrofit decisions.

PROJECT | Data collection and monitoring strategies for asset management of New Zealand road bridges

RESEARCH ORGANISATIONS | University of Auckland and Opus International Consultants

OBJECTIVES | This research aims to develop a strategy for efficient and reliable data collection and monitoring of the structural condition of road bridges, in order to assess their condition and performance.

Road bridges are of critical importance to road transport in New Zealand. Monitoring bridge responses offers a way to understand their current state, which may have deteriorated because of the impact of time or harsh environmental and operating conditions, and predict their future state. By developing a framework for the analysis and interpretation of the monitoring data, the research will identify the 'critical indices' when follow-up action is required, and make recommendations on follow-up action.

PROJECT | Enhancing the application of roughness measurement and deterioration

RESEARCH ORGANISATIONS | Pavement Management Services, R&D Consultants and University of Auckland

OBJECTIVES | This research aims to better understand how roughness affects pavement performance and deterioration, and identify factors that mask or dilute the effectiveness of roughness in determining pavement deterioration.

Ride quality is the primary criterion in setting pavement rehabilitation priorities, but the international roughness index (IRI) does not always represent the ride quality that is actually experienced by the road user. It is also difficult to accurately identify the factors that contribute to the deterioration of road roughness, and actual mode of roughness deterioration. This research will contribute to the development of a true roughness model and recommend a strategy for maintaining road roughness of different pavement types.

PROJECT | Pavement rehabilitation initiation

RESEARCH ORGANISATION | Opus Central Laboratories

OBJECTIVES | The purpose of this research is to identify the pavement information that is necessary to ensure the efficient scheduling of pavement rehabilitations.

Current maintenance cost models for pavements are not very successful. According to a recent report published by Land Transport NZ (research report 341), some factors that influence maintenance costs are either not being recorded in the RAMM database or their significance is not being recognised. Through interviews with network managers, this research intends to find those factors that are currently not being recorded, but are significant in the rehabilitation decision.

PROJECT | Screening bridges for potentially high dynamic loads using profile variance

RESEARCH ORGANISATION | Opus Central Laboratories

OBJECTIVES | Bridges in New Zealand are exposed to considerable dynamic axle loads from current commercial vehicle axle weights, and this will be intensified by the planned increase in truck weights. It is known that approaches to bridges can exacerbate impact damage.

As measurement of bridge loads is an expensive and time-consuming process, a tool that can use existing routinely collected data on this issue is required. The aim of this research is to:

- assess whether the profile variance data stored in RAMM can be used to identify bridges where poor approach pavement conditions may be contributing to high dynamic bridge loading
- identify where maintenance is required to reduce impact loading on bridges.

PROJECT | Concrete pile durability in South Island bridges

RESEARCH ORGANISATION | Opus Central Laboratories

OBJECTIVES | In 2006, routine inspections of two critical Southland bridges in marine conditions revealed extensive cracking of precast prestressed concrete piles below high tide level, caused by the interaction of two chemical reactions in the concrete. The damage has

significantly reduced the load capacity of the affected piles, and has made them vulnerable to other types of degradation.

Because this type of deterioration is not easily detected or identified, other cases that have not yet been identified and managed could exist, and the problem may be perpetuated in new structures. This research aims to identify the extent and severity of this problem, and to develop appropriate strategies to improve the durability of new concrete structures.

PROJECT | Asphalt durability

RESEARCH ORGANISATIONS | Opus Central Laboratories and EDI Works

OBJECTIVES | The purpose of this research is to ensure the service lives of asphalt surfacings in New Zealand are not reduced as a result of the growing use of harder bitumen grades, imported bitumens from new sources or new types of bitumen.

At present, the Transit New Zealand bitumen specification durability criterion is the same for all bitumen grades, and is based on the behaviour of bitumens in chip seals. However, the oxidation rate and failure mechanism of binders in asphalt mixes is different from that in chip seals.

The research will measure the physical properties of bitumens recovered from asphalt surfacings of different ages, and provide the data necessary to properly compare and assess the ageing performance of new asphalt binders.

PROJECT | Are chip seals waterproof enough on high-volume roads?

RESEARCH ORGANISATIONS | Transit New Zealand, Opus International Consultants and University of Auckland

OBJECTIVES | The purpose of this research is to ensure that chip-sealed, unbound pavements remain sufficiently waterproof for use in an environment of high traffic volumes and high tyre pressures.

Recent failures on major roads indicate that current techniques for chip sealing are not controlling water ingress enough to prevent early



New research reports

Developing school-based cycle trains in New Zealand

Research report 338

Carolyn O'Fallon, Pinnacle Research and Policy Ltd

Freely available online at www.landtransport.govt.nz/research

Hard copy \$20.00

A cycle train is similar in approach to the 'walking school bus' – adult volunteer 'conductors' cycle along a set route to school, collecting children from designated 'train stops' along the way. They are well established in Belgium and are beginning to appear in the United Kingdom. Previous research in New Zealand found a high level of interest in the cycle train concept, leading us to design and conduct a trial for implementing cycle train networks here.

Using the process and resource materials we developed after extensive consultation with key government stakeholders, six cycle trains were launched in Nelson in September 2006. Most of these cycle trains proved to be self-sustaining, even after the two-month summer break. In fact, the programme expanded – in early 2007, another school set up a cycle train, and two further cycle trains were established in the trial schools.

Our evaluation examined the characteristics of each cycle train in the trial, as well as focusing on how well the process for setting up and operating them worked. We interviewed the cycle train coordinator, cycle trainer, parent conductors and child cyclists, who all found the trial to be a success. Based on all of this input, we revised the resource material we developed for the trial so that it could be adopted and used throughout New Zealand.

Watercutting – investigating the lifecycle of watercutter rejuvenation of aggregates

Research report 336

JC Waters and BD Pidwerbesky, Fulton Hogan Ltd

Freely available online at www.landtransport.govt.nz/research

Hard copy \$20.00

There are many techniques for restoring pavement surface microtexture after levels have become deficient. An innovative method – ultra high-pressure (UHP) watercutting – is capable of restoring both the microtexture and the macrotexture on polished surfaces as an alternative to traditional resurfacing treatments such as chipsealing.

Preliminary investigations of both laboratory samples and road trial sections have shown that UHP watercutting can restore the microtexture of polished aggregate to a level similar to that of freshly crushed aggregate. The UHP watercutter combines a truck-mounted UHP pump, water supply and vacuum recovery system with an independently operated umbilical deckblaster. A rotating spraybar fitted with specialised nozzles directs very fine jets of UHP water at ultrasonic velocity on to the road surface.

This report documents a Land Transport NZ-funded research project monitoring the performance of UHP watercut surfaces against those of adjacent new surfacings on 10 sites located around New Zealand

to compare the rate of loss of the microtexture improvement delivered by the watercutting treatment system with the rate of loss of microtexture of new surfacings laid at the same time and location.

Estimating demand for new cycling facilities in New Zealand

Research report 340

Andrew A McDonald, Karisa Ribeiro and David Mallett, MWH NZ Ltd;

Andrew G Macbeth, ViaStrada Ltd

Freely available online at www.landtransport.govt.nz/research

Hard copy \$25.00

Funding for new cycling facilities is based on cost-benefit ratios, which depend on the predicted future demand by cyclists. Currently, there is no standard method to estimate future demand for a facility, and there is a danger that less worthy projects will get funding ahead of better projects due to the use of inconsistent methods of estimating cycling demand.

This research project compared cycle traffic flows after facilities have been built with predictions and with cycle traffic flows before construction. The aim of the project was to develop a tool to estimate demand for new facilities.

Ten sites (five off-road and five on-road) were studied and had cycle count surveys undertaken between November 2006 and May 2007. Analysis of the data has led to the following conclusions:

- A wide variety of methods has been used by different facility proponents to estimate cycle traffic on new facilities.
- The collection of cycle count data is in general minimal and is not consistent across road controlling authorities.
- The amount of cycle traffic growth after a facility was installed varies considerably.
- More sites need to be studied to allow a more robust analysis.

Estimation tools have been developed for both on-road and off-road facilities based on 'before' cycle counts, results of documented growth on New Zealand cycle facilities and census 'travel to work' data trends.

The prediction of pavement remaining life

Research report 341

M Gribble, R Ul-Islam and J Patrick, Opus International Consultants

Freely available online at www.landtransport.govt.nz/research

Hard copy \$25.00

The primary objective of the project was the development of criteria to define the end-of-life condition of pavements. These criteria could then be used in pavement performance modelling to obtain a more robust measure of remaining life. Another objective was the generation of a new model for maintenance costs. This could then be combined with the existing models for roughness and rutting to define a distress level at which rehabilitation should occur.

None of the maintenance cost models developed were particularly successful in producing a reliable prediction of maintenance costs

based on the pavement characteristics available from RAMM. Therefore, a logit model was developed to predict rehabilitation decisions.

The major factors in the rehabilitation model were maintenance costs, traffic levels and roughness. The rehabilitation decision model derived for this study predicted rehabilitation decisions well. Approximately 72 percent of pavements that had been rehabilitated were predicted as requiring rehabilitation. When tested on the Nelson network data, which was not used for calibration of the model, a similar performance was obtained, indicating the models developed were relatively successful.

Environmental effects of emulsions

Research report 343

GFA Ball, PR Herrington and JE Patrick, Opus International Consultants
Freely available online at www.landtransport.govt.nz/research
Hard copy \$20.00

This report describes a study, carried out in 2006/07, of the potential toxicity to the environment (ecotoxicity) of cationic bitumen emulsions used for chipsealing (surface dressing) in New Zealand. The ecotoxicities of the separate components of bitumen emulsions are reviewed to assess their contribution to emulsion ecotoxicity. Overseas reports on the environmental dangers of a non-ionic bitumen emulsion (a power station fuel) and runoff from cold mix asphalt are examined for relevant applications to sealing emulsions. Ecotoxicities are measured for four representative New Zealand emulsions. The implications of the findings for possible environmental classification of emulsions by environmental authorities are discussed.

Adaptation of the AUSTROADS pavement design guide for New Zealand conditions

Research report 305

M Gribble and J Patrick, Opus Central Laboratories
Freely available online at www.landtransport.govt.nz/research
Hard copy \$30.00

The AUSTROADS document *Pavement design – a guide to the structural design of road pavements* does not specifically design for plastic deformation in the basecourse; however, both experiments and field observations demonstrate that, with sufficient traffic loading, plastic deformation accumulates in the basecourse, sub-base and subgrade.

Furthermore, pavement design in New Zealand is critically dependent on subgrade strength, apparently neglecting the accumulation of plastic strain in the granular layers of the pavement.

This study, initiated in 2004, examines the design methodologies presented in AUSTROADS and evaluates them against available New Zealand research. Various subgrade strain criteria are examined for New Zealand conditions. The roughness model from HDM III has been used to generate a pavement design figure similar to figure 8.4 of AUSTROADS. The figure indicates that, for lower design traffic levels, AUSTROADS is highly conservative, while, for high design traffic levels, AUSTROADS is not conservative enough. The results for design traffic between 105 and 106 ESA might help explain the observation that lives greater than 50 years are being achieved in New Zealand since, assuming the modelling is correct, in effect, these roads have been over-designed.

Flexural modulus of typical New Zealand structural asphalt mixes

Research report 334

R J Peplow, Bartley Consultants Ltd
Freely available online at www.landtransport.govt.nz/research
Hard copy \$20.00

Structural hot-mix asphalt (HMA) pavements have become popular in New Zealand in recent times, as heavy traffic volumes have increased and early failures of granular pavements have become more common, especially in urban areas where road maintenance causes major traffic disruption.

Elastic modulus values are important inputs for the structural HMA pavement design process; however, there is generally a lack of data in New Zealand regarding appropriate elastic modulus values for typical HMA mixes. The primary objective of this project was to address the issue of characterising the elastic modulus parameter for HMA materials.

The project involved performing flexural modulus and indirect tensile tests on specimens of HMA typically used in New Zealand. The results were compared with published presumptive values and the results of analyses using the Shell Bands software. The report interprets the elastic modulus results with respect to a number of material and test variables. The fatigue properties of the test specimens were also examined.

Obtaining our research reports

These research reports are freely available online at www.landtransport.govt.nz/research. They can also be purchased in hard copy. To order any of these reports, or for questions regarding Land Transport NZ's research programme, please email research@landtransport.govt.nz.

Thank you, NZ Print

For almost 20 years, Tony Peterson and his team at NZ Print have with dedication, professionalism and great efficiency printed and posted out our research reports.

Tony's archive of research reports (all 341 of them and counting) filled a room at his premises in Newtown, Wellington, and he has been a constant presence during the evolution of the Research Programme from Transit New Zealand, to Transfund, to Land Transport NZ.

With the pending formation of the NZ Transport Agency and the consolidation of the agency's printing activities, the research team now bids farewell to NZ Print and welcomes Wickliffe Limited, which will print and distribute research reports on our behalf. Further to this, over the next few months, some older research reports that are not yet online will become available electronically on our website – watch this space for details.

Land Transport NZ and its predecessors have been very well served by NZ Print over the years, and we thank Tony and the team very much for all their work. We have no hesitation in recommending NZ Print as a deliverer of quality service.

Countdown to the NZ Transport Agency

The NZ Transport Agency (NZTA) starts business in July 2008*, bringing together the functions of Land Transport New Zealand and Transit New Zealand to provide an integrated approach to transport planning, funding and delivery.

The NZTA is being designed to deliver on four key outcomes:

- integration
- safety
- sustainability
- value for money.

The NZTA Chief Executive is Geoff Dangerfield. He will officially take up this role in July.

Geoff emphasises that the creation of the agency is more than just a merger of two existing organisations.

'The new agency will be greater than the sum of its two parts. It will build on their existing strengths but it also presents the opportunity to do things more effectively. There will be a greater focus on users of the transport system. It's also important that we deliver on our outcomes in a regional context and that we operate in close

partnership with key transport stakeholders.'

Contacting us after July

Here are the contact details for the new NZTA National Office:

Victoria Arcade
44 Victoria Street
Private Bag 6995
Wellington 6141

Main phone: 04 894 5400
Main fax: 04 894 6100

To email any NZTA staff member, please use the following email address format: firstname.surname@nzta.govt.nz.

A web portal with links to the Transit and Land Transport NZ websites goes live in July so you will still be able to do online transactions and access the full range of resources currently hosted on the existing sites. The new web address is www.nzta.govt.nz.

Land transport research

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Land transport research is published quarterly by Land Transport NZ. Its purpose is to report the results of research funded through the Land Transport NZ research programme, to act as a forum for passing on national and international information, and to aid collaboration between all those involved. It also aims to stimulate inquiry, discussion and solutions concerning land transport and Land Transport NZ's areas of research focus – namely, environmental effects, sustainability, travel behaviour, safety and personal security, and risk, network and asset management.

Contributed articles are welcome, and should be typed in double spacing and not exceed 1000 words. Illustrations may be either black and white or colour, and must be of high quality. *Land transport research* reserves the right to edit, abridge or decline any article.

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*The Land Transport Management Amendment Bill (currently before Parliament) provides that the NZTA will be established in July.